THE SILENT CRISIS ABOVE: A COMPREHENSIVE ANALYSIS OF THE SPACE DEBRIS PROLIFERATION, INTERNATIONAL LIABILITY REGIMES, AND THE IMPERATIVE FOR REMEDIATION

Vedanth Lokesh, Army Law College Pune

1. Introduction: The Finite Nature of the Infinite Frontier

The popular conception of outer space is one of infinite emptiness—a "Big Sky" where satellites float in solitary isolation, separated by vast, unconquerable distances. For the first few decades of the Space Age, this perception was functionally accurate. When the Soviet Union launched *Sputnik 1* in 1957, the probability of it colliding with another man-made object was zero. However, this initial state of pristine emptiness was transient. In the nearly seven decades since that epochal event, humanity has treated the near-Earth orbital environment much like it treated the terrestrial oceans during the industrial revolution: as an infinite sink for industrial waste, capable of absorbing endless detritus without consequence.

This assumption has proven cataclysmically false. Today, the orbital shells surrounding our planet—specifically Low Earth Orbit (LEO) and Geostationary Earth Orbit (GEO)—are not infinite voids but finite natural resources, congested ecosystems that are rapidly approaching a tipping point of sustainability. The accumulation of anthropogenic space debris—defunct satellites, spent rocket stages, mission-related refuse, and fragmentation impacts—has transformed the near-Earth environment into a minefield of hypervelocity projectiles.

As of 2024, the situation has escalated from a theoretical concern to an operational crisis. The European Space Agency (ESA) reports that space surveillance networks are now tracking approximately 35,000 individual objects. This number, while staggering, represents only the "tip of the iceberg"—the objects large enough to be seen by ground-based radar and optical telescopes. Beneath this visible population lies a lethal undercurrent of untraceable debris, estimated by statistical models to number in the hundreds of millions.

The implications of this pollution are profound. They threaten not only the future of space exploration but the very infrastructure of modern civilization. From global telecommunications and weather forecasting to financial timing signals and national security, the terrestrial economy is inextricably tethered to the health of the orbital environment.

A "tragedy of the commons" is unfolding in the vacuum of space, driven by a disconnect between the rapid pace of technological utilization and the glacial pace of international legal governance.

This report provides an exhaustive examination of the space debris crisis. It synthesizes the latest quantitative data on the orbital environment, traces the historical genesis of the debris belt through major fragmentation events, and subjects the current international legal framework—anchored by the 1967 Outer Space Treaty and the 1972 Liability Convention—to a rigorous stress test. It argues that while "soft law" mitigation guidelines have established necessary norms, they are insufficient to halt the cascading growth of debris known as the Kessler Syndrome. Consequently, the focus must shift to Active Debris Removal (ADR), a technological frontier fraught with unresolved legal questions regarding ownership, liability, and the dual-use nature of space capabilities.

2. The Anatomy of the Orbital Environment

To understand the legal and policy challenges of space debris, one must first grasp the physical reality of the environment. Debris does not float aimlessly; it orbits at hyper velocities, governed by the immutable laws of Keplerian mechanics. The destructive potential of this debris is not a function of its size, but of its kinetic energy.

2.1. Quantitative Classification and Distribution

The population of space objects is generally categorized by size, which correlates directly with lethality and trackability. The ESA's 2024 Space Environment Report, utilizing the MASTER-8 statistical model (reference population August 2024), provides a granular breakdown of this population.

2.1.1. The Trackable Population (> 10 cm)

The most visible segment of the debris population consists of objects larger than 10 cm. These are the objects that can be reliably tracked, catalogued, and avoided by operational spacecraft.

- **Total Count:** There are approximately 54,000 objects in this class.
- **Composition:** Of these, only about 9,100 are active payloads—functioning satellites delivering value to Earth.
- **The Derelict Majority:** The remaining ~45,000 objects are "space junk": dead satellites, spent upper stages of launch vehicles, and large fragments from past collisions and explosions.
- **Threat Profile:** A collision with an object of this size is catastrophic. It results in the complete destruction of the spacecraft and the generation of a new, massive debris cloud.

2.1.2. The Lethal Non-Trackable Population (1 cm to 10 cm)

Below the threshold of reliable tracking lies a population of dangerous shrapnel.

