Determining the ion velocity in the inner magnetosphere of comet 67P/Churyumov–Gerasimenko using Rosetta IES measurements

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Determining the ion bulk velocity is essential to understand the physics of the inner magnetosphere of comets. This velocity controls the strength of the ion-neutral drag force, which plays a very important role in the energy and momentum transfer processes of that region. Unfortunately there are no direct measurements of this quantity available. The energy thresholds of the ion instruments on board the Rosetta orbiter would prevent the direct detection of the bulk ion content of the plasma as long as the plasma is relatively slow and cold. The picture is further complicated by the spacecraft potential, which accelerates the thermal ions to energies higher than the measurement threshold, but effectively screens the magnitude and direction of their original velocity. That distortion effect is not arbitrary however; it is possible to recover the original ion velocity distribution from IES measurements by simulating the effects of the spacecraft potential on the ion motion. We performed these simulations for several bulk and thermal velocity as well as spacecraft potential values, and compared the results with IES measurements. From this we could determine the most probable values of the bulk and thermal speeds of the plasma ions in the inner magnetosphere of comet 67P/Churyumov–Gerasimenko.