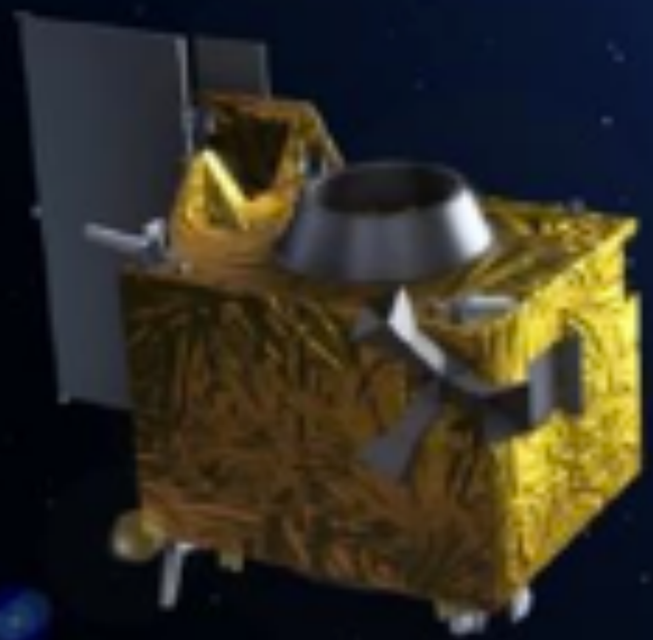
ASPIICS e KUAFU



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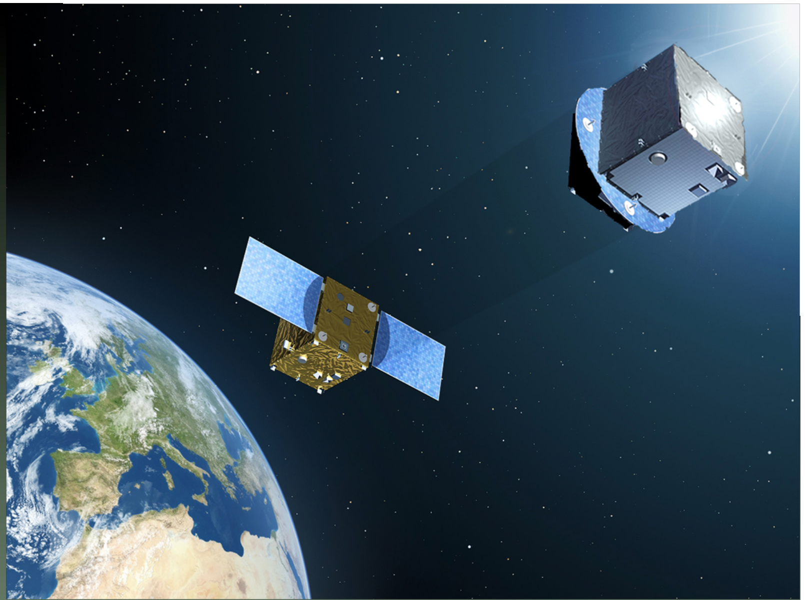
Università di Firenze

Sole e Sistema Solare
Giornata in memoria di
Angioletta Coradini
Roma, 30 ottobre 2012

ASPIICS

ASPIICS on ESA PROBA-3

Association de Satellites Pour l'Imagerie et l'Interférométrie de la Couronne Solaire



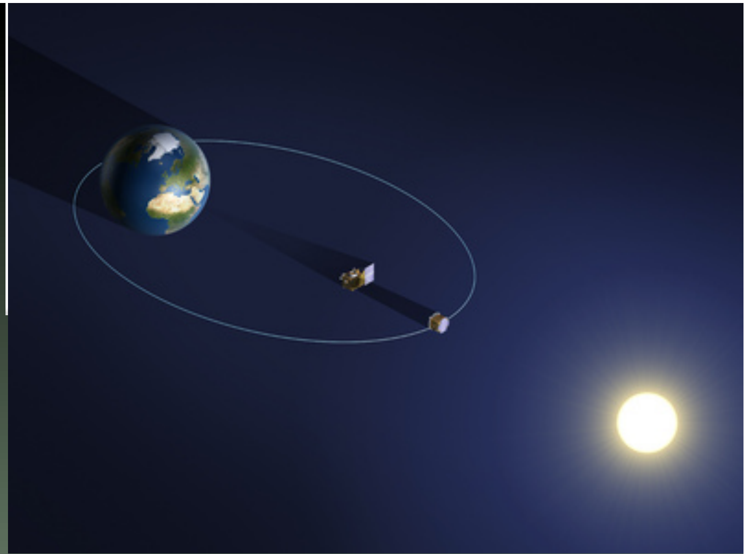
Chosen by ESA as baseline payload for a phase A study of the PROBA-3 formation flyers demonstration mission in September 2005

