National Aeronautics and Space Administration

Orbital Debris: A Policy Perspective

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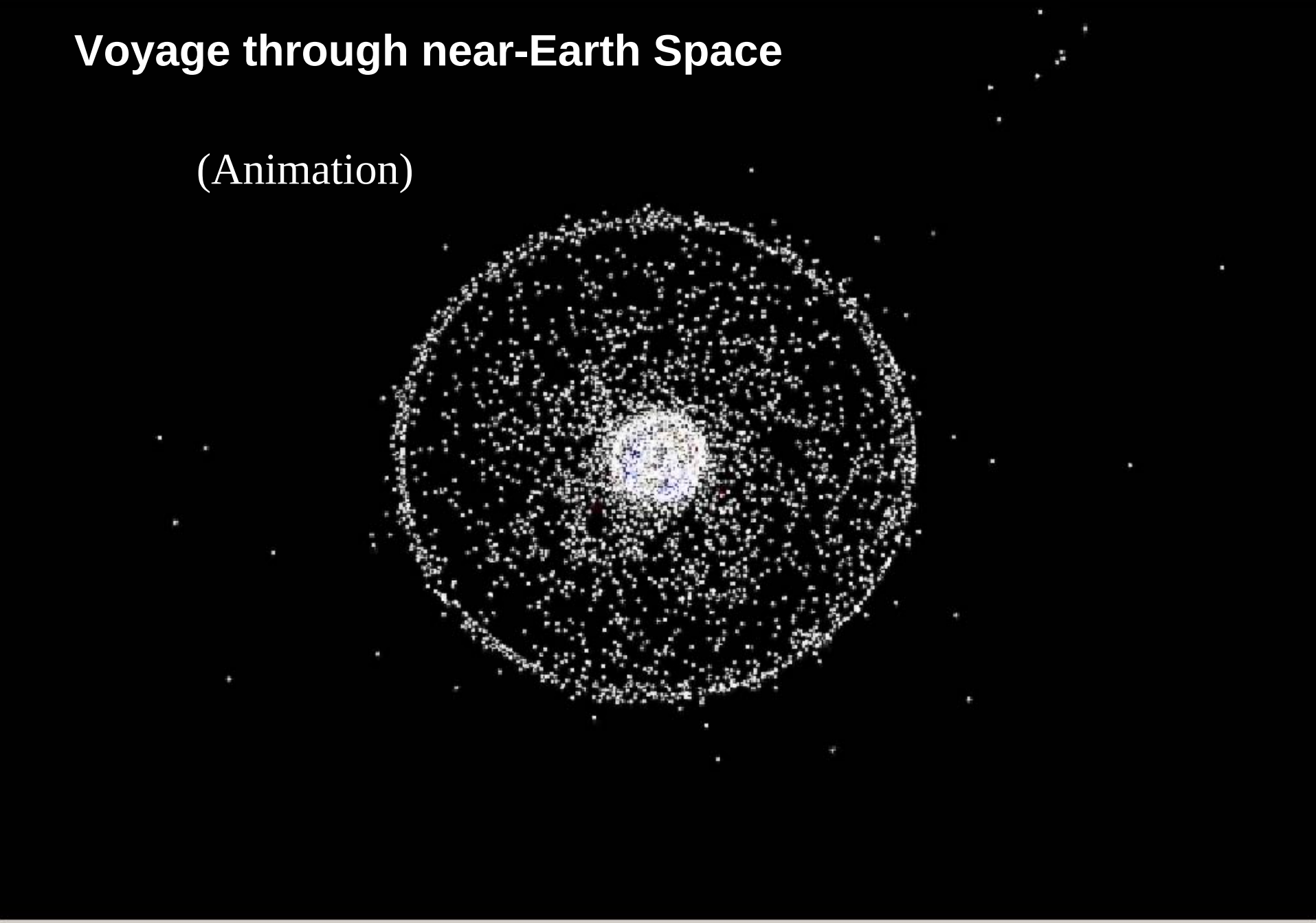
The Jefferson Society
University of Virginia

Voyage through near-Earth Space

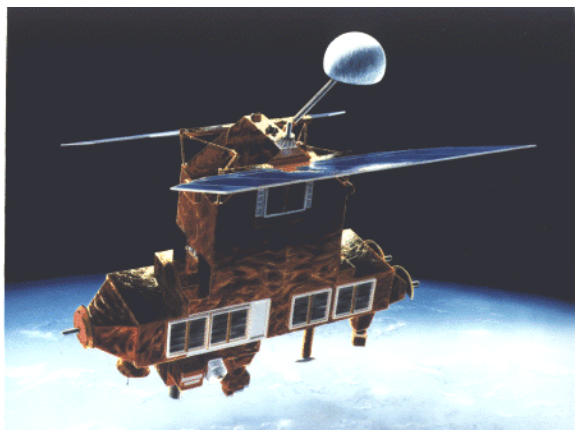
(Animation)



flythrough_SD_150sec.avi

What is Orbital Debris?

- **Space debris encompasses both natural (meteoroid) and artificial (man-made) particles.**
  - **Meteoroids are in orbit about the Sun**
  - **Orbital debris are man-made and in orbit about the Earth**

