Active In-situ Observations of Space Debris Environment in 800 km Altitude Regime: A Proposal

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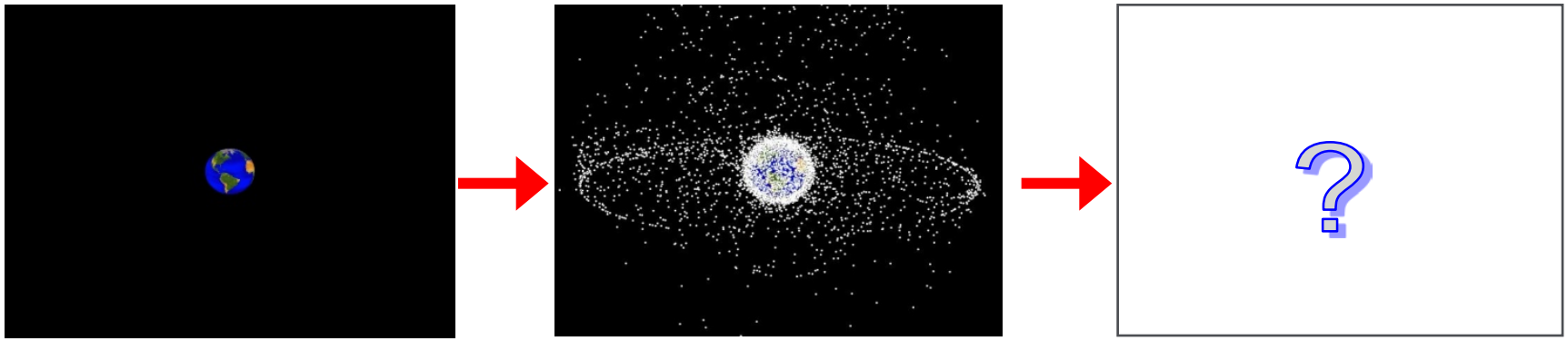
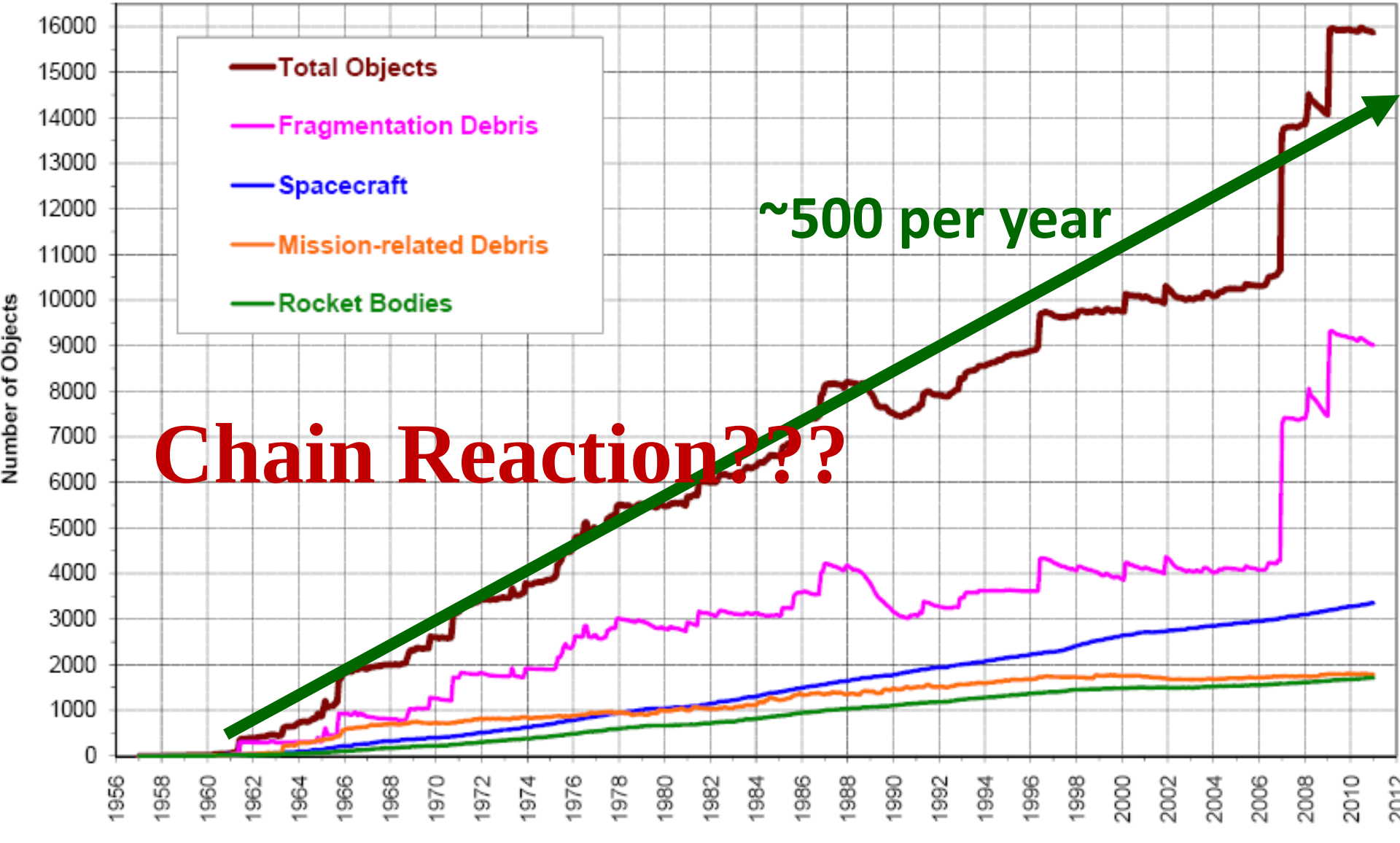
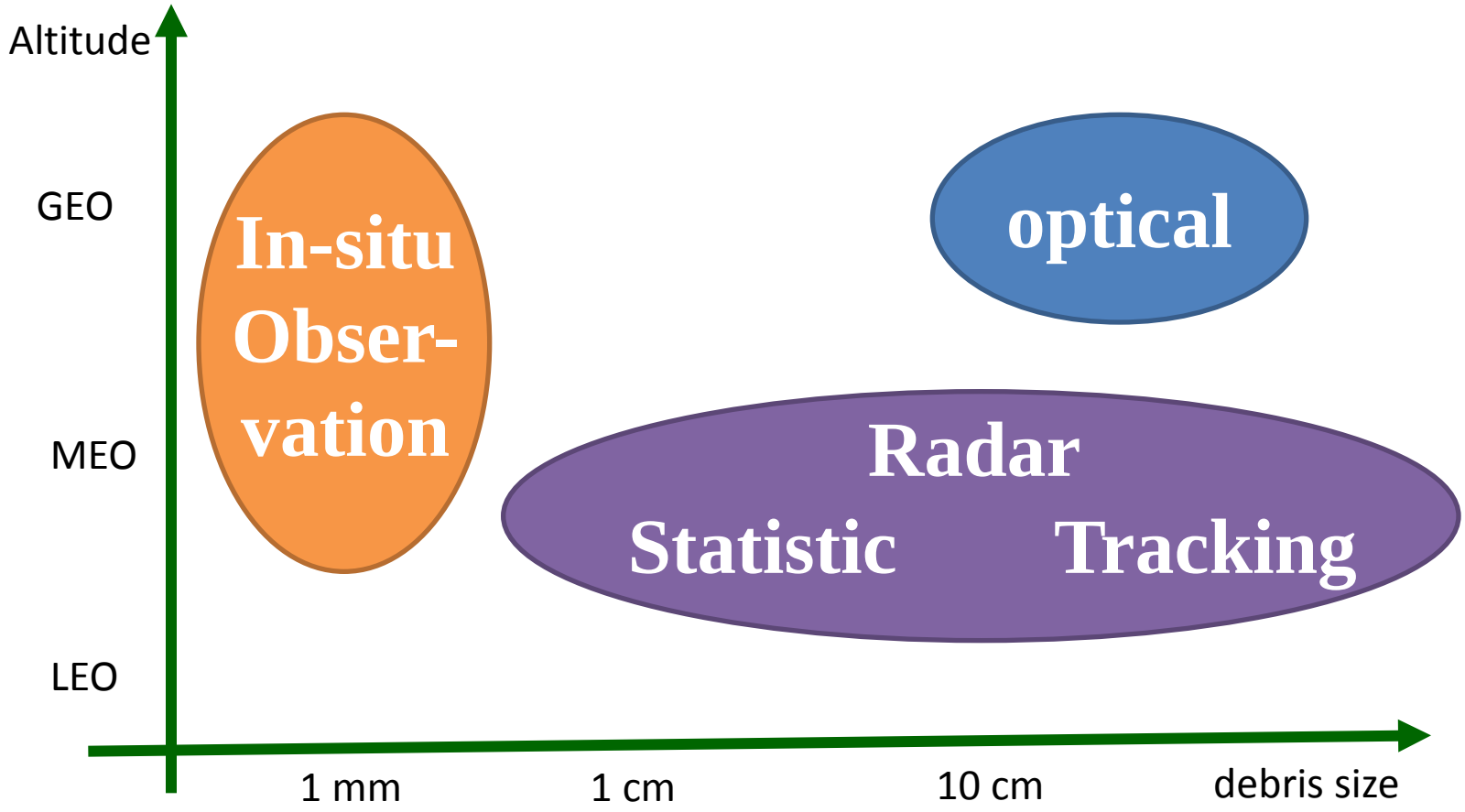


