MHD EFFECTS TRIGGERED BY BEAMS OF FAST PARTICLES IN SOLAR MAGNETIC TUBES AND THEIR POSSIBLE RELATION TO PLASMA HEATING DURING SOLAR FLARES

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MHD influence of the changing of a current system of a flaring magnetic tube ,containing a beam of fast non-thermal electrons to plasma in low solar atmosphere (transition region, lower corona),is studied. We estimate locally the disturbances of a current system of magnetic tube the beam coursed by inject into it, using the classical idea of a return current. According to this idea, the integral current density of the system in the presence of a beam, i.e. current density of magnetic tube plus current of the beam, does not change, keeping the whole magnetic structure to be the same. But this suggests that the current density of the magnetic tube in fact should change when a beam of fast electrons propagates the rough in it. This change of current of the tube is usually interpreted in terms of return current, which runs in the regions of the beam location and is directed opposite with respect to the current of the beam. At the same time any changes of current density in magnetic tube cause change of Joule heating and disturb the thermodynamical equilibrium of the tube even in a case when there are no collisions between particles of a beam and background plasma. Heating of plasma destroys as well the force balance and starts the process of a complex dynamics of the whole plasma-magnetic structure. As far as beam injection into flaring loop has an impulsive character, the dynamics of the system could be considered as two subsequent stages. In the first one, characterized by the presence of a beam of fast electrons, the preliminary equilibrium state of the magnetic tube is disturbed and the complex dynamics of plasma starts in the region of beam propagation, during the second stage, when injection of the beam is already over, plasma and magnetic field continue to evolve from the disturbed state and gradually relax to the equilibrium state. Therefore, in the model under consideration, the beam of fast electrons plays a role of a disturbing factor and appears to be a kind of trigger for a dynamical process which could impact on the observational manifestation of a flaring event. The dynamical behavior of a magnetic tube is studied on the basis of known self-similar solutions of plasma MHD. Different dynamical regimes which are possible on the stage of disturbing of the tube as well as during its relaxation are considered. The up-ward plasma flows appearing on the stage of relaxation can be associated with the observed up-ward chromospheric evaporation flows. The model gives a new approach to an explanation of a complex of observed features of flares including plasma heating and motion peculiarities. Comparison with observational data is made.