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A kinetic model of the magnetodisk of Saturn

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Abstract

In situ measurements around Jupiter and Saturn revealed that both giant planets possess a so-called magnetodisk - a complex magnetic/plasma structure resulting from the interaction of the planetary magnetic field with the relatively dense co-rotating plasma surrounding the planet. Recently it was found that the magnetodisk of Saturn shows fine-structure, featuring narrow and dense layer(s) near the actual magnetic equator, being rich in heavier water-group ions; surrounded by a more tenuous plasma containing mostly lighter ions. The heavy-rich layer is found to have significantly lower temperature than the surrounding plasma. Low-energy electron populations were also found associated with these heavy-rich events. Models describing particles having non-Maxwellian velocity distribution in a centrifugal potential are able to account for most of these properties of the Kronian magnetodisk. Here we present a re-fined version of these models, a model of three-component non-Maxwellian plasma in centrifugal potential. The effect of the plasma on the stretching of the field lines is taken into account. The model is able to explain the fine-structure (small scale heights); and significantly improve the understanding of the electron distributions as well. Numerical results supporting the findings of the theoretical model are also presented.