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A proposal for multiscale studies of plasma transport and turbulence

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Basing on comparison of the Interball and Cluster data, along with laboratory testing of fast plasma devices for future missions, we discuss new methodics for interspacecraft measurements. Moreover, we propose updated objectives for future multiscale studies: (a) turbulence on a non-uniform background as the keystone for transport processes; (b) flow structuring/ jetting with anomalous concentration of kinetic energy over that in the solar wind: impact on flow balance and boundary formation; (c) Alfvenic collapse of magnetic field lines and magnetic field generation; (d) spontaneous versus forced reconnection, (e) shock transition and particle acceleration. The objectives order takes into account possible minimization of repetition of the tasks from previous missions. We illustrate new ones by the characteristic Cluster and Interball data. We discuss distributed spacecraft networks for the exploration of the plasma interaction with an obstacle, which is the geomagnetic field or its plasma-dominated boundary layers. Local measurements on 10-12 spacecraft at distances from electron gyroradius to MHD scales in the frame of Cross-Scale mission would be enriched through the multiscale radio-tomography, which either reproduces the detailed density profile of quasi-stationary structures in movement with respect to the spacecraft network, or determines the statistical properties of the density fluctuations in the medium between the spacecraft. Only a combination of local and integral turbulence probing can avoid the ambiguity of localized small-scale multipoint measurements, when no information on electron-scale distribution between other spacecraft at larger distances is available. Cluster demonstrated the value of the outer cusp region as a critical region for energy and mass transport. Plasma- plasma interaction over polar cusps and

neutral sheet represents a natural laboratory for studying the flow jetting/ structuring and magnetic barrier generation by Alfvenic collapse. Combined influence of reconnection and intermittent turbulence on the geotail and on the intrinsically nonlinear dynamics of boundary layers should be explored for the first time with adequate techniques, including fast particle devices under development, providing plasma moments with 30-100 ms resolution. We briefly discuss potential input in the common efforts with usage of new Russian small satellites and plasma packages aboard the approved missions such as Spectr-Radioastron or aboard spacecraft boosters. This work was supported by ISSI and INTAS-03-50-4872 and 05-1000008-8050 grants.