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Mass loading of the solar wind near comet 67P at low activity

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Abstract

Analyzing data from the ion sensor RPC-ICA flying on the european spacecraft Rosetta, we study the dynamics of the interaction between the solar wind ions and a partially ionized atmosphere around a comet, further than 2 AU away from the Sun. We give a close picture of this interaction with a first case study, to then consider the whole low activity period through a statistical study, and characterize the time evolution of this dynamics.

1. Overview

The Rosetta mission reached comet 67P/Churyumov-Gerasimenko early August 2014, at a distance of 3.65AU to the Sun as 67P was heading to its perihelion. Data presented here are collected between 3.65 to 2 AU by the Rosetta Plasma Consortium Ion Composition Analyser (RPC-ICA) [2], when the comet was still presenting a low activity case. The atmosphere of 67P at low activity is permeated by the solar wind, the plasma boundaries (bow shock, ionopause) of larger objects such as planet ionosphere are not yet observed. As long as such structures are not formed, mass loading remains the main mechanism through which the comet atmosphere affects the solar wind [4] (Figure 1).

2. Case study

Using data from the 28th of November 2014, we go into details in this dynamics, on a short time scale ($10h$, $192s$ resolution) [1]. We compare flow directions from solar wind and cometary accelerated water ions, and local magnetic field direction, and diagnose the different correlations between those directions. We find that solar wind ion deflection and water ion acceleration is controlled by the convective electric field as expected for mass loading. The solar wind is deflected as depicted in Fig. 1, not flowing around the obstacle. The two flow components orthogonal to the sun line are opposing each other. A surprise is that the accelerated water ions have a dominating component of their flow velocity in the anti-sunward direction: the flow is directed very close to the sun line.

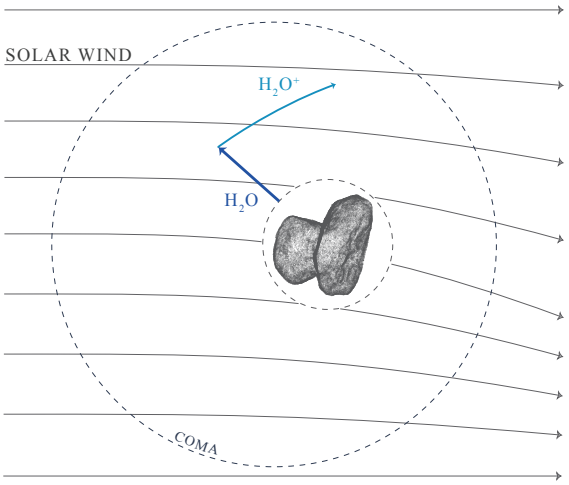

Figure 1: Illustration of the simplified interaction involving mass-loading .

Observations for this case study are made on a $30km$ terminator orbit, at $2.88AU$ away from the sun.

3 Statistical study

We produce statistics about the same interaction over a period of low activity, starting beginning of August 2014. We compute the deflection angle and the energy for solar wind protons and alpha particles, and study the influence of the plasma environment (ion densities, magnetic field amplitude).

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this study would be impossible. Sharing data within RPC is made possible by the web-based interface AMDA, developed and made available for RPC use by Centre de Donnees de la Physique des Plasmas (CDPP). This easy and efficient interface has been of a great use for this work.

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