

Orbital Debris - A New Threat My Sky Should Be Clean –Not Littered With Space Junk

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ORBITAL DEBRIS (SPACE JUNK)

An extraordinary evening with the most mundane components, I am lounging on the couch with my cherished glass of milkshake. One glance out of the window and I see this huge almost round object, which is a little bit too familiar. Of course, it is the Earth, yes, our planet Earth, looking amazingly calm and exquisite as I continue to gaze at it from the glass window of my space station. Oh! Did I forget to mention this earlier? Well this was my extraordinary evening in the space station. The sheer feeling of being there was magical. But just before the magic could seep in, here comes the mundane when suddenly, out of nowhere a resounding thud vibrates my space craft. A comparatively large metal piece is the source which hits and challenges to shatter the break proof glass window. And another thud of an even bigger metal piece, BAM! And another, BAM BAM! That's it, that's when I woke up with fear. Just like that the extraordinary of being an astronaut in my space craft ended and so did the mundane of space junk just floating around and disintegrating the space craft. This was a dream but



this is really a threat for all space stations.

During March 2021, when on one side the world was shaken by ever impounding COVID-19 threats, on the other side the news stayed marred by the glimpses of a Chinese military satellite being disintegrated

in orbit, adding to heavy space junk high above the Earth. With the severity that COVID-19 was causing across the globe, this second piece of news never got any attention, and was almost lost in transit.

What remained were some questions that arose like dust and settled in heavy layers unanswered – Did a disaster like this result in the propulsion system explode? Is there continuous collision happening among space junk?

While scientists spent their hours solving these mysteries, an astronomer at the Center for Astrophysics discovered and deduced that the Yunhai 1-02 satellite had collided with a piece of space junk which was leftover from a 1996 Russian rocket launch in July-August, 2021.

This discovery wasn't an alarming one, space collisions happen as a usual phenomenon, but it was the first major collision in Earth's orbit since 2009. Here's the alarming part, it won't be the last...

As a student, I once read how this story began. On October 4, 1957, USSR (Union of Soviet Socialist Republic) launched the first man-made object in space, Sputnik 1. The launch was a remarkable milestone and the beginning of a new era — the Space Age.

Since Sputnik 1, tons of Satellites, rockets, space stations, missiles, along with many other space structures have been sent in space. Some had successful launch and an even impactful space tenure, but on the way many other rockets and Satellites were left damaged, simply non-functional. Some of them fall down on Earth or burn up in atmosphere. However the majority of the parts end up staying in space and continue to orbit the Earth. These satellites and rockets may collide with another satellite or a rocket and shatter into smaller pieces. This is called orbital debris. Thus, with every satellite and rocket launched we are making it more challenging for us to go to space. The time to think about space junk and orbital debris is now, to solve for this problem is now, and to make the solution sustainable is now.

Is Orbital Debris really that much?

There are approximately 2000 active and 3000 dead satellites orbiting the Earth. This is nowhere close to the entire junk that constitutes the orbital debris - around

34,000 pieces of space junk with each piece no less than 10 centimeters along with a million tiny pieces can be the cause of disastrous catastrophes in space. Not surprisingly, but this is just one part of the story. Other than space junk, many unused metal can be found on the surface of the Moon from the buggies from Apollo 15, 16 and 17. This is still not all, 54 without crew probes that had crashed on the Moon can be found lingering and just lying dead on the surface of this precious celestial body. This is apart from the 190,000 kilograms of material left by humans on the Moon. We humans definitely left our mark, quite literally if I must say!

Problems due to Space Debris

Where is all this space junk exactly? Most of these debris is located in the lower Earth Orbit, in other words, the zone within approximately 2,011km of the planet's surface. Majority of the satellites that are launched in the space like ISS and NASA's Earth Observing Fleet system operate in the lower Earth Orbit. Just imagining the extent of this junk, kilograms and kilograms of either just metal, or sometimes radioactive material, going about free floating without any reason, control or stop, is a goose bumps giving and a nerve wrecking thought! The Space which has been an abode of the free flowing, naturally occurring celestial bodies since centuries and time unknown, is on the verge of getting overpowered by human created junk from just the last 5 decades. The result? High risk of collision, unwanted destruction, and completely unknown consequences.

The **Kessler Syndrome** is a phenomenon in which the amount of space junk in an orbit reaches a point which may cause more and more space debris, this in turn leads to catastrophic problems for space crafts and astronauts that are yet to venture into the Space. A number of space shuttle windows have been changed due to damage caused by paint fleets. The essential satellites like that of weather and communications are also not saved from this destruction. Their work gets hindered in their usual working due to

density of junk revolving around them. But why does this space junk keep revolving all around in the Earth's orbit? Space junk is attracted by Earth's gravitational pull which keeps on pulling it lower till it enters the Earth's atmosphere. On penetration in the Earth's atmosphere, the intensity and speed of the space objects slows down considerably. But even before that, a lot any objects burn as soon as they enter the Earth's atmosphere due to the compression of atmospheric gases. But what is troublesome here is that way many more debris do not get to penetrate the atmosphere, and nor see this fate. Thus, their fate remains in free flow orbiting around Earth, the cause of all the human created atmospheric catastrophes today.

