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Field-aligned acceleration of plasmas by slow mode wave: a primary acceleration of auroral particles

Osuke Saka[1]; Kanji Hayashi[2]

[1] Office Geophysik; [2] Non

Quasi-periodic Oscillations (QPO's) are Pi2 band oscillations of magnetic fields observed along geosynchronous orbit in the midnight sector during particle injection event [Saka et al., 1996].

We will show by close inspection of the QPO event of January 24 1986 that QPO's can be classified as a surface wave, probably generated by impulsive force arising from increased plasma pressures in substorm injections [Birn et al., 1997]. It is also found that auroral intensities recorded by all-sky imager were modulated by the QPO frequencies.

It has been suggested that earthward acceleration of plasmas along field lines can be effectively generated by slow mode waves with large Kperp/Kpara ratio, where Kperp and Kpara are wave numbers perpendicular and parallel to the field lines, respectively [Saka et al., 2005; Saka, 2006a]. In general, increased plasma pressures in the midnight sector might be composed of a number of filamentous structures of fresh plasmas supplied by injections (see figure). The slow mode excited in such a region could invoke earthward accelerations preferentially from those imbedded structures where perpendicular wave number is large.

We could show that such acceleration was modulated further by surface waves that were accompanied by QPO oscillations.

Those hot and tenuous flows can be penetrated along the field lines to a distance more than half way to the Earth [Saka, 2006b]. Electrons in the flow could be separated from protons during penetration by magnetic mirror force to gain substantial energies to ignite aurora [Schriver and Ashour-Abdalla, 1993].

Figure
Illustrations describing field-aligned acceleration by slow mode wave (top, bottom left) and modulation of field-aligned acceleration by surface wave (bottom right)

References
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