Numbers in Catalog



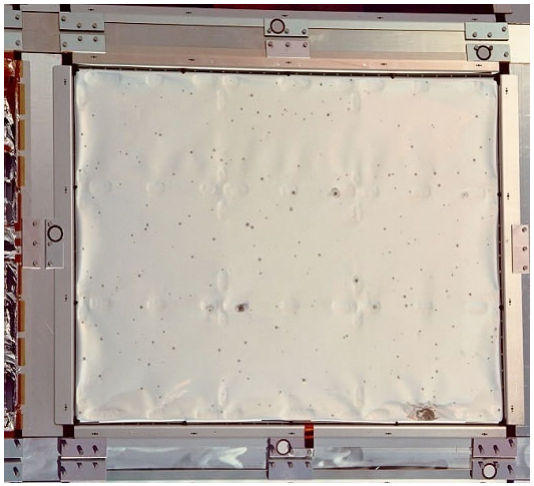
Observation Methods



In-Situ Observation(1)

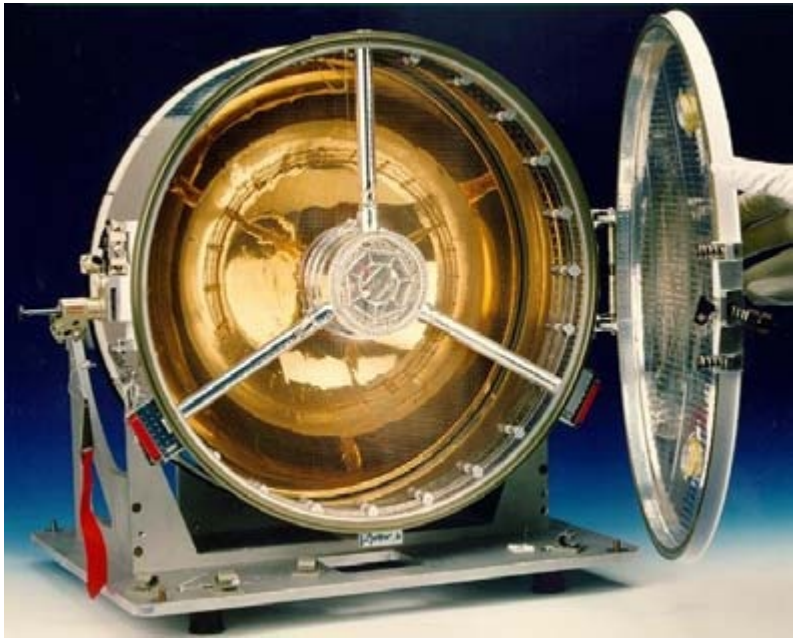
launch → exposure → retrieval → analysis

Long Duration Exposure Facility 5.7 years before being retrieved by space shuttle Columbia in January, 1990.

