Solar wind dynamics in the environment of comet 67P

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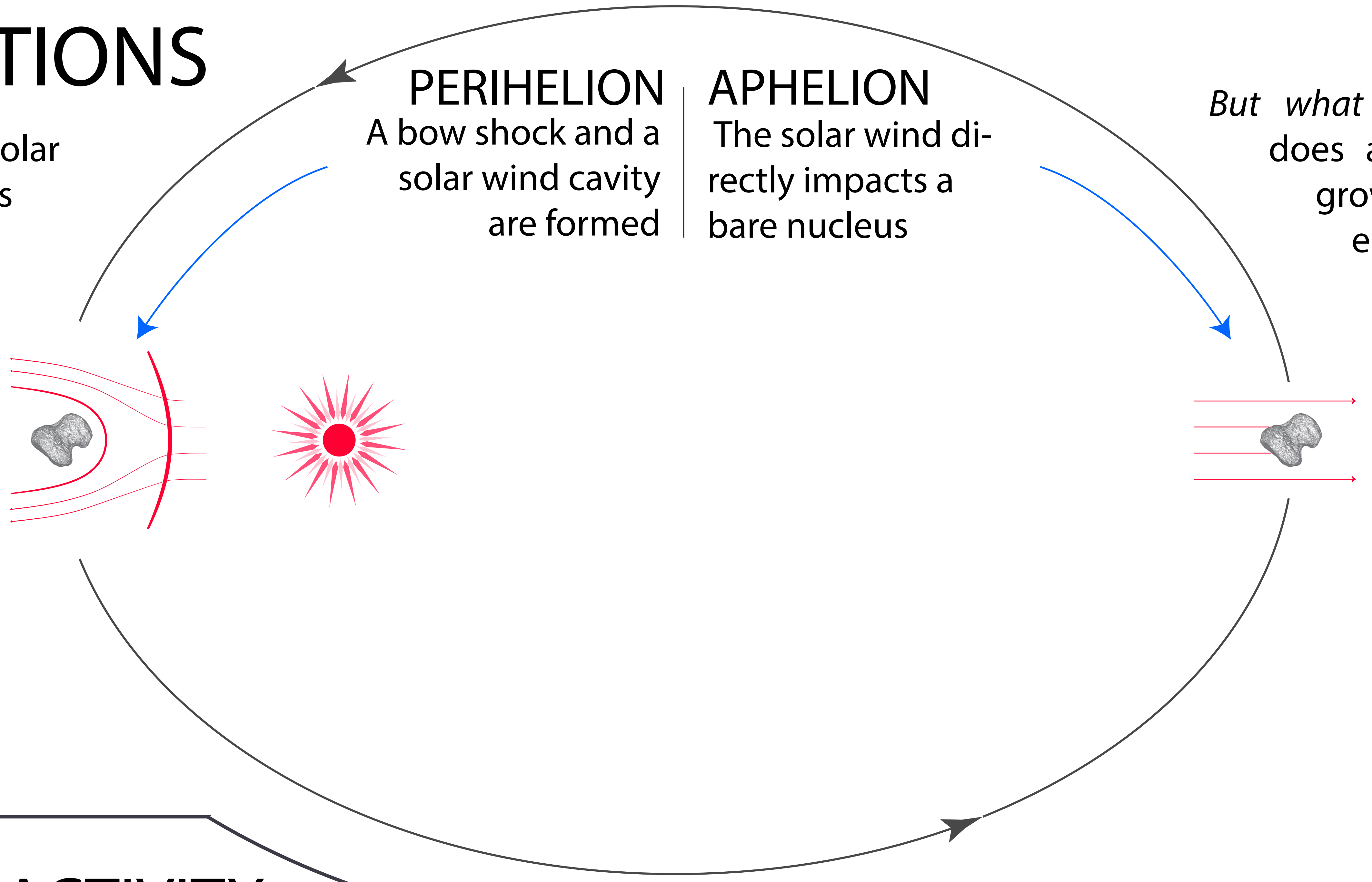
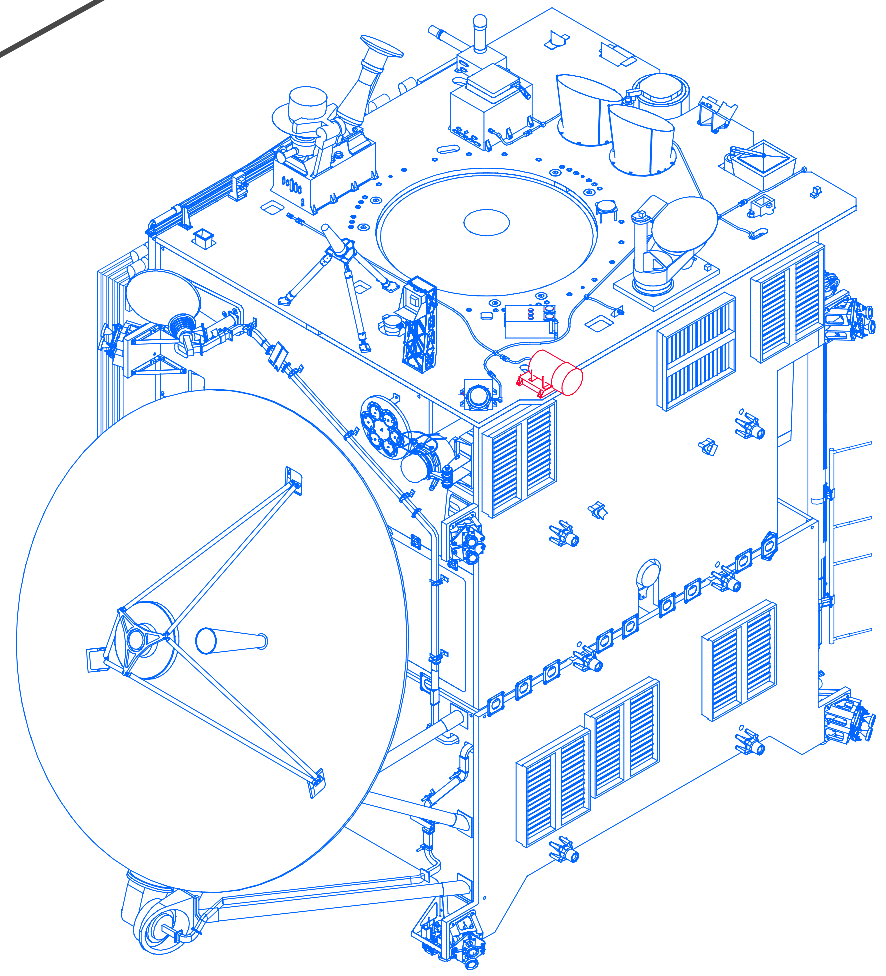
CONTEXT AND QUESTIONS

