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Evolution of the auroral signatures of Jupiter's magnetospheric injections

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Abstract

We report on the longitudinal and azimuthal motions of auroral signatures of Jupiter's magnetospheric injections appearing in Hubble Space Telescope (HST) images in the northern and southern hemispheres. Based on HST spectral observations of time-tag mode and numerical simulations, we estimate the age of auroral signatures of plasma injections.

1. Plasma injections

Measurements from the Energetic Particles Detector (EPD) on board the Galileo spacecraft provided evidence of widespread occurrence of plasma injections in the Jovian magnetosphere [3]. The plasma injections are associated with radial planetward transport of hot and tenuous plasma which is most probably the result of centrifugally driven interchange events. Once injected, energetic particles drift azimuthally around Jupiter as a result of corotational electric field drift, magnetic gradient and curvature drifts.

1.1 Auroral signatures of plasma injections

At Jupiter, energetic particle injections are associated with isolated equatorward patchy auroral ultraviolet emission reported for the first time by Mauk et al. [2002][4] based on a single set of simultaneous Galileo spacecraft and HST measurements.

Based on HST auroral data from 2000 to 2007, Dumont et al. [2014][1] reported the first statistical study of Jovian auroral features possibly associated with signatures of magnetospheric injections. They statistically investigated the properties of the equatorward auroral emissions. They demonstrated that the auroral features under study are signatures of injections.

Plasma injections processes play a key role in the dynamics of the Jovian magnetosphere, as they are markers of the radial plasma transport in the middle magnetosphere. In this study, we shed light on the motions and the age of plasma injections in the Jovian magnetosphere.

2. Summary and Conclusions

We analyse the motion and we estimate the age of auroral plasma injections. We use the HST images of the northern and southern Jovian hemispheres and we investigate the temporal variations of the center position of the auroral signature of injection over time. In order to account for the irregularities of the Jovian magnetic field, we estimated the evolution of the azimuthal and latitudinal distance between the auroral structures and reference contours in the auroral emission. We show that the plasma injections move planetward and lag in corotation. To determine the age of these injections, we use time-tagged far ultraviolet spectral observations obtained with the long slit of the STIS camera [2]. These observations are compared with the simulations of the energy-dependent drift of the injected particles. The concept of the simulation is described in Radioti et al. [2013][5] for Saturn. We conclude that the plasma injections only last for a few hours.

References

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