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Cusp observations with Cluster and THEMIS in preparation for the SMILE mission

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Solar wind Magnetosphere Ionosphere Link Explorer (SMILE) is a novel self-standing mission, being designed in collaboration between ESA and the Chinese Academy of Science. Its objective is to observe solar wind-magnetosphere coupling via simultaneous in situ solar wind/magnetosheath plasma and magnetic field measurements, soft X-Ray images of the magnetosheath and polar cusps, and UV images of global auroral distributions. The observations of the cusps and magnetosheath with the X-ray imager are possible thanks to the relatively recent discovery of solar wind charge exchange (SWCX) X-ray emissions, first at comets and subsequently in the vicinity of the Earth's magnetosphere.
To prepare for the mission, we must determine the cusp's expected morphology, motion, and in situ properties (density, velocity, temperature). We have selected a series of Cluster cusp crossings that define these properties and can therefore be used to estimate X-ray emissions across the width of the cusp for different IMF orientations. We will show that the peak soft X-ray emissions occur near the centre of the cusp where ion densities maximize. We then show that the integral lines of sight emissions through the cusp are a factor of 2.4 times larger for IMF-Bz northward than for IMF-Bz southward. The mid-altitude cusp is a factor of 7 brighter than the exterior cusp.