



Evidence of planetary Oxygen and Carbon ions in the outer flank of Venus magnetosheath

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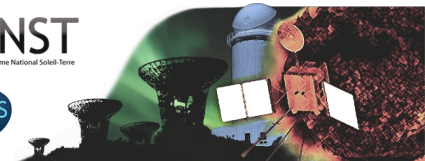
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May 18, 2022



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l'Observatoire de Paris

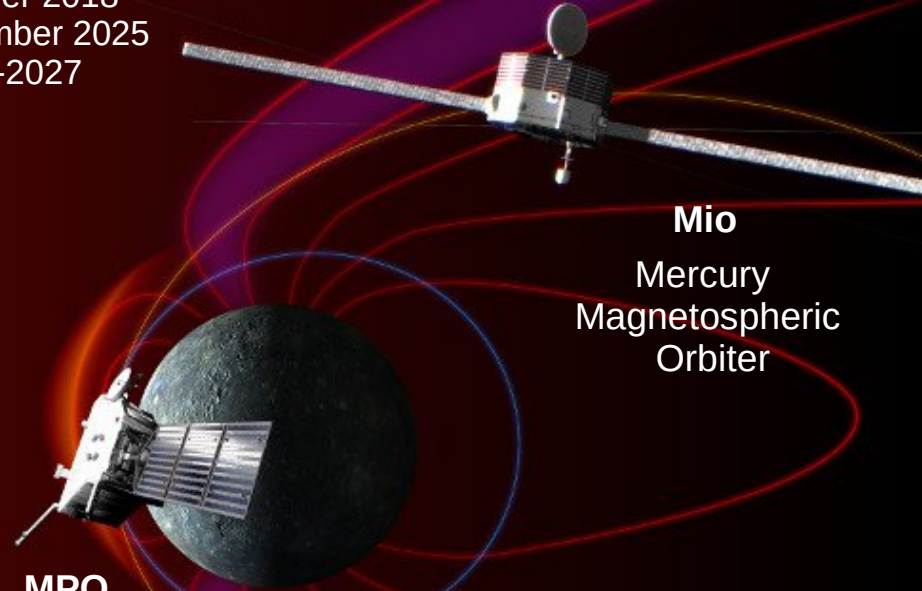


The BepiColombo ESA/JAXA mission



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Launch: October 2018
In orbit: December 2025
Science: 2026-2027



