

De-orbiting technology developments at Surrey

Prof G. S. Aglietti & Dr A. Viquerat

University of Surrey

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Background



Deorbiting technology demonstrators



InflateSail



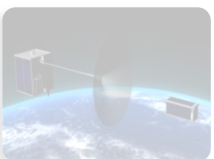
Active Debris Removal - *RemoveDEBRIS*

Part of the University of Surrey

35 years experience microsatellite research & applications with emphasis on low cost technologies

Largest UK Academic Centre for Space Engineering:
90 people: Academics, Researchers, Support staff

Activities: Research, Teaching, Consultancy

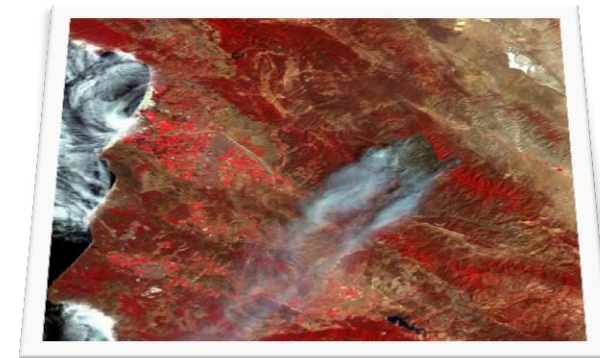
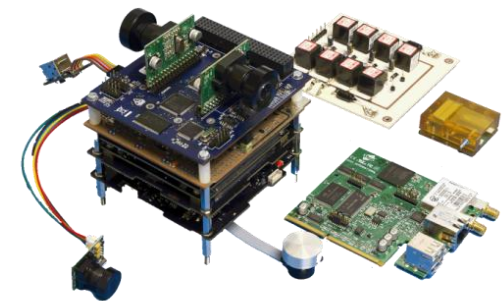
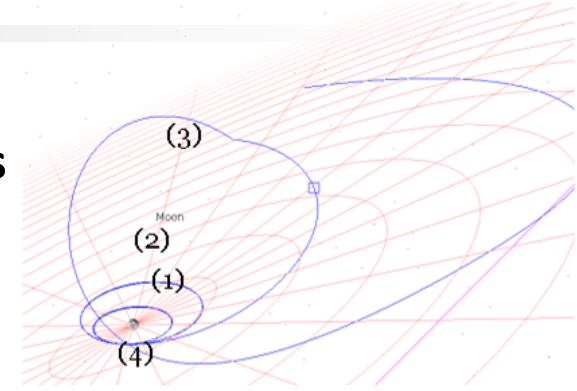


* The Guardian: 6th ; The Times: 2nd

**Unique in-house multidisciplinary capability
for Space Engineering & Satellite Applications**

Academic 'One Stop Shop' for:

- Future Mission Concept
- Mission Analysis and Design
- Spacecraft Hardware Design (all subsystems)
- Manufacturing Assembly Integration Test
- Launch Related Services
- In orbit Operation Satellite and Payload
- Applications Development
- University & Industry Network



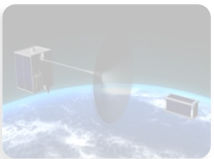
De-orbiting technologies & demonstrations