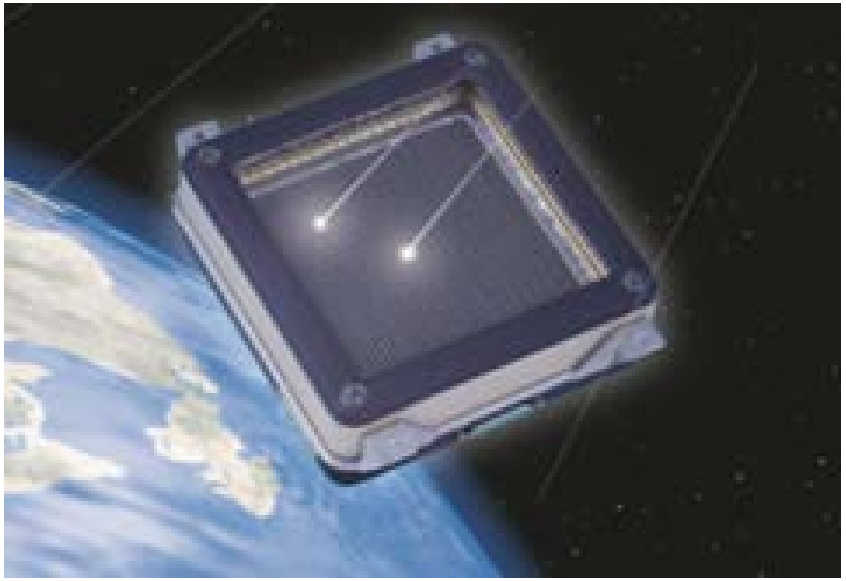


In-Situ Observation(2)

Active in-situ measurements are required in the future.

