# Space Weaponization DA

## 1NC—Space Weaponization Link

### The plan is a Trojan Horse for space weaponization.

Karl Grossman, professor of journalism at the State University of New York/College at Old Westbury, February 5 2003, “Nukes-in-Space in Columbia's Wake”, http://www.space4peace.org/articles/columbiaswake.htm

Gagnon, coordinator of the Global Network Against Weapons and Nuclear Power in Space, warns that the process of manufacturing space nuclear power systems has had human health costs from the process of manufacturing and building more “will lead to significant numbers of workers and communities being contaminated.” He says: “Serious questions need to be asked: Where will they test the nuclear rocket? How much will it cost? What would be the impacts of a launch accident? These nuclearization of space plans are getting dangerous and out of control.” Also, Gagnon sees a military connection, describing the use of nuclear power in space as “the foot in the door, the Trojan horse, for the militarization of space.” Space weapons sought by the military--space-based lasers, hypervelocity guns and particle beams--would require large amounts of power which the military sees as coming from on-board nuclear power systems, thus the close cooperation between the Pentagon and NASA in space nuclear efforts. Dr. Dave Webb, who had been a scientist in the British space program and is now principal lecturer at the United Kingdom's Leeds Metropolitan University’s School of Engineering, and is also Global Network secretary, says, "Star Wars projects like the Space-Based Laser require significant sources of power and it is very useful for the U.S. government to be able to bury some of the costs for the development work in ‘civilian’ or ‘dual use’ programs.” This week, the Global Network was leading protests at the 11th Annual Symposium on Space Nuclear Power and Propulsion in Albuquerque, New Mexico. The gathering, organized by the University of New Mexico’s Institute for Nuclear Space Power Studies, drew NASA, nuclear industry, academic, government and military space nuclear proponents. Said Gagnon from New Mexico: “We’re not saying there shouldn’t be any space program. It’s a question of what kind of seed do we carry with us out into space.”

## Link Wall

### The plan will be used to hide the weaponization of space – increased plutonium production is key

Bruce K. Gagnon senior fellow at the Nuclear Policy Research Institute, where he also serves on her advisory board, co-founder and coordinator of the Global Network Against Weapons and Nuclear Power in Space, coordinator of the Global Network Against Weapons & Nuclear Power in Space, Jan 27, 2003, “Nuclear Power In Space And The Impact On Earth's Ecosystem” , http://www.spacedaily.com/news/nuclearspace-03b.html

Critics of NASA have long stated that in addition to potential health concerns from radiation exposure, the NASA space nukes initiative represents the Bush administration's covert move to develop power systems for space-based weapons such as lasers on satellites. The military has often stated that their planned lasers in space will require enormous power projection capability and that nuclear reactors in orbit are the only practical way of providing such power. The Global Network Against Weapons & Nuclear Power in Space maintains that just like missile defense is a Trojan horse for the Pentagon's real agenda for control and domination of space, NASA's nuclear rocket is a Trojan horse for the militarization of space. NASA's new chief, former Navy Secretary Sean O'Keefe said soon after Bush appointed him to head the space agency that, "I don't think we have a choice, I think it's imperative that we have a more direct association between the Defense Department and NASA. Technology has taken us to a point where you really can't differentiate between that which is purely military in application and those capabilities which are civil and commercial in nature."

### The plan results in space weaponization – it is dual use technology to cover the military’s end goal

Bruce Gagnon, senior fellow at the Nuclear Policy Research Institute, where he also serves on her advisory board, co-founder and coordinator of the Global Network Against Weapons and Nuclear Power in Space, coordinator of the Global Network Against Weapons & Nuclear Power in Space, March 10, 2005, “BBC NUKES IN SPACE STORY”, http://space4peace.blogspot.com/2005/03/bbc-nukes-in-space-story.html

The U.S. military has long stated that they need nuclear reactors in space to power weapons technologies in the future. NASA's past director, Sean O'Keefe (former Secretary of the nuclear Navy) has stated that every mission at NASA from now on will be "dual use," meaning that each mission will be testing civilian and military technologies at the same time. So then what is the military application of the nuclear rocket? Space News, an industry publication, ran a story on March 7, 2005 called NASA Asks Public To Comment on RTG-Powered Pluto Probe. In the article Bruce Gagnon was quoted as saying, "NASA is controlled by two entities today, the Pentagon and the nuclear industry. NASA just doesn't give a damn about the public's input." With that said, the danger of the planned dramatic increase in launches of nuclear devices in coming years should concern all of us. It will only take one accident, and a release of plutonium into the Earth atmosphere, to unleash severe health consequences globally. This is not some theoretical possibility, since the beginning of the space age, there have already been eight accidents with space nuclear power, some quite severe. (See the Global Network web site for a list of those accidents.)

# Solar Counterplan

## 1NC—Solar Propulsion Counterplan

### The United States federal government should develop and deploy space solar sails and solar power propulsion systems.

### Solar sails solve all of the aff while avoiding spending, politics, and nuclear accidents

Karl Grossman, professor of journalism at the State University of New York/College at Old Westbury, Summer 2002, Covert Action Quarterly Number 73, “Plutonium in Space (Again!), <http://www.space4peace.org/articles/morenukesinspace.htm>

"Firing nuclear material into space on the top of rockets subject to frequent failures is just asking for trouble," says Webb. "How long will it be before the residents of central Florida are subjected to a shower of nuclear debris from a launch that goes wrong? Historically there is about a 1-in-10 chance of a catastrophic accident during satellite launches. Who will cover the costs including the medical costs if things like that happen to a nuclear payload?" Webb, principal lecturer at the United Kingdoms Leeds Metropolitan University’s School of Engineering, also points to the solar option and stresses the use of solar energy on Rosetta by ESA of which the UK is part. [19](http://www.space4peace.org/articles/morenukesinspace.htm#19) A branch of NASA its Photovoltaics and Space Environment Branch headquartered at the John Glenn Research Center in Cleveland has, like ESA, been working at the cutting-edge of space solar energy development. The silicon solar cells "developed decades ago" which now power the International Space Station, notes NASA’s website, have 14.5% efficiency, and the branch is "exploring new ways to harness the Suns power - including more efficient solar cells, laser-beaming energy to distant spacecraft and solar power systems for the Moon and Mars." This includes solar systems for exploring and powering bases on Moon and Mars. [20](http://www.space4peace.org/articles/morenukesinspace.htm#20) NASA’s website includes detailed NASA plans such as "Photovoltaic Power for the Moon," [21](http://www.space4peace.org/articles/morenukesinspace.htm#21) "Power Systems for Bases and Rovers on Mars" [22](http://www.space4peace.org/articles/morenukesinspace.htm#22) and "A Solar Power System for an Early Mars Expedition." [23](http://www.space4peace.org/articles/morenukesinspace.htm#23) There is no "edge" or limit to solar power, says a solar scientist at the NASA branch, Dr. Geoffrey A. Landis. "In the long term, solar arrays wont have to rely on the Sun. We're investigating the concept of using lasers to beam photons to solar arrays. If you make a powerful-enough laser and can aim the beam, there really isn’t any edge of sunshine." [24](http://www.space4peace.org/articles/morenukesinspace.htm#24) Solar is also being developed to propel spacecraft. In solar electric propulsion, electricity collected by panels is concentrated and used to accelerate the movement of propellant out of a thrust chamber. NASA’s Deep Space 1 probe, launched in 1998, is the first space probe to be propelled with solar electric propulsion. [25](http://www.space4peace.org/articles/morenukesinspace.htm#25) Then there are "solar sails" making use of the ionized particles emitted by the Sun which constitute a force in space. [26](http://www.space4peace.org/articles/morenukesinspace.htm#26) They can be utilized just like wind by a sailboat on Earth. NASA’s Jet Propulsion Laboratory in California is considering a launch at the end of the decade of a space probe to Pluto using either solar sails or solar electric propulsion. [27](http://www.space4peace.org/articles/morenukesinspace.htm#27) A space device with solar sails built in Russia for the International Planetary Society, based in California and founded by the late astronomer Carl Sagan, was launched last year. Russia's Interfax news service noted that the "objective of the mission is to test the system for opening the paddles of an experimental transport vehicle, which looks like a giant windmill, using for the first time in space exploration solar wind for propulsion." [28](http://www.space4peace.org/articles/morenukesinspace.htm#28) Jack Dixon, for 30 years an aerospace engineer, takes issue with those against nuclear power in space for being critical of it for "politically correct," anti-nuclear reasons. His criticism is cost - what he says is an enormous cost. The solar sail system "may be implemented at about 10% of the cost of nuclear and quickly." It is "simple and relatively low tech." [29](http://www.space4peace.org/articles/morenukesinspace.htm#29)

## Solvency—General

### Solar power solves the aff—here’s our solvency advocate

Karl Grossman, professor of journalism at the State University of New York/College at Old Westbury, February 5 2003, “Nukes-in-Space in Columbia's Wake”, http://www.space4peace.org/articles/columbiaswake.htm

“Why on Earth,” asks Alice Slater, president of the New York-based Global Resource Action Center for the Environment and a Global Network board member, “would any sane person propose to take nuclear poisons to a whole new level?” “Nuclear power whether in space or on Earth is a risky business,” says Sally Light, long-time executive director of the anti-nuclear Nevada Desert Experience and also a Global Board member, “whether in space or on Earth is a risky business. Why is the U.S. blindly plunging ahead with such a potentially disastrous and outmoded concept? We should use solar-powered technologies as they are clean, safe and feasible." The comittment of huge amounts of money to the Nuclear Systems Initiatitive, now Project Prometheus, "is unconscionable. Did the people of Earth have a voice in this? One of the basic principles of democracy is that those affected have a determinative role in the decision-making process. We in the U.S. and people worldwide are faced with a dangerous, high-risk situation being forced on us and on our descendents.