Passive Technologies
Gossamer *DORBITER*
deOrbitSAIL
CUBESAIL
InflateSail

Active Debris Removal
RemoveDEBRIS

Nanosatellite
Missions



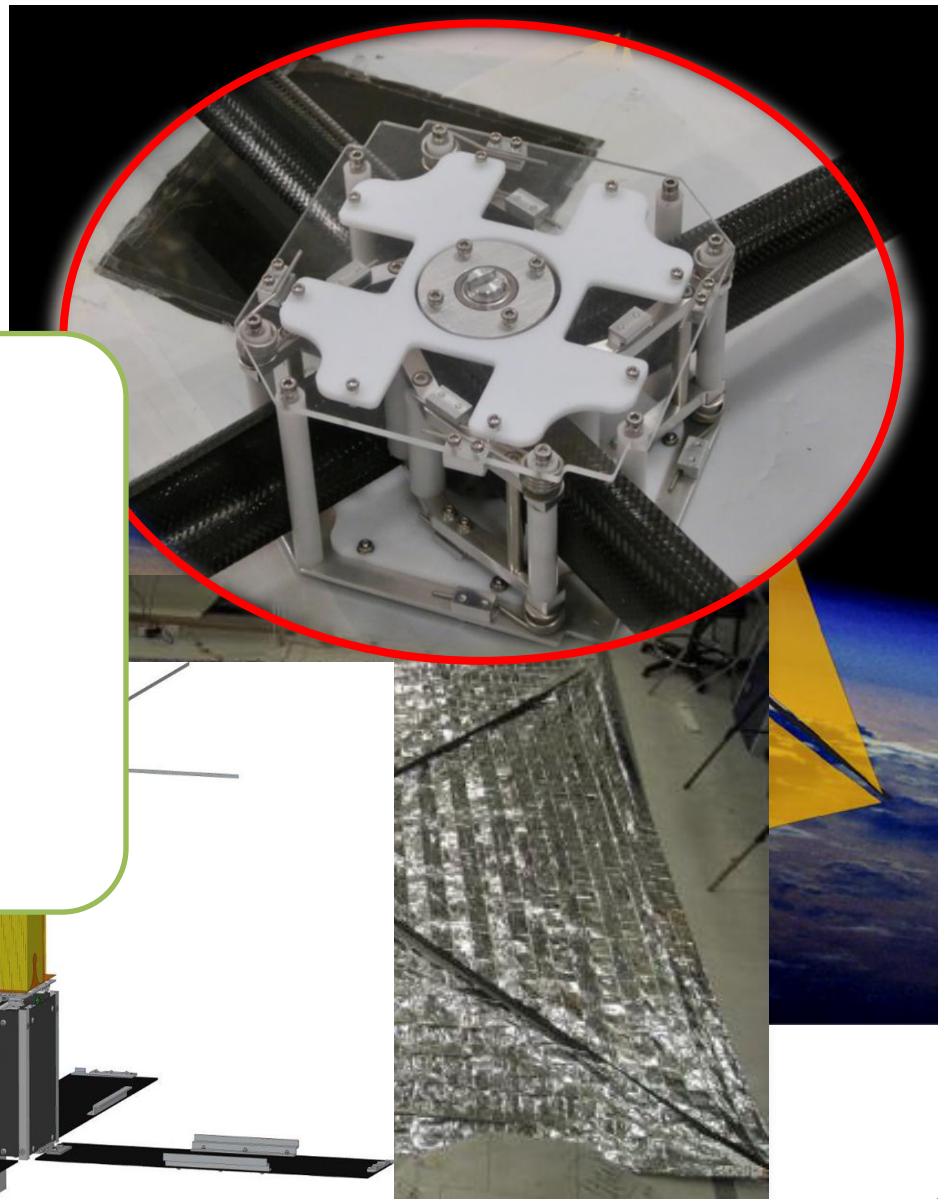
Passive Technologies

Gossamer *DORBITER*

*deOrbit*SAIL

 **CUBESAIL**

InflateSail



Gossamer

ESA project



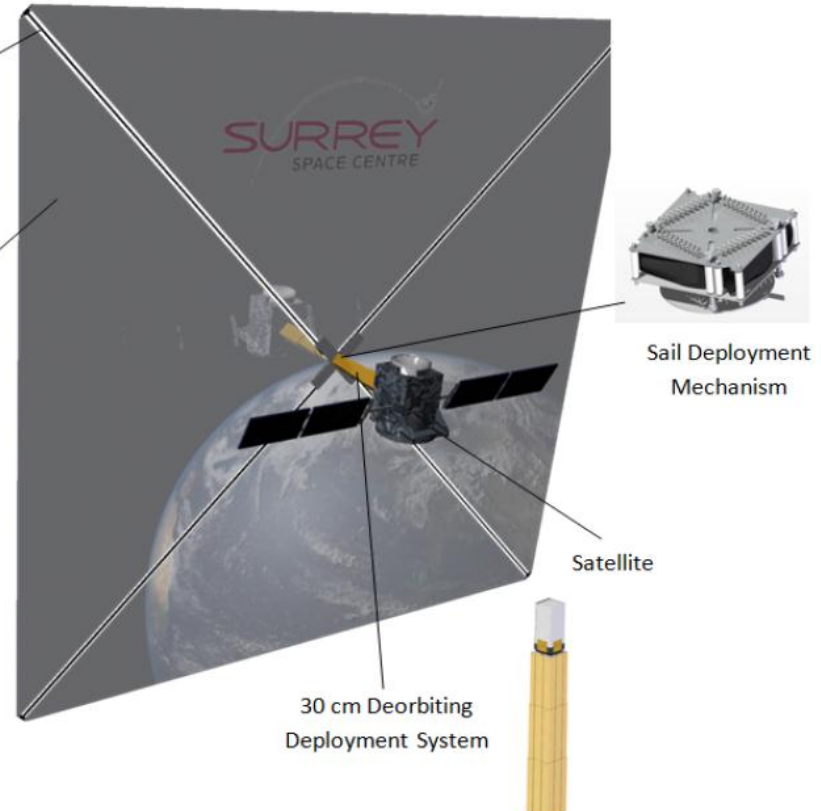
Deployable Gossamer Sail for Deorbiting

CFRP/Metallic
Ultra-light
Booms

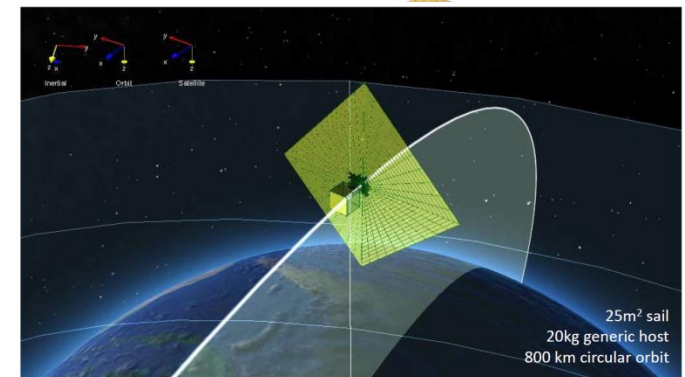
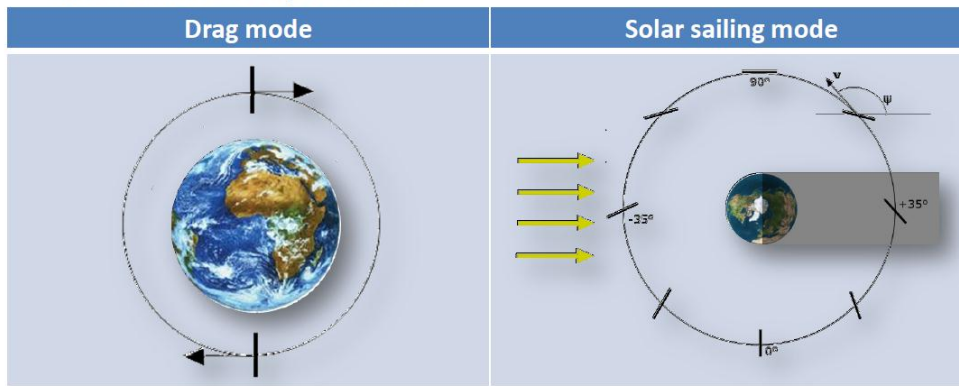


membrane

Stowed Deorbit System
15 x 15 x 25 cm, 2 kg



- Two modes of operation:



