



The auroral generator: A case study using conjugated Cluster and FAST data

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The auroral generator is a key constituent of the auroral current circuit. In the literature, however, there is a lack of detailed observational investigations of the generator and its properties. At present, Cluster provides a better platform for studies of the auroral generator, than previous single spacecraft missions. For example, the full current density vector can be derived from the simultaneous magnetic field measurements on the four spacecraft. In this paper we use conjugated data from the Cluster fleet (at an altitude of $\sim 18R_E$) and the FAST satellite (at ~ 4000 km) to investigate the auroral generator.

We examine the power density, $\mathbf{E} \cdot \mathbf{J}$, as measured by Cluster, and present a night-side event where Cluster crosses a generator region, $\mathbf{E} \cdot \mathbf{J} < 0$. At the same time FAST detects precipitating accelerated electrons. To our knowledge, this is the first experimental evidence for crossing of an auroral generator region. Our investigation is complicated by the fact that the electric field and current are close to the instrumental detection limit (the energy flux into the ionosphere requires quite small power densities in the generator region). However, a careful examination of the FAST data, of the mapping along the magnetic field line, and of the conjunction timing, contributes to the validation of the $\mathbf{E} \cdot \mathbf{J} < 0$ signature seen by Cluster.