

Was BepiColombo's second swingby the first ever passage through the southern plasma ring?

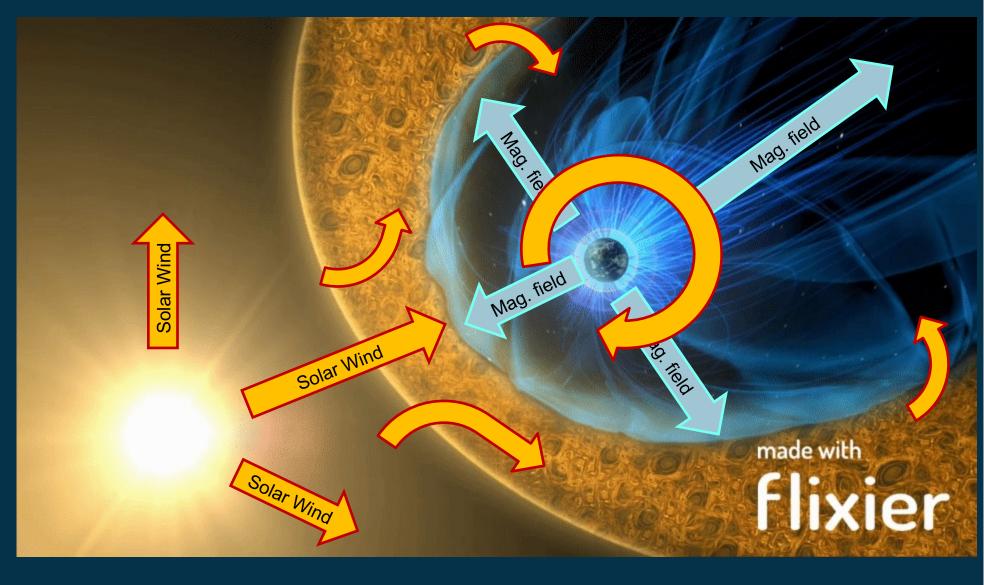
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SSW24 Aranjuez 21/01/2024

Quick Explanation: What is a Magnetosphere?

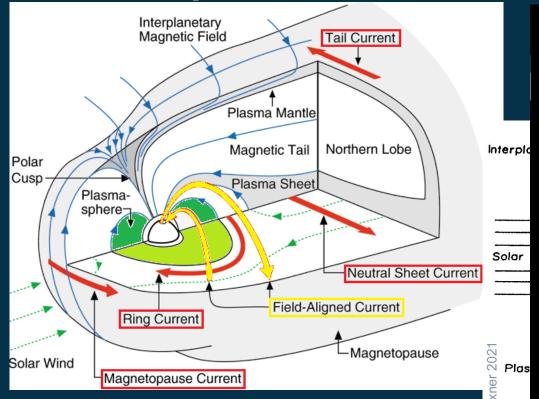


- The Magnetosphere pressure balance between the planetary magnetic field and the Solar Wind
- Solar Wind: hot plasma emitted from the Sun → gets shocked at Bow Shock
- Inside
 Magnetosheath →
 Plasma decelerates,
 heats up and is
 deflected around the
 Magnetopause the
- Plasma then diffuses into magnetosphere and fills Plasmaring

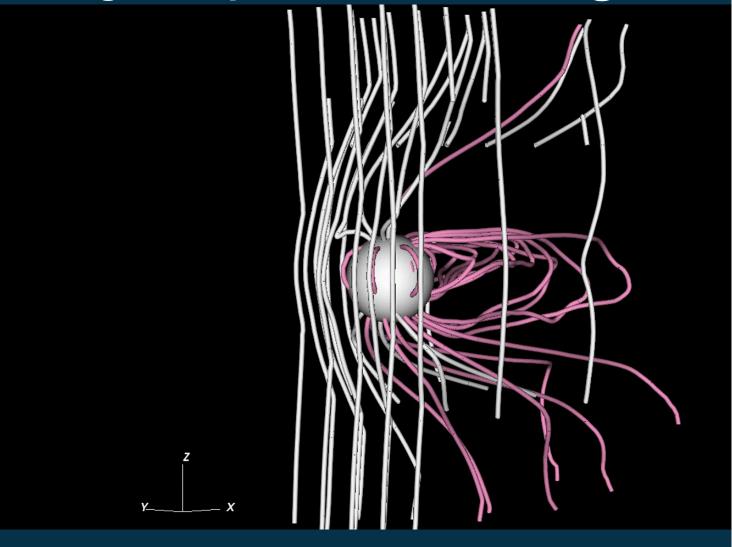


Quick Explanation: What is a Magnetosphere?





