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Plasma waves at comet 67P/Churyumov-Gerasimenko: in the diamagnetic cavity and outside it

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We present observations of waves at Comet 67P/Churyumov-Gerasimenko performed on 20 January 2015, when the activity of the comet was low, and in July and August 2015 when the activity had increased and the Rosetta spacecraft passed through the diamagnetic cavity several times.

We use distribution functions obtained by the Ion Composition Analyser of the Rosetta Plasma Consortium (RPC-ICA) and electron temperature estimates from the Langmuir Probes (RPC-LAP) to compute dispersion relations for waves on the ion timescale, and we compare the results to spectra obtained by RPC-LAP.

On 20 January 2015, at low activity, peaks of the wave spectra appeared at frequencies near 500 Hz, and we identify these waves as ion acoustic. We performed cross-calibrations between RPC-ICA, RPC-LAP, and the Mutual Impedance Probe (RPC-MIP) in order to determine the plasma density. Matching the dispersion relations to the wave observations also helps us estimating the density. We explore the relationship between the waves, the ion distribution functions, and the neutral density, which was measured by the ROSINA-COPS instrument. It is found that when the waves are seen, the ion temperature is low (approximately 0.01 eV). At times the ion temperature is higher (approximately 1 eV), approaching the electron temperature, which leads to strong damping of the ion acoustic waves. This happens when the neutral density is high, suggesting that the ions are heated by being accelerated by the solar wind electric field and scattered in collisions with the neutrals.

These results are compared to measurements of wave spectra when Rosetta was inside the diamagnetic cavity in July and August 2015. In the cavity, the plasma is effectively unmagnetised. We identify cavity passages using the magnetometer RPC-MAG. The waves are analysed in the same way as in the earlier measurements outside the cavity, and the two cases are compared.