SMILE – New mission to image the magnetosphere


ESA/ESTEC (Netherlands), NSSC/CAS (China), MSSL - UCL (UK), Leicester U. (UK), Calgary U. (Canada), GSFC (USA), EASA/ESAC (Spain)

Introduction

The Solar wind Magnetosphere Ionosphere Link Explorer (SMILE) is a novel self-standing mission to be jointly developed between ESA and the Chinese Academy of Sciences (CAS).

It will observe the solar wind-magnetosphere coupling via X-ray images of the magnetosheath and polar cusps, UV images of global auroral distributions and simultaneous in situ solar wind/magnetosheath plasma and magnetic field measurements.

Remote sensing of dayside magnetosheath and the cusps with X-ray imaging is now possible thanks to the relatively recent discovery of solar wind charge exchange (SWCX) X-ray emission, first observed at comets, and subsequently found to occur in the vicinity of the Earth’s magnetosphere.

In particular, SMILE will address the following specific scientific questions:

• What are the fundamental modes of the dayside solar wind/ magnetosphere interaction?
• What defines the substorm cycle?
• How do CME-driven storms arise and what is their relationship to substorms?

Mission

SMILE will observe the solar wind-magnetosphere coupling via X-ray images of the magnetosheath and polar cusps, UV images of global auroral distributions and simultaneous in situ solar wind/magnetosheath plasma and magnetic field measurements.

SMILE will trace and link processes ranging from the solar wind to the distant magnetosphere.

Payload

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Mission summary

• 3-axis stabilized spacecraft
• Orb: 1.842 R_E, geocentric distance, 70-90 deg., inclination, 51 h period
• Payload mass 55 kg, spacecraft total dry mass 660 kg, total wet mass 1997 kg
• Payload:
  • LIA (Light Ion Analyser) is a hot-spot analyser for detection of protons and alphas. Energy range 50 eV-20 keV
  • MAG (Magnetometer) is a flux-gate magnetometer with two sensors on a 2.3 m boom
  • SXI (Soft X-ray imager) is a wide field lobster-eye 0.2-1.2 keV X-ray imager. CCD detectors. 15 x 27 degree (TRB) FOV
  • UVI (UV imager) is a four mirror imager in the range 160-180 nm. CMOS detector
• Regions of interest:
  • 41 h around apogee over North pole
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• Launch event (on boom)
  • 14 UT N=15 cm^-3 V= 410 km/s
  • 04 UT N=15 cm^-3 V= 410 km/s
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• Launch 2021, with Soyuz dual launch or Vega C.

payload module

• spacecraft with propulsion
• 3-axis stabilized spacecraft
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Conclusion

SMILE will trace and link processes ranging from the solar wind to those acting on charged particles precipitating into the cusps and the polar ionosphere

SMILE observes magnetic field, X-rays and UV images of the magnetosheath and auroras

Cooperation with China: SMILE is a showcase, building on Double Star experience