## Solvency—Deep Exploration

### Solar sails fuel deep space exploration

Tariq Malik, 7/12/10 (Solar Sail Passes Big Test in Deep Space, Space.com, http://www.space.com/8748-solar-sail-passes-big-test-deep-space.html)

An unmanned probe riding a solar sail through space has felt its first accelerating push from sunlight in a successful test of its novel propulsion system, Japan's space agency has announced. Observations of the Ikaros solar sail built by the Japan Aerospace Exploration Agency (JAXA) confirmed that the spacecraft has received a growing speed boost from light radiated by the sun, the space agency said. "The small solar power sail demonstrator 'Ikaros,' which successfully deployed its solar sail, was confirmed to accelerate by [the] solar sail receiving solar pressure," JAXA officials said in a July 9 update.? "This proved that the Ikaros has generated the biggest acceleration through photon during interplanetary flight in history." Sailing on light JAXA engineers used Doppler radar measurements of the Ikaros craft to determine that sunlight is pressing on the probe's solar sail with a force of about 1.12 millinewtons (0.0002 pounds of force). "This is a significant milestone on their flight probably the next-to-last step before complete controlled solar sail flight is achieved (turning the spacecraft to add or subtract velocity in a controlled manner)," wrote Louis Freidman, co-founder of the California-based Planetary Society, in a message chronicling Ikaros' solar sailing success on the society's website. The Ikaros spacecraft weighs nearly 700 pounds (315 kg) has thin film solar cells built into its kite-like frame to generate electricity. The square-shaped Ikaros sail measures 46 feet (14 meters) wide and 66 feet (20 meters) diagonally. It is the first solar sail to actual fly on an interstellar mission. Solar sail milestone JAXA launched the solar sail Ikaros, short for Interplanetary Kite-craft Accelerated by Radiation Of the Sun, in May along with the Venus-bound orbiter Akatsuki (Japanese for "Dawn"). The Akatsuki orbit is due to arrive at Venus in December. The Planetary Society has been working to fly its own solar sail to demonstrate the space propulsion technology, as have NASA engineers. The Planetary Society is currently developing its next effort ?the LightSail 1 mission using a spare NASA solar sail. JAXA officials hope to follow Ikaros with an even more ambitious solar sailing mission, as well. Friedman said scientists have long-known that photons of light can push on spacecraft, but Ikaros is the first to attempt a true solar sailing flight. "The acceleration by sunlight pressure on spacecraft has been known about ever since the beginning of the space age. It is, however, a new proof of engineering ? harnessing the force of light pressure force to modify a sailcraft's path in a controlled way," Friedman wrote.

### Solar sails solve deep space exploration – fast and durable

Eric Drexler, 2011 (Solar Sails, http://www.nss.org/settlement/nasa/CoEvolutionBook/EDUC.HTML)

Solar sails are a way of moving things around in space, from one orbit to another. After a year's work, they are beginning to look like the best means of space transportation for a wide range of uses: they may be both cheap and fast. Before discussing clipper ships vs. canoes, however, we should first discuss boats and the ocean. Space is big It would take as many Earths to fill the solar system (500,000,000,000,000,000) as elephants to fill the sea (an unpleasant prospect). The Earth's orbit around the Sun is 23,000 times the Earth's circumference. Driving to the Moon (1/400 of the distance to the Sun) would take six months, at 55 mph of course. Driving to the nearest star would take 50,000,000 years, and so on. Space is Big. To get anywhere you have to go fast. But, you say, since there is no air resistance in space, perhaps a patient traveler (or load of freight) could start out slowly and simply take whatever time was needed, drifting along. But, alas, gravity is in control. Objects in space don't really go anywhere, if left to themselves; they simply go around in orbits. Unless you kick something so hard that it stops completely (in which case it falls into whatever it was orbiting) or kick it so hard in the other direction that it can fly away despite gravity, never to return, the object will simply grunt at the kick, and shift its orbit somewhat. To get from one orbit to another generally takes at least two pushes: the first to put the object onto an orbit that crosses the orbit you're trying to reach, and another at the crossing point, to make the object start following the orbit you want, instead of the transfer orbit that the first push put it on. Another way to do the same thing is to push gently for a long time, and slowly twist and stretch the first orbit until it matches the second. Either way, you can add up the change in velocity that all the pushing would produce, in the absence of gravity, play around with different directions and times of push, and find that the total velocity change needed has a minimum that can't be beaten for a given trip. This requirement is usually measured in kilometers per second (1 km/sec is about 2,200 mph). One of the lowest requirements of any interest is 2.4 km/sec: the velocity needed to get off the moon. Rockets have limits, because they must carry mass to throw away. A rocket can reach the same velocity as its exhaust fairly easily; not much fuel is needed to reach a few kilometers per second. The problem is that fuel has mass, just like the payload. Let's say you have a rocket with enough fuel to reach 1 km/sec, and to take a ton of payload with it. How much fuel would you need to reach 2 km/sec? Enough fuel to take the ton of payload to 1 km/sec, and enough fuel to take the fuel needed for the second km/sec to 1 km/sec. The total fuel mass needed turns out to increase exponentially with the velocity reached, just as population has been increasing exponentially with time. Both increases can gobble up more resources than you can afford to provide. Using the Saturn V moon rocket as a first stage, and piling up rockets from there, we could have reached 30 km/sec with enough payload to drop one haunch off an elephant into the Sun (an unpleasant prospect). Rockets burning chemical fuels run out of ability fast when measured against the solar system, although they were decent for getting us as far as the Moon. The exponential curve that gets rockets into trouble can be made less steep, however, if more energy can be put in the exhaust. This is the principle of the electric rocket; by soaking up solar energy in space and using it to throw small amounts of mass away fast (a mass driver is particularly efficient and versatile at this job), payloads may be pushed around the solar system in a reasonable way. The main problem is the cost and mass of the solar power plant. To use it efficiently accelerations must be low and trips long. Costs are also low: freight rates from Earth orbit to Mars orbit might be as little as $.20 per pound. Solar sails don't work on the rocket principle, but on light pressure. Like stage magic, this trick is all done with mirrors. Because E = mc2, energy, including light, has mass. For light in particular, that little bit of mass moves very fast through space; when it is bounced off a mirror it exerts a force, just like fast ping-pong balls bouncing off a wall. If you wanted that wall to move quickly, even without friction, you'd want it to have little mass and be hit by many ping-pong balls. Similarly, the mirror that makes up a solar sail should be very thin and lightweight, and have a large area - a square mile of reflected sunlight exerts enough force to support the weight, not of a building, not of a car, a person, or a large dog, but of a medium-sized cat. The name of the game, then, is to maximize acceleration by minimizing the mass per unit area of the mirror. People have looked at this problem, off and on, for about 20 years. They set themselves the problem of stuffing about a square mile of folded reflecting surface into the nose of a rocket, of launching it, and of making it unfold and stretch into a reasonably flat surface in space. A design for a kite-like sail, with thin, aluminized plastic film for the reflecting surface, has finally reached an advanced planning stage at the Jet Propulsion Laboratory in Pasadena, California. (See illustration on inside back cover.) Their design can accelerate at about 1/7,000 of a gravity, which is actually fairly good: the sail can reach 1 km/sec in about eight days. This lets you get around, and because it needs no fuel, and no fuel to help carry fuel, and so on, it doesn't peter out at high velocities like a rocket does. They want to use it to reach Halley's comet (an object which is going around the sun the wrong way compared to the Earth; a huge velocity is needed): the flight would take four years. They may not get to do it, because solar electric rockets, mentioned above, still look good by comparison (1/7000 of Earth's gravity isn't spectacular) and because these rockets have been sitting in everybody's "come on, let's do it" file for many years. They have seniority. Can solar sails be made better? The answer seems to be yes, if you forget about folding them up and launching them from the ground. I came to suspect this in the summer of 1976, and now, a year later, it looks as if it may be true: solar sails can be made in space, not as aluminized plastic sheet, but as aluminized nothing, which weighs far less. Designs now worked out on paper use aluminum foil as the reflecting surface, but foil 1/1000 the thickness of the kitchen kind. These sails are over 40 times as light, and therefore over 40 times as fast, as previous designs. This is spectacular. If I had to draw a sail today, it would be a hexagon about six miles across, and weighing 20 tons. This is somewhere between the size of Manhattan and San Francisco, but the metal of the sail could be wadded up to the size of a Volkswagen bug. They could be made both much larger and much smaller. The sail itself would be a spinning (to keep it taut) metal mesh with long, parallel strips of very thin metal foil glued to it. At regular intervals across the front, wires would come up, and be bundled to form groups, with each group having a wire coming from it, with these wires, in turn, bundled to form groups still farther in front of the sail. After this bundling and re-bundling has concentrated the load of light pressure on the sail enough (that's what the wires are for), shroud lines take the concentrated force to the payload (see drawing). The sail would be made on a large, lightweight framework, like a loom. Wires would be laid down, and fastened to each other where they crossed. As the wires go down, a device would travel back and forth, producing thin metal foil by vapor deposition on wax, vaporizing the wax for recycling, and laying the foil on the wire mesh. The whole process would take about six months; building the "loom" would require several flights of the Space Shuttle. Additional sails require about one flight apiece to provide needed raw materials. Eventually, sails would be built from extraterrestrial materials. What can you do with a solar sail? First, how can you "tack"? Boats can go in any direction by using both wind and water; solar sailing vessels can go in any direction by using both light pressure and the Sun's gravity. Light pressure on a mirror is always at right angles to the mirror's surface, even when the mirror tilts and bounces the light at an angle. As the mirror tilts towards being edge-on to the light, the force becomes smaller and approaches zero. This means that the mirror can collect some force in any direction that would take it farther from the light source, in this case the Sun. So how can a solar sail reach, say, Venus, which is closer to the Sun than Earth? By using light pressure to slow down in its orbit, then letting the Sun's gravity pull it in. Solar sails can go anywhere in the solar system, and, in the inner solar system (where we are), they can get there faster than almost anything proposed. The 20 ton solar sail mentioned above could take 180 tons of payload to any place in the solar system, stop (not orbit, but stop) and hang there on light pressure. With 800 tons of payload to slow it down, it would finally have the same acceleration as a plastic film sail with no load at all. With 6 tons of payload, it could fly to Pluto in one and a half years. Pioneer 11, launched over four years ago, won't reach Saturn until two years from now, and Saturn is only 1/3 the distance of Pluto. Rough cost estimates suggest that solar sails will cost between $.03 and 1/3 cent a square foot. Kitchen wrap costs about $ .01 a square foot. If nobody throws them out of the solar system, toasts them too close to the sun, or crashes them into something, they should last for thirty to three hundred years. Maintenance costs should be about nil (you don't fix the sail at all, and there are only about two dozen reels for the shroud lines to keep track of). Each sail, without fuel expenses, can cruise around the solar system almost indefinitely. While a rocket must be built differently for almost every mission, the same sail that flies from low Earth orbit to geosynchronous orbit and back can do a perfectly good job of flying twenty times the freight to the asteroid belt, out beyond Mars. Not only that, but the sail costs above, with 10% real rate of interest on capital, can give costs like $.10/lb for transportation around the solar system. And sailboats have always had little environmental impact.... How do (apparently) good ideas like this arise? Well, they never seem to be new. Solar sails are an old idea The literature even contains references to metal film solar sails, although not of the high performance discussed here. It even contains a reference to the idea of making the material in space. When I first had the idea, my reasons were not to seek high performance, but to try to make a sail out of metals, which are readily available in space. My background was oriented towards manufacture in space, towards materials properties, and towards vapor deposition. Previous workers concentrated on hauling sails up from the ground, but metal film sails are too delicate for that, so they were never studied. The few who considered making the films in space considered inappropriate manufacturing techniques, which either didn't work or produced films about 500 times as thick as optimum. Many questions come up about the new design: Can films be made that thin (thinner than a soap bubble )? Yes. Do they have decent strength? Yes, I've made some, and taken them from coast to coast in. my luggage. Are the films still reflective when so thin? Yes. Will fast moving atoms from the sun knock enough atoms from the film to destroy them quickly? No. Will this stream of atoms exert destructive forces on the sail during solar storms? No. Will electric charging or magnetic fields cause problems? No. Will the films be able to stand the temperatures they reach in the inner solar system? Yes. Will meteoroids destroy the films quickly enough to matter? No. Will they destroy the wire mesh that is the structure of the sail? No. Can the films be mass-produced in space at low cost? Yes How much does the device for making the films weigh ? It's manageable. What trajectories can the sails fly on? Name it. Could the sails possibly find use for near Earth transportation, as well as deep space? Maybe. Will the sails ripple under light pressure and gradually tear themselves apart? No. How well can the sails be turned to point where you want them to? Well enough. Will stresses from changing temperatures cause problems? No. And so on. Work of this kind never really stops until something has been built and running for a while and people take it for granted. Solar sails of this design have two things going for them: they have passed many tests, and no one has examined the idea and rejected it in the past. At the time of this writing, formal publication and widespread examination and criticism are about to take place. Time will tell, but the chances seem good that we're on to something interesting. How interesting? As interesting as cheap space transportation, free of fuels and complex maintenance. As interesting as moving Earth's industry into deep space and scattering her life to the Sun's light. Arthur Clarke said: "If man survives for as long as the least successful of the dinosaurs - those creatures whom we often deride as nature's failures - then we may be certain of this: For all but a vanishing instant near the dawn of history, the word 'ship' will mean - 'spaceship.' " And, those ships may yet have sails.

