# Space Debris Disadvantage FMMS

## 1NC Space Debris Disad

### Space Debris managed now, increased Space Exploration and development pushes us past the point of no return.

Wright, 2007 (David, Co director and senior scientist with the global security program of the Union of Concerned Scientists in Cambridge, Massachusetts, “Space Debris,” Physics Today, http://physicstoday.org/journals/doc/PHTOAD-ft/vol\_60/iss\_10/35\_1.shtml?bypassSSO=1, October, CDG)

The threat to satellites The debris threat to satellites has two aspects. The first is the near-term threat due to the current or near-term debris population. The second is the long-term evolution of the space environment as the debris population increases over the next few centuries due to the continuing release of debris from ongoing space activities and to breakups of large objects that are already in space. In the near term, the density of debris large enough to cause serious damage to satellites is sufficiently low that the risk of a damaging collision over the operational lifetime of a satellite is small. However, at some altitudes the risk is approaching the level of risk from other problems that may affect the operation of a satellite. If the debris density increases significantly, the probability of damage from debris could become the primary threat to satellites in some parts of space. Although the debris risk to satellites is relatively low, such collisions have taken place. In 1996 the French military satellite Cerise had its stabilization arm severed by a briefcase-sized piece of an Ariane rocket. Debris collisions with inactive satellites have also been seen. In 1991 the defunct Russian Cosmos 1934 satellite was hit by a piece of debris from the Cosmos 926 satellite.7 Orbital changes of the NOAA 7 satellite in 1997 and the Cosmos 539 satellite in 2002, accompanied by the release of small amounts of debris, are believed to have been caused by collisions with debris in the 1- to 10-cm range.8 And in January 2005 a fragment from a Chinese rocket body that exploded in March 2000 struck a 31-year-old US rocket body. A number of additional events, including satellite breakups and malfunctions of unknown cause, may have been due to debris that was too small to be tracked. With the current number of satellites and debris, hundreds of close approaches, in which the objects pass within less than one kilometer of each other, occur every day between cataloged objects.9 Since the distribution of debris is not uniform in space, the threat to a satellite depends on its orbit. And the regions most heavily used by satellites are also the most heavily populated with debris. Before China's ASAT test in January 2007, the average time between collisions of two large, cataloged objects in LEO was estimated to be 11–12 years.10 As noted above, three such events have been identified historically—in 1991, 1996, and 2005—a rate that is roughly consistent with that average. (The collision rate was much lower in the first few decades of the space age.) A "catastrophic" collision—one that causes the objects to completely fragment into debris—was estimated to take place every 19 years. For the coming decades, the debris from the Chinese test is expected to increase the collision rate to one roughly every 7–8 years, with a catastrophic collision every 12–14 years. A more relevant measure of risk is that before the Chinese test, a piece of debris larger than 1 cm was estimated to collide with one of the active satellites in LEO every 5–6 years. Such collisions can cause significant damage to a satellite but may not cause it to malfunction. And attributing a satellite malfunction to debris may be difficult because much of the debris is too small to be observed by the SSN. The debris from the Chinese test is expected to increase the malfunction probability by more than 50%, so a collision of this kind would be expected roughly every 3–4 years during the next decade. Another measure of the current debris risk is that in the heavily used altitude band around 800–900 km, the chance that any given satellite will be hit by debris larger than 1 cm is approaching 1% over the satellite's 5- to 10-year lifetime. Since debris from the Chinese test is concentrated near that altitude band, it will roughly double the threat for the next 5–10 years. Long-term evolution If the debris density becomes large enough at some altitudes, those regions of space can become "supercritical," meaning that collisions between objects are frequent enough that they produce additional debris faster than atmospheric drag removes debris from the region. The additional particles further increase the collision probability in the region, which leads to a slow-motion chain reaction or cascade as the large objects in orbit are ground into smaller fragments. That situation is sometimes called the Kessler syndrome after Donald Kessler, who studied the possibility.11 A study released by NASA's Orbital Debris Program Office in 2006, before the Chinese test, showed that parts of space have already reached supercritical debris densities.12 In particular, the study shows that in the heavily used altitude band from 900 to 1000 km, the number of debris fragments larger than 10 cm is expected to more than triple over the next 200 years, even assuming no additional objects are launched into the band. The study estimates that the total population of large debris in LEO will increase by nearly 40% during that time, still under the assumption of no additional launches. The debris from the Chinese test will make matters worse. An important implication of the study is that while mitigation efforts are important for slowing the increases, only debris-remediation measures such as removing large, massive objects already in orbit can hope to prevent their consequences. Remediation efforts such as robotic missions to remove defunct satellites and rocket stages are very expensive, but are being studied.

### Space debris increases the risk of strikes on Russian early-warning satellites, resulting in an accidental global nuclear war

Lewis, 4 - postdoctoral fellow in the Advanced Metods of Cooperative Study Program; worked in the office of the Undersecretary of Defense for Policy (Jeffrey, Center for Defense Information, "What if Space were Weaponized?" July 2004, http://www.cdi.org/PDFs/scenarios.pdf)

This is the second of two scenarios that consider how U.S. space weapons might create incentives for America's opponents to behave in dangerous ways. The previous scenario looked at the systemic risk of accidents that could arise from keeping nuclear weapons on high alert to guard against a space weapons attack. This section focuses on the risk that a single accident in space, such as a piece of space debris striking a Russian early-warning satellite, might be the catalyst for an accidental nuclear war. As we have noted in an earlier section, the United States canceled its own ASAT program in the 1980s over concerns that the deployment of these weapons might be deeply destabiliz- ing. For all the talk about a "new relationship" between the United States and Russia both sides retain thousands of nuclear forces on alert and con\* gured to ♦ ght a nuclear War. When briefed about the size and status of U.S. nuclear forces, President George W. Bush reportedly asked "What do we need all these weapons for?"43 The answer, as it was during the Cold War, is that the forces remain on alert to conduct a number of possible contingencies, including a nuclear strike against Russia. This fact, of course, is not lost on the Rus- sian leadership, which has been increasing its reliance on nuclear weapons to compensate for the country's declining military might. In the mid-1990s, Russia dropped its pledge to refrain from the "\*rst use" of nuclear weapons and conducted a series of exercises in which Russian nuclear forces prepared to use nuclear weapons to repel a NATO invasion. In October 2003, Russian Defense Minister Sergei Ivanov reiter- ated that Moscow might use nuclear weapons "preemptively" in any number of contingencies, including a NATO attack.44 So, it remains business as usual with U.S. and Russian nuclear forces. And business as usual includes the occasional false alarm of a nuclear attack. There have been several of these incidents over the years. In September 1983, as a relatively new Soviet early-warning satellite moved into position to monitor U.S. missile \*elds in North Dakota, the sun lined up in just such a way as to fool the Russian satellite into reporting that half a dozen U.S. missiles had been launched at the Soviet Union. Perhaps mindful that a brand new satel- lite might malfunction, the of\*cer in charge of the command center that monitored data from the early-warning satellites refused to pass the alert to his superiors. He reportedly explained his caution by saying: "When people start a war, they don't start it with only \* ve missiles. You can do little damage with just \* ve missiles."45 In January 1995, Norwegian scientists launched a sounding rocket on a trajectory similar to one that a U.S. Trident missile might take if it were launched to blind Russian radars with a high altitude nuclear detonation. The incident was apparently serious enough that, the next day, Russian President Boris Yeltsin stated that he had activated his "nuclear football" , - a device that allows the Russian president to communicate with his military advisors and review his options for launching his arsenal. In this case, the Russian early-warning satellites could clearly see that no attack was under way and the crisis passed without incident.46 In both cases, Russian observers were con\* -dent that what appeared to be a "small" attack was not a fragmentary picture of a much larger one. In the case of the Norwegian sounding rocket, space-based sensors played a crucial role in assuring the Russian leadership that it was not under attack. The Russian command sys-tem, however, is no longer able to provide such reliable, early warning. The dissolution of the Soviet Union cost Moscow several radar stations in newly independent states, creating "attack cor-ridors" through which Moscow could not see an attack launched by U.S. nuclear submarines.47 Further, Russia's constellation of early-warn-ing satellites has been allowed to decline - only one or two of the six satellites remain operational, leaving Russia with early warning for only six hours a day. Russia is attempting to reconstitute its constellation of early-warning satellites, with several launches planned in the next few years. But Russia will still have limited warning and will depend heavily on its space-based systems to provide warning of an American attack.48 As the previous section explained, the Penta- gon is contemplating military missions in space that will improve U.S. ability to cripple Russian nuclear forces in a crisis before they can execute an attack on the United States. Anti-satellite weapons, in this scenario, would blind Russian reconnaissance and warning satellites and knock out communications satellites. Such strikes might be the prelude to a full-scale attack, or a limited ef- fort, as attempted in a war game at Schriever Air Force Base, to conduct "early deterrence strikes" to signal U.S. resolve and control escalation.49 By 2010, the United States may, in fact, have an arsenal of ASATs (perhaps even on orbit 24/7) ready to conduct these kinds of missions - to coerce opponents and, if necessary, support preemptive attacks. Moscow would certainly have to worry that these ASATs could be used in conjunction with other space-enabled systems - for example, long-range strike systems that could attack targets in less than 90 minutes - to disable Russia's nuclear deterrent before the Rus- sian leadership understood what was going on. What would happen if a piece of space debris were to disable a Russian early-warning satel-lite under these conditions? Could the Russian military distinguish between an accident in space and the \*rst phase of a U.S. attack? Most Russian early-warning satellites are in elliptical Molniya orbits (a few are in GEO) and thus dif\*cult to attack from the ground or air. At a minimum, Moscow would probably have some tactical warn-ing of such a suspicious launch, but given the sorry state of Russia's warning, optical imaging and signals intelligence satellites there is reason to ask the question. Further, the advent of U.S. on-orbit ASATs, as now envisioned50 could make both the more dif\* cult orbital plane and any warning systems moot. The unpleasant truth is that the Russians likely would have to make a judgment call. No state has the ability to de\* nitively deter-mine the cause of the satellite's failure. Even the United States does not maintain (nor is it likely to have in place by 2010) a sophisticated space surveillance system that would allow it to distin- guish between a satellite malfunction, a debris strike or a deliberate attack - and Russian space surveillance capabilities are much more limited by comparison. Even the risk assessments for col-lision with debris are speculative, particularly for the unique orbits in which Russian early-warning satellites operate. During peacetime, it is easy to imagine that the Russians would conclude that the loss of a satellite was either a malfunction or a debris strike. But how con\* dent could U.S. planners be that the Russians would be so calm if the accident in space occurred in tandem with a second false alarm, or occurred during the middle of a crisis? What might happen if the debris strike oc-curred shortly after a false alarm showing a mis-sile launch? False alarms are appallingly common - according to information obtained under the Freedom of Information Act, the U.S.-Canadian North American Aerospace Defense Command (NORAD) experienced 1,172 "moderately seri-ous" false alarms between 1977 and 1983 - an average of almost three false alarms per week. Comparable information is not available about the Russian system, but there is no reason to believe that it is any more reliable.51 Assessing the likelihood of these sorts of co- incidences is dif\* cult because Russia has never provided data about the frequency or duration of false alarms; nor indicated how seriously early- warning data is taken by Russian leaders. More- over, there is no reliable estimate of the debris risk for Russian satellites in highly elliptical orbits.52 The important point, however, is that such a coincidence would only appear suspicious if the United States were in the business of disabling satellites - in other words, there is much less risk if Washington does not develop ASATs. The loss of an early-warning satellite could look rather ominous if it occurred during a pe- riod of major tension in the relationship. While NATO no longer sees Russia as much of a threat, the same cannot be said of the converse. Despite the warm talk, Russian leaders remain wary of NATO expansion, particularly the effect expan- sion may have on the Baltic port of Kaliningrad. Although part of Russia, Kaliningrad is separated from the rest of Russia by Lithuania and Poland. Russia has already complained about its decreas- ing lack of access to the port, particularly the uncooperative attitude of the Lithuanian govern- ment.53 News reports suggest that an edgy Russia may have moved tactical nuclear weapons into the enclave.54 If the Lithuanian government were to close access to Kaliningrad in a \*t of pique, this would trigger a major crisis between NATO and Russia. Under these circumstances, the loss of an early-warning satellite would be extremely suspi-cious. It is any military's nature during a crisis to interpret events in their worst-case light. For ex- ample, consider the coincidences that occurred in early September 1956, during the extraordinarily tense period in international relations marked by the Suez Crisis and Hungarian uprising.55 On one evening the White House received messages indicating: 1. the Turkish Air Force had gone on alert in response to unidenti\*ed aircraft penetrat- ing its airspace; 2. one hundred Soviet MiG-15s were \*ying over Syria; 3. a British Canberra bomber had been shot down over Syria, most likely by a MiG; and 4. The Russian \*eet was moving through the Dardanelles. Gen. Andrew Goodpaster was reported to have worried that the con\* uence of events "might trigger off ... the NATO operations plan" that called for a nuclear strike on the Soviet Union. Yet, all of these reports were false. The "jets" over Turkey were a \*ock of swans; the Soviet MiGs over Syria were a smaller, routine escort returning the president from a state visit to Mos- cow; the bomber crashed due to mechanical dif\*culties; and the Soviet \*eet was beginning long-scheduled exercises. In an important sense, these were not "coincidences" but rather different manifestations of a common failure - human er- ror resulting from extreme tension of an interna- tional crisis. As one author noted, "The detection and misinterpretation of these events, against the context of world tensions from Hungary and Suez, was the \*rst major example of how the size and complexity of worldwide electronic warning systems could, at certain critical times, create momentum of its own." Perhaps most worrisome, the United States might be blithely unaware of the degree to which the Russians were concerned about its actions and inadvertently escalate a crisis. During the early 1980s, the Soviet Union suffered a major "war scare" during which time its leadership concluded that bilateral relations were rapidly declining. This war scare was driven in part by the rhetoric of the Reagan administration, forti\*ed by the selective reading of intelligence. During this period, NATO conducted a major command post exercise, Able Archer, that caused some elements of the Soviet military to raise their alert status. American of\*cials were stunned to learn, after the fact, that the Kremlin had been acutely nervous about an American \* rst strike during this period.56 All of these incidents have a common theme - that con\* dence is often the difference between war and peace. In times of crisis, false alarms can have a momentum of their own. As in the second scenario in this monograph, the lesson is that commanders rely on the steady \* ow of reli-able information. When that information \* ow is disrupted - whether by a deliberate attack or an accident - con\* dence collapses and the re- sult is panic and escalation. Introducing ASAT weapons into this mix is all the more dangerous, because such weapons target the elements of the command system that keep leaders aware, informed and in control. As a result, the mere presence of such weapons is corrosive to the con\*dence that allows national nuclear forces to operate safely.

## ==== Uniqueness ====

## Uniqueness- Space Debris Down/Under Control

### Debris is reaching its tipping point. A single collision could threaten communication and lives.

Blake 11, investigative reporter for The Daily Telegraph, [Heidi, The Daily Telegraph, 2/1, <http://www.telegraph.co.uk/journalists/heidi-blake/>] JS

The volume of abandoned rockets, shattered satellites and missile shrapnel in the Earth’s orbit is reaching a “tipping point” and is now threatening the $250 billion (£174bn) space services industry, scientists said. A single collision between two satellites or large pieces of “space junk” could send thousands of pieces of debris spinning into orbit, each capable of destroying further satellites. Global positioning systems, international phone connections, television signals and weather forecasts are among the services which are at risk of crashing to a halt. This “chain reaction” could leave some orbits so cluttered with debris that they become unusable for commercial or military satellites, the US Defense Department's interim Space Posture Review warned last year. There are also fears that large pieces of debris could threaten the lives of astronauts in space shuttles or at the International Space Station.

The US is trying to reduce the amount of space debris in NEO

Jessa 9 (Tega, Freelance Writer, “Space Debris,” <http://www.universetoday.com/35190/space-debris/>, AD)

Fortunately, steps are already being taken. The United States Military and NASA both have agencies that monitor debris and are working on solutions to deal with them. One hindrance to implementing some solutions are the political implications. For example, if Strategic Command – the Military Debris monitoring agency – was to use laser to get rid of space debris, the technology would be the first step to a space weapon and raise the concerns of other nations. Hopefully solutions can be found that will agreeable to everyone.

**Japanese fishing nets Decreases Risk of Space Debris Now**  
The Telegraph 2011 <http://www.telegraph.co.uk/science/space/8296288/Fishing-net-to-collect-space-debris.html>   
A giant net several kilometres in size has been built as part of a collaboration between Japan’s space agency and a 100-year-old fishing net company to collect debris from space. The Japan Aerospace Exploration Agency (JAXA) and Nitto Seimo Co aim to tackle the increasingly hazardous problem of rubbish in orbit around the Earth damaging space shuttles and satellites once and for all. Last year, a US report concluded that space was so littered with debris that a collision between satellites could set off an “uncontrolled chain reaction” capable of destroying the communications network on Earth. It is estimated there are 370,000 pieces of space junk. The Japanese plan will see a satellite attached to a thin metal net spanning several kilometres launched into space. The net is then detached, and begins to orbit earth, sweeping up space waste in its path. During its rubbish collecting journey, the net will become charged with electricity and eventually be drawn back towards earth by magnetic fields – before both the net and its contents burn upon entering the atmosphere. It is likely the nets will target the orbital paths of space shuttles which are constantly monitored for debris. It is thought that the net will remain in orbit for several weeks, collecting enough rubbish to make the trip financially worthwhile, before sending another net into space. Inspired by a basic fishing net concept, the super-strong space nets have been the subject of extensive research by Nitto Seimo for the past six years and consist of three layered metal threads, each measuring 1mm diameter and intertwined with fibres as thin as human hair. The company, which became famous for inventing the world’s first machine to make strong knotless fishing nets in 1925, is aiming for the fuel-free system to be completed within two years. As many as ten million pieces of human-made debris are estimated to be circulating in space at any one time and the issue has long been a cause for concern, because of the potential for collisions with satellites and shuttles. The majority of the debris in space is believed to consist of small particles but some objects are larger, including spent rocket stages, defunct satellites and collision fragments. The US Defence Department’s interim Space Posture Review 2010 found that the volume of abandoned rockets, shattered satellites and missile shrapnel in the Earth’s orbit is threatening the £174 billion space services industry. Scientists said that a single collision between two satellites or large pieces of “space junk” could send thousands of piece of debris spinning into orbit, each capable of destroying further satellites. Global positioning systems, international phone connections, television signals and weather forecasts were among the services at risk of being disrupted, according to the report. In 2006 the Atlantis shuttle was hit by a small fragment of a circuit board which created a small hole through the radiator panels in the cargo bay. British scientists welcomed the plans yesterday but voiced concern. Dr Maggie Aderin-Pocock, a space scientist, said: “I’m glad someone is doing something about it because space debris is extremely dangerous. This sounds like a fairly straight forward solution and I think it could work if used properly. “However, I am slightly apprehensive as the net will have to be used carefully because we wouldn’t want a real satellite getting caught up in the net.”

### We’re On the brink of no return- every amount of space debris increses the risk

Taher, ’09 ( Abul, February 15, The Sunday Times, “Dangerous debris;

BRIEFING SPACE JUNK ; The collision last week of two satellites has drawn attention to the huge amount of man-made junk that remains in perpetual orbit. Abul Taher investigates”, lexis, js)

ORBITAL COLLISION Satellites crash 485 miles above Russian Arctic Last Tuesday at 4.56pm a defunct Russian military satellite that was falling out of its orbit collided with Iridium 33, a privately owned American communications satellite, 485 miles above Siberia. Both were destroyed, producing debris that scientists say could circle the Earth for tens of thousands of years. Iridium, which was travelling at about 17,000mph, was one of a network of 66 satellites positioned in near-polar orbit that circle the globe every 100 minutes. The Russian Kosmos 2251 satellite was launched in 1993 but has been out of operation since 1995, and has been gradually falling out of its original orbit about 490 miles above the Earth. It was only the fourth orbital collision on record but the first between two intact satellites.. MILLIONS OF PIECES Satellite explosions have left Earth ringed There are an estimated 300,000 objects of more than 1cm in diameter orbiting the Earth, including about 12,000 satellites, of which only 6% are still functioning. US Space Command monitors about 18,000 objects that it considers to be dangerous. Among the oddities in orbit are a glove, which was lost by an American astronaut doing repairs on the International Space Station (which is itself orbiting 135 miles up). If you include debris that is less than 1cm in diameter, the total rises to tens of millions of items. These are added to by the shooting-down of satellites that have outlived their usefulness with ballistic missiles. China destroyed a satellite by this means in 2007, as did the United States last year.. DEBRIS DANGERS Astronauts and craft could be jeopardised Scientists warn that collisions will become more of a risk as the number of satellites and amount of debris increases. Indeed, last week's incident sent two large clouds of debris into the orbits of numerous satellites. The number of satellites has increased rapidly with the growth in mobile phone networks and the use of sat nav systems in cars. A future collision could be crippling for these services. From an astronaut's perspective, debris can make life on spacecraft perilous. Space shuttles, such as the one pictured left, have had to avoid debris once a year on average. On a space walk the effects could be catastrophic: an object the size of a speck of paint hitting a spacesuit at 17,000mph would have the same effect as a bullet. The Pentagon is known to be concerned.. HOW TO SOLVE IT? Satellites should self-destruct after use This week the issue will be raised at the United Nations Committee on the Peaceful Uses of Outer Space conference in Vienna. Professor Richard Crowther, left, of the Science and Technology Facilities Council, who will represent Britain at the meeting, says that countries and companies should develop satellites that will have a mechanism that automatically sends them back towards Earth once they have finished their work so that they burn up in the planet's atmosphere. Some satellites and the International Space Station already have boosters and fuel to allow them to dodge space debris. Last week's collision also raises the issue of who is liable for crashes in space..

