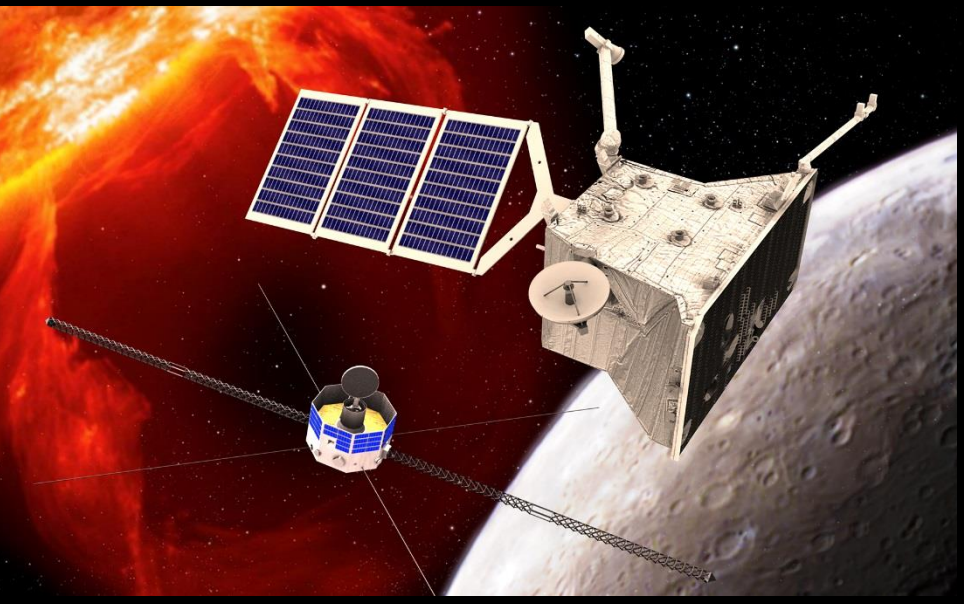
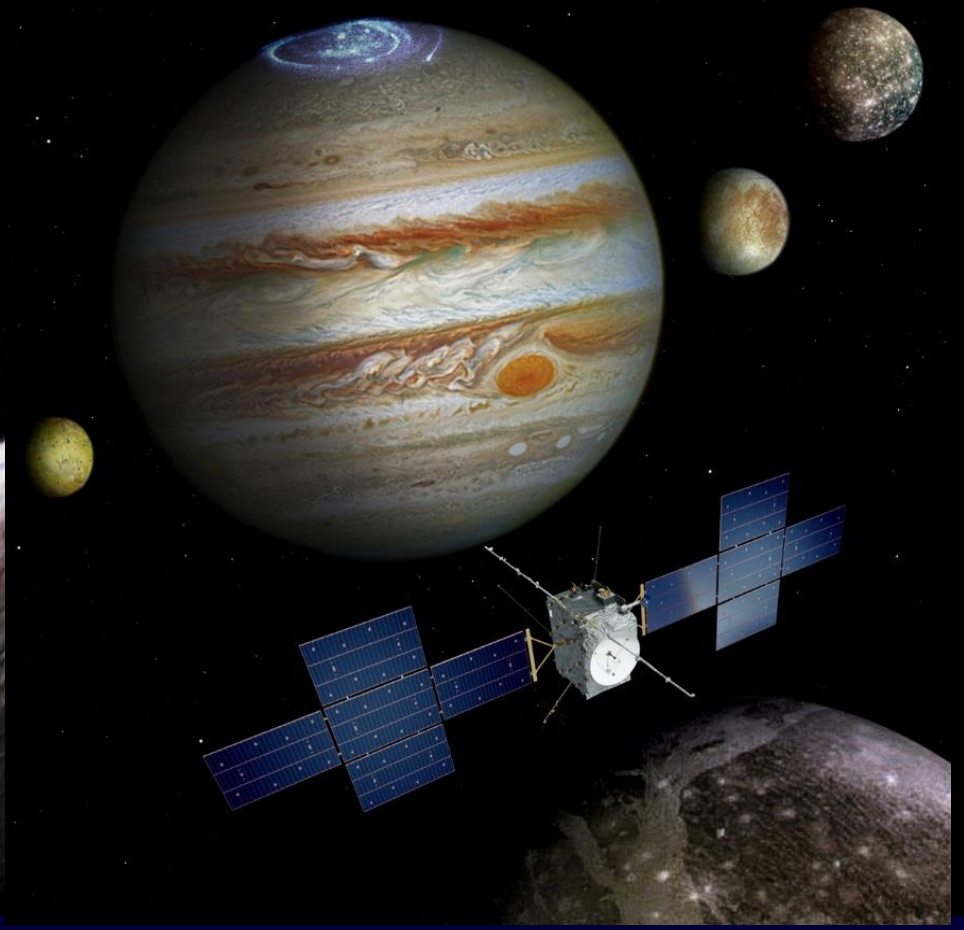
Z Košíc na kométu, Merkúr a Ganymedes

Ján Baláž

Ústav experimentálnej fyziky SAV

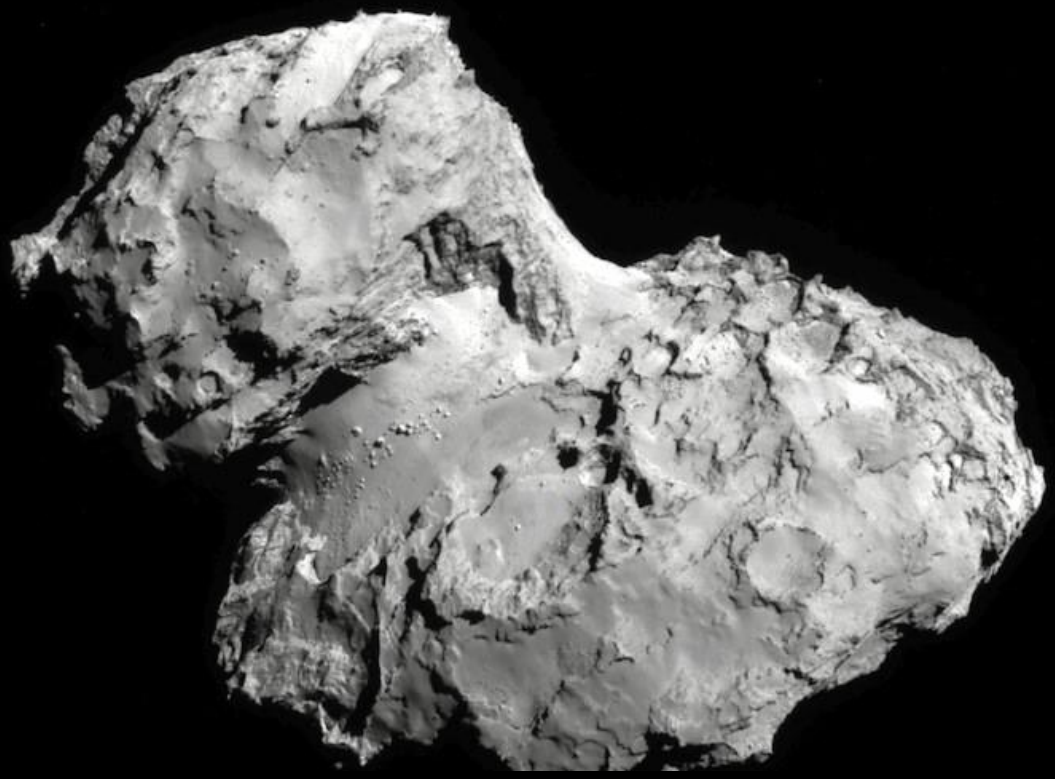
Oddelenie kozmickej fyziky





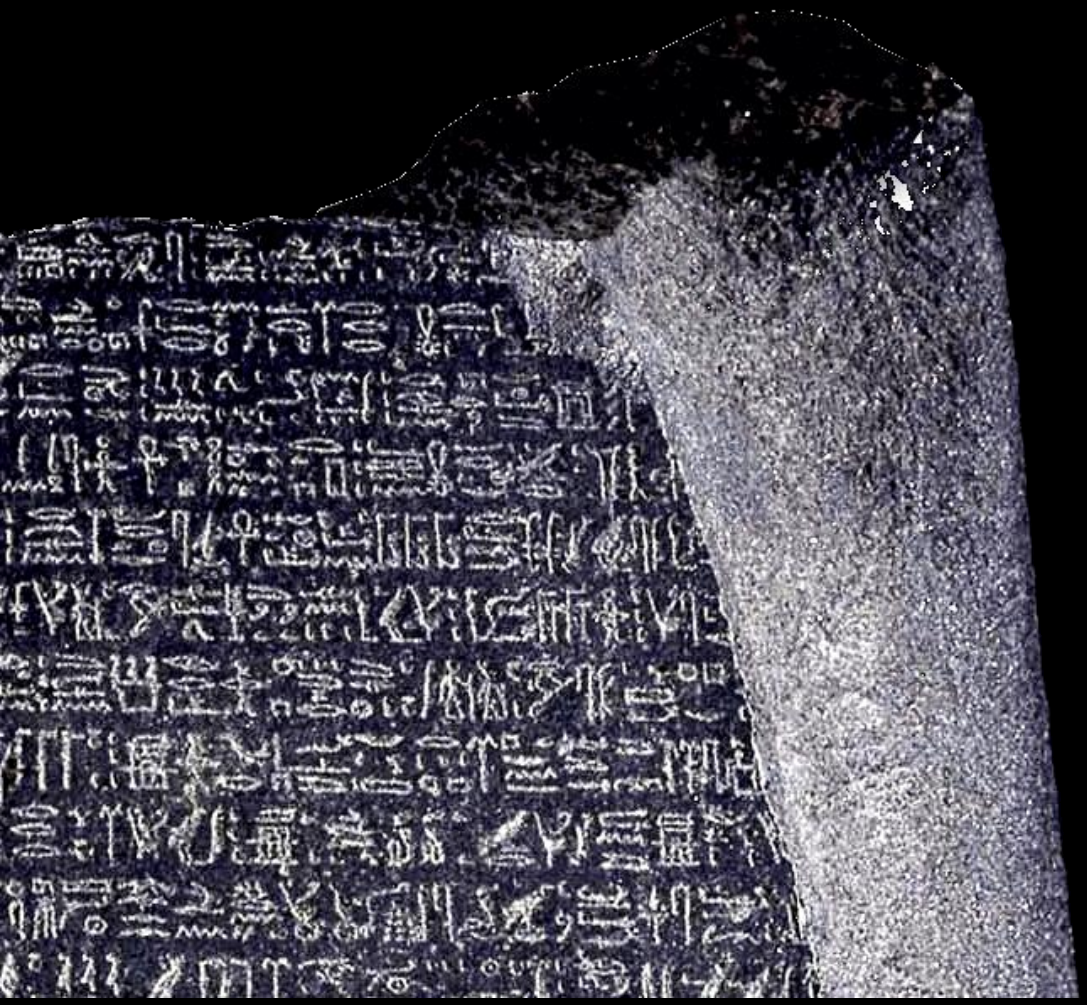
Rosetta

...nedokázali sme dostať kométu do laboratória, tak sme poslali laboratórium na kométu...



Prečo Rosetta ?

Rosettská doska, nájdená v r. 1799, pomohla rozlúštiť egyptské hieroglyfy, čím poodhalila dejiny našej civilizácie o tisícročia dozadu.



Sonda Rosetta odhaľuje dejiny Slnečnej sústavy a tajomstvá jej vzniku pred 4.6 miliardami rokov – a to najmä analýzou „primitívnej“ kometárnej hmoty, ktorá sa od tých čias nezmenila.

