

Cooperation between ESA and China in Space Science

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The ESA Science Programme



- The ESA Science Programme is part of the mandatory programme of ESA and covers astronomy, space science and elements of fundamental physics.
- The general model is that ESA funds the spacecraft, launcher and spacecraft operations, while the Member States directly fund the payloads and parts of the science operations.
- Selection of missions is “bottoms up” by the Advisory Structure (AWG, SSEWG and then the SSAC).
- We then study multiple mission concepts until one is selected for development (“adopted”) following an SSAC recommendation and approval by the SPC.
- International collaboration plays an important role in nearly all our missions. ESA can also be a minor partner in other agency’s missions.

→ ESA'S FLEET ACROSS THE SPECTRUM



Thanks to cutting edge technology, astronomy is unveiling a new world around us. With ESA's fleet of spacecraft, we can explore the full spectrum of light and probe the fundamental physics that underlies our entire Universe. From cool and dusty star formation revealed only at infrared wavelengths, to hot and violent high-energy phenomena, ESA missions are charting our cosmos and even looking back to the dawn of time to discover more about our place in space.

planck

Looking back
at the dawn of time



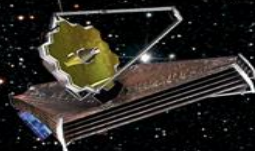
herschel

Unveiling the cool
and dusty Universe



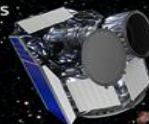
jwst

Observing the first light



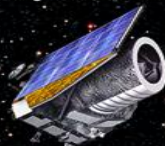
cheops

Sizing and first characterisation
of exoplanets



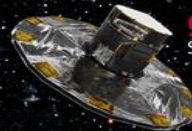
euclid

Exploring the dark Universe



gaia

Surveying a billion stars



hst

Expanding the frontiers
of the visible Universe



xmm-newton

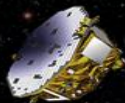
Seeing deeply into the hot
and violent Universe



lisa

pathfinder

Testing the technology
for gravitational
wave detection



integral

Seeking out the extremes
of the Universe



microwaves

sub-millimetre

infrared

optical

ultraviolet

x-rays

gamma rays

Science Programme Elements



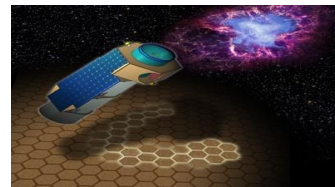
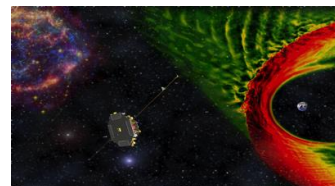
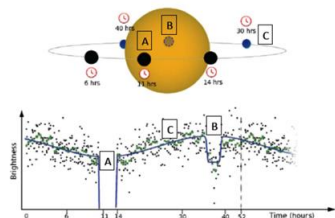
The Science Programme has an annual income of around 500 M€. The long term programme is “Cosmic Vision”. The building blocks of the programme include:

- L-missions; large European led flagship missions with a cost to ESA of around 2 annual budgets, one every 7-8 years.
- M-missions; provide the programme with flexibility. ESA led or implemented through international collaboration. Cost to ESA of around one annual budget, one every 3-4 years.
- S-missions; allow national agencies to play a leading role in missions, 0.1 annual budgets.
- M-missions; “missions of opportunity”, led by other agencies, small contributions.

Science Programme Future Missions

As well as the Adopted missions, there are a number of M missions under study:

- M3: PLATO. long duration, uninterrupted, high-precision photometry of large regions of sky to search for exoplanet transits, particularly of Earth like planets within the habitable zone. Phase B1 activities completed, and ready to be Adopted.
- M4: One of ARIEL, THOR, or XIPE. Exoplanet spectroscopy, plasma investigations and X-ray polarization. Phase A activities completed. 2024
- M5: 25 proposals submitted. Technical evaluations being completed.