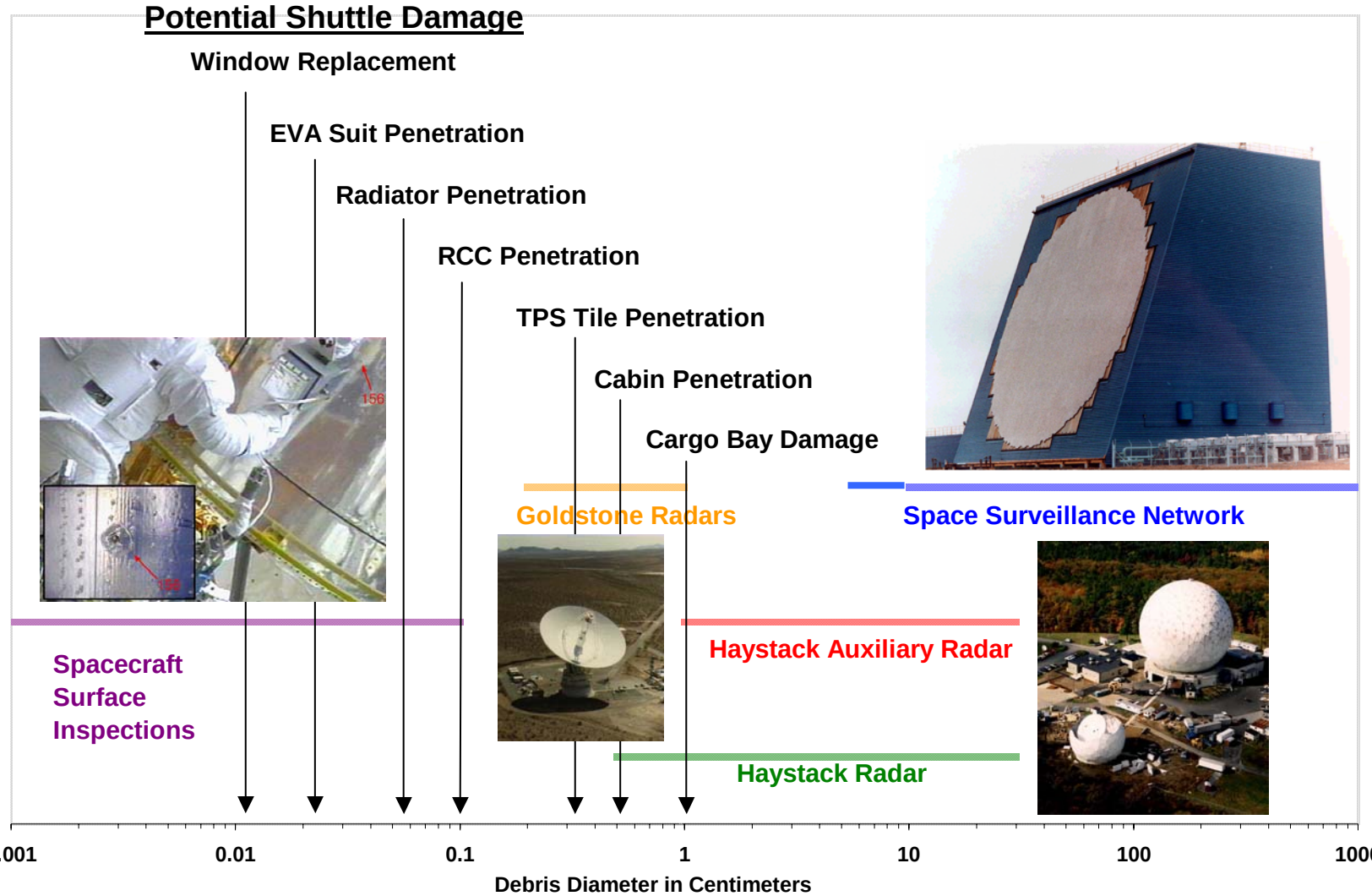


Non-operational Spacecraft

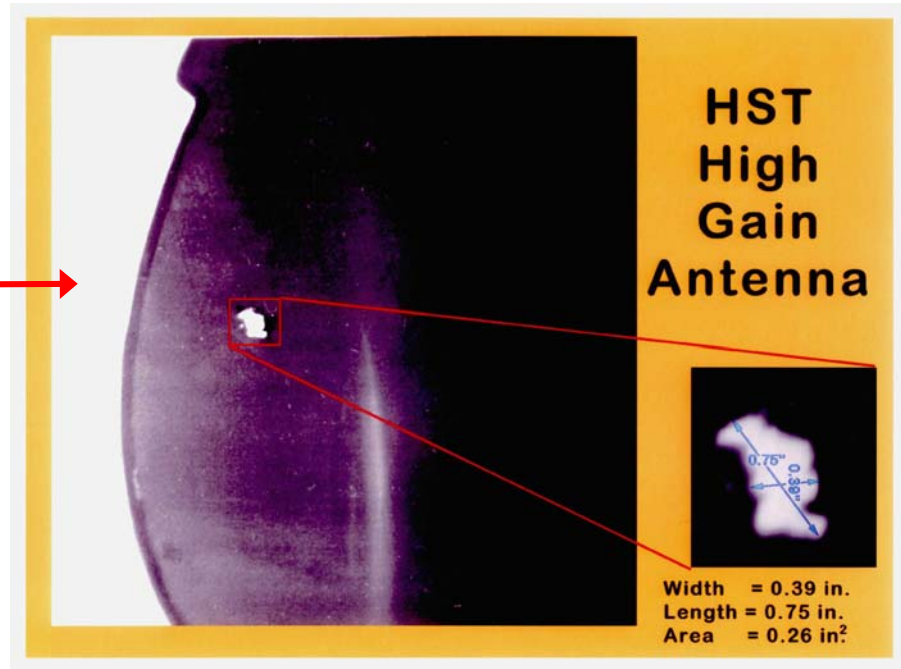
Derelict Launch Vehicle Stages

Fragmentation and Mission-related Debris

Orbital Debris Detectors and Damage Potential

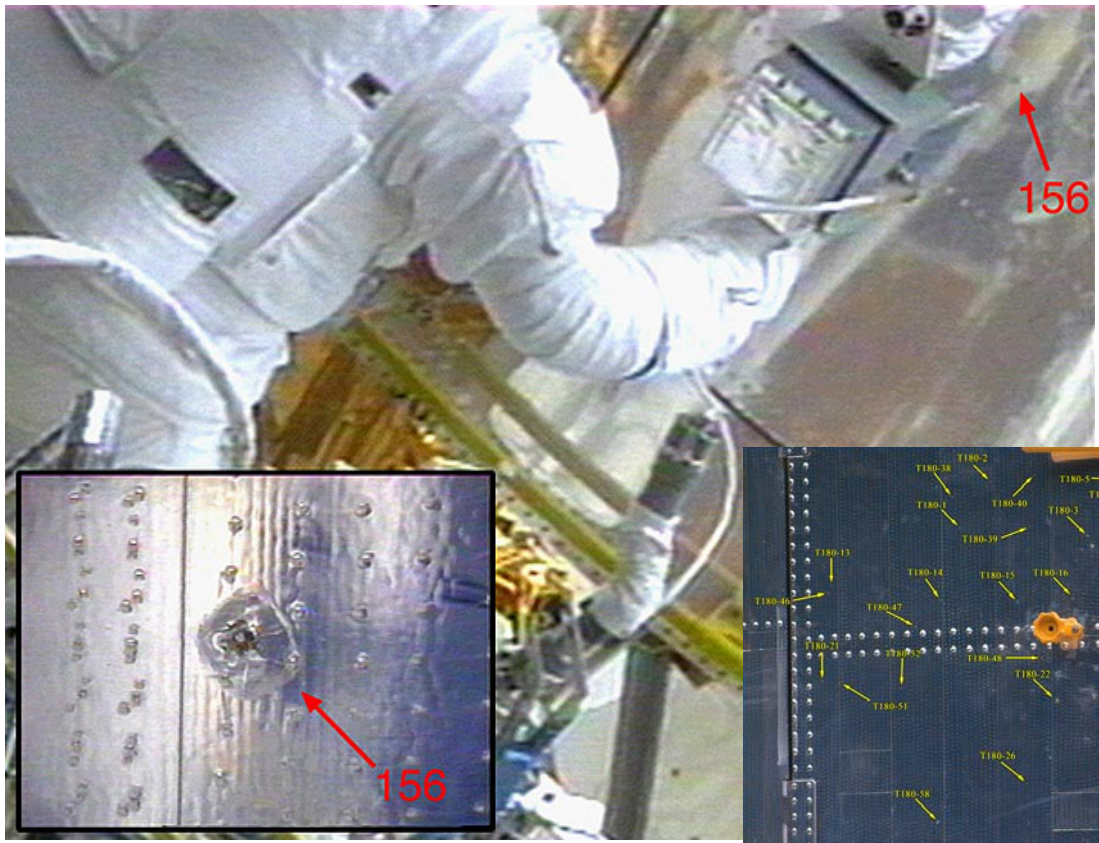


Hubble Space Telescope

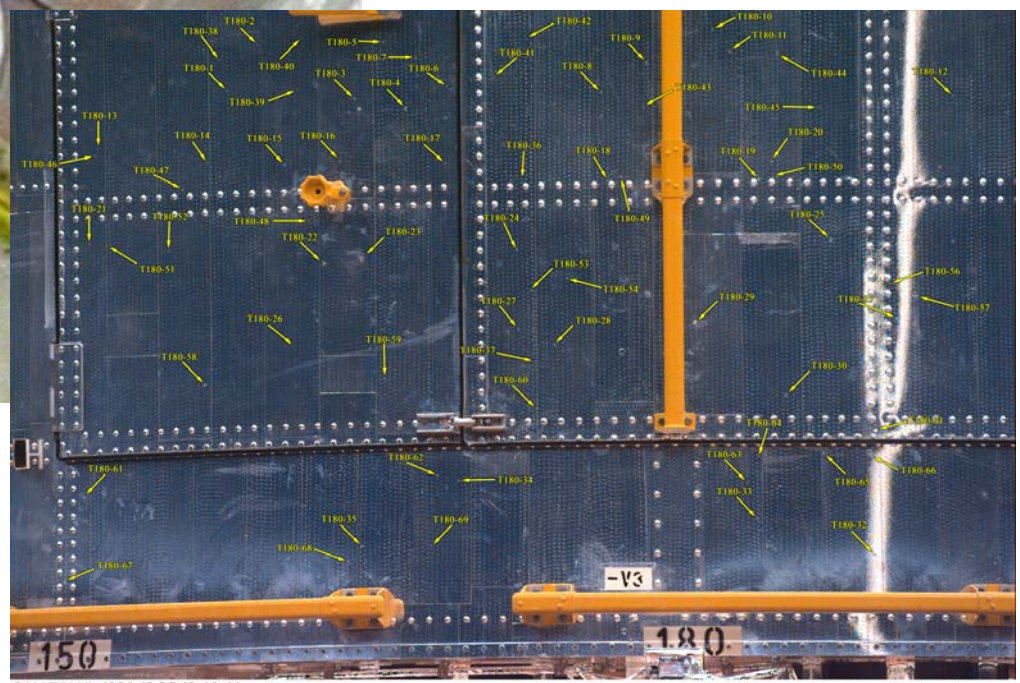


- **The Hubble Space Telescope suffered a significant impact in one high gain antenna during its first four years in space.**

