Groots worden door klein klein klein klein klein klein klein te blijven

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TU Delft Space Institute / Theme leader Space Robots

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MicroNed

MiSat

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Clusters

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Coördinator: C
3. Microfactory (
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Coördinator: H
4. Fundamentals
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Coördinator: D

MicroNed research structure

Micro Satellite

Introduction

Since 1958 space activities have developed from a zero Euro business into a multi-billion Euro business with many applications. However, cost of access to space is high, spacecraft are prone to failure in the hostile space environment, and failures come at high cost.

Traditionally, spacecraft are build to exact specifications for a particular mission, and units designed for that mission could often not be reused without major modifications. Therefore during the past years Space agencies such as ESA and NASA already have taken steps towards reusing parts of a design. Examples are the Integral satellite, which reused part of the XMM Newton design and Mars Express, which reuses hardware originally developed for Rosetta. In general space projects are large scale and complex projects in which many aspects with significant uncertainty are to be considered to make the right decision.

The trend of spacecraft development is towards lighter, more intelligent systems that achieve reduced total mission costs or add more experiments as payloads on a single spacecraft. Also the number of missions in which formation flying of two or more spacecraft is required, is expected to increase. Size and mass are key elements in the cost of a spacecraft's launch. Micro spacecraft can offer the same functionality at greatly reduced system and launch costs thereby potentially opening the space market to a wider range of participants. Using similar or identical micro satellite busses as a platform for missions with many different combinations of payload instruments will keep up the number of missions at a high level at *less costs*.

The MISAT Cluster in MicroNed

The MISAT Cluster (Cluster I of MicroNed) therefore focuses on the development of a micro satellite. This forms a technically comprehensive, challenging and interesting platform, permitting a broad range of experiments. This approach provides opportunities for component and system (sensors and actuators) qualification, monitoring behaviour in a space environment, and several autonomous system experiments.

At first instance, the MISAT research focuses on enabling technology for space based micro systems, with an emphasis on lower mass, lower volume, lower power and enhanced flexibility and re-configurability. The Cluster activities are focused on development of a knowledge infrastructure of micro system technology and the application in a strenuous environment. The robust systems that result will find a large number of applications "on earth".

Next to the science and technology expectations, the development of a "real-life" micro satellite will establish a clear challenge able to attract young research talent, and it forms an eye-catching background for public relations.

The 4 Work Packages of the MISAT Cluster

I-A Satellite Bus

Dr. ir. C.J.M. Verhoeven (c.j.m.verhoeven@tudelft.nl)
This WP focusses on navigation and orientation systems, RF bus communication, sensors and interfaces for the space environment and satellite docking systems.

I-B. Payload system

Dr. ir. B. Monna (b.monna@systematic.nl)
Topics of this WP are: reconfigurable GPS, relative navigation, microcooler systems for the space environment, position determination via accelerometer and gradiometer control, and microchannel interconnection system design.

I-C. Spacecraft Architecture

Ir. A.R. Bonnema (a.r.bonnema@isispace.nl)
This WP focuses on the main micro satellite architectural issues: strategies for reduction of size, weight, etc., damage-tolerant materials, software system architecture for modular systems, and smart power distribution systems.

I-D. Formation Flying System and Distributed Sensor-Actuator Systems

Prof. dr. ir. J.M.A. Scherpen (j.m.a.scherpen@rug.nl)
This WP focuses on solutions for autonomous formation flying guidance and control for multiple satellite constellations, multi sensors multi-satellites systems, micro-propulsion for controlled in-formation flying, and the theoretical modeling for control of distributed systems.

