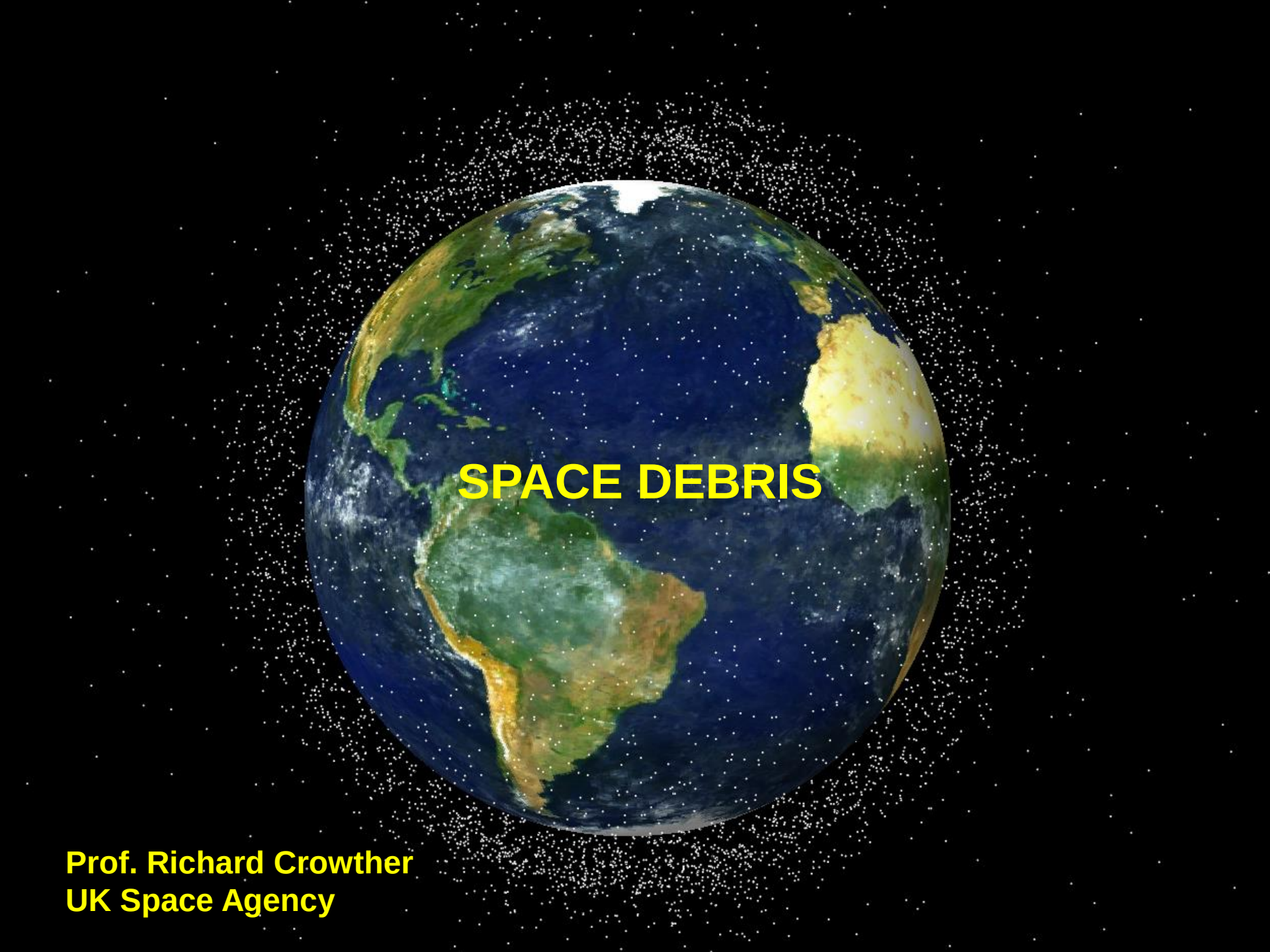


Prof. Richard Crowther
UK Space Agency

Outline

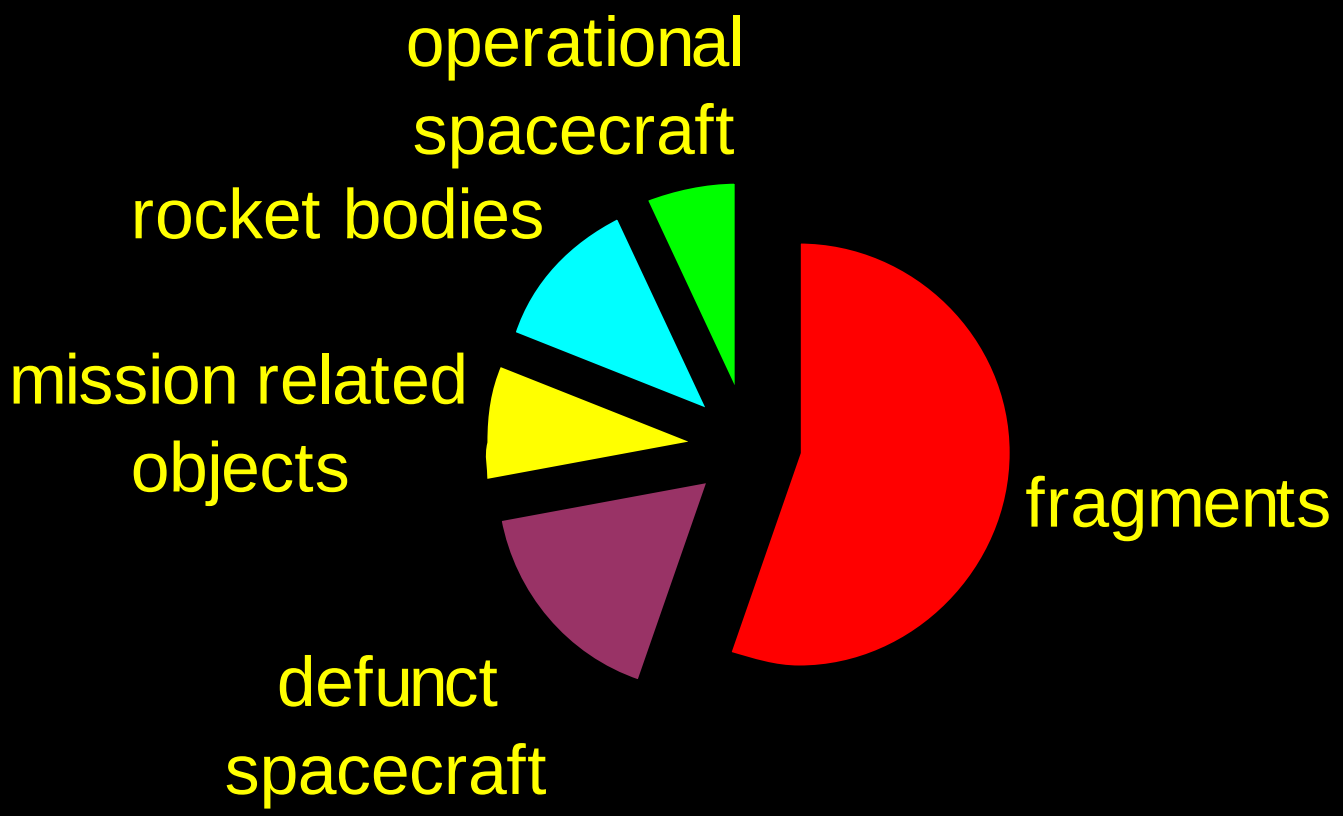
- What is in orbit around the Earth?
- How much space debris is there?
