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Study on field-aligned electrons with Cluster observation in the Earth's cusp

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Cusp region is very important to the solar wind-magnetosphere coupling. The solar wind particles, through the cusp, can directly entry into the magnetosphere and ionosphere, and transport the mass, momentum and energy. The gyrating charged particles with field–aligned velocity are significant to perform the transportation. In this study, data from Cluster observation are used to study the characteristics of field-aligned electrons (FAE's) including the downward and the upward FAEs in the cusp. We select FAE event to do analysis. The durations of the FAE event covered a wide range from 6 to 475 seconds. The FAE's were found to occur very commonly in a circumpolar zone in the polar region and the MLT and ILAT distributions showed that most of the FAE events were observed around the cusp (70-80°ILAT, 0900-1500MLT). With the FAE flux the contribution of the electrons to the Field–Aligned Current (FAC) is estimated and the result shows that the FAE was the main carrier to the FAC in the cusp. The physical mechanisms of the FAE are analyzed, namely that the downward electrons were mainly from the solar wind and the upward electrons may originated from accelerated ionospheric up-flowing electrons or mirrored solar wind electrons. The energy transportation into the magnetosphere by the solar wind electrons through the cusp is also investigated.