Mio

Mercury
Magnetospheric
Orbiter

MPO

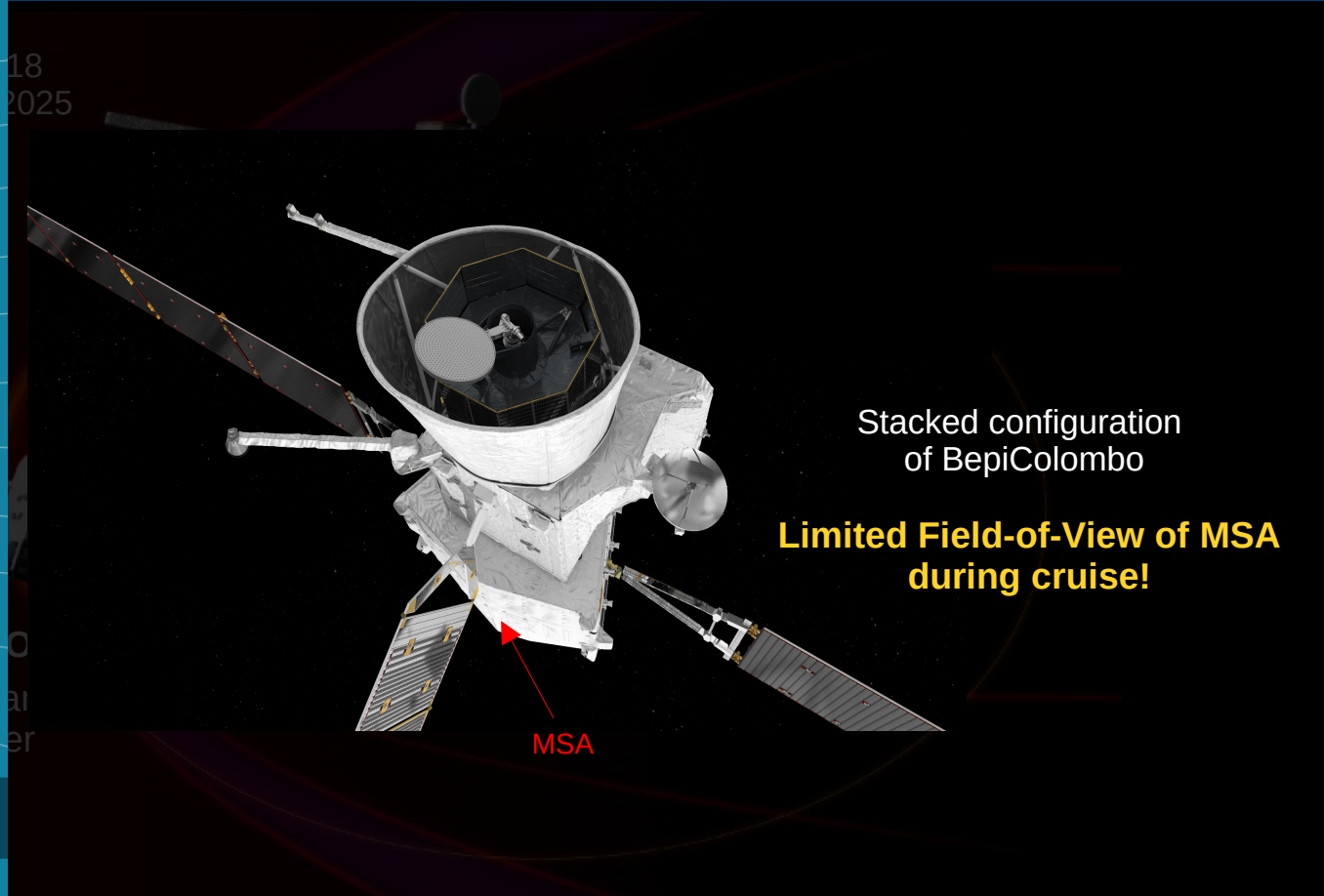
Mercury Planetary
Orbiter



Cruise phase of BepiColombo (2018 - 2025)



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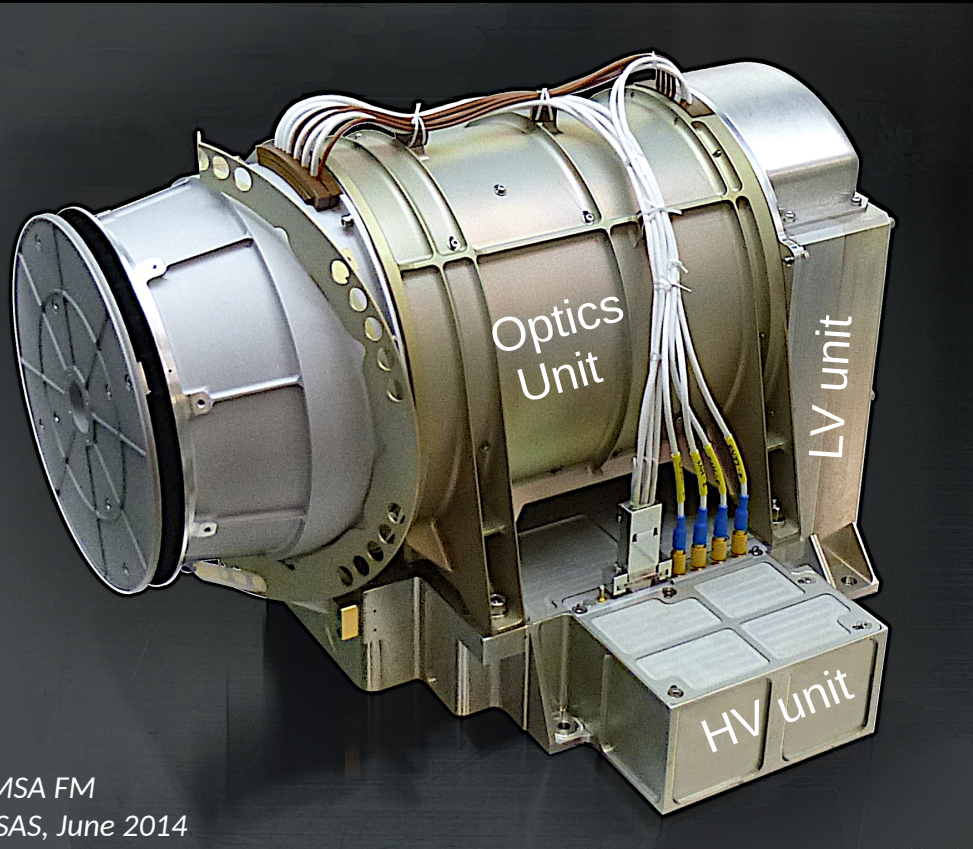
Stacked configuration of BepiColombo

Limited Field-of-View of MSA during cruise!

