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Nonadiabatic motion of energetic ions in the inner magnetosphere

JOE BOROVSKY, Space Science Institute, KATERYNA YAKYMENKO, GIAN LUCA DELZANNO, Los Alamos National Laboratory — The problem of trapped charged particle motion in a dipole magnetic field is intrinsically insoluble and full solution of this problem can only be achieved by numerical integration. The theory of adiabatic invariants is often employed to describe orbits of charged particles in the inner magnetosphere. The first adiabatic invariant, magnetic moment, is associated with fast gyromotion around the magnetic field. It leads to the concept of 'adiabatic loss cone', which determines when trapped particles can become lost by scattering into the atmosphere. We first show that when the ring-current ion energy increases or radius of curvature of equatorial magnetic field decreases, the equatorial atmospheric loss cone shifts away from the direction of the magnetic field. This modification can be described by a simple quasi-adiabatic model which works well even for significant deviations from adiabaticity. Next we discuss how nonadiabatic effects can lead to diffusion of charged particles which occur when cyclotron motion of particles around magnetic field line resonates with longitudinal oscillations of bounce motion between mirror points. We show that such diffusion becomes important for the ring current decay during geomagnetic storms.

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