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# Differences between hypervelocity impacts observed by the Cluster and the MMS satellites

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Earth-orbiting satellites seldom carry conventional dust detectors onboard. Though, when a micrometeoroid hits a spacecraft, it induces an electromagnetic pulse (EMP), which can be recorded by the electric field probes as a brief, high amplitude voltage spike. We have been systematically searching for such signals on the magnetospheric missions Cluster and MMS. The method works for the Cluster 1 satellite, which operated since 2009 in a monopole mode after several antenna failures, and hypervelocity impacts were found in the Cluster Plasma Wave Receiver Wideband Data (WBD). This mode benefits meteoroid observations since monopole detectors are much more sensitive to dust impacts than dipole antennas. The automatic gain control applied by the WBD instrument adjusts the dynamic range of the recorded signals. The impact signals can be affected both by saturation or be too weak for analysis depending on which gain level was active on the instrument when they occurred. Even natural waves confuse the observations and cannot easily been distinguished from the EMP signals. We can conclude that Cluster does not have the ideal instrumentation for a hypervelocity impact survey[1].

The case is completely different for the MMS satellites. Each of the four MMS spacecraft provides simultaneous probe-to-spacecraft and probe-to-probe potential measurement for the respective six electric field antennas in three directions. Information about the electric field profile in multiple directions allows a reliable identification of dust impacts in 3D, which was not possible with single antenna measurements such as on Cluster 1. We present examples of dust impacts on the MMS spacecraft body registered simultaneously by all the six antennas. We compare signatures of dust impacts with signatures of solitary waves and show their possible misinterpretation. The review will show and compare events observed with Cluster 1 and MMS satellites, discuss which properties of the meteoroids can be resolved, what are the benefits and limitations of the method in respect to MMS and what can be expected to be found in the further dust impact search.

1. Vaverka, J., A. Pellinen-Wannberg, J. Kero, I. Mann, A. De Spiegeleer, M. Hamrin, C. Norberg, and T. Pitkänen (2017), Detection of meteoroid hypervelocity impacts on the Cluster spacecraft: First results, J. Geophys. Res. Space Physics, 122, doi:10.1002/2016JA023755.