## ==== Links =====

## Link- Space Exploration

### Every satellite launch makes the problem worse creating a cascade effect which results in destruction of all space objects

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<Estimates of the future levels of risk are even more speculative than estimates of current risk levels, but most show an alarming trend of increasing debris. A January 2006 NASA study estimates the amount of debris ten centimeters and larger in LEO will triple within 200 years, increasing the likelihood of debris collisions by a factor of ten. n126 The greatest concentration of orbital debris will be located in the regions 800-900 kilometers and 1400-1500 kilometers in altitude. n127 The study acknowledges it seriously underestimates the future risk because it assumes no further launches into space. n128 For each of the past five years, launch providers have sent an average of sixty-one rockets into orbit each year. n129 Considering that each of these launches produces multiple pieces of debris in addition to one or more payloads, the future risk in the NASA study is understated. The cascade effect is the greatest fear of those who study the problem of orbital debris. If the cascade effect begins, orbital debris would collide with other space objects, which in turn would create new debris that would cause even more collisions. In this way, orbital debris would become self-generating and could make certain regions of space completely unusable, even without new satellites [\*19] being placed in those areas. n130 International efforts aimed at mitigating the creation of new debris have helped, n131 but will not alone solve the problem. That is why many authors are calling for increased research efforts into technologies for remediation-removal of existing debris from space. n132 Unfortunately, remediation measures are currently economically or technologically unfeasible. n133>

### The launches risk creating a chain reaction of space debris—this would turn the case by cutting off access to space forever and decreasing the effectiveness of any and all spacecraft

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We'll soon be cut off from space if we don't deal with the debris in orbit, warns Stuart Clark EARTH'S rings have never looked so beautiful, you think as you look up at the pallid sliver of light arcing through the night sky. Yet unlike Saturn's magnificent bands of dust and rubble, Earth's halo is one of our own making. It is nothing but space junk, smashed-up debris from thousands of satellites that once monitored our climate, beamed down TV programmes and helped us find our way around. This scenario is every space engineer's nightmare. It is known as the Kessler syndrome after Donald Kessler, formerly at NASA's Johnson Space Center in Houston, Texas. Back in 1978, he and colleague Burton Cour-Palais proposed that as the number of satellites rose, so would the risk of accidental collisions. Such disasters would create large clouds of shrapnel, making further collisions with other satellites more likely and sparking a chain reaction that would swiftly surround the Earth with belts of debris. Orbits would become so clogged as to be unusable and eventually our access to space would be completely blocked. On 10 February 2009 it started to happen. In the first collision between two intact satellites, the defunct Russian craft Kosmos-2251 struck communications satellite Iridium 33 at a speed of 42,100 kilometres per hour. The impact shattered one of Iridium 33's solar panels and sent the satellite into a helpless tumble. Kosmos-2251 was utterly destroyed. The two orbits are now home to clouds of debris that, according to the US military's Space Surveillance Network (SSN), contain more than 2000 fragments larger than 10 centimetres. The collision may also have produced hundreds of thousands of smaller fragments, which cannot currently be tracked from Earth. Such debris is a serious worry. With satellites travelling at tens of thousands of kilometres per hour, any encounter with debris could be lethal. "Being hit by a 1-centimetre object at orbital velocity is the equivalent of exploding a hand grenade next to a satellite," says Heiner Klinkrad, head of the space debris office at the European Space Agency in Darmstadt, Germany. "Iridium and Kosmos was an early indication of the Kessler syndrome." Space junk isn't just made up of dead satellites. It also includes spent upper-stage rockets, used to loft the satellites into orbit, and items that have escaped the grasp of butterfingered astronauts, such as the glove Ed White dropped in 1965 as he became the first American to walk in space, and the tool kit that slipped from Heide Stefanyshyn-Piper's hand during a 2008 space walk. Protective covers and the explosive bolts used to separate them from uncrewed spacecraft have also been left to float away, along with a few lens caps for good measure. Some of these objects re-enter the atmosphere and burn up, but most are still up there. The SSN has catalogued 12,000 objects in Earth orbit that are at least 10 centimetres in size, about three-quarters of which are space junk. For objects bigger than 1 centimetre, the estimates are frightening: there are anything from hundreds of thousands to millions of them, mostly in unknown orbits and each capable of smashing a satellite to smithereens. Every rocket launch creates yet more space debris, edging us ever closer to the Kessler syndrome becoming a reality. Graveyards and zombies So what can be done? For a start, we can try not to make the problem worse. This can be as simple as ensuring that protective covers are tethered to spacecraft rather than jettisoned. It also includes sticking to international guidelines intended to minimise new debris, drawn up by the Inter-Agency Space Debris Coordination Committee (IADC), which represents all the world's major space agencies. These require, for example, that spacecraft in low Earth orbit must be made to re-enter the atmosphere and burn up within 25 years of finishing their missions. Communications satellites in the high-altitude geostationary orbit cannot be brought down practically. Instead, the guidelines say operators should use the last of their satellites' fuel to boost them into a "graveyard orbit" 300 kilometres higher up (see diagram, page 49). Yet even with these guidelines in place, Klinkrad says, "It is pretty common to leave your spacecraft stranded." Twelve satellites in geosynchronous orbit failed in 2008, but only seven were boosted in accordance with the guidelines. And more than 800 of the 1200 trackable objects near the geostationary corridor are not active satellites. The most recent drama there involved the communications satellite Galaxy 15, which became widely known as the "zombie satellite" (see "March of the zombie", page 48). Even if the guidelines were followed to the letter, the number of debris fragments would still go up. "We could even stop launching and the amount of debris would still rise," says Hugh Lewis of the University of Southampton in the UK. That's because accidental collisions would still happen. Kessler predicted that if nothing were done to remove debris, we would begin to suffer the consequences in 2000. As it turned out, the Iridium and Kosmos collision did not happen for another nine years. The main reason for our period of grace may be that modern satellites are manoeuvrable. When a piece of space debris is seen approaching, satellite operators can move their "bird" out of the way. Such ducking and dodging used to be rare. Not any longer. A few years ago, operators were receiving one or two warnings of space debris a month; now it can be two or three times a week. Every time a new warning comes in, they must begin a 72-hour tracking campaign using ground-based radar to refine the orbit of the object and establish whether to take evasive action or not. As if accidents weren't bad enough, in 2007 China launched a missile that destroyed their Feng Yun 1C weather satellite. It was an ostentatious display of military capability, perhaps intended as a warning to anyone thinking of putting weapons into space, but it also sent shock waves through space operations centres around the world. That incident, in combination with the Iridium smash in 2009, created so much debris that the number of fragments in low Earth orbit large enough to be tracked from the ground almost doubled. Some craft are more vulnerable to debris than others, says Lewis, who has developed software to model how space junk spreads and evolves over time. Take the A-train –; four satellites that orbit Earth one behind the other, monitoring the atmosphere as they go. The closest pair are just 15 seconds apart, and this proximity makes the A-train especially vulnerable. Should one of the A-train's units be smashed by an incoming piece of debris, the chances are we could lose all four. As things stand, remediation –; as space engineers call it –; is a necessity. In other words, someone will have to go up there and bring the stuff down. But which bits? Who will do it? How will they do it? And who is going to pay? Initially the temptation might be to bring down as much as we can, but this will cost. "It will be so expensive to remove satellites from orbit that you will have to target which ones you want to take down," Lewis says. He has investigated a number of approaches that aim to identify the most dangerous space junk. The most obvious strategy might be to target the biggest objects, but Lewis's analysis shows that this may not be best. Just because something presents a large target does not mean that it would imperil other satellites. It may be that a smaller defunct satellite in a particular orbit presents more danger to a greater number of live craft. To make this idea more tangible, Lewis is treating satellites and space junk as elements in a kind of mathematical network, a network whose connections reveal how many objects a given satellite approaches in orbit (Acta Astronautica, vol 66, p 257). "It is like Google page-ranking. The most connected objects come up near the top of the list," says Lewis. These orbital connections can be used to decide which objects are the most dangerous. Bring those down and you halt the Kessler syndrome in its tracks. Lewis won't be drawn on which bits of junk are the most dangerous, however; he is loath to rile their owners. A range of new technology could be used to bring down dead satellites, Lewis says, and it would itself be satellite-based. A specialised satellite could fire a laser at a derelict craft, melting components and releasing gas that would propel it out of harm's way. Or the clearance satellite could play an orbital game of "pin the tail on the donkey", attaching tethers to the dead satellite to increase atmospheric drag and cause it to burn up in the atmosphere. On the face of it, every country ought to welcome the development of new technology to clean up space. In reality, the picture is clouded by the obvious military applications. "If you can bring down dead satellites, you can bring down live ones too," Lewis says. Space bounty Then there are the legal issues around space debris. Under maritime law, anyone can remove an abandoned ship without the owner's permission. Not so for space vehicles, as stipulated in the 1967 Outer Space Treaty. "Once you put it up there, it is yours for life," says James Dunstan, a lawyer specialising in issues to do with space and founder of Mobius Legal Group in Washington DC. So the US may not remove a Russian satellite from orbit with impunity, even if that satellite were completely dead and presenting a danger to working spacecraft. Together with Berin Szoka of the Progress and Freedom Foundation, a think-tank also based in Washington DC, Dunstan has created the outlines of an economic model that would see private industry taking responsibility for removing space debris. An international body, such as the IADC, would put a price –; rather like a bounty –; on every defunct satellite. Private companies can lodge bids with satellite owners for the right to buy and de-orbit their spacecraft. Once de-orbiting is successfully completed, the company could pocket the bounty, which would be funded out of a new tax that satellite operators would have to pay. But why bring these things down just to burn up in the atmosphere when they are potentially valuable? Dunstan estimates that of the 6000 tonnes of material in Earth orbit, one-sixth is high-grade aluminium in the form of discarded upper rocket stages. These empty fuel tanks have an internal volume 20 times that of the International Space Station. If they could only be corralled, they would make an inexpensive space station or, Dunstan suggests, they could be cut into shielding material to protect other satellites. "Why not set up Joe's Shingle Shack in orbit?" he asks, only half-joking. While the orbital equivalent of a used-car salesman selling satellite parts is some way off, the need to do more about space junk is immediate. "Our future ability to use space is directly jeopardised by space debris," says Szoka. Encouragingly, the European Space Agency has signed a contract with Spanish company Indra Espacio to develop a radar system to track space debris. In the US, Ball Aerospace and Technologies has collaborated with Boeing on the Space Based Space Surveillance satellite, a dedicated space-junk telescope awaiting launch. "It is very urgent that we begin to remove mass from orbit," says Klinkrad. Even as we talk, his team is beginning another tracking campaign. Something is stalking ESA's ERS-1 satellite, and they have to decide in the next day or two whether or not to use precious fuel to move the spacecraft. As Klinkrad says in a resigned voice, "This is becoming an everyday situation." n Stuart Clark is author of The Big Questions: The Universe (Quercus, 2010). Find his blog at www.stuartclark.com "A few years ago, we were receiving one or two warnings of space debris a month. Now it's three a week" March of the ZombiE Galaxy 15 is a name to strike terror into the hearts of satellite operators around the world. Once an ordinary and largely anonymous telecommunications satellite, it is now a zombie. It stopped talking to its masters on 5 April, just as a solar storm battered the Earth. The satellite's owner Intelsat is still investigating whether this caused Galaxy 15 to lose its mind. But Galaxy 15 is not only a problem for its owner. Following its malfunction, it began an inexorable march across space, bound for a natural orbital graveyard created by Earth's gravity. In its blind stumble to get there, Galaxy 15 risks colliding with other satellites. It has already menaced three and has at least three others in its path. To avert destruction, satellite operators must wait for the zombie to draw close and then manoeuvre their own satellite to "leapfrog" it. What makes Galaxy 15 particularly annoying is that its main transmitter and receiver are still working. As it drifts across the path of another working satellite, it could interfere with communications. To avoid this, satellite operators are signalling on tighter beams with larger antennae and less power. In effect they are whispering to their satellites in the hope they won't attract the zombie's attention. All of this is costing money –; big money. "These satellites are profit centres making millions of dollars a month," says James Dunstan of Mobius Legal Group in Washington DC. Every dodge to avoid a collision eats around $10 million into a satellite's profits. That's because collision avoidance manoeuvres waste precious fuel that would otherwise be used to combat the tendency for satellites to drift off into orbital graveyards. Although companies do not divulge how much fuel they use in collision avoidance manoeuvres, Dunstan estimates that each one must shorten a satellite's lifespan by between four and 12 months. He says dealing with Galaxy 15 could easily cost the telecomms industry $100 million. Tobias Nassif of Intelsat sees it differently. He says that constant vigilance means that most collision manoeuvres can be built into ones made fortnightly to stop satellites drifting. "Space debris is not a grave concern," he says, "but it is always on our mind."

### Space Exploration leads to Space Debris

Jessa 9 (Tega, Freelance Writer, “Space Debris,” <http://www.universetoday.com/35190/space-debris/>, AD)

One of the emerging concerns in space exploration is space debris; the outer space equivalent of pollution on Earth. Over the past 40 years, abandoned or obsolete man made space objects have been left in orbit around the Earth. In general we don’t worry much about them because most will eventually fall out of their orbit and burn up in the Earth’s atmosphere. However, these objects can collide creating the scattered fragments we call space debris. The problem is further exacerbated by two facts. First, these objects are traveling at very high velocities around the earth. To put this in perspective, a bullet is deadly because it is an object traveling at high speeds; its momentum comes mainly from its high velocity. Now think of much smaller objects traveling at speeds 10 times faster than a bullet; there are thousands of them out there, and they can come from any direction at any time. This is the environment most space craft and astronauts operate under on a regular basis. The second problem is the proliferation of space debris. As space debris scatters, they collide with other objects to create even more debris and so on. This phenomenon is call the Kessler syndrome. While space debris might be a manageable threat now, it can seriously hinder space exploration in the future if not dealt with. The seriousness of the situation came with two recent events in space. The International Space Station had to alter its orbit to avoid a particularly dangerous patch of space debris. The damage, even to a station as well armored as this one, would have been in the millions and halted a lot of important research. The second event was the first collision of two satellites in February of 2009. What if this had happened to a major communications satellite? The damage would also have high cost and only further exacerbate the problem with more space debris.

### Space Activity creates debris

Wright, 2007 (David, Co director and senior scientist with the global security program of the Union of Concerned Scientists in Cambridge, Massachusetts, “Space Debris,” Physics Today, http://physicstoday.org/journals/doc/PHTOAD-ft/vol\_60/iss\_10/35\_1.shtml?bypassSSO=1, October, CDG)

The space age began 50 years ago with the launch of Sputnik 1 by the Soviet Union on 4 October 1957. Since that time, some 4500 additional launches have taken place. Today 850 active satellites are in orbit, supporting a wide range of civil and military uses. The US owns and operates roughly half of those satellites, as shown in figure 1. As a result of this space activity, a tremendous amount of debris has been left orbiting in space. Orbital debris is any human-made object in orbit that no longer serves a useful purpose. It comes in the form of discarded equipment and rocket stages, defunct satellites, bolts and other hardware released during the deployment of satellites, and fragments from the breakup of satellites and rocket stages. Space debris is a growing concern. With their high speed in orbit, even relatively small pieces of debris can damage or destroy satellites in a collision. Since debris at high altitudes can stay in orbit for decades or longer, it accumulates as more is produced. As the amount grows, the risk of collisions with satellites also grows. If the amount of debris at some altitudes becomes sufficiently large, it could become difficult to use those regions for satellites. There is currently no effective way to remove large amounts of debris from orbit, so controlling the production of debris is essential for preserving the long-term use of space. The debris issue gained prominence in January 2007 when China tested an antisatellite (ASAT) weapon that destroyed one of its defunct weather satellites, the Feng Yun-1C (FY-1C), at an altitude of about 850 km. The test added significantly to the debris population near that altitude. (See PHYSICS TODAY, March 2007, pages 29 and 100.)

### Space Exploration Causes a wall of space debris

Johan, 09 (Hari, award winning journalist for The Independent, a top British newspaper, and also for the Huffington Post, New York Times, Los Angeles Times, as well as several international newspapers and journals, “We're covering our planet with a cloud of space junk,” The Independent (London), <http://www.lexisnexis.com.proxy1.cl.msu.edu/hottopics/lnacademic/>, 6/09, SR)

IN 1965, the American astronaut Edward White dropped a glove, and it has been orbiting the earth at 17,000 miles per hour ever since. This sounds like a quirky Trivial Pursuit answer - what is the deadliest garment in history? - but it could be about to give us all a galactic slap in the face. That glove is now joined by so much space trash that scientists are warning it could be poised to take out the satellites we depend on every day - and trap us here on a heating earth. In just 50 years of exploring space, humans have left 600,000 pieces of rubbish in space, all circling us at super-speed. When it is whirring so fast, a one millimetre fleck of paint hits you as hard as a .22 calibre bullet fired at point-blank range. A hard-boiled pea is as dangerous as a 400lb safe smacking into you at 60mph. And a chunk of metal the size of a tennis ball is as explosive as 25 sticks of dynamite. We are adding to this junk faster than ever before. There is no international agreement not to leave trash in the skies - and all nations are being reckless. The International Association for the Advancement of Space Safety warns that, at the current rate, the volume of Star Drek will increase fivefold in the next decade. More flights leave more rubbish, and more countries test their fancy new weapons systems by blowing up old satellites - and creating new torrents of trash. This creates a minor danger, and a major danger. There is a small risk that this rubbish will smack into human beings when minor amounts of it re-enter the Earth's atmosphere. For example, in March 2007, the wreckage of a Soviet spy satellite nearly crashed into a passenger plane over the Pacific. But only one woman has ever been hit by space junk: Lottie Williams from Oklahoma was smacked in the shoulder by a charred piece of space rocket. She was not injured. But there is a greater danger that an unstoppable chain reaction will begin: the rubbish will crash into other pieces of rubbish, causing it to shatter into smaller chunks that will then crash into each other - and on, and on, until the earth is circled by a haze of impassable metal debris that remains there for millennia. There are (contested) fears that the process began in February this year, when an old Russian satellite crashed into a US satellite high above Siberia. Dr Marshall Kaplan at John Hopkins University Applied Phyiscs Laboratory says that we face a "coming catastrophic disaster. If we don't clean up this mess in the next 20 years, we're going to lose our access to space". Vladimir Solovyov, Russia's space mission control chief, agrees. He warns: "The clouds of debris pose a serious danger... to earth-tracking and communications satellites." What would it mean? The super-speed of our globalized world is dependent on satellites. If they are taken out by a barrage of 17,000mph rubbish, you can say goodbye to your mobile phones, GPS, and weather forecasts - and we'll be needing them in this century. We will be trapped here, unable to explore space. Hubble telescope bubble, toil and trouble. What can we do now? There are some proposals for removing the rubbish, like creating a series of lasers that would sweep the trash back into our atmosphere, where it would mostly burn up. But they are regarded as of dubious scientific plausibility, and a long way off. The most urgent task is to stop adding to the rubbish - but the 20 governments that have access to space are refusing to do it. They will not agree a deal; they don't want to tell each other where their spy satellites are, or to agree not to blow them up when they feel like it, to test their flashy new weaponry. This wall of garbage orbiting us all seems like a symbol of the great dilemmas facing humanity in the 21st century. We have become capable of the most stunning technological breakthroughs - but we are sabotaging them by proving ourselves incapable of the most basic forms of self-restraint. At the moment of victory, we regress. The achievements of our frontal lobes are undermined by the backwardness of our adrenal glands. This story is being played out, with mild variations, again and again, in this century. We have dramatically improved human health - yet now seem poised to cook it under a thick blanket of our own carbon emissions. We have made it possible to fish and farm more efficiently than ever - so we do it till we have taken all the fish and destroyed all the soil. It doesn't have to be like this. We can restrain ourselves to save our satellites, and our ecosystem. Individuals restrain themselves all the time; why can't we do it collectively? The only alternative is to become a species who heroically reach for the stars - only to smack into a wall of our own trash.

**Space exploration and development increase space debris.**

**Senechal ’09** (Thierry, Policy Manager of the Commission on Banking Technique and Practice at the International Chamber of Commerce (ICC), degrees in economics and finance from Harvard University, London Business School, and Columbia University, former Sloan Fellow from the Massachusetts Institute of Technology, <http://74.125.127.132/scholar?q=cache:mjrrGXTIIjAJ:scholar.google.com/+space+weaponization+causes+debris&hl=en&as_sdt=0,23&as_ylo=2005>, Space Debris Pollution: A Convention Proposal, Scholar, SS)

As space activity increases, the accumulation of debris is also on an upward trend. Over the recent years, companies have been facing new demands to engage in public-private partnerships and are under growing pressure to be accountable not only to shareholders, but also to society-at-large. When addressing the problem posed by space debris, it is thus time to include the space industry in the international effort to tackle this pressing issue. The space industry does not bear the responsibility for leveling the playing field and ensuring that space free of pollution. However, government and the private sector must construct a new understanding of the balance of public and private responsibility and develop new governance for activity in space and thus creating social value.

## Link- Launches

### New Launches Cause Space Debris

Scott 10 (Scott, avionics editor and senior engineering editor, “Experts Consider What's Up There

Panel Addresses Space Situational Awareness and Space Debris,” <http://newsletters.spacefoundation.org/spacewatch/articles/id/479>, May 2010, AD)

Perhaps the most worrisome aspect of the increasing utilization - and globalization - of space is a simple question: "what's up there?" The Critical Issues - Space Situational Awareness & Space Debris panel at the 26th National Space Symposium examinedtwo different, but related, issues: the challenge of keeping abreast of what is taking place in near-Earth space, and the proliferation of space debris. Presented in association with the AMOS Conference, a Project of the Maui Economic Development Board, Inc. (MEDB), the panel featured a special introduction by Sandy Ryan, AMOS Conference Director, MEDB, and was moderated by space author William B. Scott. Panelists included: Lt. Gen. Brian A. Arnold, USAF (Retired), vice president for space strategy, Raytheon Space and Airborne Systems Roger L. Hall, ST, deputy director, Tactical Technology Office, Defense Advanced Research Projects Agency (DARPA) Houston T. Hawkins, senior fellow, Los Alamos National Laboratory, and chief scientist, Principal Associate Directorate for Global Security Maj. Gen. Susan J. Helms, USAF, director of Plans and Policy, U.S. Strategic Command Nicholas L. Johnson, chief scientist for orbital debris, NASA Joseph Sheehan, president, Analytical Graphics, Inc. (AGI) Arnold laid out the issues, saying, "Awareness of our space environment has never been more important," but that most of the space tracking radars are located in the northern hemisphere, "making continuous coverage impossible." He also noted that every time we send something to orbit, we contribute to the debris. "We need to preserve the environment for the future of space by looking at methods to mitigate space debris - environmental cleaning of space," he said.

### The more technology we send up to orbit, the more debris we create

Smh.com, 6/29/11

(technology news website, “Space junk sends astronauts scrambling for safety”, <http://www.smh.com.au/technology/sci-tech/space-junk-sends-astronauts-scrambling-for-safety-20110629-1gpl6.html>, June 29th, CJD)

A piece of debris travelling thousands of miles an hour narrowly missed the International Space Station, forcing the crew to scramble to their "life rafts". Russian space officials told news agencies the piece of space junk whizzed past only 250 metres from the 13-year-old station - a tiny distance in space terms - and there was no time for evasive action. The Russian space agency separately issued a terse statement noting that "a situation occurred" involving "an object of unknown origin and the crew dived into two Russian Soyuz capsules. The three-crew capsules serve as the emergency evacuation vehicles for the space station because of their reliability and well-developed emergency-escape system. "After the object passed, the crew was allowed to return to their regular working schedule," said Russian statement. Space analysts warned that incidents of this kind were growing disturbingly more common as the amount of waste -- from nuts and bolts to rocket parts -- multiplied from basic wear and tear and controversial military testing. "The ISS has had to actually manoeuvre out of the way on 10 or 12 occasions," said Moscow's Space News magazine editor Igor Marinin. "The ISS has never been hit by debris," he added. But its Russian predecessor Mir "was hit pretty often. Those would leave gashes in the windows up to two centimetres (nearly an inch) thick and tear through the solar batteries." The ISS is currently manned by three Russians, two Americans and a Japanese astronaut. "Incidents involving so-called 'space junk' are not one of a kind. They have happened before," the Russian space agency statement added. One of the most well-documented cases occurred in March 2009 when the ISS had a near miss with two US astronauts and a Russian on board. The incident came at a sensitive time for the $100 billion project because it was being hampered by yet another on-board problem that needed an emergency fix. One of its external tanks was leaking hydrogen and a US shuttle had to be ferried in with more crew and supplies -- a mission that had to be inconveniently delayed because of the space junk scare. Scientists estimate that there are more than 300,000 junk fragments in space of up to 10 centimetres (four inches) long and a billion more that are smaller. About 18,000 of these are believed to be very dangerous for the US shuttle and other space missions because they travel at tens of thousands of miles an hour. Russia is also vocally critical of tests being conducted by nations like China, in which outdated satellites are blasted by new missile systems - creating spectacular explosions that make a profound impact on outer space. Analysts said officials from all nations involved in space were taking extra precautions to make sure that the orbit being taken up by the ISS remained clean. "The orbit used by the ISS is no longer being littered," said Marinin of the Space News magazine. "The incidents we might see in the future could be extreme but they will not be fatal." The first module of the 16-nation ISS programme was launched by Russia in 1998. The craft orbits 350 kilometres (220 miles) from Earth and sometimes maneuvers up or down when dangerous incoming particles are detected in time. An emergency rescue system worked out by the Russians is extremely simple: the crew simply hop into the vessel in which they flew up from Earth and return home. AFP, with THE TELEGRAPH, LONDON Read more: <http://www.smh.com.au/technology/sci-tech/space-junk-sends-astronauts-scrambling-for-safety-20110629-1gpl6.html#ixzz1T7thOIGo>

## Link- Nuclear Propulsion

### Nuclear Technology in Space Creates Space Debris

Zaitsev 2009 (Yury, Researcher about Nuclear Power, “ Russia to develop nuclear-powered spacecraft for Mars mission” <http://www.indiastrategic.in/topstories410.htm>, November 2009)

#### On February 10, 2009, the Iridium-33 telecommunications satellite owned by US company Iridium Satellite LLC and its defunct Russian equivalent, the Kosmos-2251 with a nuclear propulsion unit, collided over northern Siberia. This resulted in potentially hazardous space debris. At present, 30 Russian and seven US spacecraft with nuclear systems onboard are orbiting the earth at 800-1,100-km altitudes, where similar collisions can take place. This makes up for about 40 "potential nuclear explosions." If any of these satellites hits a fragment of space junk, it will slow down and eventually re-enter the atmosphere, spewing radiation above the Earth and on its surface. Since the 1978 Kosmos-954 crash, the Scientific and Technical Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space has always focused on the use of space-based nuclear reactors. Its survey formed the basis for the UN General Assembly's December 1992 resolution entitled "Principles Relevant to the Use of Nuclear Power Sources in Outer Space." According to the resolution, nuclear reactors can be used in outer space only when their usage is absolutely indispensable, and after their space mission is fulfilled the spacecraft equipped with nuclear reactors should be placed on sufficiently high orbit. "...The sufficiently high orbit must be such that the risks to existing and future outer space missions and of collision with other space objects are kept to a minimum."

