CONSTRAINTS ON MECHANISMS OF AURORAL ARC FORMATION

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Up to now several tens of theories for inverted-V structure and discrete arc formation have been proposed [for survey see (J. E. Borovsky, J. Geophys. Res., 98, 6101 - 6138, 1993)]. In about half of them the source of auroral structuring is supposed to be in the ionosphere (e.g. T. Sato and T. F. Holzer, J. Geophys. Res., 78, 7314 - 7329, 1973), whereas a magnetospheric origin is inferred in others (e.g. L. R. Lyons, J. Geophys. Res., 86, 1 - 8, 1981). In the present study we show that these two classes of mechanisms can be discriminated by the relative orientation of the structured electric E and magnetic B fields,which are closely associated with the auroral features, and which power law spectrum indicates their turbulent character (D. R. Weimer et al., J. Geophys. Res., 90, 7479 - 7494, 1985). Specifically, a downward direction of the cross-product [E B] suggests a magnetospheric generator of these fields, while [E B] pointing upward indicates an ionospheric mechanism of structuring. Based on the electric and magnetic field measurements of the Dynamic Explorer-2 satellite (altitudes from 300 to 1000 km, spatial resolution of 3.8 km) during the period of one and a half year, we demonstrate that in about 95 per cent of cases the cross product [E B] turns out to be downward. This suggests a magnetospheric mechanism at work (at least on the mesoscales that we have considered). Being averaged over the polar cap, the turbulent electromagnetic fields exhibit a steady growth with northward interplanetary magnetic field (IMF) increasing, while averaged over the auroral oval, they grow with increasing the southward Bz IMF. There is a notion that the same mechanism promotes turbulence development in the auroral oval and in the polar cap with increasing, respectively, southward or northward Bz IMF. Another finding about the structured electric and magnetic fields, is their strong connection with the background field-aligned currents (FACs). Interestingly, the amplitude of E and B is determined solely by the density of the FAC and is insensitive to FAC nature. This means that transfer to a turbulent state of the Region 1 FACs, Region 2 FACs, and NBZ currents, which are quite different in their origin, should be described within the same framework.

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