In the study of the interaction between the solar wind and bodies of the solar system, there is one more parameter to consider for comets, compared to planets and moons: the distance to the Sun. The impact of this parameter on the solar wind dynamics around a nucleus is huge. We know that most of the comet present an atmosphere-less nucleus to the solar wind at aphelion, and an extended and dense coma at perihelion.

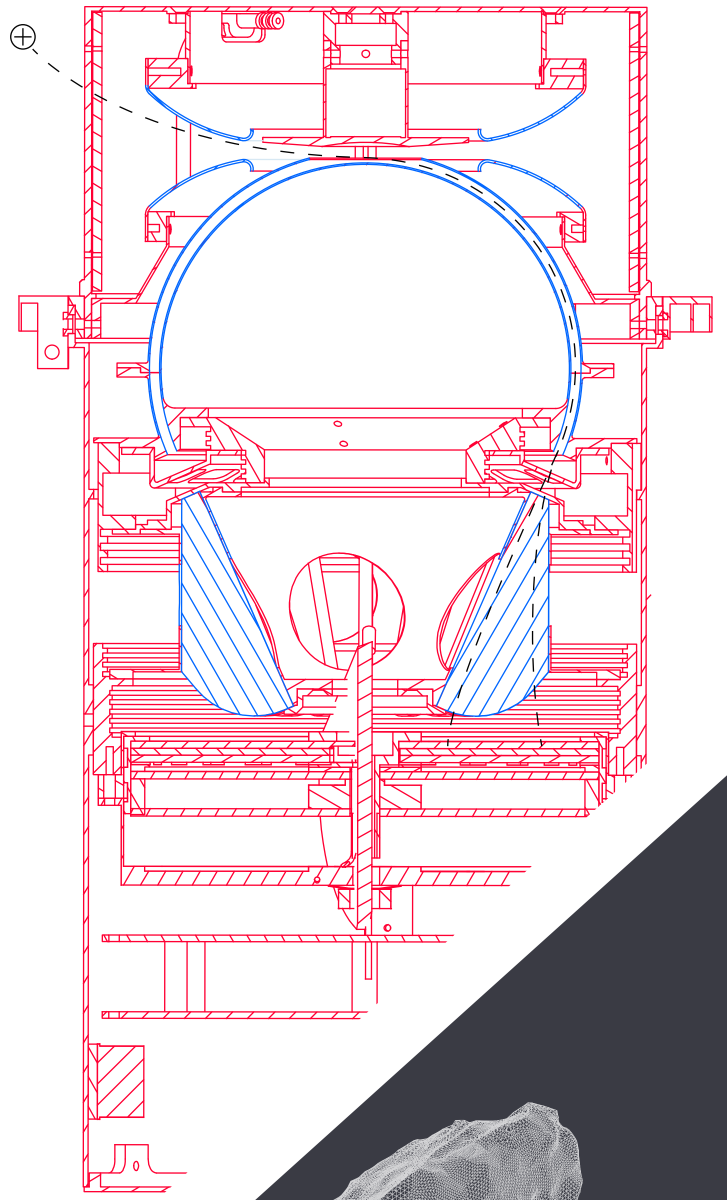