## Link- Nuclear Disposal

### Nuclear Waste disposal causes nuclear space debris

Dusek 97 (Robin Dusek, Attended William & Mary Environmental law, “

Lost in Space?: The Legal Feasability of NuclearWaste Disposal in Outer Space,” ““<http://scholarship.law.wm.edu/cgi/viewcontent.cgi?article=1286&context=wmelpr&sei-redir=1#search=%22nuclear%20disposal%20causes%20space%20debris%22>, AD)

With any type of disposal that does not actually involve the disintegration of the waste (as on the sun), harm is a real danger. Various space objects have had "near misses" with debris in space, and even some hits. The chance that nuclear waste could destroy a satellite or a manned space mission needs to be weighed heavily, for both ethical and monetary reasons. See id. 46 See The Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389 [hereinafter Liability Convention of 1972], which places absolute liability on the launching party if damage occurs on earth or with aircraft. It places liability on the launching state if it is at fault for an accident in space. See id. at 2392. ... See id. ... If the savings and safety of disposal of nuclear waste in outer space appears to greatly outweigh those of disposal on earth, the risk involved may be worth the pay-off. Science has not determined that geologic disposal of waste makes sense from either an economic or a safety perspective, so it is possible that a country may determine that the potential risk of waste disposal in outer space is worth the benefit.

## Link- Space Tourism

### Space tourism leads to more space debris

Freeland, 2006

[Steven, professor of International Law at the University of Western Sydney, Australia. “Up, up and . . . Back: The Emergence of Space Tourism and Its Impact on the International Law of Outer Space Symposium: Issues in Space Law,” Chicago Journal of International Law, <http://heinonline.org/HOL/Page?handle=hein.journals/cjil6&id=30&type=text&collection=journals>, 2005-2006]

Space tourism activities will inevitably result in greater pressures on the space environment. They will lead to the pollution of previously pristine areas. In contrast, however, to the imposition of rules relating to space debris, the control of human activities like littering would cost relatively little in dollar terms to regulate. It is imperative that this be done in order to minimise as much as possible any additional disruption to the space environment. Moreover, as the level of space tourism activities becomes more sophisticated, it will be necessary to construct infrastructure-hotels, dams, storage facilities, roads, and other "conveniences"--on the moon and (eventually) other celestial bodies. As has been the case on earth, mistakes will be made and there will be environmental accidents. Even though it envisages exploitation of the moon's natural resources, the Moon Agreement imposes obligations on parties to protect "the existing balance of its environment."6 The construction of any form of space tourism infrastructure on the moon will only add to the irreversible alteration of the space environment and worryingly it is difficult to imagine what the overall effect will be. There is an unavoidable conflict between the development of space tourism activities and any environmental protection principles that form part of international space law. It will therefore be necessary to establish clear guiding principles to regulate such activities.

## Link- SPS

### Satellite launches create space debris that destroy space objects

Michael Taylor**,** Chief of the Space and International Law Division at Headquarters United States Air Force Space Command, 2007, “Trashing the Solar System One Planet at a Time: Earth’s Orbital Debris Problem”

<Estimates of the future levels of risk are even more speculative than estimates of current risk levels, but most show an alarming trend of increasing debris. A January 2006 NASA study estimates the amount of debris ten centimeters and larger in LEO will triple within 200 years, increasing the likelihood of debris collisions by a factor of ten. n126 The greatest concentration of orbital debris will be located in the regions 800-900 kilometers and 1400-1500 kilometers in altitude. n127 The study acknowledges it seriously underestimates the future risk because it assumes no further launches into space. n128 For each of the past five years, launch providers have sent an average of sixty-one rockets into orbit each year. n129 Considering that each of these launches produces multiple pieces of debris in addition to one or more payloads, the future risk in the NASA study is understated. The cascade effect is the greatest fear of those who study the problem of orbital debris. If the cascade effect begins, orbital debris would collide with other space objects, which in turn would create new debris that would cause even more collisions. In this way, orbital debris would become self-generating and could make certain regions of space completely unusable, even without new satellites [\*19] being placed in those areas. n130 International efforts aimed at mitigating the creation of new debris have helped, n131 but will not alone solve the problem. That is why many authors are calling for increased research efforts into technologies for remediation-removal of existing debris from space. n132 Unfortunately, remediation measures are currently economically or technologically unfeasible. n133>

### Orbital crowding causes space debris

Telegraph, 2011, Space junk: a risky game of space invaders, <http://www.telegraph.co.uk/science/space/8135495/Space-junk-a-risky-game-of-space-invaders.html>)

The [space](http://www.telegraph.co.uk/science/space/) around our planet is no longer a lonely place. Vital orbits near and far from Earth's surface are shrouded in a perpetual and perilous shroud of debris and defunct satellites. In addition to thousands of large fragments, Nasa estimates there are at least half a million objects between 1cm and 10cm wide circling Earth. Even objects this small can, when hurtling at orbital velocities, cripple a satellite. And as their number grows, so does the risk of further collisions, and the release of even more shrapnel. The resulting vicious circle threatens not only the multi-billion pound satellite industry, but the safety of manned missions into space. "The crowding in low Earth orbits is a really big issue," says Professor Martin Barstow, of the University of Leicester, "and the volume of debris will only increase unless we manage to stop it accumulating, give greater protection to satellites or clear the debris." Russia's Cosmos 2251 had been circling the planet aimlessly for 14 years, following just two years of active service after its launch in 1993. At the end of its useful life, there had been no plan to move it out of harm's way. Fortunately, the Cosmos-Iridium smash may yet be viewed as the event that catalysed a pivotal change in attitudes to space safety: there are signs that the United States government, in particular, has accepted that things cannot go on as they are. Of key concern are two vital areas. The first, between 200 and 1,000 miles from the planet's surface, is known as "low Earth orbit", used by the Hubble space telescope, the International Space Station and the space shuttles that restock it. The closeness to Earth makes repair missions relatively easy – but to resist gravity, objects in these orbits must travel very rapidly (approximately 17,000mph). The resulting friction against the edge of the atmosphere – and bombardment by debris – ultimately causes the devices to fail. Examining the Hubble, says Prof Barstow, "you can clearly see the severe damage that tiny objects have caused. Even dust particles travelling at very high velocities can enter and knock out a satellite if they hit the wrong part." Because of the speed at which these satellites travel, it is hard to bounce communications signals off them, or use them to observe specific events, such as weather patterns. This is where geostationary satellites come in. Once in orbit, at approximately 22,000 miles from the planet, these craft circle in perfect synchronicity with Earth, effectively resting at a fixed point in the sky. This allows them to monitor a particular area, or to be used as a way station for the phone calls, radio signals and electronic data transfers that keep the information economy ticking over. There are two problems, however. First, the height of the orbit makes these satellites effectively impossible to repair. Second, the

### SPS results in increased space traffic, meaning more chance of collision

Bansal, 5/23(Gauray Bansal is a writer for EcoFriend, a news agency about green energy, “The Good, the bad and the ugly: Space based solar energy,” May 23 2011, <http://www.ecofriend.com/entry/the-good-the-bad-and-the-ugly-space-based-solar-energy/> )

2. Satellite traffic will increase: A large number of such projects can lead to overcrowding of space in the geosynchronous orbit. This may lead to a mishap like the one collision that happened between the Iridium Satellite LLC-operated satellite and the Russian Cosmos-2251 military satellite occurred at about 485 miles above the Russian Arctic on Feb, 2009.

## Link- Weaponization

### Space Weapons create debris

Wright, 2007 (David, Co director and senior scientist with the global security program of the Union of Concerned Scientists in Cambridge, Massachusetts, “Space Debris,” Physics Today, http://physicstoday.org/journals/doc/PHTOAD-ft/vol\_60/iss\_10/35\_1.shtml?bypassSSO=1, October, CDG)

Sources of debris There are two main sources of orbital debris. The first source is routine space activity and the accidental breakup of objects placed in orbit by such activity. The international community is attempting to address this source, in part by developing debris-mitigation guidelines to limit the debris created as a result of routine space activities. The second source of debris is the intentional creation of debris in orbit by the testing or use of destructive ASAT weapons. Kinetic-energy ASAT weapons, such as the one tested by China in January, are intended to destroy satellites by physically colliding with them at high speed. Such collisions can create tremendous amounts of orbital debris—much more than is generally realized. We discuss such events in detail below. To provide a sense of the origin of the debris population, figure 4 shows a rough breakdown of the cataloged objects in orbit. One-quarter of the "payloads" are active satellites; the rest are satellites that are no longer active and are therefore considered to be debris. The largest category of debris—nearly half of the total—is that caused by both accidental and intentional breakups of objects in orbit. Explosions due to malfunctions of propulsion systems or the ignition of residual propellant in a rocket stage are the largest source of accidental-breakup debris. The Chinese ASAT test added some 2000 fragments to the catalog; they make up about 35% of the breakup-debris total. The Soviet ASAT program in the 1970s and early 1980s, which attempted to destroy a satellite by shrapnel from an exploding ASAT weapon, created more than 700 pieces of large debris, roughly 300 of which remain in orbit. The last piece of cataloged debris from the one US ASAT test, in September 1985, decayed from orbit in 2004.3 Currently the US and Russia are each responsible for about 35% of the cataloged objects in space, and China for about 20% following its ASAT test. The Russian percentage is expected to increase to roughly 40% in the next year as debris from the February 2007 breakup of a Briz-M booster stage launched in 2006 is cataloged. International efforts are under way to control the production of debris from routine space activity. In the mid-1990s the US developed and released a set of debris-mitigation guidelines; subsequently other countries developed similar national guidelines. In 2002 the Inter-Agency Space Debris Coordination Committee adopted a consensus set of guidelines,4 and in June 2007 the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) adopted a set of mitigation guidelines based on the IADC guidelines.5 To reduce the production of debris in space, all the guidelines call for measures such as designing satellites and rocket stages to limit the release of mission-related debris and depleting propellant from nonoperational satellites or stages to reduce the risk of explosions. By calling for spent stages and satellites to be removed from orbit, the guidelines also attempt to control the number of large objects in space that could break up due to collisions. Unfortunately, the guidelines are not legally binding. Nevertheless, those efforts appear to have been partially successful. The number of objects in the catalog increased roughly linearly from 1960 through the mid-1990s, but it rose at a much slower rate from 1997 through 2006, in part due to a significant reduction in the release of mission-related and fragmentation debris.6 Unfortunately, the January ASAT test and the Briz-M explosion in February that is estimated to have created at least 1000 trackable fragments appear to have essentially undone the gains in the previous decade. The explosion of the Briz-M stage could likely have been prevented by strict adherence to the IADC guidelines, which call for venting unused propellants. There are currently no international restrictions on the testing or use of military systems intended to destroy satellites.

### Weaponization leads to the creation of debris

Kepon and Clary, 2003 (Michael Krepon, Christopher Clary, Researchers for the Weaponization of Space Project at the Stimson Center, “ Space Assurance or Space Dominance? The Case against Weaponizing Space,” The Henry L. Stimson Center, <http://www.stimson.org/images/uploads/research-pdfs/spacebook.pdf>, April 2nd, 2003, AD)

Orbital debris mitigation and space traffic management require multilateral solutions. Earth is surrounded by litter—perhaps 9,000 objects larger than ten centimeters in diameter, and an estimated 100,000 pieces of orbital debris larger than a marble. As Joel Primack has written, [S]pace does not clear after an explosion near our planet. The fragments continue circling the Earth, their orbits crossing those of other objects. Paint chips, lost bolts, pieces of exploded rockets—all have already become tiny satellites, traveling at about 27,000 kilometers per hour, 10 times faster than a high-powered rifle bullet. A marble traveling at such speed would hit with the energy of a one-ton safe dropped from a three-story building. Anything it strikes will be destroyed and only increase the debris. The weaponization of space is an environmental as well as a national security issue. The environmental degradation of space created by space-faring nations constitutes a danger to space exploration, the space shuttle, and other peaceful uses of space. Space litter also poses difficulties for the military uses of space. Indeed, the U.S. government—under the auspices of NASA—has been working hard for many years to decrease the creation of debris as well as to foster an international agreement designed to mitigate debris created from space launches. Without new measures, the population of debris (including inoperable satellites) larger than ten centimeters could grow appreciably.

### Weaponization would create fields of Space Debris around the planet

Kepon and Clary, 2003 (Michael Krepon, Christopher Clary, Researchers for the Weaponization of Space Project at the Stimson Center, “Space Assurance or Space Dominance? The Case against Weaponizing Space,” The Henry L. Stimson Center, <http://www.stimson.org/images/uploads/research-pdfs/spacebook.pdf>, April 2nd, 2003, AD)

The weaponization of space, particularly with respect to the flight-testing of antisatellite weapons, would greatly compound existing concerns over safe passage. In the event of a resumption of ASAT tests, the Pentagon would attempt to mitigate space debris, as it does with respect to missile defense tests, but the effectiveness of such efforts is questionable. Moreover, other states that test ASATs may not be as conscientious about debris creation. The actual use of ASATs would compound these dangers exponentially. Space warfare would not only constitute a threat to targeted satellites, it would also create debris fields that would threaten satellites operating in low earth orbit, including NTM, space transportation systems such as the U.S. space shuttle, and the International Space Station. The damage resulting from warfare that includes ASAT use could be more long lasting in space than on Earth. Traffic management and debris mitigation efforts are essential components of space assurance. Certainly, the UN-led efforts to craft voluntary debris mitigation guidelines are welcome and should be encouraged. At the same time, it would also be prudent to seek to codify such guidelines by strengthening the Convention for International Liability for Damage Caused by Space Objects. Industry groups advocate the establishment of operating standards for debris mitigation through the International Organization for Standardization. Space assurance requires much-improved tracking of objects in space. Currently, NASA is keeping tabs on around 10,000 objects with a diameter larger than 10 centimeters. However, debris smaller than that is difficult to find, and can be just as dangerous, as it can disable a satellite and create concerns about the safety of the space shuttle. Furthermore, while smaller objects are routinely monitored in LEO, the catalogue of space objects in GEO primarily covers objects bigger than 1 meter in diameter (such as non-working satellites).

### Space Weaponization creates space debris, which destroys commerce

Kepon and Clary, 2003 (Michael Krepon, Christopher Clary, Researchers for the Weaponization of Space Project at the Stimson Center, “Space Assurance or Space Dominance? The Case against Weaponizing Space,” The Henry L. Stimson Center, <http://www.stimson.org/images/uploads/research-pdfs/spacebook.pdf>, April 2nd, 2003, AD)

The drive toward space weaponization would have percussive effects on space commerce. Since the vulnerabilities of commercial satellites are very great and the costs of protective measures are open-ended, cost-benefit calculations of commercial investments in space would become more problematic. Space commerce requires the minimization of space debris. The growth of commerce in space therefore requires a peaceful environment. This environment has been nurtured over the past decade by the absence of space weapons’ flight-testing and deployment. Is the nurturing and expansion of space commerce now to proceed on an entirely different premise? How would proponents of the flight-testing and deployment of U.S. space warfare capabilities propose to assure commercial markets?

### Weapons lead to Debris

Kepon and Clary, 2003 (Michael Krepon, Christopher Clary, Researchers for the Weaponization of Space Project at the Stimson Center, “Space Assurance or Space Dominance? The Case against Weaponizing Space,” The Henry L. Stimson Center, <http://www.stimson.org/images/uploads/research-pdfs/spacebook.pdf>, April 2nd, 2003, AD)

An alternative to maneuverability would be to provide important satellites with their own means of self-defense, such as explosive charges or small homing missiles to destroy ASATs before they can carry out attacks. To be effective, this self-protection measure would require shooting first, rather than waiting to find out whether an approaching object were an ASAT—unless, of course, warfare has already begun. The flight-testing and deployment of weapons in space designed to defend satellites from attack would be indistinguishable, for all practical as well as for space policy purposes, from the flight-testing and deployment in space of offensive weapons. Put another way, preemptive defense of satellites could also be employed as a preemptive offense. Moreover, the military utility of defending satellites by offensive means in space might be limited against sophisticated, maneuverable ASATs. The creation of space debris resulting from an active defense in space could also impair satellite operations.

### Space Weaponization leads to Space Debris

McGill 5 (McGill, Institute of Air and Space Law, “Peaceful and Military uses of Outer Space: Law and Policy”, <http://www.eparl.net/pages/space_hearing_images/BackgroundPaper%20McGill%20Outer%20Space%20Uses.pdf>, AD)

The opponents of weapons in space argue that the flight-testing, deployment and use of space weapons pose a significant threat not only to Military uses of outer space, but also to space exploration and other peaceful uses of space. Furthermore, using anti-satellite weapons would exacerbate the problem of space debris, defined by NASA as “any man-made object in orbit around the Earth which no longer serves a useful purpose” (Johnson, 2003). According to a report by UNESCO made public in London on 28 April 2002, there were about 2.7 tons of various missile fragments in orbit. (Lukiantsev, 2002). US Space Command’s Space Catalogue currently tracks some 9,000 man-made objects in orbit, ranging in size from 10 cm in lower orbit to over 1 meter in geo-stationary orbit. Approximately 94 per cent of these objects are considered space debris and a hazard to satellites and other spacecraft. With this material flying at speeds of almost 8 km/s (which is ten times more than that of a rifle bullet), a collision with a functional space object would cause it serious damage or even destruction. (Mehrholz et al., 2002). Weaponization of space would only worsen the debris problem and could jeopardize the possibility of further space explorations and severely impair both civilian and Military uses, including communications systems. In addition, even a small number of “hits” in the lower orbits could create sufficient debris to cause a cascade of further collisions and fragmentation. (Levy, 2002). Eventually, this accumulation of debris could interfere with the Sun light (since Sun’s rays reflect off the dust) and lead to serious damage to Earth’s environment as a result of a permanent light pollution. (Primack, 2002)

### Space weapons would massively increase space debris

Su ’10 Jinyuan Su, The Silk Road Institute of International and Comparative Law, School of Law, Xi'an Jiaotong University. “Towards an effective and adequately verifiable PPWT”. Space Policy Volume 26, Issue 3, August 2010. ScienceDirect.

With regard to space weaponization, many more debates have taken place over inter-state strategic trade-offs than over the cooperative interest of avoiding a disaster arising from orbital debris. Today around 21,000 orbiting debris larger than 10 cm in diameter are tracked; and it is estimated there are over 100,000 pieces larger than a marble. Debris in orbits higher than about 800 km above the Earth’s surface will be up there for decades, above 1000 km for centuries, and above 1500 km effectively forever.32 Therefore, the amount of orbital debris is unlikely to decrease by natural degradation unless technology development enables us to dispose of it. Space debris moves at an extremely high speed of 27,000 km per hour; even tiny pieces can cause destruction to a satellite.33 This danger will be exacerbated as the Earth orbits become increasingly crowded. In addition, there is also a high risk of a chain reaction of destruction, the so-called “Kessler Syndrome”,34 in which, if a collision does occur, the resulting fragments become an additional collision risk. The deployment of space-based weapons would generate great quantities of space debris just during the initial deployment and far more if they are used.35 Testing of ASATs would further increase the amount. In the event of a real “space war”, the Earth orbits could be veiled by debris clouds, making them no-go areas and jeopardizing the possibility of space exploitation. A conservative estimate shows that a modest space war involving destruction of 30 satellites would increase the level of space debris by almost a factor of four, while a larger one involving destruction of 100 satellites would increase it by 1250%, excluding Kessler Syndrome effects.36 The space industry was projected to exceed $150 billion per year in revenues by 2010,37 yet even this figure may not fully display humanity’s heavy reliance on space technologies for daily life. If the Earth orbits were to become too inhospitable for satellites, the global economy would collapse and human society would step back in time several decades. Meanwhile, although it is possible to distinguish enemy satellites from neutral ones, collateral damage may be caused to the in-orbit or on-Earth properties of neutral states. The belligerent states would be liable, jointly or severally, to the third state.38

### The use of space weapons creates debris, which destroys satellites, creating more debris, preventing further use of space.

Wright, 2007 (David, Co director and senior scientist with the global security program of the Union of Concerned Scientists in Cambridge, Massachusetts, “Space Debris,” Physics Today, http://physicstoday.org/journals/doc/PHTOAD-ft/vol\_60/iss\_10/35\_1.shtml?bypassSSO=1, October, CDG)

A second implication is that the intentional destruction of satellites would add large amounts of debris at already-crowded altitudes and thus would significantly increase the collision rate and therefore the rate at which cascades would increase the debris population. Kinetic-energy ASATs In principle, a country could use several types of weapons, such as lasers or electromagnetic jammers, to interfere with the operation of satellites.13 However, the effectiveness of many of those weapons is uncertain and difficult to verify. A successful attack by a kinetic-energy ASAT weapon would likely cause damage that could be detected by sensors on the ground, and detection of severe physical damage would strongly imply that the satellite was no longer functioning. If a satellite were deemed an important enough military threat that a country decided to attack it, that country might have a strong incentive to use a kinetic-energy ASAT. Hypervelocity collisions—those occurring at relative speeds greater than a few kilometers per second—lead to extreme temperatures and pressures and occur over very short time scales, so modeling the response of materials to the impact is complex. Hydrodynamics codes have been developed to simulate relatively simple impact geometries, but modeling the effects of an impact on a satellite or other complicated body is beyond current capabilities. However, computer models developed in the past decade and based on ground tests and observed breakups in space can give a good approximate description of the debris resulting from the destruction of a satellite in a high-speed collision. The most comprehensive is NASA's Standard Breakup Model.14 Applying NASA's breakup model to the case of a mass of a few tens of kilograms colliding at velocities in excess of 7 km/s with a satellite having a mass of 1–10 tons illustrates the potential effects of a kinetic-energy ASAT.15 The calculation gives the number of debris particles created and the size, mass, area-to-mass ratio, and velocity distributions of the particles. That information, along with data on the atmospheric density, can be used to calculate the orbits of the particles and estimate their lifetimes. Such a collision would be catastrophic if there is a direct hit on the central mass of the satellite. Indeed, according to the NASA model, a collision between a large object and a smaller one will be catastrophic if the ratio of the impact kinetic energy of the smaller object to the mass of the larger object is greater than 40 kJ/kg. That condition implies that an interceptor of 20 kg striking a large satellite at 7.5 km/s could completely fragment a satellite with a mass up to about 14 tons. The situation is relevant to satellites in LEO, since their orbital speed is roughly 7.5 km/s, which sets the scale of the intercept speed for attacks. Of the nearly 400 active satellites in LEO, more than 200 have mass greater than 450 kg, more than 60 have mass greater than 1 ton, and roughly 15 have mass greater than 5 tons.16 The catastrophic breakup of satellites in orbit could produce a dramatic increase in the amount of space debris. The NASA breakup model shows that the catastrophic breakup of a single satellite of 5–10 tons would roughly double the amount of debris larger than 1 mm currently in LEO (see the table). That scenario is particularly applicable to US reconnaissance satellites, which are often discussed as likely targets of ASAT attacks, have masses of roughly 10 tons, and orbit in LEO to allow them to collect high-resolution images of Earth. The 3000–5000 pieces of large debris estimated to be produced in such a breakup is two to three times the roughly 1500 pieces larger than 10 cm currently in the heavily used altitude band between 800 and 900 km. If the satellite that was attacked had its orbit within that band, the resulting debris would be concentrated in the same region and would make the debris problem at those altitudes much worse. For attacks at other altitudes, the amount of debris would represent a much larger percentage increase over the existing amount. The table also shows estimates of the debris created by China's destruction of the FY-1C satellite in January 2007. That added significantly to the debris population at altitudes between 800 and 900 km (see figure 2). Debris lifetime The orbital lifetime of a piece of debris depends on how strongly it is affected by atmospheric drag. That, in turn, depends on the object's mass, size, and shape, and on the atmospheric density at its orbital altitude. Since atmospheric density drops off roughly exponentially with altitude, orbital altitude has a dramatic effect on drag and debris lifetime. For example, an object that would have a lifetime of a couple weeks if it were orbiting at 300 km would have a lifetime of a year if it were orbiting at 500 km, several decades at 700 km, and more than a century at 800 km. If a satellite destroyed by an ASAT weapon were orbiting at an altitude above about 800 km, then a large fraction of the debris particles created in the collision would remain in orbit for decades or longer. The atmospheric density at a given altitude also changes periodically with the 11-year solar cycle as variations in solar activity cause the outer regions of the atmosphere to expand and contract. That effect can be significant at low altitudes; for example, the atmospheric density at an altitude of 500 km can vary by more than a factor of 10 over the cycle. Thus the debris lifetime is strongly affected by the solar cycle, as shown in figure 5. Before the Chinese test, the only other test of a kinetic-energy interceptor destroying a satellite was conducted by the US in September 1985. The US test created roughly the same amount of debris larger than 1 cm as did the Chinese test (although apparently less large debris), since both satellites had masses of roughly 1 ton. Because the US test took place at an altitude of about 500 km, compared with about 850 km for the Chinese test, the debris from the US test remained in orbit for a significantly shorter time. Most of the large debris from the US test decayed within 10 years, while a significant fraction of debris from the Chinese test is expected to remain in orbit for decades.