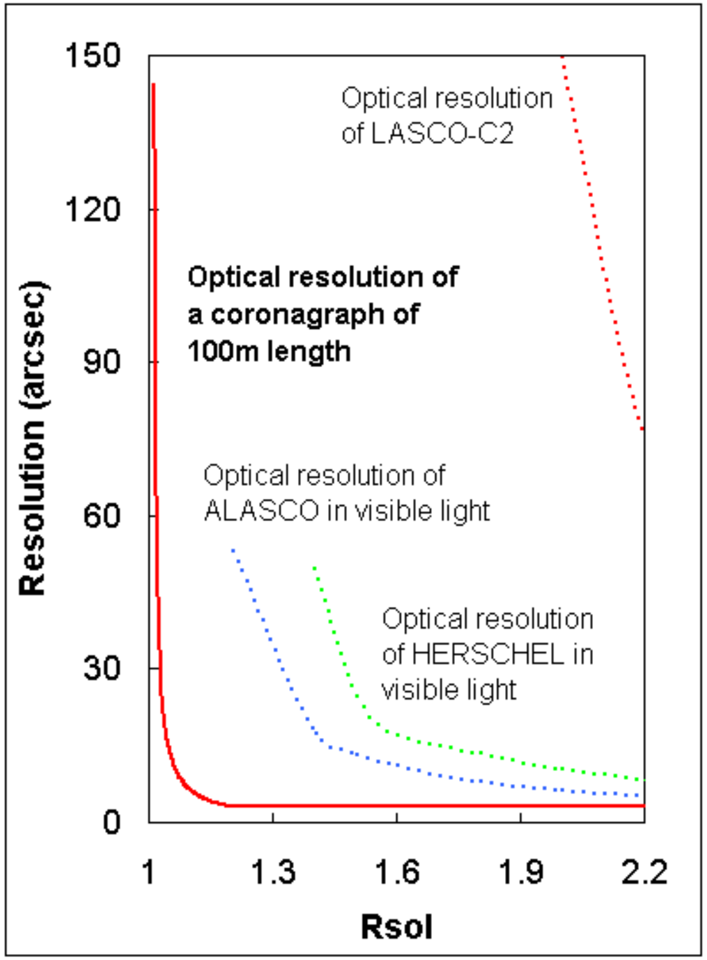
2009-10 ESA's StarTiger project is to design and develop ASPIICS sub-systems. 6 months with a core team from France, Belgium, Greece and Italy based at the Laboratoire d'Astrophysique de Marseille (LAM) in France

Presently in Phase B

Solar coronagraphy

Internal occ. coronagraphs are limited by diffraction





Moving the occulter further away preserving eclipse-like conditions for long periods is the performance offered by the Proba-3 ext. occ. coronagraph.

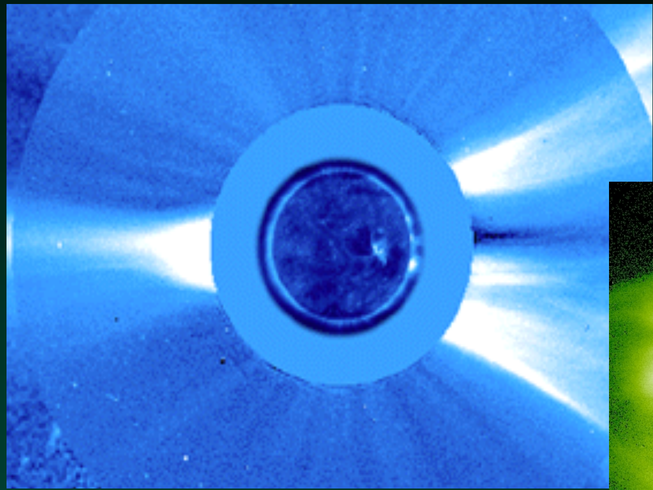
How is the corona heated, what is the role of waves ?

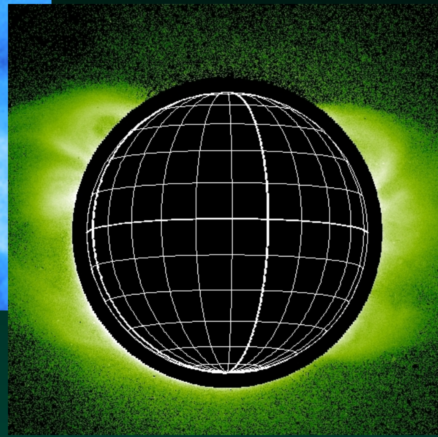
How are the Coronal Mass Ejections (CMEs) accelerated ?