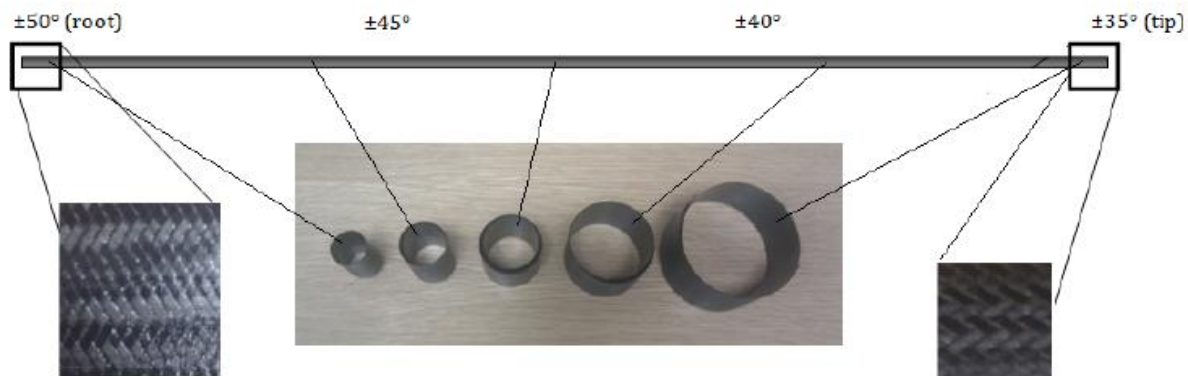
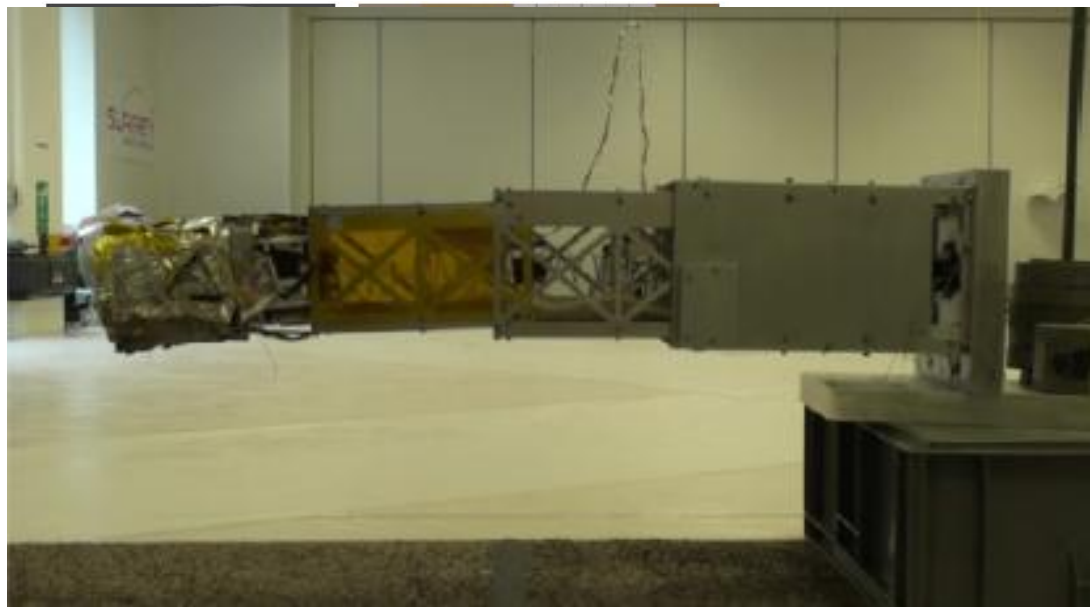
Gossamer

ESA project



DEORBITER

Deployable Gossamer Sail for Deorbiting



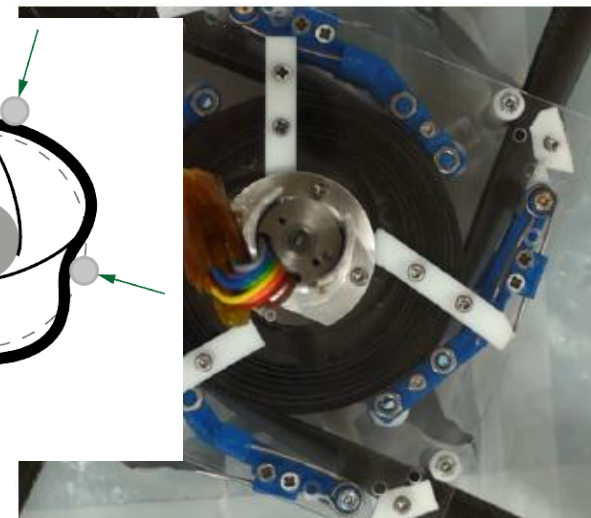
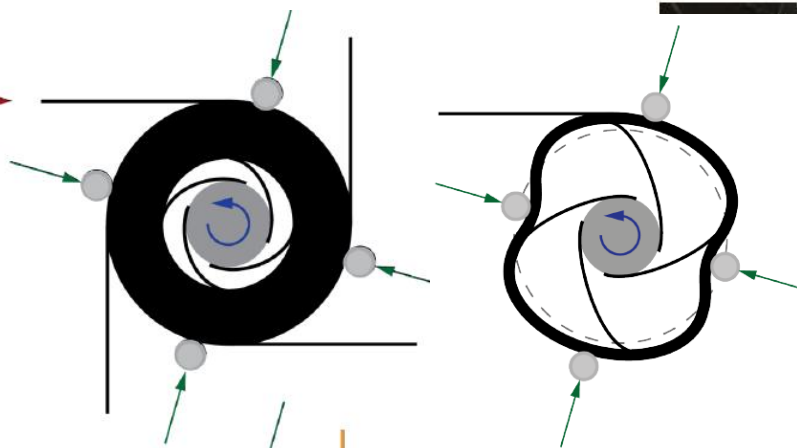
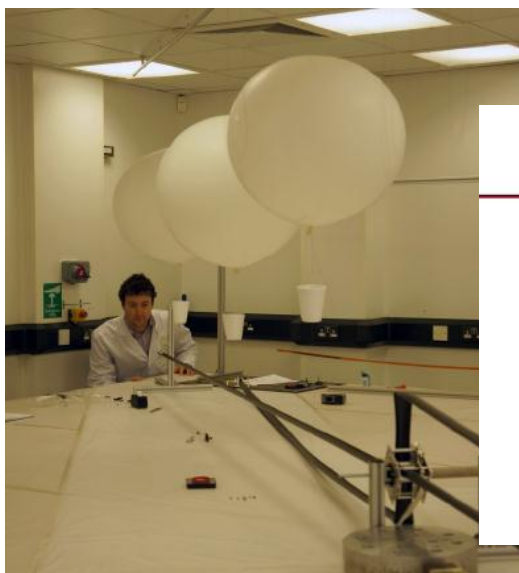
Gossamer


ESA project



DEORBITER

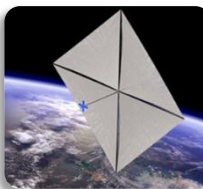
Deployable Gossamer Sail for Deorbiting



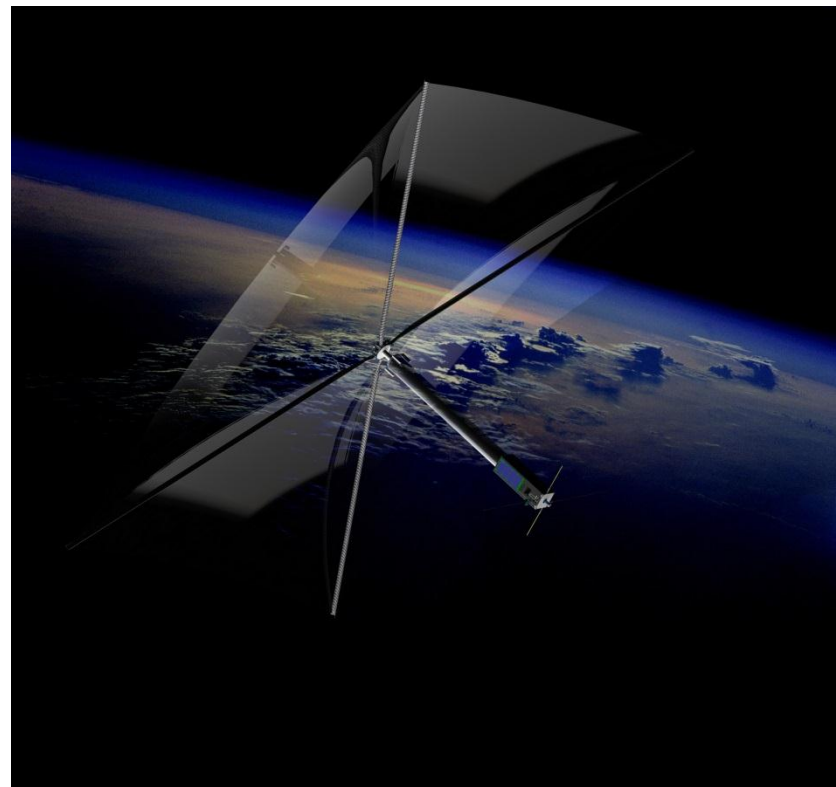
- 
- technology demonstrator for drag-deorbiting system

