Ring current ion finite motion in disturbed magnetosphere with nonequipotential

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Simulations of the transport of ring current particles in the magnetosphere during disturbances are attempted using a three-dimensional single particle code. The simulations considered, for the magnetospheric field both the dipole and Tsyganenko models. The convection electric field is described in equatorial plane by the model of Volland-Stern with dependence on geomagnetic activity and is assumed to be the same out of the equatorial plane. It implies nonequipotentiality of the geomagnetic field lines that is possible for L > 6 in disturbed magnetosphere conditions. The energetic protons of several tens of keV start on the night side at L=4 and have motion confined to the equatorial plane mostly under gradient magnetospheric drift. However, soon after crossing the noon-night meridian, at some point in their ExB transport trajectory, the protons are observed to abruptly depart from the equatorial plane and move towards high latitude regions. This latter motion is essentially confined to a plane perpendicular to the equator and is characterized by finite periodic motion. The calculations further indicated sudden violation of the first adiabatic invariant at the point of departure from the equatorial region, with slow variation latter along the orbit. The greater the convection electric field the higher is the energy of the protons participating in this off equatorial flow. These numerical calculations indicated that this perpendicular flow can significantly contribute to the morning-evening component of the magnetic field perturbation at storm time, populating the high latitude region by protons with energy around tens of keV. The more energetic ions, however, continue their magnetic drift around the Earth uninterruptedly and form the symmetric ring current population.

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