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Magnetic null points in the three-dimensional kinetic simulations of space plasma

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Fully kinetic electromagnetic particle-in-cell code iPic3D is used to model magnetic reconnection in the variety of plasma configurations. We apply Poincare index technique to locate and identify the topological characteristics of the magnetic null points in different three-dimensional simulations. The relevance of magnetic nulls to energy dissipation, turbulence and plasma instabilities is studied in the scenarios of: turbulent dissipation of an unstable plasma configuration, Lunar Magnetic Anomalies, planetary mini-magnetospheres, symmetric and asymmetric 3D Harris sheet configurations. In particular, we found out that magnetic nulls of the spiral topological type associated with the magnetic islands and flux ropes play more important role in energy dissipation than the radial nulls. This finding is in accordance with recent MHD simulations and in situ observations of Cluster spacecraft.

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