## Solvency—Asteroid Deflection

### Counterplan solves all possible asteroid missions

Paul Glister, 3/5/2007 (Solar Sail Mission to an Asteroid, http://www.centauri-dreams.org/?p=1096)

If you’re looking to shake out a solar sail design, a near-Earth asteroid (NEA) makes a tempting target. It’s relatively close and offers the opportunity of a landing and sample return. That helps us work out the age, evolution and other characteristics of a class of objects that are potentially dangerous to our planet. It’s no surprise, then, that when DLR, the German Aerospace Center, went into serious solar sail studies, it began to develop a dedicated mission via sail to one or more NEAs. That was in August of 2000, and it built on DLR’s successful ground deployment of a square solar sail 20 meters to the side the previous December, conducted in a simulated weightless environment (see below). The DLR design is a square sail with four triangular sail segments, a valuable proof of concept in a time when little budgetary emphasis is being placed on sail designs by any of the major space agencies. For the asteroid mission, DLR now ponders a larger sail. Bernd Dachwald and colleagues, writing from DLR’s Institute of Space Simulation, provide an overview of such a sail in a recent paper, saying “…we consider a (70 m)² solar sail with a speciﬁc weight of about 20 g/m² to be a realistic, however still ambitious, near-term development goal.” Using such a craft, the authors believe it possible to return a sample from the NEA 1996FG3 within ten years of launch. The spacecraft would hold a payload of 300 kg including lander and return capsule (but excluding the sail assembly). This mission, tagged ENEAS by its designers, focuses on 1996FG3 because of its scientific interest as well as its relatively accessible orbit. This NEA is a binary, with the primary body 1.4 kilometers in diameter and the secondary about a third of that. Getting to it involves, for the sake of time, a direct insertion into an interplanetary trajectory, after which the sail is deployed and oriented to follow the mission profile. At the NEA, the craft will hover in the hemisphere opposite the Sun, studying its gravitational field and deploying the lander and integrated return capsule. A number of mission profiles are possible with this technology depending on the size of the sail and payload, with multiple NEA rendezvous and sample return missions analyzed in the paper. The authors also weigh against the sail design the possibility of using NASA’s NSTAR ion thrusters, noting that the ion option is faster but leads to larger launch costs. If the cost of longer ground operations is lower than the savings in launch cost, and if “…the mission duration plays a subordinate role with respect to cost,” the solar sail might prove to be the better option. But here’s a key point, noted by the authors in their conclusion. No matter what the cost relationship turns out to be, “…on the way to more advanced solar sailcraft, as they are required for high-ΔV missions, the development of solar sails with moderate performance is an indispensable ﬁrst stepping stone.” Because we need to gain experience with this technology just as we’re building the needed data on ion thrusters through missions like DAWN and SMART-1. So the solar sail asteroid rendezvous comes with powerful incentives.

### Solar Sails provide the best means of asteroid deflection

Vieru, 12/23/10 (Solar Sails Could Deter Asteroids, <http://news.softpedia.com/news/Solar-Sails-Could-Deter-Asteroids-174434.shtml>)

According to a proposal made earlier this year at a scientific conference, it may be that one of the most effective ways of changing the path of dangerous asteroids that may beheading our way would be to deploy solar sails to nudge them off-course. On May 21 of this year, the Japanese Aerospace Exploration Agency (JAXA) launched the Akatsuki Venus climate orbiter, a spacecraft that eventually overshot its target and failed to reach orbit. Also on the H-IIA delivery system that launched the satellite was the IKAROS solar sail demonstrator, which became the first ever to show beyond a doubt that it's possible to move forward and steer in space using nothing by sunlight. Now that we know solar sail technology is viable, experts are beginning to think of possible uses for it beyond powering spacecraft. They say that diverting asteroids might also be on the table. Scientists participating at a solar sail symposium held at the New York City College of Technology in Brooklyn some months ago said that the new approach could be used against the asteroid Apophis, which will pass very close to our planet on April 13, 2036. At this point, there is no reason to believe that the rock will slam into our planet, but astronomers say that the asteroid will pass too close for their comfort. As such, shading the space rock from solar radiation with sails could be applied here. However, there are those who believe that messing about with the asteroid might make its approach even more dangerous than it is now. But the French expert who proposed the mission at the meeting says that using solar sails poses no threat. “Apophis is a nice target for launching this kind of mission for 20 years from now; not too far, not too close,” says National Center for Space Study (CNES) engineer Jean-Yves Prado. He explains that the path the asteroid takes could be influenced by a flotilla of solar sail spacecraft, which would eliminate the Yarkovsky effect on the space rocks. The effect was discovered about 100 years ago, by Russian engineer I.O. Yarkovsky, and it takes place when the Sun warms a space rock more on one side than the other, Space reports. As his happens, the asteroid begins emitting thermal radiation, which produces a little bit of thrust. Its momentum is then slightly changed, as is its trajectory. If solar sails block solar radiation, then there would be no Yarkovsky effect, and the asteroid would leave its current trajectory. Given the time we have until Aphophis comes, this should be easy to do. “It's really a very small effect and doesn't apply to very small asteroids because the temperature would be quite negligible, so thrust is negligible,” Prado says. “It also does not apply to very large asteroids because they are too heavy,” he goes on to say, adding that Apophis is right in the middle category, meaning the effect influences it considerably.