Mass Spectrometer Analyzer (MSA) instrument



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→ Part of the Mercury Plasma Particles Experiment, MPPE,
(PI: Yoshifumi Saito, ISAS/JAXA)

→ 3D ion distributions with high mass resolution

1) Optics :

LPP (D. Delcourt, L. Hadid, B. Katra, C. Verdeil, F. Leblanc, D. Fontaine, J.-M. Illiano, J.-J. Berthelier)

2) LV unit:

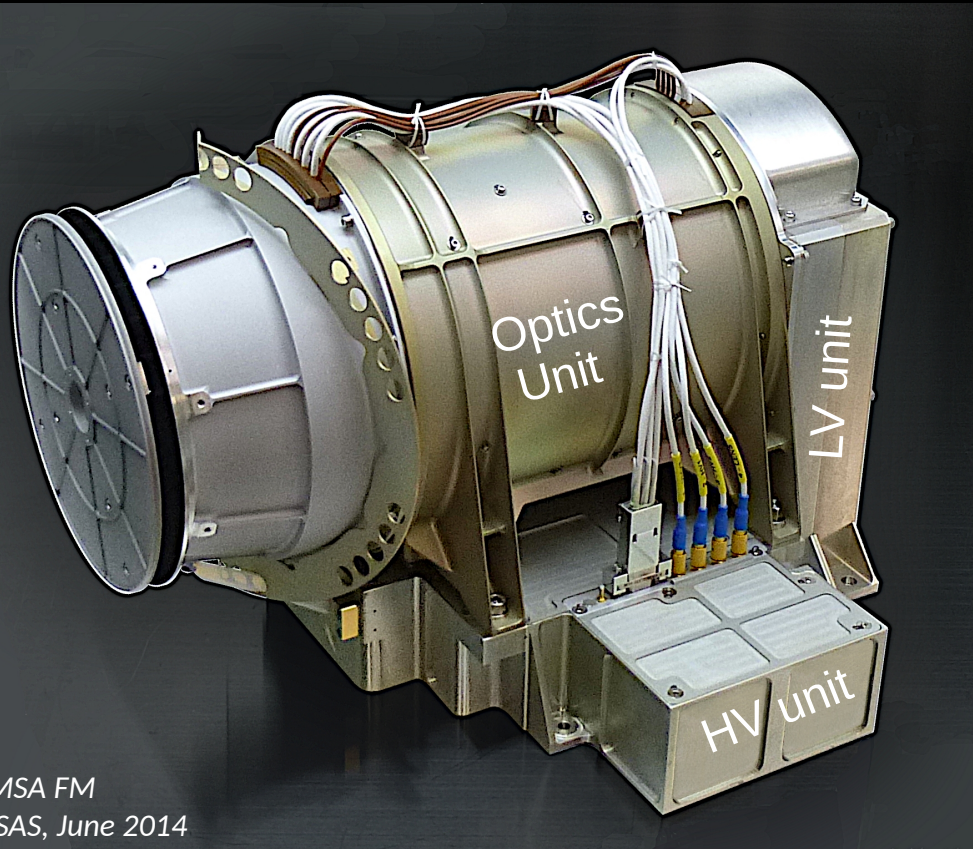
* **Amplifier board and Sw interface**, ISAS Sagamihara (Y. Saito, S. Yokota)

* **Central Processing Unit**, IDA Braunschweig (B. Fiethe)

3) HV unit :

