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Empirical probability model of cold plasma environment in the Jovian magnetosphere

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We analyzed the Galileo PLS dataset to produce a new cold plasma environment model for the Jovian magnetosphere. Although there exist many sophisticated radiation models, treating energetic plasma (e.g. JOSE, GIRE, or Salammbo), only a limited number of simple models has been utilized for cold plasma environment. By extending the existing cold plasma models toward the probability domain, we can predict the extreme periods of Jovian environment by specifying the percentile of the environmental parameters.

The new model was produced in the following procedure. We first referred to the existing cold plasma models of Divine and Garrett, 1983 (DG83) or Bagenal and Delamere 2011 (BD11). These models are scaled to fit the statistical median of the parameters obtained from Galileo PLS data. The scaled model (also called as "mean model") indicates the median environment of Jovian magnetosphere. Then, assuming that the deviations in the Galileo PLS parameters are purely due to variations in the environment, we extended the mean model toward the percentile domain.

The input parameter of the model is simply the position of the spacecraft (distance, magnetic longitude and latitude) and the specific percentile (e.g. 0.5 for the mean model). All the parameters in the model are described in mathematical forms; therefore the needed computational resources are quite low.

The new model can be used for assessing the JUICE mission profile. The spatial extent of the model covers the main phase of the JUICE mission; namely from the Europa orbit to 40 Rj (where Rj is the radius of Jupiter). In addition, theoretical extensions toward the latitudinal direction are also included in the model to support the high latitude orbit of the JUICE spacecraft.