Technology push

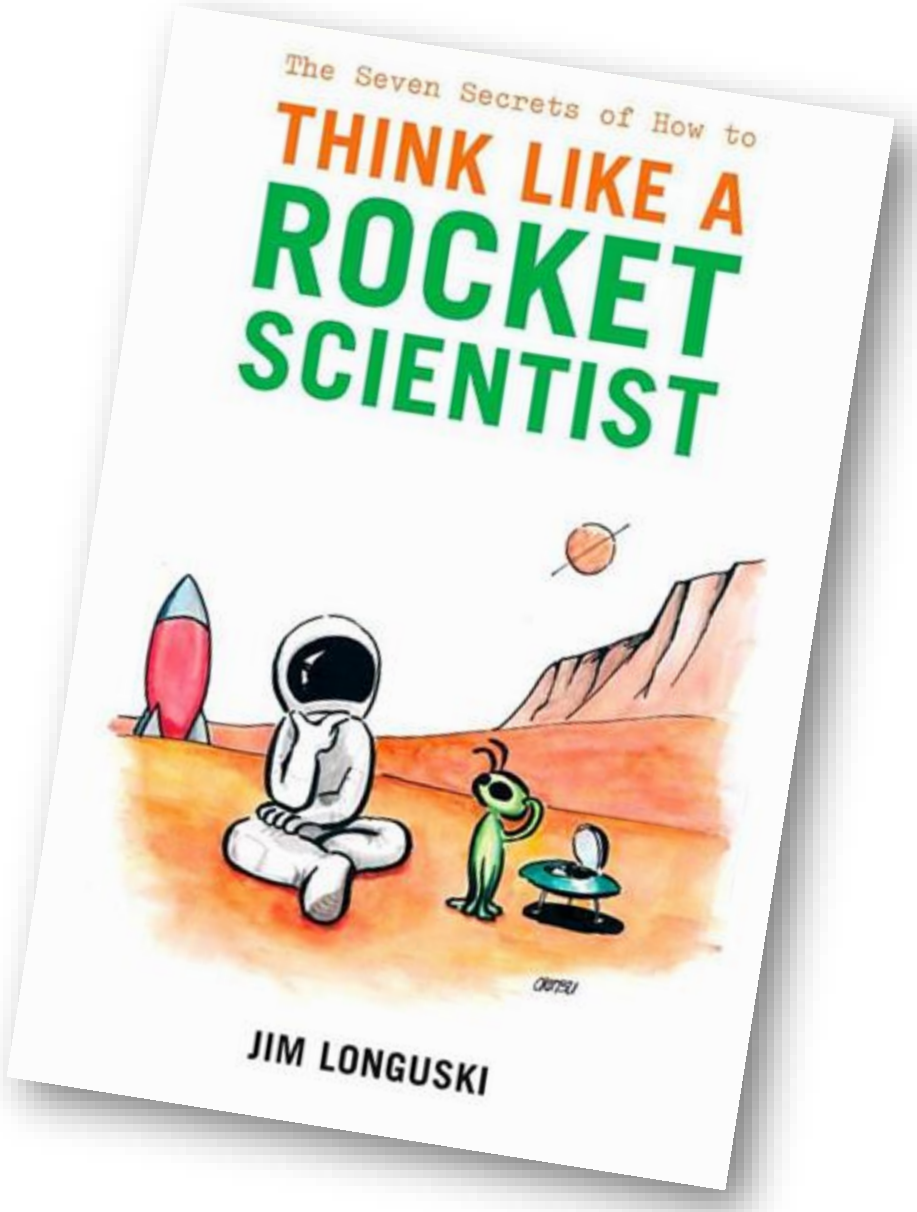
Massive investments in high reliability

Massive investments in high performance

Bulk market, mass production: low cost

Massive investments in high reliability
Massive investments in high performance
Bulk market, mass production: low cost +

“Improved” satellites


The Seven Secrets of How to
THINK LIKE A
ROCKET
SCIENTIST
JIM LONGUSKI

space

is a

place

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+

Nano-satellites

MISAT: A MICROSATTELITE COLONY

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C.J.M.Verhoeven@et.tudelft.nl

W.Jongkind

System Integration, Design and Analysis of Space Systems
Faculty of Aerospace Engineering
Delft University of Technology
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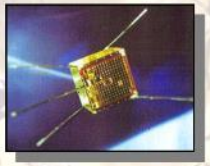
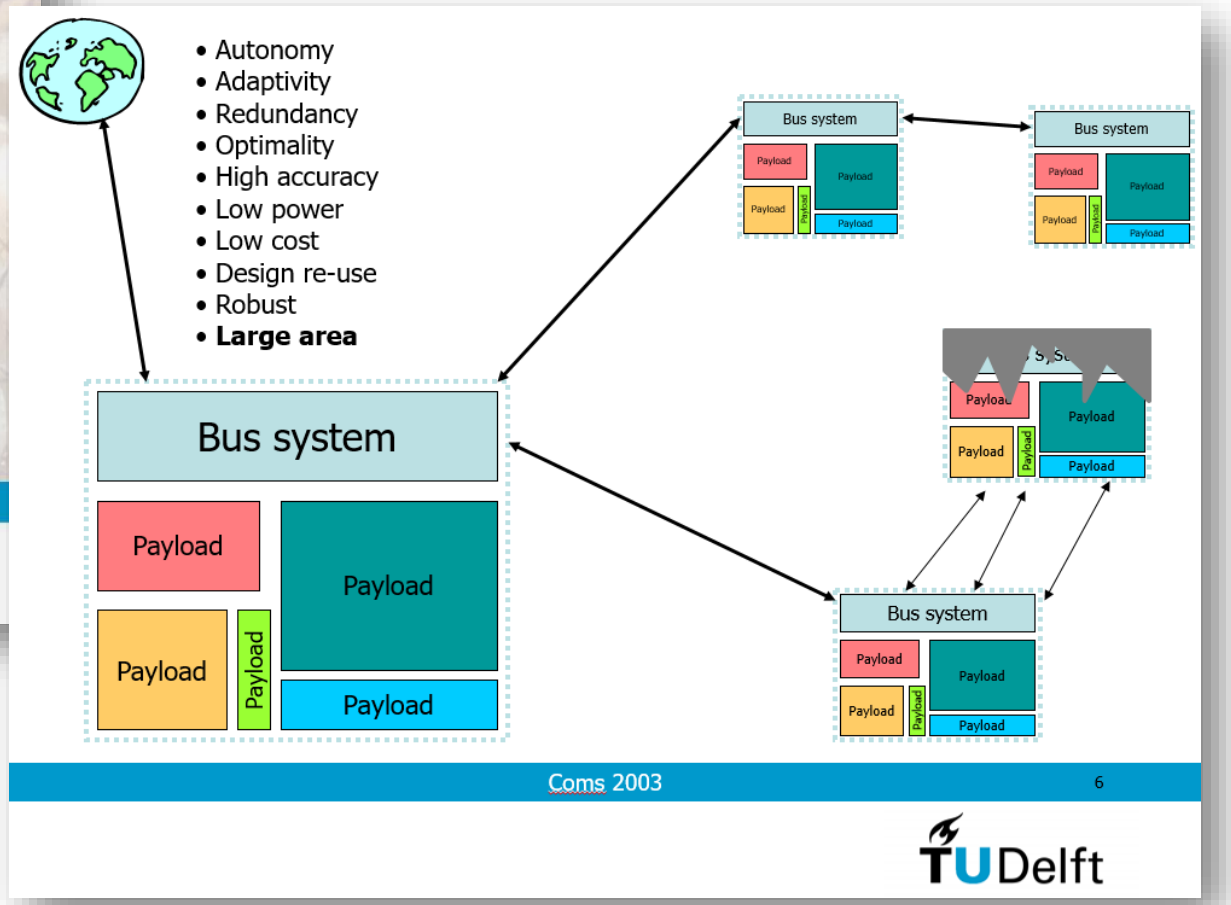




