Study of Plasma Waves Observed onboard Rosetta in the 67P/ChuryumovGerasimenko Comet Environment Using High Time Resolution Density Data Inferred from RPC-MIP and RPC-LAP Cross-calibration: Preliminary results

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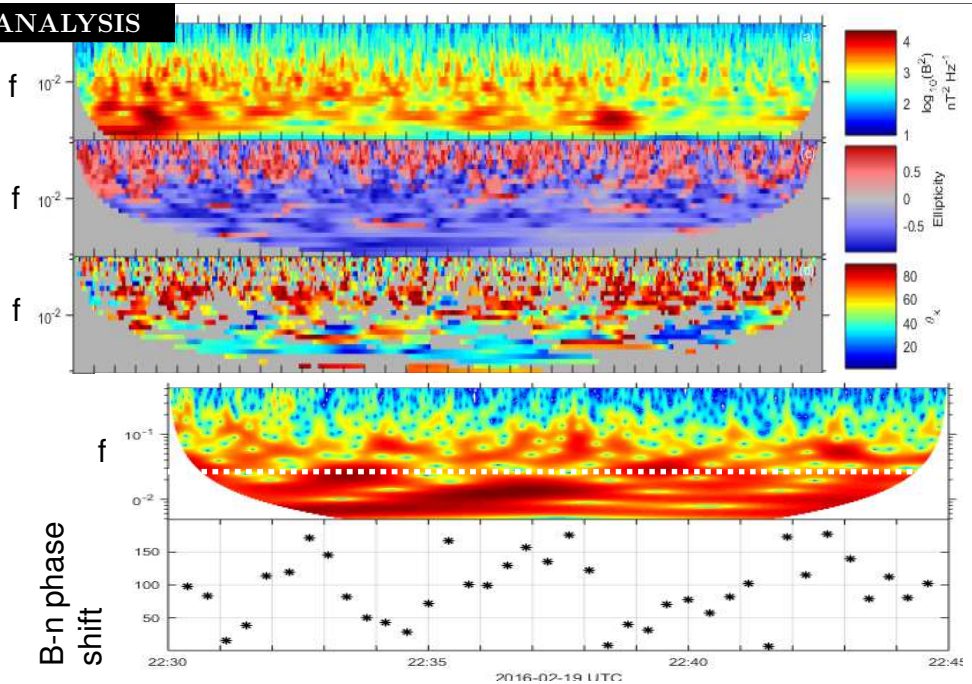
A. ABSTRACT

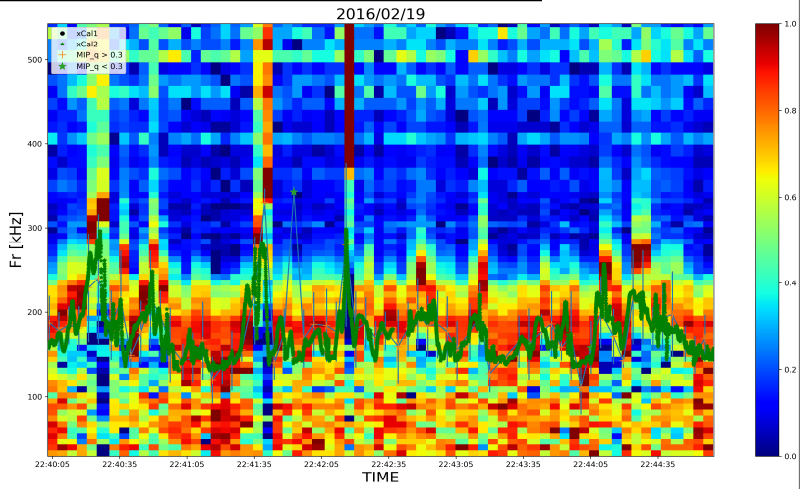
During two years, the groundbreaking ESA/Rosetta mission was able to escort comet 67P where previous cometary missions were only limited to flybys. This enabled for the first time to make *in situ* measurements of the evolution of a comet's plasma environment. The density and temperature measured by Rosetta are derived from RPC-Mutual Impedance Probe (MIP) and RPC-Langmuir Probe (LAP). On one hand, low time resolution electron density are calculated using the plasma frequency extracted from the MIP mutual impedance spectra. On the other hand, high time resolution density fluctuations are estimated from the spacecraft potential and ion current measured by LAP. In this study, using a simple spacecraft charging model, we perform a cross-calibration of MIP plasma density and LAP spacecraft potential or ion current variations to obtain high time resolution measurements of the electron density. These results are also used to derive the electron temperature, ion velocity and photoelectron current. Then we make use of these new dataset, together with RPC-MAG magnetic field measurements, to investigate for the first time the compressibility and the correlations between plasma and magnetic field variations of the "singing comet" waves observed in the plasma environment of comet 67P.

B. MIP-MAG WAVE ANALYSIS

- Electron density is derived from the resonance peak of the mutual impedance spectrum at plasma frequency
- Data is unevenly sampled in time thus no FFT possible
- We use Non-Uniform FFT ("NDFT") to study the magnetic and density fluctuations of singing comet waves



C. MIP-LAP CROSS-CALIBRATION



- High-time resolution density measurements: Cross-calibration of MIP with LAP high time resolution measurements
- One can retrieve electron temperature, ion velocity, photoelectron current

D. PRELIMINARY RESULTS / OPEN QUESTIONS

1. We study the properties of singing comet waves (Richter et al., 2015) using high-time resolution magnetic field and density measuremnts from Rosetta
2. The waves are observed to have a globally right-handed B polarization that can switch to linear within one wave packet, in agreement with theory (Koenders, 2016)
3. Phase shift between B and n is globally 180° that can switch to 0° within one wave packet, partially in agreement with theory (Volwerk, 2018, in prep.)