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Inner edge of the Jupiter equatorial current disk and the main auroral oval position

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Abstract

The equatorial magnetodisk is one of the main contributors to the Jovian magnetospheric magnetic field. The magnetic moment of this current disk, as pointed out in [1], can be by 3 times more than planetary dipole magnetic moment. As a result, the Jupiter magnetospheric size is about 1.6 times bigger than that for the dipole case (80 R_J and 50 R_J, correspondingly). Magnetodisk is also connected with the other Jovian phenomenon, main auroral oval. The Jupiter main oval is placed in the region, where strong field-aligned currents (FACs) flow. To study magnetospheric projection of the main oval we will discuss the relative positions of the FAC, of the region where the rigid corotation of the magnetospheric plasma violates, the Alfvenic radius, and the inner edge of the equatorial azimuthal current disk position [2-6]. It will be demonstrated that the inner edge of the disk current is placed not at the Io orbit, but close to the Ganymede orbit. In this region the poloidal and toroid current systems are connected to each other. This conclusion is also supported by the Hubble aurora images, in which the Ganymede auroral spot is placed close to the main oval, sometime inside (poleward) and sometime outside (equatorward) of it.

1. Main auroral oval and equatorial current disk

The Alfven radius is a distance where the magnetic energy density is equal to the kinetic energy density, or rotation linear velocity equals to the Alfven velocity. In the other words, the Alfven radius is a radial distance, where transfer from the magnetic dominated magnetospheric region (beta<1) to the plasma dominated magnetospheric region (beta>1) takes place. This distance is critical for formation of the global magnetospheric current system in the Jovian magnetosphere [1]. In relation to incoming start of the Juno mission to the Jupiter system, the relationship between Alfven radius and the inner edge of the equatorial current disk will be discussed. The Ganymede magnetosphere is placed inside the equatorial Io plasma sheet and is formed as a result of the Ganymede magnetic field interaction with the Jovian magnetized magnetospheric plasma, which rigidly corotates with the Jupiter. We discuss the relative positions of the Ganymede orbit and the inner edge of the equatorial current disk, of the equatorial projection of the Jovian main auroral oval, and of the distance, where the rigid corotation is violated. The structure of Ganymede magnetosphere forming in the close vicinity of FAC region will be also considered. The position of the Ganymede relative to the strong FAC region (relative to the main oval magnetospheric projection) can be a reason of the Ganymede magnetosphere and Ganymede aurora dynamics. For mapping of the polar Jupiter region to the equatorial magnetospheric plane we use the paraboloid model of the Jovian magnetosphere. To estimate the errors of the analytical magnetic field model, we analyze the auroral spots, which are connected with the Ganymede and other Galileo moons. Because most of the existing magnetometer data are obtained near the equatorial plane (Galileo mission, and Pioneers and Voyagers flybys), the moon spots position [2, 5] present an unique possibility for the magnetic field mapping test.

2. Summary and Conclusions

We study the mapping of the Jupiter's main oval to the magnetospheric equatorial plane. The inner edge of the equatorial current disk and the region of strong FACs (near the Ganymede orbit) are possible candidates. Accurate mappings of the Io and Ganymede orbits to the Jovian atmosphere in terms of paraboloid model during selected events shows that main oval is the rather projection of the inner edge of the magnetodisk that locates near the Ganymede orbit. The auroral spots at the Jupiter upper ionospheric level gives us a marker for the mapping of the main oval to the equatorial plane which is independent of the magnetic field model.

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