## Link- ASATs

### ASATS cause space debris

South China Morning Post 7 (January 20, “Keep space clear of weapons - and junk”, Lexis Nexis, eys)

If critics such as the United States can make an undeniable point against China for firing a missile into space to destroy one of its old weather satellites, it is because hundreds of fragments at least 10cm wide, and many more smaller pieces created by the impact, will pose a threat to other satellites for years or even decades. The debris, orbiting the Earth at more than 30,000km/h, joins millions of pieces of space junk weighing thousands of tonnes that has accumulated since the 1960s, for which China bears only a small share of responsibility. The expressions of concern from Washington, Tokyo and other capitals about the first anti-satellite missile test in more than 20 years are more problematic. The US and Russia, after all, carried out similar anti-satellite test firings decades ago. The Reagan administration halted the US tests in 1985 out of concern that the debris created could harm the civilian and military satellites upon which the west had become increasingly reliant. By then, however, Ronald Reagan had introduced the controversial "star wars" plan - a space-based laser defence shield against nuclear missile attack known as the Strategic Defence Initiative. The nightmare of a futuristic space arms race loomed as a real possibility. The collapse of the Soviet Union and the end of the cold war saved the world from that. There seems little doubt that the Bush administration has maintained an interest in laser space weapons, a quicker and more powerful way of destroying targets. In 2004, the year George W. Bush announced plans to put astronauts back on the moon before attempting a manned Mars landing, less fanfare surrounded a US Air Force proposal to put weapons in space. The announcement came amid speculation that defence contractors were developing arms, such as lasers and huge guns, that could be put into orbit. Defence think-tanks and commentators believe the Bush administration is conducting secret research on advanced anti-satellite weapons using lasers. Moreover, in August, Mr Bush approved a new space policy that ignores calls for a global ban on arms tests in space and implies Washington will not comply with any new extraterrestrial treaties. It is worth quoting: the US would "preserve its rights, capabilities and freedom of action in space" and "dissuade or deter others from either impeding those rights or developing capabilities intended to do so". The US would "deny, if necessary, adversaries the use of space capabilities hostile to US national interests". This is an aggressive stance, given that there are no weapons in space and the US is among the 98 countries to have signed and ratified the Outer Space Treaty, which forbids parties to the pact from taking nuclear arms or any other weapons of mass destruction beyond the atmosphere. China's first anti-satellite weapons test is seen as flagging an intention to play a major role in military as well as civil space activities. The test confirms that China has missiles capable of hitting US spy satellites and military reconnaissance and commercial satellites. Arms control experts say an anti-satellite arms race cannot be ruled out. Washington says Beijing's surprise test is not consistent with the spirit of co-operation that both countries aspire to in the civil space field. This may be so, but China and Russia have been pressing for years for a space weapons ban treaty. More convincing perhaps is the assessment by some experts that China could be showing off its space capabilities to bring the US to the negotiating table. Scientists at the Space Target and Debris Observation and Research Centre of the Chinese Academy of Sciences say that at the rate humans are littering space, by the end of the century nothing will be able to enter space orbit. Mankind will benefit from peaceful, co-operative exploration of the universe. Therefore, instead of reviving the worrying prospect of something like the "star wars" plan and a new arms race, America's laser research might benefit mankind if it were directed at obliterating some of this junk.

### History proves that satellite destruction will lead to massive amounts of dangerous debris

Imburgia, 11 (Joseph, Judge Advocate in the United States Air Force and is presently assigned as a legal

exchange officer to the Directorate of Operations and International Law “Space Debris and Its Threat to

National Security”, <http://www.google.com/url?sa=t&source=web&cd=10&sqi=2&ved=0CGEQFjAJ&url=http%3A%2F%2Flaw.vanderbilt.edu%2Fpublications%2Fjournal-of-transnational-law%2Fdownload.aspx%3Fid%3D6574&rct=j&q=space%20debris%20threat%20low&ei=5IMtTtXsFojksQK65_izCw&usg=AFQjCNEglOEqH_3OfmcbgE6HXwiHKrBz8g&sig2=YDkrleBq1K6JVn5yWTTMlQ>, may 1st, CJD)

China’s 2007 Intentional Obliteration of an Old Weather Satellite On January 11, 2007, China launched a small ballistic missile with a kinetic kill vehicle 537 miles into space to destroy its aging weather satellite, the Fengyun-1C.73 The resulting explosion and destruction sent thousands of destructive pieces of debris from both the satellite and the missile into various orbital planes around Earth, “ranging in altitude from 3,800 km [2,361 miles] on the high end down to about 200 km [124 miles] at the lowest.”74 Worse yet, because the fragmentation debris was ejected in a variety of initial directions and high velocities, the debris orbits rapidly spread out in a toroidal debris cloud75 that eventually surrounded the globe.76 After only six months, the debris cloud from the Fengyun-1C ASAT mission had already rapidly dispersed into various orbits around Earth.77 By January 2009, the debris cloud had completely surrounded Earth.78 The unprecedented space debris that the Chinese ASAT mission created was “described as the worst satellite fragmentation event in the 50-year history of spaceflight.”79 At the outset, scientists estimated that the explosion instantly increased the space debris population by 10 percent.80 After analyzing the problem for over a year, however, NASA scientists quickly realized that the problem was much worse than their initial predictions.81 By the end of 2007, NASA identified over 250 additional pieces of debris larger than ten centimeters.82 In March 2010, the United States was tracking 2,841 fragments from the ASAT mission that measured greater than five centimetersMorring, supra note 7, at 20. in diameter, plus another 500 fragments that had not yet been cataloged.83 NASA estimates the population of debris larger than one centimeter from the explosion to be greater than 150,000.84 Worse yet, scientists speculate that the explosion increased the space debris population by millions of undetectable pieces of debris.85 By the end of 2008, less than 2 percent of the ASAT mission’s debris population had reentered the atmosphere.86 Consequently, the debris population far exceeds NASA’s initial predictions, and unless something is done to remove it, Earth will have to deal with the resultant wreckage for years, perhaps even thousands of years, to come.87 According to NASA’s Nicholas Johnson, due to the altitude at which the satellite was destroyed, much of the debris will be “in orbit for 100 years or more . . . . Some will come down earlier, but the majority will be up there for a very long time.”88 The actual length of time that this debris will continue to move uncontrollably around Earth depends on “its altitude, mass, size, and the amount of solar activity.”89 Although numerous Earth orbits exist, “Low Earth Orbit (LEO) and Geosynchronous Earth Orbit (GEO) are the two most heavily used and, therefore, the most significant” to the space debris problem.90 A pertinent discussion of both LEO and GEO is necessary to explain just how long the Chinese ASAT debris will remain a space nuisance. See GEORGE GLEGHORN ET AL., ORBITAL DEBRIS: A TECHNICAL ASSESSMENT 25–26 (1995) (describing a toroidal, or doughnut-shaped, debris cloud’s evolution in Earth’s orbit over time). 76. Detection of Debris from Chinese ASAT Test Increases, ORBITAL DEBRIS Q. NEWS (NASA, Hous., Tex.), Jan. 2007, at 2, 3 (“The debris orbits are rapidly spreading . . . and will essentially encircle the globe by the end of the year.”). 77. Id. at 2. For a visual representation of what the debris cloud from the Fengyun-1C spacecraft looked like six months after break-up, see Figure 2 on page 2. 78. Fengyun-1C Debris: Two Years Later, ORBITAL DEBRIS Q. NEWS (NASA, Hous., Tex.), Jan. 2009, at 1, 2. For a visual representation of what the debris cloud from the Fengyun-1C spacecraft looked like two years after break-up, see Figure 2 on page 2. 79. Morring & Butler, supra note 70, at 35. 80. Morring, supra note 7, at 20. 81. Fengyun-1C Debris: One Year Later, ORBITAL DEBRIS Q. NEWS (NASA, Hous., Tex.), Jan. 2008, at 1, 3–4. 82. Id. Pg. 600-01

## Brink- Now Key

### Space Debris Snowballs- Adding more will cause a cascading effect

Yomiuri 9 (February 13, “Space debris measures must be bolstered”, Lexis Nexis, eys)

The likelihood of our planet becoming completely surrounded by space debris is a matter of increasing concern. The collision of a U.S. satellite weighing about half a ton with an unused Russian satellite about twice that weight, about 800 kilometers above the Earth's surface, reportedly produced a huge amount of debris. Surely the collision could have been avoided if their orbits had been changed. Since the world's first satellite was launched in 1957, thousands of satellite launches have taken place, meaning there are a large number of objects drifting around the Earth. Among the space debris in orbit around our planet are satellites that are no longer functioning, either because they have outlived their usefulness or have malfunctioned. Space debris also includes rocket booster parts, the remains of collisions among space vehicles and equipment dropped by astronauts. It is estimated that there are between 30 million and 40 million items of space debris currently adrift, weighing a total of several thousand tons. In 2007, China's destruction of one of its weather satellites in an experiment produced a huge amount of debris. If nothing is done to address the problem, mankind faces serious problems in its use of space as space debris has massive destructive potential. Such debris can travel at speeds of around five kilometers per second, while the energy generated from a collision of debris even just one centimeter across can be equivalent to that of a car crash on a highway. The smashing of space debris into a satellite is clearly disastrous. Previously, a French satellite was seriously damaged after colliding with space debris. In the United States, a rocket launch was postponed to prevent a collision with space debris. What is of particular concern this time is the threat to the International Space Station, which has been under construction with the participation of Japan and other nations. The ISS orbits about 400 kilometers beneath where the latest collision took place, and it is unlikely that debris will hit the ISS. But it is still possible that debris could pass over the ISS. An extended stay at the ISS by Koichi Wakata, the first of its kind for a Japanese astronaut, is expected to begin soon, and it is of some concern that the space shuttle flying to the ISS could be affected by the debris. The ISS is equipped with protective walls designed to absorb shocks from small debris and the station would alter its orbit to avoid large pieces of debris, which are tracked by radar from the ground by the U.S. military when a shuttle is to be launched. But if the amount of debris continues to increase, it will become more difficult to take all possible preventive measures. Greater precautions must therefore be taken to try and prevent trouble that could affect the ISS. A further concern is the apparent vicious circle of increased space debris from collisions, which in turn creates more potential for destruction, as can be seen in the latest collision. The growing amount of debris means the probability of a collision between a satellite and space debris is likely to increase rapidly in about a decade or so. International guidelines state that large satellites should be brought back to Earth. But is this enough? Is there no way that space debris can be collected? Japan needs to call on other nations that have space development programs to address the issue and play a more active role in strengthening measures to tackle the problem.

**We’re on the brink – any more weapon launch causes more debris than we can handle, ruining international relationships.**

**Senechal ’09** (Thierry, Policy Manager of the Commission on Banking Technique and Practice at the International Chamber of Commerce (ICC), degrees in economics and finance from Harvard University, London Business School, and Columbia University, former Sloan Fellow from the Massachusetts Institute of Technology, <http://74.125.127.132/scholar?q=cache:mjrrGXTIIjAJ:scholar.google.com/+space+weaponization+causes+debris&hl=en&as_sdt=0,23&as_ylo=2005>, Space Debris Pollution: A Convention Proposal, Scholar, SS)

We have reached a critical threshold at which the density of debris at certain altitudes is high enough to guarantee collisions, thus resulting in increased fragments. In a scenario in which space launches are more frequent, it is likely that we will create a self-sustaining, semi-permanent cloud of orbital ―pollution‖ that threatens all future commercial and exploration activities within certain altitude ranges. The debris and the liability it may cause may also poison relations between major powers. Because space debris is a global challenge that may impact any country deciding to develop space activities, the issue cannot be resolved among a few countries. This is why I am advocating that a global convention on space debris is a requirement for preserving this special environment for future generations. Following the logic of the Brundland Report, we need development that ―meets the needs of the present without compromising the ability of future generations to meet their own needs.‖1 40 A global convention is needed for the simple reason that the successful approval of voluntary guidelines has not been consistent over the last years. For instance, the Chinese test is an example of failure to enforce mitigation standards for space debris.

## ==== Impacts ====

## 2NC Impact- Laundry List

### Even minor collisions cause space debris buildup, making space unusable—this tanks the global economy, sparks resource wars, and causes mass starvation

Moore 8 Twilight War: The Folly of U.S. Space Dominance Mike author, journalist, and speaker, and research fellow at The Independent Institute June 10, 2008 https://www.carnegiecouncil.org/resources/transcripts/0048.html/:pf\_printable

Now, I can understand that point of view. And yet, the physics are really against us. The easiest way to destroy a satellite in space is to smack into it, kinetic kill. We can do it without smacking into it. We have four, five, six programs that can damage and destroy satellites without creating debris. But we are so far ahead of everybody else that nobody else is in the same game. The way most countries would hit satellites is to hit them, smash them into thousands of pieces. Now, in a battlefield there is always debris left over, and it has to be cleaned up, and so on and so forth. But when you have debris in space it stays there. It can stay there for years, for decades, for centuries, or even forever, depending on how high above the earth it is. If we clutter up orbital space with a conflict, with so many hundreds of thousands of pieces of debris—and I don't kid you about that—the debris problem is huge, and it wouldn't take much to make it beyond home. I've talked to physicists who believe if some country smashed, say, a dozen of our big satellites, or maybe two dozen of our big satellites, we might make space unusable, just plain unusable. And satellites that are undamaged would wear out and we couldn't replace them. The global economy depends on these satellites. We're not in the 1980s anymore. Everything we do in terms of the global economy depends in one way or another on satellites in space. If we can't replace satellites, if we lose the use of space, then we are going to have a situation where satellites fail and we are going to drift back to a 1950s-style economy. In the 1950s—and I grew up then, and I kind of liked it—there were only about 2 billion people in the world. Now there are 6.5 billion people If we lose the kind of global economy we have, which is space-dependent, how is that going to work? There are going to be wars for resources, there is going to be malnutrition, there is going to be mass starvation. It is going to be a very, very terrible thing. We can't go back to the 1950s

### Global depression will trigger global wars – prefer empirics

Mead ‘9 (Walter Russell, Senior Fellow in U.S. Foreign Policy at the Council on Foreign Relations, New Republic, February 4, 2009)

So far, such half-hearted experiments not only have failed to work; they have left the societies that have tried them in a progressively worse position, farther behind the front-runners as time goes by. Argentina has lost ground to Chile; Russian development has fallen farther behind that of the Baltic states and Central Europe. Frequently, the crisis has weakened the power of the merchants, industrialists, financiers, and professionals who want to develop a liberal capitalist society integrated into the world. Crisis can also strengthen the hand of religious extremists, populist radicals, or authoritarian traditionalists who are determined to resist liberal capitalist society for a variety of reasons. Meanwhile, the companies and banks based in these societies are often less established and more vulnerable to the consequences of a financial crisis than more established firms in wealthier societies. As a result, developing countries and countries where capitalism has relatively recent and shallow roots tend to suffer greater economic and political damage when crisis strikes--as, inevitably, it does. And, consequently, financial crises often reinforce rather than challenge the global distribution of power and wealth. This may be happening yet again. None of which means that we can just sit back and enjoy the recession. History may suggest that financial crises actually help capitalist great powers maintain their leads--but it has other, less reassuring messages as well. If financial crises have been a normal part of life during the 300-year rise of the liberal capitalist system under the Anglophone powers, so has war. The wars of the League of Augsburg and the Spanish Succession; the Seven Years War; the American Revolution; the Napoleonic Wars; the two World Wars; the cold war: The list of wars is almost as long as the list of financial crises. Bad economic times can breed wars. Europe was a pretty peaceful place in 1928, but the Depression poisoned German public opinion and helped bring Adolf Hitler to power. If the current crisis turns into a depression, what rough beasts might start slouching toward Moscow, Karachi, Beijing, or New Delhi to be born? The United States may not, yet, decline, but, if we can't get the world economy back on track, we may still have to fight.

### Resource wars cause proliferation of WMDs and major power nuclear war

Wooldridge, free lance writer, once lectured at Cornell University, 2009

(Frosty, “Humanity galloping toward its greatest crisis in the 21st century” http://www.australia.to/index.php?option=com\_content&view=article&id=10042:humanity-galloping-toward-its-greatest-crisis-in-the-21st-century&catid=125:frosty-wooldridge&Itemid=244

It is clear that most politicians and most citizens do not recognize that returning to “more of the same” is a recipe for promoting the first collapse of a global civilization. The required changes in energy technology, which would benefit not only the environment but also national security, public health, and the economy, would demand a World War II type mobilization -- and even that might not prevent a global climate disaster. Without transitioning away from use of fossil fuels, humanity will move further into an era of resource wars (remember, Africom has been added to the Pentagon’s structure -- and China has noticed), clearly with intent to protect US “interests” in petroleum reserves. The consequences of more resource wars, many likely triggered over water supplies stressed by climate disruption, are likely to include increased unrest in poor nations, a proliferation of weapons of mass destruction, widening inequity within and between nations, and in the worst (and not unlikely) case, a nuclear war ending civilization.

### Food crisis triggers global war.

Stephen Hume, 4/16/2008. Senior writer for the Vancouver Sun. “World Food Crisis Threatens Rich Nations (That's Us), Too,” Vancouver Sun, <http://miami.indymedia.org/news/2008/04/10852.php>

In Rome, Reuters reported Jacques Diouf, head of the United Nations Food and Agriculture Organization, warning that with 37 countries already in crisis, each day brings greater risk of global famine. "I'm surprised that I have not been summoned to the UN Security Council," Diouf said. "Naturally people won't be sitting dying of starvation, they will react." India's finance minister was more direct. "It is becoming starker by the day," Palaniappan Chidambaram said. "Unless we act fast for a global consensus on the price spiral, the social unrest induced by food prices in several countries will conflagrate into a global contagion, leaving no country -- developed or otherwise -- unscathed."

## 2NC Impact- Hege

### More debris kill will destroy our satellites- they are key to hegemony and readiness

Imburgia 11{Lieutenant Colonel Joseph S. Imburgia, (B.S., United States Air Force Academy (1994); J.D., University of Tennessee College of Law (2002); LL.M., The Judge Advocate General’s Legal Center & School, U.S. Army, Charlottesville, Va. (2009)) is a Judge Advocate in the United States Air Force and is presently assigned as a legal exchange officer to the Directorate of Operations and International Law, Defence Legal, Australian Defence Force, Canberra, Australia. He is a member of the Tennessee and the Supreme Court of the United States bars, and he is a member of the Australian and New Zealand Society of International Law. Prior to becoming a Judge Advocate, Lieutenant Colonel Imburgia was a Targeting Officer, United States Strategic Command, Offutt Air Force Base, Neb., “ Space Debris and Its Threat to National Security: A Proposal for a Binding International Agreement to Clean Up the Junk”,

These gloomy prognostications about the threats to our space environment should be troubling to Americans. The United States relies on the unhindered use of outer space for national security.151 According to a space commission led by former Secretary of Defense Donald Rumsfeld, “[t]he [United States] is more dependent on space than any other nation.”152 According to Robert G. Joseph, former Undersecretary for Arms Control and International Security at the State Department, “space capabilities are vital to our national security and to our economic well-being.”153 Therefore, a catastrophic collision between space debris and the satellites on which that national security so heavily depends poses a very real and current threat to the national security interests of the United States. Since “the [1991] Gulf War, the [United States] military has depended on satellites for communications, intelligence and navigation for its troops and precision-guided weapons.”154 Satellites are also used for reconnaissance and surveillance, command and control, and control of Unmanned Aerial Vehicles.155 According to the United States Space Command’s Fact Sheet: Satellites provide essential in-theater secure communications, weather and navigational data for ground, air and fleet operations and threat warning. Ground-based radar and Defense Support Program satellites monitor ballistic missile launches around the world to guard against a surprise missile attack on North America. Space surveillance radars provide vital information on the location of satellites and space debris for the nation and the world. Maintaining space superiority is an emerging capability required to protect our space assets. With the modern speed of warfare, it has become difficult to fight conflicts without the timely intelligence and information that space assets provide. Space-based assets and space-controlled assets have created among U.S. military commanders “a nearly insatiable desire for live video surveillance, especially as provided from remotely piloted vehicles like the Predator and now the Reaper.”157 Moreover, military forces have become so dependent on satellite communications and targeting capabilities that the loss of such a satellite would “badly damage their ability to respond to a military emergency.”158 In fact, the May 2008 malfunction of a communications satellite demonstrates the fragile nature of the satellite communications system.159 The temporary loss of a single satellite “effectively pulled the plug on what executives said could [have been] as much as 90 percent of the paging network in the United States.”160 Although this country’s paging network is perhaps not vital to its national security, the incident demonstrates the possible national security risks created by the simultaneous loss of multiple satellites due to space debris collisions.

### The Impact is Extinction

Khalilzad, Rand Corporation 95 (Zalmay Khalilzad, Spring 1995. RAND Corporation. “Losing the Moment?” The Washington Quarterly 18.2, Lexis.)

Under the third option, the United States would seek to retain global leadership and to preclude the rise of a global rival or a return to multipolarity for the indefinite future. On balance, this is the best long-term guiding principle and vision. Such a vision is desirable not as an end in itself, but because a world in which the United States exercises leadership would have tremendous advantages. First, the global environment would be more open and more receptive to American values -- democracy, free markets, and the rule of law. Second, such a world would have a better chance of dealing cooperatively with the world's major problems, such as nuclear proliferation, threats of regional hegemony by renegade states, and low-level conflicts. Finally, U.S. leadership would help preclude the rise of another hostile global rival, enabling the United States and the world to avoid another global cold or hot war and all the attendant dangers, including a global nuclear exchange. U.S. leadership would therefore be more conducive to global stability than a bipolar or a multipolar balance of power system.

