THE DYNAMICS OF THE PLASMASPHERE

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The plasmasphere is the high altitude extension of the ionosphere. To ensure accuracy and reliability of satellites stationed in this region, there is a considerable interest to understand the plasmaspheric environment and its dependence on external parameters.
Recent satellite observations provide useful information to understand the dynamics of the plasmasphere.

Dynamical simulations have been developed at the Belgian Institute for Space Aeronomy to study the deformations of the plasmasphere during geomagnetic substorms and other variations in the level of geomagnetic activity. These simulations are based on the mechanism of plasma instability for the formation of the plasmapause and on the E5D empirical electric field model. They show the global behavior of the plasmasphere and its dynamics as influenced by the geomagnetic activity variations. The simulations reproduce the development of the plasmaspheric plumes during geomagnetic substorms and their deformations linked to their differential rotation around the Earth.

Such plumes are observed by CLUSTER launched in 2000. These four spacecraft flight on a polar orbit in a tetrahedral configuration to study the magnetosphere and its environment in three dimensions. Total electron density profiles have been derived from the electron plasma frequency identified by the WHISPER sounder supplemented by relative variations of the spacecraft potential measured by the electric field instrument EFW. CLUSTER revealed new density structures in the plasmasphere and the plasmapause. Ion velocities have also been derived from the ion spectrometer CIS on board CLUSTER.
Moreover, the IMAGE spacecraft launched in March 2000 shows the first global comprehensive images of the Earth's plasmasphere. The EUV (Extreme UltraViolet) instrument gives intensity maps of the 30,4 nm emissions of Helium ions integrated along the line of sight. The observations are acquired near apogee from high above the pole. They revealed new structures in the plasmasphere such as shoulders, channels and notches. Moreover, the evolution of the plasmaspheric plumes was for the first time observed. Comparisons between CLUSTER measurements and global views of IMAGE give interesting results about the plume extension and ionic structures of the plasmasphere.

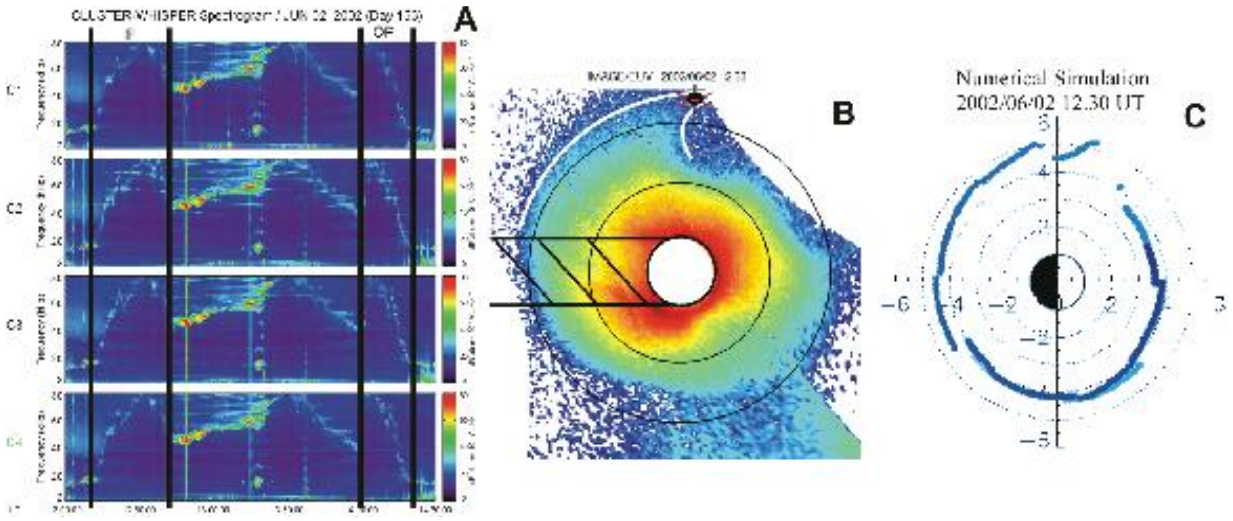

Fig. 1
Panel A: frequency-time spectrograms from WHISPER/CLUSTER; Panel B: image of the plasmasphere from EUV/IMAGE; Panel C: position of the plasmapause from numerical simulation.