The Earth's Plasmasphere: Formation and dynamics

Viviane Pierrard

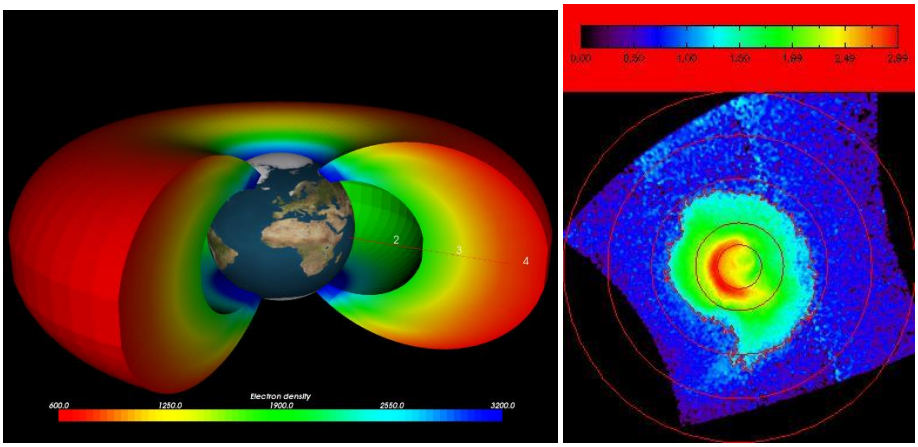
Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Space Physics and Solar-Terrestrial Center of Excellence, 3 av. Circulaire, 1180 Brussels, Belgium

Université Catholique de Louvain, Center for Space Radiation, ELI-C (Earth and Life Institute), 3 place Louis Pasteur, 1348 Louvain-La-Neuve, Belgium

The plasmasphere is the innermost region of the Earth's magnetosphere filled with cold (low energy ~ 1-10 eV) and dense (10-10^4 electrons/cm^{-3}) plasma particles trapped in the Earth's magnetic field. It is the extension of the ionosphere at higher altitudes. The plasmasphere forms a toroidal region surrounding the Earth and corotates with it. The plasmapause is the outer boundary of the plasmasphere and, beyond this limit, the plasmatrough region (very low electron density) strongly interacts with external electromagnetic waves. The plasmasphere is eroded during geomagnetic storms giving rise to structures like plasmaspheric plumes and channels, whereas the ionosphere (upper atmosphere) refills the plasmasphere during quiet times.

During this course, the mechanisms of formation of the plasmasphere and plasmapause will be explained, especially the mechanism of quasi-interchange leading to a sharp knee at the limit of the plasmasphere when the convection increases. I will review the state of the art in plasmaspheric science, starting from its discovery at the beginning of the space age from the analysis of very low frequency (VLF) whistler data to the more recent Van Allen Probes observations, including the CLUSTER and IMAGE satellite observations. I will also show the importance of this highly dynamic region for the other regions of the magnetosphere like the energetic radiation belts, including due to different waves circulating inside and outside the plasmasphere.

The PITHIA-NRF project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101007599



Figures: 3D view of the plasmasphere obtained with the BIPM model (left, Pierrard et al., 2021) and (right) Global view of the plasmasphere in the equatorial plane observed by the satellite IMAGE on 10 June 2001 (Pierrard et al., 2009).

The PITHIA-NRF project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101007599