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Influence of a guiding field on anisotropic plasma equilibria in the Earth's magnetotail

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Self-consistent theory of relatively thin anisotropic current sheets (CSs) in collisionless plasma is developed taking into account the presence of a guiding field By, which is often observed in experimental observations. We assume that plasma northern and southern sources are symmetric and By component is quite small not to magnetize ion motion in CS. This allows to use quasi-adiabatic approximation for ion motion and semi-fluid Boltzmann approach for electrons. Self-consistent Vlasov-Maxwell equations for this plasma equilibria are solved numerically and investigated in a wide area of parameters. Contrary to the case of a zero By the character of "particle - current sheet" interaction is changed in a sheet with a shear magnetic component. The coefficient of particle reflection becomes significantly asymmetric in northern and southern directions, depending on the value of By component. As a result the asymmetry of plasma density at CS edges becomes characteristic feature of CS with nonzero By. This leads to the asymmetry of current densities and corresponding magnetic fields. In the presence of nonzero guiding field the magnetic field in the very center of CS becomes stronger therefore the curvature drift of electrons (giving a narrow strong maximum of current density in the case with By=0) decreases, thus leading to the real thickening of CS. Another interesting effect which occurs due to asymmetry of plasma density is the change of the CS force balance. The stability of CS with nonzero By is studied. It is shown that this magnetotail plasma structure might become unstable verses tearing mode development. It is demonstrated that characteristic CS profiles provided by our model are in good agreement with the ones observed experimentally. This work is supported by RFBR grant 08-02-00407 and NIII-472.2008.2