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Statistical analysis of dust impacts on the MMS spacecraft — 2016

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It was shown that electric field instruments are able to detect hypervelocity dust impacts on a spacecraft body as transient pulses in the measured electric field. Many spacecraft are equipped with electric field instruments, while only a few spacecraft carry dedicated dust detectors. This provides an interesting opportunity to monitor dust by many spacecraft in various parts of our solar system. The pulses generated by dust impacts in the measured electric field were first discovered by the Voyager spacecraft during a crossing of Saturn's ring plane in 1983. Dust detection was later reported from many of other spacecraft, e.g., as Cassini, WIND, STEREO, MAVEN, and MMS. However, signatures of hypervelocity dust impacts detected by electric field instruments are still not completely understood and explained. This results in problems with signal interpretation. There is an open discussion if all events attributed to dust impacts are really generated by dust. A better understanding of this method is very important for reliable dust impact identification, especially in environments with low dust impact rate.

We present a study of dust impacts detected by multiple electric field antennas operating simultaneously in the monopole (probe-to-spacecraft potential measurement) and dipole (probe-to-probe potential measurement) configuration by the Earth-orbiting MMS spacecraft. Simultaneous using of both configurations allows us to reliably distinguish events related to changes in the spacecraft potential. Nearly 800 such events were registered during one year by two MMS spacecraft. We present a statistical analysis of these events focused on the amplitude, duration, and rising time of detected pulses. We show influence of ambient plasma environment on detected signals and discuss possible sources of the signal misinterpretation.