## ----Ext. Hege

### Satellites are essential in the military.

The Economist, 8/16/10, <http://www.economist.com/node/16843825> JS

On the face of things, all this consideration of the problem is good. But this being space, where matters military are never far from the minds of those who think about it, there remains a serious question. Satellites are crucial to modern warfare. They spy on battlefields and on even the peaceful activities of enemies, rivals and questionable allies. They provide communication links. Knocking them out—as the Chinese practised with Fengyun-1C—would be a useful military trick. Any programme designed to remove satellites from orbit thus makes military types from other countries nervous. Some people, Mr Weeden among them, argue that such fears can be overcome if there is international co-operation over exactly which objects are removed and who is doing what. It would certainly be in everyone’s interest to

## 2NC Impact- Economy

### Space Debris Collapses the Global Economy

Su ’10 Jinyuan Su, The Silk Road Institute of International and Comparative Law, School of Law, Xi'an Jiaotong University. “Towards an effective and adequately verifiable PPWT”. Space Policy Volume 26, Issue 3, August 2010. ScienceDirect.

With regard to space weaponization, many more debates have taken place over inter-state strategic trade-offs than over the cooperative interest of avoiding a disaster arising from orbital debris. Today around 21,000 orbiting debris larger than 10 cm in diameter are tracked; and it is estimated there are over 100,000 pieces larger than a marble. Debris in orbits higher than about 800 km above the Earth’s surface will be up there for decades, above 1000 km for centuries, and above 1500 km effectively forever.32 Therefore, the amount of orbital debris is unlikely to decrease by natural degradation unless technology development enables us to dispose of it. Space debris moves at an extremely high speed of 27,000 km per hour; even tiny pieces can cause destruction to a satellite.33 This danger will be exacerbated as the Earth orbits become increasingly crowded. In addition, there is also a high risk of a chain reaction of destruction, the so-called “Kessler Syndrome”,34 in which, if a collision does occur, the resulting fragments become an additional collision risk. The deployment of space-based weapons would generate great quantities of space debris just during the initial deployment and far more if they are used.35 Testing of ASATs would further increase the amount. In the event of a real “space war”, the Earth orbits could be veiled by debris clouds, making them no-go areas and jeopardizing the possibility of space exploitation. A conservative estimate shows that a modest space war involving destruction of 30 satellites would increase the level of space debris by almost a factor of four, while a larger one involving destruction of 100 satellites would increase it by 1250%, excluding Kessler Syndrome effects.36 The space industry was projected to exceed $150 billion per year in revenues by 2010,37 yet even this figure may not fully display humanity’s heavy reliance on space technologies for daily life. If the Earth orbits were to become too inhospitable for satellites, the global economy would collapse and human society would step back in time several decades. Meanwhile, although it is possible to distinguish enemy satellites from neutral ones, collateral damage may be caused to the in-orbit or on-Earth properties of neutral states. The belligerent states would be liable, jointly or severally, to the third state.38

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## 2NC Impact- Ozone Layer

### **Space debris causes ozone depletion.**

Leonard ’09 (David, “Space Junk May Be Harming Earth's Atmosphere,” Fox News, <http://www.foxnews.com/story/0,2933,520661,00.html>, WS)

There is growing appreciation that outer space has become a trash bin, with the Earth encircled by dead or dying spacecraft, along with menacing bits of orbital clutter — some of which burns up in the planet's atmosphere. The big news of late was a smashup of a commercial Iridium satellite with a defunct Russian spacecraft earlier this year. Then there was that 2007 anti-satellite test by China, purposely destroying one of its aging weather satellites. These events produced large debris fields in space — adding to the swamp of cosmic compost. But I sense a line of research that needs exploring: The overall impact of human-made orbital debris, solid and liquid propellant discharges, and other space age substance abuse that winds up in a high-speed dive through Earth's atmosphere. There's a convenient toss away line that is in vogue: that such space refuse simply "burns up" — a kind of out of sight, out of mind declaration. What chemistry is involved given the high heating during reentry of space leftovers made of tungsten, beryllium, aluminum and lots of composite materials? The impact of these materials on Earth's atmosphere — top to bottom — would seem worthy of investigation. As for total mass of uncontrolled objects that re-enter each year — it's in the range of 70 — 80 metric tons. And that's the trackable, big stuff — never mind smaller bits of orbital jetsam like bubbles of still-radioactive coolant that has been leaked from old nuclear-powered Soviet satellites. One study team that looked into the impact of de-orbiting space debris on stratospheric ozone issued their findings back in 1994.The work was done by an aerospace industry firm for the Environmental Management Division of the Space and Missile Systems Center. They reported that objects re-entering the atmosphere can affect ozone in several ways, but not on a significant level globally. Indeed, as an object plows through the Earth's stratosphere , a shock wave is created that produces nitric oxide, a known cause of ozone depletion. Spacecraft and rocket motors are composed of metal alloys and composite materials that melt away during re-entry. The researchers found that these materials, as they undergo intense heating, also form chemicals that react directly or indirectly to consume ozone. Overall, the study found that the physical and chemical phenomena associated with deorbiting debris do not have "a significant impact" on global stratospheric ozone.

### Ozone depletion causes extinction

Greenpeace, 1995. “Full of Homes: The Montreal Protocol and the Continuing Destruction of the Ozone Layer,” [*http://archive.greenpeace.org/ozone/holes/holebg.html*](http://archive.greenpeace.org/ozone/holes/holebg.html).

When chemists Sherwood Rowland and Mario Molina first postulated a link between chlorofluorocarbons and ozone layer depletion in 1974, the news was greeted with scepticism, but taken seriously nonetheless. The vast majority of credible scientists have since confirmed this hypothesis. The ozone layer around the Earth shields us all from harmful ultraviolet radiation from the sun. Without the ozone layer, life on earth would not exist. Exposure to increased levels of ultraviolet radiation can cause cataracts, skin cancer, and immune system suppression in humans as well as innumerable effects on other living systems. This is why Rowland's and Molina's theory was taken so seriously, so quickly - the stakes are literally the continuation of life on earth.

## ====Turns the Case ====

## Turns the Case- Space Control

### Increasing space debris will wreck all space control

The Toronto Star, 8 (Lynda Hurst, "Space: The Final Frontier for 'Oribtal Debris'" 04-27-08, LN)

<As this striking computer-generated picture shows, ourbeautiful, big blue marble of a planet is now wreathed in what's officially termed orbital debris \_but more prosaically known as space junk. In 1957, Sputnik, the first manmade object to enter space, beeped its away around the Earth in complete tranquillity. Today, there's everything from 4,800 or so dead satellites, derelict spacecraft (mostly upper rocket stages) and sundry electronic components to paint chips, nuts and bolts, frozen lumps of rocket fuel whizzing around up there - even human waste ejected from manned flights. According to NASA's Space Orbiting Debris Program in Houston, more than 17,000 large objects (more than 10 cm in diameter) are hurtling around the globe; some 200,000 smaller pieces, and millions of minuscule fragments, not to mention countless, naturally occurring meteoroids the size of dust particles. There used to be a glove up there, too. Dropped in 1965 by U.S. astronaut Edward White during the first American space walk, it orbited for a month before burning up in Earth's atmosphere. The oldest debris is the Vanguard I satellite, launched by the U.S. in 1958, which stopped working six years later. The most egregious? The more than 200 plastic bags of garbage simply tossed into space by Russian cosmonauts on the Mir Space Station. The flotsam and jetsam of man's exploration and commercialization of space doesn't just offend our newly awakened environmental consciousness here on Earth. It's highly dangerous to objects up there legitimately. At any given time, 850 working satellites, a space station, space telescope, space shuttle and an interplanetary probe are forced to steer cautiously to avoid a close encounter with something that could destroy them. The tiniest fleck of paint becomes a powerful missile when it impacts at 10 km a second. In 2003, when the space shuttle Columbia disintegrated during re-entry killing its seven crew members, one of the first questions NASA investigated was whether it had been struck by space debris. (It hadn't.) The U.S. Space Surveillance Network catalogues as much of the junk as possible, detecting objects as small as 3 mm with ground-based radar. It also tracks their trajectories. If the chance of collision exceeds one in 10,000, the spacecraft must manoeuvre away - if it can. Last August, something minute but fast-moving hit the space shuttle Endeavour. Going by the entry hole, it was only 2 mm in size, but it still managed to penetrate and damage the shuttle's radiator panel and thermal control system underneath. Most of the space waste is within a 2,000-km radius of Earth, in what's called Low Earth Orbit. Debris orbiting below 600 km normally falls back to Earth within several years; in fact, one object a day hits the planet, usually in the oceans. But at altitudes of 800 km, debris will circle for decades; above 1,000 km, for a century or more. The higher the orbit, the longer the junk will be up there. A scenario called the Kessler syndrome suggests there could come a time when Low Earth Orbit becomes so littered that it will be impossible to launch anything without significant risk of collision. Last year, there were 10 "fragmentation events," the highest since the space age began, says Orbital Debris Quarterly News "and the consequences will be felt for many, many years to come." Satellite explosions are the biggest source of dangerous litter, especially when upper stages containing propellants and high-pressure fluids are left in orbit. Jan. 11, 2007, saw the worst break-up ever when China blew up an inactive weather satellite testing an anti-satellite system. The intentional smashing-to-bits scattered at least 150,000 pieces of debris into high space. Minus 22 pieces that fell back to Earth, the rest will remain up in the wild, black yonder for hundreds, if not thousands, of years. As will the 1,000 fragments plus fuel from the upper stage of a Russian Proton rocket that accidentally exploded five weeks later. For a decade now, minimizing the creation of even more garbage has been a U.S. priority "to preserve near-Earth space for future generations." After it developed standards in 1997, other countries - including Japan, France, Russia, and the European Space Agency (ESA) - followed suit. In 2002, the multinational Inter-Agency Space Debris Coordination Committee set guidelines to mitigate the amount of space garbage. It specified that at the end of its life, every satellite should be boosted to a "graveyard" orbit above what's called the geostationary ring, an orbit located 36,000 km directly above the equator which moves at the same speed as the planet.>

### They cause space junk—future crashes more likely

Klotz 10 A Traffic Cop for Satellites Satellite crashes may be rare, but when they happen, the impact can be long-lasting. Irene Klotz By Irene Wed Sep 1, 2010 07:00 AM ET http://news.discovery.com/space/satellites-traffic-cop.html?

In orbit, chunks and fragments from a crash won't settle down. They'll keep moving -- extremely rapidly -- upping the odds of additional crashes. "You don't just sweep up the debris and haul it away on a tow truck. That's why we're having to take all these precautions," said Tobias Nassif, vice president of satellite operations and engineering for Intelsat and a director of the newly formed Space Data Association. The group, which began operations in July, provides advance notice of potential collisions so satellite operators can reposition their spacecraft before it's too late. Washington, D.C.-based Intelsat partnered with London-based Inmarsat and SES of Luxembourg to develop and launch Space Data Association, which currently runs interference for the group's combined 120 satellites. In 16 years of work in the field, Nassif says he's had to maneuver spacecraft perhaps twice to avoid coming too close to another satellite. But as more and more spacecraft are put into orbit, the chance of a collision increases as well, he added. The prospect of an orbital crash seemed pretty remote until Feb. 10, 2009, when an obsolete Soviet-era satellite called Cosmos 2251 plowed into a working commercial telecommunications satellite owned by Iridium. Striking at a relative speed of 7.2 miles per second, the crash, which occurred 491 miles above Earth, generated more than 1,700 pieces of debris that were large enough to be tracked by radars on Earth. Ninety-six percent of the junk remains in orbit today. The Iridium-Cosmos 2251 crash isn't even the largest source of space debris. That dubious distinction belongs to the Fengyun-1C spacecraft, which was the target of a Chinese anti-satellite test in 2007. NASA's Orbital Debris Program Office says there's still more than 2,700 pieces of orbital space junk from Fenyun-1C's destruction.

## Turns the Case- Closes off Space

### **Space Debris destroys Satellites and closes off space**

[Blake](http://www.telegraph.co.uk/journalists/heidi-blake/) 2/1 **(** Heidi Blake, February 1, 2011, ‘Space so full of junk that a satellite collision could destroy communications on Earth**,** <http://www.youtube.com/watch?v=k85mRPqvMbE>,jk)

A single collision between two satellites or large pieces of “space junk” could send thousands of pieces of debris spinning into orbit, each capable of destroying further satellites. Global positioning systems, international phone connections, television signals and weather forecasts are among the services which are at risk of crashing to a halt. This “chain reaction” could leave some orbits so cluttered with debris that they become unusable for commercial or military satellites, the US Defense Department's interim Space Posture Review warned last year. There are also fears that large pieces of debris could threaten the lives of astronauts in space shuttles or at the International Space Station.The space junk, dubbed “an orbiting rubbish dump”, also comprises nuts, bolts, gloves and other debris from space missions. "This is almost the tipping point," Dr Gopalaswamy said. "No satellite can be reliably shielded against this kind of destructive force." The Chinese missile test and the Russian satellite crash were key factors in pushing the United States to help the United Nations issue guidelines urging companies and countries not to clutter orbits with junk, the Space Posture Review said in May. The United Nations Office for Outer Space Affairs (UNOOSA) issued Space Debris Mitigation Guidelines in 2009, urging the removal of spacecraft and launch vehicles from the Earth’s orbit after the end of their missions. Mazlan Othman, director of UNOOSA, said space needs "policies and laws to protect the public interest". He added: “We should have all the instruments to make sure that lifestyles are not disrupted because of misconduct in space when people switch the television to watch the World Cup next month in Johannesburg."

Space Junk makes space unusable for 200 years

National Geographic 10 (National Geographic, October 28, 2010, “Space Junk Cleanup Needed, NASA Experts Warn, <http://news.nationalgeographic.com/news/2006/01/0119_060119_space_junk_2.html>, jk)

In addition, there are hundreds of thousands of smaller objects in space. These include everything from pieces of plastic to flecks of paint.These objects travel at speeds over 22,000 miles an hour (35,000 kilometers an hour). At such high velocity, even small junk can rip holes in a spacecraft or disable a satellite by causing electrical shorts that result from clouds of superheated gas. Previous space junk projections have assumed that new satellites and rockets would launch in the future. The new study, in contrast, looks at what would happen to the amount of space junk if no rocket bodies or spacecraft were launched in the next 200 years. "This is kind of a best-case scenario," said lead study author Jer-Chyi Liou, principal scientist and project manager for orbital debris with the Engineering Science Contract Group at NASA's Johnson Space Center in Houston. The results suggest that new fragments from collisions will replace the amount of objects falling out of orbit and back to Earth. Beyond 2055, however, fragments from new collisions will exceed the amount of decaying debris. "The debris population will continue to grow," Liou said. "We know it will only get worse." But, he says, the space-junk problem needs more attention. "It's like any environmental problem," he said. "It's growing. If you don't tackle it now, it will only become worse, and the remedies in the future are going to be even more costly than if you tackle it today."

### More space debris locks us out of space

South China Morning Post 7 (January 20, “Keep space clear of weapons - and junk”, Lexis Nexis, eys)

If critics such as the United States can make an undeniable point against China for firing a missile into space to destroy one of its old weather satellites, it is because hundreds of fragments at least 10cm wide, and many more smaller pieces created by the impact, will pose a threat to other satellites for years or even decades. The debris, orbiting the Earth at more than 30,000km/h, joins millions of pieces of space junk weighing thousands of tonnes that has accumulated since the 1960s, for which China bears only a small share of responsibility. The expressions of concern from Washington, Tokyo and other capitals about the first anti-satellite missile test in more than 20 years are more problematic. The US and Russia, after all, carried out similar anti-satellite test firings decades ago. The Reagan administration halted the US tests in 1985 out of concern that the debris created could harm the civilian and military satellites upon which the west had become increasingly reliant. By then, however, Ronald Reagan had introduced the controversial "star wars" plan - a space-based laser defence shield against nuclear missile attack known as the Strategic Defence Initiative. The nightmare of a futuristic space arms race loomed as a real possibility. The collapse of the Soviet Union and the end of the cold war saved the world from that. There seems little doubt that the Bush administration has maintained an interest in laser space weapons, a quicker and more powerful way of destroying targets. In 2004, the year George W. Bush announced plans to put astronauts back on the moon before attempting a manned Mars landing, less fanfare surrounded a US Air Force proposal to put weapons in space. The announcement came amid speculation that defence contractors were developing arms, such as lasers and huge guns, that could be put into orbit. Defence think-tanks and commentators believe the Bush administration is conducting secret research on advanced anti-satellite weapons using lasers. Moreover, in August, Mr Bush approved a new space policy that ignores calls for a global ban on arms tests in space and implies Washington will not comply with any new extraterrestrial treaties. It is worth quoting: the US would "preserve its rights, capabilities and freedom of action in space" and "dissuade or deter others from either impeding those rights or developing capabilities intended to do so". The US would "deny, if necessary, adversaries the use of space capabilities hostile to US national interests". This is an aggressive stance, given that there are no weapons in space and the US is among the 98 countries to have signed and ratified the Outer Space Treaty, which forbids parties to the pact from taking nuclear arms or any other weapons of mass destruction beyond the atmosphere. China's first anti-satellite weapons test is seen as flagging an intention to play a major role in military as well as civil space activities. The test confirms that China has missiles capable of hitting US spy satellites and military reconnaissance and commercial satellites. Arms control experts say an anti-satellite arms race cannot be ruled out. Washington says Beijing's surprise test is not consistent with the spirit of co-operation that both countries aspire to in the civil space field. This may be so, but China and Russia have been pressing for years for a space weapons ban treaty. More convincing perhaps is the assessment by some experts that China could be showing off its space capabilities to bring the US to the negotiating table. Scientists at the Space Target and Debris Observation and Research Centre of the Chinese Academy of Sciences say that at the rate humans are littering space, by the end of the century nothing will be able to enter space orbit. Mankind will benefit from peaceful, co-operative exploration of the universe. Therefore, instead of reviving the worrying prospect of something like the "star wars" plan and a new arms race, America's laser research might benefit mankind if it were directed at obliterating some of this junk.

### **Space Debris will cause a catastrophe for humankind and end exploration forever**

Johan, 09 (Hari, award winning journalist for The Independent, a top British newspaper, and also for the Huffington Post, New York Times, Los Angeles Times, as well as several international newspapers and journals, “We're covering our planet with a cloud of space junk,” The Independent (London), Lexis Nexis 6/09, SR)

IN 1965, the American astronaut Edward White dropped a glove, and it has been orbiting the earth at 17,000 miles per hour ever since. This sounds like a quirky Trivial Pursuit answer - what is the deadliest garment in history? - but it could be about to give us all a galactic slap in the face. That glove is now joined by so much space trash that scientists are warning it could be poised to take out the satellites we depend on every day - and trap us here on a heating earth. In just 50 years of exploring space, humans have left 600,000 pieces of rubbish in space, all circling us at super-speed. When it is whirring so fast, a one millimetre fleck of paint hits you as hard as a .22 calibre bullet fired at point-blank range. A hard-boiled pea is as dangerous as a 400lb safe smacking into you at 60mph. And a chunk of metal the size of a tennis ball is as explosive as 25 sticks of dynamite. We are adding to this junk faster than ever before. There is no international agreement not to leave trash in the skies - and all nations are being reckless. The International Association for the Advancement of Space Safety warns that, at the current rate, the volume of Star Drek will increase fivefold in the next decade. More flights leave more rubbish, and more countries test their fancy new weapons systems by blowing up old satellites - and creating new torrents of trash. This creates a minor danger, and a major danger. There is a small risk that this rubbish will smack into human beings when minor amounts of it re-enter the Earth's atmosphere. For example, in March 2007, the wreckage of a Soviet spy satellite nearly crashed into a passenger plane over the Pacific. But only one woman has ever been hit by space junk: Lottie Williams from Oklahoma was smacked in the shoulder by a charred piece of space rocket. She was not injured. But there is a greater danger that an unstoppable chain reaction will begin: the rubbish will crash into other pieces of rubbish, causing it to shatter into smaller chunks that will then crash into each other - and on, and on, until the earth is circled by a haze of impassable metal debris that remains there for millennia. There are (contested) fears that the process began in February this year, when an old Russian satellite crashed into a US satellite high above Siberia. Dr Marshall Kaplan at John Hopkins University Applied Phyiscs Laboratory says that we face a "coming catastrophic disaster. If we don't clean up this mess in the next 20 years, we're going to lose our access to space". Vladimir Solovyov, Russia's space mission control chief, agrees. He warns: "The clouds of debris pose a serious danger... to earth-tracking and communications satellites." What would it mean? The super-speed of our globalized world is dependent on satellites. If they are taken out by a barrage of 17,000mph rubbish, you can say goodbye to your mobile phones, GPS, and weather forecasts - and we'll be needing them in this century. We will be trapped here, unable to explore space. Hubble telescope bubble, toil and trouble. What can we do now? There are some proposals for removing the rubbish, like creating a series of lasers that would sweep the trash back into our atmosphere, where it would mostly burn up. But they are regarded as of dubious scientific plausibility, and a long way off. The most urgent task is to stop adding to the rubbish - but the 20 governments that have access to space are refusing to do it. They will not agree a deal; they don't want to tell each other where their spy satellites are, or to agree not to blow them up when they feel like it, to test their flashy new weaponry. This wall of garbage orbiting us all seems like a symbol of the great dilemmas facing humanity in the 21st century. We have become capable of the most stunning technological breakthroughs - but we are sabotaging them by proving ourselves incapable of the most basic forms of self-restraint. At the moment of victory, we regress. The achievements of our frontal lobes are undermined by the backwardness of our adrenal glands. This story is being played out, with mild variations, again and again, in this century. We have dramatically improved human health - yet now seem poised to cook it under a thick blanket of our own carbon emissions. We have made it possible to fish and farm more efficiently than ever - so we do it till we have taken all the fish and destroyed all the soil. It doesn't have to be like this. We can restrain ourselves to save our satellites, and our ecosystem. Individuals restrain themselves all the time; why can't we do it collectively? The only alternative is to become a species who heroically reach for the stars - only to smack into a wall of our own trash.

**Space debris contaminates Low Earth Orbit area and makes it unusable**

**Senechal ’09** (Thierry, Policy Manager of the Commission on Banking Technique and Practice at the International Chamber of Commerce (ICC), degrees in economics and finance from Harvard University, London Business School, and Columbia University, former Sloan Fellow from the Massachusetts Institute of Technology, <http://74.125.127.132/scholar?q=cache:mjrrGXTIIjAJ:scholar.google.com/+space+weaponization+causes+debris&hl=en&as_sdt=0,23&as_ylo=2005>, Space Debris Pollution: A Convention Proposal, Scholar, SS)

It is time to recognize that while space may be infinite, Earth orbital space is a finite natural resource that must be managed properly. The outer space environment should be preserved to enable countries to explore outer space for peaceful purposes, without any constraints. It has 39 Protocol for a Space Debris Risk and Liability Convention become obvious that space debris poses a danger to human life as well as to the environment and the economic activities of all nations in space. The problem we face is complex and serious; the danger posed by the human-made debris to operational spacecraft (pilotless or piloted) is a growing concern. Because debris remains in orbit for long period of time, they tend to accumulate, particularly in the low earth orbit. What is certain today is that the current debris population in the Low Earth Orbit (LEO) region has reached the point where the environment is unstable and collisions will become the most dominant debris-generating mechanism in the future. The tremendous increase in the probability of collision exists in the near future (about 10 to 50 years). Some collisions will lead to breakups and will sow fragments all over the geosynchronous area, making it simply uninhabitable and unreliable for scientific and commercial purposes.