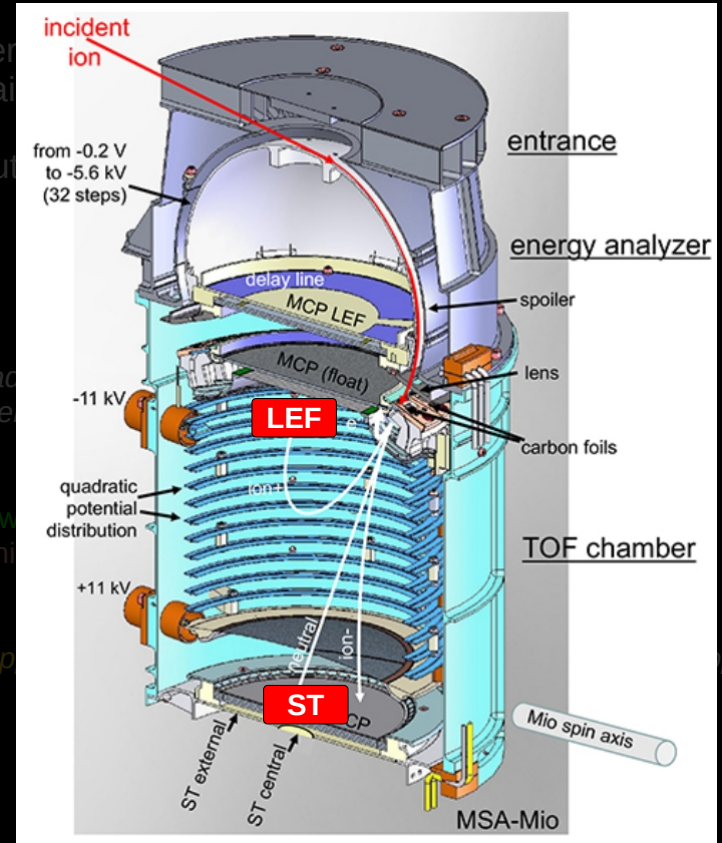
High Voltage Power Supplies, MPS Göttingen (M. Fraenz, H. Fischer, N. Krupp)

Mass Spectrum Analyzer (MSA) instrument



→ Part of the Mercury Plasma Particle Experiment (PI: Yoshifumi Saeki)
 → 3D ion distribution

- 1) Optics : LPP (D. Delcourt, L. Hadravsky, J.-M. Illiano, J.-J. Berthelin)
- 2) LV unit: * Amplifier board and Switching Unit * Central Processing Unit
- 3) HV unit : High Voltage Power Supply



