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Analysis of processes in the solar wind in a thin layer adjacent to the front of the shock wave

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A two-dimensional stationary system of nonlinear MHD equations in a thin layer adjoining the front of the interplanetary shock wave is solved. Previously, available publications focused on linear transport equations. But the presence of high energy particles in the solar wind requires taking into account the processes of self-action. Our analysis considers the nonlinear terms in the MHD equations. A solution is constructed for three cases: 1) in the absence of magnetic reconnections; 2) for magnetic reconnections; 3) with the simultaneous action of reconnections and fusions of magnetic islands. In all three cases the outcomes have been found for the main parameters of the solar wind. The results obtained make possible distinguishing realistic distribution functions corresponding to solutions of MHD equations from the families of velocity distribution functions known earlier. This allows to confirm the previously established fraction of particles excited to energies above 1 MeV. The proposed investigation gives the opportunities for modeling the solar wind conditions and will be used for analysis and assimilation of the observed results from the new registration of solar wind and solar radio bursts provided by the LOFAR diagnostics.