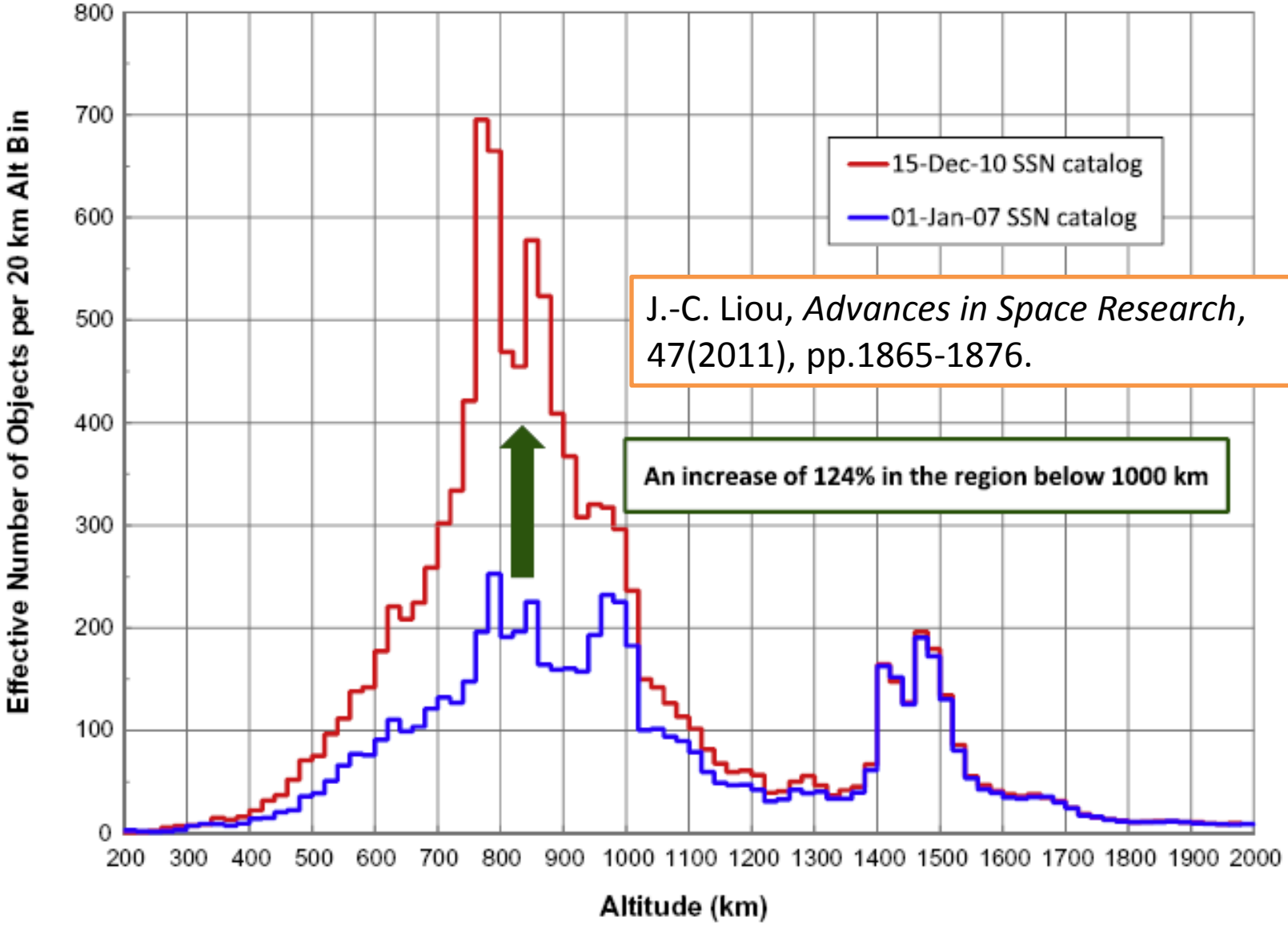


GORID (GEO)



DEBIE (LEO)