- What is the future for space debris?
- What is the solution to space debris?

WHAT IS IN ORBIT AROUND THE EARTH?

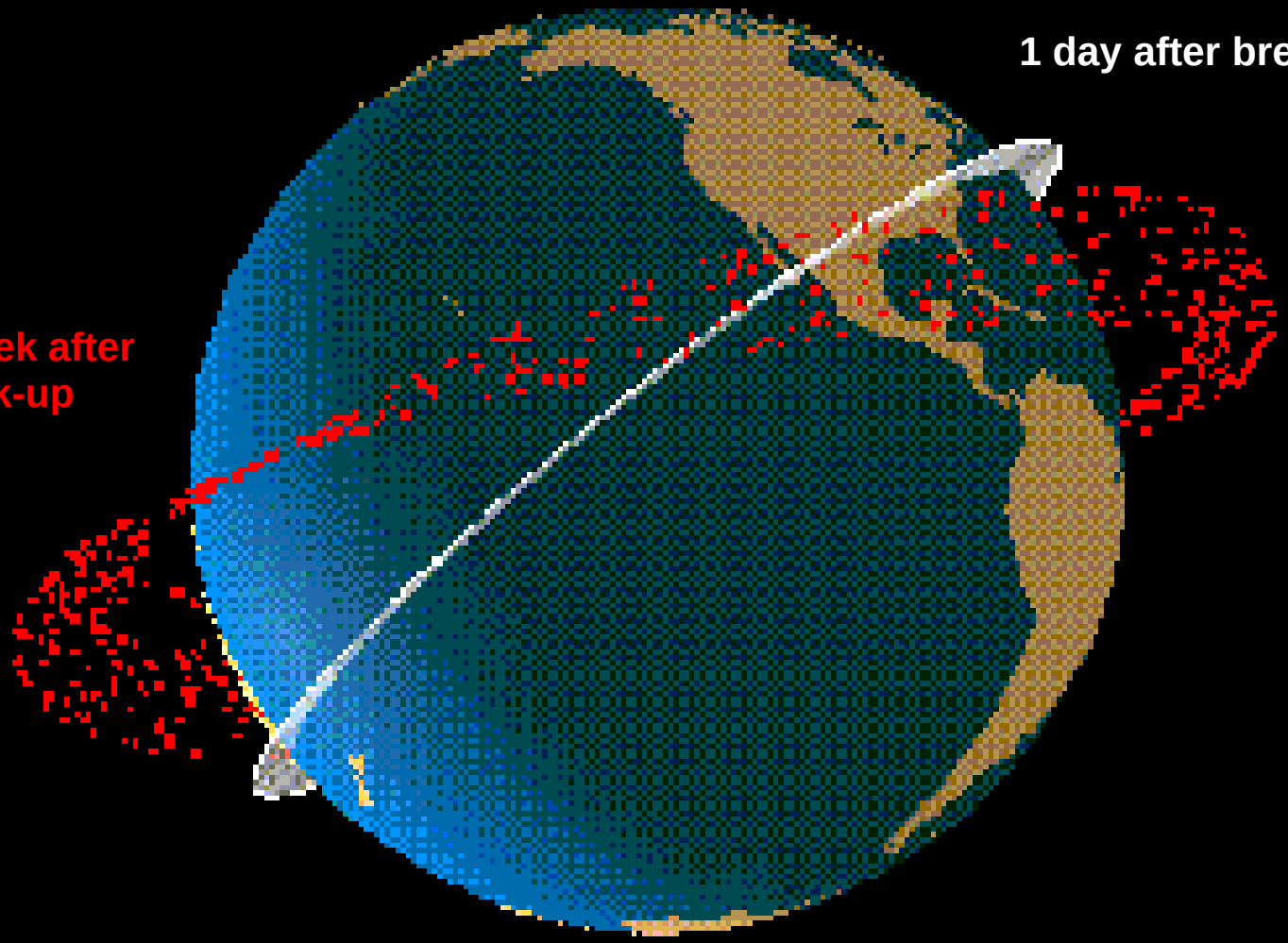
near-Earth satellite population reflects use of space