Data Collecting Swarm

Self-deploying sensor network

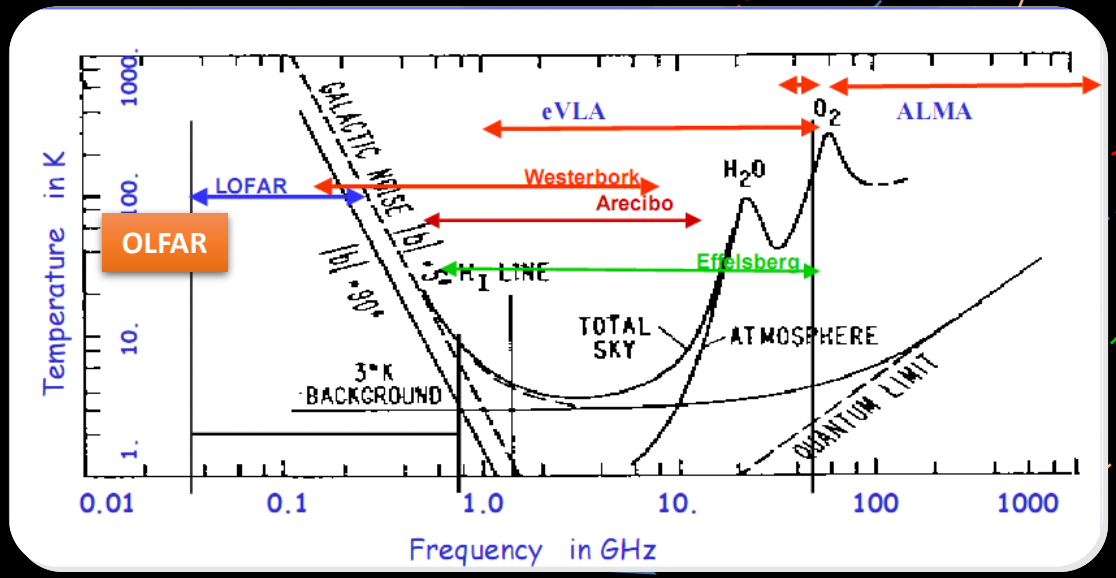
Omnipresent

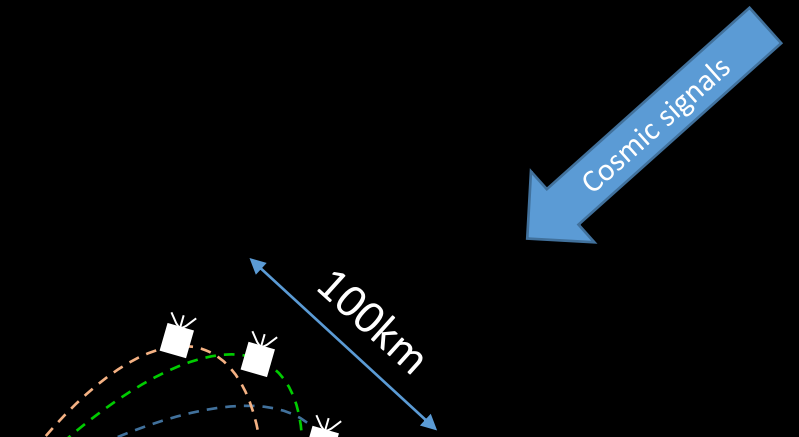
Indestructible

Self-deploying sensor network

OLFAR

