Project Details

ROSES ID: NNH08ZDA001N
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Program Element: Focused Science Topic

Topic: Measure the properties of the solar dynamo that affect solar irradiance and active region generation.

Project Title:
Multiscale Model of the Magnetosphere

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Summary:
Global MHD models of the Earth's magnetosphere have been very successful in simulating large-scale aspects of magnetospheric dynamics. However, a well known deficiency of global MHD models is their inability to model fast magnetic reconnection in the high-Lundquist-number limit. Recent advances in collisionless reconnection theory, governed by a generalized Ohm's law, demonstrate that the Hall current and electron pressure can realize regimes of fast reconnection. The principal objective of this proposal is to develop HallGGCM, an improved global multi-scale model of the Earth's magnetosphere, and to investigate multi-scale dynamics involving collisionless reconnection at the dayside magnetopause and substorm onset in the magnetotail. HallGGCM builds on the foundation of OpenGGCM, which is a global model of Earth's space environment, and is based on the resistive MHD equations. The principal changes are the replacement of the resistive MHD equations by the Hall MHD equations. This will require us to modify the underlying numerical discretization for OpenGGCM. Development of HallGGCM will take the mature framework of an existing global model of the Earth's magnetosphere (OpenGGCM) and take it to the next step where the model will have the ability to couple large-scale magnetospheric dynamics to a more sophisticated and physically realistic description of the smaller scales where non-MHD, collisionless effects play an extremely important role. Using HallGGCM, we will:

- investigate whether Hall-mediated reconnection in the high-Lundquist-number magnetosphere will enable a definitive resolution of the fast reconnection problem in the dayside magnetosphere, enabling the realization of fast reconnection rates that are insensitive to the resistivity of the plasma in the presence of fully 3D dynamics and flows, and

- investigate the role of the coupling of collisionless Hall-mediated reconnection and ballooning instabilities on the problem of substorm onset in the Earth's magnetotail when the high-Lundquist-number 3D magnetosphere is driven by the solar wind.

Publication References:

no references