The Harang Reversal: A New Interpretation based on the Magnetotail Stability

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If the transport of plasma-sheet ions is adiabatic and the magnetotail is in a steady state, it is expected, under a certain assumption, that the entropy parameter pVg increases and decreases along the convection flow in the regions corresponding to downward and upward field-aligned currents (FACs), respectively. This requirement, along with the condition for the interchange stability imposes an important constraint on the direction of the convection flow especially for downward FACs. It is deduced that for the dusk cell the convection flow in the downward R2 current has to be directed azimuthally duskward, which follows the sunward, possibly deflected dawnward, convection in the region of the premidnight upward R1 current. This duskward turn of the convection flow takes place in the vicinity of the R1-R2 demarcation, and it presumably corresponds to the Harang reversal. For the dawn cell the convection flow in the postmidnight downward R1 current has to significantly deflect dawnward, and then it proceeds sunward in the upward R2 current. Those interrelationships between the convection and FACs are verified with a quasi-steady plasma sheet configuration and convection reproduced by a modified Rice Convection model with local force balance. Using equi-potential contours as a reference, it is also suggested that auroral arcs mapped to the equator are oriented in the east-west and Sun-Earth direction if they are located in the premidnight R2 and R1 currents, respectively.