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Solar Corona Expansion and Physics of Heliospheric Current Sheet

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Heliospheric current sheet creation has been investigated by numerical solution of 3D MHD equations, using the Peresvet code. The dipole magnetic field is corresponding to the solar activity minimum, and typical corona parameters are used as initial conditions. Plasma compression, dissipation, thermal conductivity, and gravitation are taken into account. Polarization does not appear at radial expansion of the solar corona. As a result, E=0 in the sheet, and the current density becomes as $j = \sigma V \times B/c$. The MHD numerical experiments show that the normal magnetic field component is an important feature of the heliospheric current sheet. The sheet can not be a neutral one. Current generation is similar to action of a short closed MHD generator. The solar wind temperature is determined by plasma cooling because of plasma expansion and heat conduction from the Sun. In the process of expansion the solar wind is accelerated and achieves the supersonic velocity at a distance of about 3 solar radii. The stationary plasma flow is very sensible to corona parameters. The current sheet is surrounding by a thick plasma sheet, but plasma velocity is dropped inside the sheet. It is shown that the upper limit of the solar wind conductivity is determined by the current velocity limit. Plasma expansion above the magnetic pole takes place along the magnetic field lines. The original dipole magnetic become almost straight. Here braking of expanding plasma takes place only by gravitation. The maximum of plasma velocity $\sim 8.5 \times 10^7$ cm/s is bigger by the factor 1.25 than the maximum velocity in the equatorial region. The velocity above the pole becomes supersonic at $\sim$ 2.2 solar radii. Alignment of magnetic dipole lines along the plasma flow results in increasing the magnetic field above the pole by the factor order of 2.