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Modelling and calibration of the mutual impedance experiments - Application to ESA's Rosetta Mission and preparation of BepiColombo and JUICE

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The RPC-MIP experiment onboard the ESA's ROSETTA orbiter have monitored the plasma activity around the comet 67P/Churyumov-Gerasimenko from Summer 2014 to the end of September 2016. In order to finalize the calibration of more than 2 years of mutual impedance spectra in the ionized environment of comet 67P/CG and to prepare the calibration of mutual impedance experiments onboard futures exploratory planetary missions (PWI/AM2P on-board BepiColombo and RPWI/MIME on-board JUICE), a modelisation of the electric potential generated by a pulsating charge is needed, that possibly takes into account the fact that space plasmas are out of local thermodynamic equilibrium, and therefore non-Maxwellian.

The physical model of interest is the linearized Vlasov-Poisson coupled equations. In previous works, these coupled equations are Fourier transformed both in time and space and treated in the cold are Maxwellian plasma. This work extends these previous approaches and relaxes the constraint on the cold or Maxwellian character of electron velocity distribution function, in order to account for departures from local thermodynamic equilibrium. We consider both (i) a two-electron temperature plasma and (ii) electrons described by a Kappa distribution function.

The electric potential is computed using a numerical integration over all wavenumbers. The main numerical difficulty is to take into account singularities of the dielectric function in the vicinity of the resonant modes. A method of grid refinement is therefore used. To tackle the large number of parameters to be explored (namely (i) density ratio, temperature ratio or (ii) kappa value), a parallel computation is implemented. Mutual impedance simulations are compared to RPC-MIP measurements in the ionized environment of comet 67P/CG.