Cieľ Rosetty: Kométa 67P-Čurjumov-Gerasimenko

Rozmery jadra (odhad): ~ 4 km
Doba rotácie okolo vlastnej osi: 12,3 hodín
Obežná doba okolo Slnka: 6.57 roka
Perihélium : 194 mil. km (1.29 AU)
Afélium : 858 miliónov km (5.74 AU)
Albedo: 0,04
Rok objavu: 1969
Objavitelia: Klim Čurjumov (UA)
Svetlana Gerasimenko (UA)

Základné technické údaje sondy Rosetta

Rozmery:

hlavná štruktúra 2.8 x 2.1 x 2.0 m

rozpätie sol. panelov 32 m

plocha sol.panelov 64 m^2

výkon sol. panelov 8700 W - 1AU

850 W - 3.4 AU

395 W - 5.25 AU

Hmotnosť pri štarte:

celková: 2900 kg

palivo 1720 kg

vedecký náklad 165 kg

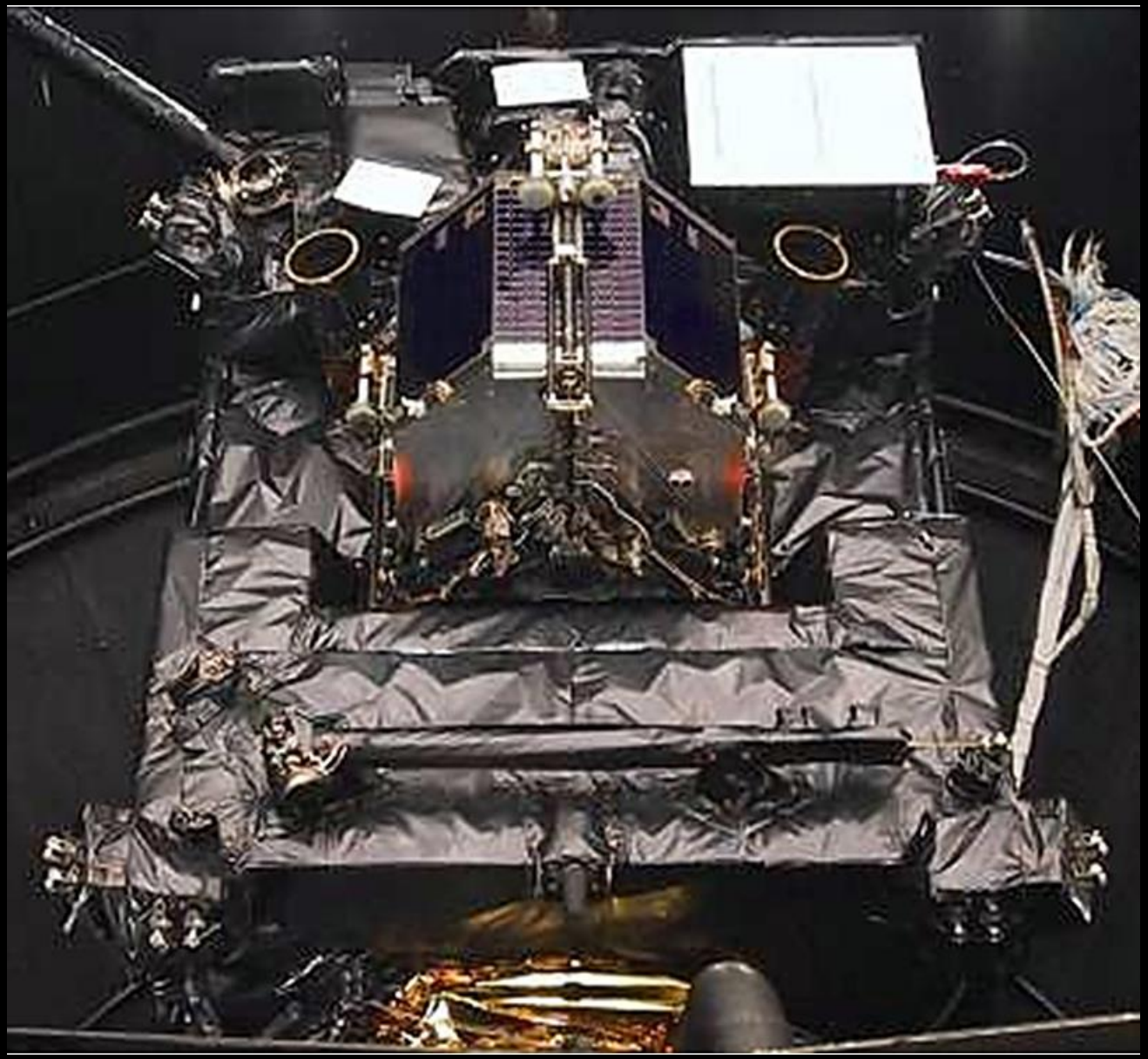
Lander Philae 100 kg

Propulzný systém: 24 thrusterov 10N

palivo MMH + N_2O_4

Operačná doba: 12 rokov (2004-2016)

ROSETTA a Philae v laboratóriách ESA-ESTEC

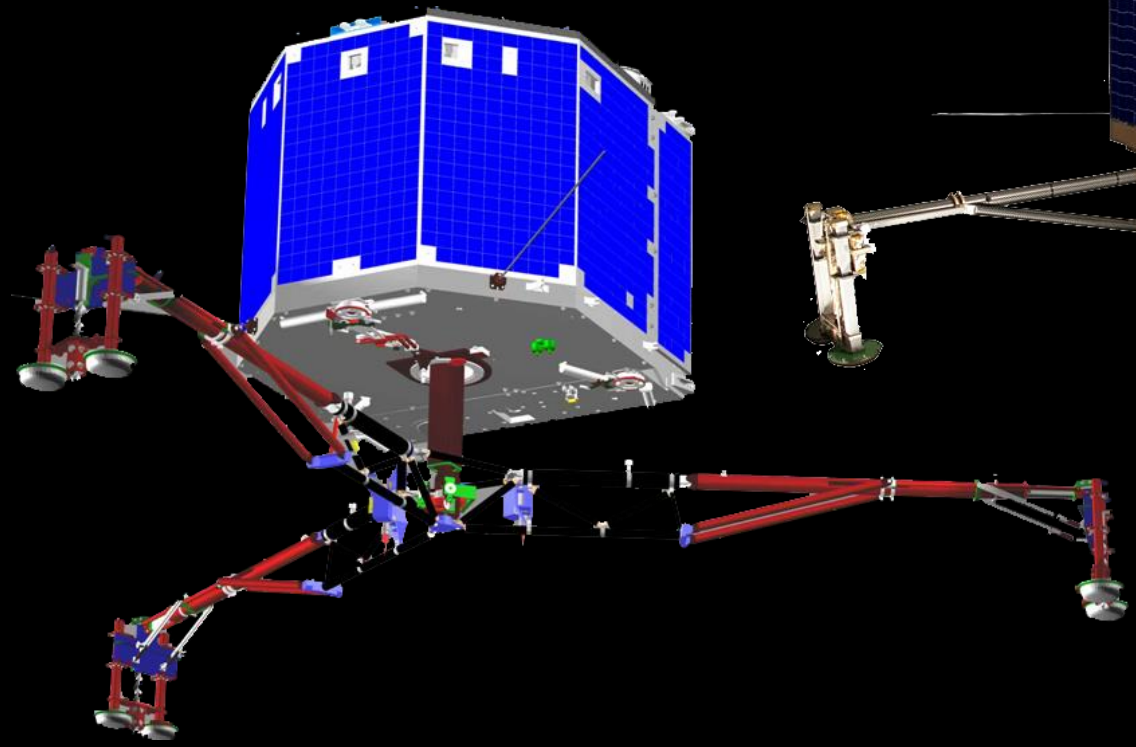


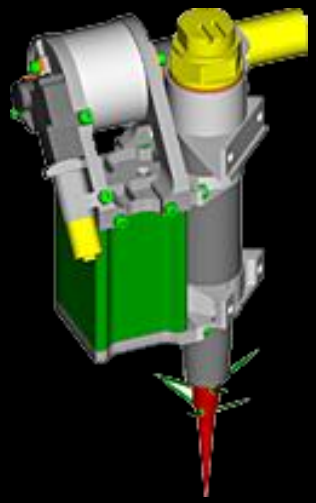
ROSETTA pozostávala z dvoch častí:

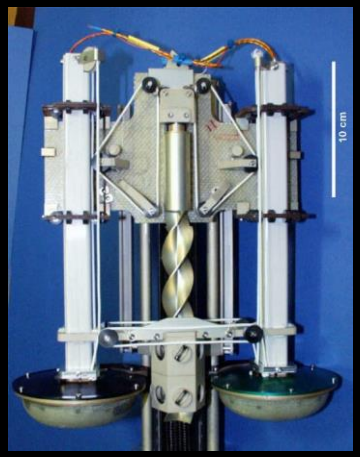
Orbiter –na orbite v blízkosti kometárneho jadra,

Lander – pristál priamo na povrchu jadra.

Lander (Philae)