Currently, orbital debris is removed only by friction. But as emissions of carbon dioxide, a greenhouse gas, continue to increase, these gases cool off an atmospheric layer known as the thermosphere. This increase in emission is reducing the density of the thermosphere. The drop in density leads to less friction, thus, extending the orbit of space debris to keep moving around and not enter the Earth's atmosphere where it could have been burnt out. As a result, the chances of debris hitting something else within the orbit peaks drastically. This year, scientists were encountered with a dramatic discovery that the International Space Station was headed for a piece of snow left over from a 2009 collision. To avoid debris, the space station changed its trajectory in April. This change in transition was not its first type, for the fifth time in less than three years, the station has taken a different course in order to stay clear of floating debris.

These were large debris and thus locating and problem solving for them was still doable. On the other hand, small debris pose a considerably higher risk since it is harder to track from earth and can cause malfunctions in satellites. Even small pieces moving at a speed of 30,000km/h can pose a serious threat to satellites and other space infrastructure orbiting our planet. It is estimated that over 100 million of these

small pieces are revolving around the earth. These pieces are so small that it is almost impossible to track them.

Can I think of reaching the Space? if Yes, how?

Even though the frequency of collisions is increasing, the intensity of these collisions is something that is debatable and not something devastatingly worrisome. In 2009, two communications satellites, Iridium 33 and derelict Russian military Kosmos2251 accidentally collided in space. This collision created massive amount of orbital debris. After nearly 11 years in 2020, a huge disintegration of China's Yunhai 1(02) satellite happened. Post rigorous investigations, it was deduced that this was a result of the collision of a small piece of 2009 collide space junk. The Yunhai -1 Series of satellites are mainly used for detecting the atmospheric and marine and space environment, apart from being critical in disaster control and other scientific experiments. This miniscule piece of junk absent mindedly left in the space 11 years back, led to the damage, loss and destruction of such a critical satellite for the country and the world as a whole. The usual talk that we hear in a normal household is the concern of the problems caused by garbage on the road. Now imagine, 20 times its intensity of garbage in the Space, unmonitored, unknown, and just roaming there. The cribbing about not being able to walk on the road is common, but what about the trouble of the important satellites not having free space to orbit around Earth? Who gets to answer for that, let alone solve that?

Currently there are a number of experiments under way to clean orbital debris. Many organisations have proposed ways to get rid of orbital debris and unused satellites.1) Snagging and move orbital debris - in 2014, e.DeOrbit mission planned to seek out orbital debris in a polar orbit at an altitude between 800 and 1000 kilometer. The European Space agency is considering several kinds of capture mechanism to pick up the debris like nets, harpoons, robotic

arms. 2) Using Power of Electricity - The Japanese Aerospace Exploration Agency proposed to use an electrodynamic tether whose current would reduce the speed of space debris. As speed of stateliness slows down, it gradually fall closer to Earth, where it will burn up due to Earth's atmospheric pressure. 3) During the mid-1990's, NASA issued the guidelines to deuce the growing space junk, which was followed by other International Space agencies. 4) Electric Propulsion Systems: Satellites are using Electric propulsion system like ion and Hall effect thruster also plasma thruster to minimise small particles from chemical rockets which push particles into Earth's atmosphere. 5) Japan is experimenting with wooden satellite to reduce the levels of toxic debris introduced into Earth's upper atmosphere when satellites de-orbit. 6) Many researchers have recommended sending people to collect debris from space. Implementing this idea, however, is more difficult than it seems. We cannot remove even one piece a year because scientists aren't sure how to clean it up. Thus, Human led space cleaning missions are not expected to be executed anytime soon.

Way Ahead

Garbage in space increases every year. This is a grave problem for space agencies all over the world since even small pieces of

Reference Material

https://www.nasa.gov/mission_pages/station/news/orbital_debris.html

Space junk is a huge problem—and it's only getting bigger <https://www.nationalgeographic.com/science/article>

What is space junk and why is it a problem? <https://www.nhm.ac.uk/discover/what-is-space-junk...>

<https://www.space.com/space-junk-growing-problem-complicated-solution>

<https://www.americanscientist.org/article/the-dilemma-of-space-debris>

<https://www.bbc.com/news/50827462>

<https://www.nytimes.com/2019/04/02/world/asia/nasa-india-space-debris.html>

<https://www.youtube.com/watch?v=ySlibDImAYU>

https://www.youtube.com/watch?v=LkeTk-Fi_c8

<https://www.space.com/24895-space-junk-wild-clean-up-concepts.html>

https://www.nasa.gov/mission_pages/station/news/orbital_debris.html

<https://www.thehindu.com/children/what-is-space-junk-why-is-it-a-serious-problem/article34532546.ece>

debris - the size of a pencil point - can be the cause of undulating troubles for satellites and spacecraft, and resultantly for Humankind as a whole. But the good news here is that the space industry is becoming more aware and empathetic to this real life concern. There are constant efforts to make reusable rockets and use tons of other technologies to reduce space junk. The efforts, however, are trumped by the increasing number of weapon tests on satellites that more and more countries are undertaking.

If this concern is not solved and treated like a priority, we may end up with a deadly barrier around the Earth that would delay the plans of our space travel, satellite and space colonies on mars and moon by decades if not centuries. Not only that even on Earth the technologies we rely on daily like GPS may not be accessible at all. This would send us to the time before 1970s, where GPS may turn into physical maps and Global connectivity may not be just a few clicks away. If this problem is not solved soon, this may mark the end of Space Age. Are we as humans really ready to take steps forward into space age, or are we actually and realistically taking steps backward into Stone Age? Only time and our concrete actions in the right meaningful direction will tell.