Title
Dangers of Space Debris

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Space Debris: the Hubris of Humanity

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10 centimeters is not big. 10 centimeters is the average diameter of a bagel. 10 centimeters is even shorter than the length of an average smartphone. So why is 10 centimeters a big deal? Imagine a piece of metal 10 centimeters in diameter orbiting around the Earth in space Yet this piece of metal has enough momentum and force to puncture the International Space Station. A single puncture could effectively destroy all electronics, release all the oxygen, impair the escape vessels, and even kill all members aboard. This is the danger of space debris.

Space debris is junk that orbits the earth. This ranges from abandoned satellites to broken segments from rockets and missiles. It also includes defragmented rocket stages as well as broken equipment from collisions with other debris. The first real serious satellite fragmentation occurred in June of 1961 when two satellites collided with one another[4]. The collision resulted in a break-up of the satellites, sending pieces of both into orbit. This only increases the chances of another collision of occurring. Yet the fragmentation does not stop there. Back in 2007, China conducted an anti-satellite weapon test that destroyed a decommissioned weather satellite, smashing the object into 150,000 pieces each larger than 1 cm [8]. Not only does space junk pose a threat to space travel, it also increases the chance of self multiplication.

Space debris was not always a problem. In the early years of the space age, scientists would leave abandoned rocket stages in orbit after use. This was not such a bad idea, considering how empty space was at the time. However, over time, the number of space missions increased from simply sending a weather satellite into space to landing a man on the moon. With each mission, more waste was left behind, increasing the amount of debris orbiting the earth. The used rocket stages that once were few and unnoticeable now cloud our view of the heavens. So much in fact, that, 47.7% of debris orbiting Earth is from break-up debris[4] and used propulsion engines cause 45.4% of all satellite break-ups[4]. Such a recent collision occurred in 2005. A 31-year-old U.S. rocket body hit

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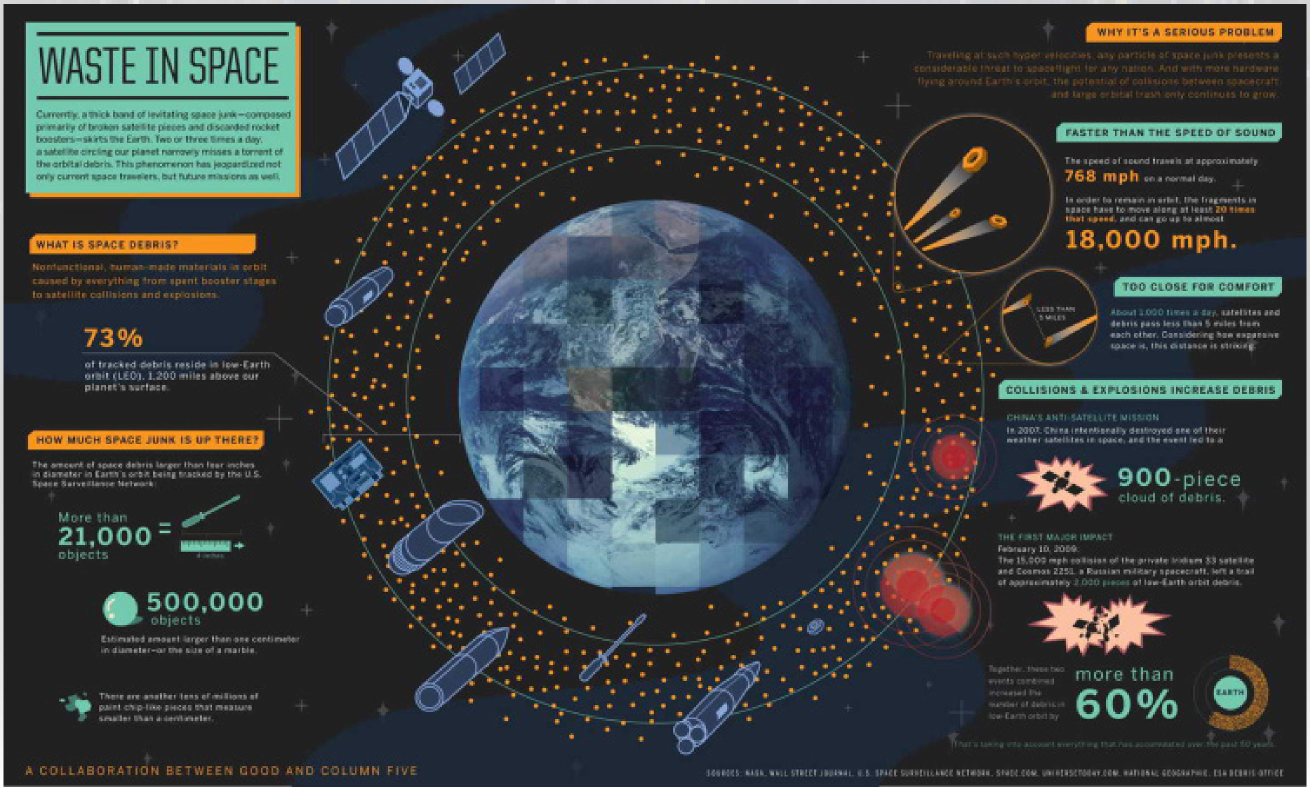
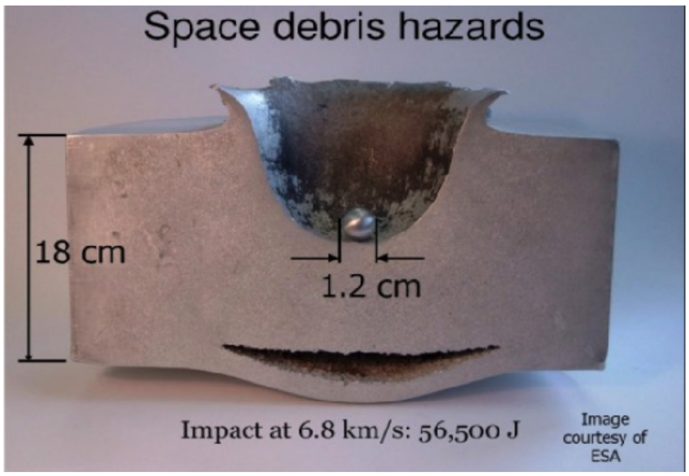