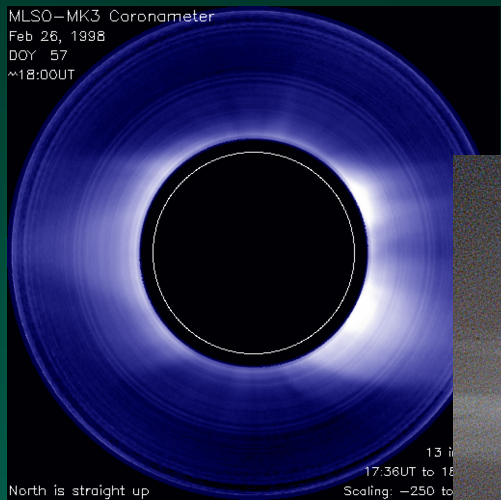
What is the topology of the coronal magnetic field ?

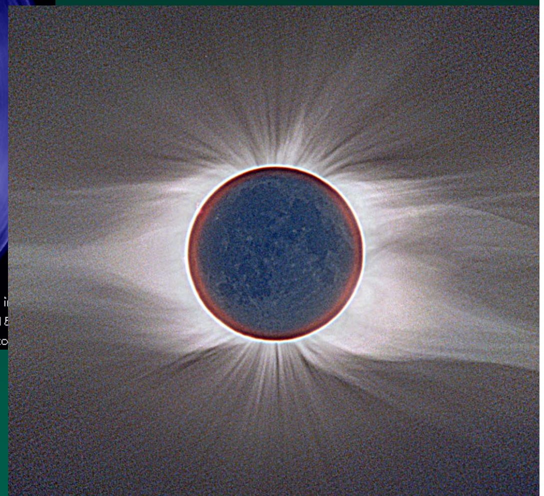
Observing the inner corona

- After 40 years of space coronagraphy, the lower corona (<2.5Rsol) remains practically unobserved
  - SOHO/LASCO-C1: high level of instrumental straylight
  - SOHO/UVCS: EUV spectroscopy
  - STEREO/SECCHI-COR1: internally occ. coronagraph
  - Ground-based coronagraphs: affected by seeing and atmospheric conditions, FOV<1.5Rsol
  - Total solar eclipses: very rare!!!



