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Global Hybrid Simulations of the Solar Wind Interaction with the Earth's Moon

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The solar wind interaction with the Earth's moon leads to a plasma wake-tail on the lunar nightside. This structure has been simulated using a two dimensional global hybrid code (particle ions, fluid electrons) that models a wake-tail region with spatial scales up to 50 lunar radii using up to 200 million particles. Different interplanetary magnetic field (IMF) configurations have been examined for the angle between the direction of the solar wind flow and the IMF between 0 and 90 degrees. The Moon acts as a diamagnetic obstacle removing plasma from the solar wind flow and the tail refilling process on the moon's nightside occurs due to plasma expansion into a vacuum driven by the thermal motion of particles along the IMF magnetic field lines. Results of our study suggest that kinetic processes occur in the Moon's wake-tail beyond the ideal MHD description. For example, counterstreaming and anisotropic ion distributions in the Moon's downstream tail refilling region represent unstable plasma configurations that excites different types of wave modes whose nature depends on the structure of the tail (i.e., on the orientation of the IMF). Initial analyses of these waves for the different cases studied thus far indicate the presence of temperature anisotropy driven electromagnetic emissions. The simulation results are compared with Wind satellite data flybys of the lunar wake-tail where possible.