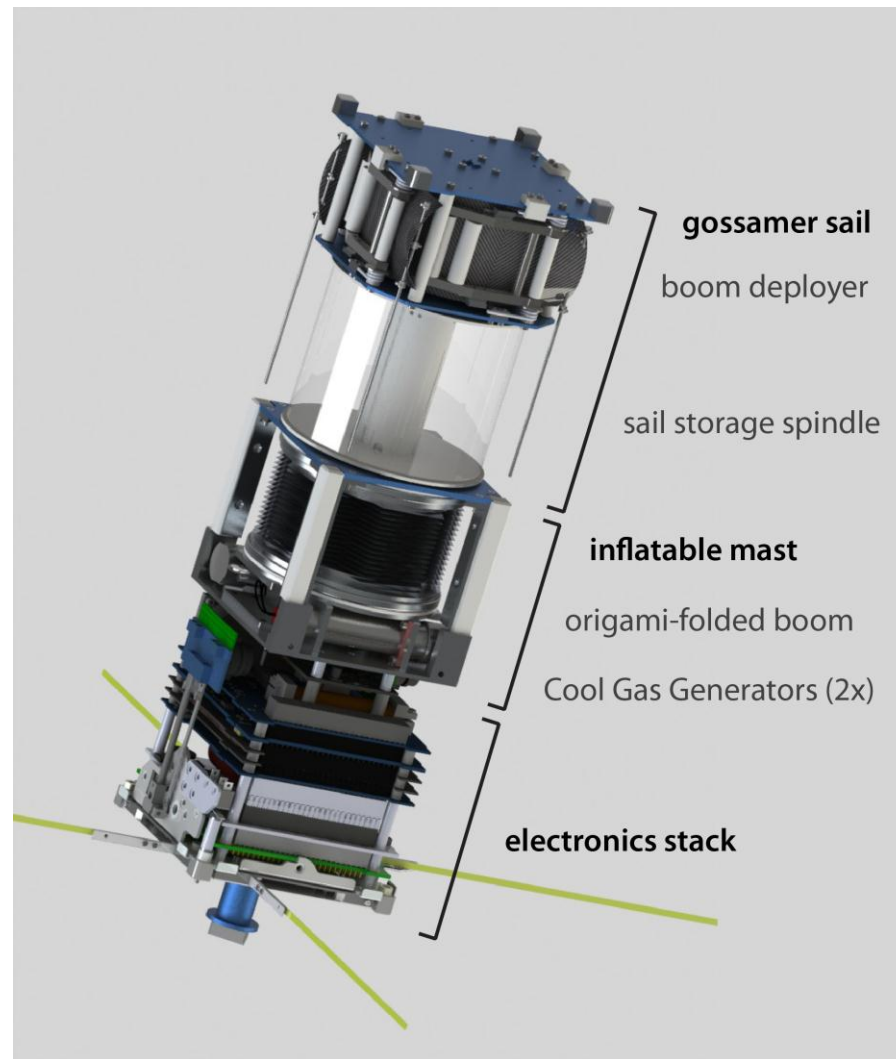
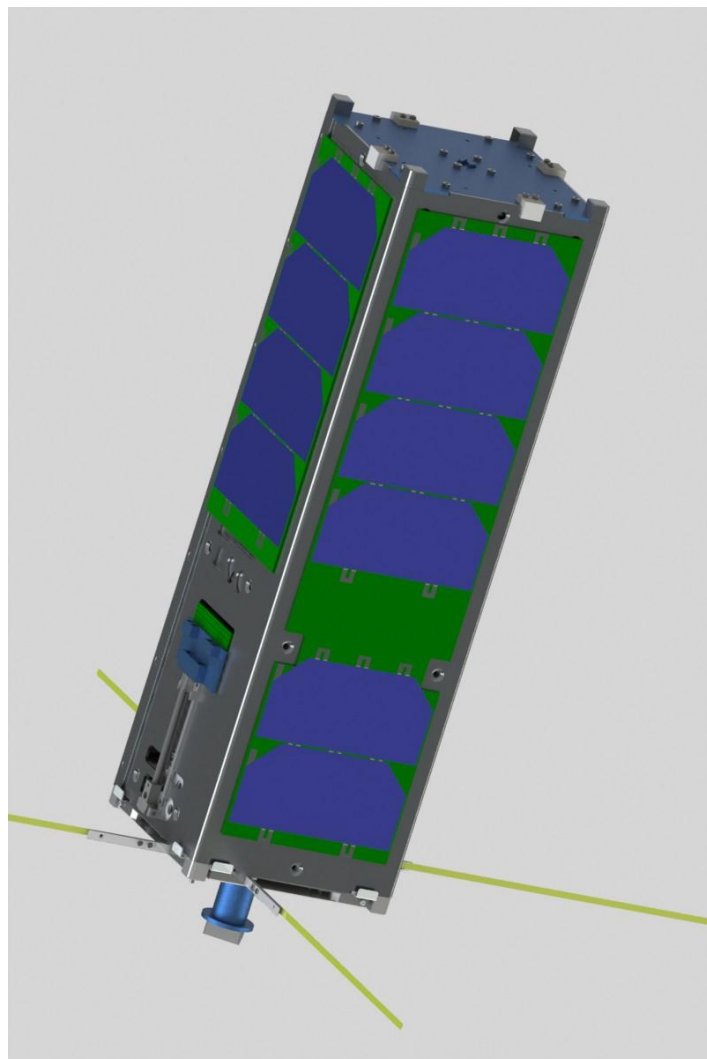
- 
- 3U CubeSat