## Solvency—Asteroid Mining

### Solar sails best for asteroids – multiple reasons.

Esther Morrow ET AL, D.J. Scheeres, Dan Lubin, 2001 (Universit of California, San Diego; University of Michigan; University of California, San Diego. Solar Sail Orbit Operations at Asteroids. Journal of Spacecraft and Rockets. <http://www-personal.umich.edu/~scheeres/reprints/JSR_solar-sail.pdf>)

We have shown that both hovering and orbital options are available with a solar sail spacecraft operating in close proximity to a spherical asteroid in a circular orbit. There are a continuum of hovering positions available near the asteroid. These hovering points depend on sail attitude, asteroid mass, and the acceleration of the sail. For a given distance from the asteroid and sail acceleration, the sail attitude can be determined to maintain that position for extended periods of time. It has also been shown that several orbital options are available that offer good coverage of the asteroid and that neither impact the surface nor escape. These orbits are stable and sun synchronous. A sail could maintain orbit for extended periods of time in such an orbit. Some asteroids (such as Eros) require small sail accelerations for orbital operations to be feasible. In such cases as these, where it may be necessary to reduce the sail acceleration, we can make adjustments with trims in the sail area. With the possible exception of spin-stabilized sails, the deployment mechanism could be reversed so that the sail could be partially refurled. In this way we could decrease the sail area and thereby decrease sail acceleration ( ap ), making orbital operations about smaller asteroids possible. Solar sails offer the advantage that long-duration missions can be planned, visiting several solar system objects, without the spacecraft mass and complexity involved with conventional propulsion and fuel supply. For example, after one asteroid has been investigated, the spacecraft is capable of escaping from orbit, in principle under sail propulsion alone, and traveling to another asteroid or returning to Earth. This capability offers the potential for low-cost and flexible solar system exploration.

### Solar power makes asteroid mining feasible.

Dr. Daniel D. Durda, 2006 (The Solar System beckons with resources unimaginable on Earth, <http://www.nss.org/adastra/volume18/durda.html>)

The near-Earth asteroids (NEAs) represent a vast and, as yet, untapped reservoir of mineral resources for in-space use as we expand the human presence beyond low-Earth orbit. About half the NEAs are made up of the same materials as a typical rocky meteorite. These contain small flakes of nickel-iron alloys and platinum group metals in much greater abundance than typical rocks from the Earth's crust. Most of the rest of the NEA population resembles the carbonaceous meteorites and contain a higher fraction of water and carbon-containing minerals. A little less than 10 percent of the NEAs are essentially massive mountains of nearly pure iron and nickel. All of the NEAs represent a resource smorgasbord far richer than the lunar regolith, the bleak soil on the Moon, another favorite target for future off-world mining operations. The question before us here is: Could we mine a small NEA right now and actually make use of some of this mineral wealth? That is, assuming that the operational and economic infrastructure were now in place and required the in-space utilization of materials mined from small asteroids, do the techniques and technologies exist that would allow us to do so? If not, what do we still need to do and to learn in order to make asteroid mining a reality? The answers to these questions also bear directly on the closely related requirements for preventing the impact of a threatening asteroid. Let's first look at the environment that exists on and around small NEAs before considering the technological requirements for harvesting their mineral riches. Planetary scientists estimate that there are some 1,100 asteroids larger than a kilometer in diameter. Smaller, football-field-size objects are much more numerous—more than 100,000 of them orbit the Sun in near-Earth space (although at present we have catalogued only a few percent of them). Objects so small exert only a feeble gravitational pull befitting their diminutive stature. The surface gravity of even a modest-size kilometer-diameter rocky asteroid is only of order 1/30,000 of a g. It is in fact the negligible surface gravity of these objects that makes them such attractive targets for future mining activities; the materials mined from their surface need not be lifted back out of a deep gravity well in order to be delivered to the places where the resources are needed. But this low gravity can cause serious operational challenges as well. Simply moving around in the close vicinity of a lumpy and potentially rapidly rotating or tumbling NEA can be counterintuitive. Rather than orbiting the smallest asteroids, oilplatform-like equivalents of future mining factories may instead "station keep" in close proximity, rather like a Space Shuttle orbiter maneuvering around the International Space Station. Human and robotic mining engineers moving about along the surface will similarly need their own on-board and very capable navigation systems for the real-time trajectory calculations necessary in simply moving from point A to point B. The difficulties faced by the Hayabusa mission in trying to simply "drop" the tiny MINERVA rover onto the surface of the 500-meter-diameter asteroid Itokawa show that we still have some work to do in even this most basic area of mining operations. Once finally on an asteroid's debris-strewn surface, fine dust—easily motivated in the milli-g environment—will likely be a problem. Electrostatic charging now becomes a dominant force on dust particles, causing them to adhere to just about anything, the fine workings of mining equipment included. And once it is there you can't simply brush it away. Apollo 16 Commander John Young doesn't mince words when describing what he sees as one of the most serious concerns for future lunar explorers, and the same goes for asteroids as well: "When people talk about long-duration operations on the Moon, the thing they better worry about is the dust." Now, how do we actually go about mineral mining in such an environment? First, we have to get there! Today, we can obviously travel to and even "land" on asteroids, but real mining operations are going to require much more massive and expansive spacecraft operations than NASA's NEAR-Shoemaker mission or Japan's Hayabusa. Ion propulsion allowing for sustained and highly efficient operations will be essential if we decide we'd like to move a particularly attractive (or threatening) asteroid into a more accessible orbit. The nuclear electric propulsion technology that NASA was pursuing through the Prometheus program was a very promising move in the right direction, but, unfortunately, that program has been abandoned for now. Although certainly challenging, Prometheus required no extraordinary technological stretch. Revamping something like that program will simply require the political and financial will to do it. What about power to run the operation? No problem! Solar power is a practical and abundant option in near-Earth space. And of course, if you're moving about the Solar System in nuclear fission-powered spacecraft, you have a lot of power to spare coming along for the ride. Affixing or docking to the surface of a small asteroid in order to actually dig into its regolith or drill into its bedrock, may be easier said than done. And the methods that work for one object may not work at all for another. Harpoons or penetrators may be a tractable option for objects with porous but cohesive surfaces. Electromagnet pads might just work on the iron-rich asteroids. If we pick very small asteroids, our mining facility may not even "land" on the object at all—the rock could be swallowed whole by the spacecraft itself and mechanically and chemically digested for its resources. That, of course, is a technology yet to be demonstrated for large-scale, in situ operations. So, are we ready? Could we mine an asteroid today? Clearly the answer is "no." Our autonomous robotic capabilities are not yet developed enough to allow it (we don't even have the capabilities to do so in a fully autonomous manner here on Earth), and we're still at least a decade away from returning people to the Moon. But as soon as the scale of our operations in space reach a point where it becomes more economical to obtain and use mineral resources there rather than delivering them from deep in the Earth's gravity well, we'll be off and mining the most attractive resources out there—the asteroids.

## NASA Investing In Solar Now

### NASA is investing in solar propulsion

Space Media Network, 2011 (NASA Issues Announcement For Solar Electric Propulsion Studies, Staff Writers, http://www.spacetravel.com/reports/NASA\_Issues\_Announcement\_For\_Solar\_Electric\_Propulsion\_Studies\_999.html)

NASA issued a Broad Agency Announcement (BAA) seeking proposals for mission concept studies of a solar electric propulsion system demonstration to test and validate key capabilities and technologies for future exploration missions. Multiple studies have shown the advantages of using solar electric propulsion to efficiently transport heavy payloads from low Earth orbit to higher orbits. This concept enables the delivery of payloads to low Earth orbit via conventional chemical rockets. The use of solar electric propulsion could then spiral payloads out to higher energy orbits, including Lagrange point one, a potential assembly point in space between Earth and the moon. This approach could facilitate missions to near Earth asteroids and other destinations in deep space. Science missions could use solar electric propulsion to reach distant regions of the solar system, and commercial missions could use solar electric propulsion tugs to place, service, resupply, reposition and salvage space assets. NASA's strategic roadmaps for exploration, science and advanced technology all consider solar electric propulsion a vital and necessary future capability. NASA is examining potential mission concepts for a high-power solar electric propulsion system demonstration. Flying a demonstration mission on a representative trajectory through the Van Allen radiation belts and operating in actual space environments could reveal unknown systems-level and operational issues. Mission data will lower the technical and cost risk associated with future solar electric propulsion spacecraft. The flight demonstration mission would test and validate key capabilities and technologies required for future exploration elements such as a 300 kilowatt solar electric transfer vehicle. This Solar Electric Propulsion Demonstration Mission Concept Studies announcement is open to all non-government United States institutions, academia, industry and nonprofit organizations. NASA anticipates making multiple firm-fixed-priced awards with a total value up to $2 million. The deadline for submitting proposals is July 18.

## EU Investing In Solar Now

### EU is creating the tech now for effective Solar Sails

Karl Grossman, professor of journalism at the State University of New York/College at Old Westbury, February 5 2003, “Nukes-in-Space in Columbia's Wake”, http://www.space4peace.org/articles/columbiaswake.htm

The Nuclear Systems Initiative, or, as it is now to be called, Project Prometheus, would be pushed as scientists in the European Space Agency--ESA, the European counterpart of NASA--and in space industry and at NASA itself have made breakthroughs in developing safer ways of propelling rockets and energizing space probes and planetary landers. This includes solar electric propulsion and the use of “solar sails” and other solar technologies that stress the generation of electricity with new high-efficiency solar cells.