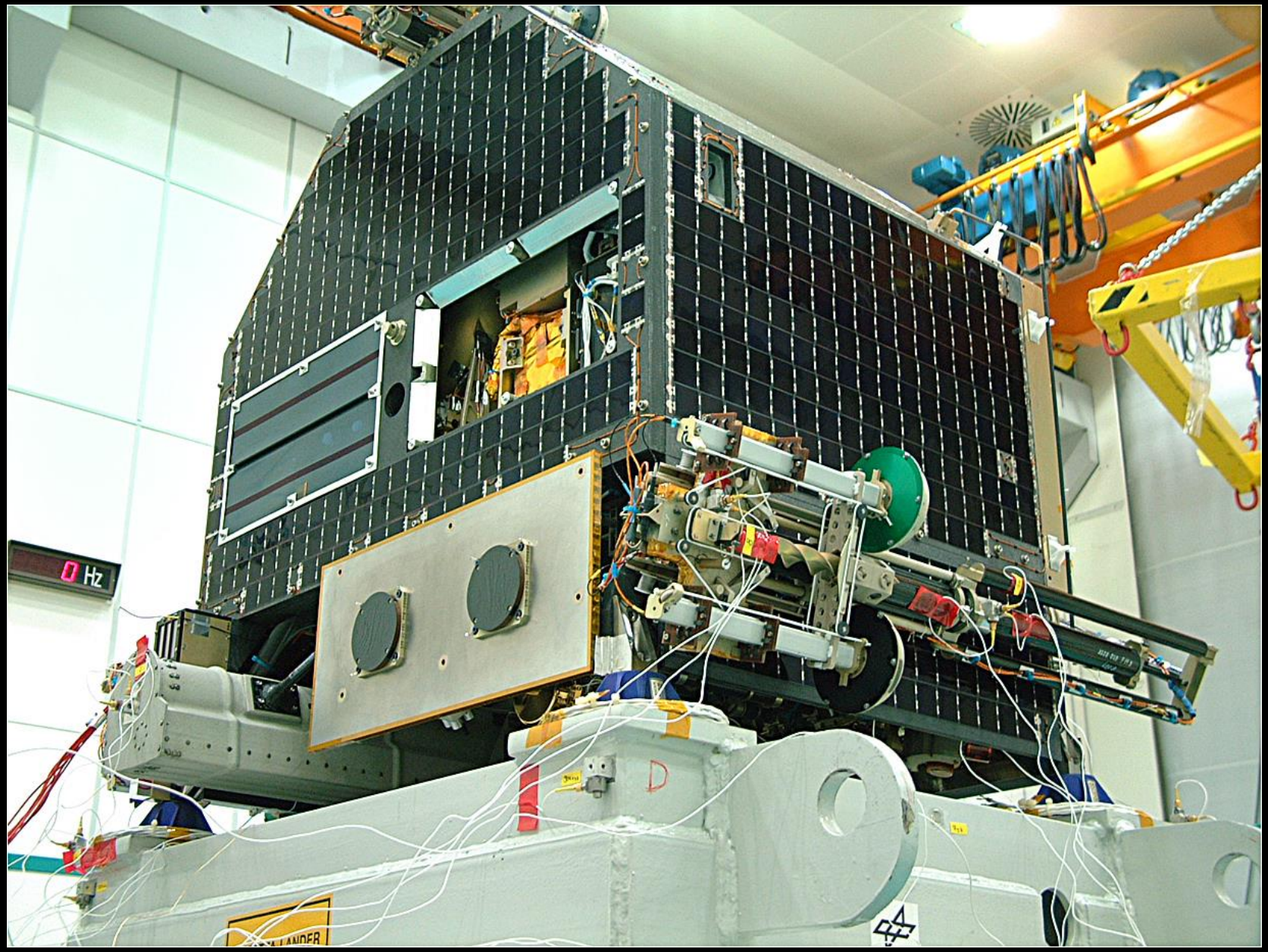




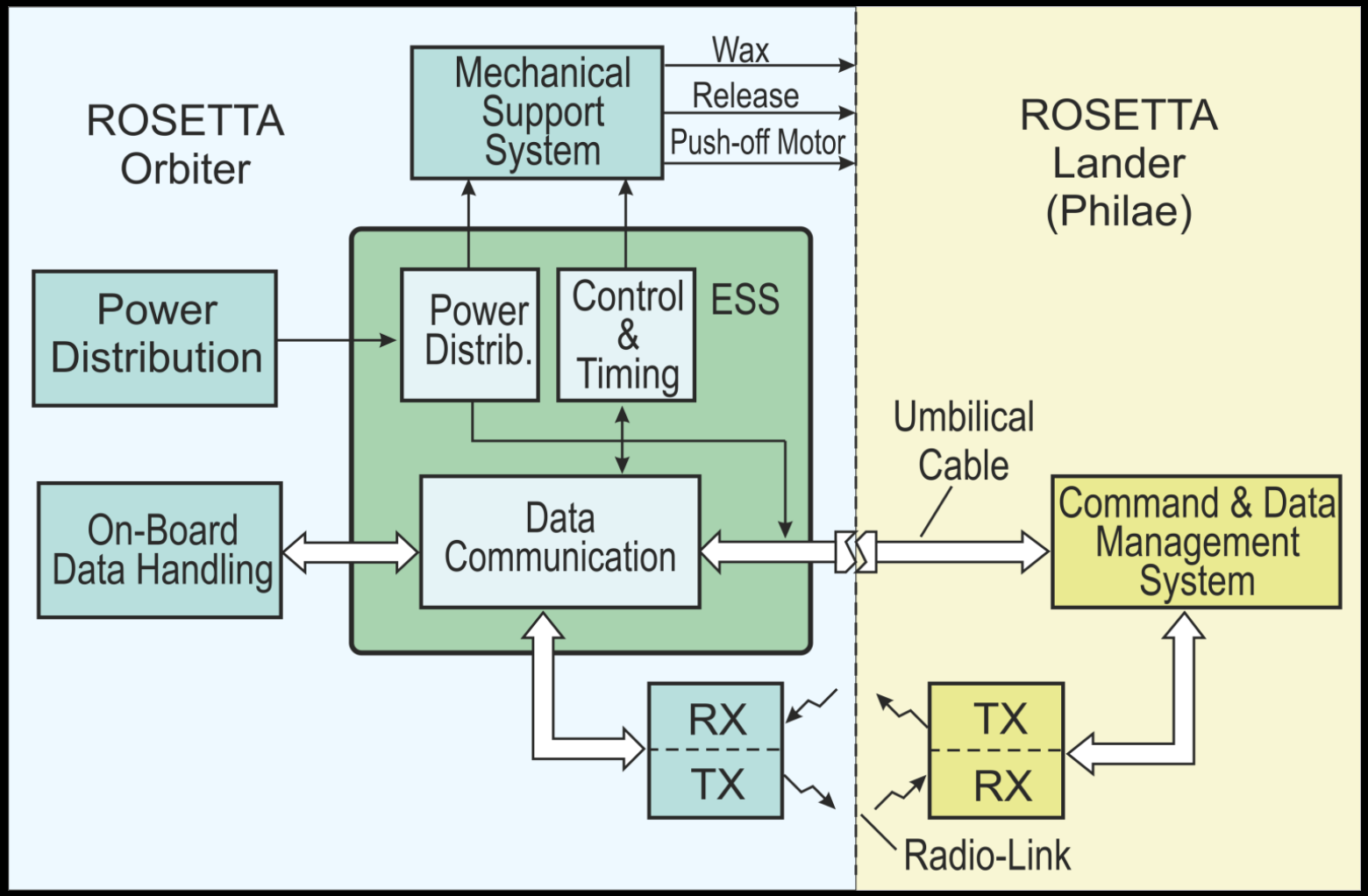


Hmotnosť: 100 kg
Vypustenie z výšky: ca 22 km
Rýchlosť oddelenia: 0,05 – 0,52 m-s
Odpruženie: Trojnohý podvozok,
Ukotvenie: 2 harpúny + 3 snežné skrutky,
Korekcie náklonu, Rotácia 360°

Lander Philae - vibračné akceleračné testy

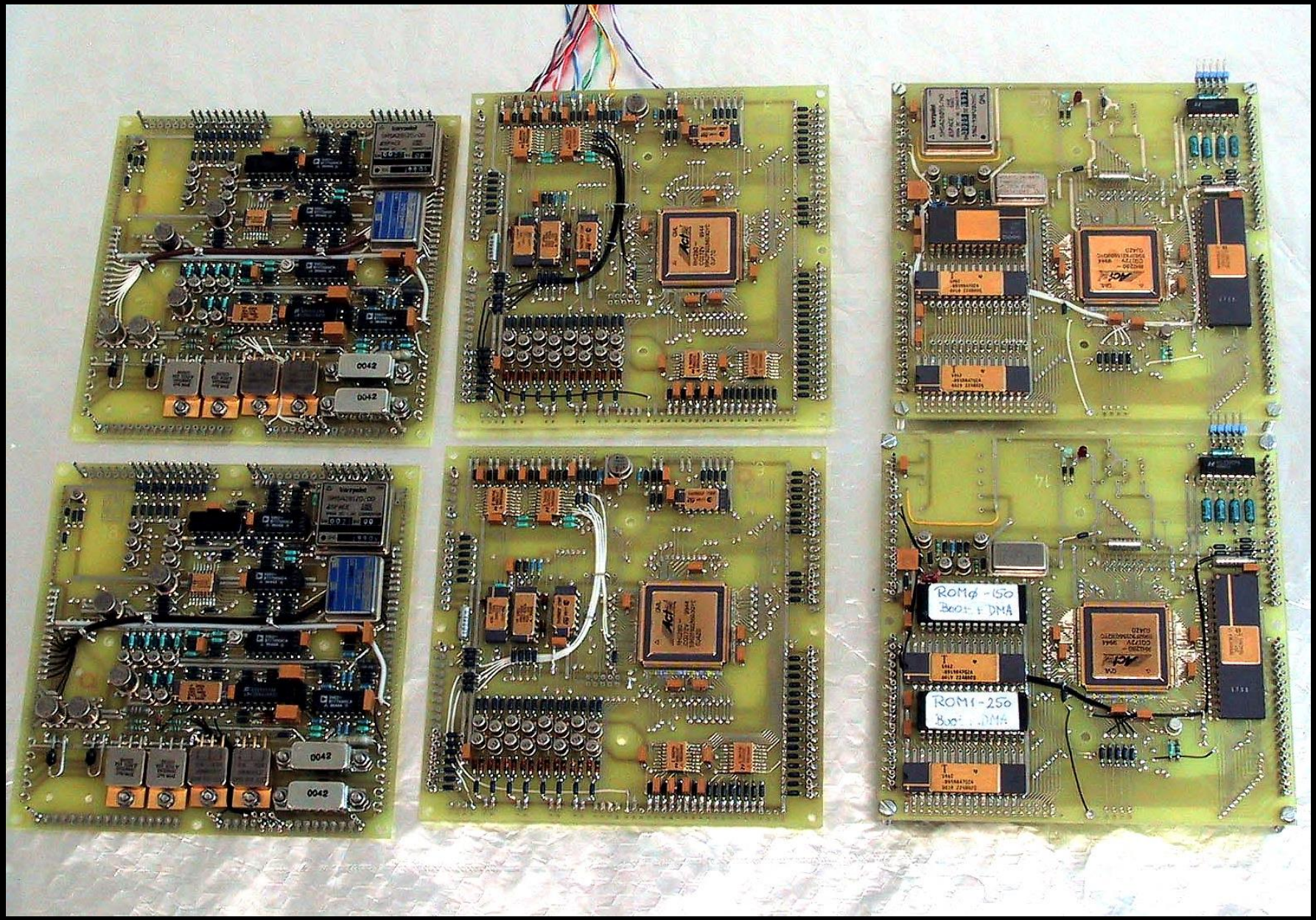


ESS-processor (Interface Orbiter – Lander)



ESS-processor zabezpečoval oddelenie pristávacieho modulu Philae od Orbitera a obojsmernú dátovú komunikáciu medzi nimi.

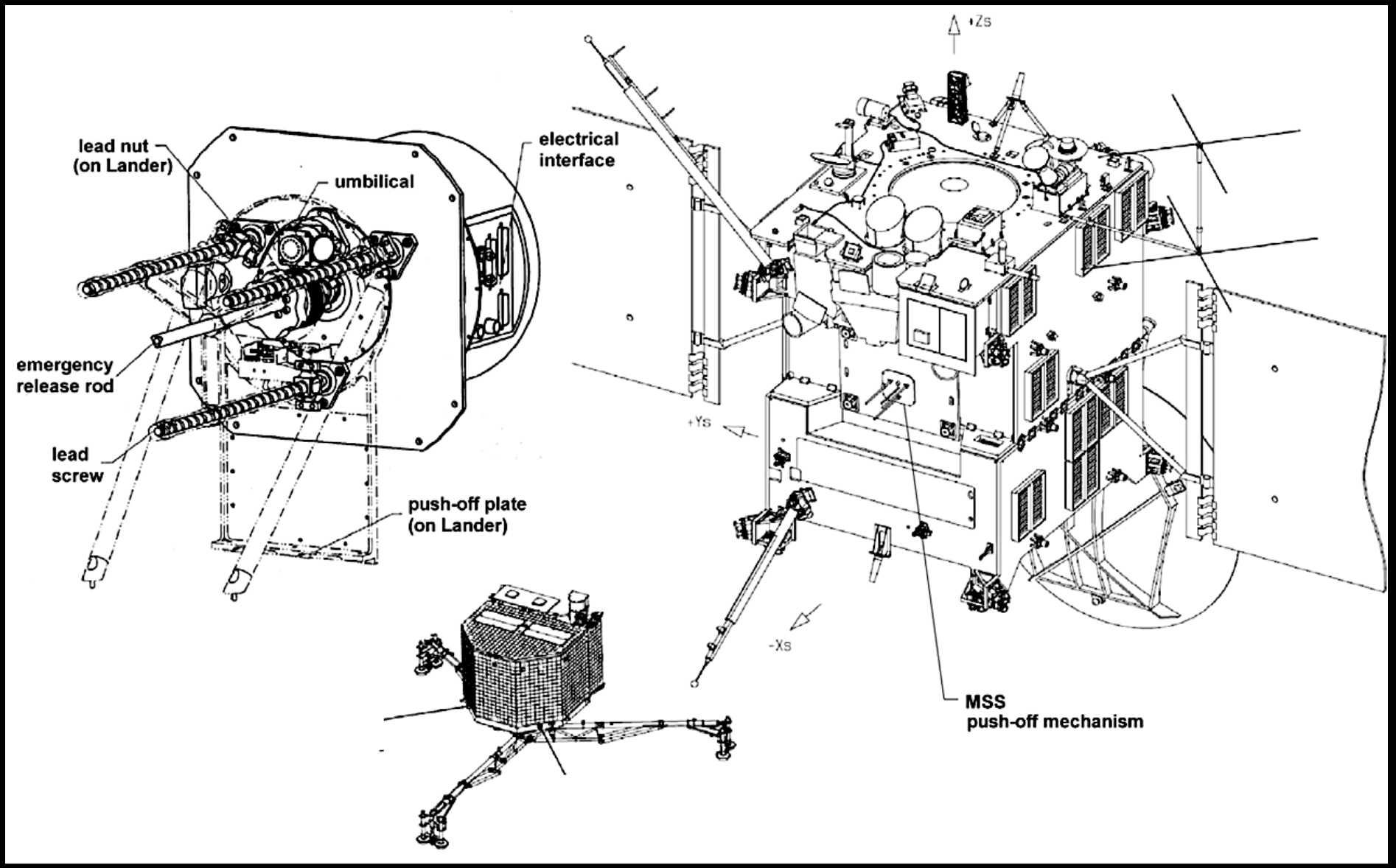
Z realizácie ESS-procesora (2000 - 2001)



