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Detection of hypervelocity dust impacts on the Earth orbiting Cluster and MMS spacecraft and problems with signal interpretation

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Detection of hypervelocity dust impacts on a spacecraft body by electric field instruments have been reported by several missions such as Voyager, WIND, Cassini, STEREO. The mechanism of this detection is still not completely understood and is under intensive laboratory investigation. A commonly accepted theory is based on re-collection of plasma cloud particles generated by a hypervelocity dust impact by a spacecraft surface and an electric field antenna resulting in a fast change in the potential of the spacecraft body and antenna. These changes can be detected as a short pulse measured by the electric field instrument.

We present the first detection of dust impacts on the Earth-orbiting MMS and Cluster satellites. Each of the four MMS spacecraft provide probe-to-spacecraft potential measurements for their respective the six electric field antennas. This gives a unique view on signals generated by dust impacts and allow their reliable identification which is not possible for example on the Cluster spacecraft. We discuss various instrumental effects and solitary waves, commonly present in the Earth's magnetosphere, which can be easily misinterpreted as dust impacts. We show the influence of local plasma environment on dust impact detection for satellites crossing various regions of the Earth's magnetosphere where the concentration and the temperature of plasma particles change significantly.