# Accidents DA

## 1NC—Nuclear Accidents DA

### **Nuclear propulsion risks malfunctions and nuclear fallout**

Bruce Tyson, 4/08/11 (Russia and US plan talks on new nuclear spacecraft, Helium, Inc., http://www.helium.com/items/2133329-russia-and-us-plan-talks-on-new-nuclear-spacecraft)

Space travel requires an enormous amount of energy to sustain spacecraft during increasingly lengthy journeys that will eventually take them to the outermost regions of the universe. In search of a way to power future space journey the United States and Russia are meeting to discuss the use of nuclear power. Hoping to work together on the project engineers from both countries will share their ideas to see if safe and practical nuclear power can be used in spacecraft. Although military use of nuclear power has proven safe and reliable, the technology has never been used in space and therefore raises obvious concerns. For example, if a nuclear –powered space craft should malfunction on liftoff, the impact on the world could prove to be disastrous. Similarly, there are questions to be addressed when it comes to nuclear fallout in space which could prove disastrous to humans and equipment. The Register says that all nations with well-developed manufacturing sectors are sought as partners in the endeavor, meaning Japan, Britain, France, China and Russia. For its part, Russia has already said that it wants to roll out its design for a nuclear space engine by the end of 2012. The engine would be used for power and propulsion simultaneously, creating new challenges. The register story says that nuclear power appears to be the only option to traditional rockets for lift-off, although nuclear ion or plasma-based solutions are expected to work better for propulsion after spacecraft are in orbit. Although some space-based nuclear projects have already been deployed, they have been relatively small. The Register says that radioisotope power is currently used in an array of satellites and will be used in future space rovers. NASA experience has shown that solar powered machines such as the Mars rovers cannot move very far with only solar power. In spite of the emerging plans Russia has for nuclear propulsion in space, it may be redundant, seeing that NASA reportedly has completed plans of its own. Regarding the joint initiative, the Register appears to be skeptical, making the inference that Russia’s inability to finance such a project on its own is the factor that drives its desire for an international partnership in the endeavor. Perhaps one of the greatest lessons of the Russian – US collaboration in nuclear power is that solar power does not have the potential to create enough energy to power the developed world. Just as space projects appear poised to abandon solar power; developed western nations that have pinned al future hopes on solar and wind energy may ultimately discover that the only way to fuel the future is with safe implementations of nuclear energy.

## Link Wall

### The launch increases the risk of nuclear accidents linearly

Bruce K. Gagnon senior fellow at the Nuclear Policy Research Institute, where he also serves on her advisory board, co-founder and coordinator of the Global Network Against Weapons and Nuclear Power in Space, coordinator of the Global Network Against Weapons & Nuclear Power in Space, Jan 27, 2003, “Nuclear Power In Space And The Impact On Earth's Ecosystem” , http://www.spacedaily.com/news/nuclearspace-03b.html

Ultimately NASA envisions mining colonies on the Moon, Mars, and asteroids that would be powered by nuclear reactors. All of the above missions would be launched from the Kennedy Space Center in Florida on rockets with a historic 10% failure rate. By dramatically increasing the numbers of nuclear launches NASA also dramatically increases the chances of accident.

### Prefer our links – their authors make up numbers to justify their projects

Joseph J. MacAvoy, received his A.B. in Astrophysics from Princeton University in 2001, and expects to receive his Juris Doctor and Master of Public Policy Degrees from the College of William and Mary in 2005, 2004, Nuclear Space and the Earth Environment: The Benefits, Dangers, and Legality of Nuclear Power and Propulsion in Outer Space, 29 Wm. & Mary Envtl. L. & Pol'y Rev. 191 (2004), http://scholarship.law.wm.edu/wmelpr/vol29/iss1/6

In its risk assessment for the Cassini mission, NASA estimated that the likelihood of cancer fatalities due to the launch were one in one hundred thousand.182 It also estimated that the likelihood of cancer fatalities due to an accidental re-entry was one in one million.83 However, these statistics have been disputed by critics. "'I find that NASA bureaucrats in some sense are living in Fantasyland', says Michio Kaku, a physics professor at City University of New York. 'Pure guesswork has replaced rigorous physics. Many of these numbers are simply made up."84 Bruce Gagnon of the Global Network Against Weapons and Nuclear Power in Space noted that "[w]hen you look at the average failure rate for rockets, eventually, you are going to have a problem."85 Others have used the space shuttle Columbia tragedy in Texas to illustrate the strong possibility of an accident.86 "I think the [Columbia] tragedy definitely raises legitimate questions about the technical risks associated with the current space program," said Edwin Lyman, the head of the Nuclear Control Institute, "and should give anyone pause before we continue to expand nuclear capabilities in space."1 87

## Impact

### Accidents turn the case – collapses the whole space program

Karl Grossman, professor of journalism at the State University of New York/College at Old Westbury, February 5 2003, “Nukes-in-Space in Columbia's Wake”, http://www.space4peace.org/articles/columbiaswake.htm

In contrast, NASA’s renewed emphasis on nuclear power in space “is not only dangerous but politically unwise,” says Dr. Michio Kaku, professor of theoretical physics at the City University of New York and author of best-selling books including "Hyperspace." “The only thing that can kill the U.S. space program is a nuclear disaster. The American people will not tolerate a Chernobyl in the sky. That would doom the space program.” “NASA hasn’t learned its lesson from its history involving space nuclear power,” says Kaku, “and a hallmark of science is that you learn from previous mistakes. NASA doggedly pursues its fantasy of nuclear power in space. We have to save NASA from itself.” He cites “alternatives” space nuclear power. “Some of these alternatives may delay the space program a bit. But the planets are not going to go away. What’s the rush? I’d rather explore the universe slower than not at all if there is a nuclear disaster.” Dr. Ross McCluney, a former NASA scientist now principal research scientist at the Florida Solar Energy Center, says NASA’s push for the use of nuclear power in space is “an example of tunnel vision, focusing too narrowly on what appears to be a good engineering solution but not on the longer-term human and environmental risks and the law of unintended consequences. You think you’re in control of everything and then things happen beyond your control. If your project is inherently benign, an unexpected error can be tolerated. But when you have at your project’s core something inherently dangerous, then the consequences of unexpected failures can be great.”

# Politics Links

## Plan Unpopular—General

### Nuclear propulsion unpopular – perceived as a move towards weaponization. Also costly and empirically fails.

Peter Pae, 2/07/2002 (NASA Seeks $1 Billion for Nuclear Propulsion Plan. Aerospace: Space agency will take a new look at developing technology, which foes fear would be used by military. TIMES STAFF WRITER)

After a 30-year hiatus, government rocket scientists want to resurrect efforts to design a nuclear-powered propulsion system, a controversial concept crucial to any program for human exploration of the solar system. A $125-million initiative for developing the technology, which has frustrated scientists and engineers since the 1950s, was quietly inserted into the proposed fiscal 2003 NASA budget, which was unveiled this week. The space agency's plan calls for a $1-billion program over five years, a project that would include significant roles for the Jet Propulsion Laboratory in Pasadena, Glenn Research Center in Cleveland and Marshall Space Flight Center in Huntsville, Ala. The agency spent 13 years and more than $10 billion before concluding that the technology was not technically feasible and abandoned the effort in 1972. NASA scientists now hope that advances in nuclear reactors and rocket propulsion systems as well as lessons learned from past failures will give the quest for a nuclear rocket new life in the 21st century. Such spaceships would have small nuclear reactors, which would give the engines greater thrust and virtually unlimited fuel supply to travel to the farthest reaches of the solar system. Using nuclear technology would in theory slash a trip to Mars and back by more than half from about two years to less than a year, for instance, and alleviate lingering concerns with the health effects of long-duration space travel, NASA officials said. Astronauts who occupied the former Soviet operated Mir space station for months at a time suffered from muscle atrophy, bone loss and other crippling effects of prolonged exposure to micro gravity. With nuclear power, "missions will be able to speed through the outer reaches of the solar system, at speeds as much as two times faster than is possible even with the most sophisticated space probes available today," NASA officials said in its budget proposal. The technology will "allow NASA to consider more ambitious possibilities involving missions that could travel from one interesting planet, moon or comet to another for a close-up, in-depth study." The proposed initiative was lauded by astronauts and astronomers but slammed by antinuclear activists. "We welcome the proposal to develop nuclear power and propulsion technology to make the entire solar system more accessible with much shorter flight-times and more powerful investigations of the planets," said Wesley T. Huntress Jr., president of the Planetary Society. "These developments will revolutionize space exploration in the same way that the Navy was revolutionized by nuclear power." But Bruce Gagnon, secretary for the Global Network Against Weapons & Nuclear Power in Space, said that in addition to potential health concerns from radiation exposure, the NASA initiative represents the Bush administration's covert move to develop power systems for space-based weapons such as lasers on satellites. "It's our position that just like missile defense is a Trojan horse for the Pentagon's real agenda for domination of space, NASA's nuclear rocket is a Trojan horse for militarization of space," Gagnon said. Donald Savage, a NASA spokesman, dismissed the argument. "This is a solar system exploration program," he said. "This is a scientific program and that's what we are involved in." Still, sensitive to the criticism and safety concerns, NASA officials stressed that the nuclear propulsion systems envisioned by the agency would be used only for traveling through space outside Earth's orbit. They would not be used for launching rockets into space. In one possible scenario, the spacecraft would be assembled in space and the reactors would be turned on only after leaving Earth's orbit. The reactor and other components would be ferried into space by conventional rockets that use chemicals such as hydrogen and oxygen for combustion. Under the so-called Nuclear Systems Initiative, NASA proposes funding three programs including developing nuclear power systems to power on-board equipment such as sensors to survey planets and instruments to control the craft and communicate with Earth. Another major element would be to develop a nuclear propulsion system that would use a small nuclear reactor to generate electricity and propel ionized or plasma gas out of the rocket nozzle to provide thrust. The reactor would produce enough heat to generate electricity and ionized gas. One advantage of a nuclear propulsion system is that it can generate significantly more energy for almost unlimited duration compared with a conventional chemical combustion engine. A soft-drink can full of uranium, for instance, yields 50 times the energy contained in the Space Shuttle's massive external tank, according to NASA. The reactor would be co-developed with the Department of Energy, which has been looking for ways to maintain its know-how in nuclear power.

## Plan Unpopular—Public

### The plan is unpopular with the public

Karl Grossman, professor of journalism at the State University of New York/College at Old Westbury, June 10, 2010 , “Obama Brings Back Space Nuclear Power”, http://karlgrossman.blogspot.com/2010/06/obama-administration-in-new-push-for.html

Bolden, a former astronaut and U.S. Marine Corps major general, spoke in the May 24th address, of work by another ex-astronaut, Franklin Chang-Diaz, on a nuclear-propelled rocket. “Chang-Diaz is developing what’s called a VASIMIR rocket,” said Bolden. “It’s an ion engine, very gentle impulse that just pushes you forever, constantly accelerating. And this, theoretically, is something that would enable us to go from Earth to Mars in a matter of some time significantly less than it takes us now.” But, he said, “most people…in the United States are never going to agree to allow nuclear rockets to launch things from Earth.” Yet “once you get into space, you know, if we can convince people that we can contain it and not put masses of people in jeopardy, nuclear propulsion for in-space propulsion” would enable a faster trip to Mars. He said, “You don’t want to have to take eight months to go from Earth orbit to Mars.”