- Intricate system
 of electric
 currents, plasma
 flows,
 momentum
 transfer
- But Mercury
- Smaller magnetic field strength
- → Scaled model ok, but what about plasma ring or other currents? S/C coverage??



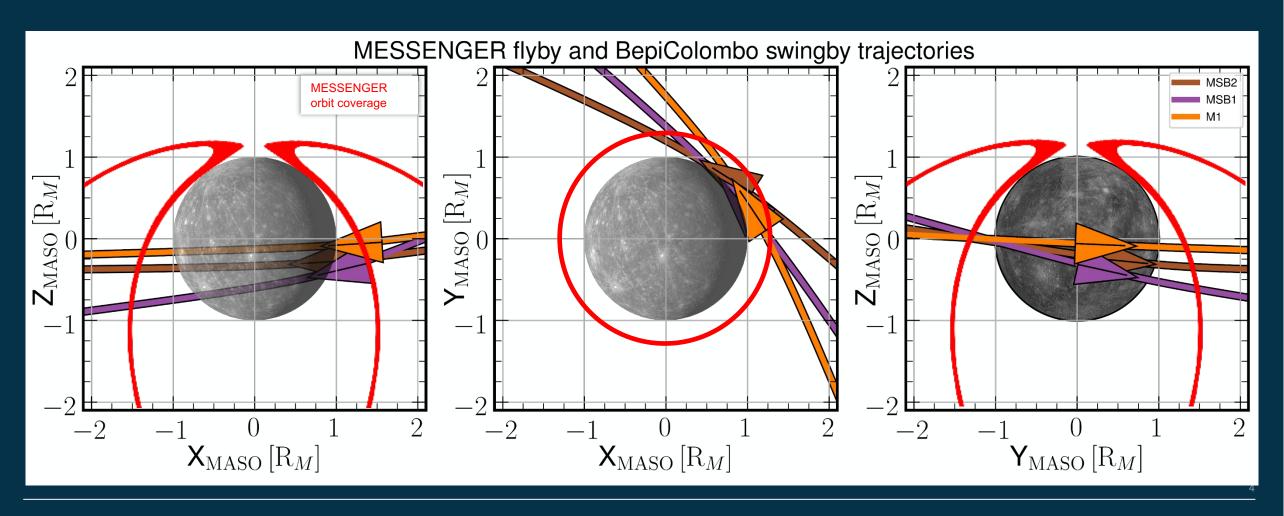
Challenge: Theory vs Numerical Modeling vs Observations

Swingby Trajectories



MSB2 trajectory below geographic equator

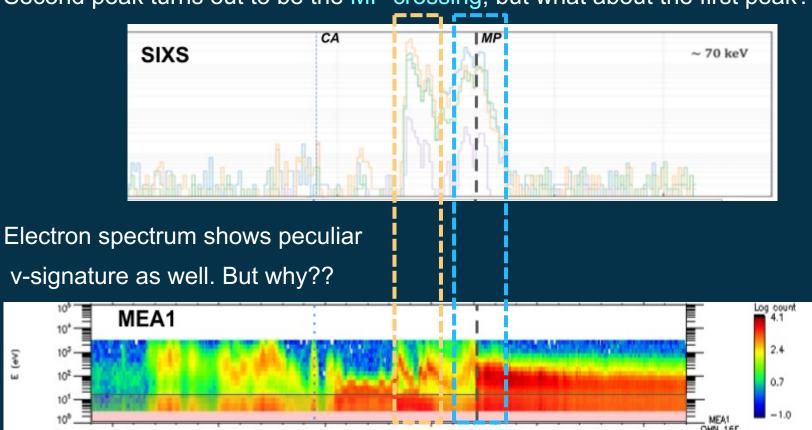
→ What magnetospheric regions do we cross?