a fragment from the third stage of a Chinese launch vehicle that exploded in March 2000[9]. What once was not even a consideration during missions, now hinders our very ability to travel in space.

Despite the amount of junk floating in orbit, much of the waste is currently tracked by various organizations. Since 1989, NASA and other organizations have been monitoring and measuring debris, especially in low Earth orbit (below 2,000 kilometers from sea level)[5]. According to a 2012 report by NASA Orbital Debris Program Office, more than 21,000 orbital debris larger than 10 cm (large orbital debris) exist[1]



and more than 500,000 orbital debris between 1 and 10 cm exist[1]. The U.S. Space Surveillance Network is currently tracking over 13,000 human-made objects larger than 10 centimeters in diameter, which include operational spacecraft and debris from old rocket bodies[9]. Anything orbiting in low earth orbit (LEO) will be orbiting the Earth at around 7.5 km/s. Anything higher can reach speeds of over 10 km/s or 22,370mile/hr. Imagine getting hit by a metal football at that speed. Imagine the destruction that could cause to any space craft.

during normal operations, minimizing the potential for break-ups during operational phases, limiting probability for collision in orbit, avoiding intentional destruction or harmful actions, minimizing potential for post-mission break-ups from stored energy, limiting long-term presence of launch orbital stages in LEO after missions, and limiting long-term interference from launch orbital stages with satellites[3]. Despite these guidelines, they only serve to minimize the amount of trash produced every mission. What about the trash already in space?

One of the solutions proposed to remove orbital debris is space lasers. Despite how science fiction has characterized them, lasers may prove to be one of our better solutions. These lasers could either destroy fragments of rocket stages by reducing them into smaller pieces without blowing them into many pieces or push the waste out of orbit. Current estimates say ground-based laser facilities could cost around $100 million and would be most likely operated near the equator[6]. Experts also say that such technology could remove all orbital debris up to an altitude of 800 km in two years[6]. It sounds like a promising solution considering the fact that a recent analysis suggests that with the current levels of debris and satellites, there will be approximately one collision per year[6].

Despite how promising a lasers system sounds, the price of such a method is quite a problem. Why not have the rockets bring themselves down, rather than having us remove them? SPOT-1, a French weather satellite, was successfully launched on February 22, 1986 with a 3 year expected lifetime[7]. Officials decided to re-orbit the satellite after a replacement, SPOT-5, was declared operational[7]. Rather than sending someone up into orbit to retrieve the used satellite, experts used its residual propellant to maneuver the satellite into a lower altitude disposal orbit, from which reentry could be completed within 15 years[7]. If this could be the future of space travel, boomerang space engines, then all future debris could be eliminated.

"Despite all the potential disasters that could be caused by the orbital debris, the issue has been far from unnoticed."

Despite all the potential disasters that could be caused by the orbital debris, the issue has been far from unnoticed. As mentioned previously, some nations have developed computer models of space debris based on the large, catalogued population and statistical observations from a wide range of sensors[2]. As a result, many organizations involved in space operations have become aware of the potential threats of space debris, and some of those organizations have initiated efforts to mitigate debris generation and to share the results of those efforts with the international community[2]. In 2007, the United Nations set 7 Space Debris Mitigation Guidelines for future reference. The seven include limiting debris released

Orbital debris has been and probably will be an issue for the next few decades. Our plans of removing all the debris from the past 60-plus years will be a challenge for humanity. Yet, technology that once created the waste is now developing into a method of removing it. Even as you are reading this, humans are making space travel a viable option. And when you are on that spacecraft peering out into the vast heavens, the last thing you want is a piece of metal hurdling at you at nearly 30 times the speed of sound.

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