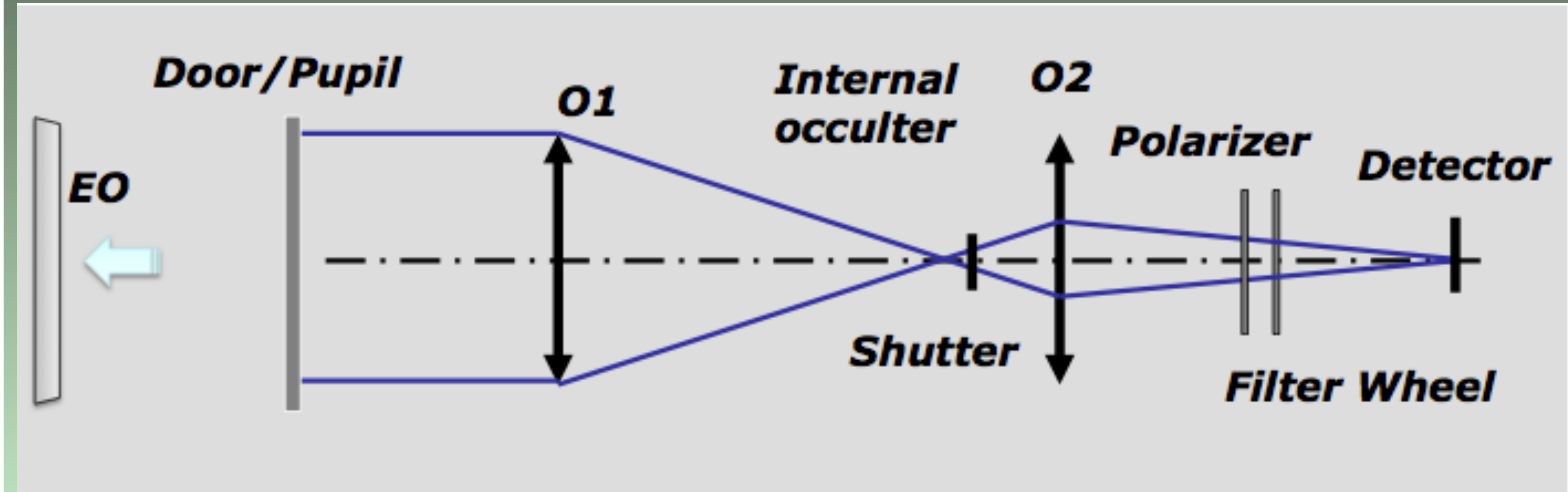




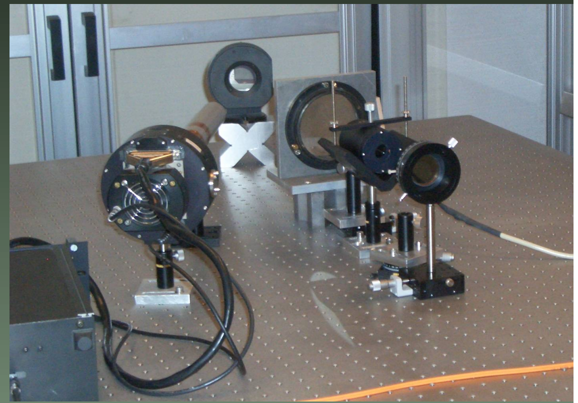


ASPIICS

The paired Proba-3 satellites will have a highly elliptical orbit with an apogee (or top of orbit) of 60,524 km and perigee of 800 km.

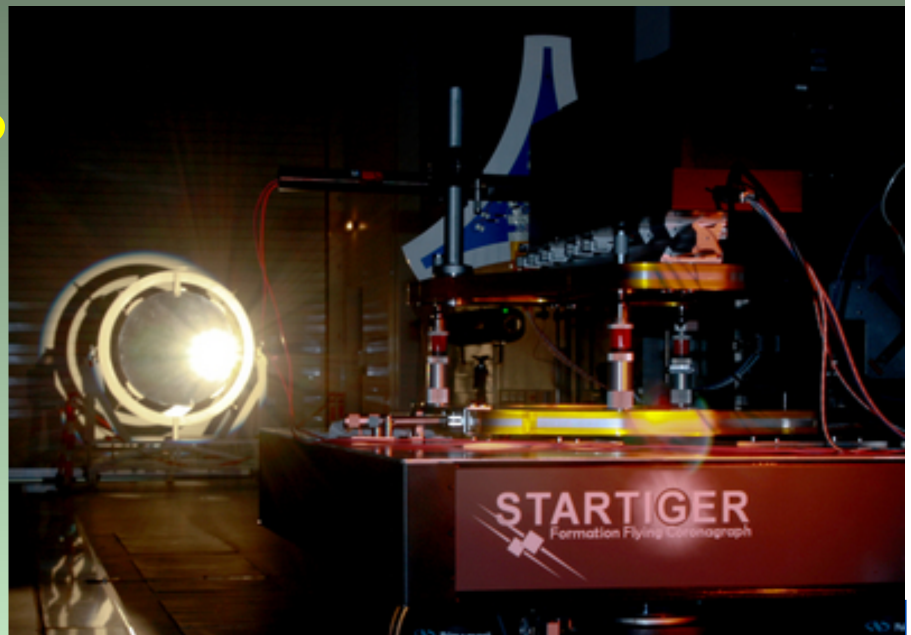


ASPIICS Italian role



- Participation to StarTiger program:
- Development and test of OPS and SPS
- Ext. occ. diffraction evaluation and testing

- Development and test of a Liquid Crystals Tunable Polarimeter LCTP



Contributions to Phase B:

- SPS and OPS
- Stray light analysis

KUAFU

Named after a giant of the Chinese mythology

Kuafu is a space weather mission in collaboration between China and ESA

Kuafu consists of three S/C:

- Kuafu-A: remote sensing of the Sun and in situ from L1
- Kuafu-B1 and B2: remote sensing of auroras and in situ from Molniya type polar orbits

KUAFU

Nov., 2010, the space science pioneer program, including Kuafu, has been selected as one of the CAS strategic pioneer research program.