>16000 catalogued objects concentrated in distinct orbits with unique characteristics

CATEGORIES OF CATALOGUED OBJECTS

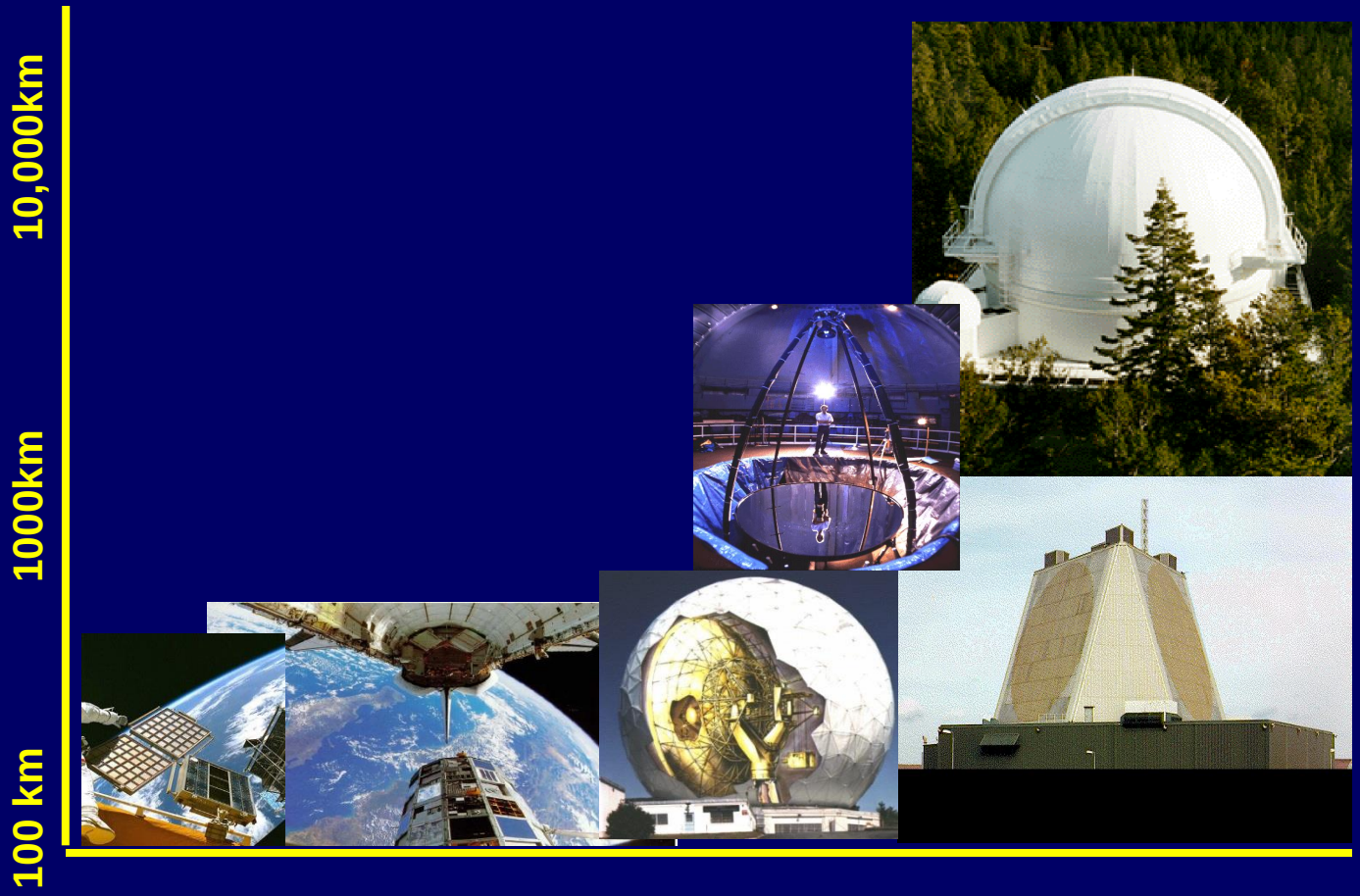


FRAGMENTS FROM BREAK-UP QUICKLY DISPERSE



HOW MUCH SPACE DEBRIS IS THERE?

