

**Op-Ed for Applied Physics Seminar E4903 – Professor Michael
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On December 2nd, the United States and Israel were the only two countries to abstain from a U.N. General Assembly resolution on the "Prevention of an arms race in outer space." 178 voted in favor, including Russia, India, and, perhaps surprisingly, China, whose 2007 anti-satellite test generated a record-breaking 100,000 pieces of space debris in Earth orbit. Our nation's lack of participation in this vital international effort is disturbing given our prevalence in space, and should be a serious concern for American citizens and elected officials alike.

We depend on space daily for telecommunications, national defense, disaster relief, climate change data, and more. In 2012, the World Economic Forum even concluded that "a day without satellites" would spell global economic disaster. In this context, space debris – consisting of discarded rocket bodies, defunct satellites, and the results of numerous anti-satellite tests by Russia, the U.S., and China -- is a grave threat to this infrastructure. Due to the nature of orbital mechanics and high speeds, a single collision in orbit can generate multitudes of debris, which in turn produce further collisions and more debris in a snowballing cascade effect. In fact, we have reached a point of no return at which, even if we ceased all further launches, the quantity of junk in orbit is near the brink of triggering a major cascade effect. If the U.S. launched a weapon into space, its consequences could trigger results as disastrous for us as for our enemies. Peace is a necessity for all nations and their citizens.

If space becomes saturated with debris, nobody will have access to it. According to the U.N., space is "the common heritage of humankind." Space is a neutral territory under international law, and any governments that make it inaccessible are destroying a natural resource we have every right to explore.

We as American citizens have a responsibility to push Congress and the White House to accelerate funding and direction for projects to remove debris. One such project is "drag enhancement," which would shoot nanoparticles into the path of debris to slow them down, as if they were moving through honey – enough that they spiral inward toward Earth and burn up in the atmosphere. While the Naval Research Lab is working on preliminary designs for drag enhancement, projects like these need the funding to accelerate their work out of the R&D process

and into reality. A push from the American public might just do the trick.

Ultimately, this isn't only a funding problem -- it is also a challenge, and perhaps an opportunity, for constructive international cooperation. If nobody takes responsibility, then space will soon be covered with detrimental high velocity debris that may eventually destroy satellites currently in use, affecting our daily living. Indeed, the problem is imminent and there is no time to waste for the world to toss the responsibility to one nation or another. Our nation, as a leader in space activities (and debris production), needs to step up to the plate and help establish an international organization in which participating countries can share their up-to-date space research, distribute the financial burdens of debris together, and mediate possible space-related political issues with each other. Especially, the three nations (Russia, China, and the U.S.) which have created the most debris in recent years would be obliged to be part of the organization and fulfill their responsibilities.

As scientists, we find it imperative that the United States work with other nations, especially Russia and China, to ensure that space is a zone accessible and safe to all nations. It is regrettable that the United States chose to not vote for the United Nations' resolution calling for the prevention of an arms race in outer space. The fact that 178 nations voted in favor of the resolution (including Russia and China), with the United States being among the only two nations to abstain, clearly demonstrates that not only is international cooperation in space possible, but it is also desirable by the overwhelming majority of nations on Earth. This United Nations resolution is an effective and much needed one in the context of space debris. An international agreement to prevent an arms race in outer space protects the United States' satellites and makes military activity in space unneeded. It allows for securing U.S. infrastructure in space, while at the same time saving money that could be used to expand research activities in space.

In addition, international cooperation should extend to not only include limiting military activity in space, but commercial activity as well. We urge the United States to work with other countries to regulate access to space as a market. With the current level of debris, space cannot remain an open arena where any company or corporation can launch missions. National research interest should be prioritized in light of how important research in space is for the entirety of humanity. Thus, it is imperative that the United States works with other

countries, most importantly Russia and China, to ensure an international agreement on a framework for regulating commercial activities in space and to set the ground rules for a balance where commercial activities in space are restricted so as to limit space debris.

Debris is a serious issue. Its effect may appear indirect, but it threatens systems integral to our daily lives. China's anti-satellite test was a disaster for debris -- and yet China voted in favor of the General Assembly's resolution.

If China can do it, why can't we?

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December, 2014