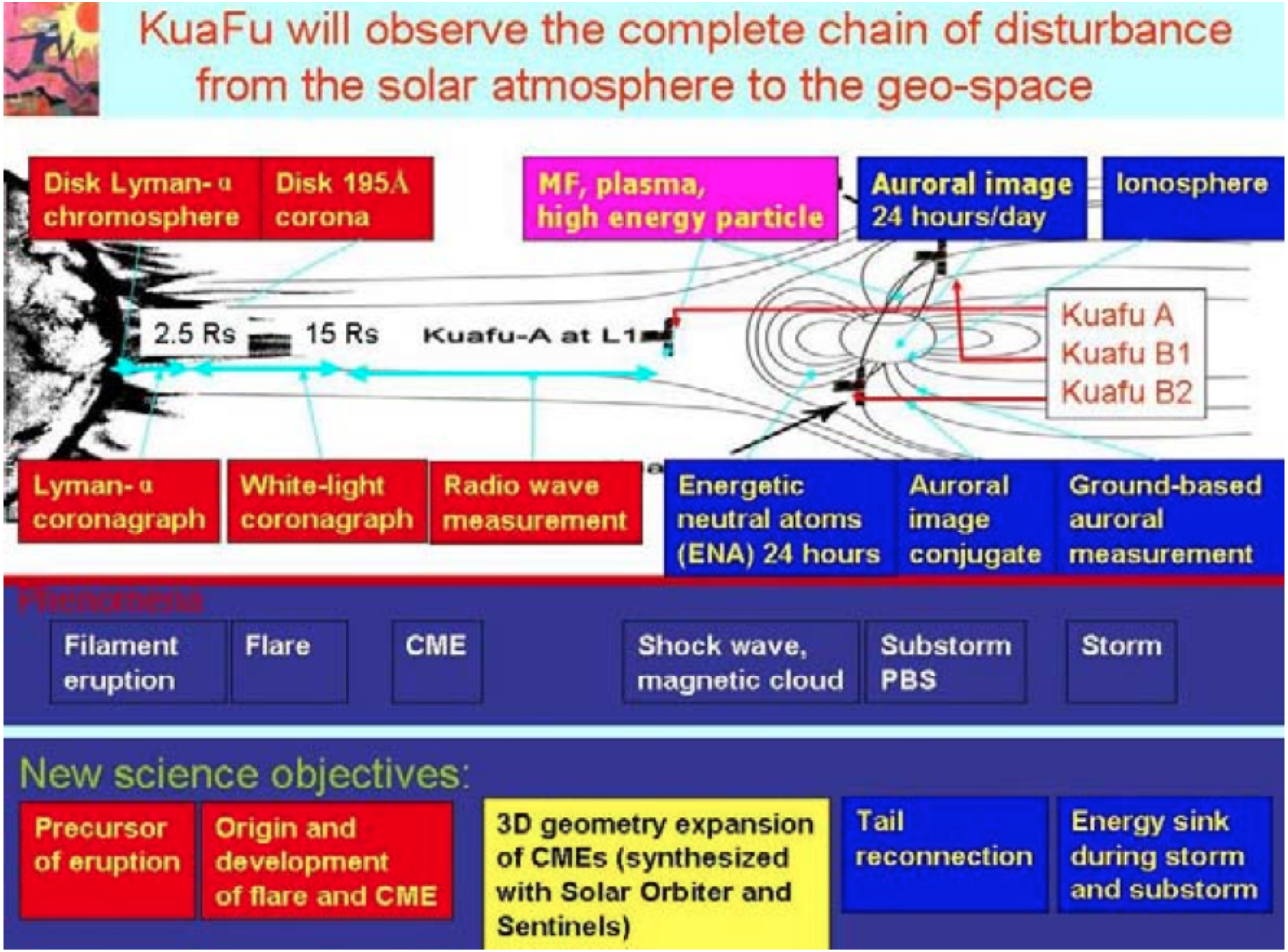
China and ESA collaboration will focus on KuaFu A;

China side:

- Platform
- Launch
- Payload, most of in-situ measurements

ESA side:

- Some Payload, most of remote-sensing measurements
- Provide help on the satellite design
- Provide help on TT&C, data receiving


KuaFu will observe the complete chain of disturbance from the solar atmosphere to the geo-space
Disk Lyman-α chromosphere
Disk 195Å corona
MF, plasma, high energy particle
Auroral image 24 hours/day
Ionosphere
2.5 Rs
15 Rs
Kuafu-A at L1
Kuafu A
Kuafu B1
Kuafu B2
Lyman-α coronagraph
White-light coronagraph
Radio wave measurement
Energetic neutral atoms (ENA) 24 hours
Auroral image conjugate
Ground-based auroral measurement
Phenomena
Filament eruption
Flare
CME
Shock wave, magnetic cloud
Substorm PBS
Storm
New science objectives:
Precursor of eruption
Origin and development of flare and CME
3D geometry expansion of CMEs (synthesized with Solar Orbiter and Sentinels)
Tail reconnection
Energy sink during storm and substorm

