PLASMA ENVIRONMENT IN THE INNER COMA OF COMET 67P PROBED BY ROSETTA

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Rosetta offered us the first opportunity to sample the plasma environment close to a comet under a variety of outgassing activities, solar conditions, seasons, and cometocentric distances all the way down to the surface. From its arrival at 3.6 AU to perihelion (1.2 AU) and then up to the end of mission at 3.8 AU, the plasma environment in the inner coma was primarily of cometary origin. It was dominated by water ions, though carbon-bearing ions were significant at times. Near perihelion, more exotic species were observed, sometimes even dominating, such as NH_4^+ measured unambiguously for the first time in a cometary coma thanks to the high-mass resolution of Rosetta Orbiter Spectrometer for Ion and Neutral Analysis (ROSINA)–Double Focusing Mass Spectrometer (DFMS).

Unlike at Halley where ion production rate was balanced by chemical net charge loss, ion transport was significant throughout the escort phase of comet 67P. At the end of mission, a few kilometres from the surface, ion plasma carried the clear signature of adiabatic expansion of the neutral parents. The energy budget of the electrons, which was revealed from recent analysis of the Rosetta Plasma Consortium (RPC)–Langmuir Probe (LAP) and RPC–Mutual Impedance Probe (MIP) dataset, attests of the evolution from a warm population at large heliocentric distances to the apparition of an additional cold population at smaller heliocentric distances and higher outgassing rates.

Through in situ multi-instrument analysis of RPC and ROSINA sensors, it has been possible to identify the source of the cometary plasma. Around perihelion, solar Extreme UltraViolet (EUV) radiation was found to be the main source of ionisation. It was also a dominant source during pre-perihelion over the northern hemisphere summer. In contrast, both during pre-perihelion over the southern hemisphere winter and during post-perihelion, energetic electrons were found to be the dominant source of ionisation. The origin of these energetic electrons, which play a key role in producing the ionosphere, will be discussed in the light of recent comparisons between in situ and remote-sensing observations and 3D kinetic modelling.