Hubble Space Telescope (continued)

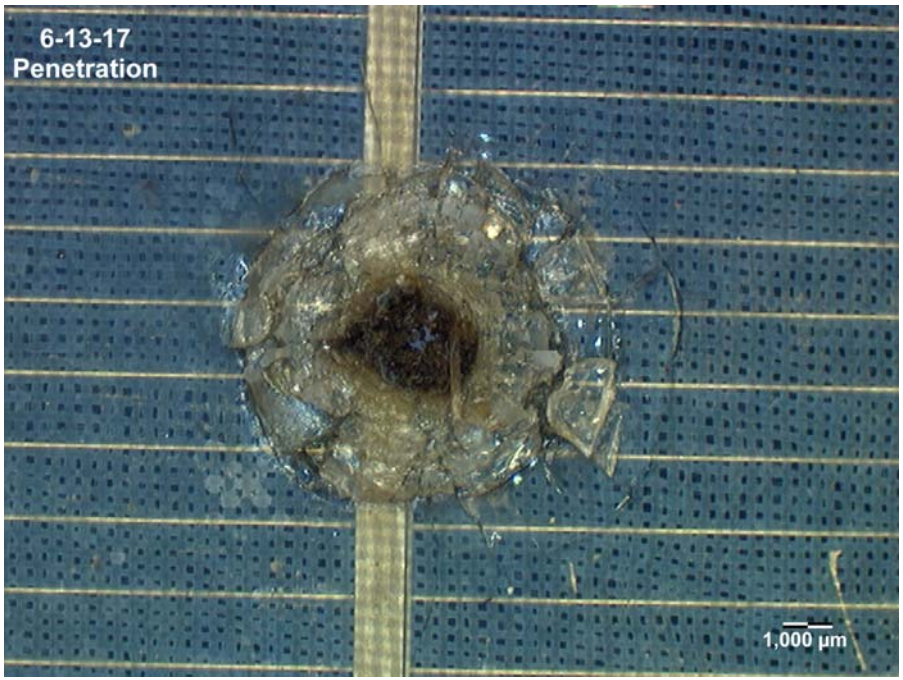


After 7 years in space the Hubble Space Telescope had been peppered with more than 500 craters on its aft shroud.

