The Sun, planets, magnetosphere and plasma physics: Small bodies in the Solar System

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Voyager 2050 Workshop, Madrid, 29-31 Oct, 2019

White Papers submitted in Solar System Small Bodies area

- AMBITION - Comet Nucleus Cryogenic Sample
- Cometary Plasma Science
- GAUSS - A Sample Return Mission to Ceres
- Sample return of primitive matter from the outer Solar System
- (Son of Giotto)

Cometary Plasma Science

Further questions?
Find this person during coffee break
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Cometary plasma itself is worth investigating further

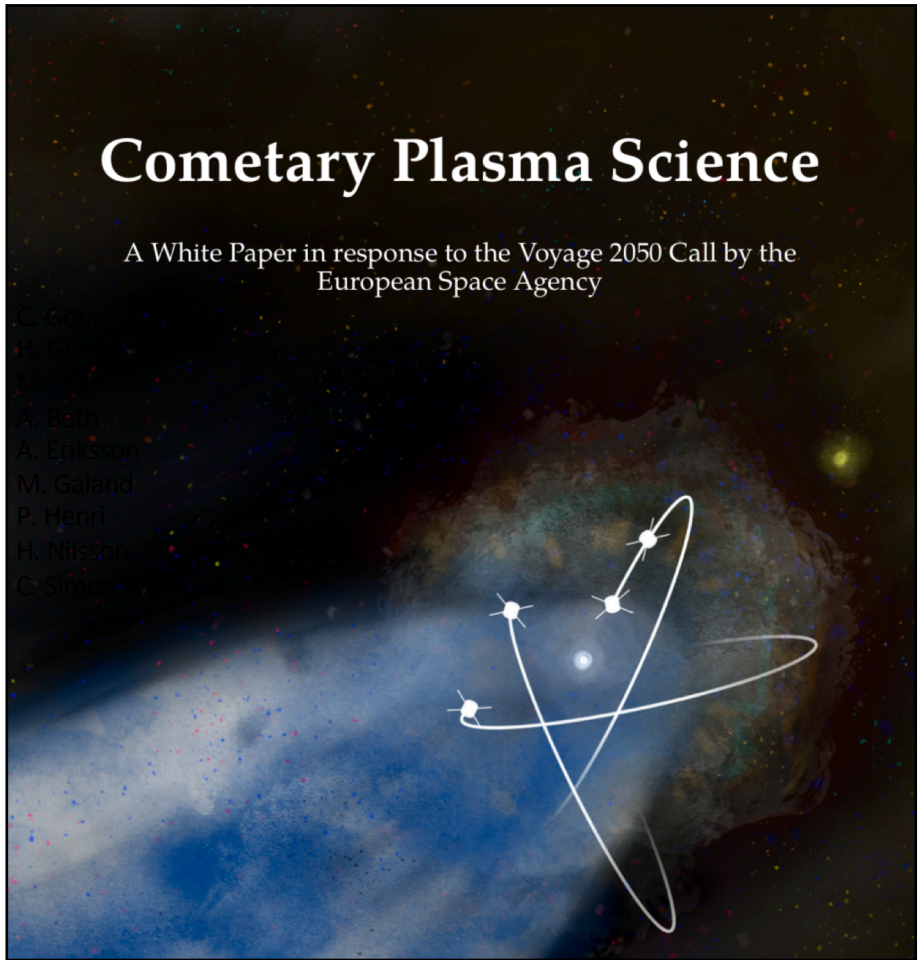
Large scale asymmetries due to ion gyro radius much larger than typical length scales

- Significant influence of collisions and chemistry
- Many open questions remain after Rosetta
  - What forms the diamagnetic cavity?
  - What is the cause of tail disconnection events?
  - Which boundaries really exist during a comet's journey through the solar system?
  - What is the role of charged dust in the coma?

Comet as a plasma laboratory

- Exploring a comet's environment can also help to understand other environments (e.g. terrestrial planets, ice giant moons etc)
  - How do collisions affect the large scale processes in a plasma?
  - How are energy, mass, momentum transferred on scales smaller than ion gyro radius?