## Plan Popular—Nelson

### Plan is popular with Nelson

Karl Grossman, professor of journalism at the State University of New York/College at Old Westbury, June 10, 2010 , “Obama Brings Back Space Nuclear Power”, http://karlgrossman.blogspot.com/2010/06/obama-administration-in-new-push-for.html

“And by 2025,” Obama said, “we expect new spacecraft designed for long journeys to allow us to begin the first-ever crewed missions beyond the Moon into deep space. So we’ll start—we’ll start by sending astronauts to an asteroid for the first time in history. By the mid-2030s, I believe we can send humans to orbit Mars.” “I want to repeat this,” Obama asserted. “Critical to deep space exploration will be the development of breakthrough propulsion systems and other advanced technologies.” With Obama on the platform was U.S. Senator Bill Nelson of Florida—who he introduced at the start of his speech. Nelson in 1986 was a passenger on the space shuttle (before the 1986 Challenger disaster ended the shuttle passenger program) and he is a member of Senate Science and Transportation Committee. Although Obama was not specific on the kind of spacecraft he envisioned for trips to Mars, later that day on “Hardball With Chris Matthews” on MSNBC, Nelson was—and it was Chang-Diaz’s nuclear rocket. “One of my crewmates,” said Nelson, speaking of former astronaut Chang-Diaz who was with him on the 1986 shuttle flight, “is developing a plasma rocket that would take us to Mars in 39 days.” The object of Administrator Bolden and Senator Nelson’s technical affections, Chang-Diaz, a Costa Rican-native, the first naturalized U.S. citizen to become a U.S. astronaut, founded the Ad Astra Rocket Company after retiring from NASA in 2005. He is its president and CEO. In an interview with Seed.com last year, he said the engine for his VASIMIR (for Variable Specific Impulse Magnetoplasma Rocket) could work with solar power. The engine uses plasma gas heated by electric current to extremely high temperatures. But larger versions are needed for space travel and they require nuclear power, said Chang-Diaz. “What we really need is nuclear power to generate electricity in space. If we don’t develop it, we might as well quit, because we’re not going to go very far. Nuclear power is central to any robust and realistic human exploration of space. People don’t really talk about this at NASA. Everybody is still avoiding facing this because of widespread anti-nuclear sentiment.” “People have fears of nuclear power in space,” continued Chang-Diaz, “but it’s a fear that isn’t really based on any organized and clear assessment of the true risks and costs.”

## Plan Popular—Nuclear Lobby

### Plan is popular with the nuclear lobby

Karl Grossman, professor of journalism at the State University of New York/College at Old Westbury, June 10, 2010 , “Obama Brings Back Space Nuclear Power”, http://karlgrossman.blogspot.com/2010/06/obama-administration-in-new-push-for.html

Comments Bruce Gagnon, coordinator of the Global Network Against Weapons & Nuclear Power in Space: “Despite claims that ‘new’ and innovative technologies are under development at NASA, the story remains much the same—push nuclear power applications for future space missions. Obama is proving to be a major proponent of expansion of nuclear power—both here on Earth and in space. His ‘trip to an asteroid and missions to Mars’ plan appears to be about reviving the role of nuclear power in space. The nuclear industry must be cheering.”

# Case Materials

## 1NC—Solvency Frontline

### Nuclear propulsion limited by size, radioactivity, and production capabilities.

The Millennial Project, 2011 (Plasma and Fusion Propulsion, http://tmp2.wikia.com/wiki/Plasma\_and\_Fusion\_Propulsion)

Though it may always have some role, particularly in surface transport applications, the days of the chemical rocket as a primary means of propulsion in space are numbered. By the time of Asgard a variety of alternative propulsion technologies may likely be in use, based primarily on a quest to increase ISP or ‘specific impulse’ while simplifying the handling and management of propellants. Today, the most likely of general purpose alternative rocket propulsion technologies is plasma propulsion, which evolved from the ion propulsion used for satellite attitude control and which will set down a path of evolution ultimately culminating in the anti-matter propulsion envisioned by Marshal Savage. Plasma propulsion is based on ionizing a propellant and accelerating and directing the resulting plume of charged molecules as thrust with electrostatic and magnetic fields –an advance over ion propulsion that performs the same operation primarily with electrostatic repulsion. Specific impulse of such rockets is extremely great, the chief advantage of plasma propulsion over earlier ionic propulsion being that much larger volumes of propellant can be accelerated –so much so that plasma ‘jets’ have been considered as the basis of propulsion for some forms of very high altitude terrestrial aircraft. The very high ISP of such rockets affords high potential velocities for a spacecraft but even with their increased thrust volume they are still far lower in this volume than chemical rockets and thus long acceleration periods of continuous thrust are required to overcome the inertia of a large vessel. Also, a continuous supply of high voltage electric power is needed to operate such rockets. But despite these limitations, plasma propulsion is generally considered superior to chemical rockets for trans-orbital travel because their high ISP can radically reduce net transit times, engines are simpler, more solid-state, lower mass, more reliable, finely tunable, and able to be switched on and off frequently, and because a wide variety of non-explosive propellants can be used. Early in the Asgard phase both chemical rockets and plasma rockets will likely co-exist, the former preferred for shorter distant transit and the latter for interplanetary and asteroid missions. Plasma propulsion use will likely steadily increase across the Asgard phase but from mid to late in the Asgard phase it may be supplanted by another derivative of similar engine technology; fusion propulsion. Similar in basic configuration, fusion rockets will be based on the generation of an ionized plasma magnetically confined to the point of nuclear fusion with the resulting explosively-powerful fusion plasma and charged particle ejecta directed as thrust. This will afford both the extremely high ISPs of plasma rockets with great thrust volume while also allowing the engines to generate their own power during operation. Though much more limited in potential range of propellants –the technology likely favoring hydrogen isotopes just like speculated fusion reactors– fusion propulsion would potentially become a workhorse form of propulsion for most space vehicles. Other forms of nuclear propulsion are likely to explored over the Asgard phase but will tend to be hampered by the problems of producing, handling, and disposing of highly radioactive materials as well as large radiation shielding masses. Though early fusion propulsion engines would likely be massive owing to the need for large super-conducting magnetic field arrays, radiation shielding would be much reduced over other forms of nuclear propulsion owing to the greater control over the fusion reaction. Over time this control may become so refined that fusion engines may be capable of ‘fusion lasing’ –effectively acting in the manner of an optical laser that precisely outputs energy in very specific forms along very specific vectors. (a long pursued goal of nuclear research today once attributed to the concept of orbital X-ray laser weapons) Such capability would radically reduce the mass of fusion engines while greatly increasing their safety and reducing issues of ‘charged particle pollution’ limiting the proximity of vehicles to habitats during engine use. Some time from late in the Asgard period into the Solaria phase fusion propulsion may see its evolution into its ultimate form; anti-matter reaction propulsion. Again based on very similar configurations and components and, again, based on magnetic confinement as a basis of control, anti-matter propulsion would employ stored anti-matter as fuel reacting with an inert propellant. Function would be essentially the same as any fusion engine but with power on a tremendous new scale that would vastly shorten travel times across the solar system and compel an evolution of Asgard’s traditional Beamship architectures to much more streamlined forms –not for sake of aerodynamics but rather to reduce the erosive damage caused by interaction with the charged particle solar wind at such high new velocities. Such propulsion could reduce the travel times for any points within the solar system to mere days. However, the production of anti-matter fuel in volume may require the establishment of new facilities and technologies that can extract anti-matter from solar ejecta in close solar proximity, much as envisioned by Marshal Savage in the original TMP. This may also coincide with the development of practical nuclear isomers –materials that store vast amounts of energy in the quantum states of particles in the atomic nucleus and release it in a controlled manner– which might also rely on similar facilities for their production.

### Multiple barriers – core heat, complexity, and cost.

AIAA (American Institute of Aeronautics and Astronautics), 2011 (External Pulsed Plasma Propulsion (EPPP) Analysis Maturation, http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20000097368\_2000138015.pdf)