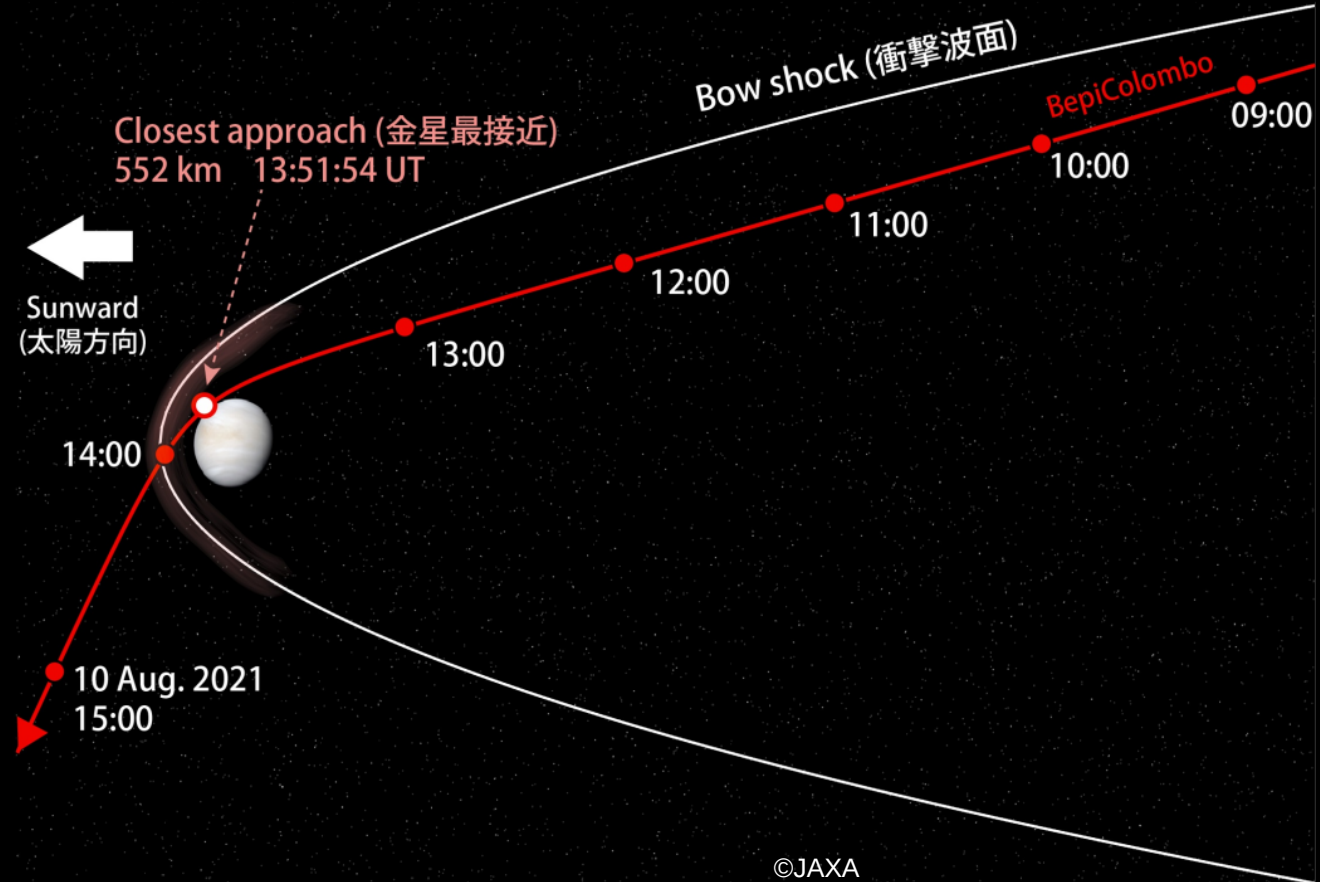
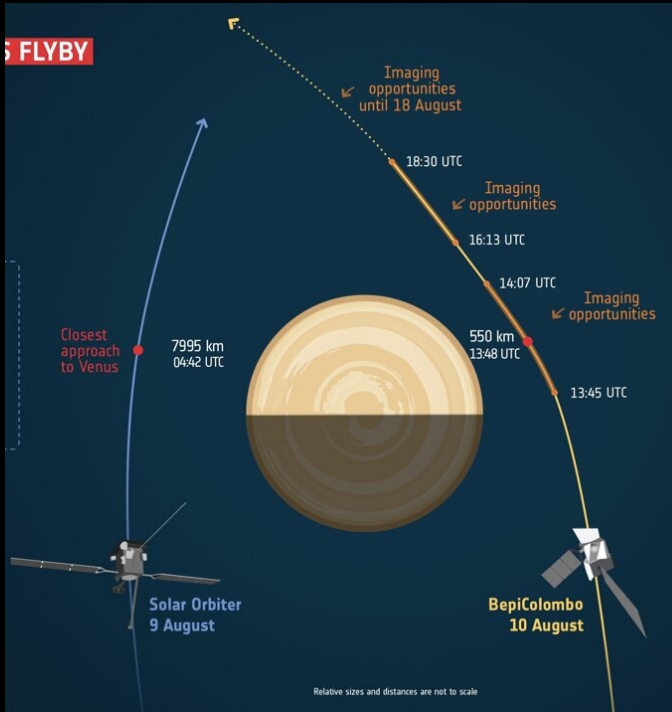
MSA FM
 ISAS, June 2014

