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New remote sensing of the Earth's magnetosphere: the SMILE mission

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The interaction between the solar wind and the Earth's magnetosphere, and the geospace dynamics that result, are key questions in plasma physics. In situ instruments on a fleet of solar wind and magnetospheric constellation missions now provide the most detailed observations of the Sun-Earth connection. However, we are still unable to quantify the global effects of those drivers, including the conditions that prevail throughout geospace. This information is the key missing link for developing a complete understanding of how the Sun gives rise to and controls Earth's plasma environment and space weather.
The Solar wind Magnetosphere Ionosphere Link Explorer (SMILE) is a novel self-standing mission dedicated to observing the solar wind-magnetosphere coupling via simultaneous in situ solar wind/magnetosheath plasma and magnetic field measurements, X-ray images of the magnetosheath and polar cusps, and UV images of global auroral distributions. Remote sensing of the magnetosheath and 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. SMILE is a collaborative mission between ESA and the Chinese Academy of Sciences (CAS) that was selected in November 2015 and is due for launch at the end of 2021. The SMILE science and the technical developments jointly undertaken by ESA and CAS will be presented.