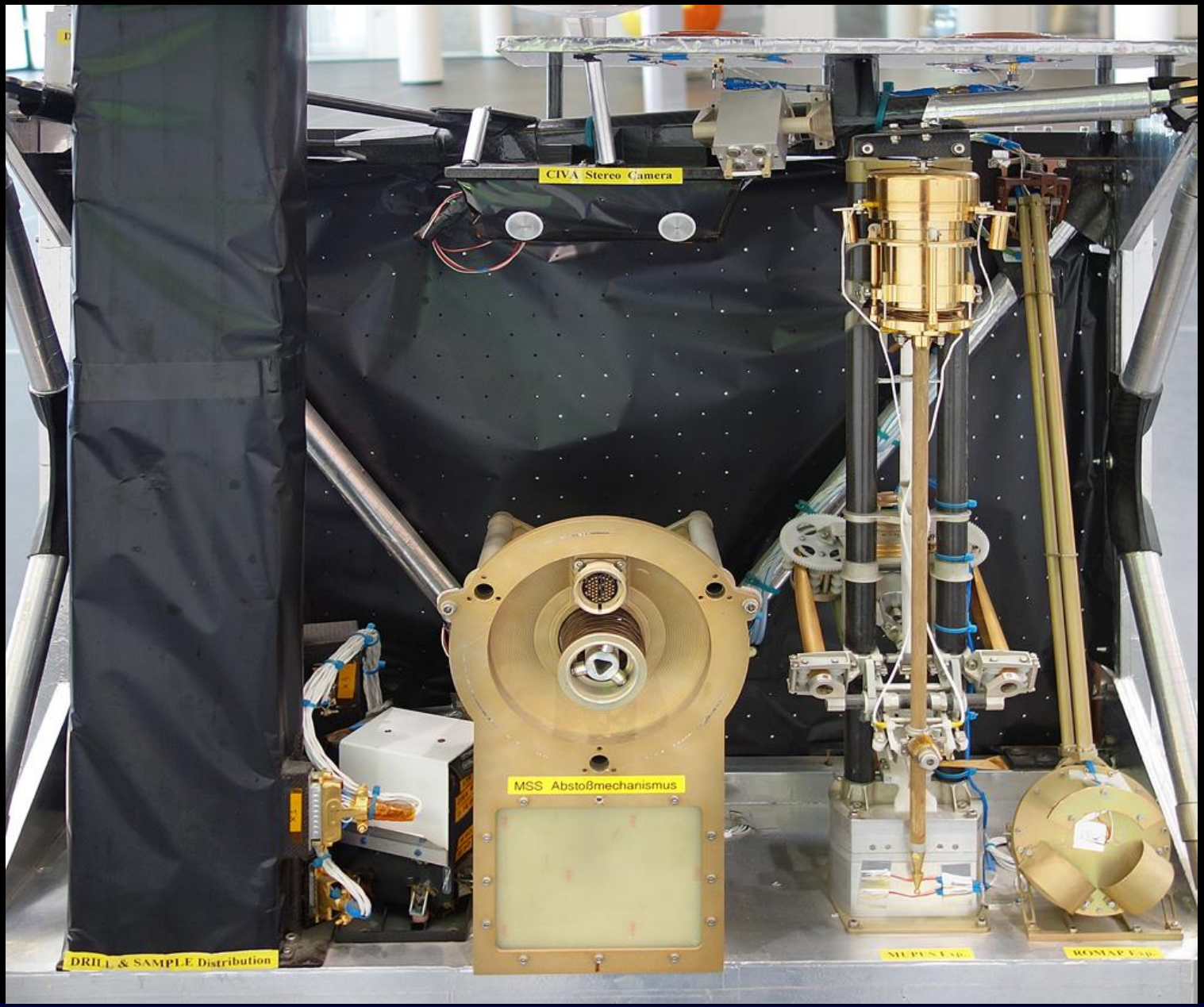
Záverečné práce na ESS procesore (STIL 2001)

Elektronický Servisný Systém Rosetta / ESS

Lander - oddeľovací mechanizmus (MSS)



Lander - oddeľovací mechanizmus



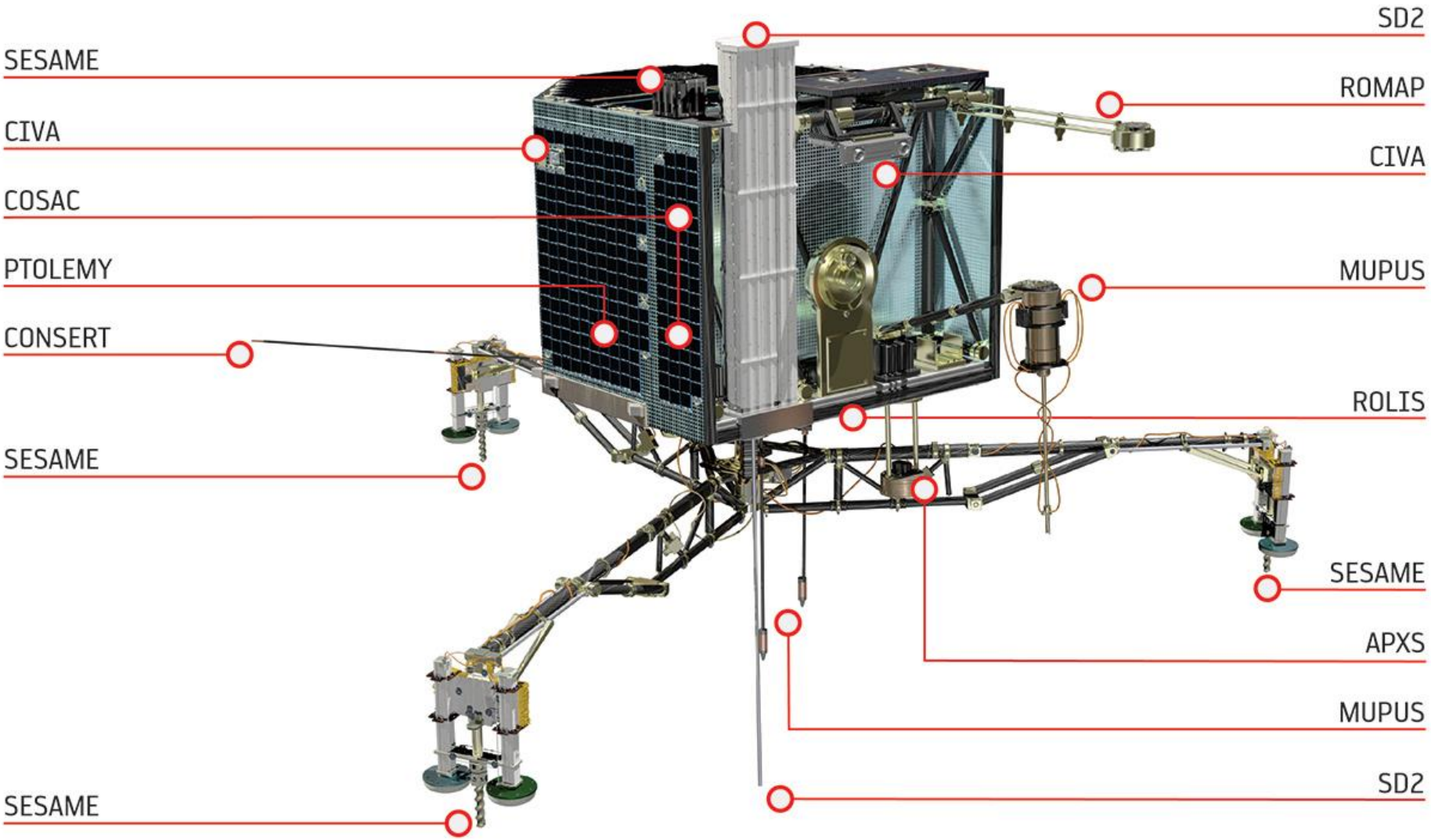
Orbiter – Vedecký náklad (payload)

1. **ALICE** Ultraviolet Imaging Spectrometer
2. **CONSERT** Comet Nucleus Sounding Experim. by Radio Transmission
3. **COSIMA** Cometary Secondary Ion Mass Analyser
4. **GIADA** Grain Impact Analyser and Dust Accumulator
5. **MIDAS** Micro-Imaging Dust Analysis System
6. **MIRO** Microwave Instrument for the Rosetta Orbiter
7. **OSIRIS** Rosetta Orbiter Imaging System
8. **ROSINA** Rosetta Orbiter Spectrometer for Ion and Neutral Analysis
9. **RPC** Rosetta Plasma Consortium
10. **RSI** Radio Science Investigation
11. **VIRTIS** Visible and Infrared Mapping Spectrometer

Lander Philae - Vedecký náklad

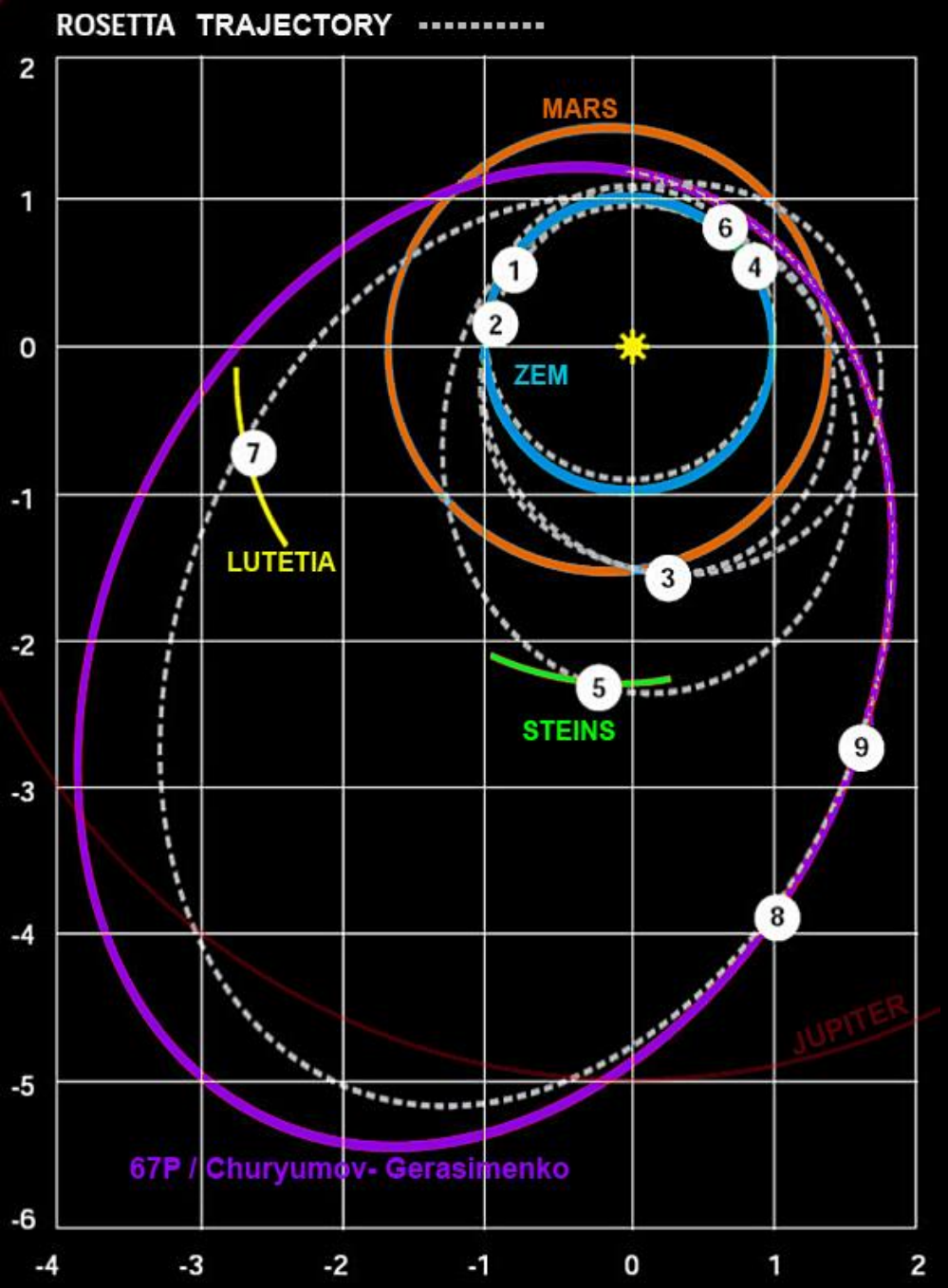
1. **APXS** Alpha-X-ray spektrometer
2. **ÇIVA** Panoramatická a mikroskopické stereo-kamery
3. **CONSERT** Rádiová tomografia jadra (s CONSERT – orbiter)
4. **COSAC** Analyzátor plynov - prvková a molekulárna analýza (chiral.)
5. **MODULUS Ptolemy** Analyzátor plynov - izotopová analýza
6. **MUPUS** Meranie podpovrchových vlastností (penetrátor)
7. **ROLIS** Down looking camera“ – detailné snímkovanie povrchu
8. **ROMAP** Magnetometer a plazmový monitor
9. **SD2** Vŕtací systém a transport vzoriek na analýzu
10. **SESAME** Seizmický, elektrický, akustický a prachový monitoring

