On the modelling of 3D solar coronal structures in a kinetic approach

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The nature of the dynamical solar corona three-dimensional (3D) global fine structure consisting of transient type magnetic island elements and radial type magnetic flux rope structures is studied in a kinetic approach. We use a stationary model where we have a diamagnetic neutral current sheet (slab disk) submerged into the solar wind high speed hot plasma flow. In the vicinity of the sheet a low speed flow is formed and the particle distribution function is a bimaxwellian (double humped) one and describes a double velocity flow with a relative velocity. On the periphery of the sheet we have a high speed flow with a maxwellian distribution function. There is a set of parameters describing a current carrying plasma and flow in stationary state: particle gyroradius, velocity, and pressure in the high-velocity flow. The ratio between these parameters is weakly dependent on the radial distance and determines the value and sign of the plasma anisotropy $\kappa = 1 - \varepsilon_c/\varepsilon_w$ in the system. The fine structure of the corona is treated like the result of an instability of the diamagnetic state due to excitation of large scale surface electromagnetic modes interacting with the plasma particles which are studied here with two orthogonal wave vector orientations called tearing and stratification mode. For negative sign of anisotropy when currents have a stronger effect than flows, we have a tearing mode while at a positive sign when flows are stronger a stratification mode is observed. The tearing mode characterizes the formation of radially moving magnetic islands while the stratification mode characterizes the formation of the radial magnetic ropes. When anisotropy increases we have a decrease of the scale of the structures. When there is a balance between flow and current and the anisotropy is damped, i.e. under stable conditions current disk thickness rapidly decreases in the lower corona but then in the interplanetary space its value grows smoothly in accordance with dynamics of solar wind flow .

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