SM11C-02 Data Mining Reconstruction of the Cislunar Magnetotail

Monday, 9 December 2024
08:30 - 10:00
eLightning Theater 4 (Convention Center)

Abstract

Earth's magnetotail within 31R_E has been thoroughly investigated due to many missions from Geotail to MMS. These studies helped understand structure of the magnetospheric currents and their evolution during storms and substorms. In contrast, global structure of the cislunar tail beyond 31 R_E and its evolution under different driving condition and different phases of substorms and storms are poorly understood. Local observations using the recent two-probe lunar-orbit mission ARTEMIS in the radial range 55-65 R_E since 2011, revealed a number of interesting features of the near-Moon region. They include significant quiet-time components of the magnetic field normal to the tail axis, plasmoids, thin and strong as well as quasi force free current sheets (CSs). Some of these findings are puzzling and controversial, and they might be explained if we knew the global structure of the cislunar magnetotail. This challenge of the unknown global magnetotail structure is addressed by processing ARTEMIS and transition period data for 2010-2023 using a data-mining (DM) algorithm guided by the solar wind/IMF input, storm and substorm indices and complemented by other spaceborne magnetometer measurements closer to Earth. For an event of interest, the combined database is mined to create a swarm of synthetic probes, historical measurements made during similar solar wind and IMF parameters, as well as similar phases and intensities of storms and substorms. The swarm data is fit with a flexible magnetic field architecture. DM reveals that the cislunar tail is rather regular in space and it evolves regularly in time during substorms. Thin CSs may indeed appear at lunar distances for certain substorm phases and their existence that far from the Earth can be explained by the nearby magnetic reconnection or the accumulated magnetic flux earthward of the CS.

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