Mission requirements: multi-point measurements with large and wide cometocentric distance variations



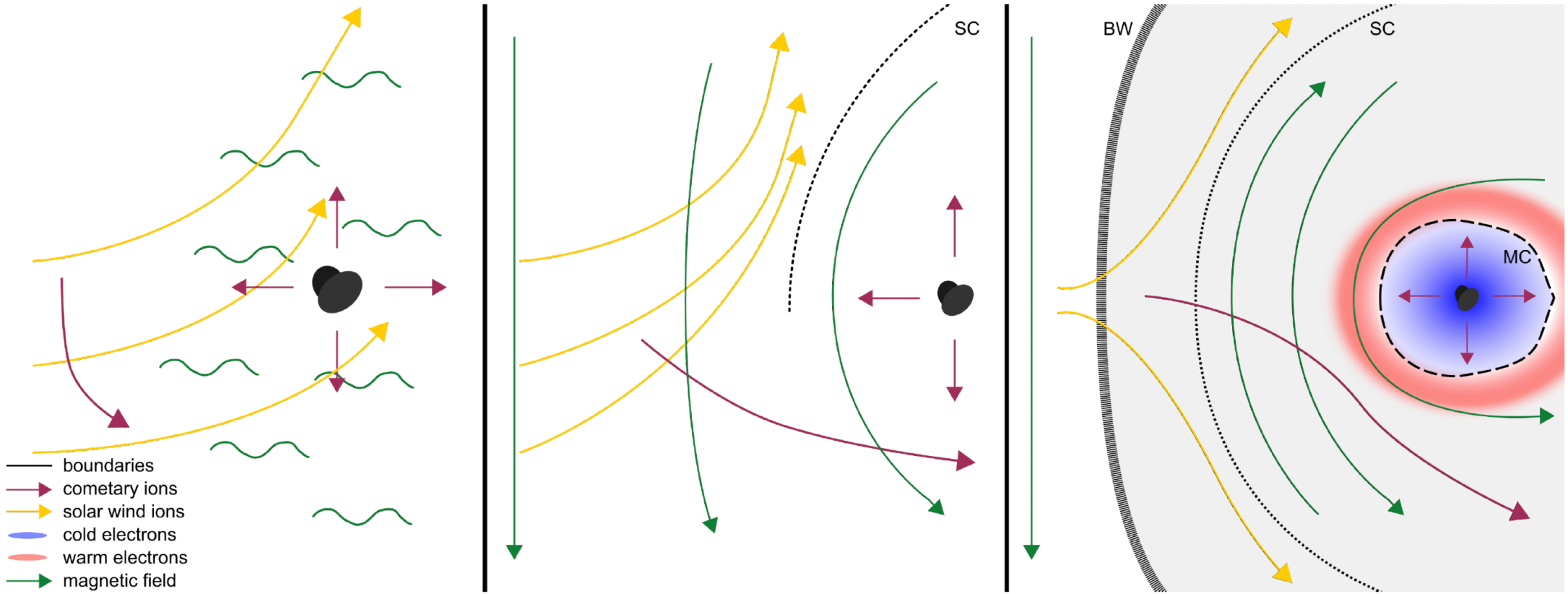
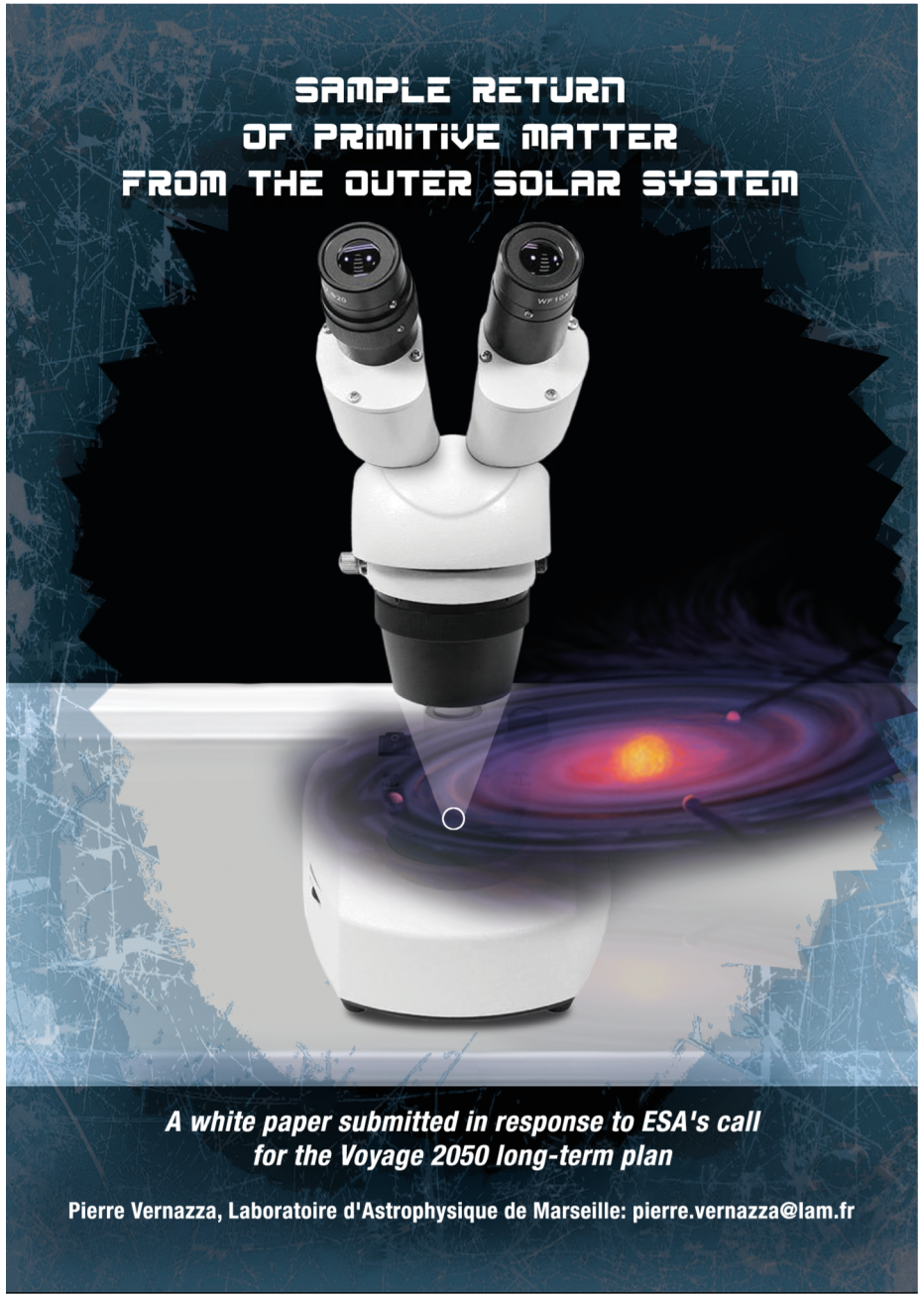


