MODELING THE HELIOSPHERE – LISM INTERACTION: COUPLING MICRO- AND MACRO-SCALES

NIKOLAI POGORELOV, Sergey Borovikov, Jacob Heerikhuisen, Igor Kryukov, Gary Zank

Department of Physics and Center for Space Physics and Aeronomic Research
The University of Alabama in Huntsville, e-mail: Nikolai.Pogorelov@uah.edu

The interaction of the solar wind (SW) with the local interstellar medium (LISM) creates the outer heliosphere which appears to be a space laboratory for the investigation of physical phenomena that couple at different time and length scales. While frequently we are interested in averaged plasma and neutral particle distributions in the global sense, new and existing space missions provide us observational data which exhibit finite, short-living structures. Investigation of those requires an advanced, physically justified numerical model and high computer power. We perform an MHD-kinetic analysis of the effect of charge exchange between neutral and charged particles on the structure of the properties of the heliosphere. We investigate the behavior of a thin heliospheric current sheet separating the regions of different polarity in the interplanetary magnetic field both in the supersonic SW and in the inner heliosheath. The deflection between the neutral hydrogen and helium flows in the inner heliosphere is investigated numerically and results are compared with the SOHO SWAN experiment. The effects of the Sun's rotation and solar cycle on the distribution of plasma quantities and heliospheric magnetic field are discussed. Finally, a comparison is made of a multi-fluid (four neutral fluids and one plasma fluid) and MHD- kinetic models of the heliosphere. Analysis is performed using a Multi-Scale FLUid-Kinetic Simulation Suite (MSFLUKSS) which combines the power of high-resolution, adaptive mesh refinement calculation of discontinuous plasma flows with the versatility of a stochastic Monte Carlo approach to treat neutral particle transport.

Sun, solar wind, interstellar medium, neutral atoms