Lander - rozmiestnenie vedeckého nákladu

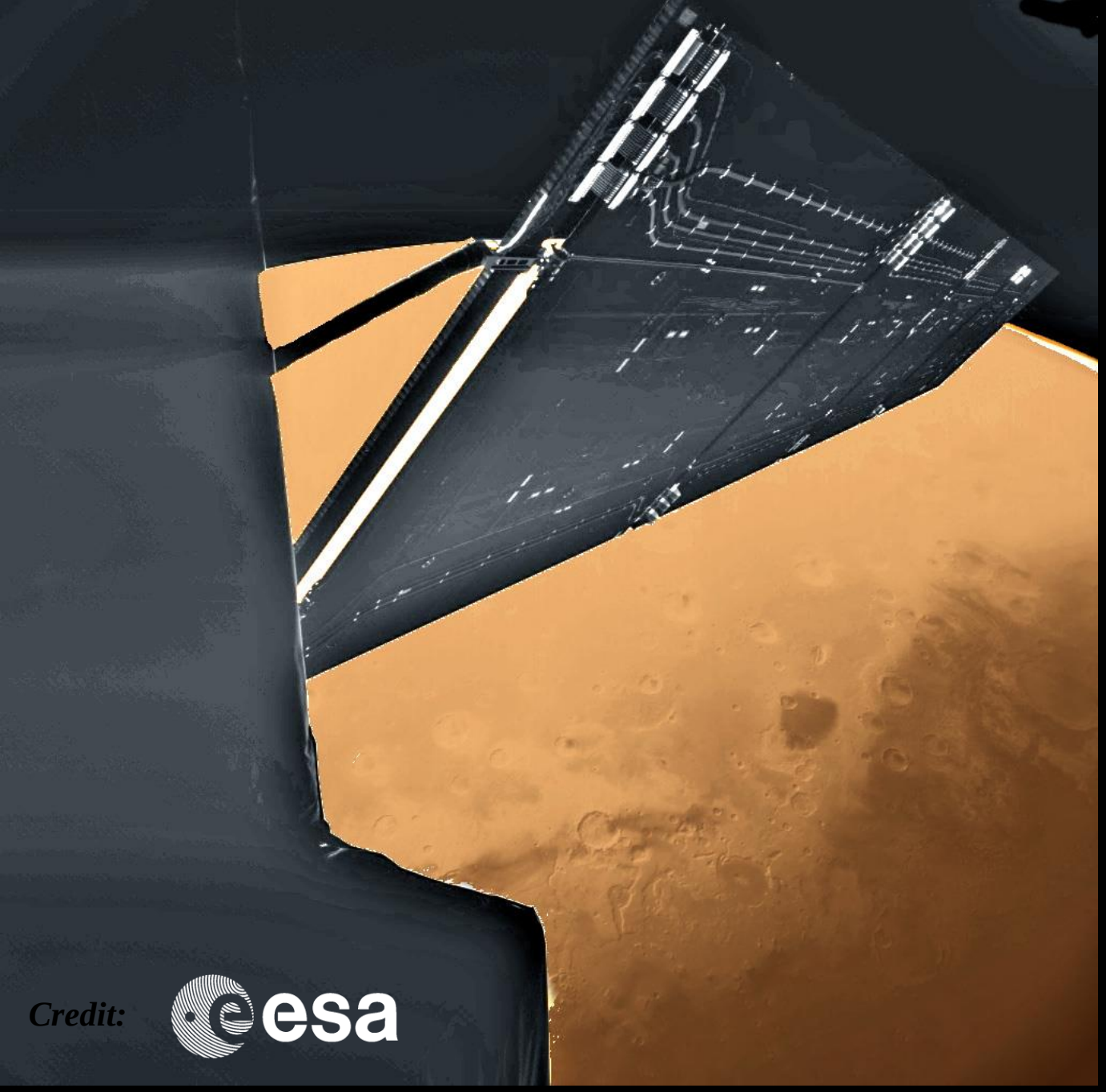


Štart sondy ROSETTA
02. 03. 2004
(kozmodróm ESA Kourou, Francúzska Guyana)

Letový plán sondy ROSETTA



1. **2004 /03/02 Štart (Kourou)**
2. **2005/03/04 Zem (prelet 1950km)**
3. **2007/02/25 Mars (prelet 250km)**
4. **2007/11/13 Zem (prelet 5300km)**
5. **2008/09/05 Steins (prelet 802km)**
6. **2009/11/13 Zem (prelet 2481km)**
7. **2010/07/10 Lutetia (prelet 3162km)**
8. (2011/06/08 - 2014/01/20) – hibernácia
9. **2014/08/06 67P (priblíženie ~100km)**
10. **2014/11/12 67P (pristátie Philae)**
11. **2015/08/13 Perihélium** (1.2432 AU)
12. **2016/09/30 Koniec misie (Grand Finale)**



Rosetta nad planétou Mars

(25. 02. 2007, 250.6 km)

“One-Billion Gamble”

(Mawrth Vallis region)

foto: CIVA-P

Asteroid 21 Lutetia

(10. 07. 2010, 3162 km, 15km/s)