External Pulsed Plasma Propulsion (EPPP) is a highly efficient method of propulsion. No matter what energy source is used to generate the plasma burst, there are inherent advantages to its operation. EPPPs primary' advantage is that it reduces the material temperature constraint innate in all conventional thermal rocket engines. In most liquid chemical engines, using a combustion chamber and an exhaust nozzle, a large amount of fuel is used to convectively cool the chamber walls. Without which the walls would quickly reach their melting temperature. The same is true for nuclear thermal concepts (solid core) there the fuel temperature must I%" maintained below its melting point. In practice, the temperature is further curbed b 3 lower material yield strengths at higher temperatures and practical engineering safe b margins. Even in a gas core nuclear reactor, the fuel temperature cannot be left unchecked as the containment walls, operating in steady state must be actively cooled to avoid exceeding practical material limitations. The material limit paradox is that an arbitrary hot central core must be separated by a physical barrier. If the barrier is a solid, it will conduct the energ? when the core is in contact with it. If the core is not in contact (e.g. b\_ some high-speed flow effect or electromagnetic effects) then the core's radiative energy is still absorbed or transmitted by the wall. In the transmitted case, there must be a second nontransparent wall or the hot core will be radiating into space (a 4 Kelvin heat sink). In these radiative cases, the core temperature to the fourth power dominates the heat loss from the system. Assuming material temperatures are limited to roughly 3,000 Kelvin, then even a 5,000 Kelvin gas temperature generates a huge 30 MW/mA2 of waste heat (through radiation alone) that must be rejected. Depending on the particular configuration and gas properties, that is the same order-of-magnitude as the energy needed to heat the gas (i.e. approximately 5 MW/kg to ideally heat a gas from 300 Kelvin to 5,000 Kelvin. which even for a pressure of 1,000 atmospheres is about 15 MW'kg to reject). Obviously, the actual temperature, pressure and heat fluxes would be different at equilibrium in a real engine. Nevertheless, the equilibrium performance is onl? further degraded. Another discouraging fact is that even an ideal radiator requires an order-of-magnitude greater surface area to radiantly reject the heat into space. Both these problems become worst as the gas temperature rises. In all realistic cases, known material temperature limits are exceeded in any steady state operation without active heat rejection. This almost always requires using large amounts of cold gas as film cooling. That immediately' reduces the engine's Specific Impulse (Isp), while adding complexity and cost to the system. The solution is to operate the hottest part of the engine external to the confinement walls. In the pulsed fission rocket. the "'containment chamber" or engine walls are allowed to •"melt" (more precisely vaporize into a plasma) with each pulse and no limitation is imposed. This would suffer the same thermal limitation on the rest of the propulsion unit if the engine were not then pulsed. Thus, the same quantit? of energ} is liberated, but in a exceedingl) short duration. Since thermal heating processes are relatively slow, propagating at the speed of sound in a material, the heating is minimal, if the energ? is released at a much faster rate. This implies the pulse be an "'explosion" and propagate at roach numbers much greater than one, as is the case for conventional explosives and supercritical nuclear reactions. In the case of self-contained pulse units, the entire energy, generation mechanism is consumed in the plasma pulse process. It would be comparable to using the structural tankage of conventional chemical propellant s}stems and exhausting it out the engine as thrust. That is unlike most space propulsion drives (including most fusion, antimatter and various tbrms or" MHD) where the bulk of the vehicle mass is the engine. Fast fission processes are also unique in the tact that the vast majority of the energ? released is directed to the exhaust velocity of the propellant. There is no thermal conversion loss (as in a nuclear thermal or electric system that must actively' reject waste heat) and onl'\_ minimum loss of energy, due to it not being in a usable propulsion form (i.e. fusion or antimatter).

### Plasma propulsion is infeasible and risks cancer and radioactive fallout

Chad Boutin, 2002 (Macmillan Reference USA, Nuclear Propulsion, <http://www.novelguide.com/a/discover/spsc_04/spsc_04>

\_00391.html)

Nuclear energy remains an attractive potential means of propulsion for future spacecraft. When compared with conventional rocket engines, a nuclear propulsion system would in theory be less massive, and could provide sustained thrust with greater energy. Many believe nuclear-powered spacecraft can and should be built, but first many technical problems and other hurdles must be overcome. Both the U.S. and Soviet space programs were researching nuclear propulsion as far back as the early 1960s, and since then, dozens of ideas for nuclear propulsion systems—and the spacecraft they would power—have been proposed. Each system, however, is based around one of the two methods of generating nuclear energy: fission and fusion. Fission Propulsion Fission is the act of splitting a heavy atomic nucleus into two lighter ones, which results in a tremendous release of energy. Common fuels for fission reactions are plutonium and enriched uranium, a soft-drink sized can of which carries 50 times more energy than the space shuttle's external tank. Fission has been used to generate electricity on Earth for six decades, often by using the heat from the reactor core to boil water and spin a turbine. But a reactor core could also be used to heat a propellant such as hydrogen into a super hot gas. The gas could then be expelled out of a nozzle, providing thrust, just like in a conventional chemical rocket. Engines of this type are called nuclear thermal rockets (NTRs), and were ground-tested by the United States in the Rover/NERVA program of the 1960s. A related method, being studied by the National Aeronautics and Space Administration (NASA) in the early 2000s, would give an NTR the equivalent of a military jet's afterburner. In this scheme, liquid oxygen could be pumped into the exhaust nozzle. This would cool the hydrogen enough that it could combine with the oxygen and burn, providing additional thrust and leaving water vapor as a by-product. NTRs could produce enough thrust to carry a spacecraft into orbit, but because the propellant itself would quickly run out, they are unsuitable for longer missions to Mars or beyond. An alternative approach to NTRs is to use the reactor to produce electricity, which could power various types of electrical thrusters. Such nuclear-electric propulsion systems (NEPs) would use electric fields to ionize and/or accelerate propellant gas such as hydrogen, argon, or xenon. NASA plans to put development of NEPs on a fast track beginning in 2003. NEPs would be able to produce smaller amounts of continuous thrust over periods of weeks or months, making them extremely suitable for robotic missions to the outer planets or slow journeys between Earth orbit and the Moon. For human missions, when diminishing supplies for the crew make speed a more important factor, a combination of NTRs and NEPs could be used. Fusion Propulsion We have nuclear fusion to thank for life on Earth: Most solar energy comes from the four million tons of hydrogen that is converted into helium every second in the interior of the Sun. But fusion can only occur in superheated environments measuring in the millions of degrees, when matter reaches a highly ionized state called plasma. Since plasma is too hot to be contained in any known material, controlled nuclear fusion remains one of humanity's great unrealized scientific goals. However, plasma conducts electricity very well, and it could be possible to use magnetic fields to contain and accelerate it. It might even be more feasible to use fusion in space, where it would not be necessary to shield the reactor from the environment in all directions, as it would be on Earth. Experiments toward developing a fusion propulsion system are underway at NASA's Marshall Space Flight Center in Huntsville, Alabama. The Gas Dynamic Mirror (GDM) Fusion Propulsion system would wrap a long, thin current-carrying coil of wire around a tube containing plasma. The current would create a powerful magnetic field that would trap the plasma in the tube's center section, while each end of the tube would have special magnetic nozzles through which the plasma could escape, providing thrust. The amount and efficiency of the energy released by fusion makes it a good candidate for interplanetary travel. As a comparison of their efficiency, if a chemical rocket were an average car, a fusion rocket would get about 3,000 kilometers (1,864 miles) per liter! Fusion also has great potential as an energy source because of the nature of the fuel and reaction—hydrogen is the most common element in the universe, and the by-products are non-radioactive (unlike fission products, which remain hazardous for many years). But until fusion becomes a reality, fission is humanity's sole option for nuclear-powered space travel—and is not without strong opposition. Pros and Cons Plutonium is one of the most poisonous substances known; doses of one millionth of a gram are carcinogenic, and it is difficult to contain the radioactive by-products of fission safely. These dangers have made nuclear fission controversial from the outset, and the prospect of a nuclear reactor reentering Earth's atmosphere and scattering radioactive material over a wide area makes many people nervous. Many space probes have not carried reactors but are powered by radioisotope thermoelectric generators (RTGs), which derive electrical power from the slow decay of radioactive material. There was concern in 1997 that the Cassini probe to Saturn might meet with an accident as it flew by Earth, scattering its RTG's 33 kilograms (72 pounds) of plutonium into the atmosphere. This did not occur and Cassini continued on its route to Saturn. However, such concerns, along with the high projected cost of research and construction, have been obstacles in the way of nuclear-propelled spacecraft. Still, nuclear propulsion could dramatically decrease travel time to the planets. A round trip to Mars could be accomplished in half the time with fusion power, which would lessen the crew's exposure to the hazards of weight-lessness and cosmic radiation. A nuclear-propelled craft could conceivably be used repeatedly for round trips to the Moon and planets, cutting down the cost of operating such a long-term transit system. Funding for the development of new nuclear propulsion will be boosted in 2003 with a view to production of an operational system within a few years.

### Multiple Barriers – dangerous material, weak thrust, and weight.

AIAA (American Institute of Aeronautics and Astronautics), 2011 (External Pulsed Plasma Propulsion (EPPP) Analysis Maturation, http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20000097368\_2000138015.

EPPP is a descendant of the Air Force's 1958 ORION project, but with substantial differences, in the GABRIEL series, an evolutionary framework of EPPP concepts, the vehicles are only for interplanetary exploration and asteroid/comet defense missions where Earth contamination is not an issue, in the initial concept resurgence one-year ago, the vehicles were conjectured to be small, slow pulsing and use existing materials and technologies. " A somewhat subjective goal of 5,000 seconds lsp was set as the minimum performance that would be necessary to overcome political objections of self-contained nuclear pulse units (although very different from a nuclear weapon as seen from Table 1, the mere use of fissionable material is objectionable to some, even when it is for permanent disposal). The small size of the pusher plate (limited to 5 meters to keep it within existing launch vehicle shroud sizes) closed the design parameter space outside the predefined limits. Falling far short of the desired 5,000 seconds Isp. the GABRIEL vehicle needed an alternate approach, since it appeared that the pulse unit mass could not be reduced nor directionalized sufficientl? to compensate for the restricted plate size. Fusion Enhanced Possible Increasing the effective plate size, or the area over which the plasma acts upon the vehicle, was explored in a \_ariet\_ of ways. In brief, three ways were considered. First, was to look at other EPPP configurations. MEDUSA was considered as well as spinning cables and areoshield mechcanisms. \_ In all these, the structure size was on the order of kilometers and the mass was large as well. Although solar sail and tether technologies could be borrowed, the technology was not considered practical, particularly in the deployment/control of the large structure. Costs also were a concern, as the mass in LEO was substantial and development would be expensive. Second, was the use of electromagnetic fields where direct plasma contact is limited. This has great potential, but the magnet mass is prohibitive within reasonable development expectations. Also, field strength is inversely proportional to the radius squared, which makes it very difficult to create a field much larger than the ship itself. Concepts, such as MagOrion, appear to be large, costly and rely on major state-oftheart improvements or breakthroughs. 4 If it is feasible to scale down the MagOrion concept sufficiently, this concept has tremendous potential. Some feasibility, tests and further analysis is required before this technological path can be explored further (highly encouraged research to be undertaken). The third approach was the most direct. Build a bigger physical plate and either launch it in pieces and or assemble/manufacture it in space or on the Moon. Assembling in space is difficult and very costly, as the International Space Station has shown. Whether assembled or manufactured in space the Moon option was not considered possible because the infrastructure requirements are overwhelming), the completed structure would need to be thoroughly examined with zero defects before it could be placed into operation. Confidence in such final certification would be unacceptably low. Only complete manufacture inspection and testing on the ground was considered a practical 10to 20meter push epr late particularily composite rs advanced alloys were involved. If the entire ship had to be constructed on the Earth then launching it would require a news upeheaval launch vehicle(as large or larger than the SaturnV ) or a cluster of strap-on component(it.se..6 to 12SSMEengineusndertheplatefor example). Again expense and complexity makes this on unattractivie f t,he entire EPPP system is considered payload" to get into orbit. However if. The basic EPPP engine mass could be used in place of conventionial engines plumbing and tankage mass,the need to design a new launch vehicle would be eliminated. The expectation is that additional pulse propellant expense(i.e. some form of advanced chemical explosive or "'beamed propellant" methodology)would easily' be offset by the design and fielding cost of the additional liquid propellant stem. It is this approach that has been adopted GABRIEL design.

