NON-ADIABATIC PLASMA ACCELERATION IN CURRENT SHEETS: REGULARITY ISLANDS IN STOCHASTIC PARAMETER SPACE

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Region around magnetic separatrix between open and closed field lines in the Earths magnetotail (usually called PSBL=Plasma Sheet Boundary Layer) plays very important role in the overall magnetosperic energy circulation.

Experimentally dynamical plasma processes occurring in this region have very complicated spatial/temporal manifestations. The echoes of powerful acceleration processes operating in the distant regions of magnetotail could be seen in the high-latitude auroral region as VDIS (Velocity Dispersed Ion Structures) often fragmented at a sets of isolated sub-structures. Higher apogee satellites (e.g. INTERBALL and CLUSTER) observe these phenomena as spatially and/or temporally localized highly accelerated ion beams termed beamlets. Trajectories of solar wind ions interacting with magnetotail current sheet as a rule are non-integrable and one may expect that non-adiabatic CS interactions should be accompanied by strong stochastic scattering and could produce only the energized quasi-isotropic thermal population of the plasma sheet. However detailed analysis reveals the existence of so called CS resonances producing islands of regular motion in otherwise chaotic phase space. If the existence of high velocity almost field aligned PSBL ion beams could be attributed to this effect then their fragmentation on a finite number of substructures is an intrinsic result of a discreet nature (N=1, 2, 3,) of such resonances.

Quantitatively the values of ion fluxes in PSBL are very high and their generation in the current sheet should be accompanied by strong nonlinear modifications of cross-tail currents. Non-linearity competes with standard velocity filter and time of flight dispersion effects and produces well-defined features in VDIS patterns which could be seen in Cluster data.