KUAFU objectives

KuaFu-A will:

- survey for the solar disk with Lyman-alpha imager;
- survey of the external corona, with a Lyman-alpha and VL coronagraph, in order to identify the initial sources of CMEs and the acceleration profiles of CMEs;
- observe in-situ the solar wind variability: stream structures, co-rotating interaction regions, Alfvénic fluctuations, shock waves, magnetic clouds, etc.;
- measure the fluxes of solar energetic particles accelerated at flare sites and at shock fronts.

KUAFU-A payload

Lyman alpha imager	CAS interest
Coronagraph	TBC, open to European interest
Fluxgate Magnetometer	CAS interest
Plasma Instrument	TBC, open to European interest
Hard X-ray/Gamma-ray spectrometer	CAS interest
Solar High-Energy Proton Detector	CAS interest
Solar High-Energy Electron Detector	CAS interest
Solar High-Energy Ion Detector	CAS interest
Solar electron-proton telescope	Possible spare of Stereo instrument
Digital Absolute Radiometer (Solar Irradiance Measurement)	Potential Interest from Switzerland

KUAFU-B

KuaFu-B will provide :

- Systematic observation of the geo-effectiveness (storm/substorm and other consequences) of solar disturbances;
- First-ever 24 hour per day global auroral imaging;
- First systematic program of conjugate auroral observations;
- First global auroral imaging program carried out in conjunction with the operation of networks of higher-resolution ground-based imagers in Scandinavia, North America, and Antarctica;
- First-ever 24×7 ENA imaging of the ring current ion population.

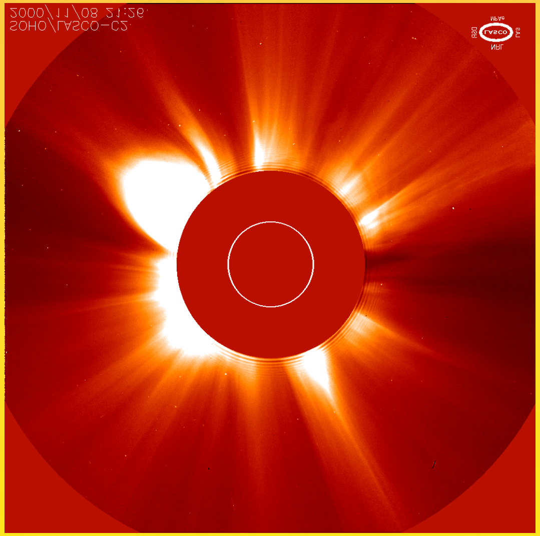
KUAFU-B payload

Characteristic	Wide Field Auroral Imager (Perigee Imager)	Wideband Imaging Camera
Instrument Acronym	WFAI	WIC
Description	Wide field FUV imager for auroral observations primarily at perigee (1.8 Re geocentric) and apogee (for low resolution auroral oval measurements)	Auroral Imaging primarily at apogee (7 Re geocentric) and at perigee (to cover the auroral oval partially)
Heritage	MIXS (BepiColombo), DE-1, ROSAT	WIC from the US IMAGE mission
Detector type	MCP optics – photon-counting detector	MCP intensified CCD
Measurement Range(s)	140-180 nm (FUV)	140 -190 nm (FUV)
Measurement Resolution/Accuracy	Spatial resolution 40 km at 0.8 Re altitude (angular resolution: 14 arcmin)	Spatial resolution at apogee 100 km, angular resolution: 0.13 degrees and 6 km at perigee
Field of View (per package)	44 by 44 degrees	17 by 17 degrees
Cadence	1 image per 10 seconds	1 image per 10 seconds
Mass per package	3 kg (excluding DPU)	5 kg (excluding DPU)
Power per package	10 W (excluding DPU)	4 W (excluding DPU)
Assumed shielding	Shielding mass assumed: 1.1 kg	Shielding mass assumed: 1.1 kg

KUAFU UV and VL coronagraphy

With combined

- visible light imaging
- UV HI Ly α,1216 Å, monochromatic imaging capabilities



in one optical path, in one coronagraph

- externally occulted
- multiwavelength (VL & UV 1216 Å)
- with UV imaging ≥ 1.2 R

(reduced vignetting & stray light contamination in UV)

