Contribution ID: **95** Type: **Oral Paper**

A coded aperture approach for particle measurements in space plasmas

Monday 8 September 2014 09:40 (20 minutes)

Current plasma analysis instruments in the near-Earth environment are limited in their capabilities of measuring angular distribution at a high resolution over a wide field of view, especially of higher energy electrons and ions.

A novel low-resource concept is proposed, using a coded aperture manufactured from high density material and a position sensitive detector capable of particle detection behind it. Deconvolution techniques applied to the resulting readout allow very accurate identification of directional particle fluxes. Such a setup could be used in an orbital situation where available on-board resources would not permit a larger or higher-power instrument, and where magnetic field lines are aligned in such a way that higher-energy charged particles may be strongly directional.

Simulations have been performed of such a setup, both in a laboratory and space situation, demonstrating the theoretical capabilities of such an instrument. This has then been compared to the results of an proof of concept setup using a specialised CCD and a radioactive beta source in a vacuum chamber. The potential possibilities for the instrument and further considered improvements in the detector choice and geometry is analysed and quantified.

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Session Classification: Session 1: Applications in Astronomy and Astrophysics

Track Classification: Applications in Astronomy, Planetary and Space Science