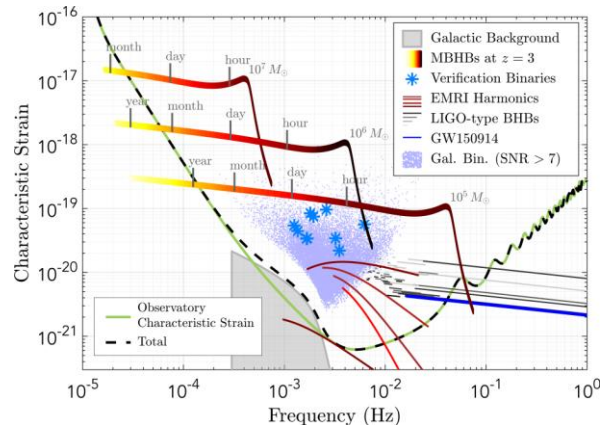
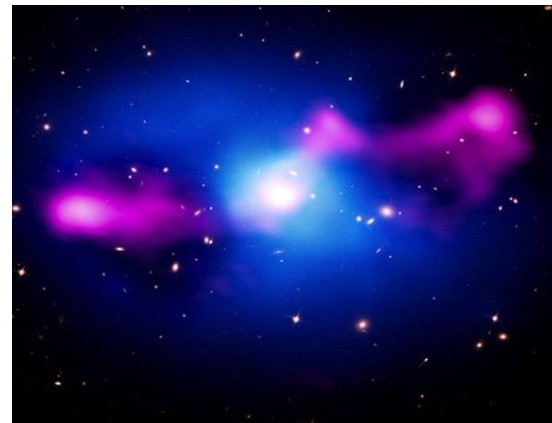


Science Programme Future Missions

As well as the Adopted missions, there are two L missions under study:

- L2: Athena. X-ray imaging spectroscopy. Observatory for launch in 2028. Approximately half way through its Phase A activities.
- L3: One proposal received ("LISA") for a Gravitational Wave observatory to be launched in 2034 .

S2 is SMILE and undergoing its Phase-A study.



Collaboration with China

- First agreement between ESA and Commission for Science and Technology of China in 1980.
- ESA-China co-operation agreement on Cluster signed in November 1993, creation of Chinese Cluster data centre. Chinese scientists became Cluster co-investigators.
- ESA-China agreement on Double Star in July 2001. Provision on 8 European scientific instruments based on the Cluster payload.
- At the 2014 Council of Ministers meeting, China was recognised as one of three strategic partners (together with Russia and the US).
- SMILE selected by joint ESA-Chinese committee in June 2015.

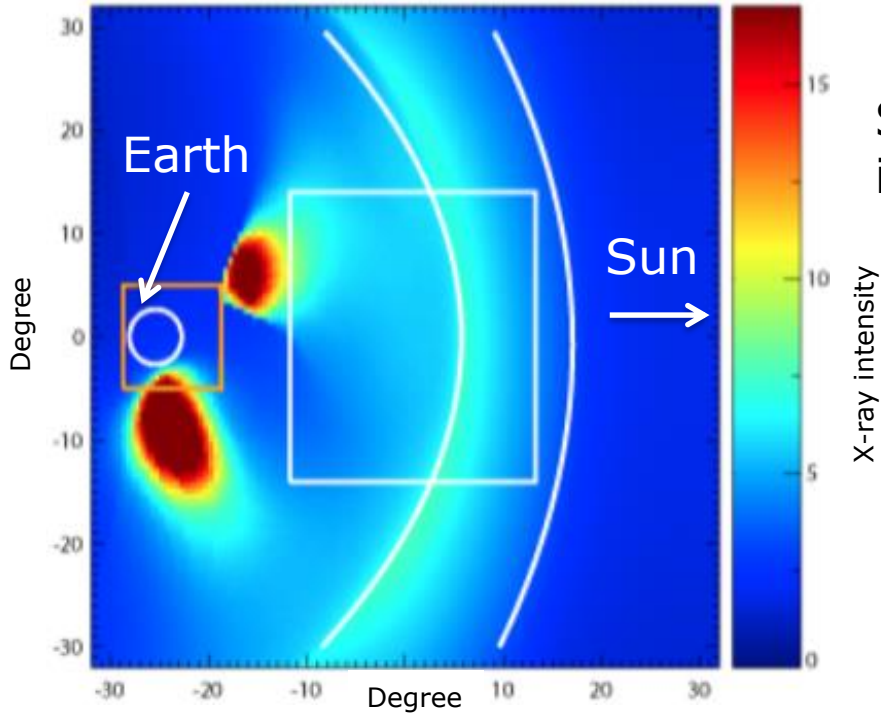


Double Star TC-1 launched on TC-2/SM from Xichang on 29 December 2003

- A joint call was issued in January 2015 for a small mission to be conducted jointly by ESA and the Chinese Academy of Science (CAS)
- Small spacecraft (<300 kg) and payload (<60 kg)
- 13 proposals received
- SMILE was recommended in June 2015 by a joint European and Chinese scientific committee as candidate for a collaborative science mission for launch in 2021 into a highly eccentric polar orbit:
 - First X-ray imaging of the magnetosphere
 - Auroral imaging and in-situ measurements