## Turns the Case- Aerospace

### Space debris turns Aerospace- increases cost and collapses commercialization

Senechal ’09(Thierry, Policy Manager of the Commission on Banking Technique and Practice at the International Chamber of Commerce (ICC), degrees in economics and finance from Harvard University, London Business School, and Columbia University, former Sloan Fellow from the Massachusetts Institute of Technology, <http://74.125.127.132/scholar?q=cache:mjrrGXTIIjAJ:scholar.google.com/+space+weaponization+causes+debris&hl=en&as_sdt=0,23&as_ylo=2005>, Space Debris Pollution: A Convention Proposal, Scholar, SS)

The market for commercial space launchers has witnessed rapid growth over the past several years. If more space debris accumulates, the business is at risk. Today, more and more activities rely on well functioning communication equipment in space. Any disruption can have major consequential losses. World geopolitics has dramatically changed since the 1960‘s race to the moon. At the time, the U.S. and the Soviet Union competed with one another, both on Earth and in space. Today, the space market is again on the upward trend. By the end of last century, the world satellite market generated revenues of about $11 billion. In terms of satellite launches, the year 2002 has shown the highest number of launches with 289. Today, the worldwide revenues for the market are around the $16 billion. The health of the global telecommunications market determines to a great extent the sustainability, and therefore the continuity, of space industry. For instance, of the 155 satellites successfully launched by Ariane-4, the French space launcher, in the course of its operation, 139 are telecommunications satellites. Of the 39 satellites launched by Ariane-5 by mid-2005, 26 are telecommunication satellites. It is estimated that 90% of the value of satellite payloads launched by Ariane-5 will be telecommunications-related.12 Several trends are positively impacting on the commercial satellite market. First, new needs have appeared. Networks of Little LEOs, Big LEOs, LEO broadband systems, MEOs and GEOs are scheduled for launch within the next seven years. With improvements in satellite components, technologies and production processes, satellite systems are improving in function, as well as in production and operational costs. Second, the space market is also gaining prominence in many countries. For instance, Brazil and Mexico have become important operators of space systems. Today, the Brazilian Instituto Nacional De Pesquisas Espaciais‘ (INPE) has an ambitious and visionary space program dating back to 1979. Since 1992, Argentina‘s space activities have been considerably developed. In Sénéchal 45 Protocol for a Space Debris Risk and Liability Convention 1994, a Space Plan for 1995-2006 was drawn and a U.S.$700 million budget allocated, for the launch of science and telecommunication satellites. South Korea, India, China and Japan all have strong space programs capable of integrating and launching satellites. As pointed by Frost and Sullivan, the ―space systems market is encouraged by a new space race among Asian rocket and satellite builders vying for commercial customers on the global market.‖13 At this pace, incidents are likely to occur. As a result, in case of damage and consequential business interruption for the commercial operators, there must be a compensation instrument put in place for recovering the cost of the loss

## Turns the Case- Satellites

### Space Debris Destroy Satellites

Ingham 6/28 (Richard Ingham, [June 28, 2011](http://www.physorg.com/archive/28-06-2011/), "Space debris a growing problem”, <http://www.physorg.com/news/2011-06-space-debris-problem.html>, jk)

Millions of chunks of metal, plastic and glass are whirling round Earth, the garbage left from 4,600 launches in 54 years of space exploration. The collision risk is low, but the junk travels at such high speed that even a tiny shard can cripple a satellite costing tens of millions of dollars. Around 16,000 objects bigger than 10 centimetres (four inches) across are tracked by the US Space Surveillance Network, according to NASA's specialist.To cope with such threats, the ISS has some shielding but depends mainly on manoeuvering to get out of the way, an operation it has done several times. "Critical components, e.g. habitable compartments and high pressure tanks, will normally be able to withstand the impact of debris as large as one centimetre (half an inch) in diameter.”The European Space Agency (ESA), Japan, Russia and the United States have issued guidelines for mitigating the debris problem, such as designing satellites and spacecraft so that they can be deliberately "de-orbited," using a fuel reserve, rather than let them drift in space. Leading space agencies have also formed a panel to address the problem and the issue is also discussed in the UN's Committee on the Peaceful Uses of Outer Space (COPUOS).

### Turns Satellites

Bates 10 (Claire Bates, May 27, 2010, “ Space junk threatens 'chain reaction' that could destroy communications on Earth”, <http://www.dailymail.co.uk/sciencetech/article-1281775/Space-junk-threatens-cause-chain-reaction-wipe-communications-Earth.html#ixzz1T8E0T5U8http://www.dailymail.co.uk/sciencetech/article-1281775/Space-junk-threatens-cause-chain-reaction-wipe-communications-Earth.html>, jk)

There is so much junk whizzing around Earth that any collision in space could now cause a knock-on effect that would destroy vital satellites, according to a Pentagon report. A crash between a satellite and a hunk of space junk could send thousands of pieces of debris spinning out, which could destroy other satellites. Television signals, weather forecasts, global-positioning navigation and international phone connections are just some of the services at risk. The uncontrolled chain reaction could make some orbits unusable for both commercial or military satellites, according to the U.S Space Posture Review sent to Congress in March. 'This is almost the tipping point,' Indian rocket scientists Bharath Gopalaswamy told Bloomberg. 'No satellite can be reliably shielded against this kind of destructive force.' The warning follows the first major crash last year between a U.S. communications satellite and a defunct Russian military probe over Siberia. The collision at speeds of at least 15,000mph created a cloud of 1,500 pieces of space junk that the International Space Station then had to manoeuvre to avoid.Mazlan Othman, the director of the UN's Outer Space Affairs office, said: 'Space needs policies and laws to protect the public interest.

### **Space Debris destroys Satellites and closes off space**

[Blake](http://www.telegraph.co.uk/journalists/heidi-blake/) 2/1 **(** Heidi Blake, February 1, 2011, ‘Space so full of junk that a satellite collision could destroy communications on Earth**,** <http://www.youtube.com/watch?v=k85mRPqvMbE>,jk)

A single collision between two satellites or large pieces of “space junk” could send thousands of pieces of debris spinning into orbit, each capable of destroying further satellites. Global positioning systems, international phone connections, television signals and weather forecasts are among the services which are at risk of crashing to a halt. This “chain reaction” could leave some orbits so cluttered with debris that they become unusable for commercial or military satellites, the US Defense Department's interim Space Posture Review warned last year. There are also fears that large pieces of debris could threaten the lives of astronauts in space shuttles or at the International Space Station.The space junk, dubbed “an orbiting rubbish dump”, also comprises nuts, bolts, gloves and other debris from space missions. "This is almost the tipping point," Dr Gopalaswamy said. "No satellite can be reliably shielded against this kind of destructive force." The Chinese missile test and the Russian satellite crash were key factors in pushing the United States to help the United Nations issue guidelines urging companies and countries not to clutter orbits with junk, the Space Posture Review said in May. The United Nations Office for Outer Space Affairs (UNOOSA) issued Space Debris Mitigation Guidelines in 2009, urging the removal of spacecraft and launch vehicles from the Earth’s orbit after the end of their missions. Mazlan Othman, director of UNOOSA, said space needs "policies and laws to protect the public interest". He added: “We should have all the instruments to make sure that lifestyles are not disrupted because of misconduct in space when people switch the television to watch the World Cup next month in Johannesburg."

### Space Debris leads to the destruction of satellites

Lele 10 ( Ajey, Researcher at IDSA, December, “Weaponization of Space”, http://www.indiandefencereview.com/Military%20&%20space/Weaponization-of-Space-.html)

Actually, this is not the first time that such an act was undertaken. In 1959 and 1968 the US and the erstwhile USSR had tested anti-satellite systems. The late sixties was a period when ‘weaponisation of space’ was a much debated isue. The last ASAT test before this recent Chinese adventurism was carried out during the mid-eighties by the US. However, subsequently, the consequences of weaponising space were understood, and the superpowers realised that such tests would cause huge amounts of space debris which could harm their own satellites. So, an unwritten understanding was reached that states would not attempt to “conquer” this last bastion. But, the latest Chinese ASAT test indicates that this ‘space reality’ may change. Such tests would boost the desire of space powers to engage in one-upmanship.

## Turns The Case- ISS

### **Turns the ISS- Space Debris Knocks out the station**

Leary ’90 (Warren E. , April 25, The New York Times, “Peril Seen from Space Debris”, lexis, js)

A Congressional agency has warned that astronauts aboard the proposed space station could be endangered by space debris and that NASA is underestimating the threat. The agency, the General Accounting Office, said Monday that the National Aeronautics and Space Administration had been using an outdated 1984 model of space debris in designing the space station Freedom. The study, which was requested by the House Committee on Science, Space and Technology, found that although the space agency was making progress in updating the model, documents used by contractors to design the spacecraft had not been revised. It said the old model underestimated risks of being hit by debris big enough to cause severe damage. The Congressional investigative agency recommended that the space agency immediately analyze the dangers posed by orbiting debris. It also called for studies on the best ways to avoid debris problems and on how the solutions would affect the cost of the space station. The Congressional agency said the studies should be completed in time for the results to be heeded in the final design requirements for the station. These requirements are due by July 1992. Extent of Debris in Orbit The G.A.O. report said there were 3.5 million artificial objects orbiting the Earth, including fragments of rockets, discarded equipment and other debris. About 24,500 of these objects are larger than a centimeter, about the diameter of an aspirin tablet, and could cause catastrophic damage to the space station upon impact, it said. For example, a one-centimeter aluminum sphere traveling at a speed of 22,000 miles an hour in space would strike with the energy of a 400-pound weight hitting the ground at 60 miles an hour. Representative Robert A. Roe, Democrat of New Jersey, chairman of the science committee, released the report. Mr. Roe said that the hazards of space debris had been a continuing concern of Congress and that the latest report would be reviewed by his committee. ''NASA must insure that space station plans reflect the most up-to-date information on space debris,'' he said. In a written reply to a draft of the report, the Assistant Deputy Administrator of NASA, John E. O'Brien, said his agency recognized the significance of the debris problem and was seeking to reduce the risks to the space station. Among ideas high on the list of proposed solutions, he said, is adding shielding. Mr. O'Brien wrote that NASA was cooperating with other nations to reduce future debris from space launchings, had commissioned studies in cooperation with the Air Force to use ground radar to estimate debris in space better, and was ''paying serious technical and managerial attention to how best to deal with the future hazards posed by space debris.''

### Space Debris Destroys the ISS

Powers, 7/24/11 (Scott, McClatchy Newspapers writer, “Space station faces steady threat from orbiting junk”, <http://www.sltrib.com/sltrib/world/52252297-68/space-station-nasa-debris.html.csp>, July 24th, CJD)

Cape Canaveral, Fla. • Now that the space shuttle is retired, NASA and space agencies around the world will focus on the International Space Station for the rest of this decade — and cross their fingers that it lasts that long. The station, with its crew of six international astronauts, orbits Earth at an altitude of about 220 miles, a neighborhood that is increasingly cluttered by space junk, mainly parts of old rockets and satellites that were either abandoned or destroyed in orbit. Thousands of pieces are big enough — and shooting through space fast enough — to seriously damage or destroy the $100 billion laboratory. "The orbit they are flying in is the worst possible. … The Russians blew up all kinds of things in that damned orbit. So there are thousands of pieces in that particular orbit," said Christopher Kraft, a retired director of NASA’s Manned Space Flight Center. The odds are against the station getting hit by debris big enough to destroy it before its planned abandonment in late 2020. But the threat is no long shot. NASA’s projections indicate the chance of a disastrous collision with space junk are about 1 in 13. Most space debris — and the station itself — flies at or near orbital velocity of 17,500 mph. At that speed, collision with debris the size of a large bullet could blow open a hole in a station module, releasing the air inside. Larger pieces could destroy one or more of the modules. In recent weeks, Kraft organized a belated campaign urging NASA to reconsider retiring all the shuttles, contending they are needed as emergency repair and rescue trucks. A June 30 letter he and Washington consultant Scott Spencer sent to NASA Administrator Charles Bolden and others was endorsed by other high-profile NASA retirees, including astronauts Bob Crippen, Neil Armstrong and James Lovell; flight director Gene Kranz; and space-station program director Tom Moser. But a response by Bill Gerstenmaier, NASA associate administrator for space operations, said the station is "fully stocked" with spare components. "The space station has a spacewalk capability, with redundant suits and systems, which will allow crews to perform repairs on orbit without the need of the space shuttle," he said. Story continues below McEntee: After the last shuttle, future exploration is inevitable Published Jul 23, 2011 10:54:05PM 8 Comments Utah students witness final shuttle flight Published Jul 21, 2011 08:04:02PM 0 Comments End of an era: Last space shuttle comes home Published Jul 21, 2011 07:56:01PM 2 Comments In addition, debris shields have been put in place around the station’s modules, and around critical life-support units. Air-pressure sensors in each module can trigger airlock closings. And two Russian Soyuz spacecraft wait as lifeboats. "We’ve done our best to put ourselves in a good position, now that the shuttle is being retired," said NASA spokesman Kelly Humphries. Still, the shields — made of layers of aluminum, ceramic and the Kevlar fabric used in bulletproof vests — can withstand only hits by tiny debris and micro-meteors; bigger things could blow through them. And the threat posed by space junk is getting worse. In 2007 China blew up one of its satellites, dropping thousands of pieces into range of the station’s orbit. In 2009, an American and a Russian satellite collided, spreading more debris. NASA, which evaluates risk in six-month increments, says there is a 1-in-114 chance a serious debris strike will partially disable the space station during the next six months, and 1 chance in 241 of a collision that kills astronauts or totally disables or destroys the station. During the station’s lifetime, that works out to a 1-in-6 chance of a disabling strike — and a 1-in-13 chance of a fatal collision. A 2007 task force reporting to NASA found slightly worse odds — estimating a 1-in-8 chance that an astronaut would die or the station would have to be abandoned. The task-force chairman, retired NASA space-station program manager Tommy Holloway, praised Gerstenmaier for overseeing improvements the report recommended, principally retrofitting old modules with shields, and building a stock of repair supplies and tools. "But that only reduced it somewhat," Holloway said, adding that such collisions remain a "substantial risk over the lifetime of the program." NASA and the U.S. military debris surveillance systems can track junk no smaller than about 4 inches, and have identified about 20,000 pieces that size or larger. But the agency estimates there might be 500,000 smaller pieces that are big enough to do damage. Alarms caused by detectable chunks are increasing. To avoid collisions with tracked debris, the station has had to change its orbital altitude five times in the past three years. In its first eight years, such maneuvers were required only six times. On June 28, a piece of debris of unknown size and origin was detected 14 hours before it would cross the station’s path. There was no time for an avoidance maneuver, so the astronauts took safe harbor aboard the station’s two docked Soyuz spacecraft waited. The debris passed about 1,100 feet from the station.

## Turns the Case- Space Vehicles/Assets

### Debris causes serious damage to space assets

Wright, 2007 (David, Co director and senior scientist with the global security program of the Union of Concerned Scientists in Cambridge, Massachusetts, “Space Debris,” Physics Today, http://physicstoday.org/journals/doc/PHTOAD-ft/vol\_60/iss\_10/35\_1.shtml?bypassSSO=1, October, CDG)

Current space debris The first two rows of the table on page 36 give estimates of the amount of orbital debris in space, by size. In reality, debris particles have irregular shapes, so "size" refers to some characteristic dimension of the object. Also found in space are naturally occurring meteoroids, which add significantly to the number of objects in the 0.1- to 1-cm range. But they pose less of a threat to satellites due to the small population density of meteoroids large enough to cause significant damage. The orbiting objects that are sufficiently large are tracked by the US Space Surveillance Network (SSN), which consists of a mix of radars and optical sensors. That system can track objects in low-Earth orbit (LEO, defined as altitudes less than 2000 km) with size larger than 5–10 cm and objects in geosynchronous orbit (GEO, at an altitude of 35 876 km) larger than roughly a meter. Using SSN data, US Strategic Command maintains a catalog of objects;1 to be in the catalog, the object must be tracked by the SSN and its origin must be known. Currently the catalog contains some 12 000 objects, including about 850 active satellites. The SSN also tracks several thousand additional objects whose origins are not known. Debris is not uniformly distributed in space but is concentrated in those regions that are heavily used by satellites. Figure 2 shows the distribution of LEO debris as a function of altitude before and after China's January test. More than 3000 of the 12 000 objects in the US catalog lie in the altitude band from 800 to 1000 km.2 The bulk of the debris at higher altitudes is concentrated in the geosynchronous band (figure 3). Orbital speeds in low earth orbit are greater than 7 km/s, and the relative speed of a piece of debris approaching a satellite in an intersecting orbit may be 10 km/s or higher. To give a sense of the potential destructiveness of debris at those speeds, note that a 1-g mass traveling at 10 km/s has the same kinetic energy as a 100-kg mass traveling in excess of 100 km/hr. Alternately, at 10 km/s, the kinetic energy of a mass m is roughly equal to the energy released in an explosion of a mass 10m of high explosive. Debris between 1 mm and 1 cm in size can damage a satellite if it hits a vulnerable area. Shielding can protect against objects of that size, but adding shielding increases the cost both of building satellites and of launching them, and many satellites have minimal shielding. Debris larger than about 1 cm can seriously damage or destroy a satellite in a collision, and there is no effective shielding against such particles. Debris particles larger than 1 cm but too small to be tracked are especially dangerous because satellites are unlikely to have warning to allow them to avoid colliding with such objects. Debris larger than 10 cm may be massive enough to create large amounts of additional debris in a collision with a satellite or another large piece of debris.

### **1cm long space debris causes space catastrophes.**

Flury ’07 (Walter, ESA principal space debris expert, “Space Debris Spotlight,” ESA Focus On, <http://www.esa.int/esaCP/SEMHDJXJD1E_FeatureWeek_0.html>, 9/28/2007, WS)

At closing speeds reaching 50 thousand km per hour, even the smallest bits of space debris can cause serious harm to spacecraft; larger ones cause catastrophe. Near-Earth missions, like the International Space Station, now carry ever-more sophisticated shielding. Not only is space debris a hot topic, it is also a fascinating — and growing — field of space science. (Part 1 of a 3-part series.) Professor Walter Flury, the European Space Agency's resident expert on space debris, casually uses rather startling terms like "hypervelocity impact" and "spacecraft break-up" as though he investigates such possibilities regularly, which he does. And he is not lacking for work. Together with a team of space debris specialists located in the Mission Analysis Office at ESA's Operations Centre (ESOC) in Darmstadt, Germany, and in the Space Environments and Effects Section at the agency's Research and Technology Centre (ESTEC) in Noordwijk, Netherlands, Flury is point man for ESA's efforts to study, model and assess the space debris problem and determine how to mitigate risk for current and future missions. "There have been cases of damage and destruction caused by hypervelocity impacts. Just last week, we had to do an avoidance manoeuvre," says Prof. Flury. In plain language, space debris is anything Up There that can interfere with a spacecraft — including other spacecraft. \* operational spacecraft — 7% \* old spacecraft — 22% \* rocket bodies — 17% \* mission-related objects — 13% \* miscellaneous fragments — 41% Artificial debris includes spent satellites, cast off Yo-Yo de-spinners (used to de-spin spacecraft after launch), tools dropped during spacewalks, discarded rocket upper stages and the fragmentary remains of craft that have exploded or otherwise broken up. 50 000 uncatalogued objects pose threat There are many thousands more uncatalogued objects larger than 1 cm — perhaps more than 50 000; no one really knows the exact count. Uncatalogued objects include bits of aluminium slag from solid rocket motor propellant and droplets of Sodium-Potassium coolant that escaped from Russian nuclear-powered reconnaissance satellites when they ejected their reactor cores. The really dangerous bits are intermediate in size, between 1 and 10 cm. These are hard to detect yet pack a kinetic energy punch sufficient to cause catastrophic damage. One cm is also the maximum size of debris that can be defeated by modern shielding technology; Space Shuttle windscreens have been damaged by flecks of paint as small as 0.3 mm in size travelling at a mere 14 400 kph. The fastest debris, at 50 000 kph, are travelling about 17 times faster than a machine gun bullet.

## ====ATs====

## AT: Current Detection Measures Solve

### Space debris are dangerous and currently undetectable

Zenko, 7/5/11

(Micah, a fellow for conflict prevention at the Council on Foreign Relations, “The danger of space debris”, <http://globalpublicsquare.blogs.cnn.com/2011/07/05/the-danger-of-space-debris/>, July 5th, CJD)

Last week, six astronauts living on board the International Space Station (ISS), which orbits some 200 miles above the earth’s surface, received notice that a piece of space debris travelling 29,000 miles per hour would pass dangerously nearby. NASA officials calculated that the probability of the ISS being hit at around one in 360. (One in 10,000 is NASA’s nominal threshold for which it will authorize a “collision avoidance maneuver.”) Normally, the ISS receives ample notice so that it can maneuver out of the pathway of potential space debris. However, with less than fifteen hours’ warning, the astronauts were forced to relocate to Soyuz space capsules for only the second time in the ISS’s thirteen-year history. While the debris missed the space station by 1,100 feet, orbital space debris is a growing threat to civil, military, and commercial satellites in space. Presently, there are some 22,000 items over ten centimeters across, or roughly the size of a softball, which can be regularly tracked with existing resources and technology. These include the upper stages of launch vehicles, disabled spacecraft, dead batteries, solid rocket motor waste, and refuse from human missions. In addition, there are approximately 300,000 other fragments of space junk measuring between one and ten centimeters, and over 135,000,000 less than one centimeter, which could potentially damage operational spacecraft. Read: Excessive secrecy in national security. Though it took forty years to produce the first 10,000 pieces of softball-sized space debris, it required less than a decade for the next 12,000. This recent increase was due in part to two worrying incidents, which, according to NASA, combined to increase the number of total space objects by over 60 percent. In January 2007, the Chinese military destroyed a defunct polar-orbiting weather satellite with a mobile ballistic missile, and in February 2009 an active Iridium communication satellite and a defunct Russian satellite, which had been predicted to pass each other 1,900 feet apart, unexpectedly collided. The ability to detect, track, characterize, and predict objects in space and space-related events is known as space situational awareness (SSA). The U.S. Strategic Command’s Joint Space Operations Center (JSpOC) provides this function for the Pentagon by monitoring space debris (over ten centimeters) with a worldwide network of twenty-nine ground-based radars and optical sensors. In addition to supporting U.S. military and intelligence agencies, JSpOC provides e-mail notifications to commercial space operators when their satellites are at risk from space debris. JSpOC provides twenty to thirty close-approach notifications per day, which last year resulted in satellite owners maneuvering 126 times to avoid collision with other satellites or debris. According to U.S. officials, the United States even notifies the Chinese government when their satellites are threatened by space debris created by the 2007 anti-satellite test. Despite JSpOC’s best efforts, however, these same officials acknowledge that no country has the resources, technical expertise, or geography to meet the growing demands for SSA. Read: The consequences of stalemate in Libya. The space debris problem is a classic global governance dilemma: though eleven states can launch satellites, and over sixty countries or government consortia own or operate the approximately 1,100 active satellites, no one country or group of countries has the sovereign authority or responsibility for regulating space. Under Article II of the 1967 Outer Space Treaty: “Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty.” The solution to reducing the amount of new space debris, mitigating the threat it poses to satellites and spacecraft, and eventually removing on-orbit debris from space, will require enhanced international cooperation. Last summer, the Obama administration released its National Space Policy, which featured the objective of preserving the space environment via “the continued development and adoption of international and industry standards and policies to minimize debris,” and “fostering the development of space collision warning measures.” Unfortunately, progress toward constructing international agreed upon rules of the road for the responsible uses of space have been slow going. The views expressed in this article are solely those of Micah Zenko. Read more at his blog, Power, Politics and Preventive Action.