## Status Quo Solves

### Project Prometheus is developing nuclear propulsion now – but proves empirically the plan will result in more plutonium production

Bruce Gagnon, senior fellow at the Nuclear Policy Research Institute, where he also serves on her advisory board, co-founder and coordinator of the Global Network Against Weapons and Nuclear Power in Space, coordinator of the Global Network Against Weapons & Nuclear Power in Space, March 10, 2005, “BBC NUKES IN SPACE STORY”, http://space4peace.blogspot.com/2005/03/bbc-nukes-in-space-story.html

BBC radio ran a half hour story (click on link above to hear it) on NASA's plan to launch nuclear power into space. Called Project Prometheus, BBC investigated (mostly from NASA's point of view) the prospects for nuclear propulsion in space. Project Prometheus is the name that the Bush administration has given to the planned nuclear rocket now under development by NASA and the Department of Energy (DoE). The BBC story interviewed Global Network Coordinator Bruce Gagnon about the organizations opposition to space nuclear power. In order to meet the growing demand for plutonium for future space nuclear missions, NASA is now planning to expand plutonium production facilities at the Idaho National Laboratory. In addition to the nuclear rocket, NASA also plans a growing list of nuclear missions to outer planets in the coming years. The next plutonium mission set for launch is the New Horizons mission to Pluto. New Horizons will carry a radioisotope thermoelectric generator (RTG) that transforms heat from decaying plutonium-238 into electricity to power the spacecraft's instruments. The New Horizons mission is set to launch from the space center in Florida in January or February, 2006. The Global Network will be organizing opposition to this launch and your help will be needed.

### EVEN IF the project is different it results in the aff

Leonard David, Senior Space Writer, Feb, 2003, “NASA’S Nuclear Prometheus Project Viewed as Major Paradigm Shift”, PDF

"We’re a baby that’s been crawling and we’re trying to get ready to stand up and take our first baby steps," said Alan Newhouse, NASA Manager of the Project Prometheus Nuclear Systems Program. "So it’s going to be a while before we know how fast we can run," he told SPACE.com in a phone interview. Newhouse emphasized that Prometheus is not a rocket. Rather, what is being championed is a demonstration of nuclear electric propulsion in space. In the near future, NASA intends to open up formal dialogue with industry to hammer out technical approaches needed to fabricate a nuclear electric propulsion spacecraft. "We are welcoming all practical ideas for building reactors…practical in the sense of something that can sit in a spacecraft and has some pedigree in design. If at the end of that process, if we have one or three designs, so be it. We’ll see what it looks like," Newhouse said.

### More Evidence – The project causes a paradigm shift

Leonard David, Senior Space Writer, Feb, 2003, “NASA’S Nuclear Prometheus Project Viewed as Major Paradigm Shift”, PDF

Project Prometheus is a paradigm shift in the way solar system exploration can be carried out, said Colleen Hartman, NASA’s Solar System Exploration Division Director. "We’ve been running on a 100- watts and this is stadium lighting, all of a sudden," she said. Hartman said in a phone interview that a request for proposals to build high-powered instruments will soon be released. Scientists need to better understand how to take advantage of the energy level cranked out by a space nuclear reactor. The nuclear power capability is "just going to be unbelievable…orders of magnitude higher capabilities than what we’ve ever done before," Hartman said. Fortified by a nuclear power system, a range of instruments can be utilized, such as ice penetrating radar. Additionally, broadband communications gear can relay to Earth unprecedented quantities of data about Jupiter’s icy moons, Hartman said.

# Miscellaneous

## Grossman Prodict

### Believe Grossman—he’s the leading expert in the field.

Deborah Dupre, Author for the examiner, The Huston Free Thinkers, 19 May 2011, “Exclusive Karl Grossman Interview: Fukushima Fallout over US Censored By News”, http://www.houstonfreethinkers.com/index.php?option=com\_content&view=article&id=507:exclusive-karl-grossman-interview-fukushima-fallout-over-us-censored-by-news&catid=63:japanese-tragedy&Itemid=135

Karl Grossman: Nuclear investigative journalism excellence Over forty-five years ago, Karl Grossman began his humanitarian pioneer service as an investigative journalist and environmental rights defender in a variety of media. He is narrator and host of award-winning environmental TV documentaries for EnviroVideo (www.envirovideo.com) including "Nukes In Space: The Nuclearization and Weaponization of the Heavens." Karl Grossman is author of six books: "Cover Up: What You Are Not Supposed to Know About Nuclear Power;" "Power Crazy;" and "The Wrong Stuff: The Space Program's Nuclear Threat to Our Planet." Karl Grossman's nuclear power in space journalism has been repeatedly cited in the annual judging of Sonoma State University's Project Censored of issues most "censored" or "under-reported" by national news media. In 1997, Project Censored selected Grossman's articles on the subject as their "top censored story of 1996." He was cited for number 6 of top ten most censored stories of 1997 for his reporting on the Russian Plutonium lost over Chile and Bolivia. Karl Grossman is a professor at State University of New York/College at Old Westbury and has received journalism honors including George Polk, James Aronson and John Peter Zenger Awards. His weekly column runs in newspapers of the Press Newspaper Group and in other papers. He has given presentations in the U.S. and around the world and represented in lecture.

## Topicality “Substantial” Helper

### Obama has just increased nuclear propulsion funding to 650 Million – the aff isn’t substantial

Karl Grossman, professor of journalism at the State University of New York/College at Old Westbury, June 10, 2010, “Obama Brings Back Space Nuclear Power”, http://karlgrossman.blogspot.com/2010/06/obama-administration-in-new-push-for.html

The Obama administration is seeking to renew the use of nuclear power in space. It is calling for revived production by the U.S. of plutonium-238 for use in space devices—despite solar energy having become a substitute for plutonium power in space. And the Obama administration appears to also want to revive the decades-old and long-discredited scheme of nuclear-powered rockets—despite strides made in new ways of propelling spacecraft. Last month, Japan launched what it called its “space yacht” which is now heading to Venus propelled by solar sails utilizing ionized particles emitted by the Sun. “Because of the frictionless environment, such a craft should be able to speed up until it is traveling many times faster than a conventional rocket-powered craft,” wrote Agence France-Presse about this spacecraft launched May 21. But the Obama administration would return to using nuclear power in space—despite its enormous dangers. A cheerleader for this is the space industry publication Space News. “Going Nuclear” was the headline of its editorial on March 1 praising the administration for its space nuclear thrust. Space New declared that “for the second year in a row, the Obama administration is asking Congress for at least $30 million to begin a multiyear effort to restart domestic production of plutonium-238, the essential ingredient in long-lasting spacecraft batteries.” The Space News editorial also noted that “President Obama’s NASA budget [for 2011] also includes support for nuclear thermal propulsion and nuclear electric propulsion research under a $650 million Exploration Technology and Demonstration funding line projected to triple by 2013.” *Space News* declared: “Nuclear propulsion research experienced a brief revival seven years ago when then-NASA administrator Sean O’Keefe established Project Prometheus to design reactor-powered spacecraft. Mr. O’Keefe’s successor, Mike Griffin, wasted little time pulling the plug on NASA’s nuclear ambitions.”

## Critique Helper

### Elites dominate the current nuclear propulsion debate – our K is necessary to avoid ecological collapse – challenging through highschool debates is key

Bruce K. Gagnon senior fellow at the Nuclear Policy Research Institute, where he also serves on her advisory board, co-founder and coordinator of the Global Network Against Weapons and Nuclear Power in Space, coordinator of the Global Network Against Weapons & Nuclear Power in Space, Jan 27, 2003, “Nuclear Power In Space And The Impact On Earth's Ecosystem” , http://www.spacedaily.com/news/nuclearspace-03b.html

For the third year in a row the Global Network (GN) will organize two days of protests on February 3-4, 2003 in Albuquerque, N.M. at the 20th Annual Symposium on Space Nuclear Power & Propulsion. This event draws the top players from NASA, DoE, DoD, nuclear academia and nuclear aerospace each year to plan the push of nuclear power into space. Hundreds of middle and high school students are brought to the symposium for indoctrination and the GN has been able to speak to many of these young people at our protests. NASA, DoE, and the Pentagon are not asking the tax paying public if we want to suffer the risk and costs of nuclear power in space. Their corporate and military interests make it necessary to push ahead without real citizen input . Scientists and technologists are out of control. Their plans now literally threaten the life of the entire planetary ecosystem. The time has come for vigorous global public debate around the space nuclear power issue.