V-Shape signature observed along MSB2



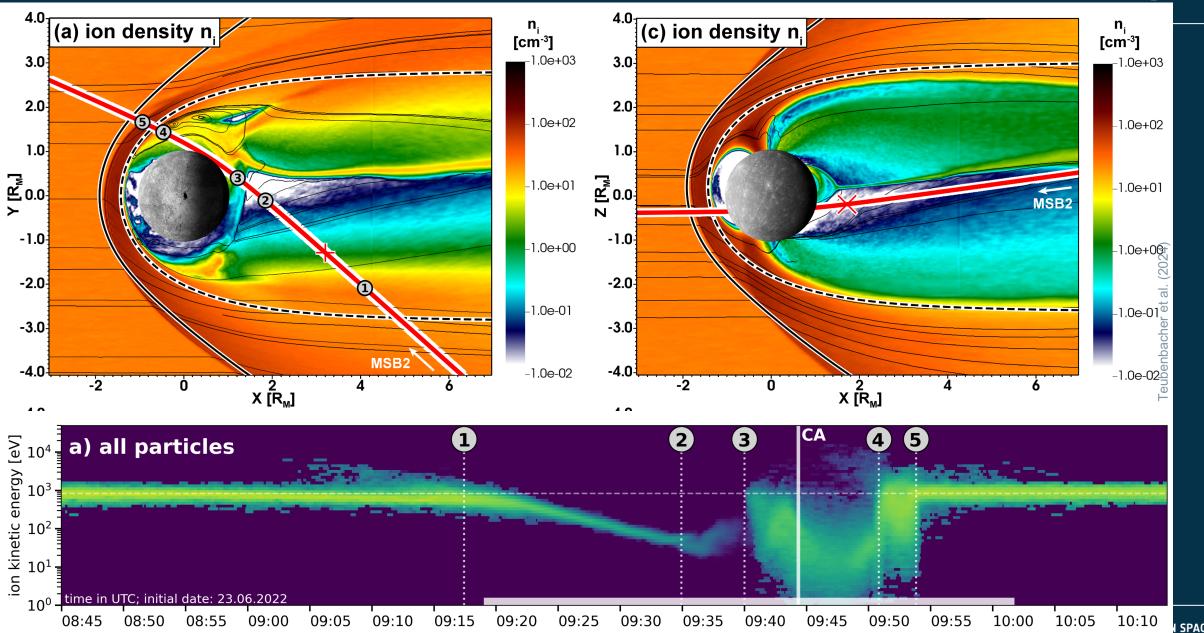
Observations of Electron Flux along MSB2 yields a v-shaped signature Second peak turns out to be the MP crossing, but what about the first peak?





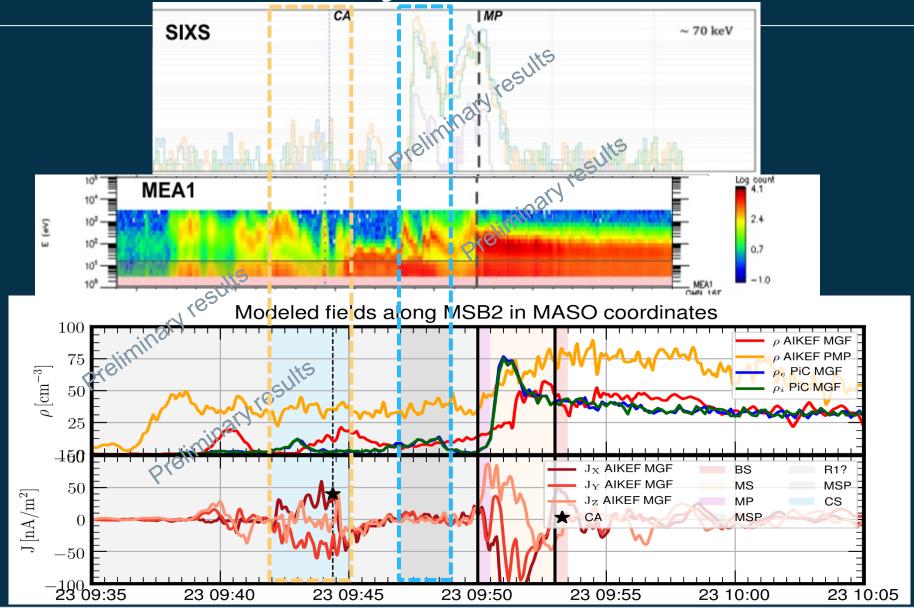
Model Results by AIKEF Code, XY- and XZ-Planes