Estimating the debris population



BAY 5


T180-2
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T180-67
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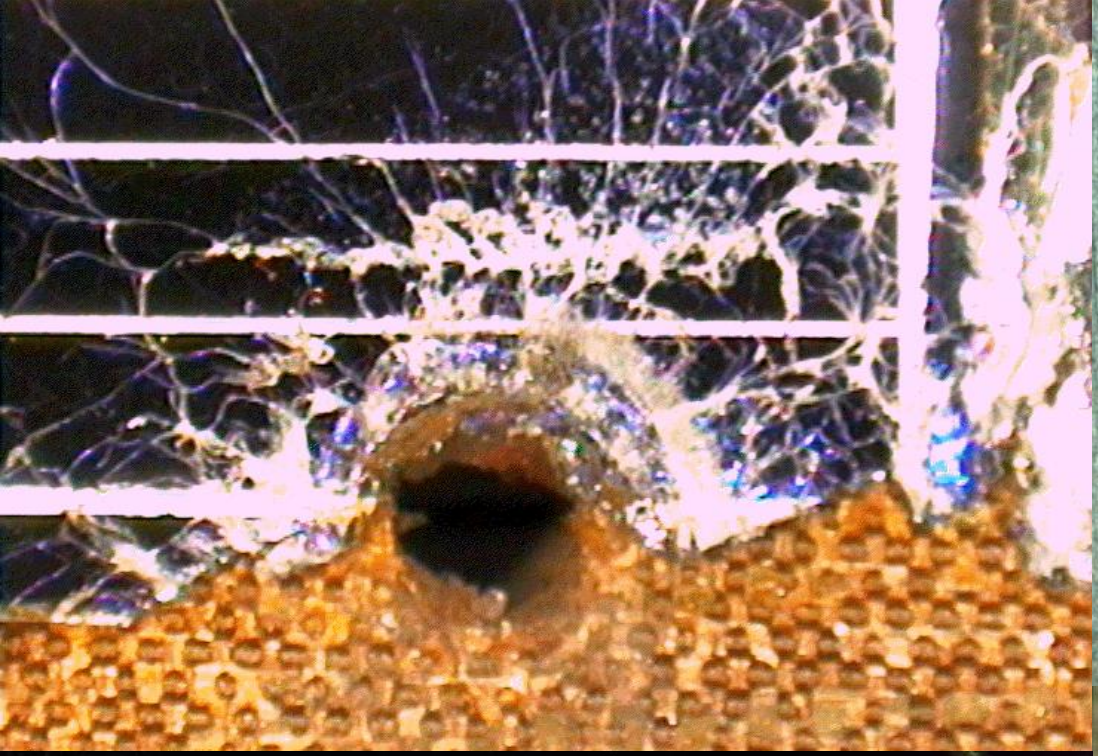
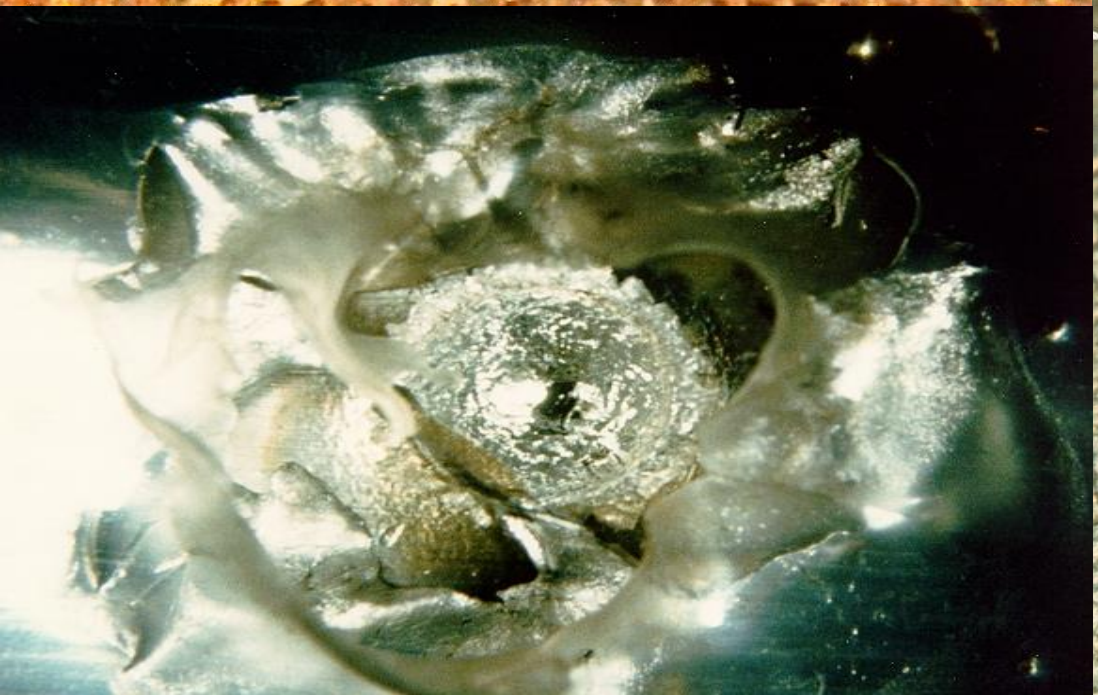