But what happens inbetween? How does a solar wind cavity form and grow, out of nothing, to a large and established cavity? For two years, *the European Rosetta mission* provided the ideal observation conditions for this precise topic.

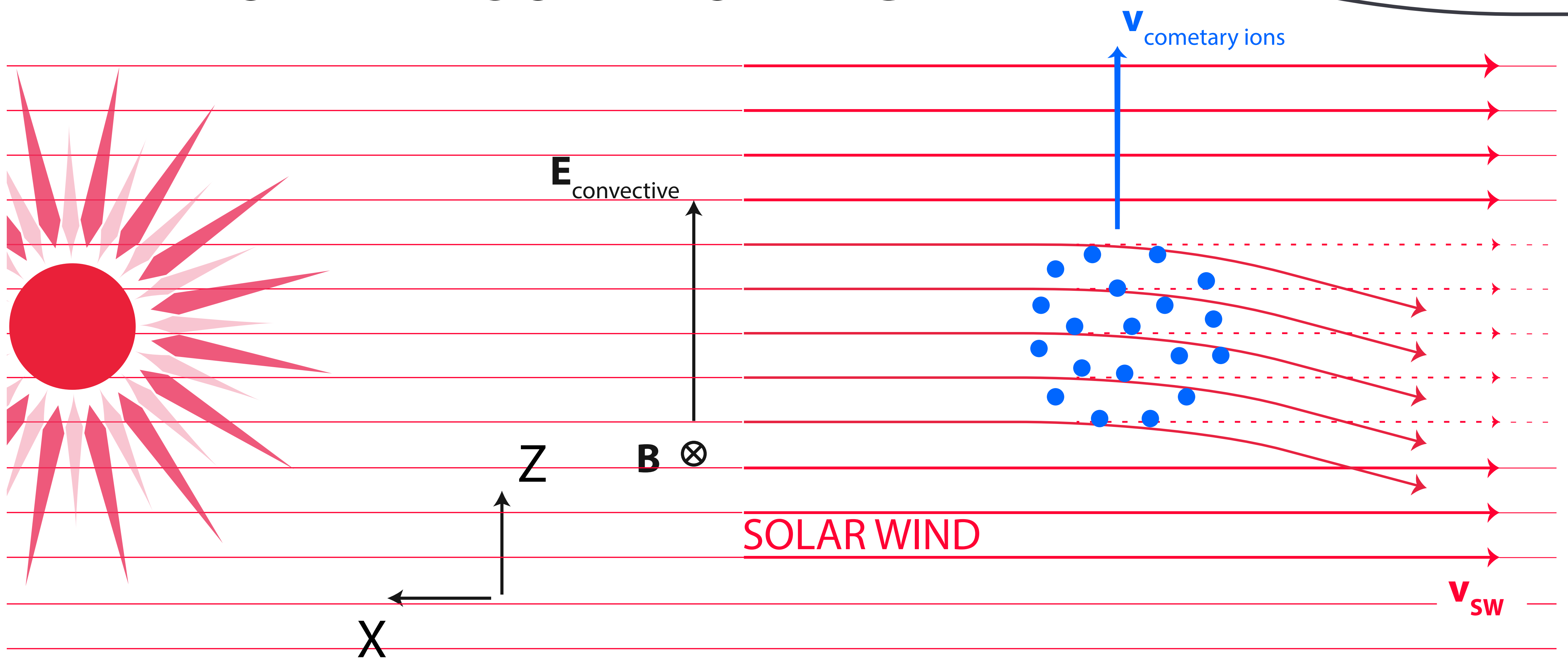


INSTRUMENT

The Ion Composition Analyzer
Rosetta Plasma Consortium RPC-ICA:
E: 10 eV - 40 keV
FOV: 90x360 °
Cadence :192 s
M: 1, 2, 4, 8, 16 and 32 amu/e

