



A Multi experiment study of polar cap ion outflow

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This paper presents nearly field aligned outflowing ion beams observed on the Cluster multi-satellite system over the polar cap. Data are taken at altitudes of the order of 4-7 Re. The distinction is made between ion beams originating from the polar cusp/cleft and ion beams accelerated along the local magnetic field line passing by the spacecraft. Polar cusp ion beams are characterized by the encounter of field aligned proton and oxygen ions with energies differing by a factor of about 4 (velocity filter effect). These events show a high temporal and spatial variability. A case study taken from 28 September 2001 is discussed in detail. On the contrary, local beams are characterized by field aligned proton and oxygen ions with similar energies. These beams show the typical inverted V structure observed in the auroral zone and are associated with a quasi-static converging electric field. The field aligned potential drop well fit the ion energy profile. The simultaneous observation of precipitating electrons and upflowing ions of similar energies at Cluster orbit indicates that the spacecraft is crossing the mid-altitude part of the acceleration region. In the polar cap, the parallel electric field can extend to higher altitudes than that of the satellite. A detailed analysis of the ion distribution function shows that they are heated during their parallel acceleration and that energy is exchanged between H⁺ and O⁺. Furthermore, intense electrostatic waves are observed simultaneously. These observations could be due to an ion-ion two-stream instability. We finally present results on the correlation of these events with the IMF orientation and use DMSP data to study the simultaneous occurrence of electron precipitation over the polar cap at different local times.