Peculiarities of quasi-adiabatic dynamics of charged particles in current sheets with magnetic shear

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The dynamics of quasi-adiabatic ions in the current sheet (CS) of the Earth's magnetotail during substorms is investigated, when CS is thinned, and the scale of the magnetic inhomogeneity is about proton gyroradius. Experimental data indicate sometimes that the shear magnetic component from the interplanetary magnetic field can penetrate within the magnetosphere and support self-consistent currents. The numerical model of CS is constructed, taking into account the normal magnetic component and shear component of three types: 1) constant profile within CS, 2) bell-shaped and 3) antisymmetric ones. Poincaré maps characterizing quasi-adiabatic dynamics of ions are studied. The jumps of quasi-adiabatic invariant of motion are calculated, and comparison is made with the case of the absent magnetic shear. It is shown that the presence of constant and bell-shaped magnetic components in the current sheet leads to the asymmetric scattering of particles in the North-South direction after their interaction with CS and corresponding differences in the structure of the phase space. It is demonstrated that the jumps of the approximate invariant $I_z$ depend on the location of the plasma source in the Northern or Southern hemispheres. At the same time, for configurations with anti-symmetric shear component, the particle scattering near the sheet plane is negligible, therefore in this case it is no scattering asymmetry, and the jumps of invariants of motion are smallest; they do not depend on the value of the magnetic field amplitude inside CS. Applications of these results to interpret experimental observations are discussed.