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Universal approach to basic modelling of stellar winds and coronal mass ejection for the study of stellar planetary interactions

M. Panchenko (1), M. L. Khodachenko (1), H. Lammer (1), H. O. Rucker (1)

(1) Space Research Institute, Austrian Academy of Sciences, Graz, Austria
(Mykhaylo.Panchenko@oeaw.ac.at / Fax: +43 316 4120 690 / Phone: +43 316 4120 622)

Abstract

The investigation of the stellar-planetary interactions needs reliable model for the propagation and evolution of the solar wind plasma. A general approach to basic MHD simulations of solar/stellar wind propagation is presented. This simulation is based on VAC MHD code (Versatile Advection Code) which is a powerful and very flexible tool for solving any sets of non-relativistic MHD equations. The developed model is able to reproduce an evolution of the solar/stellar wind as well as the coronal mass ejections (CME) in 3D space in distances from 0.14 (~30 Rsun) AU to 10 AU with a self-consistent magnetic field (Parker's corotating magnetic field model). CME cloud is introduced as a time-dependent injection of hot and dense plasma into the ambient solar/stellar wind. The typical theoretical and observational values of the solar/stellar wind parameters have been used as input parameters of the model. Radial profiles of the main solar/stellar wind and CME parameters such as velocity, density, temperature and intermedium magnetic field has been obtained. The outcome of this study is used for the simulations of the planetary atmospheric erosion as well as for the analysis of the relations between solar wind parameters measured simultaneously by spacecraft in different parts of the heliosphere.