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Space weather effect on the inner magnetosphere: kinetic models for the plasmasphere-ionosphere coupled system, the polar wind and the radiation belts

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Kinetic models of the inner magnetosphere have been developed at BISA.
The 3D dynamic model of the plasmasphere is based on the velocity distribution functions of the particles obtained from the kinetic approach. The position of the plasmapause, the limit of the plasmasphere, is determined by the interchange instability mechanism and depends on the level of geomagnetic activity. The dynamics of the plasmasphere is mainly determined by the convection electric field combined with the corotation electric field. The highly dynamic region of the plasmasphere is disturbed during geomagnetic storms and substorms, with formation of a sharp plasmapause closer to the Earth and generation of a plume in the afternoon MLT sector. The plasmasphere model has been coupled with the IRI ionospheric model to determine the composition, the number density and the temperature in the plasmasphere. Correspondence exists between the plasmapause position and the F region ionospheric trough. Coincident observations of middle and top ionosphere, satellite tomography, radar measurements and plasmapause observations are used to investigate the conditions when the F region trough is associated with the plasmapause.

Moreover, the plasmaspheric region has direct influence on other regions of the magnetosphere. For instance, radiation belt energetic particle populations are very sensitive to the core plasmasphere distribution and specifically to the position of the plasmapause. CLUSTER observations are used to compare the radiation belt boundaries with the plasmapause positions. The kinetic approach is also used to study the radiation belts. The differential flux J(E) observed in space radiations can be related to the characteristics of the particle momentum distribution functions. In fitting flux spectra by a sum of Maxwellians or by power laws, the slope of the differential flux can be related to the characteristic energy of the distributions and the normalization constant is proportional to the density. Using AP8 and AE8 models, a density-energy description of the radiation belts is obtained.
Finally, the polar wind is also influenced by the ionospheric conditions. A kinetic model has been developed to determine the profiles of the moments of the different particles and especially the escape ion fluxes.
These models are provided on the space weather portal.