SIXS-P VS MEA VS Hybrid and PiC





Southern Skimming of the plasma sheet

- Current density signature

MP and BS crossing okay - Current density signature

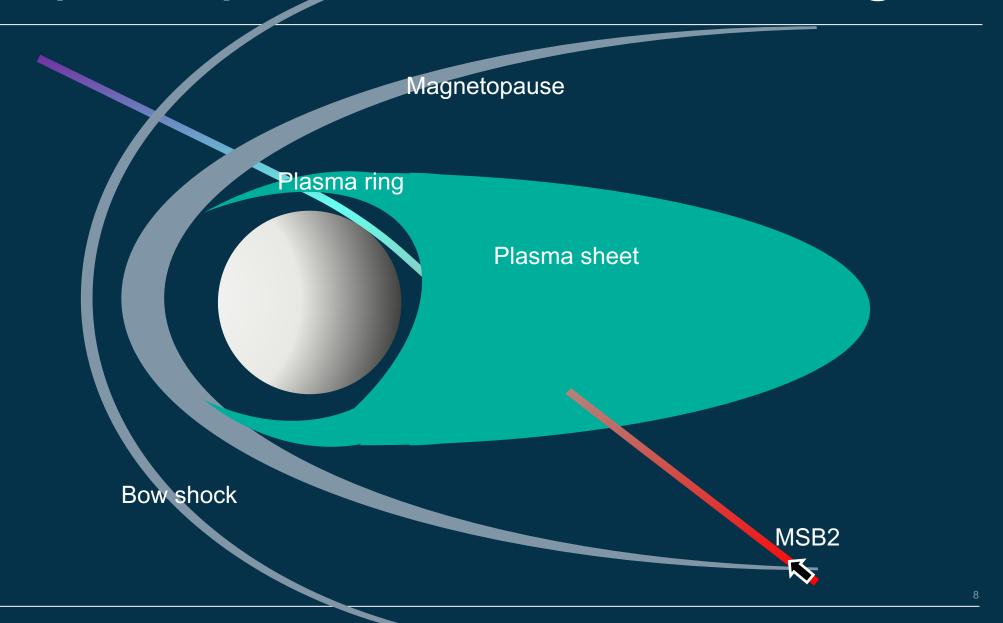
Modeled Density enhancement in Protons and Electrons: Most likely first ever crossing of the southern, dayside plasma ring!

No Current density!

IMF dependency of plasma density along the trajectory

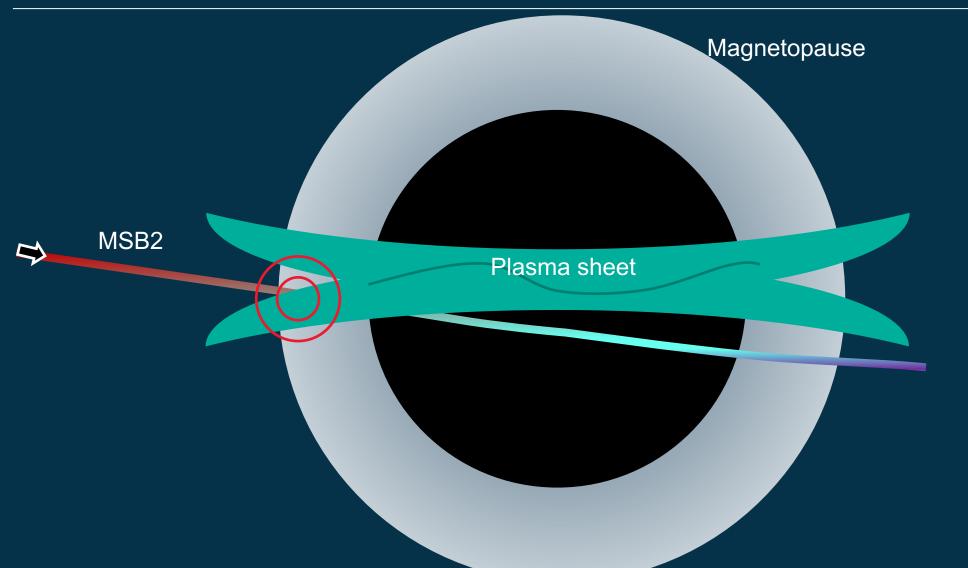
Sketch of the equatorial plasma distribution