Estimated Debris Population

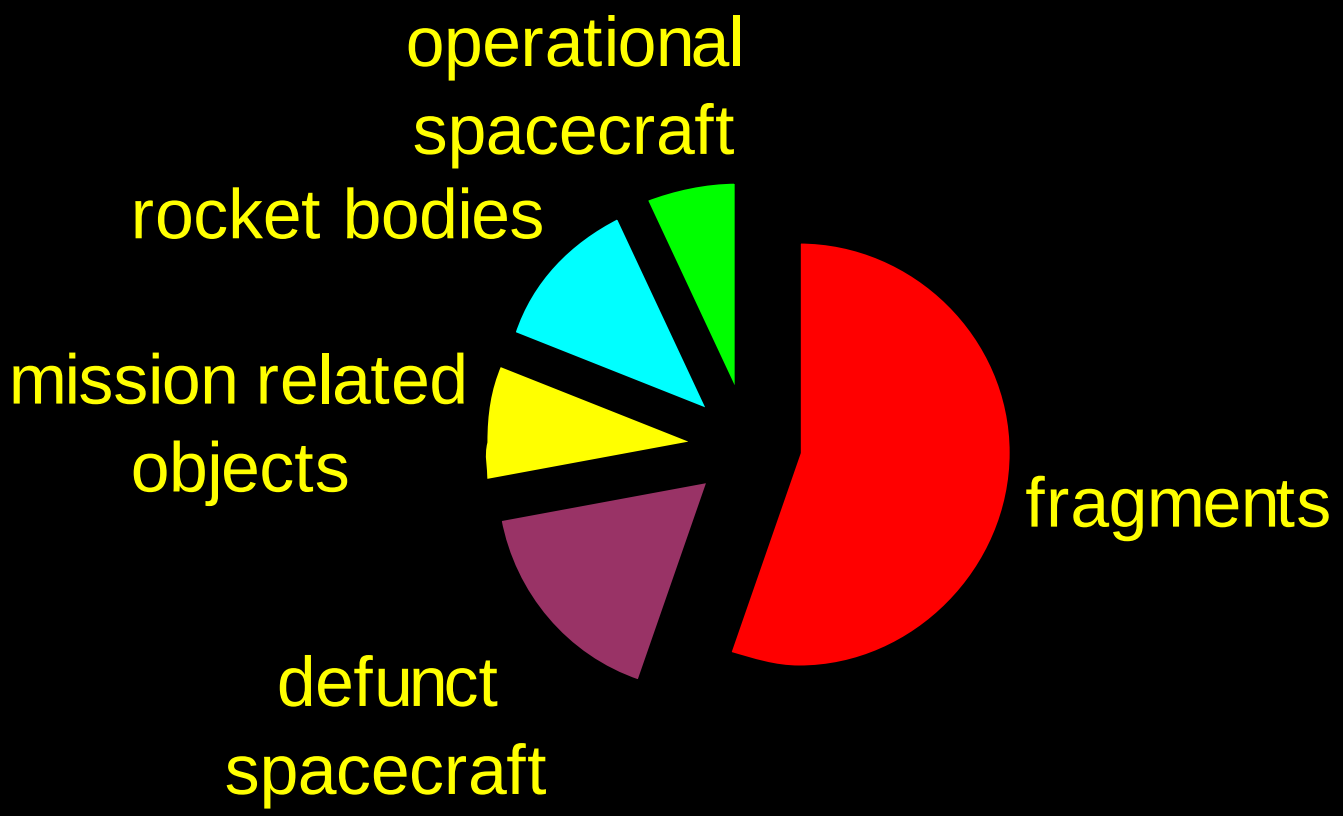
Size	Number	% Mass
>10 cm	>20000	99.93
1-10 cm	>500,000	0.035
<1 cm	>50,000,000	0.035
Total	>50,000,000	>5,000 tonnes

