GEOMAGNETIC CUTOFF PENUMBRA STRUCTURE: APPROACH BY TRANSMISSIVITY FUNCTION

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Numerical tracing of cosmic ray trajectories in the model magnetospheric field is widely used to understand the "magnetospheric optics" of the Earth's magnetosphere for primary cosmic rays and their access to ground based observation sites. Recent review on the subject can be found, e.g., in [1]. Penumbra structure is usually described as system of allowed and forbidden trajectories (A,F) between low, Rl , and up, Ru , cutoff rigidities. The probability of a particle in a given rigidity interval within (Rl,Ru) to access the position of a station, the transmissivity function TF, is deduced from the (A,F) structure which is dependent on the elementary step in rigidity for computations, on local time (if the external field is included) and on the geomagnetic activity level. We describe TF using Tsyganenko'89 field model with rigidity steps ?R=10-5 GV - 10-1 GV, for the high latitude Oulu site (65.05o N 25.47o E) and vertical directions at two different local times and extremal values of Kp. We estimate the stability range of numerical simulations and discuss the significance of the penumbra structure in terms of the divergence of asymptotic direction of neighboring allowed trajectories. The effect of small perturbations of the model field, adjusted as random fluctuations of dB/B with a given dispersion along the trajectory, upon TF is also estimated. The TF function weighted statistically by the Kp distribution over long time may serve as a tool for CR transparency characteristic at a particular station.

1. Smart, D.F., M.A. Shea, and E. O. Flückiger, Space Sci. Rev., 93, 305-333, 2000