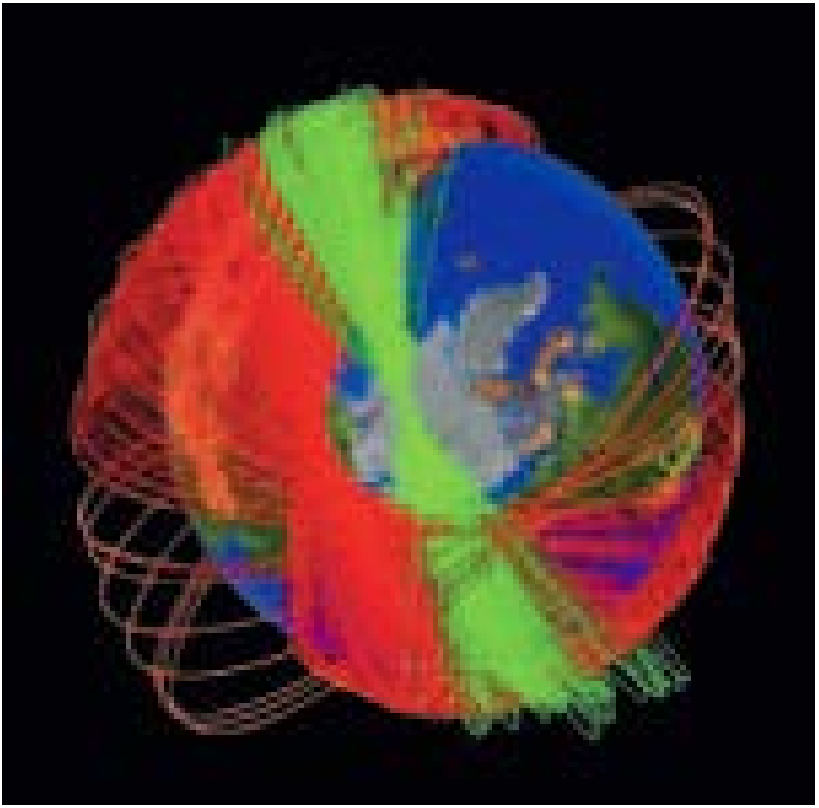
Two Recent Events

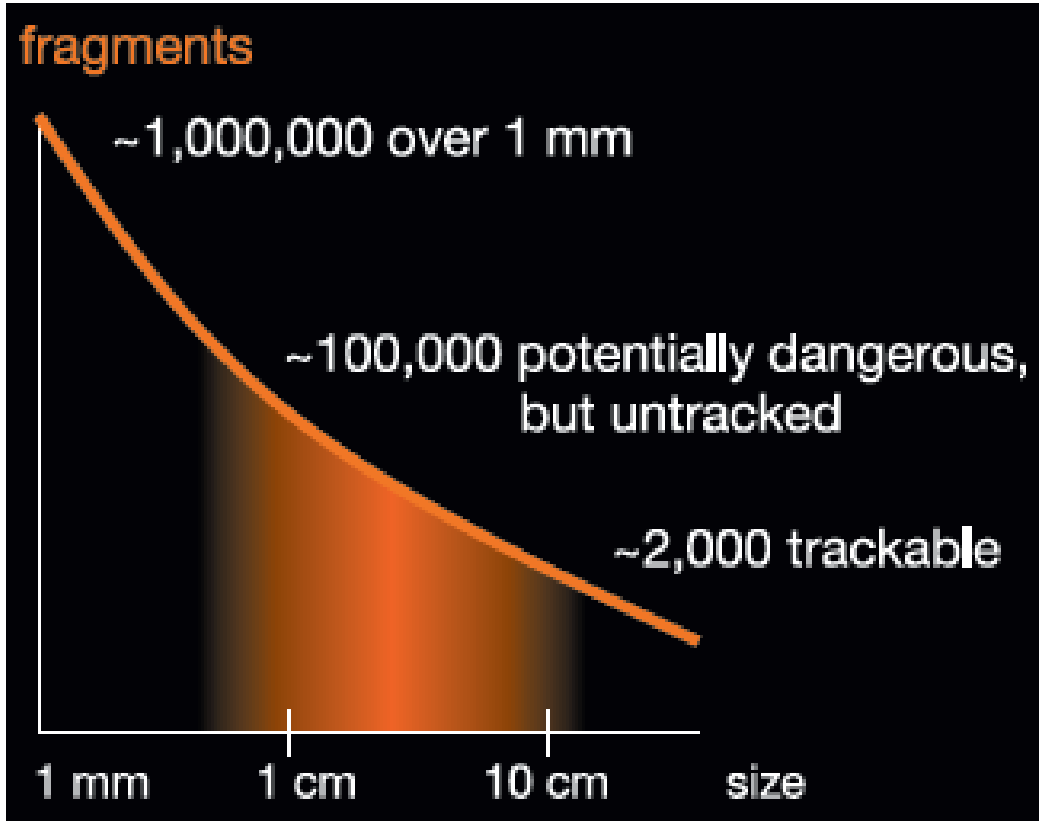


J.-C. Liou, *Advances in Space Research*, 47(2011), pp.1865-1876.

Small Debris Sources(1)

Sources (1): Fragments from on-orbit collisions and breakups.