Estimated Debris Population

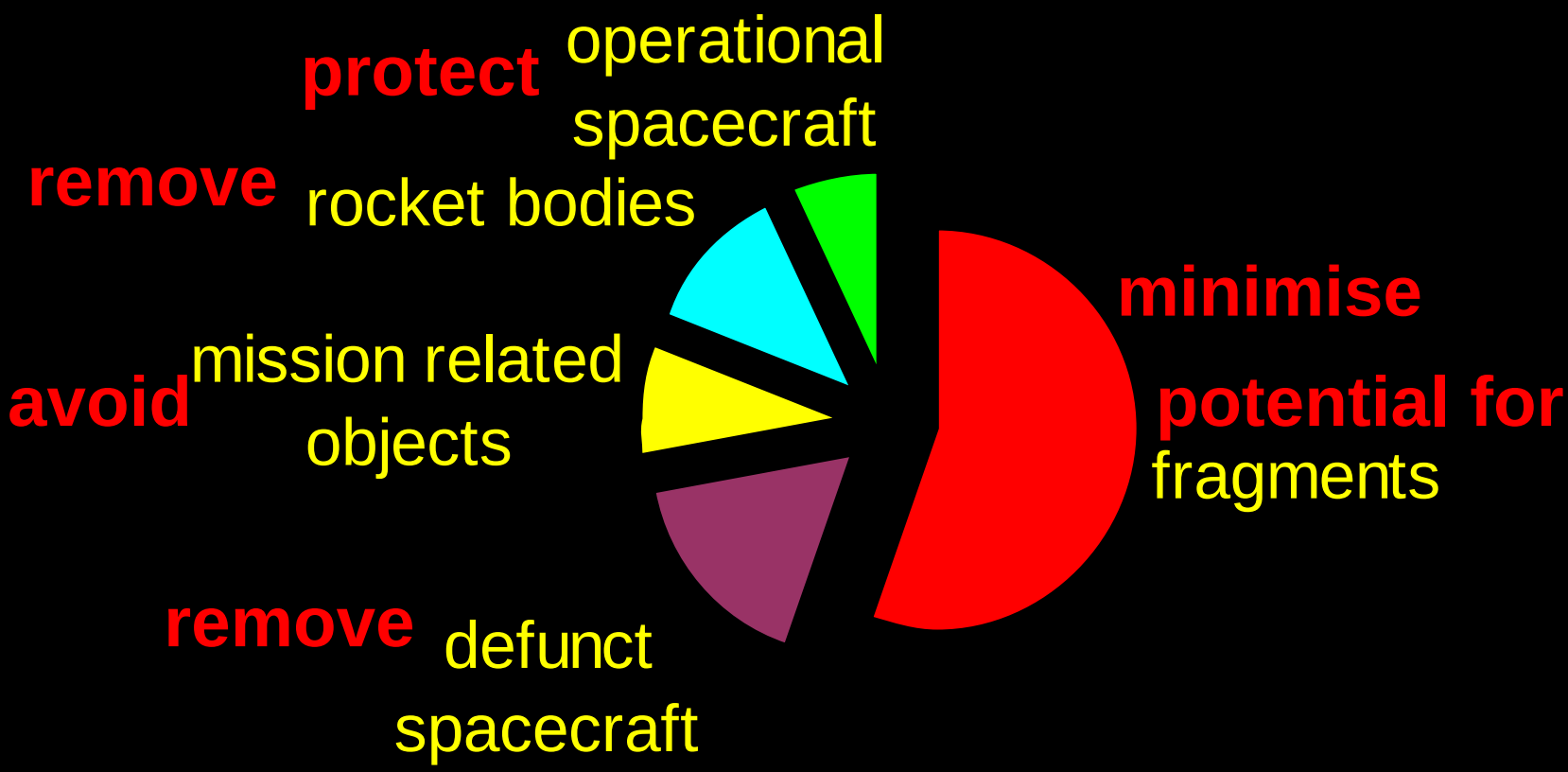
	Size	Number	% Mass
<10% active	>10 cm	>20000	99.93
	1-10 cm	>500,000	0.035
	<1 cm	>50,000,000	0.035
	Total	>50,000,000	>5,000 tonnes

WHAT IS THE SOLUTION TO SPACE DEBRIS?

