Geophysical Research Abstracts, Vol. 8, 10083, 2006
SRef-ID: 1607-7962/gra/EGU06-A-10083
© European Geosciences Union 2006

Convective Instability in the Plasmasphere: the Driver of a Plasmaspheric Wind

N. André (1) and J. F. Lemaire (2)

(1) Mullard Space Science Laboratory, University College London, Dorking, UK (2) Center for Space Radiations, Université Catholique de Louvain, Louvain-La-Neuve, Belgium

According to ISEE observations, after prolonged periods of quiet geomagnetic conditions, the average equatorial plasma density distribution is decreasing exponentially with L from $L = 2$ to $L > 7$ (: d ln n / d L = - 0.724). During more typical quiet conditions even steeper slopes are often observed (: d ln n / d L = - 1.5). These density slopes are steeper (: i.e. corresponding to greater stability) than that for which a distribution of plasma in magnetostatic equilibrium is usually assumed to be convectively unstable in the gravitational field and corotation electric for $L < 6.6$. Indeed, the geosynchronous orbit is usually considered to be the equatorial distance beyond which a negative density slope (: plasma density decreasing with L as observed) is convectively unstable. For $L < 6.6$ it was generally considered that negative density slopes like that reported above were stable with respect to pure interchange motion : i.e. for which the shape of magnetic field lines are not perturbed during interchange motion. However, this conclusion holds only under the assumption that the unperturbed magnetic field lines are straight (i.e. not curved, as are geomagnetic field lines). This assumption is not realistic and the effects associated with the magnetic curvature are largely dominant over the effects of the effective gravity in the equatorial regions of the plasmasphere and of the magnetosphere in general. When the effect of magnetic field tension (due to the curvature of the dipole magnetic field lines, and B-field gradient) is properly taken into account, the thermal plasma confined in the Earth's dipole magnetic field cannot remain in magnetostatic equilibrium; it becomes convectively unstable for smaller L, i.e. much deeper inside the plasmasphere. In other words, the equatorial region of the plasmasphere becomes convectively unstable at much lower altitudes when the curvature of dipole magnetic field lines is taken into account. Thus the existence of a plasmaspheric wind is supported by our theoretical result: i.e. that the equatorial plas-

masphere is not in magnetostatic/barometric/diffusive equilibrium, but is convectively unstable at $L = 2$ and beyond, where the type 2 quasi-interchange mode is becoming unstable, with dominantly larger field-aligned than transverse plasma displacements. The picture of a static equatorial plasmasphere is at odd, even in a saturated stage following a long period of refilling and quiet geomagnetic conditions.