Debris of different sizes from the 2009 US/Russia satellites collision

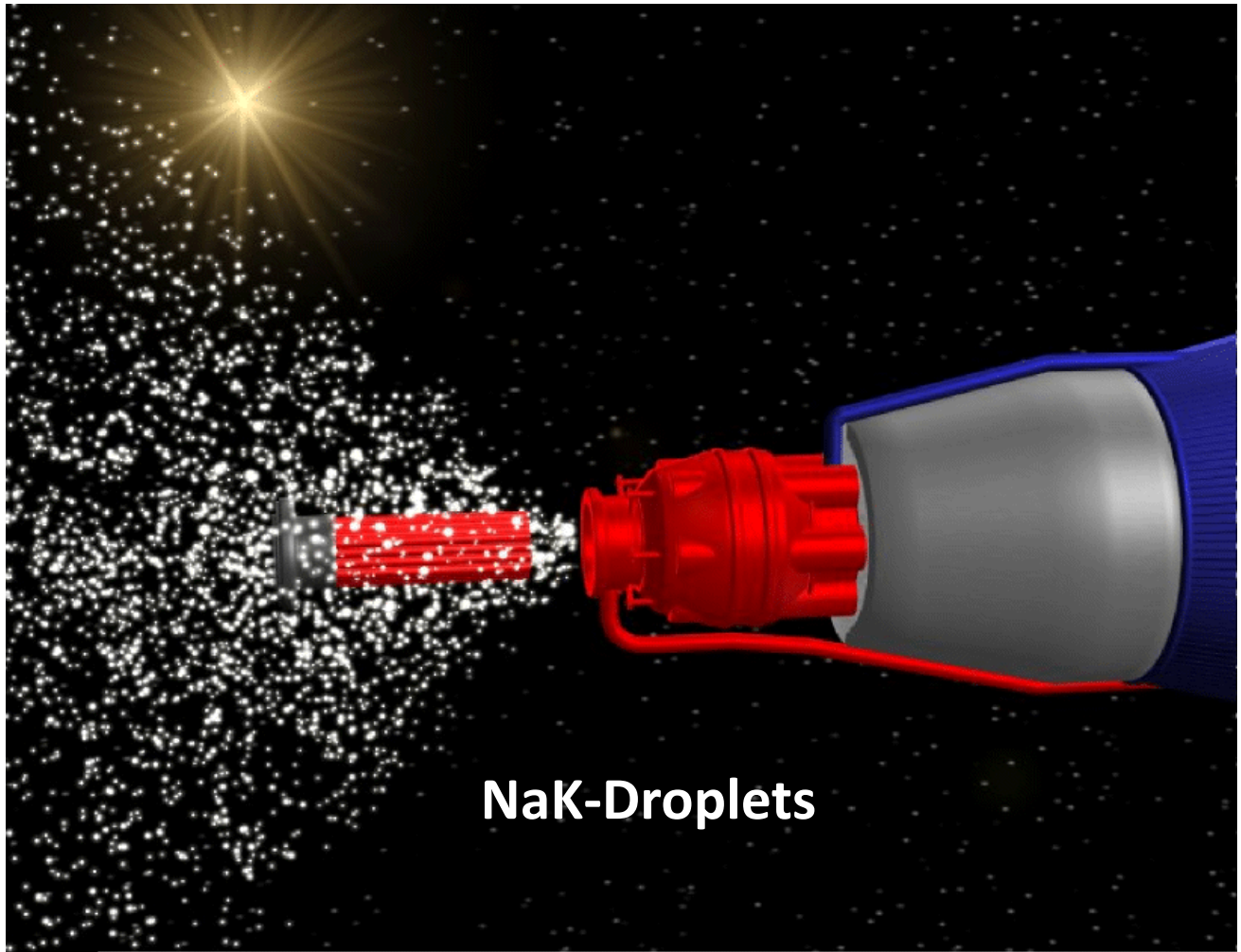
Small Debris Sources(2)

Sources (2): Slag.

Solid rocket motor (SRM) of rocket produces aluminum oxide (Al2O3) particles when working.