OSIRIS *imaging (1px = 60m)*

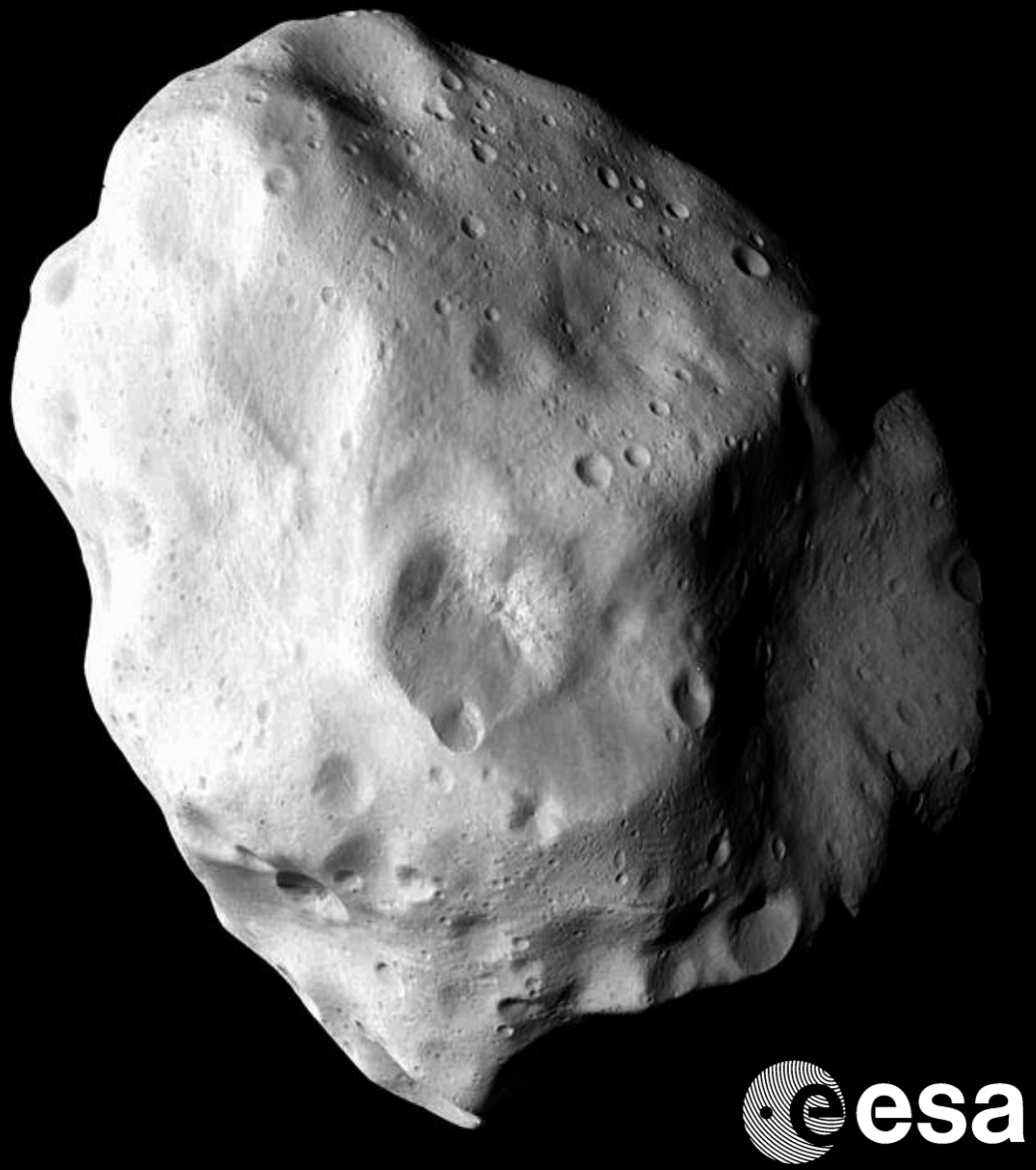
Hmotnosť 1.7 x 10^{18} kg,

Hustota ~ 3.4 g/cm^3 - pomerne vysoká, obsah Fe

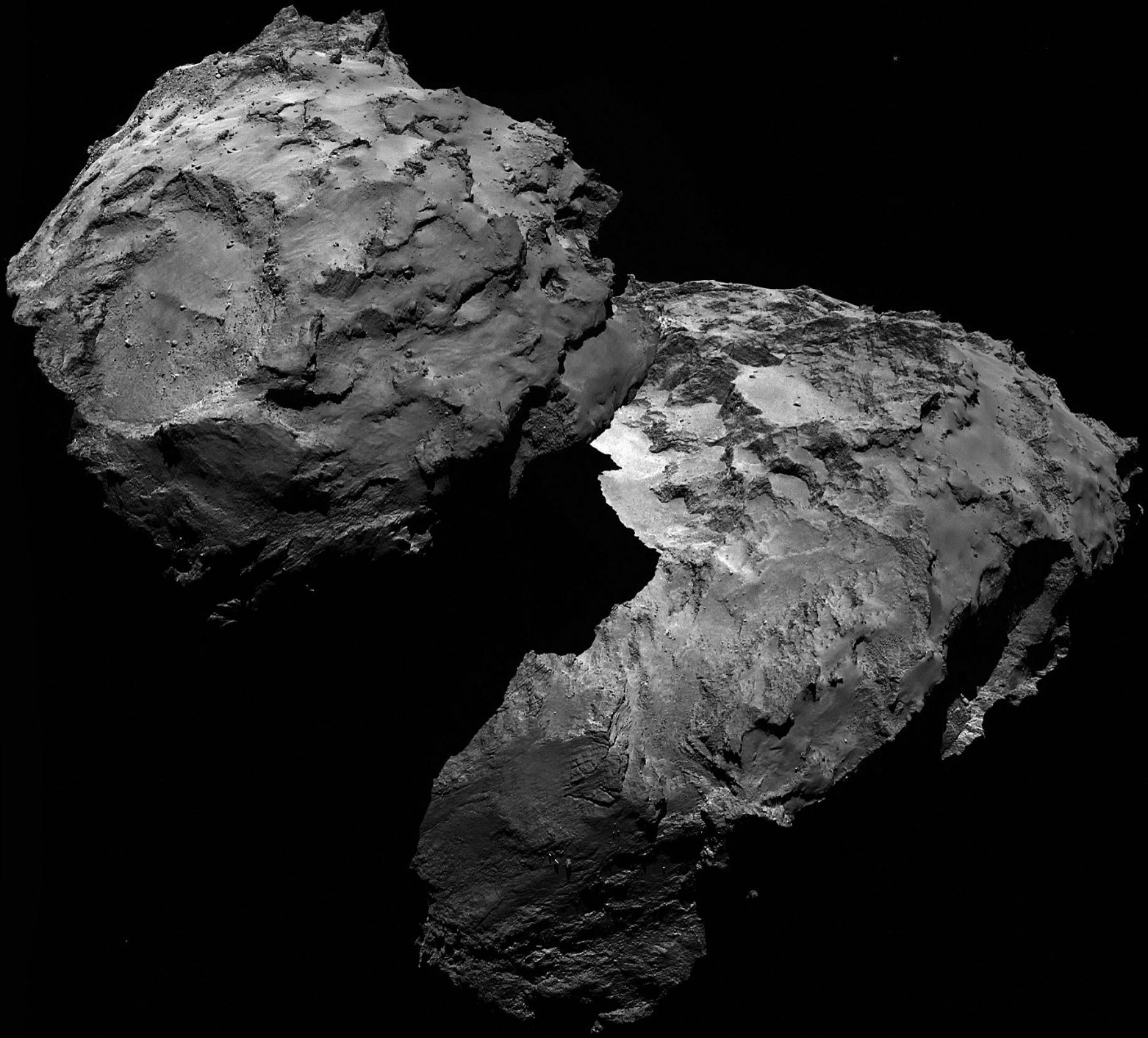
Povrch chondritický

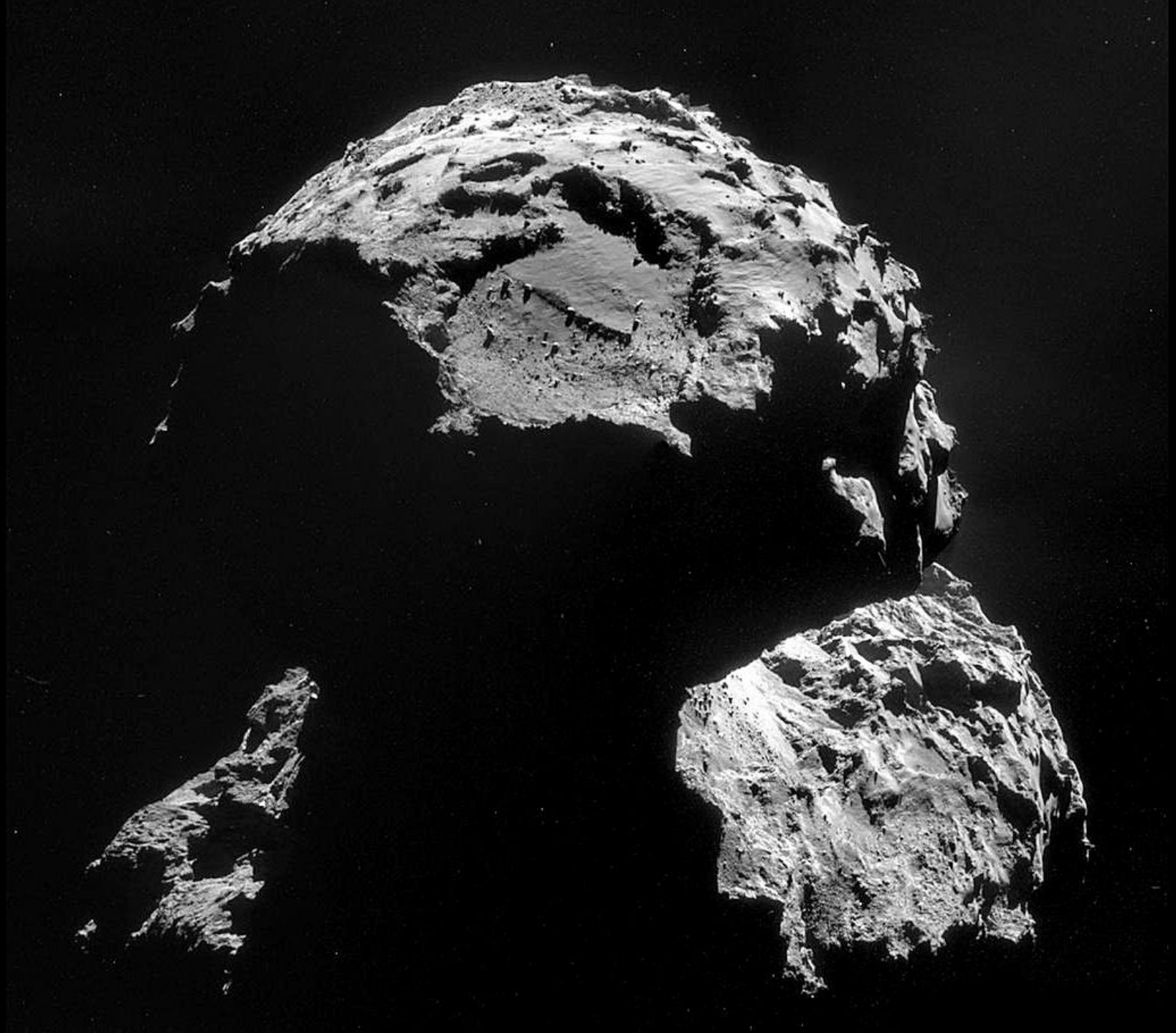
Vnútro asi bolo kedysi pretavené.

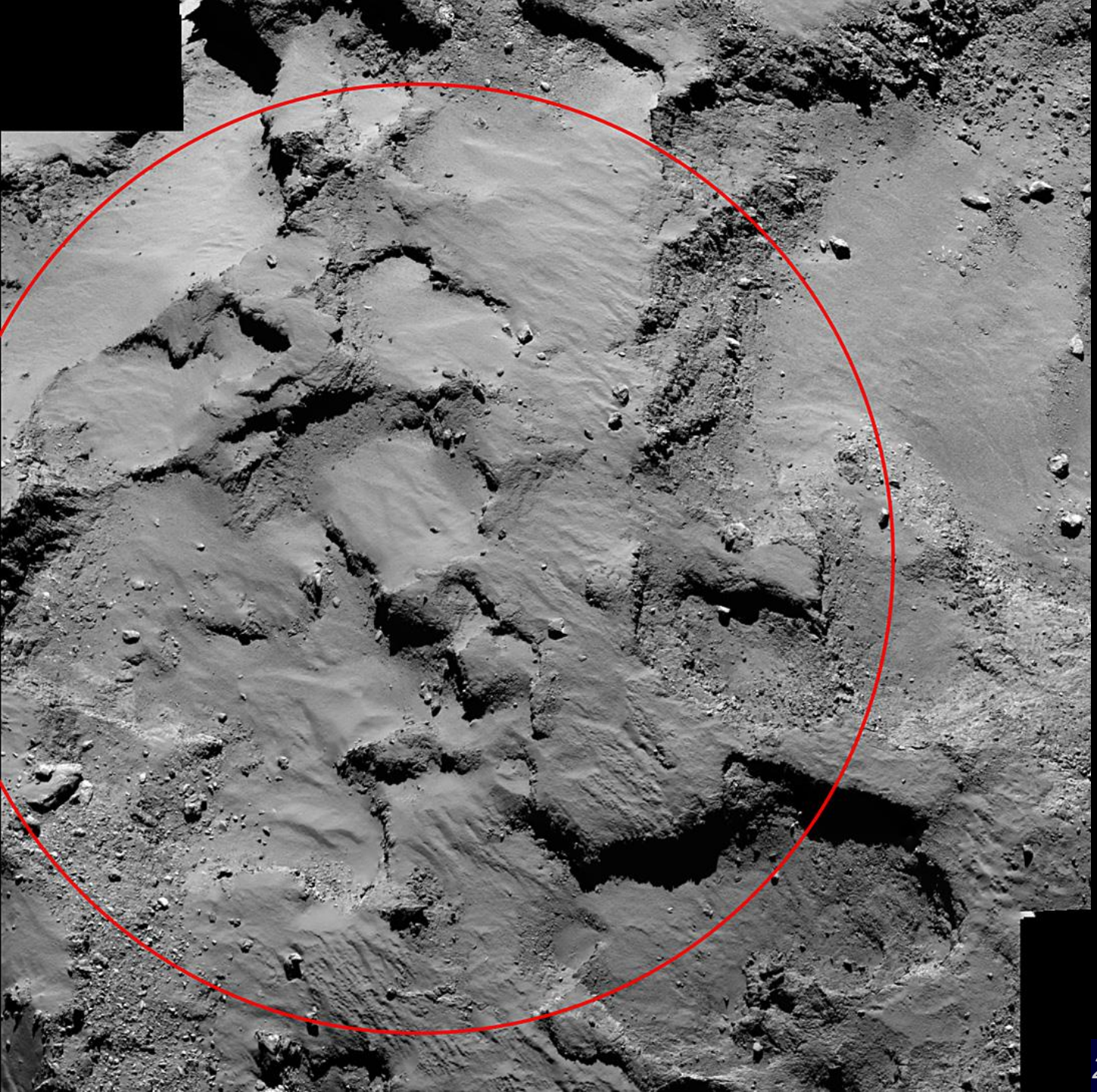
Lutetia je pravdepodobne primordiálna planetezimála.



Rendezvous s 67P (6 august 2014)







AGILKIA

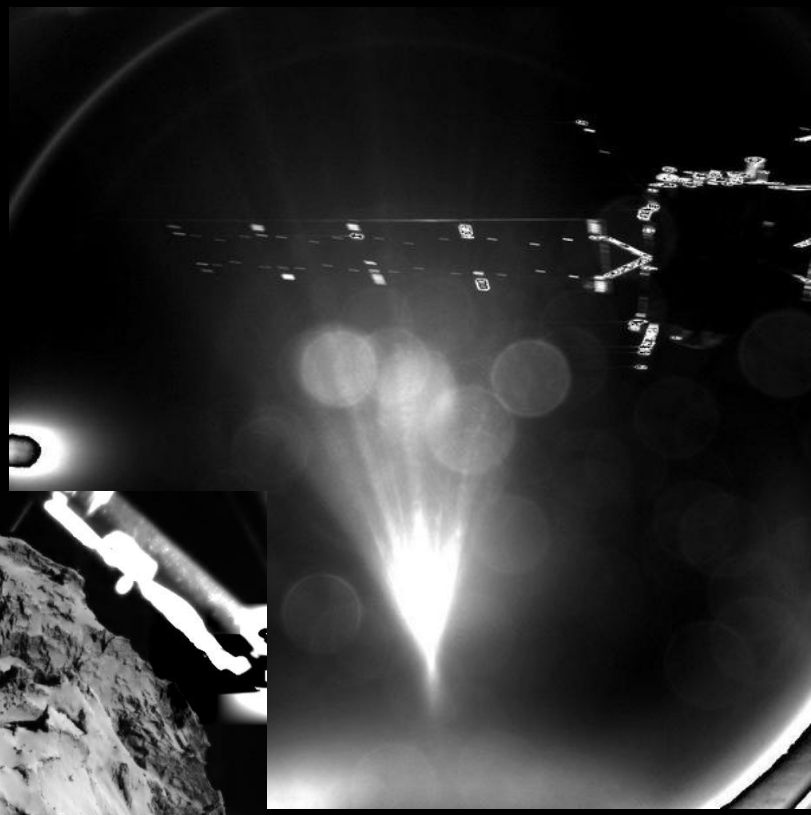
OSIRIS telefoto

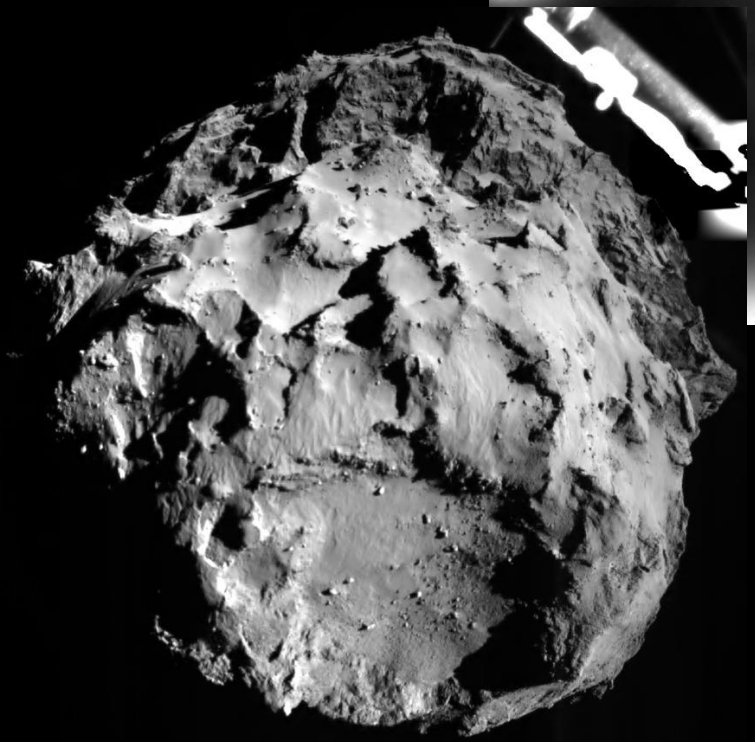
14 September 2014

Záber z výšky 30 km.

