

Imaging Earth's magnetosphere with the Soft X-ray Imager (SXI) on the SMILE mission

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The Solar wind Magnetosphere Ionosphere Link Explorer (SMILE) is an Earth orbiting satellite being developed as a joint European Space Agency (ESA) and Chinese Academy of Sciences (CAS) planetary science mission. The spacecraft is scheduled for launch in 2025 and equipped with complementing imaging instruments which will provide wide-field images with the goal of providing a more complete understanding of the full Sun-Earth connection. Two further instruments will capture in-situ measurements of particle flux and magnetic field as the spacecraft follows a highly inclined and highly elliptical orbit to study the flow of charged, solar wind (SW), particles.

The Soft X-ray Imager (SXI) instrument, a compact X-ray telescope developed and led by the University of Leicester, will detect photons in the soft X-ray band that are produced by a process called Solar Wind Charge eXchange (SWCX). This process results from the interaction of heavy ions in the SW with neutrals in the Earth's exosphere and provides a mechanism for imaging the SW flow around the Earth. With a large field-of-view of 26.5 x 15.5 degrees, SXI captures images through a combination of a micropore optic array and two large area X-ray sensitive back-illuminated Charge Coupled Devices (CCDs).

We introduce the motivation for investigating the Sun-Earth interaction and link with the SMILE mission science objectives. We describe the SXI instrument architecture, including the X-ray focusing technique using micropore optics, and detail the detector subsystems along with radiation protection mechanisms, plus flight operational planning, designed to prolong the performance of the CCDs. We summarise the space readiness testing covering thermal, vibration and electromagnetic compliance and present the timeline to launch through commissioning. Finally, we discuss recent orbit simulations which highlight the opportunity for serendipity science observations and potential links with other operational space telescopes.

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