Ion cloud expansion after hypervelocity dust impacts detected by the MMS spacecraft

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Dust grains impacting with high velocities the spacecraft body can be partly or totally evaporated and create clouds of charged particles. Presence of electrons and ions generated by such hypervelocity impacts can consequently influence the spacecraft potential and/or measurements of on-board scientific instruments. Electric field instruments are able to register signals generated by dust impacts as short pulses in the measured electric field. These signals can be used for detection of dust grains by the spacecraft without dedicated dust detectors. This dust detection method has been successfully used for data collected by many spacecraft as Voyager, Cassini, Wind, STEREO, MAVEN, and MMS. On the other hand, our understanding of this complex process comprising from dust grain evaporation, generation of charged particles, to impact cloud expansion and signal detection is still not complete.

We present a study of events related to dust impacts on the spacecraft body detected by electric field probes operating simultaneously in the monopole (probe-to-spacecraft potential measurement) and dipole (probe-to-probe potential measurement) configurations by the Earth-orbiting MMS spacecraft. The presented study is focused on events when expanding ions affect not only the potential of the spacecraft body but also one or more electric probes on the end of antenna booms. Expanding ions can influence electric probes located far from the spacecraft body only when the spacecraft is located in tenuous ambient plasma as inside of the Earth's magnetosphere. This analysis can confirm if these events are really connected to dust impacts and gives us some information about ion expansion velocity, and improve our knowledge of dust impact process.