- large deployable structures

- 
- 1 m inflatable mast
 - 10 m² gossamer sail

- 
- launch on QB50 mission

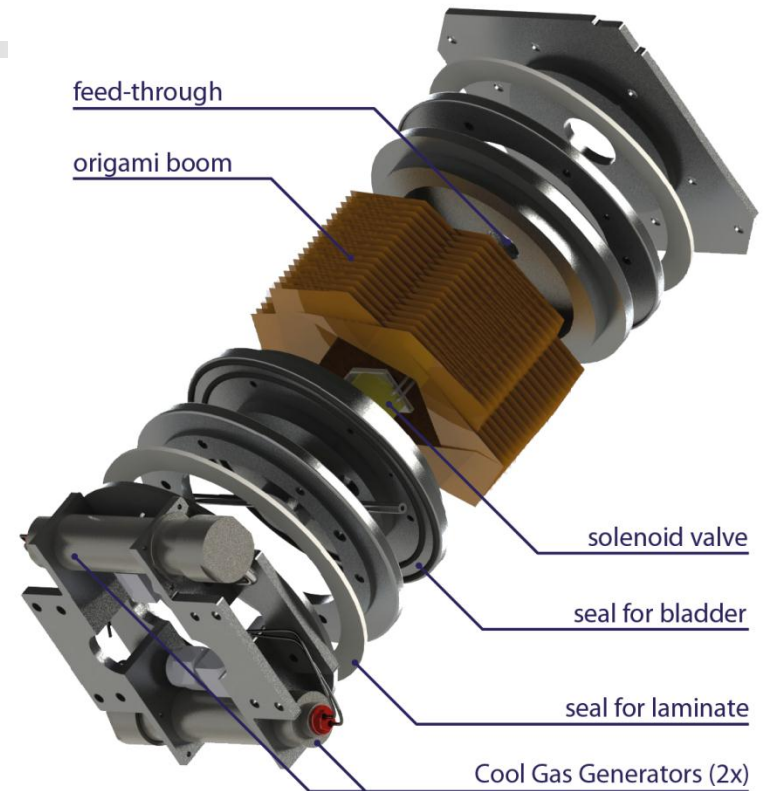




- inflatable-rigidisable mast
 - deployed: $L = 1 \text{ m}$, $D = 90 \text{ mm}$
 - stowed: $L = 63 \text{ mm}$

- aluminium-laminate skin
 - $45 \mu\text{m}$ Al/Mylar/Al
 - strain-rigidisation: remove folds and creases

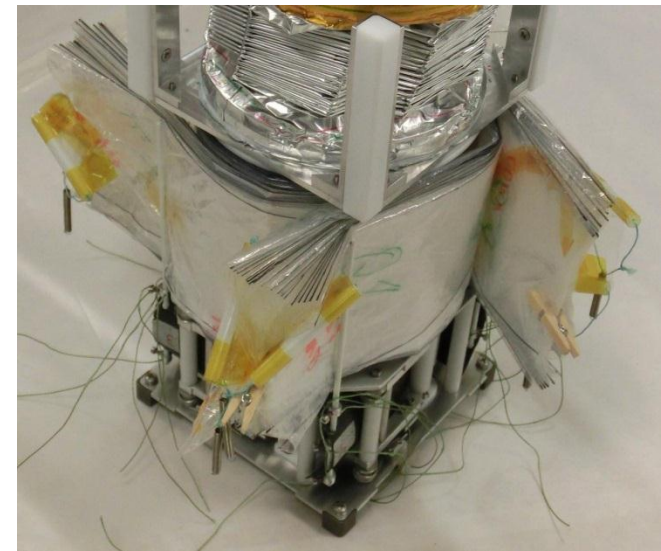
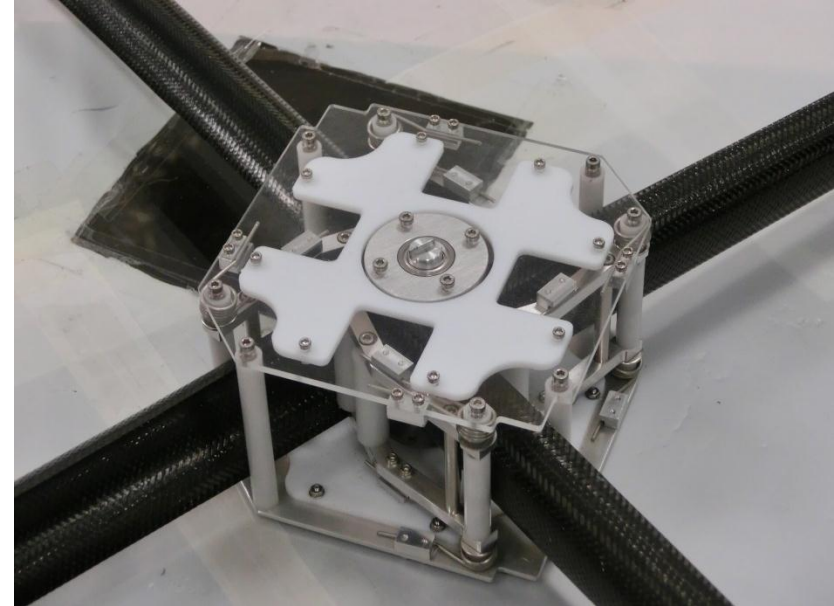
- Cool Gas Generators
 - 2 x 3.9 grams N_2
 - long-term storage

