Quasi-stationary current sheets of the solar origin in the heliosphere

Roman Kislov
Space Research Institute of the Russian Academy of Sciences (IKI), Space plasma physics, Moscow, Russian Federation (kr-krk@bk.ru)

The solar magnetic field (SMF) has historically been considered as dipole in order to build models of the radially expanding corona, that is, the solar wind in the solar minimum. The simplified approach suggests the existence of only one quasi-stationary current sheet (QCS) of solar origin in the heliosphere, namely, the heliospheric current sheet (HCS). However, the SMF becomes more complicated over the solar cycle, comprising higher-order components. The overlapping of the dipole and multipole components of the SMF suggests a formation of more than one QCS in the corona, which may expand further to the heliosphere. We study the impact of the quadrupole and octupole harmonics of the SMF on the formation and spatial characteristics of QCSs, building a stationary axisymmetric MHD model of QCSs in the heliosphere. It is shown that if the dipole component dominates, a single QCS appears in the solar wind at low heliolatitudes as the classic HCS. In other cases, the number of QCSs varies from one to three, depending on the relative input of the quadrupole and octupole components. QCSs possess a conic form and may occur at a wide variety of heliolatitudes. The existence of QCSs opens wide opportunities for explanations of puzzling observations of cosmic rays and energetic particles in the heliosphere and, at the same time, raises a risk of misinterpretation of in situ crossings of QCSs because of mixing up the HCS and higher-heliolatitude QCSs, which can be significantly disturbed in the dynamical solar wind.