MITIGATION OBJECTIVES

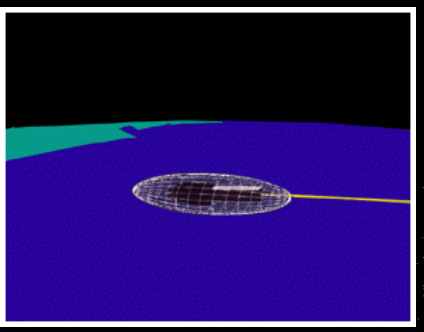


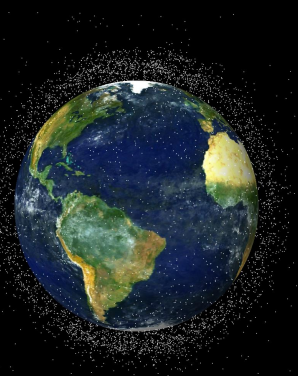
MITIGATION OBJECTIVES

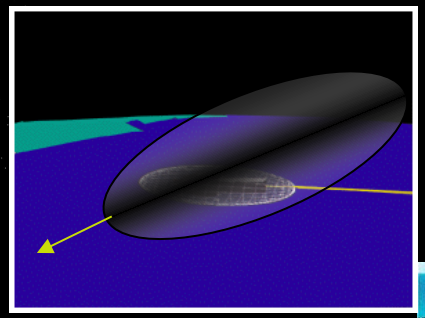


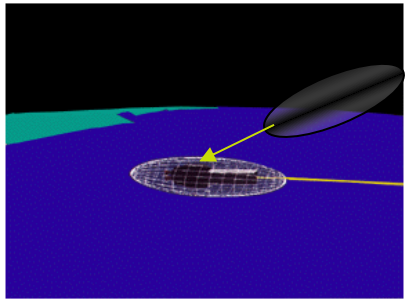

V 503
00:43:14.10
V 503
00:43:14.10

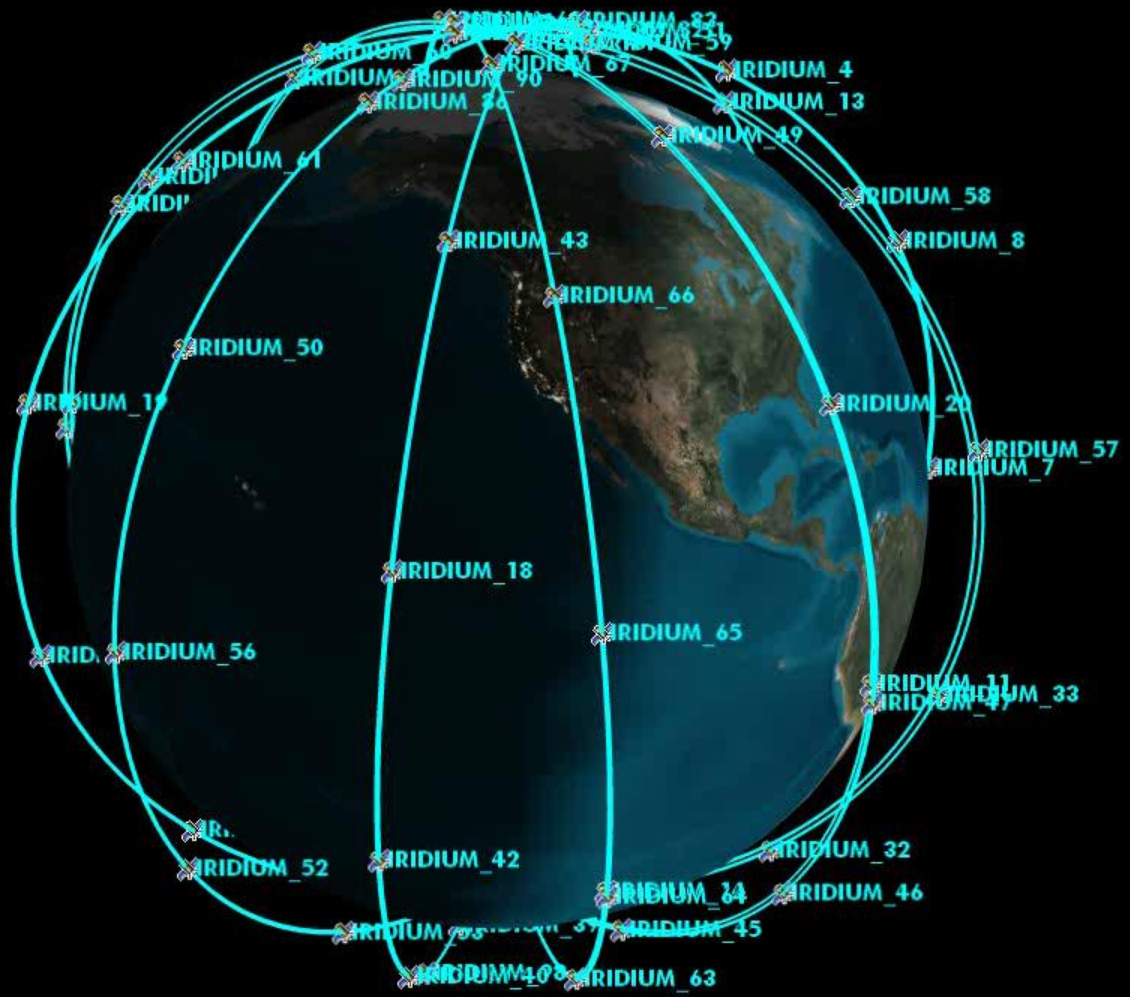
Collision Avoidance







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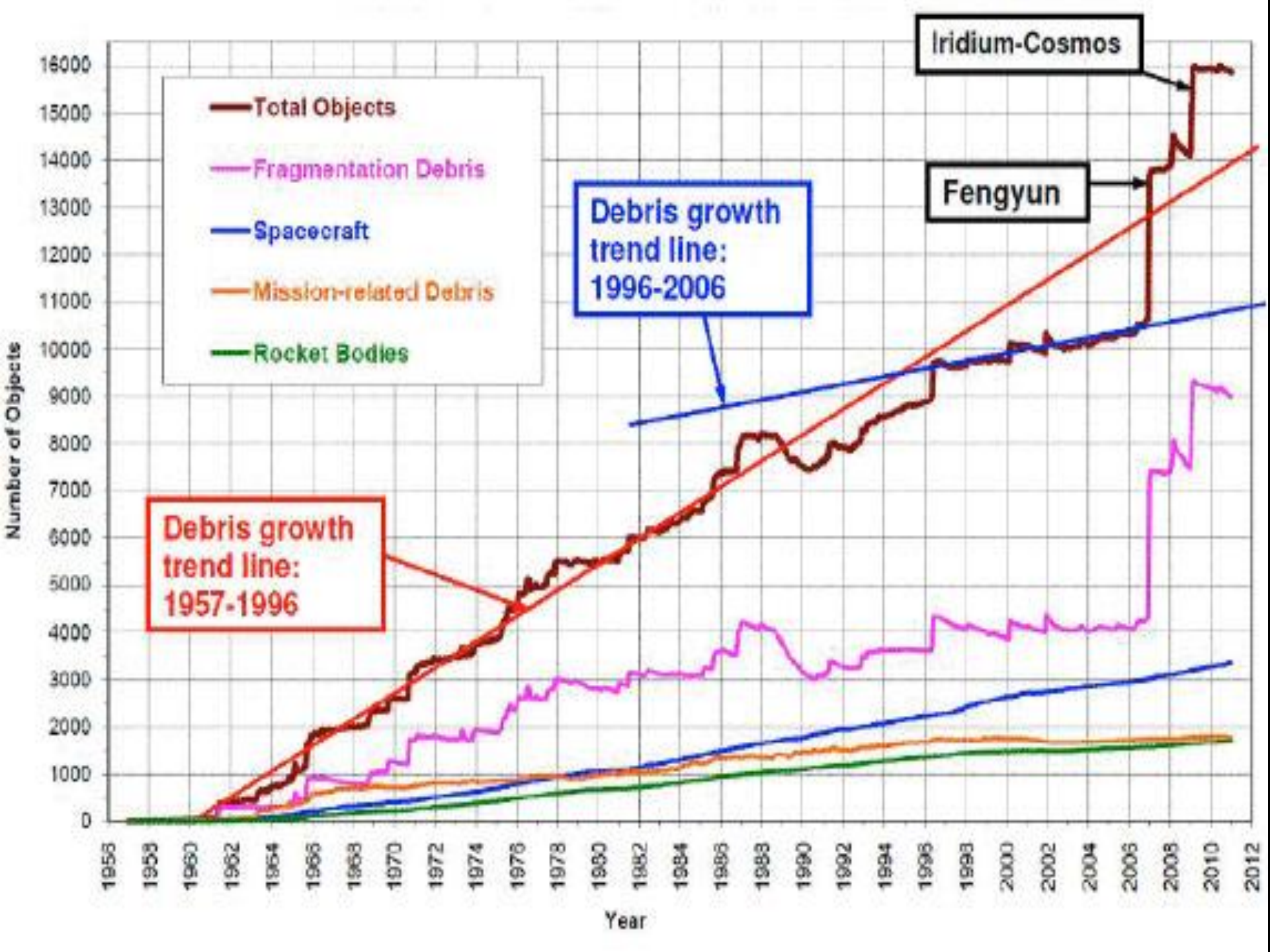
IRIDIUM_63