- **Total Count:** Current models estimate there are **1.2 million** debris objects in the 1 cm to 10 cm range.
- **Threat Profile:** While too small to be tracked and avoided, these objects possess sufficient mass to penetrate the shields of the International Space Station (ISS) or shatter a satellite's bus. At orbital velocities, a 1 cm aluminium sphere packs the kinetic energy equivalent to an exploding hand grenade. This class of debris represents the highest statistical risk to space missions because it cannot be dodged, only endured through shielding—which has physical limits.

2.1.3. The Erosion Population (1 mm to 1 cm)

The smallest category consists of tiny particles—paint flecks, solid rocket motor slag, and coolant droplets.

- **Total Count:** Estimates suggest a staggering **130 million to 140 million** objects between 1 mm and 1 cm.
- **Threat Profile:** While unlikely to destroy a spacecraft instantly, these particles cause surface degradation, sensor blindness, and solar panel erosion. Over time, they can

shorten a satellite's operational life.

2.2. Orbital Regimes and Congestion Zones

Debris is not uniformly distributed around the Earth. Its clusters in the specific orbital highways that are most valuable for human utilization.

2.2.1. Low Earth Orbit (LEO)

LEO, extending from the Earth's atmosphere up to 2,000 km, is the most congested regime. It is the home of the ISS, the Hubble Space Telescope, and the vast majority of Earth observation satellites.

- **The New Density:** In recent years, the deployment of mega-constellations (such as SpaceX's Starlink and OneWeb) has radically altered the population density. The ESA notes that for the first time, the number of active satellites in the 500–600 km altitude band effectively matches the density of debris objects.

- **Collision Avoidance:** The congestion in LEO has operational consequences. SpaceX reported that its satellites performed nearly 50,000 collision-avoidance maneuvers in a single year. This creates a "maneuver tax" on operators, who must expend fuel and operational lifespan to dodge junk.

2.2.2. Geostationary Earth Orbit (GEO)

Located at an altitude of approximately 35,786 km, GEO is a unique resource where satellites appear stationary relative to the ground. This orbit is prime real estate for telecommunications and weather monitoring.

- **The Permanence of Debris:** Unlike LEO, where atmospheric drag eventually pulls debris down to burn up (a process that can take years to centuries), debris in GEO is effectively permanent. There is no atmospheric drag to cleanse the environment.

- **Graveyard Orbits:** To manage this, operators are expected to boost dying satellites into a "graveyard orbit" approximately 300 km above GEO. However, historical non-compliance has left many derelict objects drifting through the GEO belt, posing an eternal hazard to operational assets.

2.3. The Kessler Syndrome: A Chain Reaction

The ultimate existential threat posed by this accumulation is the "Kessler Syndrome." First hypothesized by NASA scientists Donald Kessler and Burton Cour-Palais in 1978, this theory describes a self-sustaining cascade of collisions.

- **Mechanism:** As the density of objects in LEO increases, the probability of a collision between two objects rises. When a collision occurs (e.g., between two large derelict satellites), it does not merely remove two objects; it creates thousands of new, smaller fragments. These new fragments then increase the probability of *subsequent* collisions.

- **Criticality:** The terrifying conclusion of Kessler's model is that once a critical mass density is reached, the cascade becomes independent of new launches. Even if humanity stopped launching rockets today, the debris population would continue to grow as existing large objects collide and fragment.

- **Current Status:** Scientific consensus in 2024 suggests that certain orbital bands (particularly 800–1000 km) may have already passed this critical tipping point.[7] The 50% increase in debris levels in LEO over the last five years supports the fear that the syndrome is in its early stages.

3. The Genesis of the Debris Belt: A History of Fragmentation

The current debris environment is not a natural phenomenon but a historical artifact of human activity. While routine launches contribute to the population (via rocket bodies and mission-related debris), the most significant spikes in the debris population have been caused by discrete fragmentation events—explosions and collisions.

3.1. The Era of Explosions (1960s–2000s)

For the first four decades of the space age, the primary source of debris was the accidental explosion of spent rocket stages. Leftover fuel and oxidizer in upper stages would often over-pressurize and detonate weeks or months after a successful launch.

- **The Ariane 1 Breakup (1986):** One of the most notable early events was the breakup of an Ariane 1 rocket stage, which generated nearly 500 trackable pieces of debris.[8]

- The Pegasus/HAPS Breakup (1996): This event generated over 750 trackable fragments, further polluting LEO.