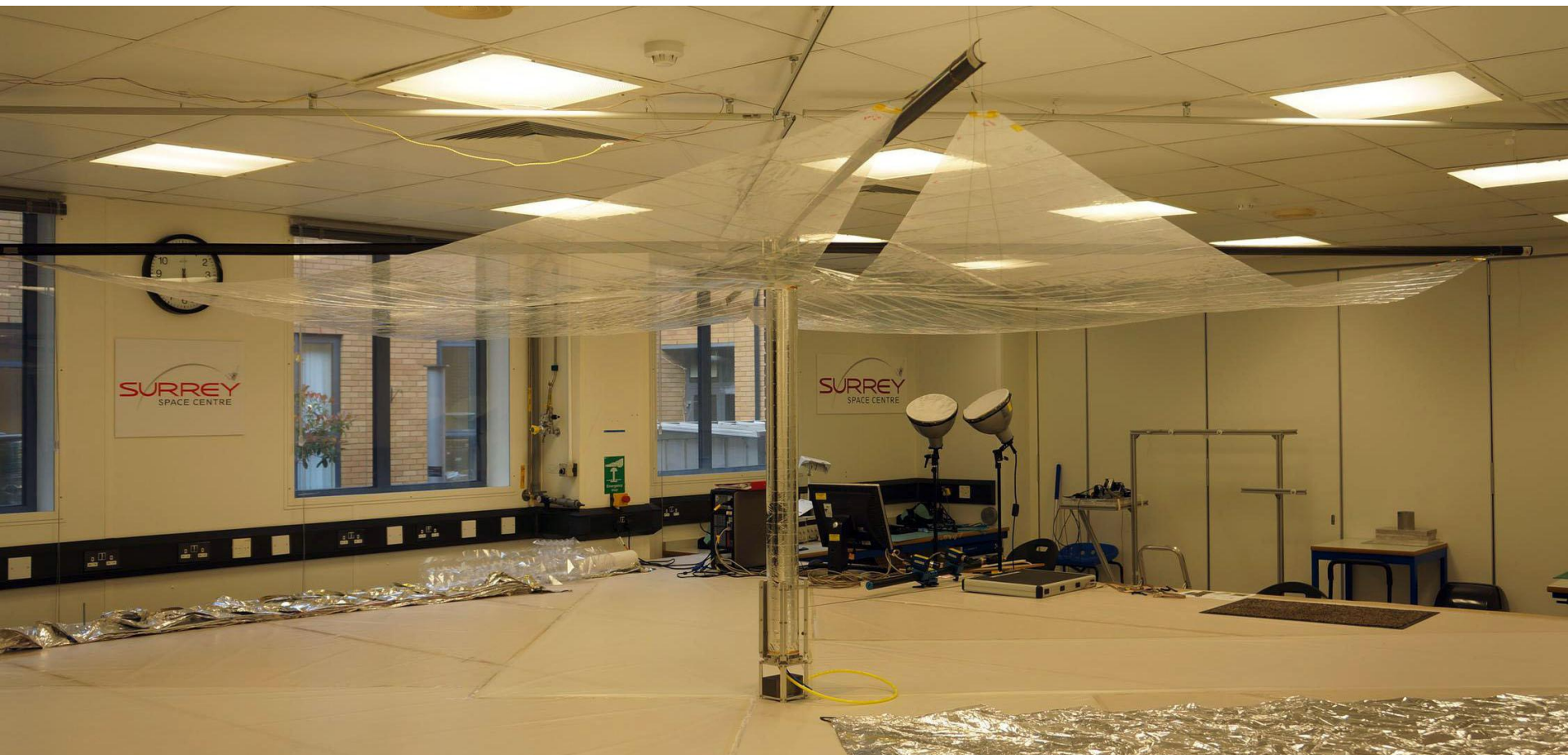


gossamer drag sail

- boom deployment mechanism
 - 4 bi-stable CFRP booms
 - booms co-coiled around spindle
 - brushless DC-motor

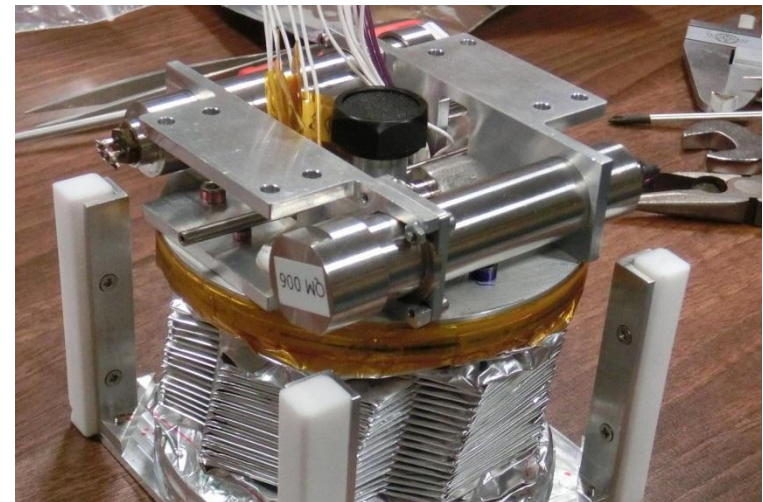
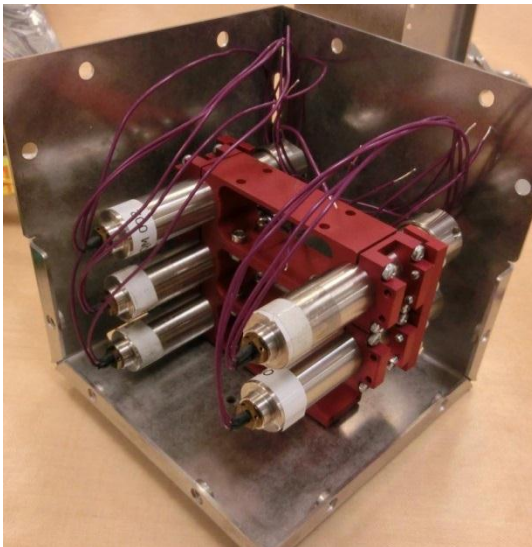
- sail storage
 - membrane (10 m²) / 4 quadrants
 - 12 μm clear PEN membrane
 - Z-folded and wrapped around spindle



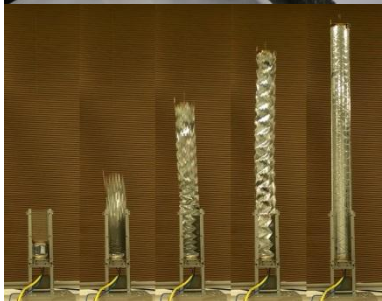
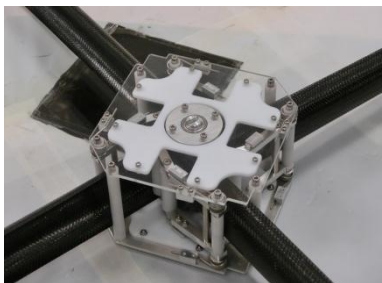


Cool Gas Generators

- Capable of long term storage in orbit
- Two included in satellite for redundancy
- Each CGG contains enough gas to fully deploy and rigidise mast