SMILE: new magnetosphere imager

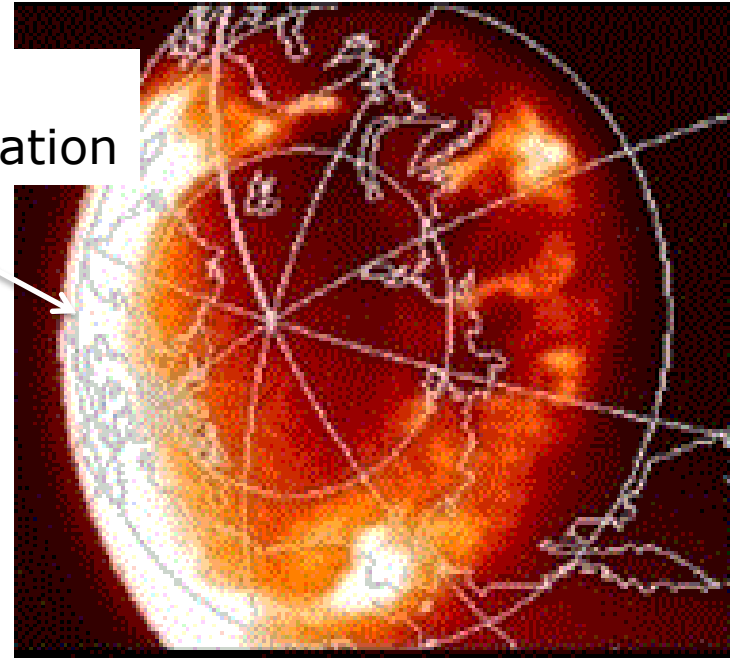
MHD simulation



New: Soft X-Ray imaging of the magnetosphere

NASA Polar image

Solar illumination



New auroral imaging technique: suppression of Sun illumination



SMILE Payload Complement

The SMILE payload consists of:

Two imaging instruments:

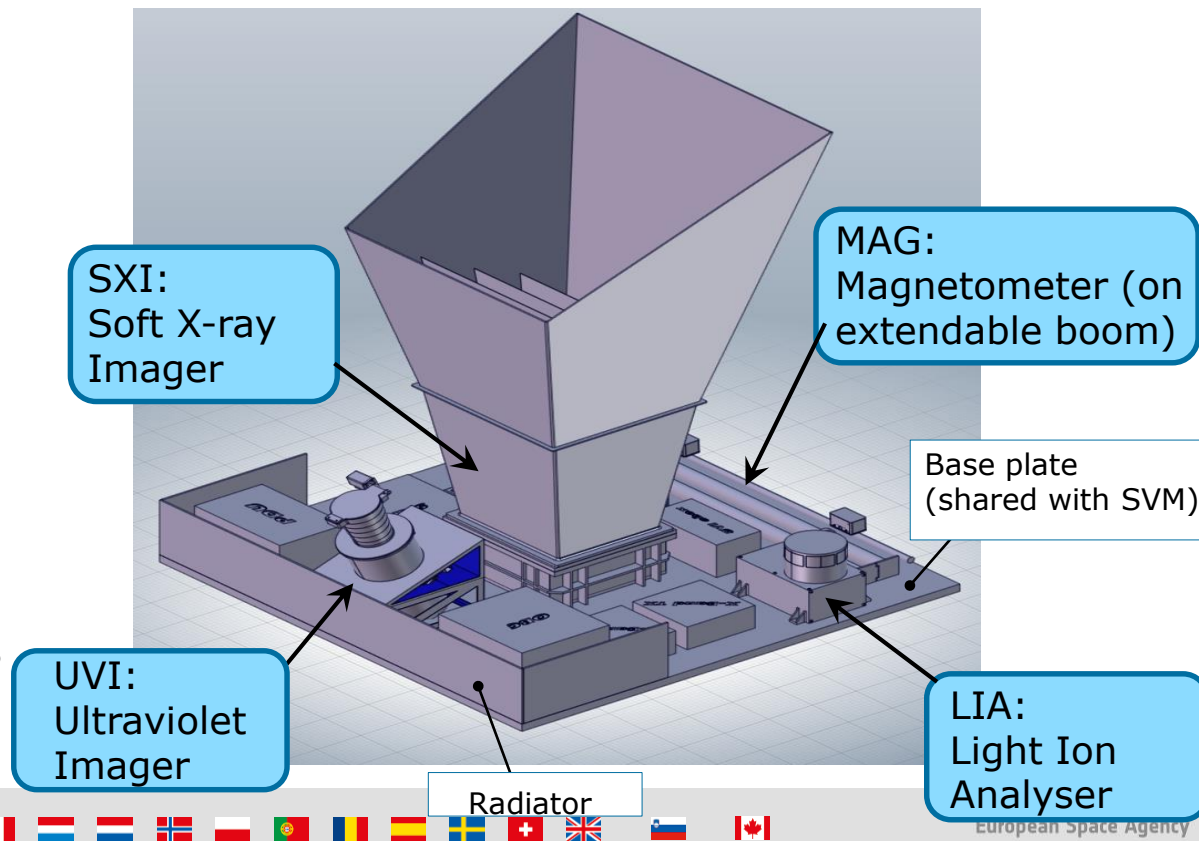
- Soft X-ray Imager (SXI)
- Ultraviolet Imager (UVI)

