

P4.4016 Analytical model of a current sheet at a magnetosheath's boundary in a collisionless plasma

Thursday, 11 July 2019 14:00 (2 hours)

See full abstract here:

<http://ocs.ciemat.es/EPS2019ABS/pdf/P4.4016.pdf>

We suggest and investigate in detail an analytical model of a quasi-stationary current sheet in a collisionless plasma describing the boundary of a magnetosheath formed by the solar (stellar) wind [1]. The model significantly expands the scope of the magnetohydrodynamic approach and is based on a consistent kinetic description of the inhomogeneous anisotropic momentum distribution functions of electrons and ions with different effective temperatures.

Using the method developed in [2], we find exact one-dimensional solutions to the Vlasov-Maxwell equations with electron and ion distribution functions in the form of a Maxwellian function multiplied by a Heavyside step function of the particle generalized momentum, which includes the vector potential. We analyze in detail possible monotonic profiles of the magnetic field and number density of plasma species, and localized structure of the current density, which are all expressed by the error and the exponential functions of the vector potential.

We present various examples of one-, two- and three-component current sheets formed by the electrons and one or two fractions of energetic protons, including the cases of the same and opposite directions of their currents. For all these sheets we explicitly find the widths of different components of the current and describe their asymmetry, as well as the anisotropy degree of the particle momentum distributions. The widths and the values of electron and proton current components depend on gyroradii, number density and effective temperature of particles.

The model allows us to give a qualitative description of the inhomogeneous current structure in the bow shock and the magnetopause for a broad class of objects, including the heliospheric shock layer, the planetary magnetospheres modified by an incident stellar wind, the boundary layers of the magnetic clouds filled with plasma and moving from a star through the surrounding plasma of its wind, the high coronal magnetic loops immersed in the wind on the late spectral class stars. We give estimates of current sheet parameters in these cases and use the analytical solutions for the interpretation of observational data.

References

- [1] V. V. Kocharovsky, Vl. V. Kocharovsky, V. Yu. Martyanov, A. A. Nechaev, *Astron. Lett.* (2019). Submitted.
- [2] V. V. Kocharovsky, Vl. V. Kocharovsky, V. Yu. Martyanov, S. V. Tarasov, *Phys. Uspekhi*, 59, 1165 (2016).

Presenter: NECHAEV, A.A. (EPS 2019)

Session Classification: Poster P4

Track Classification: BSAP