Mechanisms for generation of the pre-noon high-latitude auroral arcs

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We present observations of the high-latitude poleward-moving auroral arcs, which appeared on closed magnetic field lines in the pre-noon (08-10 MLT) ionosphere. The arcs were investigated together with the ionospheric plasma flows derived from the EISCAT radar measurements over Svalbard. Developing of the auroras in the East-West direction and relative motion of the auroras with respect to the ambient F-region ionospheric plasma has been used as a criterion for selecting proper mechanisms for the aurora formations. Five possible mechanisms have been examined including: Magnetosheath plasma injection; Plasma irregularities produced by the Kelvin-Helmholts (K-H) instability; Field-line resonances (FLR) excited due to the K-H instability; the FLR excited by convection disturbances; and the Interchange instability. A case study of December 7, 2000 is presented when TV ASC camera in Barentsburg (Svalbard) observed pre-noon rayed auroral arcs, which occurred at the poleward edge of the auroral oval after IMF Bz turning from negative to positive. The arcs appeared from the area of enhanced luminosity seen in the western (nightside) horizon, and developed to the east progressing at a velocity of about 1.5 km/s. Simultaneously, the arcs were drifting poleward at a velocity of 300 - 500 m/s, which value was equal to the F-region ionospheric plasma drift velocity observed by the Svalbard EISCAT radar. The arc appearance and motion corresponded well to the poleward expansion of the auroral oval following the IMF Bz northward turning, which was observed by the ultraviolet imager onboard the Polar satellite. The observed auroras were associated with closed LLBL indicated by the particle precipitation data from DMSP satellites showing also several-keV electrons of plasmasheet origin. The observation allows us to suggest that the arcs arise due to the interchange instability that starts to develop at the boundary between the magnetospheric plasma and the magnetosheath flux tubes entering the magnetosphere due to the reconnection beyond the cusp after the IMF Bz changing. The interchange instability can be suggested as a possible mechanism for the formation of the LLBL.