Typical Tests



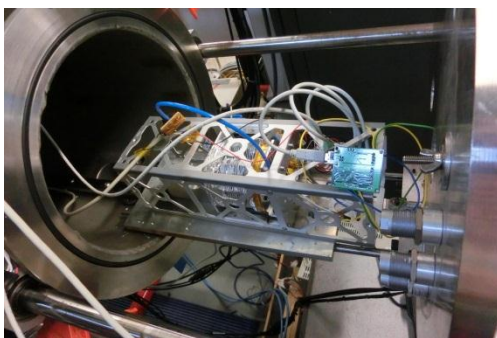
Functional



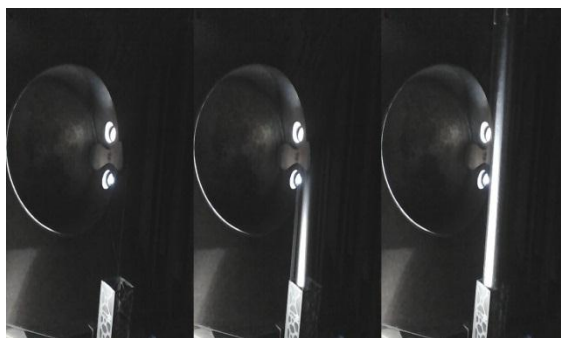
Structural



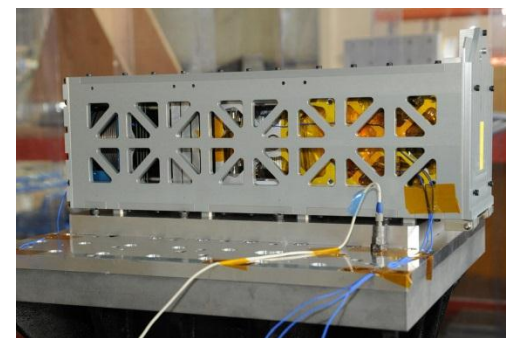
Thermal



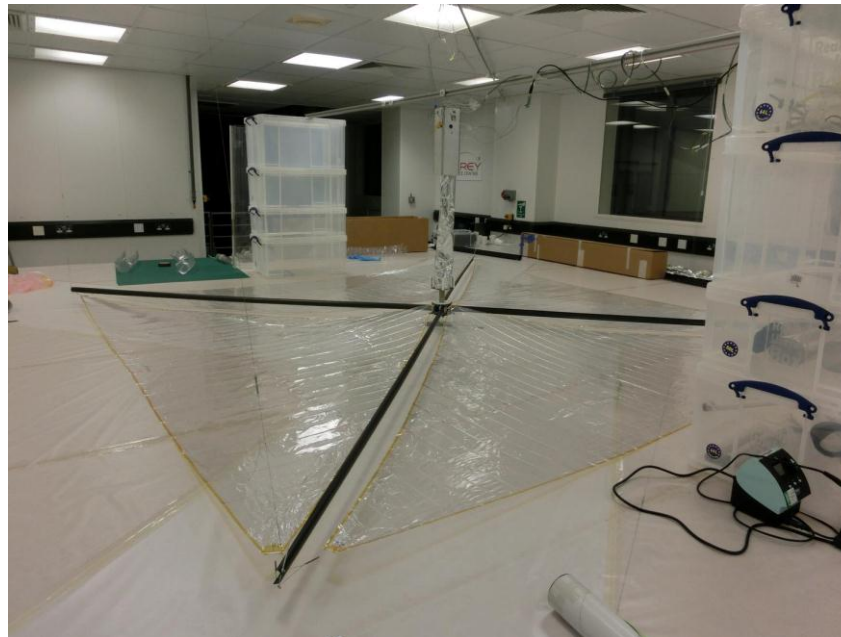
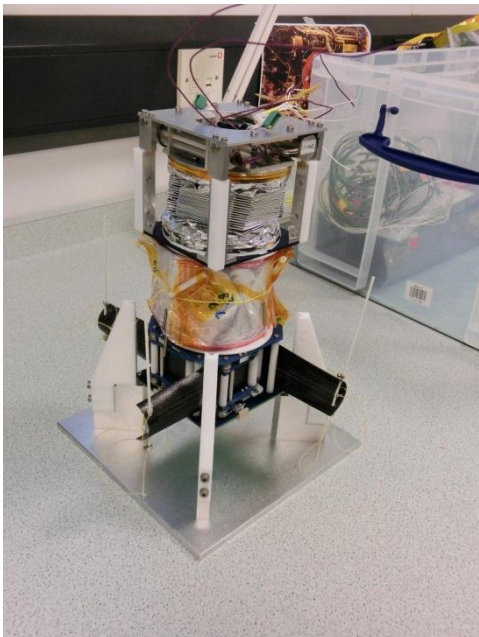
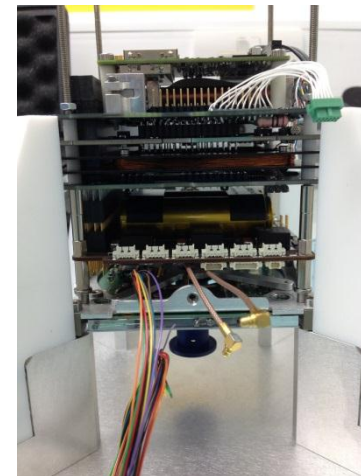
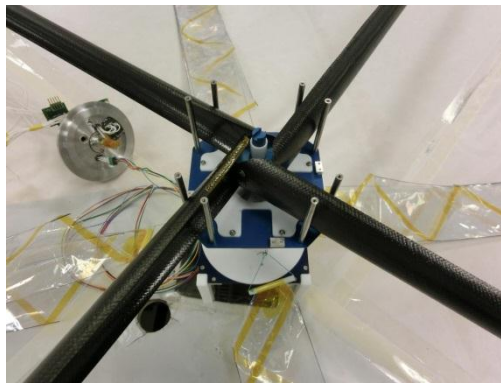
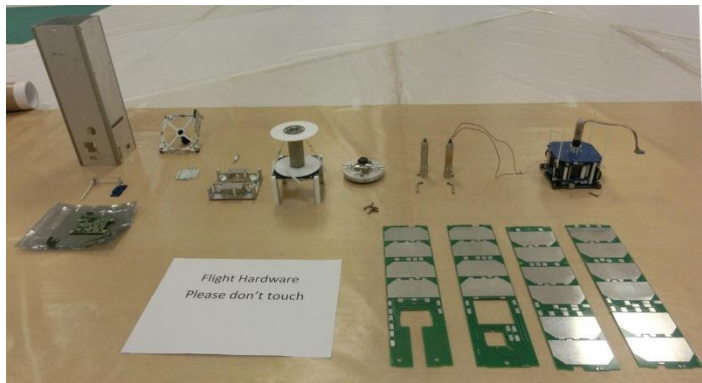
Ascent vent



Vacuum



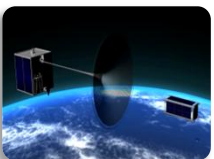
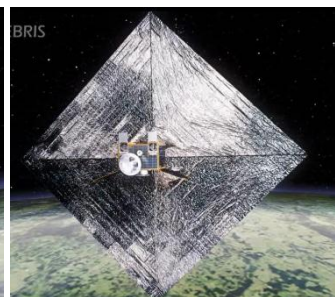
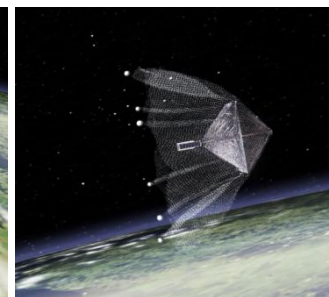
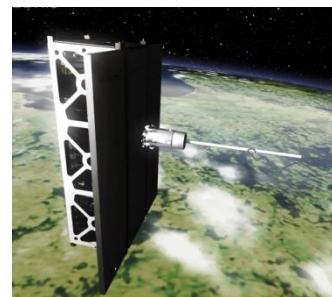
Vibration