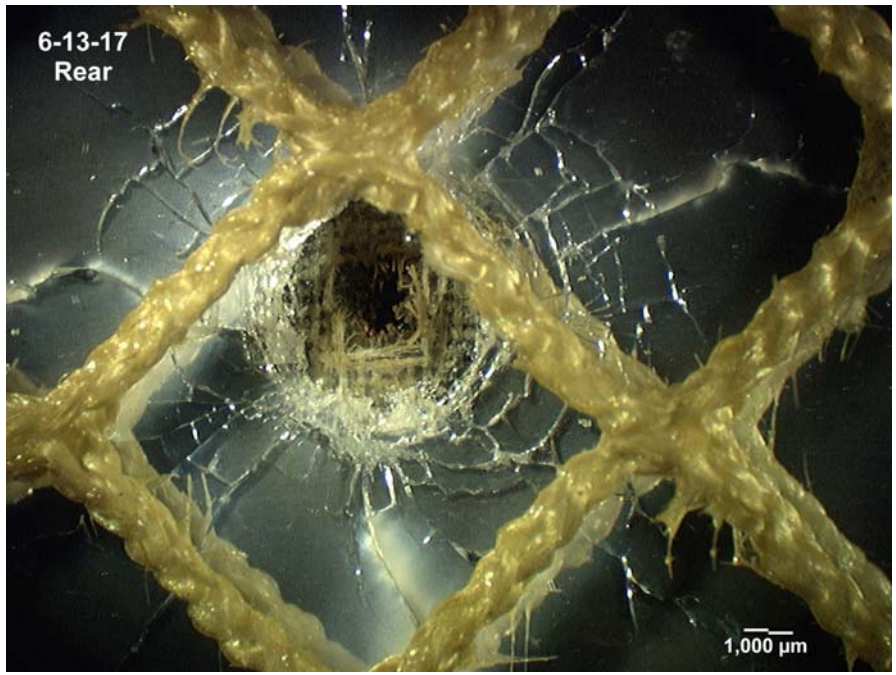


Mir Space Station Solar Array

- **Sample impact from Mir solar array returned in 1998 by Space Shuttle.**

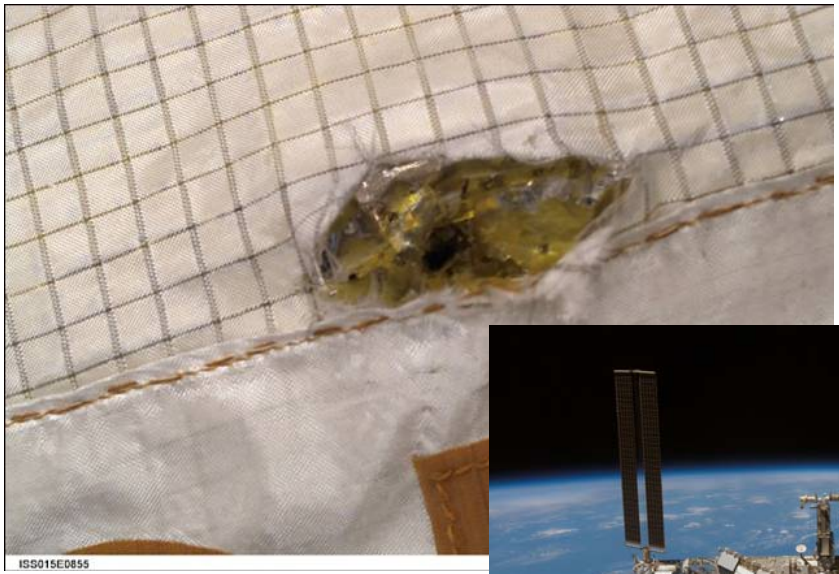


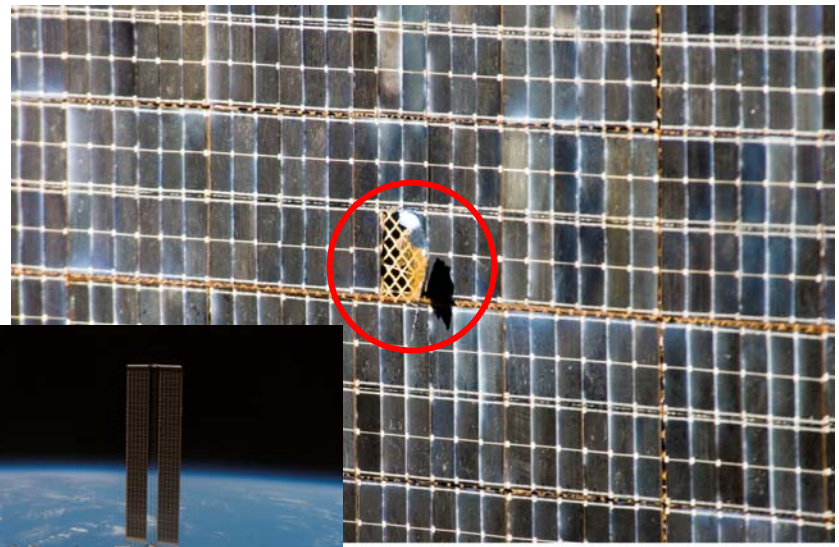
Front of Panel

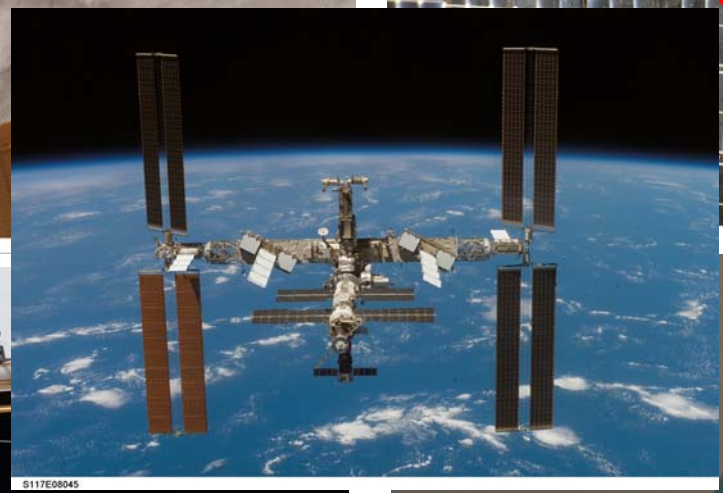


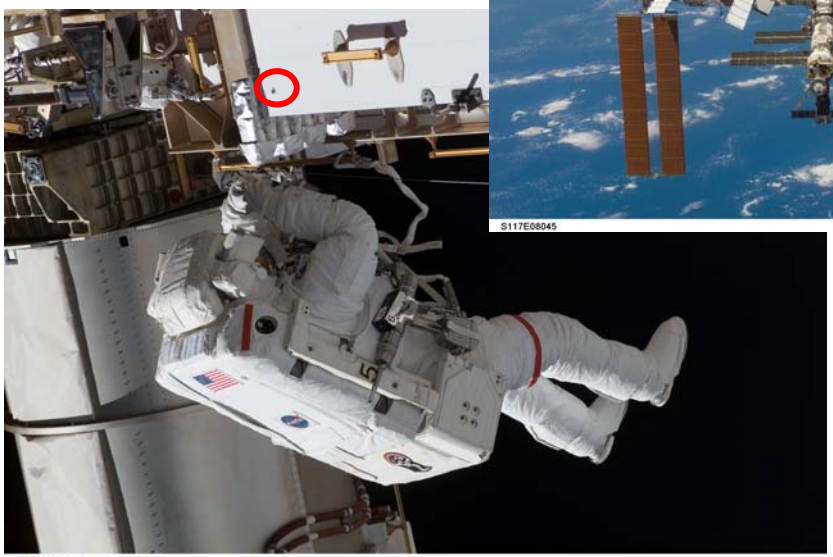
Rear of Panel

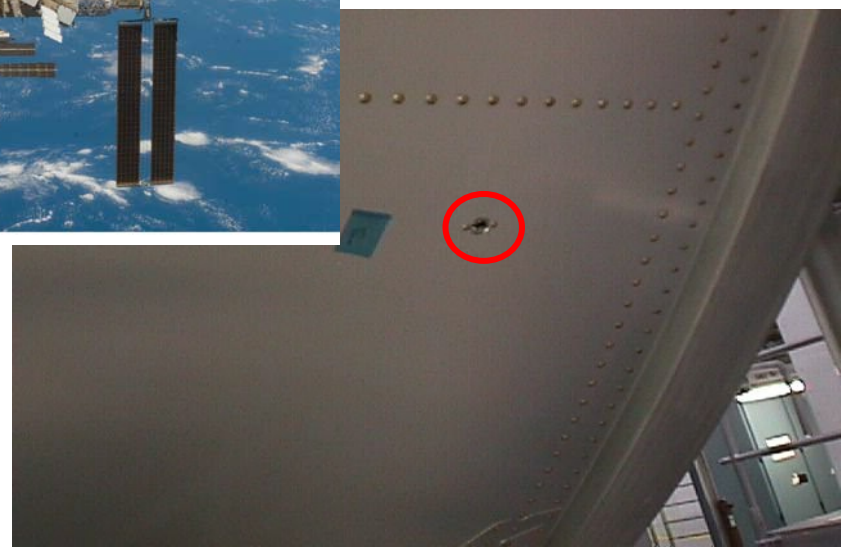
International Space Station



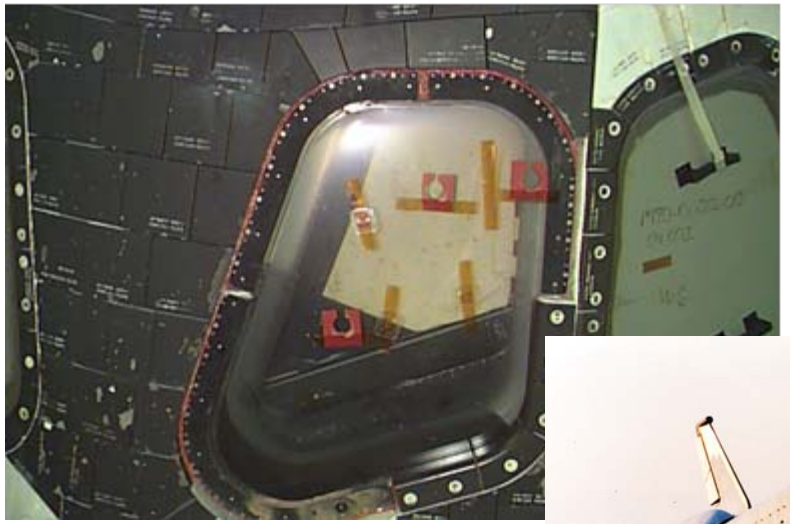


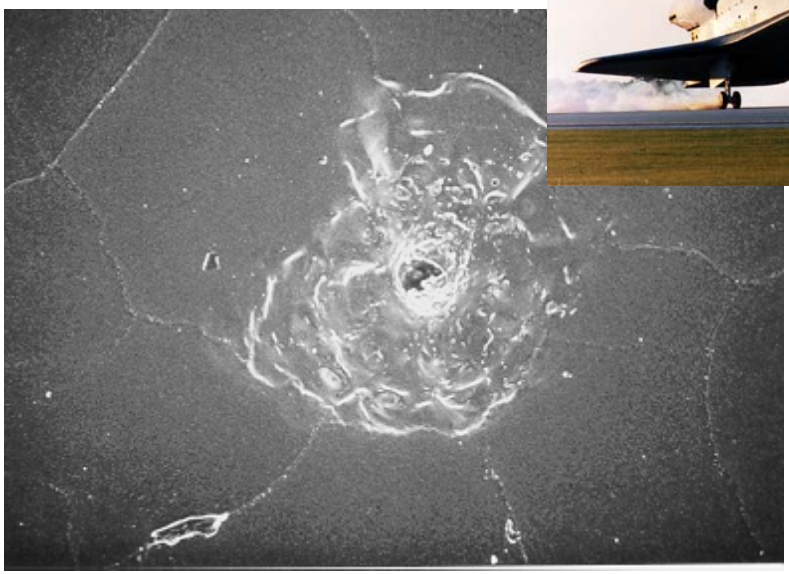


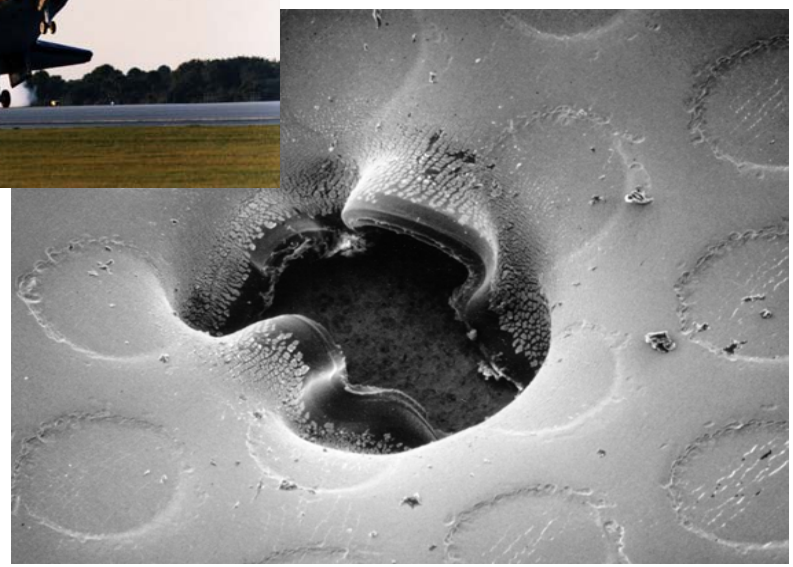




Space Shuttle

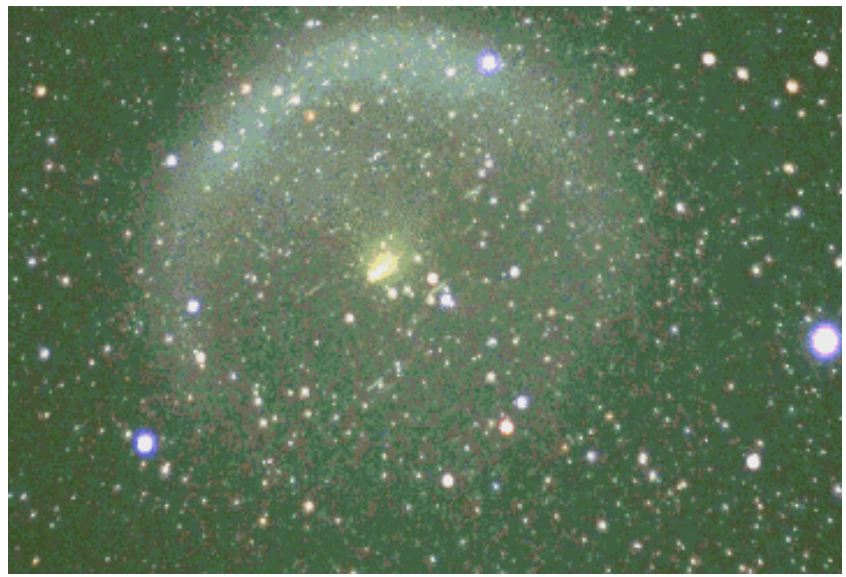






Satellite Explosions

- **Nearly 200 satellite breakups identified since 1961**
  - **Primary source of orbital debris larger than 1 cm**

