Plasma source and loss at comet 67P during Rosetta escort phase

K.L. Heritier[1], M. Galand[1], P. Henri[2], F. Johansson[3], A. Beth[1], A. Eriksson[3], X. Vallières[2], K. Altwegg[4], J. Burch[5], C. Carr[1], R. Hajra[2], and M. Rubin[4]

[1] Department of Physics, Imperial College London, Prince Consort Road, London, SW7 2AZ, UK e-mail: k.heritier15@imperial.ac.uk

[2] LPC2E, CNRS, Université d'Orléans, Orléans, France

[3] Swedish Institute of Space Physics, Ångström Laboratory, Lägerhyddsvägen 1, Uppsala, Sweden

[4] Physikalisches Institut, University of Bern, Sidlerstrasse 5, 3012 Bern, Switzerland

[5] Southwest Research Institute, P.O. Drawer 28510, San Antonio, TX 78228-0510, USA

The Rosetta spacecraft provided us with a unique opportunity to study comet 67P/Churyumov-Gerasimenko from a close perspective and over a two-year time period. Comet 67P is a weakly active comet. It was therefore unexpected to find an active and dynamic ionosphere where the cometary ions are largely dominant over the solar wind ions, at large heliocentric distances. Our goal is to understand the different drivers of the cometary ionosphere and assess their variability over time and over the different conditions encountered by the comet during the escort phase.

We used a multi-instrumental data-based ionospheric model to compute the total ion number density at the position of Rosetta. In-situ measurements from the Rosetta Orbiter Spectrometer for Ion and Neutral Analysis (ROSINA) and the Rosetta Plasma Consortium (RPC)–Ion and Electron Sensor (IES), together with the RPC–LAngmuir Probe instrument (LAP) are used to compute the local ion total number density. The results are compared to the electron densities measured by RPC–Mutual Impedance Probe (MIP) and RPC–LAP.

We were able to disentangle the physical processes responsible for the creation of the cometary ions throughout the two-year escort phase and we evaluated their respective magnitude. The main processes are photo-ionization and electron-impact ionization. The latter is a significant ionizer at high heliocentric distance (> 2 A.U.) and was predominant during the last 4 months of the mission. It was occasionally subject to singular solar events, temporary increasing the ambient energetic electron population. Solar photons were the main ionizer near perihelion at 1.3 AU from the Sun, during summer 2015.