Orbiting **L**ow **F**requency **A**ntenna for **R**adio-astronomy





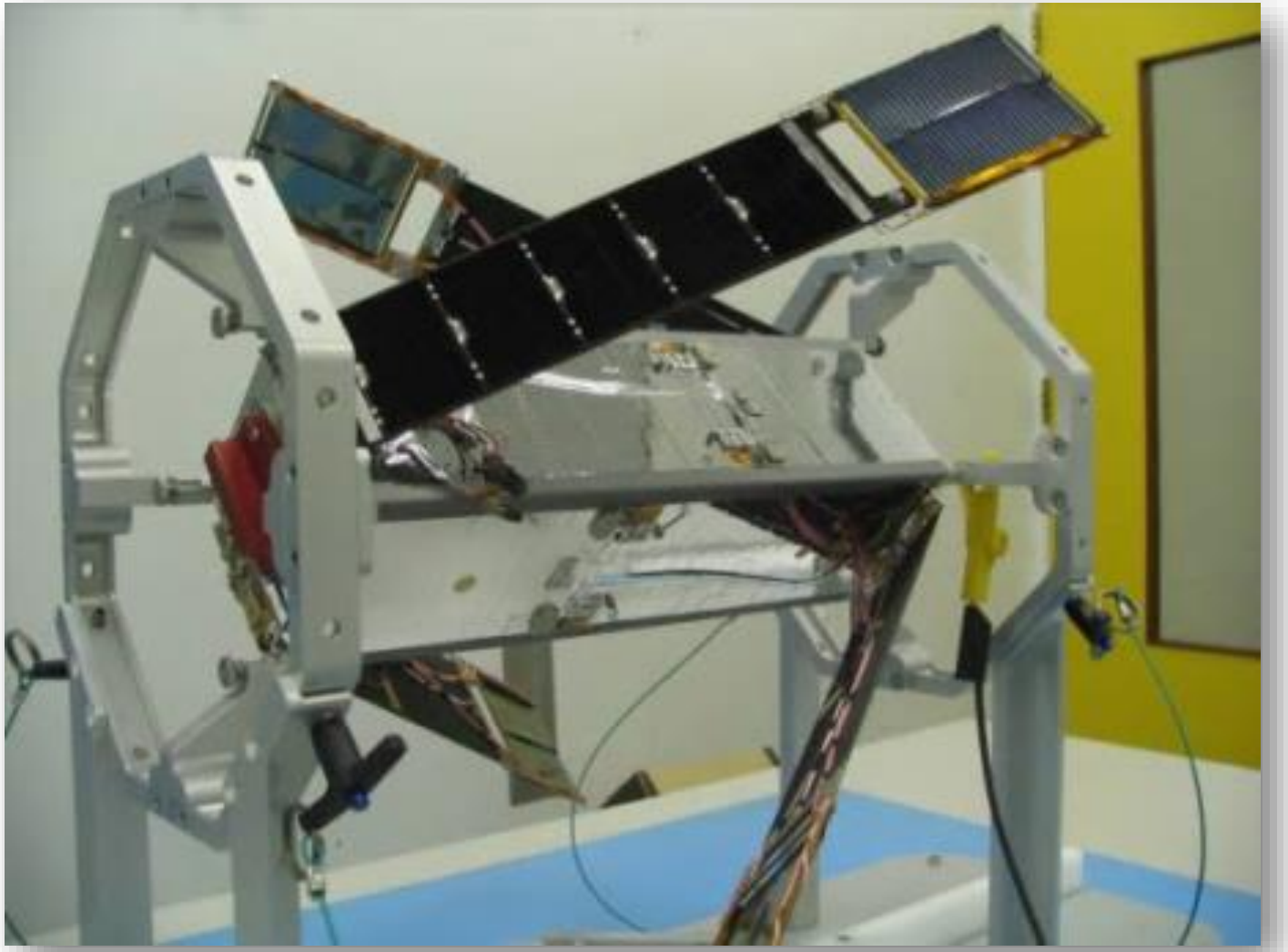
Radio telescope

Swarm

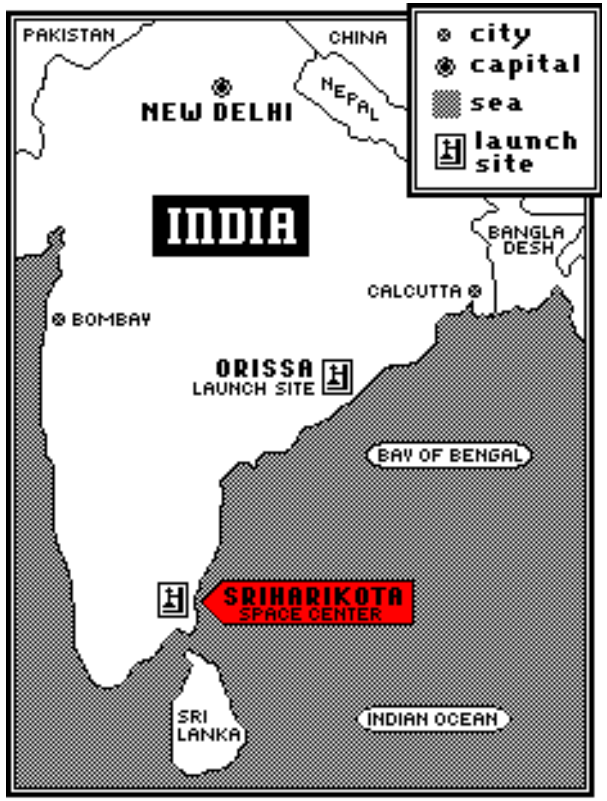
Moon orbit

30kHz-30MHz

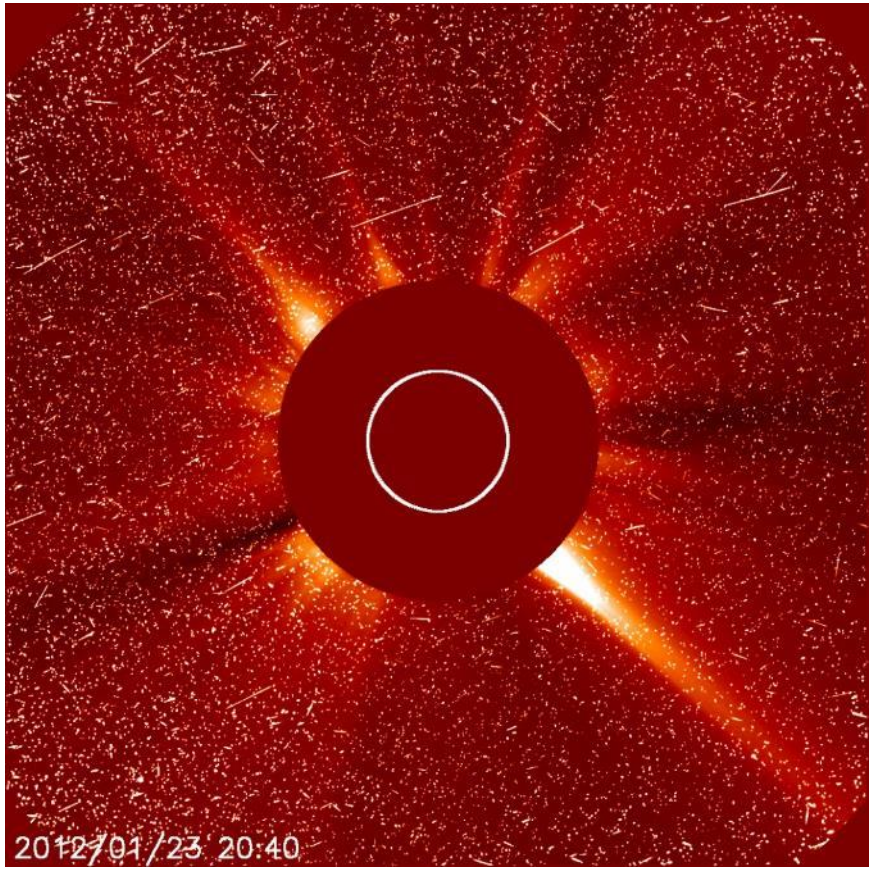
Delfi-C3