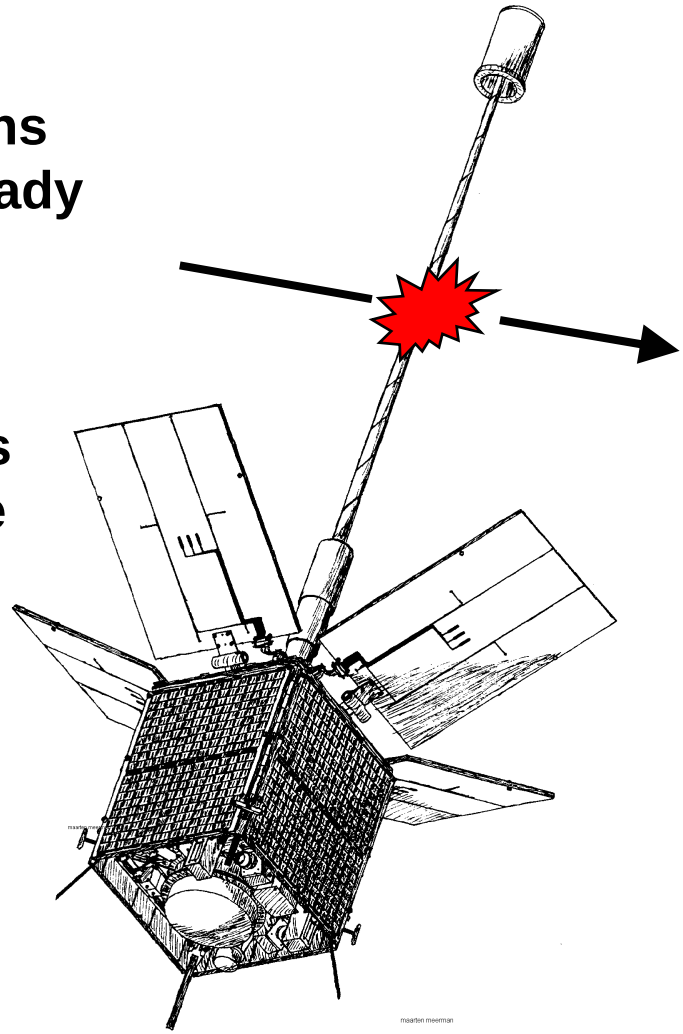


Explosion of Russian Launch Vehicle Stage in February 2007

Satellite Collisions

- **Three accidental satellite collisions from different missions have already been identified.**

- **In the future, accidental collisions among derelict objects will be the greatest source of new debris.**



NASA Orbital Debris Mitigation Guidelines

- **Avoid the unnecessary release of orbital debris**
- **Avoid accidental and deliberate satellite fragmentations**
- **Properly dispose of spacecraft and launch vehicle orbital stages**
- **Protect people and property on Earth from reentering debris**

International Space Station Jettison Policy

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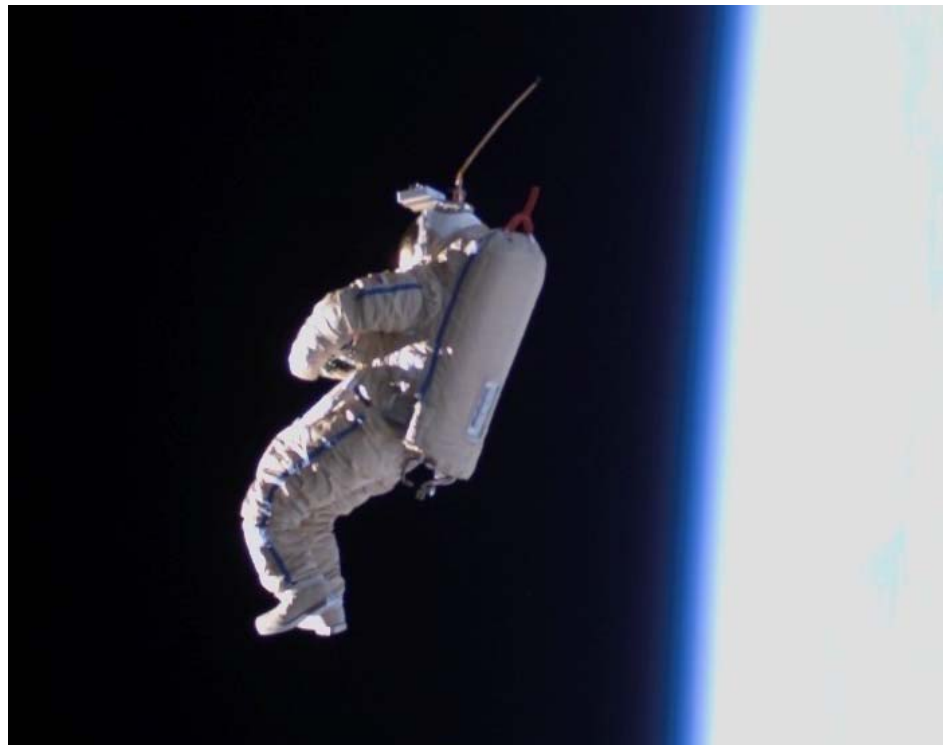


