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Ion-neutral coupling in cometary comae

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We discuss acceleration of ions by the ambipolar electric field in the diamagnetic cavity of a cometary coma. We challenge the view that ions are collisionally coupled to the neutrals throughout the cavity, arguing that the so-called ion-neutral decoupling distance i) can be severely reduced in the presence of a non-negligible ambipolar electric field and ii) is not to be viewed as a sharp limit where ion velocities start to depart from the neutral velocity. For a given potential profile it is possible to derive analytic expressions for the ion-neutral decoupling distance and to calculate ion speed distributions and mean ion velocities as a function of cometocentric distance. The outstanding issue is that the potential structure is not given and not easily assessed either. Recently developed strategies to infer from MIP- and LAP data the relative abundances of cold versus warm electrons may give some constraints on the potential profile. In the scenario of a very dominant cold electron population the ambipolar electric field would be very low. In such a case there would, within the cavity, be no field to accelerate the ions. The ions would then move outward with the same bulk velocity as the neutrals, and there would in principle be no reason to attribute this to ion-neutral collisional coupling.