BepiColombo trajectory during the 2nd Venus flyby August 10, 2021

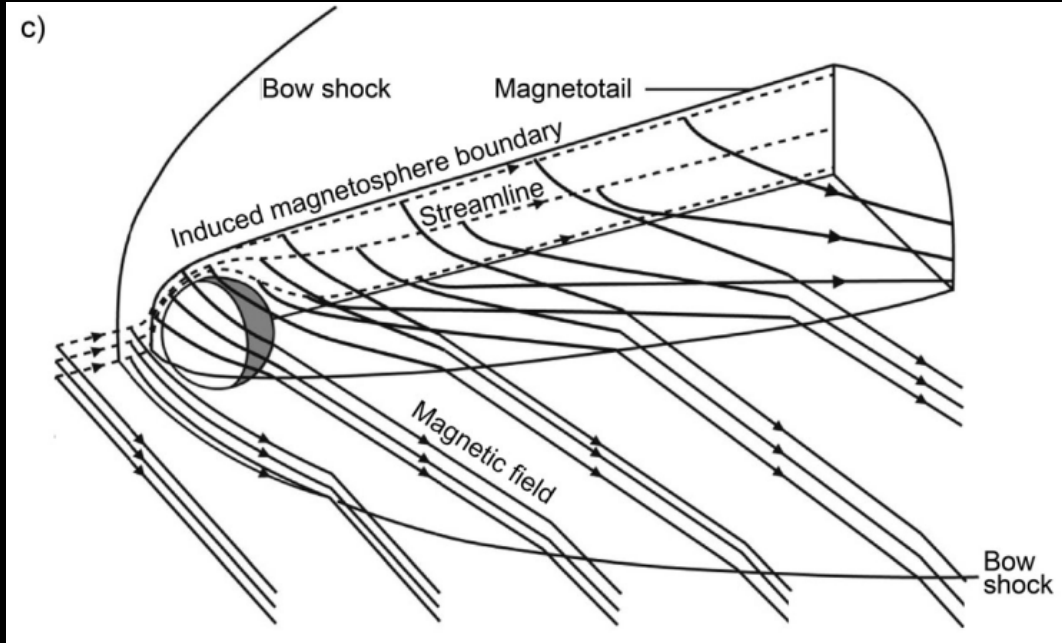


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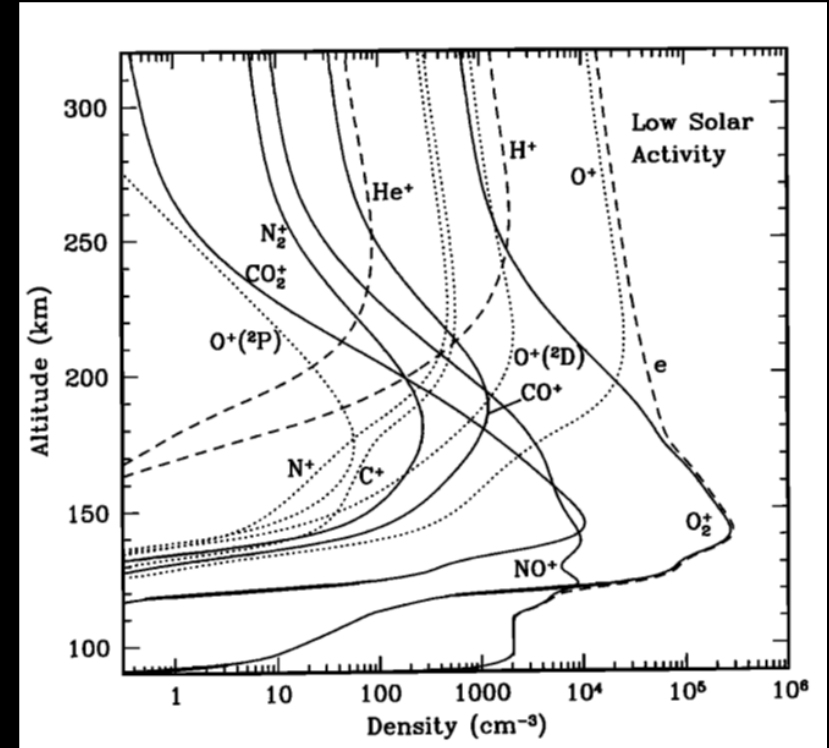
Double Venus flyby: Solar Orbiter on August 09 2021



