

RECENT ADVANCES IN THE RESEARCH OF POLAR CAP AURORAS

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During the periods of strong northward interplanetary magnetic field (IMF), the polar cap (normally no aurora) often appears clear auroral structures. Their appearance not only directly links to solar wind-magnetosphere-ionosphere coupling processes, but also often results in variable space weather disturbances. However, their formation and evolution are still poorly understood, and there is no forecasting tool to predict either their formation or evolution. Here we summarize the recent new progresses about the formation, evolution, and space weather impact of polar cap auroras. 1) A general formation mechanism has been proposed for the formation of transpolar auroral arcs (TPA): strong flow shear sheets in the magnetosphere generate field aligned current (FAC) sheets which field-aligned accelerate electrons through the Knight's current-voltage process to precipitate into the polar cap ionosphere. 2) A cyclone-shaped aurora has been identified and named as space hurricane above the Earth's magnetic north pole with strong heated electron precipitations, a clockwise circulation of the plasma flow, ion upflow, upward FAC and circular magnetic field perturbation. 3) Merging poleward edges of a conjugate horse-collar aurora (HCA) have been identified in both hemispheres' polar ionosphere, indicating an almost complete disappearance of the open-flux polar cap and a shrunk and nearly closed magnetosphere due to the quasi-steady dual-lobe reconnection continuously eroding the magnetotail open and even closed magnetic field lines that reclosed at the dayside magnetopause under long-time strong northward IMF. These results indicate that there are still significant energy disposition and coupling in the solar wind-magnetosphere-ionosphere interactions under strong northward IMF conditions.