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Observations of cold electrons by RPC-MIP at 67P/Churuymov-Gerasimenko

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The Mutual Impedance Probe (MIP) of the Rosetta Plasma Consortium (RPC) onboard the Rosetta orbiter operated during more than two years from August 2014 to September 2016 in order to measure the electron density in the cometary ionosphere of 67P/Churyumov-Gerasimenko. This experiment is based on the resonance of plasma eigenmodes to detect the electron plasma frequency, itself directly related to the electron density. Recent models of mutual impedance probes [1,2] showed that in a two-electron temperature plasma, a double-resonance can be visible on mutual impedance spectra. This characteristic has been observed in-situ within the RPC-MIP data during the post-perihelion operation at all heliocentric distances (from 1.3 to 3.8 AU), corroborated the measurement of a mix of two electron populations done independently by the Langmuir Probes (RPC-LAP) [3,4,5].

For this study, we investigated the RPC-MIP dataset containing the characteristics of a mix of two electron populations in order to characterize the colder population observed by RPC-MIP during the cometary mission.

We show that the observation of cold electrons strongly depends on the latitude. Indeed, in the southern hemisphere of 67P, where the neutral outgassing activity was higher than in northern hemisphere during post-perihelion, the cold electrons were more presents which confirms the cooling of the electrons by the cometary neutrals. We also show that the cold electrons are mainly observed outside the electron-neutral collision dominated region (exobase) where electrons are expected to have cooled down which supposed that the cold electrons have been transported. Finally, RPC-MIP measured cold electrons far from the perihelion where the neutral outgassing activity is lower, which suggest that the collisional electron cooling is more efficient than previously expected.

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