Cross-reference simulations by scalable communication library for the study of wave-particle interactions in planetary magnetospheres

*Yuto Katoh[1], Keiichiro Fukazawa[2], Takeshi Nanri[3], Yohei Miyake[4]

1. Department of Geophysics, Graduate School of Science, Tohoku University, 2. Academic Center for Computing and Media Studies, Kyoto University, 3. Research Institute for Information Technology, Kyushu University, 4. Graduate School of System Informatics, Kobe University

We have been developing a cross-reference simulation code by scalable communication library for the study of wave-particle interactions in planetary magnetospheres. We use Advanced Communication Primitives (ACP; http://ace-project.kyushu-u.ac.jp/main/jp/01_overview/) library for the communication among the simulation codes, which enables us to carry out 'strong' cross-reference simulations; the data exchange among simulation codes is conducted by direct memory access, instead of file output as has been used in conventional 'weak' cross-reference simulations. By a series of electron-hybrid and MHD cross-reference simulations, we study the generation and propagation of whistler-mode chorus emissions in the planetary magnetosphere. Chorus emissions are electromagnetic plasma waves commonly observed in planetary magnetospheres and are a group of coherent wave elements changing their frequency in time. While the generation process of chorus has been reproduced by numerical experiments [e.g., Katoh and Omura, GRL 2007a] and has been explained by the nonlinear wave growth theory [Omura et al., JGR 2008, 2009], previous studies revealed similarities and differences of the spectral characteristics of chorus in planetary magnetospheres, which has not been understood yet. In the cross-reference simulations, we use the MHD code for the investigation of the range of variation of the spatial scale of the planetary magnetosphere. The electron hybrid code is used to reproduce the generation process of chorus emissions under the initial conditions provided from the MHD simulations. An electron fluid code [Katoh, 2014] is also used for the study of the propagation of chorus emissions in the meridional plane of the magnetosphere. We describe the simulation models used in the developing code and show their initial results.

Keywords: numerical experiments, cross-reference simulation, planetary magnetosphere