**Debris is already a threat in Low Earth Orbit, but prevention systems are weak – treaties do nothing.**

**Senechal ’09** (Thierry, Policy Manager of the Commission on Banking Technique and Practice at the International Chamber of Commerce (ICC), degrees in economics and finance from Harvard University, London Business School, and Columbia University, former Sloan Fellow from the Massachusetts Institute of Technology, <http://74.125.127.132/scholar?q=cache:mjrrGXTIIjAJ:scholar.google.com/+space+weaponization+causes+debris&hl=en&as_sdt=0,23&as_ylo=2005>, Space Debris Pollution: A Convention Proposal, Scholar, SS)

On 11 January 2007 a Chinese ground-based missile was used to destroy the Fengyun-1C spacecraft, an aging satellite orbiting more than 500 miles in space since May 1999. Although the test was hugely successful from a military point of view, demonstrating China‘s ability to use very sophisticated weapons to target regions of space that are home to various satellites and space-based systems, it caused great concerns to both the military and scientific communities. Indeed, the event is a real danger in the sense it may fuel an arms race and weaponization of space, with some countries being tempted to show they can easily control space as well. From the scientific perspective, the Chinese destruction of Fengyun-1C gave a new dimension to the space debris issue. In shattering the old weather-watching satellite into hundreds of large fragments, the Chinese created a large ―debris cloud.‖ The debris are now spreading all around the earth, the majority of them residing in very long-lived orbits. The debris cloud extends from less than 125 miles (200 kilometers) to more than 2,292 miles (3,850 kilometers), encompassing all of low Earth orbit. As of 27 February 2007, the U.S. military‘s Space Surveillance Network had tracked and cataloged 900 debris fragments greater than 5 centimeters in size, large enough to create potentially serious collision problems. The total count of objects could go even higher based upon the mass of Fengyun-1C and the conditions of the breakup, which could have created millions of smaller pieces. The Chinese test has demonstrated that the actual system for preventing the creation of space debris is still weak—with a single test threatening to put in shamble the long-term efforts made by other countries. In particular, questions are now raised as to the extent to which the existing organizations working on space debris could take measures to protect the orbital space from pollution. The test also shows that the various existing treaties and conventions regulating outer space activities do not play a significant role in preventing such an incident because they lack coverage on such issues or are impossible to enforce. 1.2 Space Debris: Managing the Future

### Space debris are dangerous and currently undetectable

Zenko, 7/5/11

(Micah, a fellow for conflict prevention at the Council on Foreign Relations, “The danger of space debris”, <http://globalpublicsquare.blogs.cnn.com/2011/07/05/the-danger-of-space-debris/>, July 5th, CJD)

Last week, six astronauts living on board the International Space Station (ISS), which orbits some 200 miles above the earth’s surface, received notice that a piece of space debris travelling 29,000 miles per hour would pass dangerously nearby. NASA officials calculated that the probability of the ISS being hit at around one in 360. (One in 10,000 is NASA’s nominal threshold for which it will authorize a “collision avoidance maneuver.”) Normally, the ISS receives ample notice so that it can maneuver out of the pathway of potential space debris. However, with less than fifteen hours’ warning, the astronauts were forced to relocate to Soyuz space capsules for only the second time in the ISS’s thirteen-year history. While the debris missed the space station by 1,100 feet, orbital space debris is a growing threat to civil, military, and commercial satellites in space. Presently, there are some 22,000 items over ten centimeters across, or roughly the size of a softball, which can be regularly tracked with existing resources and technology. These include the upper stages of launch vehicles, disabled spacecraft, dead batteries, solid rocket motor waste, and refuse from human missions. In addition, there are approximately 300,000 other fragments of space junk measuring between one and ten centimeters, and over 135,000,000 less than one centimeter, which could potentially damage operational spacecraft. Read: Excessive secrecy in national security. Though it took forty years to produce the first 10,000 pieces of softball-sized space debris, it required less than a decade for the next 12,000. This recent increase was due in part to two worrying incidents, which, according to NASA, combined to increase the number of total space objects by over 60 percent. In January 2007, the Chinese military destroyed a defunct polar-orbiting weather satellite with a mobile ballistic missile, and in February 2009 an active Iridium communication satellite and a defunct Russian satellite, which had been predicted to pass each other 1,900 feet apart, unexpectedly collided. The ability to detect, track, characterize, and predict objects in space and space-related events is known as space situational awareness (SSA). The U.S. Strategic Command’s Joint Space Operations Center (JSpOC) provides this function for the Pentagon by monitoring space debris (over ten centimeters) with a worldwide network of twenty-nine ground-based radars and optical sensors. In addition to supporting U.S. military and intelligence agencies, JSpOC provides e-mail notifications to commercial space operators when their satellites are at risk from space debris. JSpOC provides twenty to thirty close-approach notifications per day, which last year resulted in satellite owners maneuvering 126 times to avoid collision with other satellites or debris. According to U.S. officials, the United States even notifies the Chinese government when their satellites are threatened by space debris created by the 2007 anti-satellite test. Despite JSpOC’s best efforts, however, these same officials acknowledge that no country has the resources, technical expertise, or geography to meet the growing demands for SSA. Read: The consequences of stalemate in Libya. The space debris problem is a classic global governance dilemma: though eleven states can launch satellites, and over sixty countries or government consortia own or operate the approximately 1,100 active satellites, no one country or group of countries has the sovereign authority or responsibility for regulating space. Under Article II of the 1967 Outer Space Treaty: “Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty.” The solution to reducing the amount of new space debris, mitigating the threat it poses to satellites and spacecraft, and eventually removing on-orbit debris from space, will require enhanced international cooperation. Last summer, the Obama administration released its National Space Policy, which featured the objective of preserving the space environment via “the continued development and adoption of international and industry standards and policies to minimize debris,” and “fostering the development of space collision warning measures.” Unfortunately, progress toward constructing international agreed upon rules of the road for the responsible uses of space have been slow going. The views expressed in this article are solely those of Micah Zenko. Read more at his blog, Power, Politics and Preventive Action.

### Small fragments can’t be detected, those are the most dangerous

Mirmina 5 (Steven A., July, “Reducing the Proliferation of Orbital Debris: Alternatives to a Legally Binding Instrument”, The American Journal of International Law, Vol. 99, No. 3, JSTOR, eys)

Two types of debris are found in space. Naturally occurring debris, or meteoroids, are part of the space environment and naturally pass through the Earth's orbit. The precise amount of this type of debris is indeterminate, but observational data have suggested a total, at any given instant in time, of about two hundred kilograms of meteoroid mass within two thousand kilo- meters of the Earth's surface (the region encompassing the most frequently used orbits).2 These naturally occurring meteoroids pass through Earth's orbit at a relative velocity of about twenty kilometers per second.3 The other type of debris, the type that is the subject of this Note, is man-made debris.4 Man-made debris, or orbital debris, does not pass through the Earth's orbit as meteoroids do. Rather, it remains on orbit for its lifetime, until, eventually, sufficient friction and gravity combine to pull it toward the Earth's surface, where it frequently, but clearly not always, burns up in the atmosphere. This process, depending on the mass of the object and its orbit, can take hundreds of years, or longer. For this reason, the amount of orbital debris has progressively increased since humans began launching objects into orbit. The estimated mass of this man-made orbital debris within two thousand kilometers of the Earth's surface is about two million kilograms.6 These objects travel at a velocity of approximately ten kilometers per second; thus, collisions between them are dramatic, resulting in many more, smaller pieces of debris.7 The vast majority of orbital debris was not caused by accident. Space operators have deliberately abandoned rocket bodies and payloads and intentionally caused various operational or fragmentation debris. Many objects have been jettisoned into space: lens covers, separation bolts used to lock fixtures in place, auxiliary motors, launch vehicle fairings, various shrouds, and objects merely dropped or discarded during manned missions (such as the glove that a U.S. astronaut dropped during a spacewalk from Gemini 4 in 1965).8 Fragmentation debris has numerous causes, including accidents, malfunctions, weapons testing, and intentional self- destruction.9 An operational satellite or a manned vehicle can avoid larger debris objects (that is, larger than ten centimeters) relatively easily, because their orbits are detected, monitored, and tracked from the ground. However, the chief concern about these objects is that they may break up even more and potentially create millions of fragments. Certain types of debris are degraded by solar heating and radiation, and split into smaller components such as bits of insulation, solid fuel fragments, and paint flakes. Moreover, frozen bits of nuclear reactor coolant have leaked from various nuclear-powered satellites and some of them are in orbits dangerously close to that of the International Space Station (ISS). All of these debris objects may cause serious damage to persons or property in outer space. The United States National Aeronautics and Space Administration (NASA) has repeatedly stated its concern that orbital debris could damage the space shuttle or the ISS. It does not take a large piece of debris to cause serious damage to the shuttle or the ISS and risk the loss of human life.10 If a fleck of paint as small as four one-hundredths of one millimeter hits a shuttle window, the window would have to be replaced.' Debris as small as one-tenth of one millimeter could penetrate the protective suit of an astronaut involved in a spacewalk. The shuttle's reinforced carbon-carbon panels on the leading edge of its wings would be compromised by the impact of debris as small as one millimeter, while debris from three to five millimeters in size could penetrate the vehicle's thermal protection tiles. Larger debris (five millimeters) could penetrate the crew cabin, and a piece between five and ten millimeters in size could damage the payload bay.12 Compounding this concern is that debris of this size is too small to be tracked from Earth. As mentioned, debris larger than ten centimeters can be tracked, and the shuttle has executed collision avoidance maneuvers when threatened by these objects. In fact, two unmanned satellites have also executed maneuvers to avoid large debris.13 When the shuttle is on orbit, NASA turns it so that its windows face away from the direction of the velocity vector (in layman's terms, backwards) to protect its sensitive systems from collisions with small debris. Furthermore, NASA has adopted operational restrictions for extravehicular activity that use the orbiter itself to shield the crew involved from debris. The U.S. Space Surveillance Network also watches the orbits of oncoming orbital debris and informs NASA if an object is expected to pass within a few kilo- meters of the orbiting shuttle. About once every year or two, NASA maneuvers the shuttle away from the trajectory of oncoming orbital debris, even if the chances of collision are relatively slim. In addition to the lives of the astronauts, NASA is concerned about its other assets in outer space, including observatories such as the Hubble Space Telescope, whose high- gain antenna was completely pierced by a piece of debris. One other major concern about orbital debris remains to be addressed. Besides the danger to objects and people in outer space, it poses a threat to humans and property on the ground. This threat, while serious, is not mathematically high as yet. In fact, every day, on average, some piece of orbital debris enters and burns up in the Earth's atmosphere, but most of it does not survive the intense heat of reentry. Components that do survive are most likely to land in oceans and other bodies of water, or in remote and thinly populated areas such as the Canadian tundra, the Australian outback, and the Siberian steppe.14 Fortunately, until now reentering debris has not caused any deaths or serious injuries. In addition to smaller debris such as paint chips, various large objects are orbiting the Earth, including spent stages of rocket bodies.15 Although many remain on orbit for years, a signifi cant number have returned to Earth. Orbital debris that reenters and does not completely burn up in the atmosphere will strike the Earth's surface somewhere.16 Even though the world community has been spared any serious property damage or loss of life so far,17 the risk that orbital debris will return to Earth and cause serious harm will only intensify if steps are not taken to mitigate the proliferation of such debris.

## ==== Counterplans NB ====

## Code of Conduct CP

### **Code of Conduct necessary to solve space debris.**

Flury ’07 (Walter, ESA principal space debris expert, “Space Debris Spotlight,” ESA Focus On, <http://www.esa.int/esaCP/SEMHDJXJD1E_FeatureWeek_0.html>, 9/28/2007, WS)

Flury argues quite passionately for an international code of conduct, worldwide-accepted standards, and international regulations or space law to create a comprehensive framework for reducing space debris and boosting spaceflight safety. The need for a global framework is becoming widely accepted given the uneven results of past efforts by individual space-active nations and the growing environment of dangerous debris that surrounds the Earth. ESA's policy effort focuses on the Inter-Agency Space Debris Coordination Committee (IADC), comprising space agencies from China, France, Germany, India, Italy, Japan, Ukraine, the UK, the USA, Russia and ESA, as well as the Scientific and Technical Subcommittee of the UN Committee on the Peaceful Use of Outer Space (UNCOPUOS). "Once upper stages are discarded and satellites are turned off, their mission is over. During the first 30 years of space flight, few operators disposed of their spacecraft in a controlled way. This attitude has gradually changed in the past 20 years", says Klinkrad. In 2002, the IADC created Debris Mitigation Guidelines that require spacecraft owners to protect the commercially valuable low-Earth and geostationary orbit zones. Requirements include limiting debris during normal operations, suppressing deliberate break-up of rockets or payloads, and properly disposing of spacecraft and upper stages, typically by moving them to "graveyard" orbits or by deorbiting them into the atmosphere, where most burn up. While the overall risk of a destructive impact, i.e. involving debris bigger than 1 cm, remains small, Flury argues for action now to protect scientific and commercial space activity in the future. "Application of the current voluntary mitigation measures is rather mixed. Debris preventative measures need to be applied now," he said at a recent conference. He would like to see a formal Code of Conduct based on the IADC Guidelines issued by UNCOPUOS as soon as possible.

### Code of Conduct solves space debris

Wright, 2007 (David, Co director and senior scientist with the global security program of the Union of Concerned Scientists in Cambridge, Massachusetts, “Space Debris,” Physics Today, http://physicstoday.org/journals/doc/PHTOAD-ft/vol\_60/iss\_10/35\_1.shtml?bypassSSO=1, October, CDG)

ASAT debris distribution A common assumption is that the debris created from the fragmentation of a satellite in an attack expands outward with a spherically symmetric distribution relative to the center of mass of the original satellite. According to the NASA breakup model, the speeds of the vast majority of the debris particles created in such a collision, measured relative to the center of mass of the debris cloud, would be much smaller than the orbital speed of the satellite. In particular, for debris larger than 10 cm resulting from a collision of the type being considered here, 80% of the particles would have relative speeds less than 0.25 km/s, which is only 3% of the 7.5 km/s speed of the orbiting satellite. A similar result holds for smaller debris particles. Because the relative speed of most debris particles is small compared with the orbital speed of the satellite, the total velocity of the particles would be very close to the original orbital velocity of the satellite, and the particles, especially those with large mass, would follow orbits at an altitude close to that of the original satellite. The distribution of speeds of the debris particles will cause the debris to spread out along the orbit of the original satellite within several days (see figures 6a and 6b ). Once it is spread out, the debris will pose a collision threat to essentially all satellites whose orbits pass through that altitude. Over time, forces due to anisotropies in Earth's gravitational field will cause the debris orbits to precess around Earth's axis at slightly varying rates, so the debris will spread out of the plane of the original orbit (figure 6c). For debris in a nearly polar orbit, after a few years the particles would be essentially uniformly distributed within a shell around Earth (figure 6d). Debris in orbits near the equator would slowly spread into a band around it. Preserving the space environment Space is uniquely suited for a range of important uses, such as communication, Earth observation, and navigation, and in the 50 years since Sputnik 1, society has become highly dependent on satellites. As we start the second 50 years of the space age, failing to take steps to preserve humanity's ability to use space would be incredibly short-sighted. Controlling the production of debris is crucial to the sustainable use of space. The international community has begun to take steps in the right direction by developing debris-mitigation guidelines for routine activity in space. However, there are no legal restrictions on the testing or use of weapons intended to destroy satellites in orbit. Given the very large quantities of debris that would be created by destroying satellites, such weapons could have a significant, long-term impact on the space environment. Developing international measures to prohibit the testing or use of kinetic-energy ASAT weapons should therefore be an international priority.

## ==== Affirmative ====

## 2AC Frontline

### Space Debris not a threat- cataloging and protection in place

UPI 7/11 (Upi News, Houston, July 11, 2011 “Space debris no threat to shuttle, station”, <http://www.upi.com/Science_News/2011/07/11/Space-debris-no-threat-to-shuttle-station/UPI-99951310423744/>, jk)

Debris from a dead Soviet-era satellite poses no threat to the International Space Station and the shuttle Atlantis currently docked with it, NASA says. The Space Surveillance Network operated by the U.S. military informed notified NASA of the orbiting piece of space junk Sunday. NASA began tracking the object's path to determine how close it might come to the station and the shuttle, SPACE.com reported Monday. "Mission Control has verified that the track of a piece of orbital debris will not be a threat to the International Space Station and space shuttle Atlantis," NASA officials in Houston said in a statement. "No adjustments to the docked spacecraft's orbit will be necessary to avoid the debris." More than 500,000 pieces of space junk, including the chunk of the defunct Soviet Cosmos 375 satellite currently being tracked, are cataloged and monitored in Earth's orbit, NASA officials said.

Alt Cause - Warming

Collard-Wexler et al. 6 ( Simon Collard – Wexler, Thomas Graham, Wade Huntley, Ram Jakhu, William Marshall, John Siebert, International Research Program, “ Space Security” <http://www.spacesecurity.org/SSI2006.pdf>, AD)

In 2004, scientists at the US Naval Research Laboratory found that greenhouse gasses are causing the cooling and contraction of the thermosphere over 80 kilometers in altitude above the Earth. While this thermospheric cooling may allow operational satellites to remain in orbit for longer periods of time by reducing atmospheric drag, it appears that rising carbon dioxide levels will also make space debris more persistent.90 In 2005, scientists at the University of Southampton found that rising carbon dioxide levels, and the resulting decreases in atmospheric density, could cause an increase in space collisions. In addition, if satellites are launched and destroyed at the existing rate, the researchers predicted a 17 percent increase in the number of collisions and a 30 percent increase in the number of objects more than one centimeter in diameter by the end of the 21st century.91

### Space Debris inevitable by 2055

Lovgren, 6 (Stefan, for National Geographic News “Space Junk Cleanup Needed, NASA Experts Warn”, <http://news.nationalgeographic.com/news/2006/01/0119_060119_space_junk.html>, January 19th , CJD)

Space is filling up with trash, and it's time to clean it up, NASA experts warn. A growing amount of human-made debris—from rocket stages and obsolete satellites to blown-off hatches and insulation—is circling the Earth. Enlarge Photo Printer Friendly Email to a Friend What's This? SHARE Digg StumbleUpon Reddit RELATED Undetectable Asteroids Could Destroy Cities, Experts Say 40,000 Children Help Build Space "Disco Ball" Keeping Space Free of Trash Scientists say the orbital debris, better known as space junk, poses an increasing threat to space activities, including robotic missions and human space flight. "This is a growing environmental problem," said Nicholas Johnson, the chief scientist and program manager for orbital debris at NASA in Houston, Texas. Johnson and his team have devised a computer model capable of simulating past and future amounts of space junk. The model predicts that even without future rocket or satellite launches, the amount of debris in low orbit around Earth will remain steady through 2055, after which it will increase. While current efforts have focused on limiting future space junk, the scientists say removing large pieces of old space junk will soon be necessary. Researchers present an overview of the space junk problem in tomorrow's issue of the journal Science. Ripping Holes Since the launch of the Soviet Union's Sputnik I satellite in 1957, humans have been generating space junk. The U.S. Space Surveillance Network is currently tracking over 13,000 human-made objects larger than four inches (ten centimeters) in diameter orbiting the Earth. These include both operational spacecraft and debris such as derelict rocket bodies. "Of the 13,000 objects, over 40 percent came from breakups of both spacecraft and rocket bodies," Johnson said. In addition, there are hundreds of thousands of smaller objects in space. These include everything from pieces of plastic to flecks of paint. Much of this smaller junk has come from exploding rocket stages. Stages are sections of a rocket that have their own fuel or engines. Enlarge Photo Printer Friendly Email to a Friend What's This? SHARE Digg StumbleUpon Reddit RELATED Undetectable Asteroids Could Destroy Cities, Experts Say 40,000 Children Help Build Space "Disco Ball" Keeping Space Free of Trash These objects travel at speeds over 22,000 miles an hour (35,000 kilometers an hour). At such high velocity, even small junk can rip holes in a spacecraft or disable a satellite by causing electrical shorts that result from clouds of superheated gas. Three accidental collisions between catalogued space-junk objects larger than four inches (ten centimeters) have been documented from late 1991 to early 2005. The most recent collision occurred a year ago. A 31-year-old U.S. rocket body hit a fragment from the third stage of a Chinese launch vehicle that exploded in March 2000. "We've been fortunate that in all three cases only a few [new] debris [fragments] have been created," Johnson said. Best-Case Scenario Previous space junk projections have assumed that new satellites and rockets would launch in the future. The new study, in contrast, looks at what would happen to the amount of space junk if no rocket bodies or spacecraft were launched in the next 200 years. "This is kind of a best-case scenario," said lead study author Jer-Chyi Liou, principal scientist and project manager for orbital debris with the Engineering Science Contract Group at NASA's Johnson Space Center in Houston. The results suggest that new fragments from collisions will replace the amount of objects falling out of orbit and back to Earth. Beyond 2055, however, fragments from new collisions will exceed the amount of decaying debris. "The debris population will continue to grow," Liou said. "We know it will only get worse." Removing Junk Johnson, the program manager for orbital debris, says space-faring nations agree that the space junk problem needs to be addressed. There is even a special organization called the Inter-Agency Space Debris Coordination Committee, made up of space agencies from ten countries and the European Space Agency. So far, efforts have concentrated on preventing new debris. Johnson believes it may be time to think about how to remove junk from space. But that is a difficult proposition. Previous proposals have ranged from sending up spacecraft to grab junk and bring it down to using lasers to slow an object's orbit to cause it to fall back to Earth more quickly. Given current technology, those proposals appear neither technically feasible nor economically viable, Johnson admits. But, he says, the space-junk problem needs more attention. "It's like any environmental problem," he said. "It's growing. If you don't tackle it now, it will only become worse, and the remedies in the future are going to be even more costly than if you tackle it today."

### EVEN WITHOUT a solution, the debris problem won’t escalate for hundreds of years

The Times 2010 (Duncan Graham-Rowe, Science Writer, “Junk in space,” 6-3, Lexis)

How you define the point at which Earth's orbit will become unusable very much depends on your perception of what risks are acceptable. From Nasa's perspective, there is still plenty of time. "We're talking about hundreds of years of doing nothing before it gets to be a serious issue,"says Johnson. But Nasa's idea of "safe" is unlikely to tally with that of the average space tourist. What's more, even if it does take 200 years toget to this stage, a tipping point will arrive long before that. Around 2055 we will start to see a shift in the main cause of debris. Exploding obsolete satellites will cease to be the main source of junk and collisiondebris will take over.

### Collisions will be few and far between for 200 years

National Post 2006 (Canada, “Space junk endangering launches: Risk of collisions with satellites expected to triple within 200 years”, 1-20, Lexis)

The future commercialization of space could be jeopardized because the amount of debris is expected to rise dramatically after 2055, say the authors of a new U.S. Space Agency computer simulation published in today's edition of the journal Science. The "Leo-to-Geo Environmental Debris" model, or LEGEND, created by scientists at NASA's Johnson Space Center in Houston, Tex., shows the number of collisions will triple within 200 years. There have been at least three minor documented collisions so far, starting with a 1986 crash between a Soviet rocket and a French military probe. More junk in space increases the odds of the world's first "catastrophic" collisions between larger fragments. Those would shatter into thousands of tiny pieces, then keep colliding to create widening debris fields that could "pollute" space for hundreds of years. Alternatively, the debris could plunge to Earth on uncontrollable trajectories. "It's like a snowball effect," said J.C. Liou, a planetary scientist who developed the three-dimensional simulation. Hurtling through zero gravity between 10 and 20 kilometres a second, each fragment packs more than 10 times the punch of a speeding bullet. "The outcome would be quite severe." A model developed by the scientist predicts catastrophic collisions will begin occurring at least every 20 years -- and that's the "best-case" scenario. The model conservatively assumes no satellites will launch into space for the next 200 years; in fact, about 100 are launched annually. In the worst-case scenario, China, which recently set up its own space-junk monitoring station, says that beyond the year 2300, every satellite or manned mission in low Earth orbit will risk a collision with space debris.

### NO Impact to Space Debris

Dolman 2006**,** US Air Force’s School of Advanced Air and Space Studies Comparative Military Studies professor,

(Everett, “Toward a U.S. Grand Strategy in Space,” Washington Roundtable on Science and Public Policy, George C. Marshall Institute, 3-10-06, http://www.marshall.org/pdf/materials/408.pdf

Dolman: Well, I think that some assumptions that you made are extremely problematic. You know, the Soviet Union launched twenty ASATs into space and those were the worst kind of ASAT you can imagine. They were essentially shotgun shells of hundreds of bits of debris smashing into other satellites. Did that cause a debris problem? No, because it a planned orbital mechanics issue that the kinetic force of that engagement goes into policy debate to differentiate “rods from God” and missile defense and some of the other space-based options that the United States might nse mission. You have a difficult time arguing that we are building a capability r ballistic missile defense and not for something more offensive. I think the question those things and as Karl is saying, it is really hard to do that in pracis the atmosphere and debris is burned up on reentry. There are thus ways to use weapons in space that don’t really cause a debris problem, and there are ways to use them that actually clean up space in orbit. But also I agree with you. No hegemon, no empire, no state or business lasts forever. Does that mean that we should accelerate our own decline? No. It is important to do things to extend it. The United States inevitably will lose its power relative to the rest of the world, so it needs to set up the conditions that are seen as beneficial around the world in such a way that whoever replaces the United States is going to be in the same sort of liberal mode that the United States had been, the same type of benevolent hegemon or follow-on power. What it cannot do is set up a situation where the next power is likely to be antithetical to those ideas. What I am talking about is extending the period of American hegemony into the foreseeable future, not creating a permanent empire in that sense, but continuing to have a situation where there is a power to create and enforce some sort of order.

