Low-Density Regions in the Plasmasphere

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ABSTRACT

Using global images of the plasmasphere from the IMAGE Extreme Ultraviolet Imager, we investigate the characteristics of localized low-density regions of the plasmasphere. These may be surrounded by higher-density regions (and therefore called cavities) or open toward higher L ("voids" or "bite-outs"). The latter are often a source of kilometric continuum radiation. Our goal is to understand their relationships with one another, with other known features of the plasmasphere, and to elucidate the mechanisms by which they form and dissipate.

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These structures are of interest from several points of view. Green *et al.* [2] have identified the voids as the source region for kilometric continuum radiation. Furthermore, the voids are probably related to the troughs or plasmaspheric cavities that have been known for some time [3].

Our study to date has encompassed about 40 examples of low-density regions. The voids are characterized by deep radial indentations in the plasmapause, with a radial extent of 1-2 R_E and an azimuthal extent of 10°-20°. The intensity contrast in an azimuthal profile across the void ranges from 2 to more than 4. The shape of the low-intensity region suggests reduced density in a complete flux tube extending from the equator to the ionosphere. The voids are most often observed during times of geomagnetic quiet, but also are sometimes found at times of moderate geomagnetic activity. They can persist for periods of at least 40 hours. The azimuthal position of the void often lags the angular velocity of local corotation by about 10%, and the data suggest that voids form (or at least are observed) preferentially in the range of magnetic longitude 200°-300°.

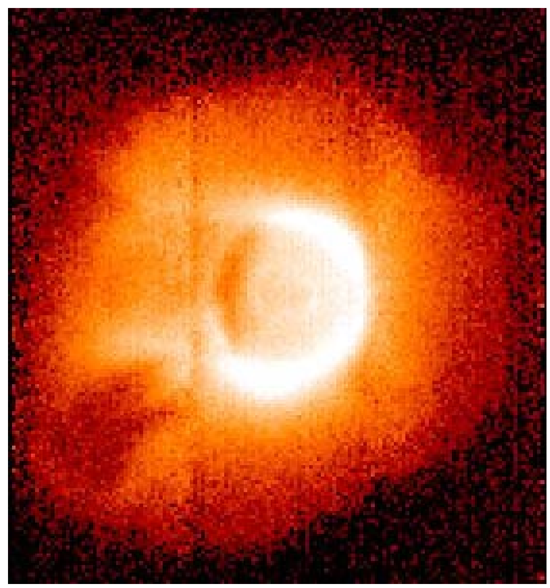

IMAGE EUV image of Earth's plasmasphere taken at 1712 UT on 24 June 2000. To the lower left is a prominent low-density region or "void." The sun is to the right.

We distinguish the cavities described by Carpenter *et al.* [3] (which have a higher-density outer boundary) from voids (which do not). Although *in-situ* measurements suggest that cavities are rather common, they appear in EUV images much less frequently than do voids. Models of the brightness profile expected from a cavity show that such a structure should be easy for EUV to detect, unless the plasma is distributed in latitude in a way that is inconsistent with best estimates of the characteristics of the cavities and is also physically implausible. Thus understanding the relationship of cavities and voids is particular important.

This analysis attests to the usefulness of global imaging in investigations of this type. With global imaging, we can measure the shapes and distributions of these macroscopic features, and track specific features unambiguously and nearly continuously over periods of days.

[1] Bill R. Sandel *et al.*, "Initial results from the IMAGE Extreme Ultraviolet Imager," *Geophys. Res. Lett.*, vol. 28, pp. 1439-1442, 2001.

[2] J. L. Green, B. R. Sandel, S. F. Fung, D. L. Gallagher, and B. W. Reinisch, "On the origin of kilometric continuum," *J. Geophys. Res.*, in press.

[3] D. L. Carpenter, R. R. Anderson, W. Calvert, and M. B. Moldwin, "CRRES observations of density cavities inside the plasmasphere" *J. Geophys. Res.,* vol. 105, pp. 23,323-23,338, 2000.