Sketch of the YZ-plasma distribution at X = 2RM





Inbound passage of Magnetosheath

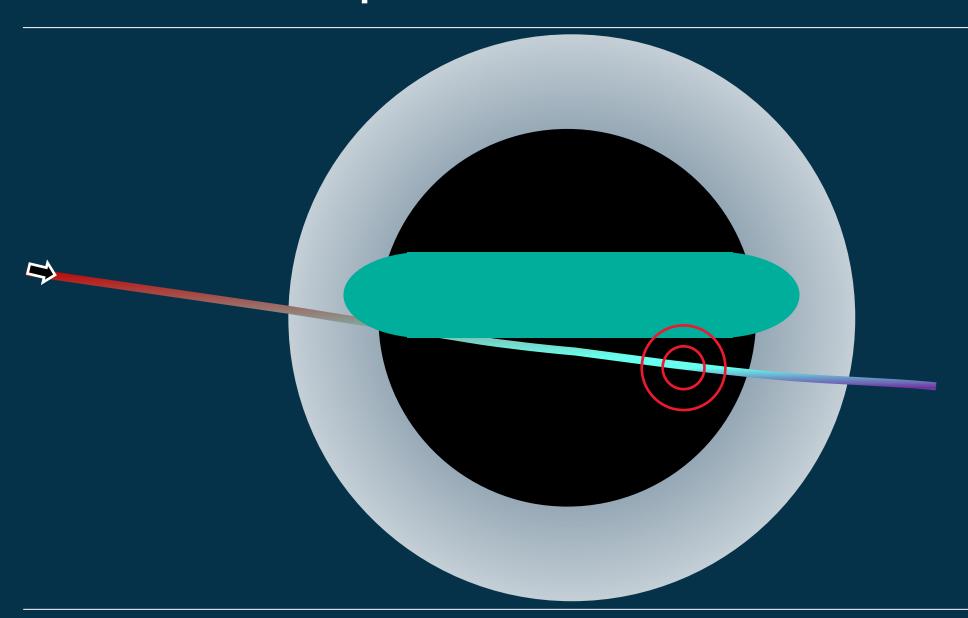
Crossing of plasma sheet on the duskside into southern tail lobe

(Z location of current sheet dependent on upstream IMF Bx (Daniel's Talk)

Inclination/Warping/Twis ting dependent on IMF BX, By and Bz)

Sketch of the YZ-plasma distribution at X = 1.2RM

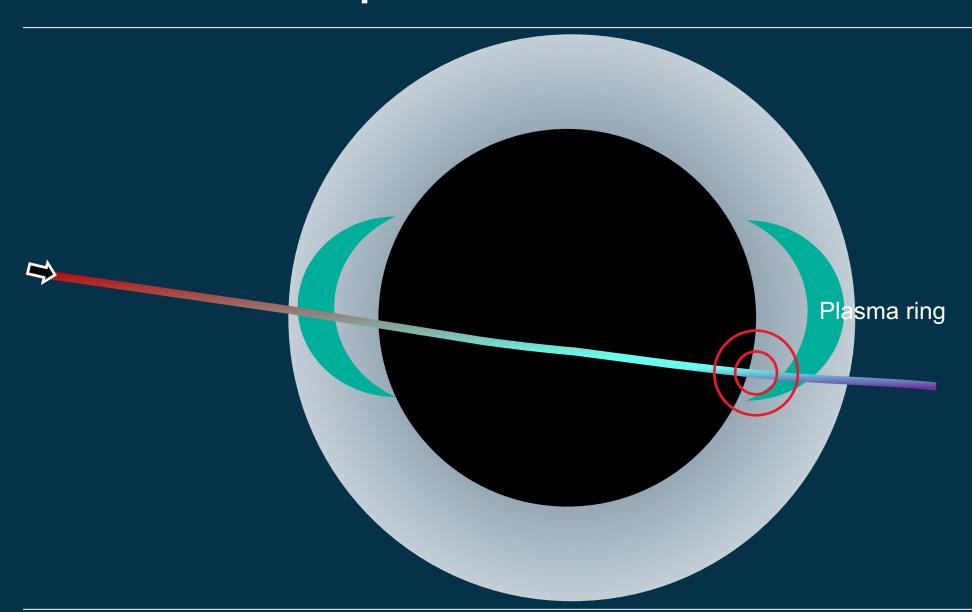




Skimming of inner southern plasma sheet boundary / beginning of Plasma ring → Still some plasma density but low values

