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AXIOM: Advanced X-ray Imaging Of the Magnetosphere

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Planetary plasma and magnetic field environments can be studied by in situ measurements or by remote sensing. While the former provide precise information about plasma behaviour, instabilities and dynamics on local scales, the latter offers the global view necessary to understand the overall interaction of the magnetospheric plasma with the solar wind. Here we propose a novel and more elegant approach employing remote X-ray imaging techniques, which are now possible thanks to the relatively recent discovery of solar wind charge exchange X-ray emissions in the vicinity of the Earth's magnetosphere. We describe how an appropriately designed and located X-ray telescope, supported by simultaneous in situ measurements of the solar wind, can be used to image the dayside magnetosphere, magnetosheath and bow shock, with a temporal and spatial resolution sufficient to address several key outstanding questions concerning how the solar wind interacts with the Earth's magnetosphere on a global level. Our studies have led us to propose 'AXIOM: Advanced X-ray Imaging Of the Magnetosphere', a concept mission using a Vega launcher with a LISA Pathfinder-type Propulsion Module to place the spacecraft in a Lissajous orbit around the Earth - Moon L1 point. The model payload consists of an X-ray Wide Field Imager and an in situ plasma and magnetic field measurement package. This package comprises sensors

designed to measure the bulk properties of the solar wind and to characterise its minor ion populations which cause charge exchange emission, and a magnetometer designed to measure the strength and direction of the solar wind magnetic field. We show simulations that demonstrate how the proposed X-ray telescope design is capable of imaging the predicted emission from the dayside magnetosphere with the sensitivity and cadence required to achieve the science goals of the mission.

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