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Numerical Simulation on a Possible Formation Mechanism of Interplanetary Magnetic Cloud Boundaries

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Abstract: The formation mechanism of the interplanetary magnetic cloud (MC) boundaries is numerically investigated by simulating the interactions between an MC of some initial momentum and a local interplanetary current sheet. The compressible 2.5D MHD equations are solved. Results show that the magnetic reconnection process is a possible formation mechanism when an MC interacts with a surrounding current sheet. A number of interesting features are found. For instance, the front boundary of the MCs is a magnetic reconnection boundary that could be caused by a driven reconnection ahead of the cloud, and the tail boundary might be caused by the driving of the entrained flow as a result of the Bernoulli principle. Analysis of the magnetic field and plasma data demonstrates that at these two boundaries appear large value of the plasma parameter β, clear increase of plasma temperature and density, distinct decrease of magnetic magnitude, and a transition of magnetic field direction of about 180 degrees. The outcome of the present simulation agrees qualitatively with the observational results on MC boundary inferred from IMP-8, etc.

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