### The link is small - the US doesn’t produce much debris and is already engaged in cleanup - and national security outweighs anyway

USSD 7 (US State Department, “Study on Space Policy: Report on the International Security Advisory Board,” April 27, Accessed on Spacedebate.com, http://www.spacedebate.org/evidence/3003/, EMM)

The United States is party to the Convention on International Liability for Damage Caused by Space Objects, the Return of Objects Launched into Outer Space and also the Agreement on the Rescue of Astronauts and the Return of Astronauts. The United States has been the world's leader in raising awareness about the dangers of man-made space debris and in developing ways of dealing with this consequence of human activity in space. The National Space Policy commits the United States to seek the minimization of space debris by government and nongovernment activities. The United States should continue to play a strong leadership role in the Inter-Agency Debris Coordination Committee, at the United Nations, and elsewhere, for the minimization of man-made space debris. At the same time, it should be recognized that space debris produced by human activity is quite low compared to that produced by nature. To minimize does not mean stopping all activities that would or might produce some debris. It is a relative not an absolute matter. U.S. national security requirements could take precedence over the goal of minimization of space debris –for example, the testing and use of ballistic missile defense interceptors against objects in space that would threaten populations, armed forces, and infrastructure.

## ----Weaponization Solves

### Space deterrence key to preventing debris

SWF, 9 – staff writers, Secure World Foundation (SWF) is headquartered in Superior, Colorado, with offices in Washington, D.C. and Vienna, Austria. SWF is a private operating foundation dedicated to the secure and sustainable use of space (4/24, “Space Deterrence Concept Critical To US Space Asset Security,” http://www.spacewar.com/reports/Space\_Deterrence\_Concept\_Critical\_To\_US\_Space\_Asset\_Security\_999.html)

A fundamental workshop observation is that the U.S. faces the key issue of what the face of 21st century deterrence might look like. In a post- Cold War era, the number, range, and variety of players has increased significantly, and space is perhaps the most globalized of political and military arenas. As such, there is much debate as to what the face of deterrence for space should look like, and how large a role it should play in overall US strategic thinking in protection its space assets. "Maturing the discussion of space deterrence is important because deterrence ultimately provides the best protection of space and enhances U.S. national security", says Colonel Sean McClung, Director of the National Space Studies Center at Maxwell Air Force Base. McClung adds: "Successful space deterrence can prevent conflicts that create massive debris fields and result in a universal inability to effectively use the space environment." Other events on this topic, most notably those of the National Defense University and the Eisenhower Center for Space and Defense Studies, highlight the currency of this theme and its consideration by the upper echelons of political and military thinkers.

## ----Ext. SQ Solves

### SQ Efforts Solve Space Debris

Periscope 11 (news website, “Space is full of our junk, Space Fence needed”, <http://www.periscopepost.com/author/periscope/>, July 12th 2011, CJD)

News that NASA’s final space shuttle Atlantis successfully docked with the International Space Station on Sunday delighted space enthusiasts. But it’s not all plain sailing in space. A series of alerts sounded on the International Space Station over the last few weeks have highlighted the problem of how much space debris there is out there and how much of the human-made litter is not picked up by radars until it is dangerously close to colliding with satellites or space stations. Plans are already afoot to build a $3.5 billion ‘Space Fence’ scanner to track the estimated 500,000 pieces of space debris bigger than half-an-inch long that are believed to be in orbit. Existing tracking systems can fail to pick up smaller debris, which although small, is potentially life-threatening. “At orbital speeds of up to 17,500mph, even an inch-wide piece of debris could destroy a satellite or damage the space station if it struck in the wrong place,” noted the MSNBC Cosmic Log blog. This month marks the end of an era in American space exploration: After 30 years of ferrying materials and people from earth to space stations, repairing satellites, performing scientific studies, and all other manner of space maintenance, NASA, the nation’s space agency, is shuttering its shuttle programme. Read more here. Latest near squeak. One of the alerts, on June 28, came so late that the station didn’t have time to get out of the way and the six astronauts living aboard the orbital outpost had to take shelter in Russian Soyuz lifeboats while debris of unknown origin zoomed past at a distance of just 850 feet (260 meters), warned MSNBC Cosmic Log blog. The other alert came Sunday, just as the space shuttle Atlantis was beginning its last visit to the space station. Dodging space junk. Kenneth Chang of The New York Times flagged up what happens when there’s a space junk alert: “Usually, when NASA gets a warning, several days in advance, that something that might come too close to the station, it moves the station by firing thrusters. Or, if a space shuttle happened to be visiting at the time, the shuttle would nudge the station out of danger. That has happened 12 times.” Lockheed Martin is competing with Raytheon for the Space Fence contract. The Air Force aims to have the system up and running by 2015. Watch their tub-thumping videos below. We are heavily reliant on space. “This issue has always been on the minds of people who are trying to use space for all the things that it’s used for today. … We really are heavily reliant on space,” John Morse, director of Lockheed Martin’s Space Fence Program, told Discovery News. Space and commerce. “Throughout the past ten years, space has become inextricably linked to all aspects of human life. Just try to imagine one day without essentials like ATM machines, GPS devices, DirectTV and Weather.com. Both private activity and global commerce largely depend on communication, remote sensing and navigation satellites from space,” reminded Scott Spence, Director, Raytheon Space Fence Program, Integrated Defense Systems.

### SQ Solves- Detection

Madison et al 11 (James Mason, Jan Stupl, William Marshall, Creon Levit, Cornell university space physics author “Orbital Debris-Debris Collision Avoidance” <http://arxiv.org/abs/1103.1690>, March 9th, CJD)

We focus on preventing collisions between debris and debris, for which there is no current, effective mitigation strategy. We investigate the feasibility of using a medium-powered (5 kW) ground-based laser combined with a ground-based telescope to prevent collisions between debris objects in low-Earth orbit (LEO). The scheme utilizes photon pressure alone as a means to perturb the orbit of a debris object. Applied over multiple engagements, this alters the debris orbit sufficiently to reduce the risk of an upcoming conjunction. We employ standard assumptions for atmospheric conditions and the resulting beam propagation. Using case studies designed to represent the properties (e.g. area and mass) of the current debris population, we show that one could significantly reduce the risk of nearly half of all catastrophic collisions involving debris using only one such laser/telescope facility. We speculate on whether this could mitigate the debris fragmentation rate such that it falls below the natural debris re-entry rate due to atmospheric drag, and thus whether continuous long-term operation could entirely mitigate the Kessler syndrome in LEO, without need for relatively expensive active debris removal.

Russian Cleaning up Space Debris NowAtkinson 2010 Nancy Professor at North Alabama and Maryland, department of history [http://www.universetoday.com/80643/russia-wants-to-build-sweeper-to-clean-up-space-debris/ November 29, 2010 Russia is using sweepers and sweeper pods to push debris out of orbit  
Energia Russia is looking to build a $2 billion orbital “pod” that would sweep up satellite debris from space around the Earth. According to a post on the Russian Federal Space Agency, Roscosmos’ Facebook site, (which seems to confirm an earlier article by the Interfax news agency) the cleaning satellite would work on nuclear power and be operational for about 15 years. The Russian rocket company, Energia proposes that they would complete the cleaning satellite assembly by 2020 and test the device no later than in 2023. “The corporation promises to clean up the space in 10 years by collecting about 600 defunct satellites on the same geosynchronous orbit and sinking them into the oceans subsequently,” Victor Sinyavsky from the company was quoted as saying. Sinyavsky said Energia was also in the process of designing a space interceptor that would to destroy dangerous space objects heading towards the Earth. No word on exactly how the space debris cleaner would work, of how it would push dead satellites and other debris into a decaying orbit so that objects would burn up in the atmosphere, or if it might somehow gather up or “vacuum” debris. But at least someone is thinking about space debris and asteroid deflection and putting more than just a few rubles (60 billion of ‘em) towards these concepts

**Space Lasers Can Shoot down Debris**  
**The Week ’11** The Week, NASA’s Plan to Clean up Space Junk: Lasers. 3/17/11. <http://theweek.com/article/index/213197/nasas-plan-to-clean-up-space-junk-lasers>.

Actually, it wouldn't destroy it. Instead,NASA's plan is to move the garbage out of the path of satellites and spacecraft. The laser would ideally be mounted on one of the Earth's poles, where the atmosphere is thinner, and would send pulses of photon pressure to "nudge" objects out of the way.

### Status quo solves - NASA’s implemented a new policy to clean up and limit debris

Selding 10(Peter, Space News Writer, “NASA May Move Orbital Debris Mitigation Off Back Burner,” July 23, http://www.spacenews.com/civil/100723-nasa-orbital-debris-mitigation.html, EMM)

BREMEN, Germany — NASA’s Orbital Debris Program Office expects to begin active work on how to remove debris in orbit on the strength of the new U.S. National Space Policy, according to the office’s chief scientist. Nicholas L. Johnson said the office, which assembles data from the U.S. Air Force-run Space Surveillance Network, has been working on these issues for years, but only on an informal basis, with few resources and no formal mandate. That changed on June 28, when President Barack Obama issued an updated space policy that specifically orders NASA and the U.S. Defense Department to “pursue research and development of technologies and techniques … to mitigate and remove on-orbit debris.” Attending the 38th Congress of the Committee on Space Research (Cospar) here July 18-25, Johnson said it is too early to tell exactly how the new policy will be transformed into programs and budgets. But the specificity of the wording, he said, gives reason to conclude that NASA will be able to increase its efforts. In addition to asking NASA and the Defense Department to research debris mitigation — making satellites and rockets less likely to break up in orbit, and removing satellites from the orbital highways upon retirement — the policy’s inclusion of orbital debris removal may take the NASA office in a new direction.

### No impact - tracking solves and even weapons firing doesn’t cause much debris - your authors grossly exaggerate

Hackett 7(James, Washington Post Writer, “ Much ado about space debris,” April 25, Lexis, EMM)

China's deliberate destruction of one of its own satellites in a January test of an anti-satellite (ASAT) weapon has led to much hand-wringing about the creation of space debris, reinvigorating the opponents of weapons in space. Orbiting debris is dangerous, but the danger has been greatly exaggerated and is no reason for new unenforceable arms control agreements. When the space age began 50 years ago there were no man-made objects in space. Since then, Space Command has tracked more than 25,000 objects of baseball size or larger. More than 10,000 have fallen into the atmosphere and disintegrated or landed, but in 50 years not one person anywhere on Earth has been killed or injured by falling debris. Space debris is only slightly more likely to strike one of the 850 active spacecraft. Most are in low Earth orbit below about 800 miles. These operational spacecraft are only 6 percent of the objects tracked. The rest is space junk that includes inactive satellites, spent rockets, debris from exploding rockets and just plain trash. Space Command monitors debris to identify threats and alerts operators of satellites to move out of the way if they appear to be in danger. Some 80 percent of debris orbits between 500 and 600 miles altitude. The Chinese test, at 527 miles, created more debris right where traffic is heaviest. Air Force Space Command is tracking more than 1,000 pieces of debris from the Chinese test, plus 14,000 that were there before. So far, none has hit an active spacecraft. In fact, over the last 50 years there have been only three documented debris impacts with operational spacecraft, and none have been destroyed. A Space Command Web site describing the Space Surveillance Network that tracks debris notes there is only a small amount in the low orbits of the space shuttle and space station, and gives a worst-case estimate of 1 chance in 10,000 years of a piece of debris of baseball size or larger hitting either one. Even in the debris-heavy area around 500 miles altitude, Space Command says normally there are only three or four objects orbiting in an area equivalent to the airspace over the continental United States up to an altitude of 30,000 feet. Thus, it states, the likelihood of a collision is very small. Now there are reports U.S. intelligence agencies knew about and monitored Chinese preparations for the ASAT test, but senior administration officials decided to say nothing to deter Beijing in orderto protect intelligence methods. That shows that despite the anguish about space debris the creation of more was not considered a serious danger. Most debris eventually migrates down and burns up in the atmosphere. The main efforts are to avoid existing debris, design spacecraft and rockets that will not explode in space, limit the release of debris on orbit, and at the end of their mission de-orbit satellites or move them to parking orbits where there is little traffic. The Inter-Agency Space Debris Coordination Committee (IADC) is an international governmental group that promotes good conduct in space. Most space-faring nations are members, including the United States, Russia, China and the European Space Agency, which together have created some 95 percent of space junk. The IADC was supposed to meet in Beijing in late April, but after creating a new debris field, China postponed the meeting until November. Now an earlier meeting at a new location is under consideration. It will be interesting to see if China explains its anti-satellite test. By conducting the test without advance notice to anyone, Beijing ignored the concerns of governments and commercial satellite operators alike, and violated a cardinal rule of the IADC by creating a lot of long-lived debris at a relatively high altitude. Though the danger is not as great as many believe, China's action has led to renewed calls for a ban on tests in space that might cause debris. That would be a mistake. Banning weapons or tests in space could adversely affect our ability to protect our armed forces on land and sea from satellite reconnaissance and targeting.

### We Already possess technology to scout out Space Debris

### Atkinson 10 (Nancy, Published Articles for Nasa, “New Satellite for Monitoring Space Debris To Launch,” <http://www.universetoday.com/67750/new-satellite-for-monitoring-space-debris-to-launch/>, AD)

The U.S. Air Force will launch the first-ever satellite dedicated solely to tracking the positions of other satellites and the thousands of pieces of space debris in Earth orbit. The $500 million Space-Based Space Surveillance satellite, scheduled for a July 8 launch from Vandenberg Air Force Base, in California, will continuously monitor the “traffic” around the Earth, providing an unobstructed view day or night. Currently, the ground-based radar and optical telescopes used to track satellites and space junk can only be used on clear nights, and not all the observatories are powerful enough to detect objects in high or geosynchronous orbits. This is the first satellite in the SBSS System that will eventually lead to a constellation of satellites to detect and track orbiting space objects, according to Boeing, the prime contractor for this first “Pathfinder” satellite. While the Air Force is the primary user of the SBSS satellites, the US Department of Defense will also use data from the eventual satellite system to support military operations, and NASA can use the information to calculate orbital debris collision-avoidance measures for the International Space Station and Space Shuttle missions.

## ----Ext. Threat Exaggerated

### NASA says that debris aren’t a threat

UIP.com, 7/11/11 (UIP.com, news website, “Space debris no threat to shuttle, station” <http://www.upi.com/Science_News/2011/07/11/Space-debris-no-threat-to-shuttle-station/UPI-99951310423744/>, July 11th, 11, CJD)

HOUSTON, July 11 (UPI) -- Debris from a dead Soviet-era satellite poses no threat to the International Space Station and the shuttle Atlantis currently docked with it, NASA says. The Space Surveillance Network operated by the U.S. military informed notified NASA of the orbiting piece of space junk Sunday. NASA began tracking the object's path to determine how close it might come to the station and the shuttle, SPACE.com reported Monday. "Mission Control has verified that the track of a piece of orbital debris will not be a threat to the International Space Station and space shuttle Atlantis," NASA officials in Houston said in a statement. "No adjustments to the docked spacecraft's orbit will be necessary to avoid the debris." More than 500,000 pieces of space junk, including the chunk of the defunct Soviet Cosmos 375 satellite currently being tracked, are cataloged and monitored in Earth's orbit, NASA officials said.

### Debris Threat Exaggerated – be weary of their evidence

Hackett 7 (James, writer for the Washington Times, April 25, “Much ado about space debris”, Lexis Nexis, eys)

China's deliberate destruction of one of its own satellites in a January test of an anti-satellite (ASAT) weapon has led to much hand-wringing about the creation of space debris, reinvigorating the opponents of weapons in space. Orbiting debris is dangerous, but the danger has been greatly exaggerated and is no reason for new unenforceable arms control agreements. When the space age began 50 years ago there were no man-made objects in space. Since then, Space Command has tracked more than 25,000 objects of baseball size or larger. More than 10,000 have fallen into the atmosphere and disintegrated or landed, but in 50 years not one person anywhere on Earth has been killed or injured by falling debris. Space debris is only slightly more likely to strike one of the 850 active spacecraft. Most are in low Earth orbit below about 800 miles. These operational spacecraft are only 6 percent of the objects tracked. The rest is space junk that includes inactive satellites, spent rockets, debris from exploding rockets and just plain trash. Space Command monitors debris to identify threats and alerts operators of satellites to move out of the way if they appear to be in danger. Some 80 percent of debris orbits between 500 and 600 miles altitude. The Chinese test, at 527 miles, created more debris right where traffic is heaviest. Air Force Space Command is tracking more than 1,000 pieces of debris from the Chinese test, plus 14,000 that were there before. So far, none has hit an active spacecraft. In fact, over the last 50 years there have been only three documented debris impacts with operational spacecraft, and none have been destroyed. A Space Command Web site describing the Space Surveillance Network that tracks debris notes there is only a small amount in the low orbits of the space shuttle and space station, and gives a worst-case estimate of 1 chance in 10,000 years of a piece of debris of baseball size or larger hitting either one. Even in the debris-heavy area around 500 miles altitude, Space Command says normally there are only three or four objects orbiting in an area equivalent to the airspace over the continental United States up to an altitude of 30,000 feet. Thus, it states, the likelihood of a collision is very small. Now there are reports U.S. intelligence agencies knew about and monitored Chinese preparations for the ASAT test, but senior administration officials decided to say nothing to deter Beijing in order to protect intelligence methods. That shows that despite the anguish about space debris the creation of more was not considered a serious danger. Most debris eventually migrates down and burns up in the atmosphere. The main efforts are to avoid existing debris, design spacecraft and rockets that will not explode in space, limit the release of debris on orbit, and at the end of their mission de-orbit satellites or move them to parking orbits where there is little traffic. The Inter-Agency Space Debris Coordination Committee (IADC) is an international governmental group that promotes good conduct in space. Most space-faring nations are members, including the United States, Russia, China and the European Space Agency, which together have created some 95 percent of space junk. The IADC was supposed to meet in Beijing in late April, but after creating a new debris field, China postponed the meeting until November. Now an earlier meeting at a new location is under consideration. It will be interesting to see if China explains its anti-satellite test. By conducting the test without advance notice to anyone, Beijing ignored the concerns of governments and commercial satellite operators alike, and violated a cardinal rule of the IADC by creating a lot of long-lived debris at a relatively high altitude. Though the danger is not as great as many believe, China's action has led to renewed calls for a ban on tests in space that might cause debris. That would be a mistake. Banning weapons or tests in space could adversely affect our ability to protect our armed forces on land and sea from satellite reconnaissance and targeting. ASAT technologies that do not cause debris are under development and need to be tested in space. China's aggressiveness in space and Russia's military resurgence may require us to develop new defensive weapons. We do not need another treaty that we honor while our adversaries do not. The IADC has adopted standard practices to mitigate orbital debris. China deliberately violated those standards. At the next IADC meeting the other space-faring nations should insist that China explain its actions and press Beijing to act more responsibly. They also should review the guidelines to see if they can be improved. Space debris is a problem, but it is manageable and should not be used to limit our freedom of action in space.

### Debris threat is massively exaggerated

The Washington Times 2007 (James Hackett, “Much ado about space debris”, Lexis)

China's deliberate destruction of one of its own satellites in a January test of an anti-satellite (ASAT) weapon has led to much hand-wringing about the creation of space debris, reinvigorating the opponents of weapons in space. Orbiting debris is dangerous, but the danger has been greatly exaggerated and is no reason for new unenforceable arms control agreements. When the space age began 50 years ago there were no man-made objects in space. Since then, Space Command has tracked more than 25,000 objects of baseball size or larger. More than 10,000 have fallen into the atmosphere and disintegrated or landed, but in 50 years not one person anywhere on Earth has been killed or injured by falling debris. Space debris is only slightly more likely to strike one of the 850 active spacecraft. Most are in low Earth orbit below about 800 miles. These operational spacecraft are only 6 percent of the objects tracked. The rest is space junk that includes inactive satellites, spent rockets, debris from exploding rockets and just plain trash. Space Command monitors debris to identify threats and alerts operators of satellites to move out of the way if they appear to be in danger. Some 80 percent of debris orbits between 500 and 600 miles altitude. The Chinese test, at 527 miles, created more debris right where traffic is heaviest. Air Force Space Command is tracking more than 1,000 pieces of debris from the Chinese test, plus 14,000 that were there before. So far, none has hit an active spacecraft. In fact, over the last 50 years there have been only three documented debris impacts with operational spacecraft, and none have been destroyed. A Space Command Web site describing the Space Surveillance Network that tracks debris notes there is only a small amount in the low orbits of the space shuttle and space station, and gives a worst-case estimate of 1 chance in 10,000 years of a piece of debris of baseball size or larger hitting either one. Even in the debris-heavy area around 500 miles altitude, Space Command says normally there are only three or four objects orbiting in an area equivalent to the airspace over the continental United States up to an altitude of 30,000 feet. Thus, it states, the likelihood of a collision is very small. Now there are reports U.S. intelligence agencies knew about and monitored Chinese preparations for the ASAT test, but senior administration officials decided to say nothing to deter Beijing in orderto protect intelligence methods. That shows that despite the anguish about space debris the creation of more was not considered a serious danger. Most debris eventually migrates down and burns up in the atmosphere. The main efforts are to avoid existing debris, design spacecraft and rockets that will not explode in space, limit the release of debris on orbit, and at the end of their mission de-orbit satellites or move them to parking orbits where there is little traffic.

## ----Ext. Space Debris Inevitable

Space Debris hitting satellites is inevitable

O’Neill 8 (Ian, Works for Discovery Channel’s Sci-Tech, “Space Debris May be Catastrophic to Future Missions,” <http://www.universetoday.com/12933/space-debris-may-be-catastrophic-to-future-missions-and-google-earth-is-watching/>, AD)

Even the most tightly controlled missions, such as the International Space Station, are expected to shed bits and pieces over the course of their lifetimes. Space junk comes in all shapes and sizes and can be anything from a small screw to entire dead satellites. Recorded examples of space junk include an old glove lost by Ed White during the first ever US space walk in 1965 (during the Gemini-4 mission), a camera that Michael Collins let slip in space in 1966 (during the Gemini-8 mission) and a pair of pliers that International Space Station astronaut Scott Parazynski dropped during an EVA last year.

## ----Ext. No Impact

No impact to space debris, other countries will fill in

David 11(Leonard, Space.com, “How to Clean Up Space Junk: DARPA's Orbital Catcher's Mitt,” <http://www.space.com/11657-space-junk-orbital-debris-cleanup-darpa.html>, AD)

Although space is not an ecosystem per se, the problem is dependent on the cumulative effects of human activity over and above the ability of the nature system to balance like any other environmental challenge," Pulliam said. Additionally, Pulliam advised that the constraints on finding an agreeable, cost-effective solution are remarkably similar to other current environmental issues. Specifically, the orbital debris problem can be characterized as a "tragedy of the commons." The problem can also be explained by what is called "common but differentiated responsibility," which is also seen in other worldwide environmental challenges such as chlorofluorocarbons (CFCs) and global warming, Pulliam pointed out. "It is likely new space-faring nations will make a similar argument if current mitigations efforts prove to be insufficient to forestall the deterioration of the low-Earth orbit environment and an international agreement on debris removal is required," Pulliam advised. There is a "therefore" to Pulliam's view: That is, if you are one that believes that debris has become a risk which will soon make operations difficult in low-Earth orbit, then a top-priority has to be in continued research into cost-effective methods to remove debris mass already in orbit. That's because this mass is what will cause the future growth in the debris population.