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Constraining the properties of the convective electric field in Saturn's inner magnetosphere by using moon microsignatures

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Abstract

The position of energetic electron absorption signatures caused by orbiting moons can be a powerful tool for detecting convective electric fields that are present in the magnetospheres of outer planets. In this work we used energetic electron data from the MIMI-LEMMS detector onboard Cassini and studied the so called microsignature events of several Saturnian moons, covering a radial distance between 2.5 and 9.5 Rs. We considered numerical as well as analytical methods and used these events to constrain the properties of the recently discovered convective electric field in Saturn's inner magnetosphere, that was found to have an average strength of 0.2 mV/m and an orientation in the noon-midnight direction. The study of the electric field has been performed on an average scale (using all events) but also on a single-case event scale and its possible sensitivity with respect to radial distance and time has been examined and confirmed. It is also interesting that although the average electric field orientation is found to be at approximately 01-02 hours in local time, regardless of the examined radial distances, we report high variability of the electric field pointing on short spatial and temporal scales of single microsignature events. Additionally, we discuss the possible connection to other convective electric field patterns that might be present in the inner part of the Saturnian magnetosphere. A constrain of the electric field properties from such a work can lead to insights towards revealing the source of such a convection pattern, that has been observed for the first time in the inner magnetosphere of Saturn.