Geophysical Research Abstracts
Vol. 20, EGU2018-10843, 2018
EGU General Assembly 2018

Current sheets, magnetic reconnection and particle acceleration throughout the heliosphere

Olga Khabarova and the ISSI International Team 504 “Current Sheets, Turbulence, Structures and Particle Acceleration in the Heliosphere”; http://www.issibern.ch/teams/structpartaccel/

Pushkov Institute of terrestrial magnetism (IZMIRAN) RAS, Heliophysical laboratory, Troitsk, Moscow, Russian Federation (olik3110@gmail.com)

We present the first results of the ISSI International Team 504 project titled "Current Sheets, Turbulence, Structures and Particle Acceleration in the Heliosphere” http://www.issibern.ch/teams/structpartaccel/ and compare them with current understanding of the spatial evolution of turbulence.
The project links coherent structures (current sheets, discontinuities and magnetic islands), the occurrence of energetic particles accelerated up to keV-MeV/nuc locally and characteristics of turbulence at different heliocentric distances. Besides the most stable heliospheric current sheet, smaller-scale and less long-lived current sheets are observed in the solar wind very often. Most of them show signatures of ongoing magnetic reconnection, such as initial heating, formation of magnetic islands and waves as well as particle acceleration. These products of magnetic reconnection are considered as an essential manifestation of turbulence.
It has been shown that coherent structures play a significant role in the development of secondary stochastic particle acceleration (Zank et al. ApJ, 2014, 2015; le Roux et al. ApJ, 2015, 2016; Khabarova et al. ApJ, 2015, 2016, 2017; Khabarova & Zank, ApJ, 2017). This kind of particle energization increases the final energy level to which energetic particles can be accelerated locally in the solar wind independently of the way how particles were pre-accelerated, affecting solar energetic particles or particles accelerated at interplanetary shocks associated with corotating interaction regions and changing their time-intensity profiles as well. We have shown that charged particles can gain significant energies up to tens MeV/nuc due to local processes occurring near current sheets and represent therefore an obvious, but underestimated radiation hazard.
We employ a multi-spacecraft data analysis to understand the radial evolution of key characteristics of intermittent turbulence related to coherent structures and magnetic reconnection in the solar wind, tracing selected samples of different plasmas from 1 AU to further distances and analyzing statistical properties of the solar wind current sheets and coherent structures at different distances from the Sun. We confirm the growing role of intermittent turbulence and simultaneous simplification of profiles of strong current sheets with distance, which is in agreement with our theoretical predictions of the changing regime of magnetic reconnection from steady-like to stochastic at further heliocentric distances.

This work is partly supported by the International Space Science Institute (ISSI) in the framework of International Team 504 entitled “Current Sheets, Turbulence, Structures and Particle Acceleration in the Heliosphere.” OVK’s work is additionally supported by RFBR grants 16-02-00479, 17-02-00300 and 17-02-01328.