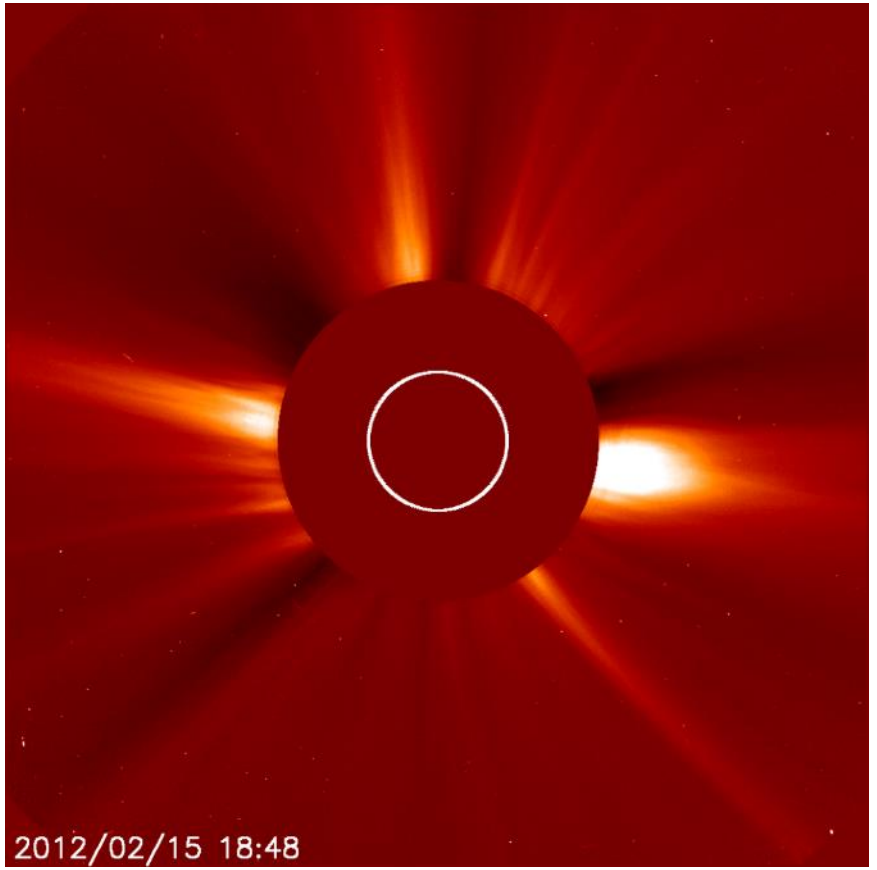


April 28, 2008



Large angle and spectrometric coronagraph on SOHO

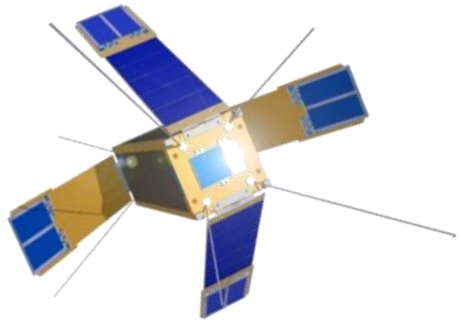




Consumer electronics survives extreme space conditions

Nano-Satellite: Delfi-C3