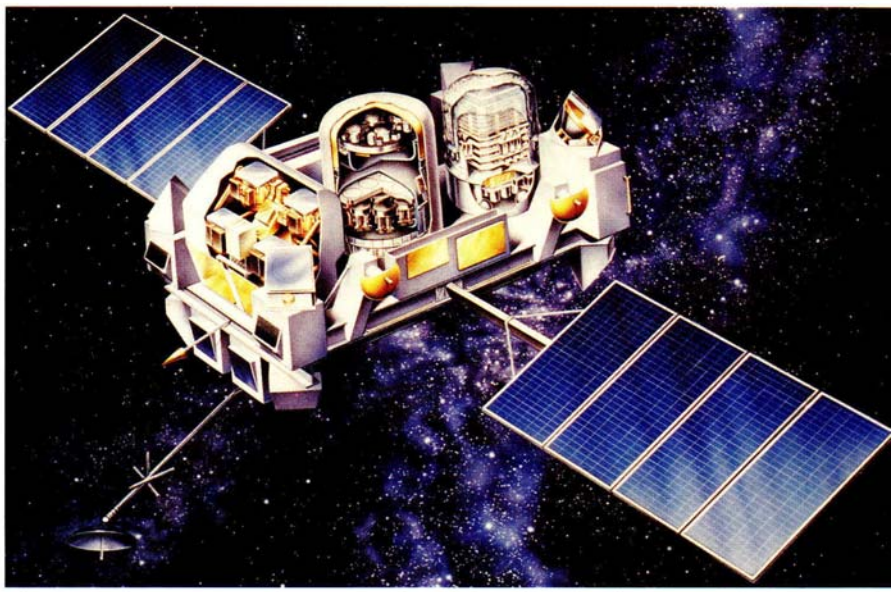
SUITSAT

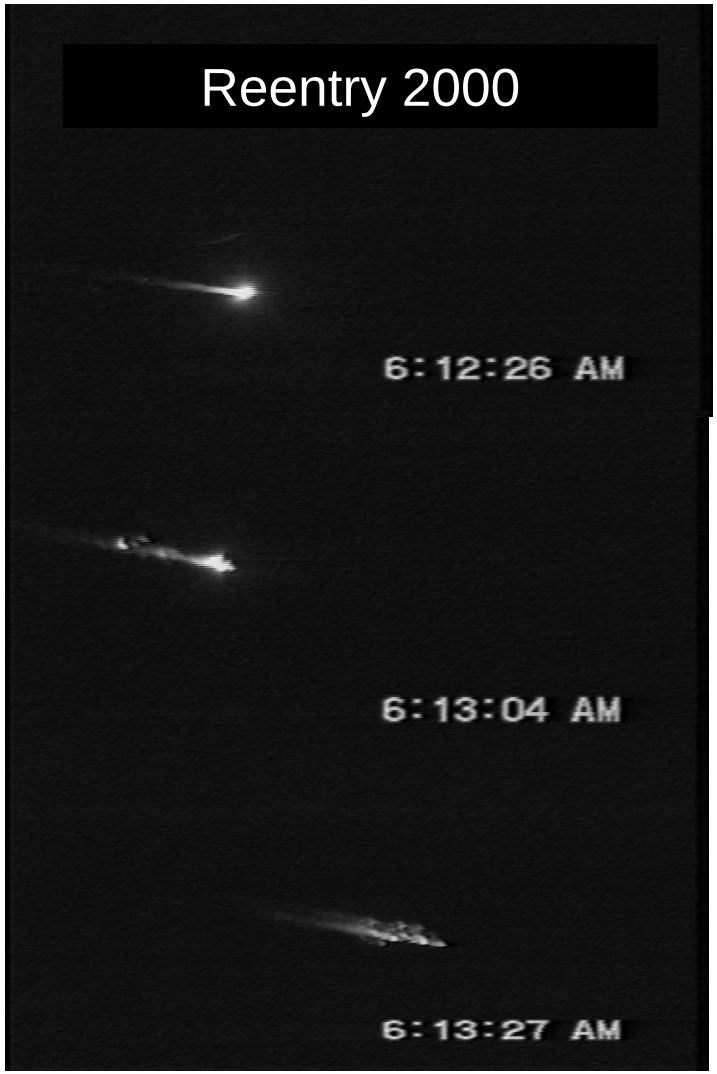
International Space Station Jettison Policy

(Video)

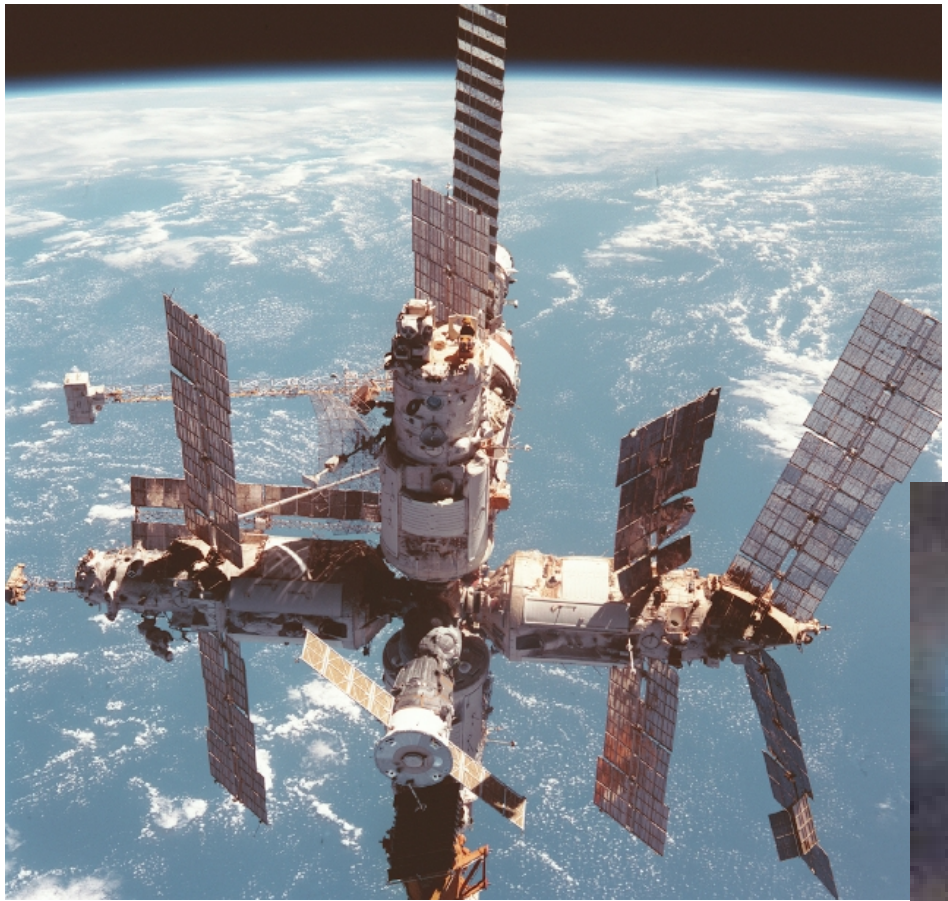
Controlled Satellite Reentries

Compton Gamma Ray Observatory





Controlled Satellite Reentries



Mir Space Station

Reentry 2001

Uncontrolled Satellite Reentries

- **Georgetown, Texas, 1997**

Return of Space Objects

- **Nose cone launched in October 1998**
- **Washed ashore in Texas in Feb 2000**
- **Returned to France in 2004**