Sketch of the YZ-plasma distribution at X = 0.0RM

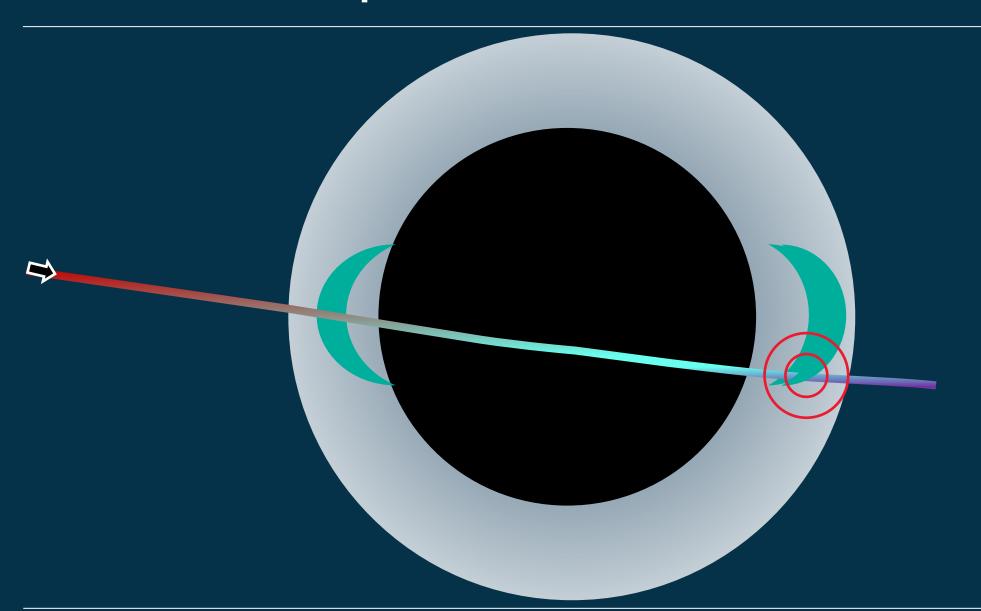




Passage of the no-density zone between Mercury's surface plasma ring

Sketch of the YZ-plasma distribution at X = -0.6RM



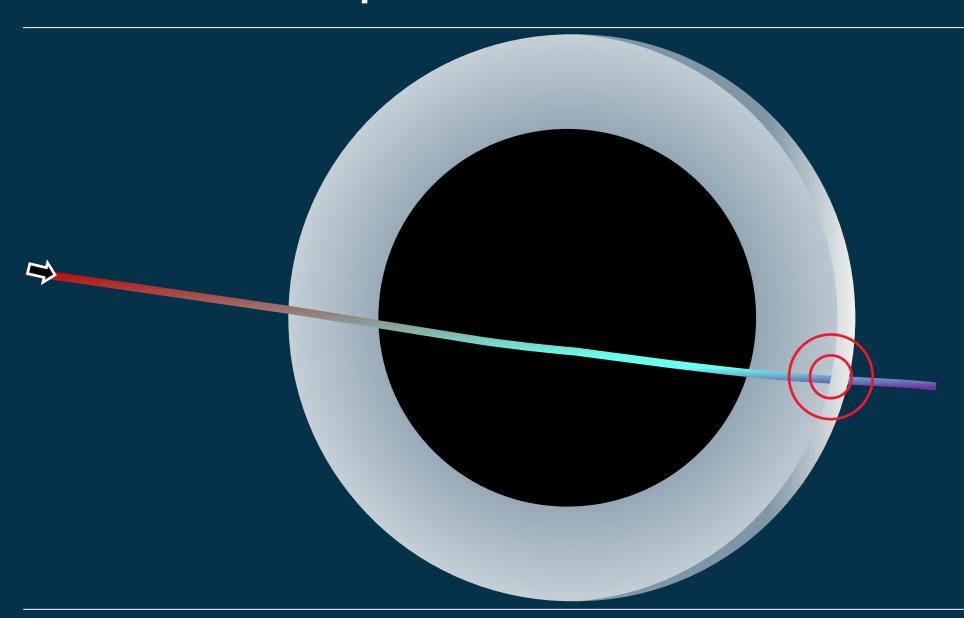


Crossing of the southern part of the dayside plasma ring section into low density region

(Dependent on upstream IMF By)

Sketch of the YZ-plasma distribution at X = -0.8RM





Outbound passage of Magnetopause with a passage of low plasma density zone before

What next?

Preliminary Result:

First ever crossing of the dayside, dawnside plasma ring

Upstream IMF is not yet precise: Find variations of plasma ring existence along trajectory depending on upstream IMF Other instrument signatures available? Why no signal at MSB1?

FOV analysis:

How much flux comes from which side of the magnetosphere, electrons vs protons?

Why no current density signal here?

How would MPO and Mio orbits observe this feature?