Iridium-Cosmos
Fengyun
Total Objects
Fragmentation Debris
Spacecraft
Mission-related Debris
Rocket Bodies
Debris growth trend line: 1996-2006
Debris growth trend line: 1957-1996
Number of Objects
Year
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
1957
1958
1960
1962
1964
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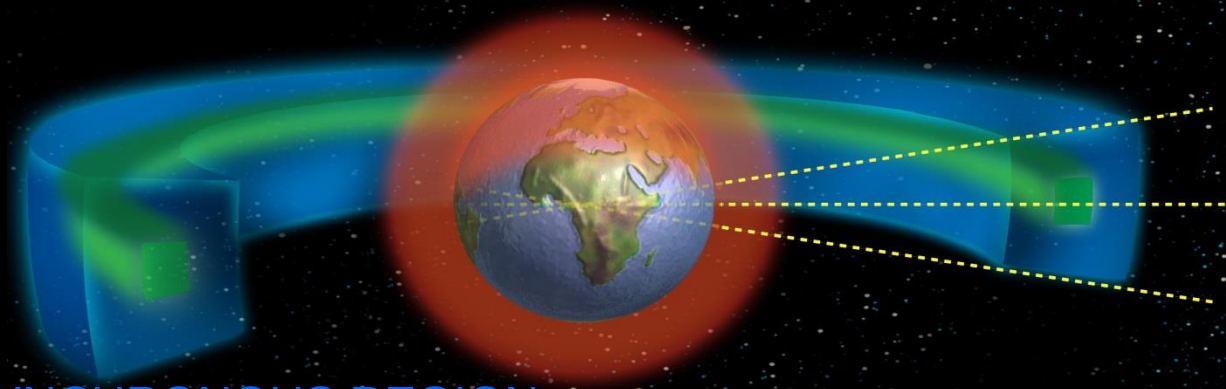
2002
2004
2006
2008
2010
2012

Debris Mitigation

- Managing the debris environment does work
- Requires information of orbital population
- Need to share experience between operators
- Effectiveness of measures can be demonstrated
- Need comprehensive implementation to be effective
- Increasing reflected in national legislation
- Regulators need to assess compliance

Definition of Protected Regions

- **Activities in space should recognise the unique nature of 2 regions in space:**



LOW EARTH ORBIT REGION

Earth surface up to 2000 km

GEOSYNCHRONOUS REGION

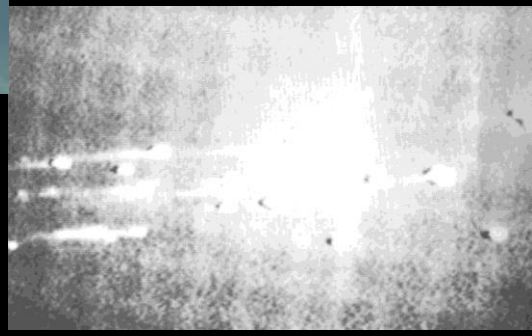
Geostationary altitude +/- 200 km

Equatorial latitude +/- 15 deg

cnes

CENTRE NATIONAL D'ETUDES SPATIALES


AP




0
7
0
8


FRIBEL

Lessons Learnt

- Need to focus efforts on “cause” rather than just “effect”
- As environment deteriorates, cost impacts will increase significantly for all users of space
  - Loss of systems
  - Loss of fuel budget and lifetime due to increased manoeuvres
  - Increased demands of space surveillance
- Active management will be necessary
- Best practice needs to become <u>common</u> practice