Still alive after nearly **9 years!**



Delfi-C3

2008

Science

Delfi-n3Xt

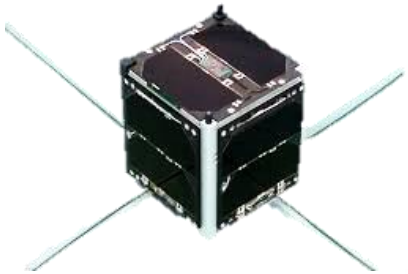
2013

Science

Triton-1

2013

Industry

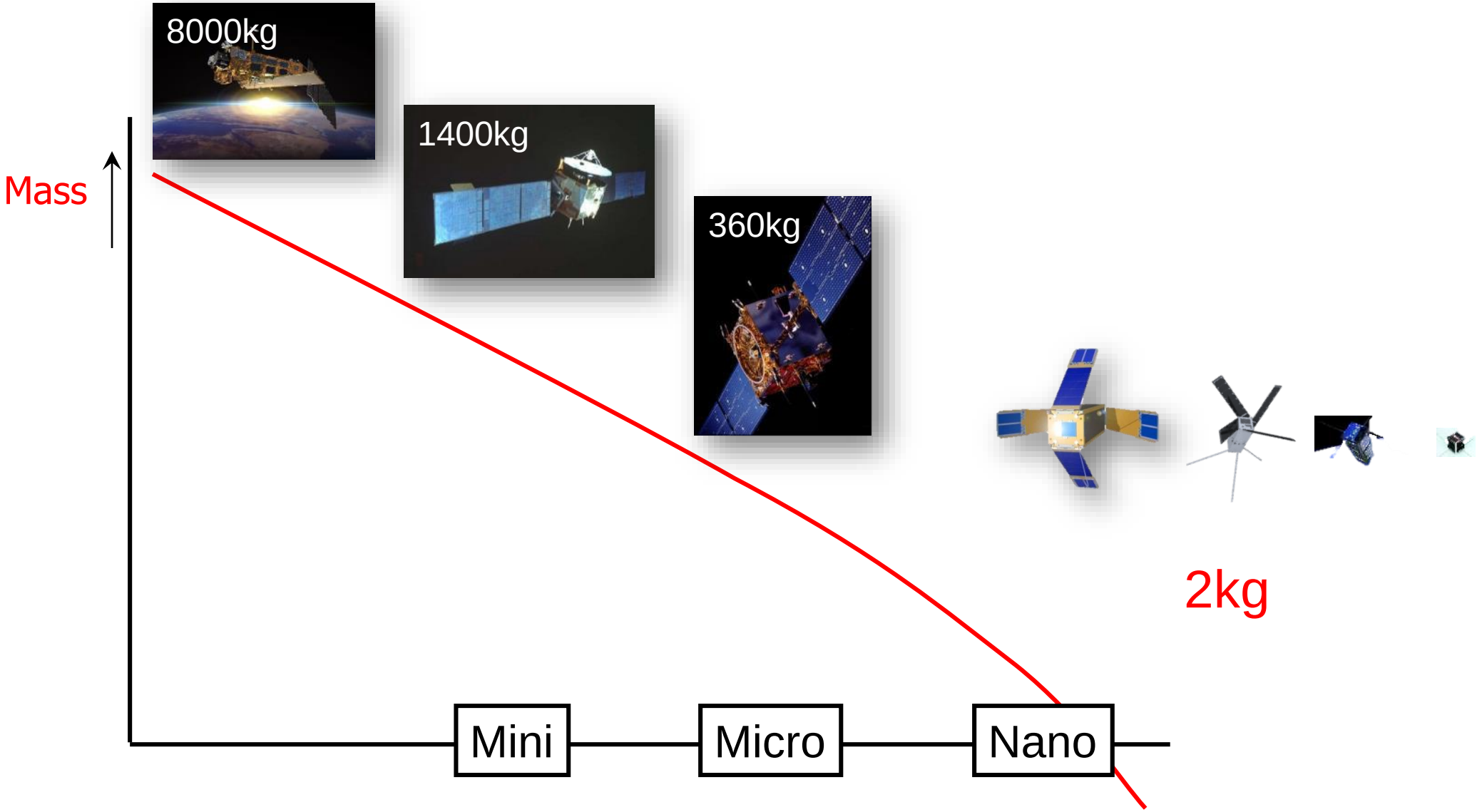


FUNcube-1

2013

Education

Niche?



