Conceptual Design of the Asymmetric Reconnection EXperiment (AREX)

MAO Aohua[1)*], Ji Hantao[2)], REN Yang[2)], E Peng[1)], WANG Zhibin[1)], XIAO Qingmei[1)]), WANG Xiaogang[1, 3)]

[1)] Laboratory for Space Environment and Physical Sciences, Harbin Institute of Technology, Harbin, China 150001

* aohuamao@hit.edu.cn

[2)] Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08543, USA

[3)] Department of Physics, Harbin Institute of Technology, Harbin, China 150001

Abstract

A new terrella device, the Space Plasma Environment Research Facility (SPERF), is designed and under construction at Harbin Institute of Technology (China), with Asymmetric Reconnection EXperiment (AREX) as one of the experiment components to simulate interaction between the interplanetary and magnetosphere plasmas. Different from existing reconnection experiments with both axisymmetry and symmetry about the neutral line, the aim of AREX is to provide a unique platform for simulating asymmetric magnetic reconnection such as that at magnetopause. The new AREX regime explores reconnection dynamics by driving reconnection with a set of coils and flux cores for simulating "solar-wind-side" magnetosheath field to reconnect with a dipole field generated by the Dipole Research EXperiment (DREX) coil on the "magnetosphere-side". Thus it will be able to investigate a range of important reconnection issues in magnetosphere geometry, such as the electron and ion-scale dynamics in the current sheet, particle and energy transfer from magnetosheath to magnetosphere, particle energization/heating mechanisms during magnetic reconnection, 3D and asymmetric effects in fast reconnection and so on. The design of AREX device approximately follows the Vlasov scaling laws between the laboratory plasma of the device and the magnetosphere plasma to reproduce local reconnection dynamics. The plasma is generated by the flux cores at the "solar-wind-side" and an electron cyclotron resonance (ECR) source at the "magnetosphere-side" to achieve a wide range of plasma parameters. Different kinds of coils with specific current driven functions, as well as advanced diagnostics are designed to be equipped for the facility. Motivation, design criteria for AREX experiments and reconnection scenarios will also be discussed.