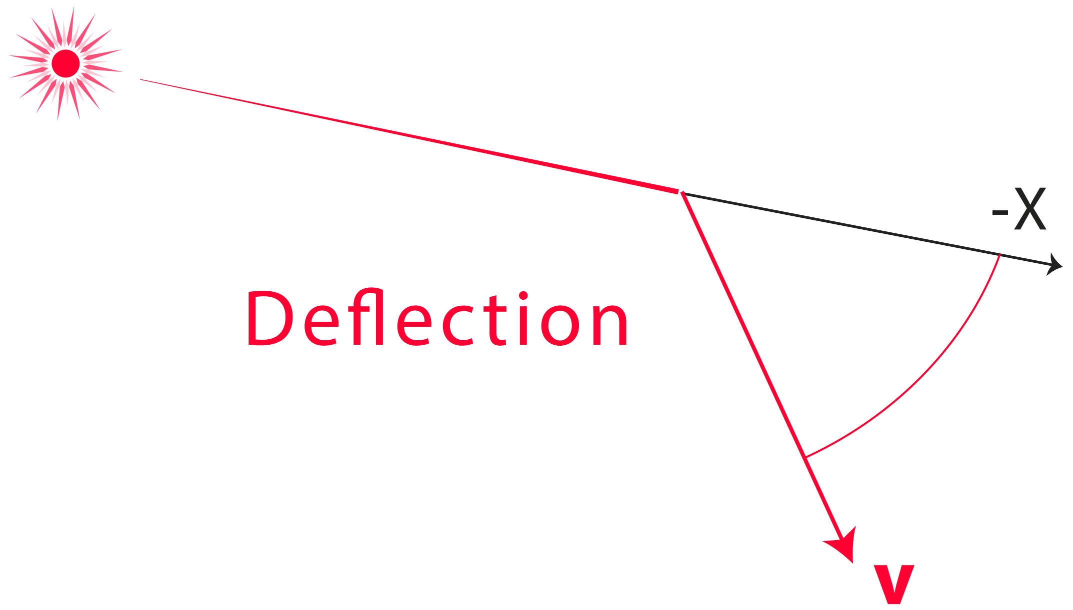


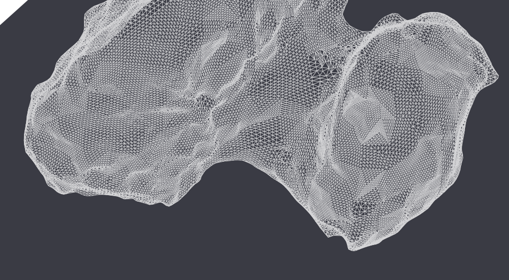
FAR FROM THE SUN - LOW ACTIVITY

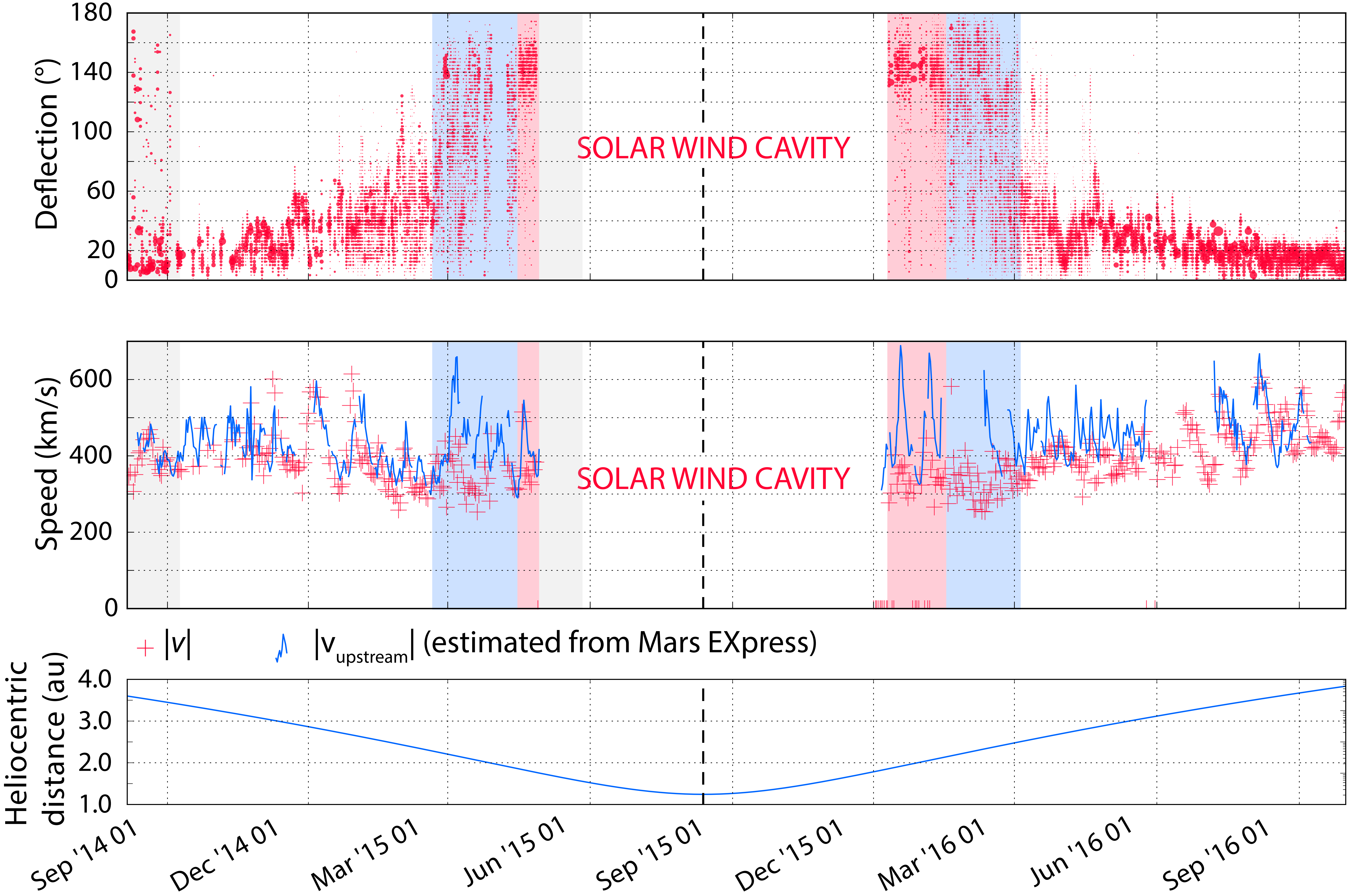


When sublimation and ionisation start: cometary ions are accelerated by the convective E-field, the solar wind loses the momentum and the enrgy gained by the cometary population. Two effects are expected on the solar wind:

- DEFLECTION
- DECELERATION







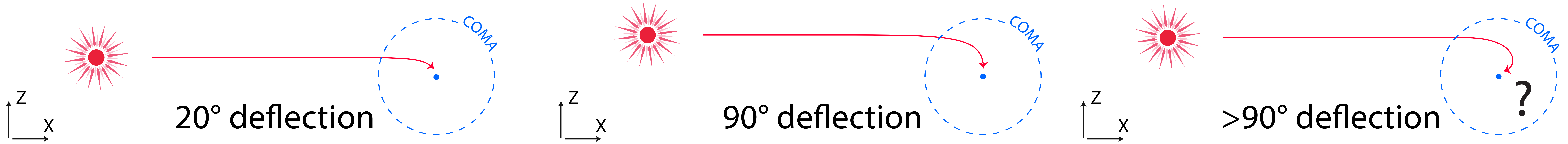
OBSERVATIONS
Proton bulk properties

- Deflection is in fact observed, but surpisingly up to 180°

- Clear solar wind cavity (>7 months, centered around pe-rihelion)

- Deflection gets more and more spread, before refocusing at ~140° just before and after the cavity

- Little deceleration observed



Velocity space Differential flux
(#/s/cm-2/sr/eV)
2014-08-06 - 3.6 au
2014-11-22 - 2.9 au
2015-03-19 - 2.1 au
2015-04-20 - 1.8 au
500
0
−500
v_z
v_z (km/s)
v_x
Heliocentric distance
OBSERVATIONS
VELOCITY SPACE
3.6 au
Deflection: 10-20°
Deceleration: none
Almost undisturbed
solar wind
2.9 au
Deflection: 40-50°
Deceleration: none
2.1 au
Deflection: 45-135°
Partial ring distribution
Deceleration: small
1.8 au
Deflection: 120-160°
Deceleration: small
Measrued just before
entering the solar
wind cavity
INTERPRETATION
PHYSICAL SPACE
Heliocentric distance
Z
X
ZOOM-IN
CAVITY
Terminator
plane
Proton trajectories
Nucleus position
SUMMARY
- *Macroscopically*, the solar wind is:
deflected and decelerated (v_{bulk})
- *Microscopically*, the solar wind is:
well ordered, single particles
gyrate without losing much
energy (v_{mean}).