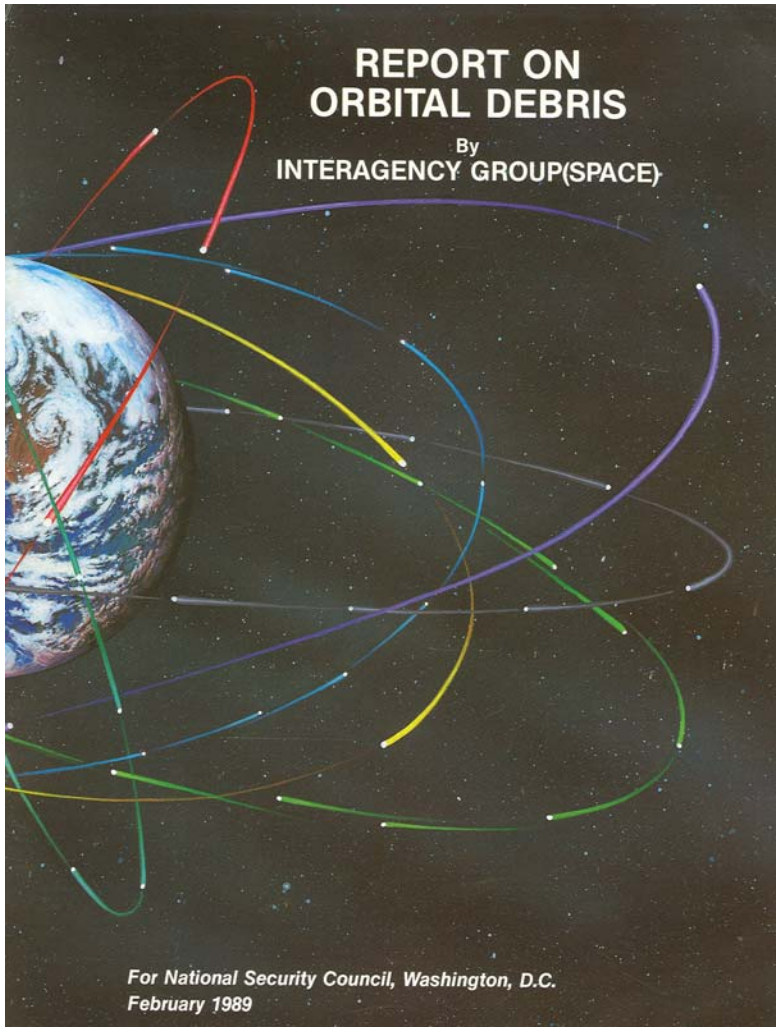
Orbital Debris and U.S. National Space Policy

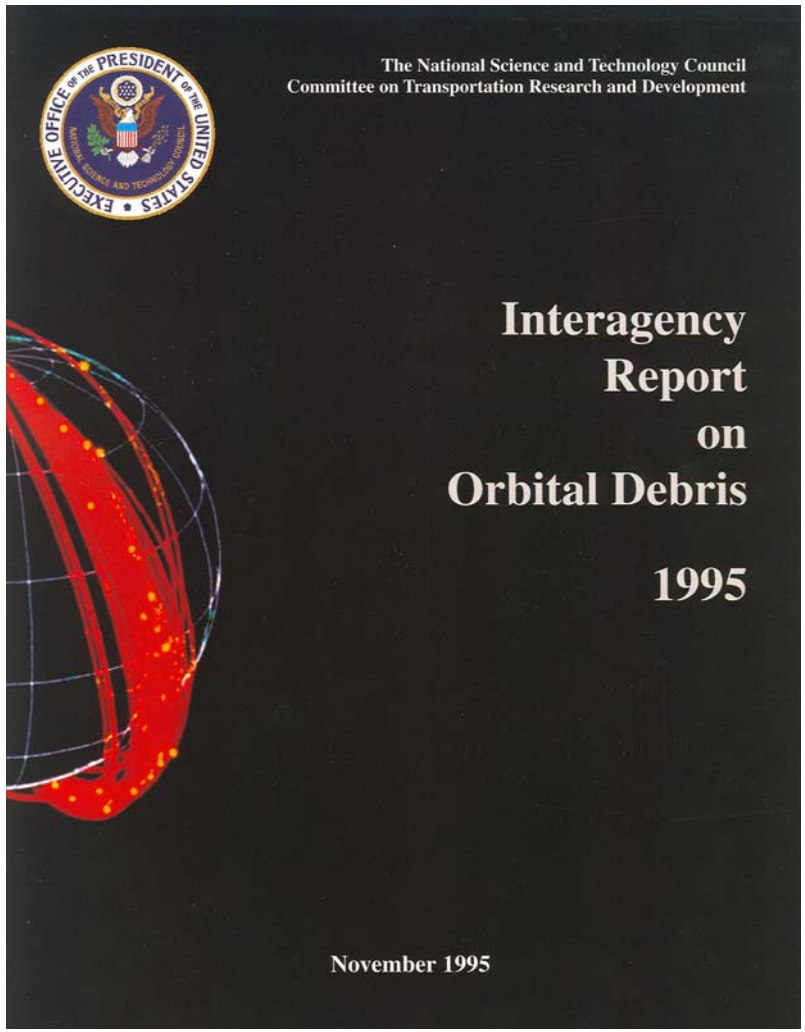
- **Orbital debris has been addressed in all U.S. national space policies since 1988.**

- **New National Space Policy (signed 31 August 2006 by President Bush) states:**

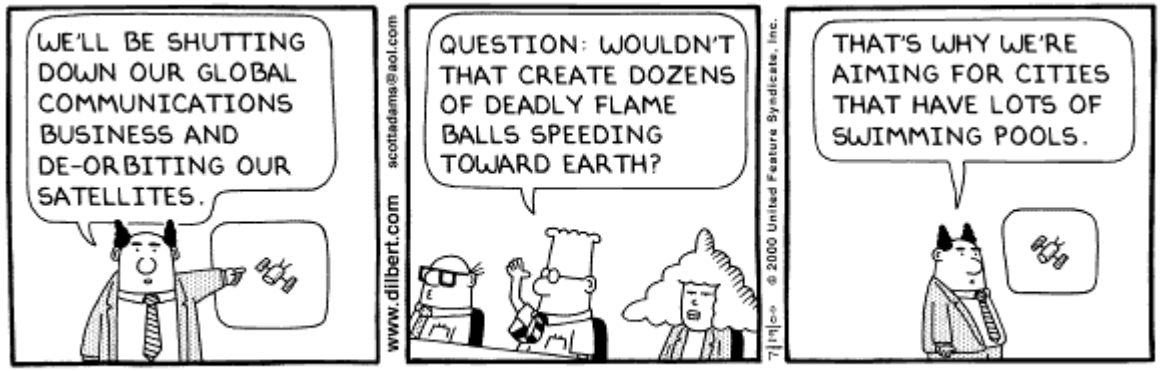
"Orbital debris poses a risk to continued reliable use of space-based services and operations and to the safety of persons and property in space and on Earth. The United States shall seek to minimize the creation of orbital debris by government and non-government operations in space in order to preserve the space environment for future generations."

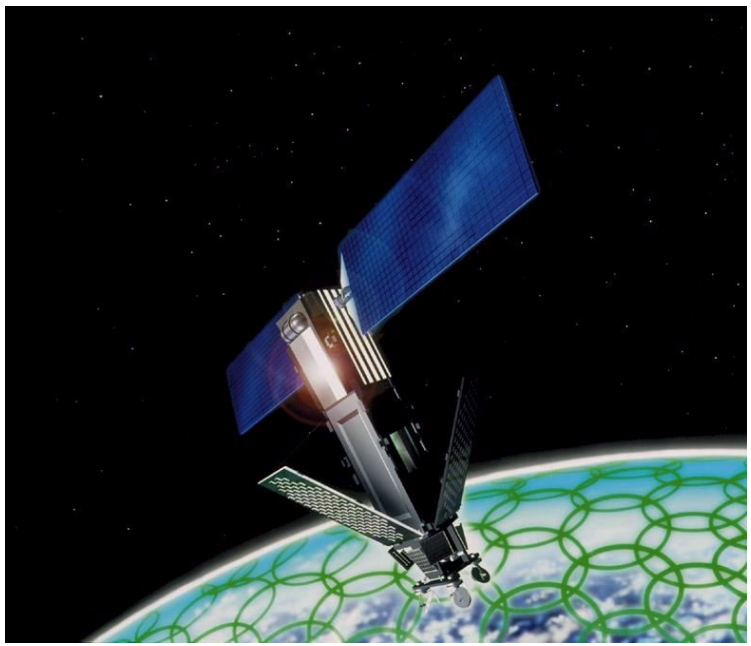
U.S Government Policy Strategy





Bankruptcy of the Iridium Satellite System





Inter-Agency Space Debris Coordination Committee (IADC)