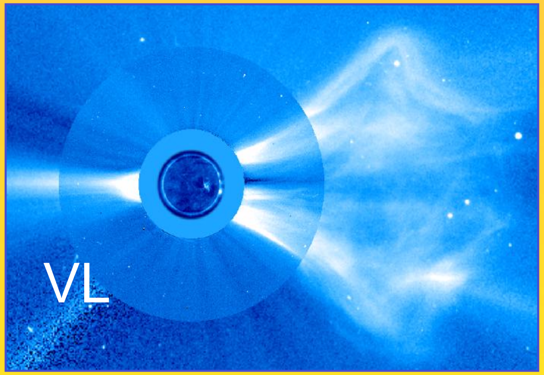
best observing condition
in absence of geocorona effects: L1

Design based on HERSCHEL-SCORE (2009 rocket flight) and on Solar Orbiter/METIS

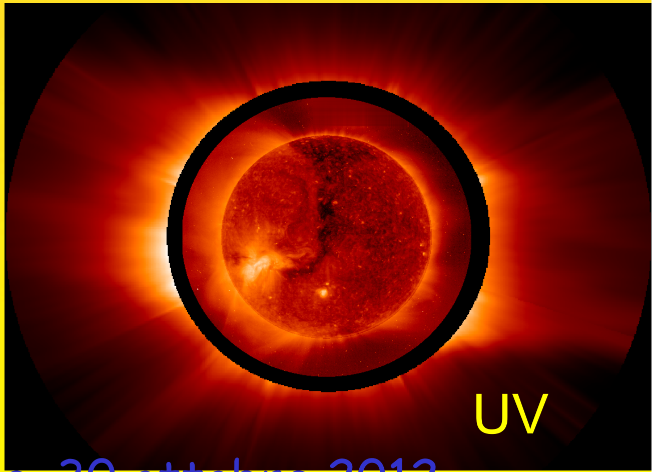
Coronal Diagnostics

Polarized Visible Light (VL)
- electron density of the ejected material
- velocity projected on the p.o.s. of the density inhomogenieties
- geometry and temporal evolution of such parameters.

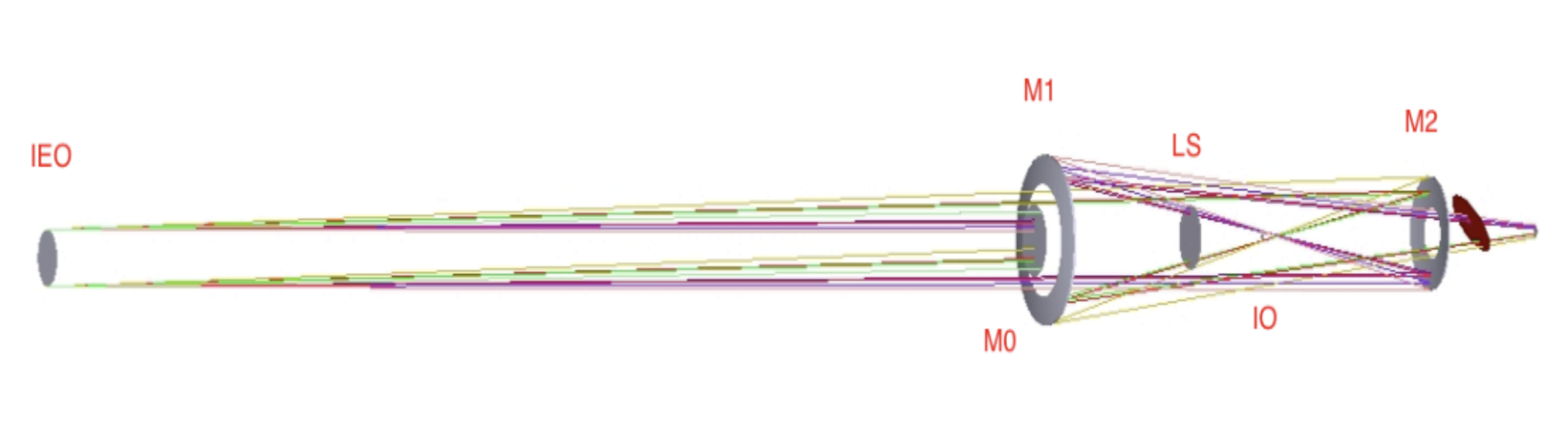
HI Ly α UV combined with polarized VL
- dynamics of the entire corona and solar wind
- radial speed of CMEs
- directionality of the ejected material



New diagnostic approach
Dynamics of the full corona
Magnetic topology of the full corona possible
with a polarized VL & HI Ly α Imager



