Effect of Accelerated Electrons on Quiet Auroral Arc Formation

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Because of the recent development of particle simulations, auroral energetic electrons which excite the emission lines in aurora are thought to be produced by the ion-acoustic double layer [1, 2] that should be created by microscopic instability. On the other hand, the theory of feedback instability between the magnetosphere and ionosphere [3] is believed as one of the candidate to explain the formation of large-scale structure of quiet auroral arc. Then, some magneto-hydro-dynamics (MHD) simulations showed the arc formation by this macroscopic instability [4], while the effect of auroral energetic electrons on the arc formation was neglected or given as a macroscopic parameter in these simulations. In order to make close investigation of auroral arc formation, however, it is necessary to consider the interaction with microscopic instability. In this paper, we numerically study the effect of auroral energetic electrons on quiet auroral arc formation by means of the Macro-Micro Interlocked (MMI) simulation [5]. Our MMI code consists of an MHD code that calculates the ionospheric feedback instability and a particle simulation code that computes the electron acceleration (i.e., the microscopic instability).

The simulation result shows that the growth of field-aligned current by the macroscopic instability triggers off the microscopic instability (i.e., electron acceleration). Further, accelerated electrons increase the ionospheric plasma density through the ionization of ionospheric neutral particles. Then, the intensity of ionospheric electric field decreases in inverse proportion to the growth of ionospheric plasma density. The distribution of field-aligned current is modified because of the response to the variation of the ionospheric electric field.

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