Italy

United Kingdom

France

China

European Space Agency

Germany

India

Japan

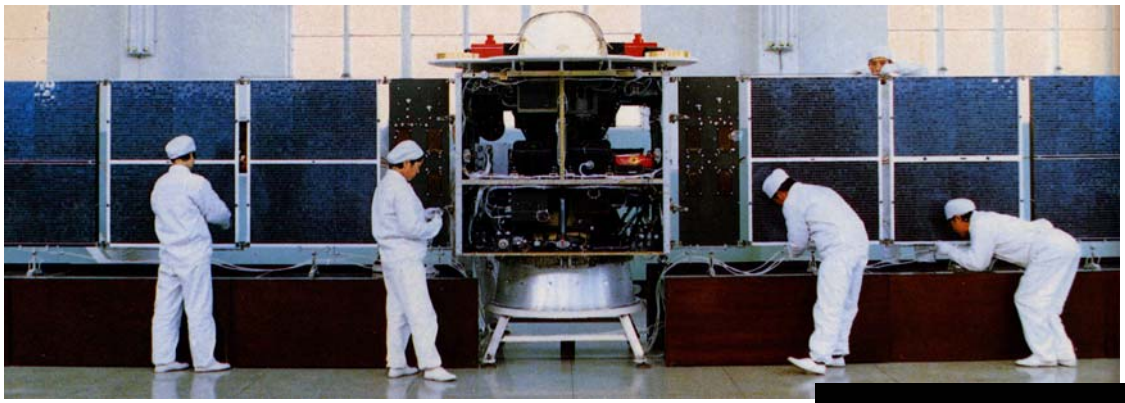
Ukraine

US

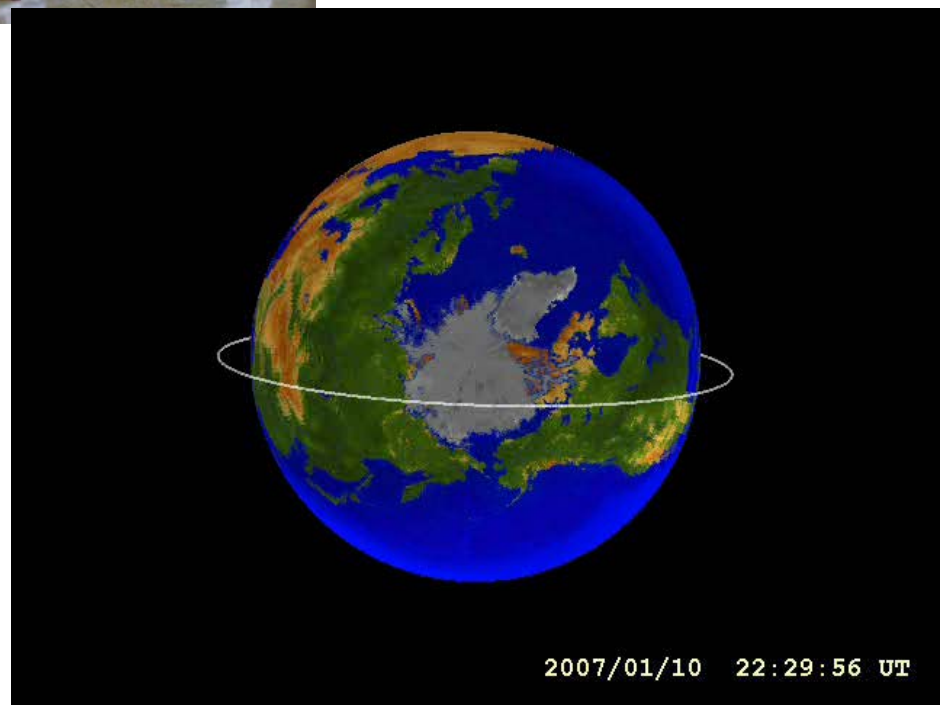
Russia

Orbital Debris at the United Nations

Chinese Anti-satellite System



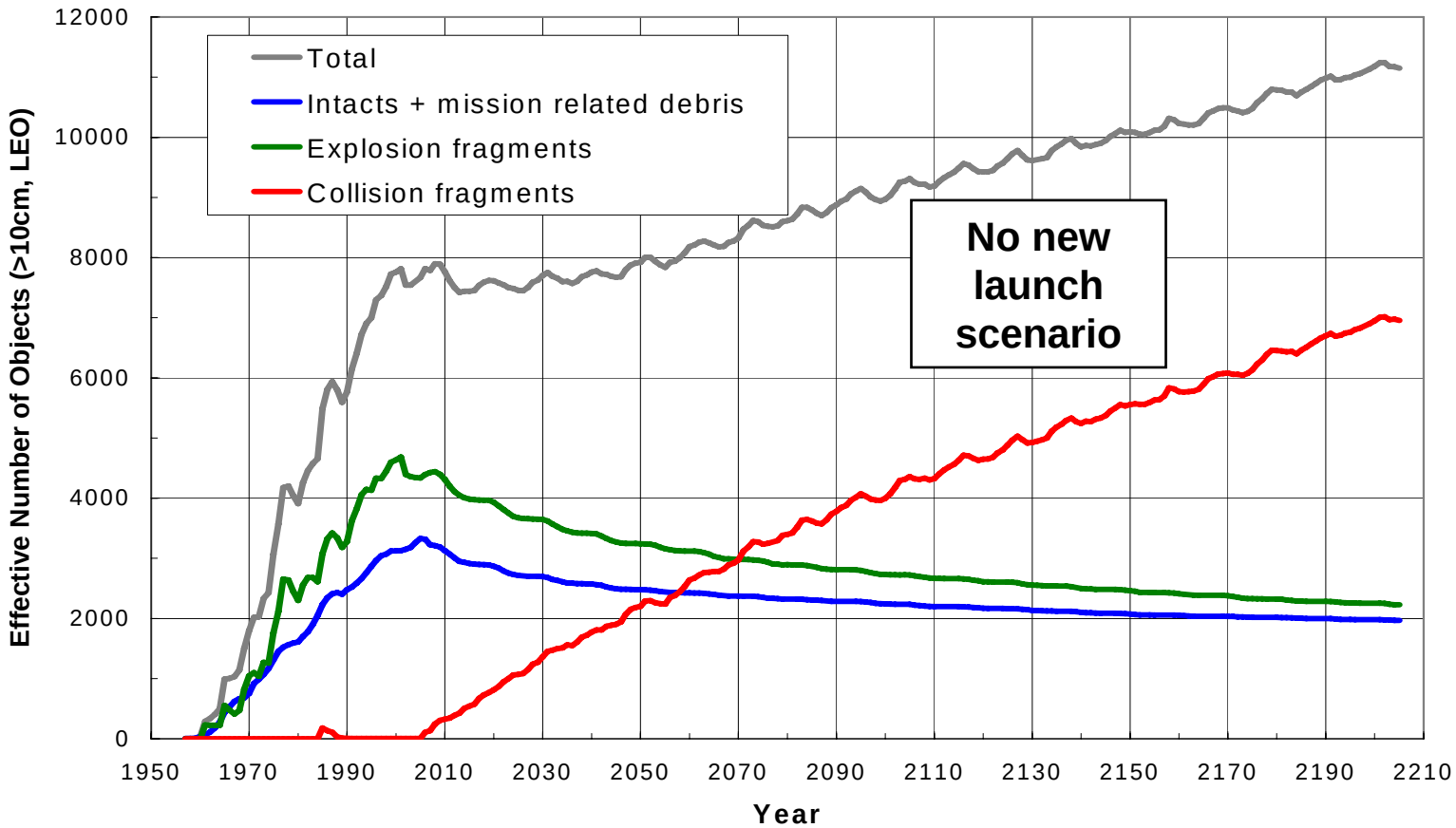
(Animation)



- **Test conducted 11 Jan 2007**
- **~2500 large orbital debris**
- **Some debris will remain in orbit for > 100 years**

Future Evolution of Satellite Population

- **In the future accidental collisions will dominate the growth of debris population.**



Challenge of Orbital Debris

- **Failure to curtail the growth of orbital debris will eventually lead to potential loss or limitation of the practical use of portions of near-Earth space for economic, scientific, and national security purposes.**

- **The challenge of orbital debris is to identify economically acceptable, but effective, mitigation practices which will be implemented by the majority of international space-faring community.**

  - **The alternative is to bequeath a degraded space environment to future generations**