Venus induced magnetosphere and ionosphere



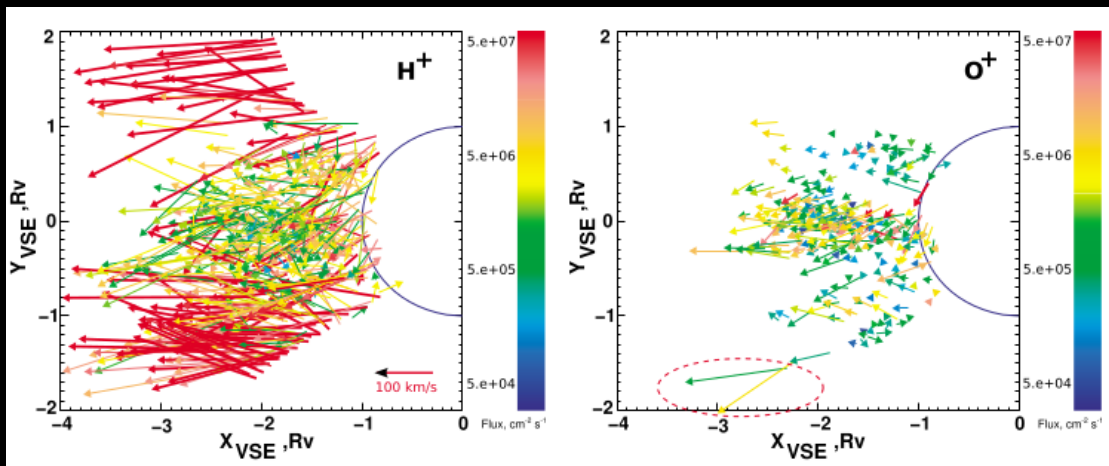
Saunders and Russell 1986



Fox and Sung, JGR, 2001

Dominance of O^+ and H^+ above 200 km

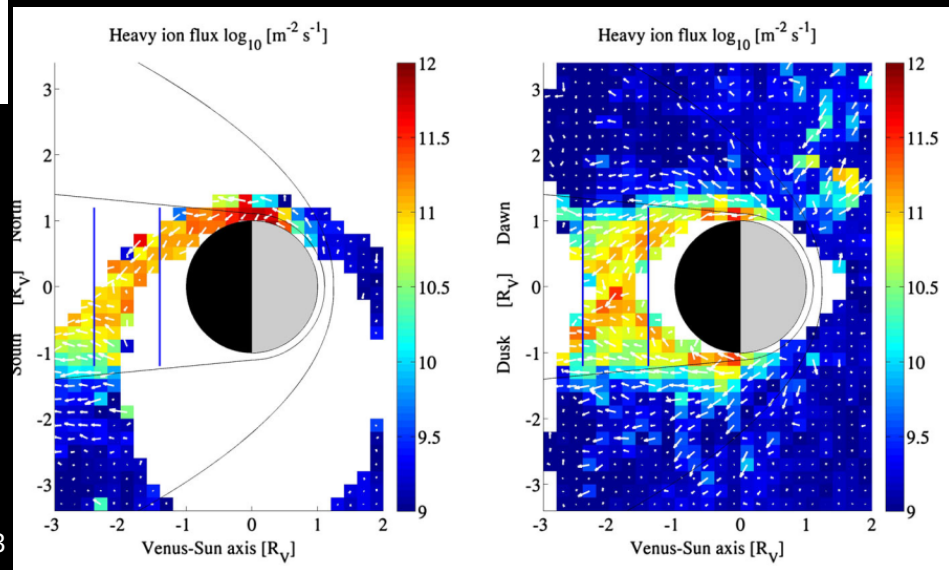
Loss of heavy ions observed by APERA-4/VEX (2006-2014)



Fedorov et al. JGR, 2011

Heavy ions ($m/q \geq 16$) and protons directed tailward and towards the center of the tail.

Detection of heavy ion species, but C^+ and N^+ could not be distinguished from O^+

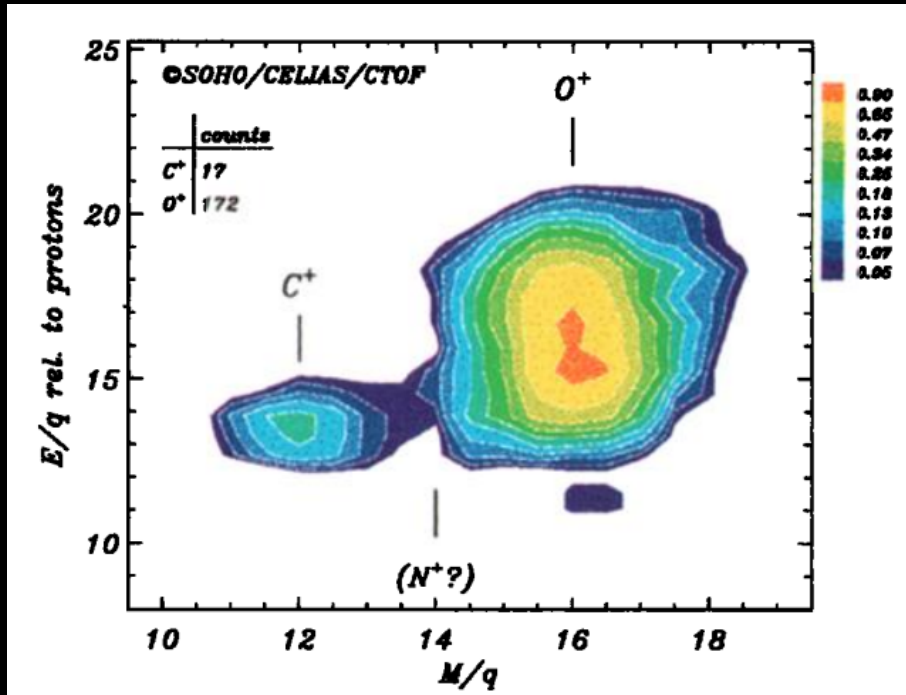


Nordström et al. JGR, 2013

The only in situ observation of C^+ in the ionotail of Venus by SOHO



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Grünwaldt et al., GRL, 1997

Identification of C^+ , N^+ and He^+ in the ionotail of Venus around 45 million km by the SOHO spacecraft