Polomer kruhu 500 m.

Pristátie na kométe 67P (12 november 2014)

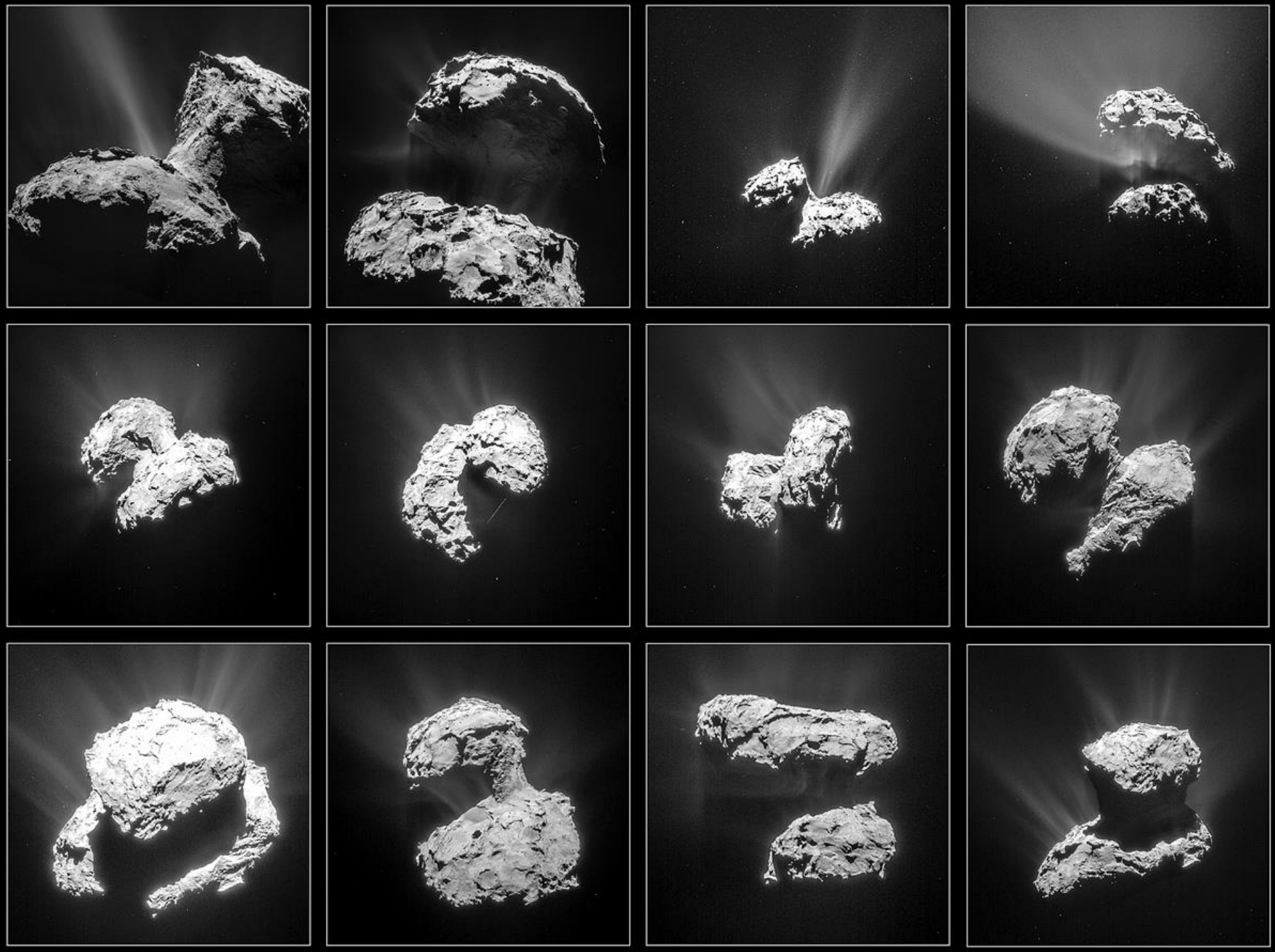




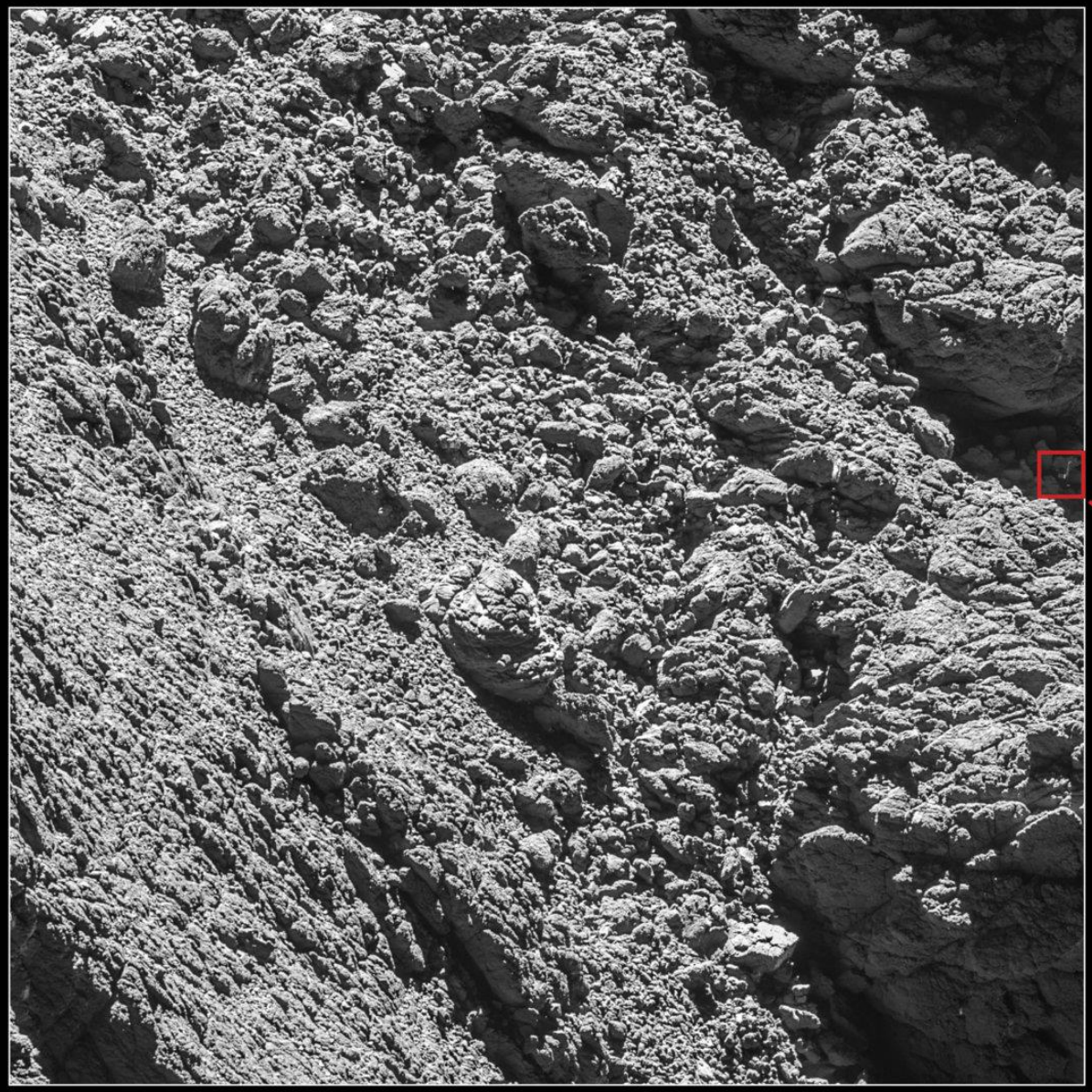
Pristátie na kométe 67P (12 november 2014)

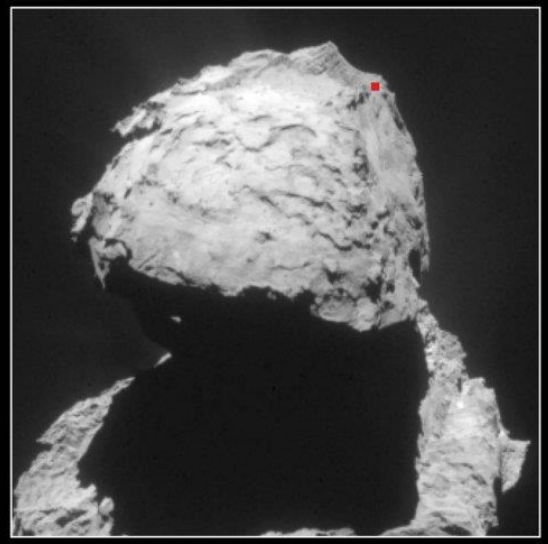
Welcome to a Comet

Prebúdzanie kométy...



Philae found !!! (2. 9. 2016) *2700 m*





Koniec misie (30. 9. 2016, 3.6 AU)

„Grand Finale“ - kontrolovaný náraz v oblasti Maat

Nespočet vedeckých publikácií v prestížnych časopisoch... (doposiaľ, aj v budúcnosti)

Report

67P/Churyumov-Gerasimenko, a Jupiter family comet with a high D/H ratio

K. Altwegg *et al.*

In situ mass spectrometry reveals a deuterium-to-hydrogen ratio three times that of Earth, which is suggestive of diverse origins for comets in this class.

Report

The organic-rich surface of comet 67P/Churyumov-Gerasimenko as seen by VIRTIS/Rosetta

F. Capaccioni *et al.*

The reflectance behavior of an illuminated comet is consistent with the presence of nonvolatile organics and sparse water ice.

Report

Time variability and heterogeneity in the coma of 67P/Churyumov-Gerasimenko

M. Hässig *et al.*

Mass spectrometry performed in situ shows a highly heterogeneous coma with large diurnal and possibly seasonal variations.

RELATED PODCAST

Report

Birth of a comet magnetosphere: A spring of water ions

H. Nilsson *et al.*

The interaction of the solar wind and a comet atmosphere is characterized through detection of the energetic ion environment.

Report

Subsurface properties and early activity of comet 67P/Churyumov-Gerasimenko

S. Gulkis *et al.*

Measurements at a comet yield water production rates and an assessment of low thermal inertia.

Research Article

On the nucleus structure and activity of comet 67P/Churyumov-Gerasimenko

H. Sierks *et al.*

A comet with an unusual shape has an array of surface features and high porosity, with early outgassing between its two lobes.

Research Article

The morphological diversity of comet 67P/Churyumov-Gerasimenko

N. Thomas *et al.*

Images with better than 1-meter-per-pixel resolution shows a comet's morphology with evidence for complex active processes.

Research Article

Dust measurements in the coma of comet 67P/Churyumov-Gerasimenko inbound to the Sun

A. Rotundi *et al.*

Observations of the dust outflow show bound and unbound grains and imply a comparatively high dust-to-gas ratio of 4.