Figure 1.1: *A sketch of the cometary plasma environment in the plane containing the magnetic field and the solar wind flow. The three panels show different stages, left: weak activity, middle: intermediate activity, right: high activity. Boundaries and regions are labelled: bow wave (BW), solar wind ion cavity (SC), and diamagnetic cavity (MC). Adapted from Götz (2019).*


SAMPLE RETURN
OF PRIMITIVE MATTER
FROM THE OUTER SOLAR SYSTEM
A white paper submitted in response to ESA's call
for the Voyage 2050 long-term plan
Pierre Vernazza, Laboratoire d'Astrophysique de Marseille: pierre.vernazza@lam.fr

A collective brainstorming exercise between ground and space observers and astro/cosmochemists identified the following top-level science objectives that justify a sample return mission of a primitive small body:

- What is the path to an inhabited planetary system?

- What were the initial ingredients of the Solar System and how were these ingredients distributed around the young Sun?

- What is the fraction of presolar material that survived until today in outer Solar System bodies?

- How diverse was the origin of the starting materials and what was the environment of the pre-solar cloud core?

- What is the pathway of life-forming elements (C,H,N,O) from the interstellar medium to the Solar System?

- How and when did planetesimals accrete in the outer Solar System?

3) Extra-terrestrial samples: a partial and biased view of Solar System building blocks

The suite of extra-terrestrial materials offers a unique opportunity to study early Solar System processes in the laboratory, and to understand the nature of the small bodies population. Still, the science value of these samples is dependent on our understanding of where they come from (parent bodies) and whether or not they sample all reservoirs of early Solar System materials.

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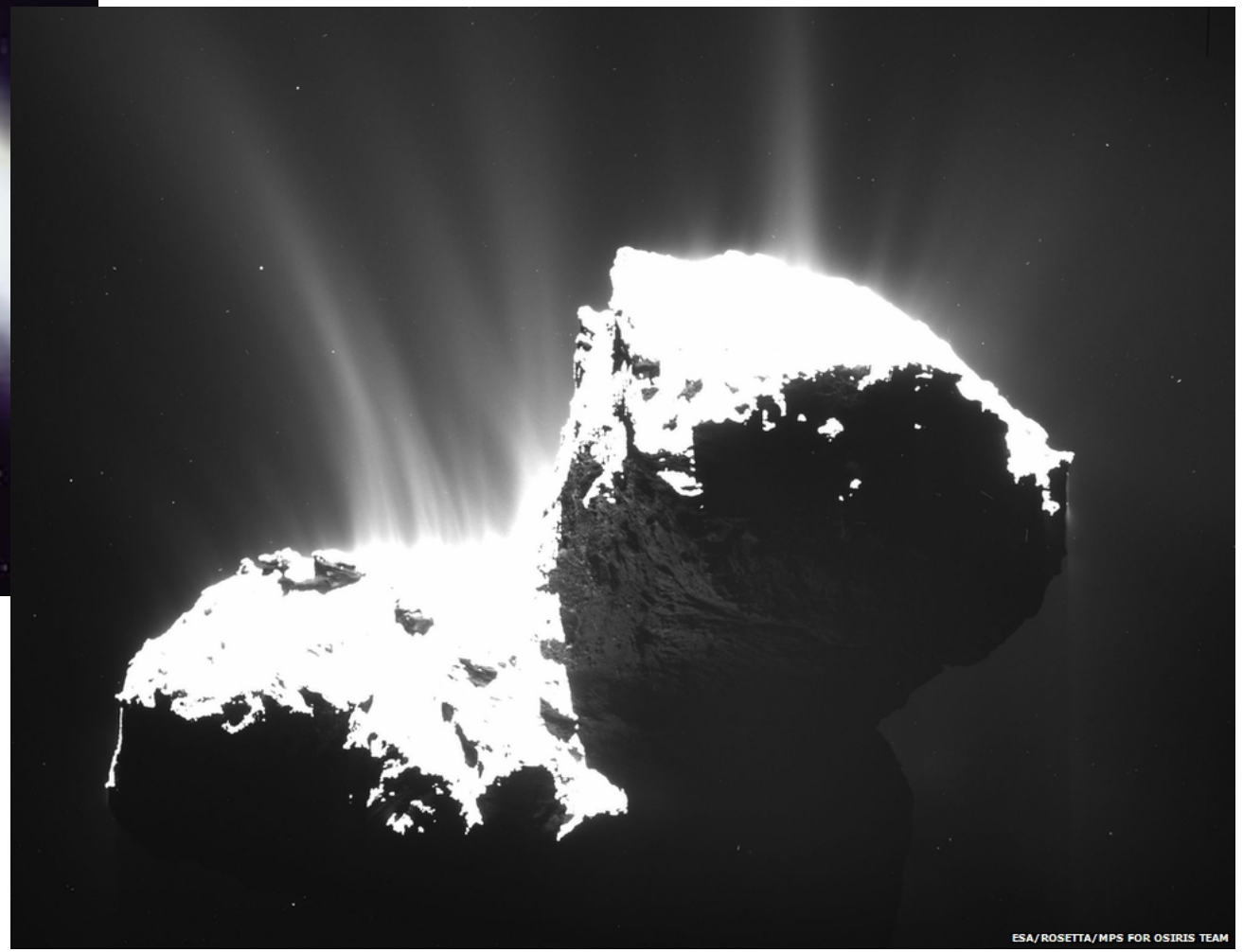
ESA/ROSETTA/MPS FOR OSIRIS TEAM