MSA ion observations at Venus through Venus magnetosheath flank

Protons

He²⁺

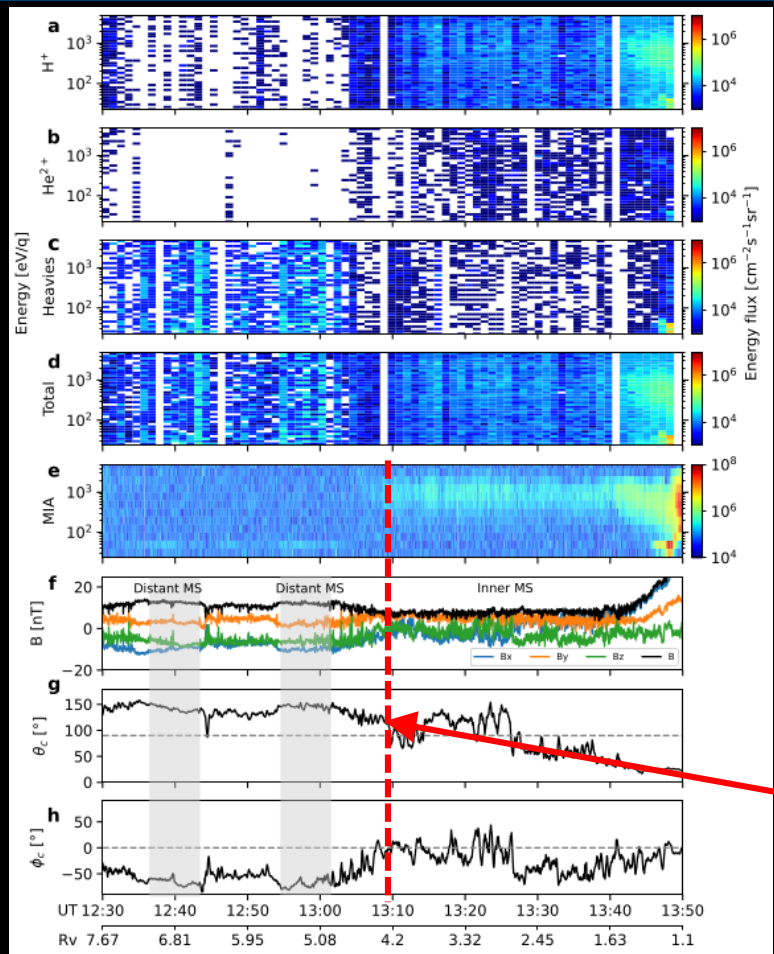
Heavies

MSA Tot

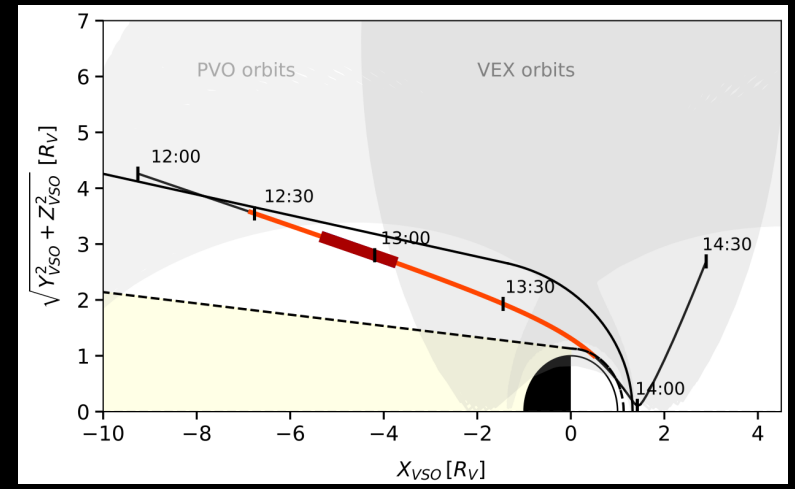
MIA

$\Theta_c = 0^\circ/180^\circ \rightarrow$
sunward/anti-sunward B-field

$\varphi_c = 0^\circ/90^\circ \rightarrow$
eastward/northward B-field



Mio-MPPE spectrograms of ion observations during VGAM2



Clear rotation in the cone angle coinciding with an increase of the H⁺ energy flux

Evidence of O^+ and C^+ cold ions escaping in Venus magnetosheath flank



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