These events highlighted the need for "passivation"—the practice of venting leftover fuel and discharging batteries at the end of a mission to render the vehicle inert.

3.2. The Return of Anti-Satellite (ASAT) Testing

While accidental explosions were a chronic issue, the intentional destruction of satellites via Anti-Satellite (ASAT) weapons has caused the most severe acute damage to the environment.

3.2.1. The Fengyun-1C Event (2007)

On January 11, 2007, the People's Republic of China conducted a kinetic ASAT test that fundamentally altered the LEO environment. A ground-based missile intercepted the defunct Chinese weather satellite *Fengyun-1C* at an altitude of 865 km.

- **The Impact:** The collision occurred at hypervelocity, completely pulverizing the 950 kg satellite. It instantly created the single largest debris cloud in history, consisting of over 3,000 trackable fragments and an estimated 150,000 shards larger than 1 cm.
- **Long-Term Consequences:** Because the test was conducted at a high altitude (~865 km), atmospheric drag is negligible. NASA models indicate that this debris cloud is extremely stable; the fragments will remain in orbit for decades, if not a century. The cloud rapidly dispersed into a shell around the Earth, increasing the collision risk for sun-synchronous satellites (like the Italian COSMO-SkyMed) by nearly 40%.

3.2.2. Operation Burnt Frost (USA, 2008)

In response to a malfunctioning satellite (*USA-193*) containing toxic hydrazine fuel, the United States conducted "Operation Burnt Frost" in February 2008. A ship-launched SM-3 missile destroyed the satellite.

- **Mitigation:** Unlike the Chinese test, this interception occurred at a very low altitude (~247 km). As a result, the majority of the debris re-entered the atmosphere within weeks or months due to high atmospheric drag, demonstrating that altitude is a critical variable in the environmental impact of such events.

3.2.3. Mission Shakti (India, 2019)

On March 27, 2019, India demonstrated its ASAT capability by destroying the Microsat-R satellite.

- **Debris Profile:** The test was conducted at 283 km. While most debris decayed rapidly, the kinetic energy of the impact kicked some fragments into higher, longer-lived orbits, adding to the background flux of the environment.

3.2.4. The Nudol Test (Russia, 2021)

The most recent major ASAT event occurred on November 15, 2021, when the Russian Federation used a PL-19 "Nudol" missile to destroy the Soviet-era satellite *Cosmos 1408*.

- **The Threat to Human Life:** The interception occurred at 480 km—uncomfortably close to the International Space Station. The explosion generated a cloud of 1,500 trackable fragments.

- **Immediate Impact:** The expansion of the debris cloud intersected the orbit of the ISS, triggering a "safe haven" alarm. Astronauts and cosmonauts were forced to don pressure suits and shelter in their return vehicles (Crew Dragon and Soyuz), prepared for an emergency evacuation if the station was struck.

- **Diplomatic Fallout:** The event drew sharp condemnation. US Secretary of State Antony Blinken described it as "reckless and irresponsible," emphasizing that the debris would threaten satellites and astronauts for years.

3.3. The Iridium-Cosmos Collision (2009)

While ASAT tests are intentional, the nightmare scenario is the accidental collision of two intact satellites. This nightmare became reality on February 10, 2009.

- **The Event:** *Iridium 33*, an operational US communications satellite, collided with *Cosmos 2251*, a defunct Russian military satellite. The collision occurred over Siberia at an altitude of 789 km.

- **Kinetic Energy:** The relative velocity of the impact was 11.7 km/s (approx. 26,000 mph). Both spacecraft were annihilated.

- **Debris Generation:** The collision produced two distinct debris clouds containing over 2,000 trackable fragments combined.
- **Significance:** This event shattered the "Big Sky" theory forever. It demonstrated that without active disposal of dead satellites, the LEO environment would eventually become a shooting gallery. The debris from this single event continues to pose a significant risk to the 700–1000 km altitude regime.

4. The International Legal Framework: Hard Law and Its Limitations

The governance of outer space is anchored in the "Five United Nations Treaties on Outer Space." These instruments, negotiated primarily during the Cold War, established the fundamental principles of space law. However, they were designed in an era when the primary concern was nuclear weaponization, not environmental degradation. Consequently, applying them to the modern debris crisis involves navigating significant interpretive gaps.