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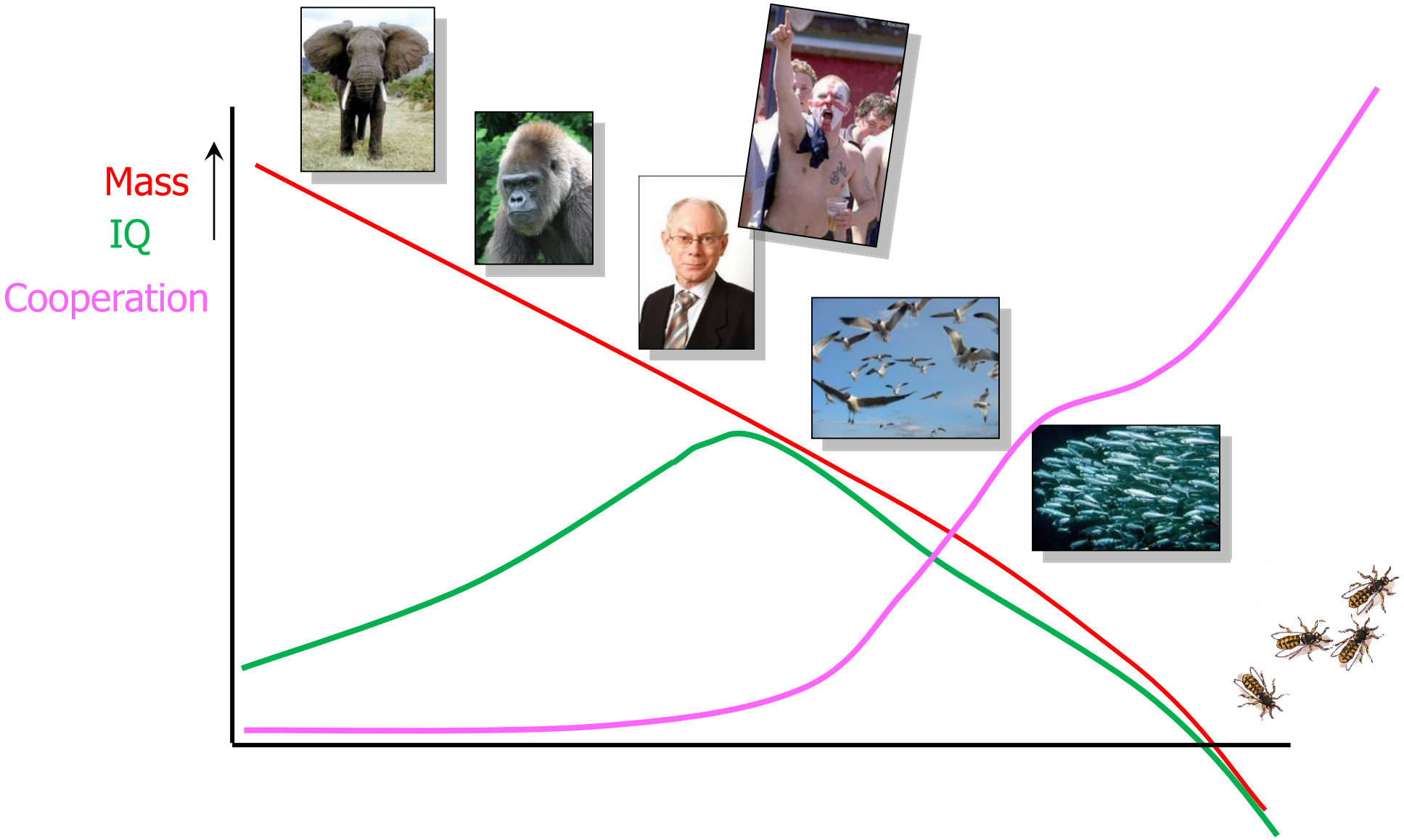
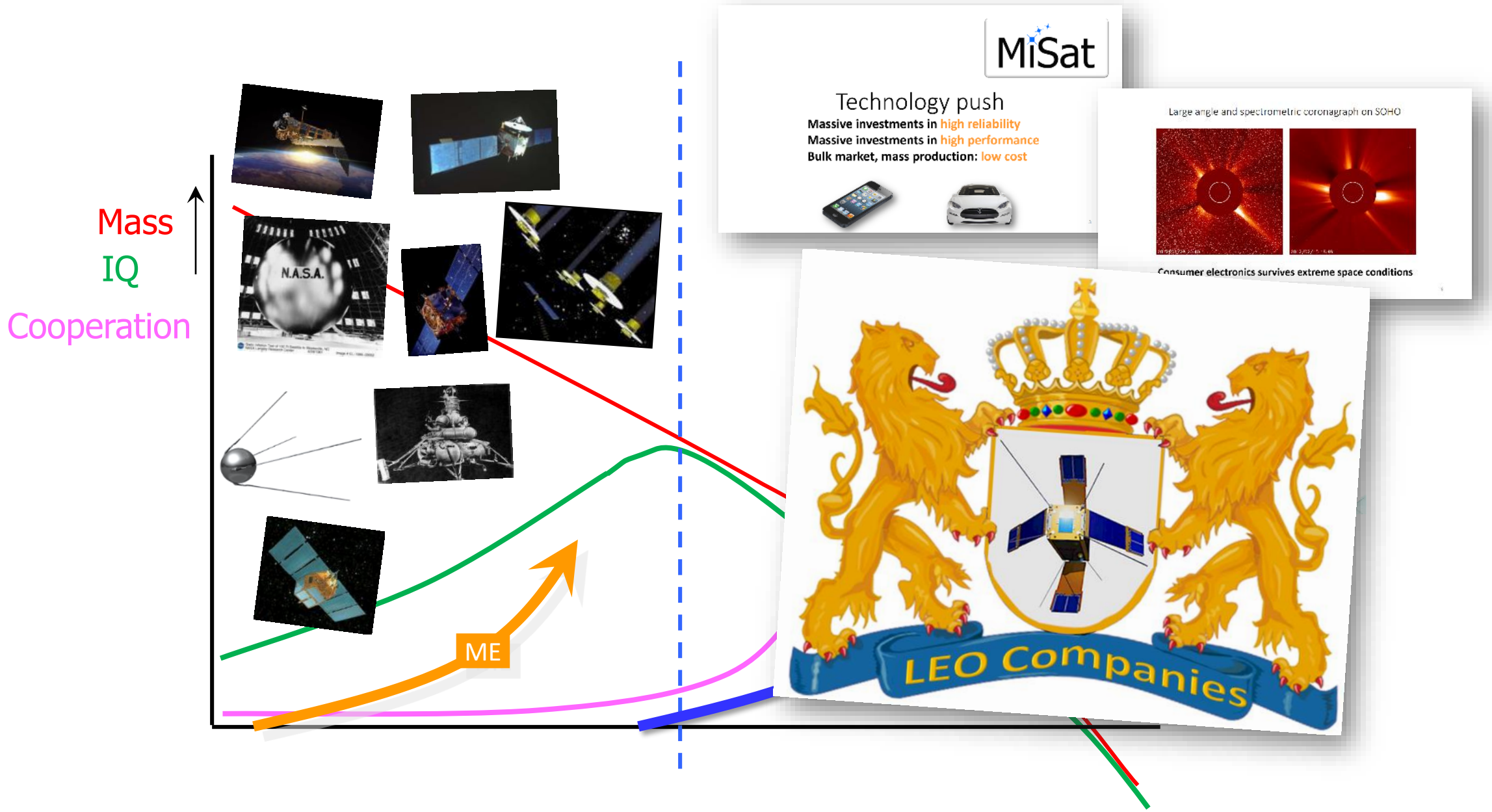


Niche !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Mass
IQ
Cooperation
N.A.S.A.
ME
LEO Companies

Spin-in!

Bulk market technology

Spin-in!

Space technology is becoming “normal”

Bulk market technology

Space technology

Deep Space technology

Conclusions

https://www.youtube.com/watch?v=aYf_uyHQN5o&t=33s

Bulk market technology enters space
Space has become “normal”
LEO is the place to be
New space systems
New (LEO) space companies

Conclusions

http://www.ruimtevaart-nvr.nl/media/vk_1223/Website/Presentaties_evenementen/OLFAR_IAC2013.pdf

Bulk market technology enters space
Space has become “normal”
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New (LEO) space companies

I believe that this country should commit itself to become big, by staying small,
and realize **OLFAR** *at the moon,*
Because that goal will serve to organize and measure the best of our energies and skills.