Low cost
Active Debris Removal
mission to demonstrate,
de-risk and mature key
in-orbit technologies

R&D project with an in orbit
research and demonstration
component capture
technologies

- net and harpoon
- de-orbiting with a drag augmentation sail
- proximity rendezvous operation technologies with vision-based navigation



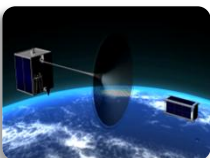
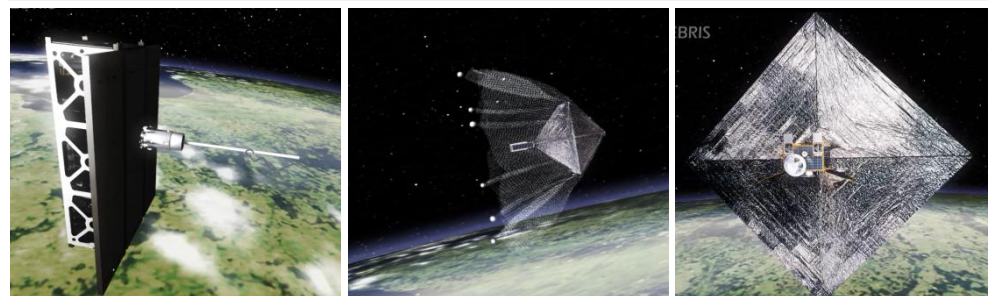
Low cost

Active Debris Removal mission to demonstrate, de-risk and mature key in-orbit technologies

R&D project with an in orbit research and demonstration component capture technologies

- net and harpoon
- de-orbiting with a drag augmentation sail
- proximity rendezvous operation technologies with vision-based navigation

- A European Commission FP7 project (€13 million) coordinated by SSC
- 9 Partners, over 60 staff
- Project duration: 3 years Project start: late 2013
Launch: mid 2016



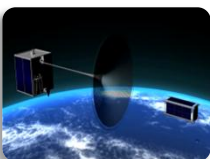
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R&D project with an in orbit research and demonstration component capture technologies

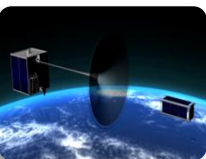
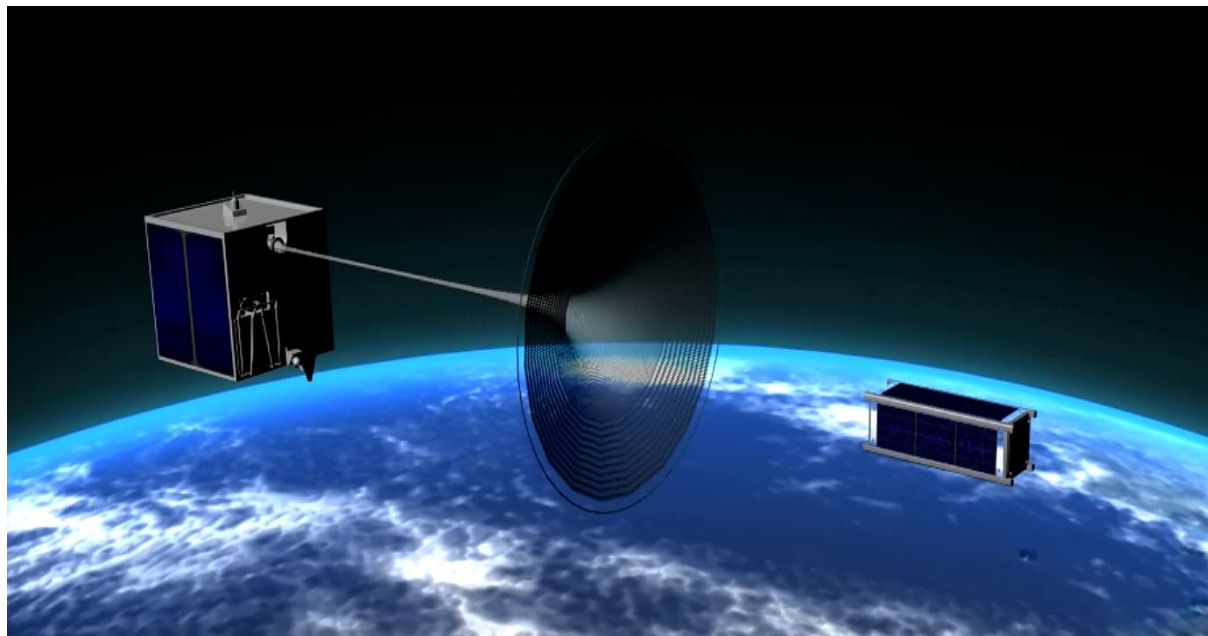
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	Short name	Country	Business activity	Role(s) in the project
1	SSC	United Kingdom	University – Teaching and Research	Project coordinator, DebrisSAT CubeSat development and de-orbit technology development
2	SSTL	United Kingdom	Small satellite bus and sub-system provider	Satellite platform provider, satellite operations
3	ASG	Germany	Prime contractor for space missions (space transportation and satellites)	Net development
4	ASF	France		Vision-based navigation development, mission & system engineering
5	ASU	United Kingdom		Harpoon development
6	ISIS	Netherlands	Small satellite company, specializing in nanosatellites	CubeSat deployers and sub-systems
7	CSEM	Switzerland	Research and development centre	LiDAR camera
8	INRIA	France	Research	VBN algorithms
9	STE	South Africa	University – Teaching and Research	CubeSat ADCS hardware and software



Video



RemoveDEBRIS



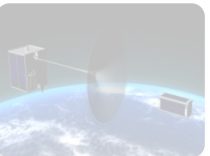
RemoveDEBRIS



All researchers in SSC, past and present,
and in particular:

Prof. Vaios Lappas
Johnny Fernandez
Mark Schenk
Olive Stohlman
Lourens Visagie
Jason Forshaw
Adam Hoskin
Gabriel Secheli
Martin Richter
Chiara Massimiani
Giuseppe Martinotti

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Thank you

for more info please visit our web pages:

www.surrey.ac.uk/ssc/