4.1. The Outer Space Treaty (1967)

The *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies* (Outer Space Treaty or OST) is the "Magna Carta" of space law.

4.1.1. Article VI: International Responsibility

Article VI creates a unique regime of state responsibility. It dictates that States Parties bear "international responsibility" for national activities in outer space, whether those activities are carried on by governmental agencies or by non-governmental entities.

- **Implication:** In terrestrial law, a state is generally not responsible for the torts of its private citizens. In space law, the state is directly responsible. If a private company (e.g., SpaceX) creates debris that causes damage, the United States government is responsible under international law. This compels states to regulate their private space industries rigorously.

4.1.2. Article VII: International Liability

Article VII establishes the principle that a State that "launches or procures the launching" of an object, or from whose territory an object is launched, is "internationally liable" for damage caused to another State Party.

- **Scope:** This liability extends to damage caused on Earth, in air space, or in outer space.

4.1.3. Article VIII: Jurisdiction and Control

Article VIII stipulates that the State on whose registry an object is carried retains "jurisdiction and control" over that object.

- **Perpetuity:** Crucially, this jurisdiction does not expire when the satellite stops working. A dead satellite from 1960 remains the sovereign property of the launching state today. This creates a legal barrier to cleanup: no other state can touch or remove that debris without violating the sovereign rights of the owner.

4.1.4. Article IX: Due Regard

Article IX requires states to conduct their activities "with due regard to the corresponding interests of all other States Parties" and to avoid "harmful contamination" of space.

- **Ambiguity:** While this could theoretically serve as a basis for anti-debris litigation, the terms "due regard" and "harmful contamination" are vague. They have historically been interpreted to refer to biological contamination or radio interference, rather than physical debris.

4.2. The Liability Convention (1972)

The *Convention on International Liability for Damage Caused by Space Objects* elaborates on Article VII of the OST, creating a bifurcated liability regime that is critical for debris analysis.[25]

4.2.1. Article II: Absolute Liability

"A launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to aircraft in flight".

- **Meaning:** This is a strict liability standard. The claimant does not need to prove the launching state was negligent or at fault. If a piece of debris falls on a house in Paris, the launching state pays.

- **Precedent:** This was the legal basis for the claim when the Soviet nuclear-powered satellite *Cosmos 954* crashed into Canada in 1978, contaminating a vast area with radioactive debris. The USSR paid Canada roughly $3 million CAD in settlement.

4.2.2. Article III: Fault-Based Liability

"In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State... by a space object of another launching State, the latter shall be liable only if the damage is due to its fault".

- **The Trap:** For collisions *in orbit* (where debris problems happen), the victim must prove "fault."

- **The Definition Gap:** The Convention does not define "fault".[24] Does "fault" mean negligence? If so, what is the standard of care? If a state followed the standard practices of 1990 when it launched a satellite, is it "negligent" if that satellite explodes in 2024?

- **Attribution:** Proving fault requires proving identity. In the vast majority of debris impacts, the projectile is a millimeter-sized fleck of paint or metal that vaporizes on impact. It is usually impossible to identify which state launched that specific speck of debris, rendering Article III functionally useless for most small-debris litigation.

4.3. The Definition of "Space Object" vs. "Space Debris"

A persistent ambiguity in the treaties is the lack of a legal definition for "space debris."

- **Status Quo:** The treaties define "space object" to include "component parts of a space object as well as its launch vehicle".[26] Legal scholars and US registration practices suggest that debris fragments are considered "component parts".

- **Consequence:** This confirms that debris remains a "space object" under the law. Therefore, the strict ownership rules of Article VIII apply to even the smallest fragment of junk. This "ownership in perpetuity" confirms that no "law of salvage" exists in space; one cannot simply collect abandoned space junk as one might collect a derelict vessel on the high seas.

5. Soft Law and Mitigation Guidelines: The Shift to Voluntary Norms

Given the difficulty of amending the hard treaties (which requires consensus among geopolitical rivals), the international community has pivoted to "soft law"—non-binding guidelines that establish technical norms for responsible behavior.