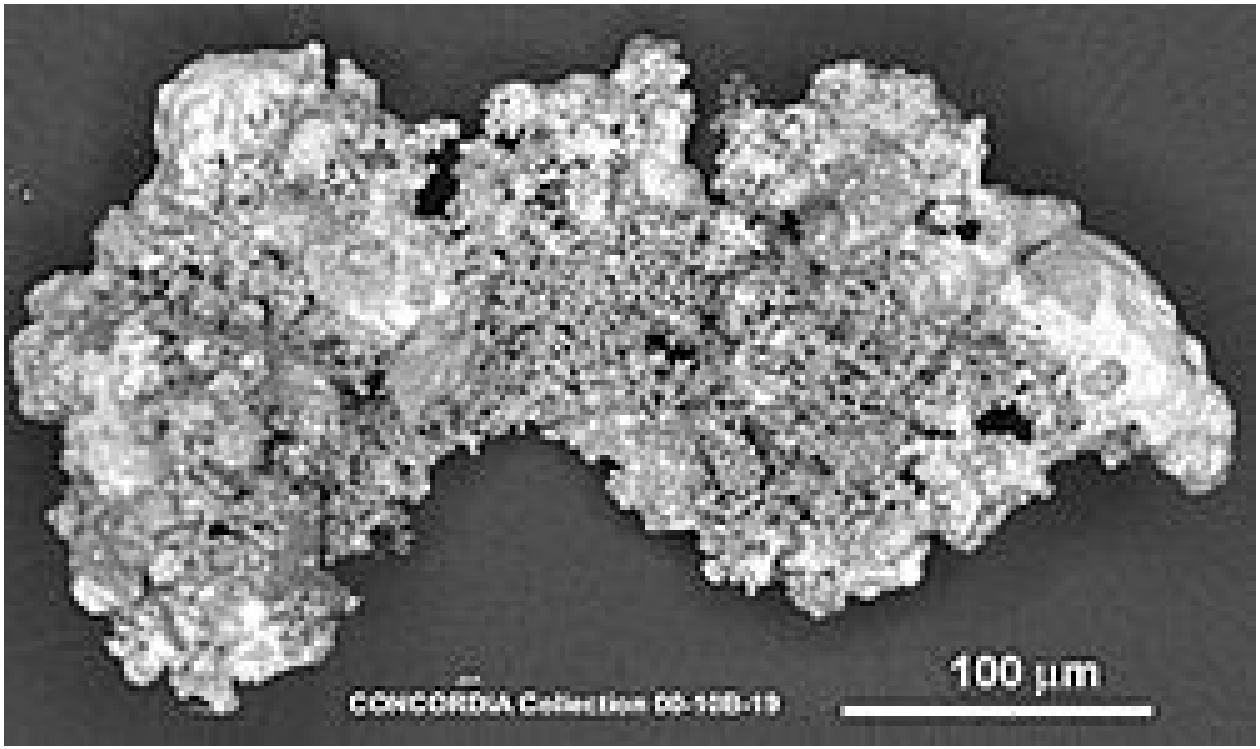
Small Debris Sources(3)

Sources (3): Sodium-potassium (NaK) droplets.



Small Debris Sources(4)

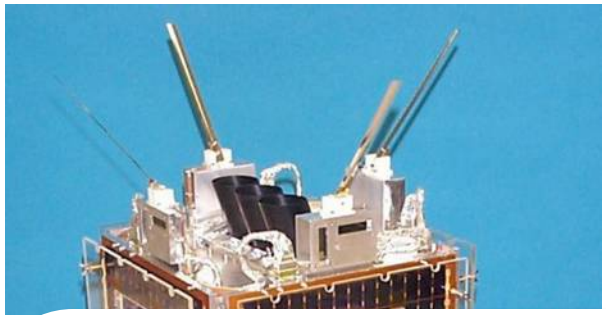
Sources (4): Micrometeoroids.



Micrometeoroids usually have small weights and relative large velocities compared to man-made debris, less than 1 gram and larger than 10 km/s, respectively.

Our Proposal

launching a small satellite attached with high-performance space debris detectors.



The recording data is further transmitted to the ground via satellite TT&C subsystem, we further analyze the impact and estimate the characteristics of the debris, such as mass, size, velocity, direction, etc.

The Tsinghua-1 micro-satellite

Purposes

① **to investigate space debris environment in the regime of 600-1000 km altitude;**

② **to gather in-situ observation data for space debris modeling;**

③ **to better understand the evolution of space debris;**

④ **to collect information for spacecraft safety design;**

⑤ **to provide strong support for future Chinese Space Station program.**

Key Parameters

- Orbit Altitude： ~800 km；
- Lifetime： >10 years；
- Detectable size Range： 0.01-1 mm；

Emergency!!!

We must be responsive to this problem quickly!!!

Wall-E, PIXAR, 2008.

THANK YOU!

If you have any question, please do not hesitate to ask!

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