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On the generation of ion beamlets in the magnetotail: resonant acceleration versus stochastic acceleration

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In the Earth magnetotail two types of ion beams (so-called beamlets of type I and of type II) are observed in the plasma sheet boundary layer. Type I beamlets have energies < 20 keV and small velocity dispersion, while type II beamlets have energies up to 100 keV and large velocity dispersion. It is believed that beamlets of type I result from non-adiabatic, resonant acceleration by the cross-tail electric field E_y at the fulfillment of the resonant condition in the current sheet, while beamlets type II could be generated by sufficiently large level of electromagnetic fluctuations in the magnetotail. The resonant condition is very sensitive to the presence of the perturbation and eventually should be destroyed by growing "noise". We performed test particle simulation taking into account two possible acceleration mechanisms, cross-tail electric field E_y and stochastic acceleration due to electromagnetic perturbations. Electromagnetic perturbation were generated by a set of oscillating clouds in the plasma sheet. We obtained that type I beamlets could be observed even in the presence of moderate levels of perturbation $\delta B \sim B_z(z = 0)$, where B_z is a magnetic field component perpendicular to the current sheet plane. Increasing the perturbation level, beamlets of higher energy are obtained but energies are no more discrete, as is typical of type I beamlets. The interplay of ion resonant acceleration and magnetic perturbation in the magnetotail leads to a continuous transition from beamlets of type I to beamlets of type II. A comparison of the numerical results with the observations of ion populations in magnetotail is also discussed.

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