5.1. The IADC Space Debris Mitigation Guidelines

The *Inter-Agency Space Debris Coordination Committee* (IADC) is the premier technical body for debris research. Its guidelines, first published in 2002 and revised subsequently, serve as the industry standard.

Key Provisions:

1. **Limiting Debris Release:** Spacecraft should be designed not to release mission-related debris (e.g., sensor covers, separation bolts) during normal operations.[29]

2. **Passivation:** To prevent accidental explosions—the historic leading cause of debris—operators must deplete all stored energy sources at the end of a mission. This includes venting leftover fuel tanks and discharging batteries to prevent over-pressurization or thermal runaway.

3. **The 25-Year Rule (Post-Mission Disposal):** The most famous guideline. It recommends that satellites in LEO be removed from orbit within 25 years of the end of their mission. This can be achieved by maneuvering the satellite into a trajectory that will cause it to re-enter the Earth's atmosphere and burn up.

4. **Collision Avoidance:** Operators should calculate collision probabilities and perform avoidance maneuvers if the risk exceeds acceptable thresholds.

Citation Note: These guidelines were formally submitted to the UN under document code *A/AC.105/C.1/L.260*.

5.2. UNCOPUOS Guidelines for the Long-term Sustainability (LTS)

In 2019, the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS) adopted a set of 21 guidelines for the *Long-term Sustainability of Outer Space Activities*.

- **Policy Focus:** Unlike the purely technical IADC guidelines, the LTS guidelines focus on policy and regulatory frameworks.
- **Guideline B.1 and B.2:** These urge states to adopt national regulatory frameworks that enforce debris mitigation as a condition for granting launch licenses.
- **Guideline B.6:** Promotes the sharing of orbital data to improve space situational awareness.

5.3. Compliance and Effectiveness: A Mixed Record

Are these voluntary guidelines working? The data suggests only partial success.

- **Compliance Rates:** According to the ESA's 2024 report, compliance is improving but remains inadequate. For satellites in LEO that have reached their end-of-life and lack "natural" decay (i.e., they must be actively maneuvered to de-orbit), the compliance rate with the disposal guidelines is only about **60%**. This means roughly 40% of high-altitude LEO satellites are still being abandoned, adding to the long-term clutter.
- **The "Zero Debris" Approach:** recognizing that the 25-year rule is too lenient for the modern era of mega-constellations, ESA has introduced a "Zero Debris Charter." This initiative aims to reduce the post-mission disposal timeline from 25 years to just **5 years** and targets a "debris neutral" status by 2030.

6. The Remediation Imperative: Active Debris Removal (ADR)

The consensus among orbital debris experts is that mitigation alone is no longer sufficient. Even if all launches ceased today, the collision of existing debris would continue to increase the population (Kessler Syndrome). To stabilize the environment, humanity must engage in *Remediation*—the active removal of large, dangerous objects from orbit.

6.1. Technological Solutions: The Engineering of Cleanup

Active Debris Removal (ADR) is one of the most challenging engineering feats imaginable. It involves launching a "chaser" satellite to rendezvous with a "target"—typically a spent rocket stage weighing several tons.

- **The Challenge:** The target is "uncooperative." It is tumbling, has no grappling fixtures, and may be fragile due to decades of exposure to the harsh space environment.
- **Methods:** Proposed capture mechanisms include robotic arms, throw-nets, harpoons, and magnetic grapples.
- **Pathfinder Mission:** The European Space Agency has commissioned the **ClearSpace-1** mission, the world's first commercial ADR mission. Scheduled for launch in 2025, it aims to capture a Vespa (Vega Secondary Payload Adapter) upper stage left in orbit from a 2013 launch. The chaser will use a four-armed robotic capture system to grab the Vespa and drag it into the atmosphere for a destructive re-entry.

6.2. The Legal Quagmire of ADR

While the technology is maturing, the legal framework for ADR is paralyzed by the "ownership" issue discussed in Section 4.

