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# Evolution of the ion dynamics at comet 67P during the escort phase

**Zoe Lewis**[1], Peter Stephenson[2], Esa Kallio[3], Marina Galand[1], and Arnaud Beth[1]
[1]Department of Physics, Imperial College London, London, UK
[2]Lunar and Planetary Laboratory, University of Arizona, USA
[3]Aalto University, Helsinki, Finland

Comet 67P/Churyumov-Gerasimenko was escorted by the Rosetta spacecraft through a 2 year section of its 6 year orbit around the Sun. This enabled the observation of a large variation in comet outgassing and the resulting evolution of the plasma environment. The diamagnetic cavity, a region of negligible magnetic field arising from the interaction of the unmagnetised cometary plasma with the solar wind, began to be detected sporadically by the Rosetta Plasma Consortium/ Magnetometer (RPC/MAG) in April 2015 at a heliocentric distance of 1.8 au [1]. The last detections were in February 2016 at 2.4 au. Within this cavity, the flow of cometary ions has been shown to be largely radial [2]; the ions are accelerated above the neutral gas speed by an ambipolar electric field, but many newborn ions still undergo multiple ion-neutral chemical reactions before escaping [3,4]. Outside the diamagnetic cavity boundary, which is itself highly variable, the ion flow is considerably more complex, and the ambipolar electric field plays a more minor role compared to the convective electric field of the solar wind [2]. At large heliocentric distances (>2.5 au), the total plasma density observed from RPC plasma sensors is well explained by a simple flux conservation model that assumes the ions travel radially away from the nucleus at speed close to that of neutrals [5,6]. However, closer to perihelion and once the diamagnetic cavity has formed, such an approach does not hold [7]. We aim to better understand this transition, the driver of ions' acceleration, and the role that the diamagnetic cavity plays.In this study, we explore the varying ion dynamics both in the presence (e.g. during high outgassing activity) and absence (low outgassing activity) of a diamagnetic cavity. Electric and magnetic fields from hybrid simulations of the cometary environment are used to drive a 3D test particle model of the cometary ions for a range of comet activity levels. We model the behaviour of three key ion species, H2O+, H3O+, and NH4+, in order to assess the impact of the ion dynamics on the ionospheric composition and density.

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