Ku-Cor simplified optical design



Based on METIS optical design

This optical configuration is optimized for working at 1 AU

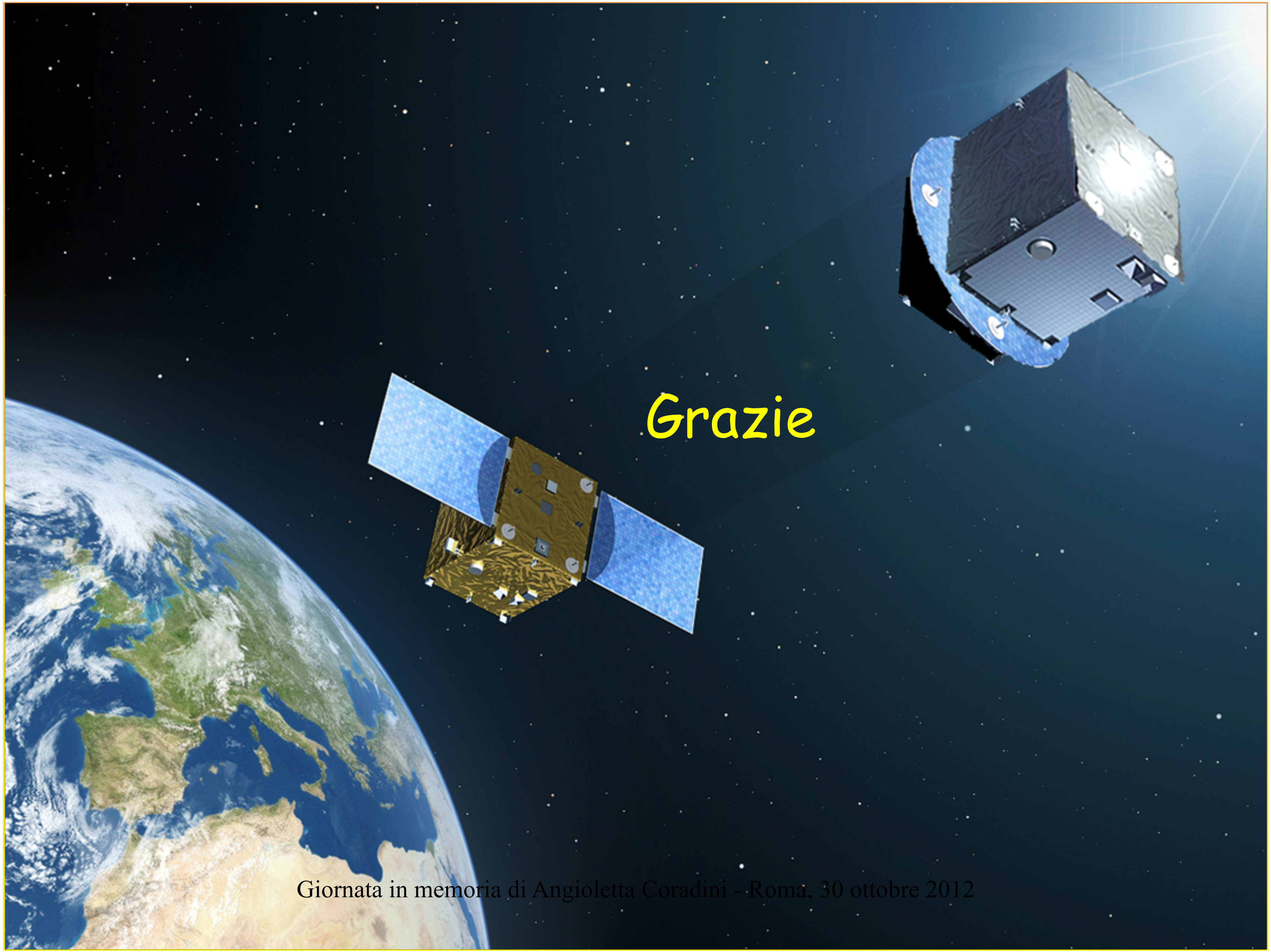
- Inverted external occulter
- Disk light rejection mirror M0
- On-axis gregorian telescope
- UV path for HI Lyα
- Broadband polarized visible light path

KuCor will be a simplified version of METIS, with the development of an extendable boom

Optical design and science improvements

- Trade-off between internal and external occultation

- Implementation of linear polarization measurement of HI Lyα to derive the coronal magnetic field through the Hanle effect.


Grazie
Giornata in memoria di Angioletta Coradini - Roma, 30 ottobre 2012