- **Consent is King:** Because the target object belongs to the launching state in perpetuity, no ADR mission can touch a piece of debris without the express consent of the owner.[28]
- **Sovereign Immunity:** Many of the most dangerous objects are spent rocket stages from Cold War-era military launches (Soviet Zenit stages, US Centaur stages). These are military assets protected by sovereign immunity. A private company like Clear Space cannot legally salvage a Russian military rocket body without a formal treaty or agreement between the nations involved.
- **Liability:** If an ADR mission goes wrong—for example, if the chaser satellite accidentally smashes into the target and creates *more* debris—who is liable? Under the Liability Convention, the state launching the ADR mission would be liable. This creates a massive financial risk.
- **Insurance:** The insurance market for ADR is nascent. For ClearSpace-1, the question of insuring a mission designed to intentionally collide with another object is rewriting

the rules of space insurance. States like the UK and France are developing indemnity schemes to protect operators, capping their liability if they adhere to sustainability standards.

6.3. The Security Dilemma: Dual-Use Technology

Perhaps the most potent barrier to ADR is geopolitical. The technology required to remove a piece of debris is inherently "dual-use."

- **The Weaponization Fear:** A satellite capable of maneuvering up to a defunct rocket stage, grappling it, and de-orbiting it is functionally identical to a space weapon capable of grappling an active enemy satellite and destroying it.
- **Strategic Mistrust:** If a nation deploys a fleet of "debris removal" satellites, adversaries may view this as the deployment of a covert ASAT capability. This is the "Security Dilemma" in space: defensive environmental actions can be misinterpreted as offensive military posturing.
- **Transparency:** To overcome this, scholars argue for extreme transparency in ADR operations, including on-orbit inspections and international notification regimes, to verify that "garbage trucks" are not "warships" in disguise.

7. Conclusion: The Fork in the Road

The research presented in this report leads to an inescapable conclusion: the status quo in Low Earth Orbit is unsustainable. The "Big Sky" is gone. We have replaced it with a fragile, congested ecosystem where the mistakes of the past—ASAT tests, explosions, and abandoned stages—threaten the promise of the future.

The current legal regime, built on the foundations of the 1967 *Outer Space Treaty*, has successfully prevented nuclear war in space but has failed to prevent environmental degradation. The "fault-based" liability standard of the ***Liability Convention*** is ill-suited for a debris environment where the "bullet" is often invisible and untraceable. While voluntary "soft law" guidelines like those of the IADC have improved the behaviour of new actors, the legacy population of debris remains a ticking time bomb that mitigation alone cannot defuse.

The transition to Active Debris Removal is therefore not a luxury but a necessity. However, this transition requires a "grand bargain" in international law. Nations must find a way to navigate the absolute ownership of space objects, perhaps by creating legal mechanisms for "abandonment" or "consent-by-default" for clearly hazardous debris. Simultaneously, the dual-use nature of ADR technology demands a new era of transparency to prevent environmental cleanup from sparking a geopolitical arms race.

As we look toward 2030, the choice is stark. We can invest in the legal and technological infrastructure of remediation, accepting the short-term costs and risks. Or, we can continue to rely on passive mitigation, gambling that the statistical probability of the Kessler Syndrome does not catch up with us. The data from the 2024 reports suggests that the time for gambling is over.

Statistical Annex

Table 1: The Master-8 Debris Population Estimate (August 2024)

A hierarchical breakdown of the anthropogenic orbital population.

Object Size	**Estimated Population**	**Detectability**	**Kinetic Threat**
> 10 cm	~54,000	Trackable (Radar/Optical)	Total spacecraft destruction; Fragmentation event.
1 cm – 10 cm	~1,200,000	Non-Trackable	Mission-ending damage; Hull penetration.
1 mm – 1 cm	~130,000,000+	Non-Trackable	Sensor degradation; Surface erosion; Power loss.
Source: ESA Space Debris Environment Report 2024.			

Table 2: Major Historical Fragmentation Events

Events that fundamentally altered the debris flux.

Event	**Date**	**Type**	**Altitude**	**Debris Impact**
Fengyun-1C	Jan 11, 2007	Chinese ASAT Test	865 km	Created >3,000 trackable fragments; long-lived high-altitude cloud.[11]
Iridium 33 / Cosmos 2251	Feb 10, 2009	Accidental Collision	789 km	Created >2,000 trackable fragments; first satellite-satellite hypervelocity impact.[17]
Mission Shakti	Mar 27, 2019	Indian ASAT Test	283 km	Low altitude test; majority of debris decayed rapidly due to drag.[9]
Cosmos 1408	Nov 15, 2021	Russian ASAT Test	480 km	Created >1,500 fragments; intersected ISS orbit causing "safe haven" alarm.[14]

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