Imaging the solar wind interaction zones & northern aurora

In-situ measurement package:

- Light Ion Analyser (LIA)
- Magnetometer (MAG)

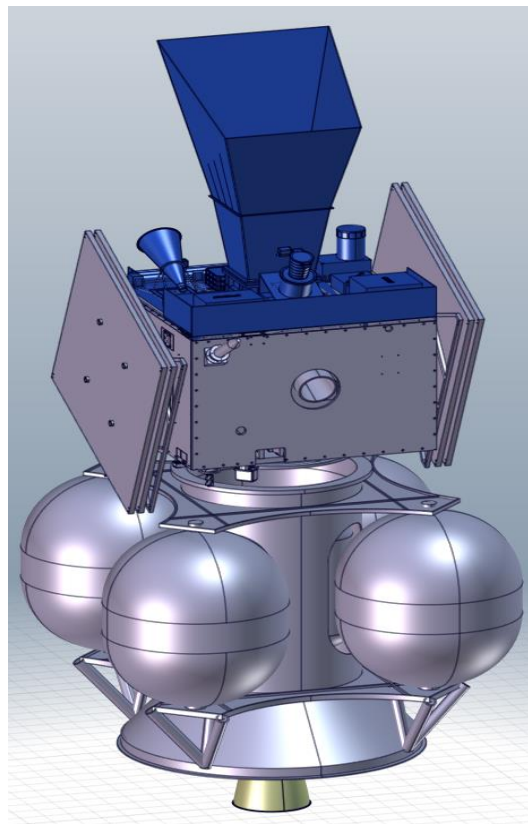
Measure the solar wind properties simultaneously with the imagers



SMILE: Responsibilities



- ESA responsibilities:
 - Payload module (PLM)
 - Launch
 - Spacecraft integration
- Chinese responsibilities:
 - Service module (SVM)
 - Propulsion module (PM)
 - Ion detector and Magnetometer
- ESA and China share operations
- SXI: UK led, UVI: Canadian led,
- US scientists have expressed a strong interest in contributing to science



Launch
(ESA)

PLM
(ESA)

SVM
(CAS)

PM
(CAS)



SMILE: Current Status



- SMILE is currently undergoing its industrial Phase-A studies in Europe and China which should be completed by Q4 of 2017.
- Mission Adoption (final approval) by the SPC is planned to be requested in February 2018
- Launch is planned for late 2021
- Nominal mission duration of 3 years

Future Collaboration Opportunities



- European and Chinese scientists have many areas of common interest and a number of teams are closely engaged developing joint activities.
- Chinese scientists are the first authors of >1000 refereed papers that use data from ESA science missions.
- The ESA Science Directorate and CAS have yearly bilateral meetings to exchange information and coordinate activities.
- ESA and CAS have exchanged information about our prospective plans for gravitational wave astronomy missions.
- The successful completion of SMILE could pave the way for more extensive and larger future ESA/China collaborations.
- There is an established mechanism – Missions of Opportunity – where ESA could play a minor role in Chinese led scientific missions.