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Ion variability at 67P during perihelion: cross-comparison between ROSINA/DFMS and RPC dataset

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Abstract

During the escort phase, the Double Focusing Mass Spectrometer (DFMS), one of the three Rosetta Orbiter Spectrometer for Ion and Neutral Analysis (ROSINA) sensors onboard Rosetta, probed the neutral and plasma composition of the coma of comet 67P/Churyumov-Gerasimenko (67P). Major ion species detected include water ions (e.g., H_2O^+, H_3O^+, HO^+). The analysis of DFMS data revealed a large zoo of ion species near perihelion (summer 2015). During this period, the Rosetta Plasma Consortium (RPC), made up of five sensors (Ion Composition Analyzer (ICA), Ion and Electron Spectrometer (IES), Langmuir Probe (LAP), Magnetometer (MAG), and Mutual Impedance Probe (MIP)), probed the plasma properties, such as ion/ electron number density, electron temperature, ion and energetic electron distribution, magnetic field magnitude and component.

We will show a cross comparison between ROSINA/DFMS and RPC data to interpret the ion composition variability. Our primary goal is to highlight any correlation between observations from these different sensors and to find relevant signatures of physical processes which can affect the chemistry and dynamics (e.g., acceleration and deflection) of the involved neutral and ion species.

Introduction

For two years, ROSINA/DFMS gave us the opportunity thanks to its high mass resolution to probe the neutral and ion species within 67P's coma. Analyses of the dataset have revealed strong day-to-day variations of the plasma composition through the entire mission.

Complementary to the ROSINA/DFMS ion dataset, the five sensors from RPC probed the properties of the plasma surrounding 67P.

In this study, we highlight and emphasise the strong correlation between the data from these different sensors and the necessity to perform further analyses all together.

Preliminary results

The first results already revealed a strong correlation between ROSINA ion data, the spacecraft potential from RPC/LAP and diamagnetic crossings identified by RPC/MAG.

Spacecraft potential: On the one hand, for a positive spacecraft potential, the spacecraft repelled ions such that they cannot enter into ROSINA/DFMS instrument to be detected. On the other hand, for a too negative spacecraft potential, incoming ions may earn too much kinetic energy close to the spacecraft so that they have a too high energy within the instrument to be detected.

Diamagnetic crossings: The cross-comparison between ROSINA/DFMS and RPC/MAG data showed that the ion count rate strongly increased when the Rosetta entered into the diamagnetic cavity, supporting which has been previously observed at 1P/Halley.