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Hybrid Plasma Simulations of 67P/Churyumov-Gerasimenko

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The forthcoming arrival of the Rosetta spacecraft at the comet 67P/Churyumov-Gerasimenko requires the development of models of the cometary plasma environment in order to prepare the measurements of the experiments on board the spacecraft, especially measurements of the Rosetta Plasma Consortium (RPC).

Based on the unique design of the mission the experiments will recognise very different types of the interaction. In the early phase, the cometary activity will be low, the environment differs from the observations made by previous spacecraft missions, e.g. Giotto at comet 1P/Halley. At this stage, the cometary ions will be picked-up and move along a cycloidal tail and the comet triggers Mach cones. Later, the activity will rise and different plasma structures and boundaries will occur, e.g. the magnetic pile-up region and the diamagnetic cavity.

Since the behaviour of the different ion species differs from each other in the early stages, a single fluid description of the plasma is not appropriate. Moreover kinetic effects, like the ring distribution of the picked-up cometary ions, cannot be modelled in this framework. The hybrid model describes the ions as individual particles and is therefore able to describe these important aspects of the cometary plasma environment. In this paper we will present our latest model based on the A.I.K.E.F. (Adaptive Ion Kinetic Electron Fluid) code.
Next to the various chemical processes, which are modelled in the code, a hierarchical mesh is used to resolve the different structures on the smaller scales as well. In addition, we show different stages of the plasma environment of Churyumov-Gerasimenko with special focus on the inner Coma.