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Rosetta observations of solar wind deflection in the coma

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Until recently, study of the solar wind around comets was limited to remote observations and brief in-situ encounters. With the arrival of Rosetta at the comet Churyumov-Gerasimenko (CG), we have had near constant solar wind observations at the comet for over 6 months. This is an unprecedented opportunity to study this dynamic interaction over time.

Neutral atoms produced by the comet become ionized through photoionization or charge-exchange with the solar wind. The freshly ionized particles experience v x B electric field and begin to gyrate around the interplanetary magnetic field. Currently, CG is $\sim$2.6 AU from the Sun, and as of this writing, neutral production is still relatively low. Consequently, most pickup ions are produced locally (< few hundred kilometers), and a diamagnetic cavity may not exist. Moreover, neutral production is variable and changes over the comet's rotational period.

We find the following: 1) The solar wind is heavily deflected near the comet (in some cases >45º away from the anti-sunward direction). 2) The solar wind helium experiences less deflection than the protons. 3) The periodicity of the deflection is highly variable, and can vary over minutes or hours.

From these results, we conclude that the solar wind is deflected by a mechanism very close to the comet. We suggest the following possibilities: 1) The solar wind could be deflected by a Lorenz force in the opposite direction to that experienced by the pickup ions, which would also conserve the momentum of the two fluid system. This would explain why solar wind protons are more strongly deflected than the heavier alpha particles. Additionally, this would explain the periodicity of the deflections, which would react to changes in the interplanetary magnetic field. 2) The solar wind deflection might occur from strong charging of comet's nucleus. In which case, the nucleus may charge both positively or negatively. The nucleus could charge positively due photoionization of the surface, but could also charge negatively due to the high electron fluxes that are regularly observed. This mechanism might also explain the preferential deflection of lighter ions and the variable periodicity of the deflection.