Latest News

Close-ups of comet Churyumov-Gerasimenko/67P reveal an actively sculpted surface

E. Hand

Diversity of features points to a more complicated cometary birth.

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日本語要約

Aggregate dust particles at comet 67P/Churyumov–Gerasimenko

Mark S. Bentley, Roland Schmied, Thurid Mannel, Klaus Torkar, Harald Jeszenszky, Jens Romstedt, Anny-Chantal Levasseur-Regourd, Iris Weber, Elmar K. Jessberger, Pascale Ehrenfreund, Christian Koeberl & Ove Havnes

Affiliations | Contributions | Corresponding author

Nature **537**, 73–75 (01 September 2016) | doi:10.1038/nature19091

Received 17 December 2015 | Accepted 06 July 2016 | Published online 31 August 2016

The presence of clathrates in comet 67P/Churyumov-Gerasimenko

Article *in* Science Advances · April 2016

DOI: 10.1126/sciadv.1501781

Properties of the 67P/Churyumov-Gerasimenko interior revealed by CONSERT radar

Article *in* Science · July 2015

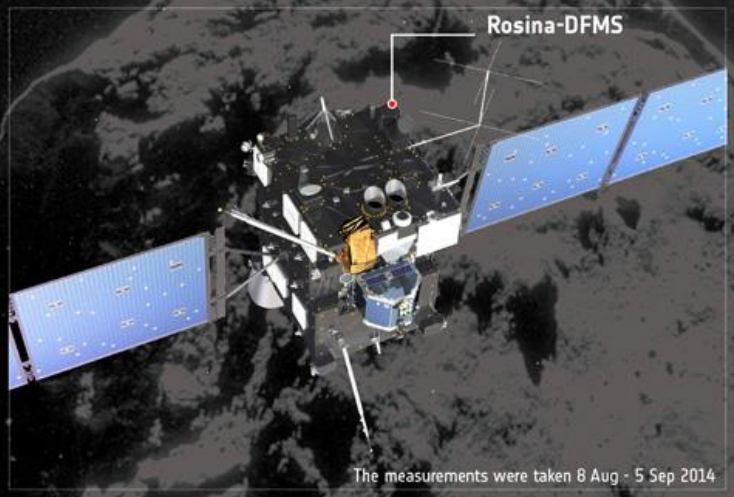
DOI: 10.1126/science.aab0639

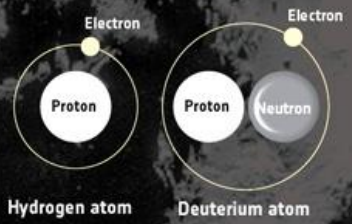
Voda z kométy 67P je iná... (Iné izotopové zloženie - D/H pomer)

Zem: 1.56×10^{-4} (0.0156 %)

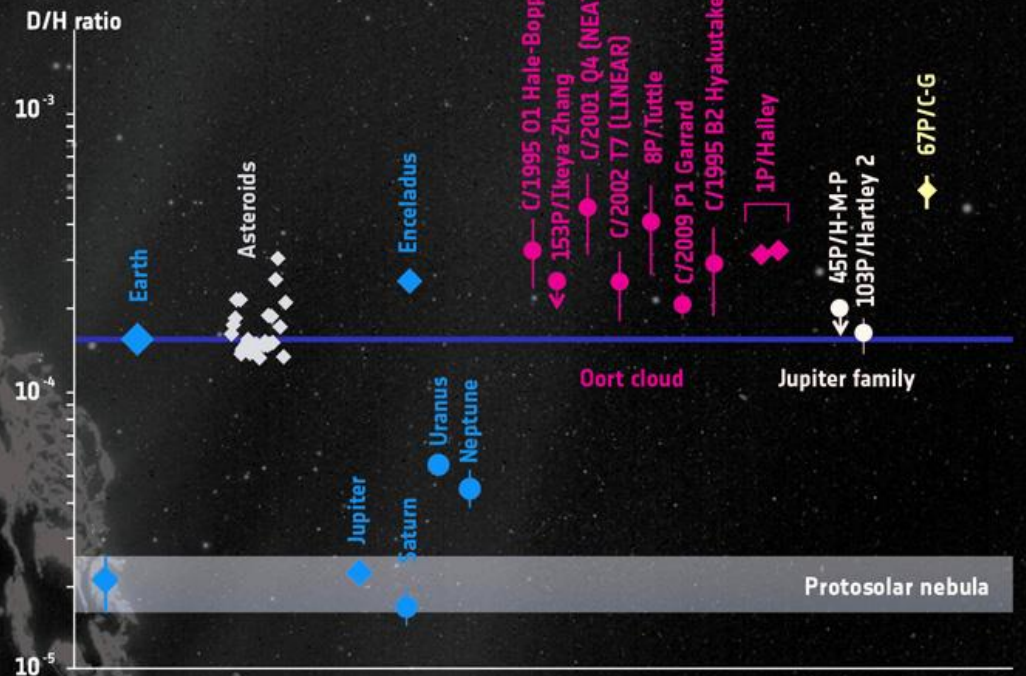
67P: 5.3×10^{-4} (0.053 %)

Rosetta's ROSINA instrument finds Comet 67P/Churyumov-Gerasimenko's water vapour to have a significantly different composition to Earth's oceans.





The ratio of deuterium to hydrogen in water is a key diagnostic to determining where in the Solar System an object originated and in what proportion asteroids and comets may have contributed to Earth's oceans



D/H ratio for different Solar System objects, grouped by colour as planets and moons (blue), chrondritic meteorites from the Asteroid Belt (grey), comets originating from the Oort cloud (purple) and Jupiter family comets (pink). Comet 67P/C-G, a Jupiter family comet, is highlighted in yellow. ◆ = data obtained in situ ● = data obtained by astronomical methods

www.esa.int

Spacecraft: ESA/ATG medialab; Comet: ESA/Rosetta/NAVCAM; Data: Altwegg et al. 2014 and references therein.

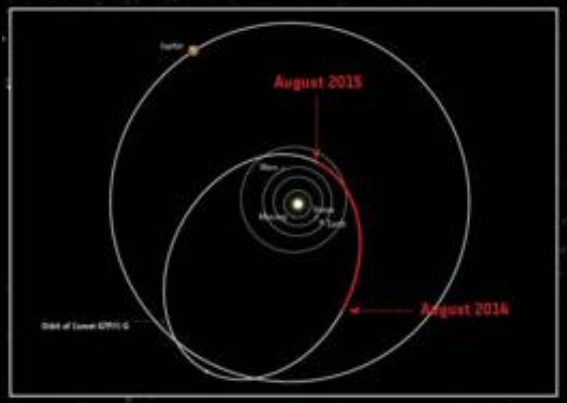
European Space Agency

Bio-prekurzory: fosfor a aminokyselina glycín

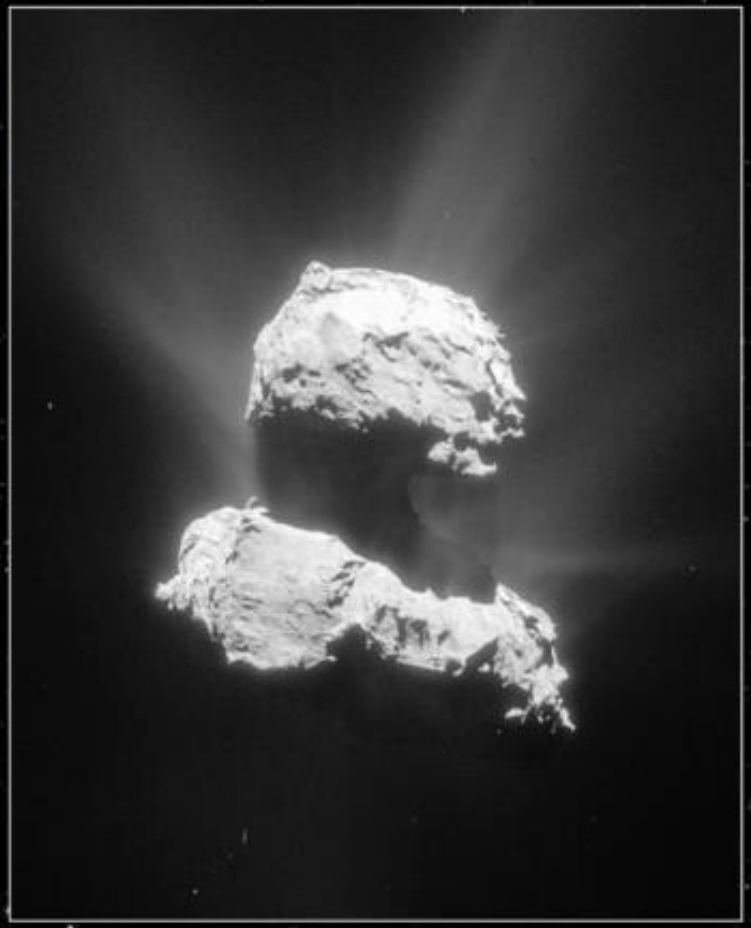
ROSETTA'S COMET CONTAINS INGREDIENTS FOR LIFE

esa

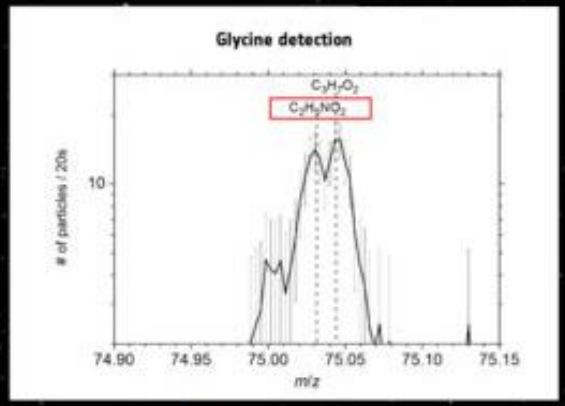
The measurements were made with the Rosetta Orbiter Spectrometer for Ion and Neutral Analysis Double-Focusing Mass Spectrometer (ROSINA-DFMS).



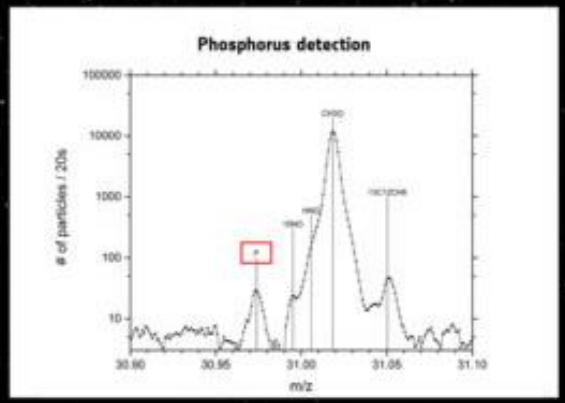
The data were collected between August 2014 and August 2015.



The measurements were made when Rosetta was between 10 and 200 km from the comet.



Spectrum indicating glycine ($C_2H_5NO_2$) detection on 9 July 2015. The simple amino acid glycine is a biologically important organic compound commonly found in proteins.



Spectrum indicating phosphorus (P) detection, along with other gases, on 26 October 2014. Phosphorus is a key element in all living organisms. It is found in DNA, RNA and in cell membranes, and it is used in transporting chemical energy within cells for metabolism.

Rosetta – resume

- ROSETTA sa ako prvá sonda v histórii stala súputnikom kométy v studenej oblasti Slnečnej sústavy a zblízka pozorovala jej aktivitu pri približovaní sa k Slnku, prechode perihéliom a pri návrate do zmrznutého stavu.

- Prvýkrát v histórii dielo vytvorené človekom kontrolovane pristálo na jadre kométy, a analyzovalo praveký materiál, z ktorého sa kedysi zrodila naša Slnečná sústava.


esa
European Space Agency
Presents this certificate to
Jan Balaz
In recognition of your outstanding contribution to the ESA Rosetta Mission
Alvaro Giménez
Director of Science
European Space Agency
Patrick Martin
Rosetta Mission Manager
European Space Agency
Matt Taylor
Rosetta Project Scientist
European Space Agency
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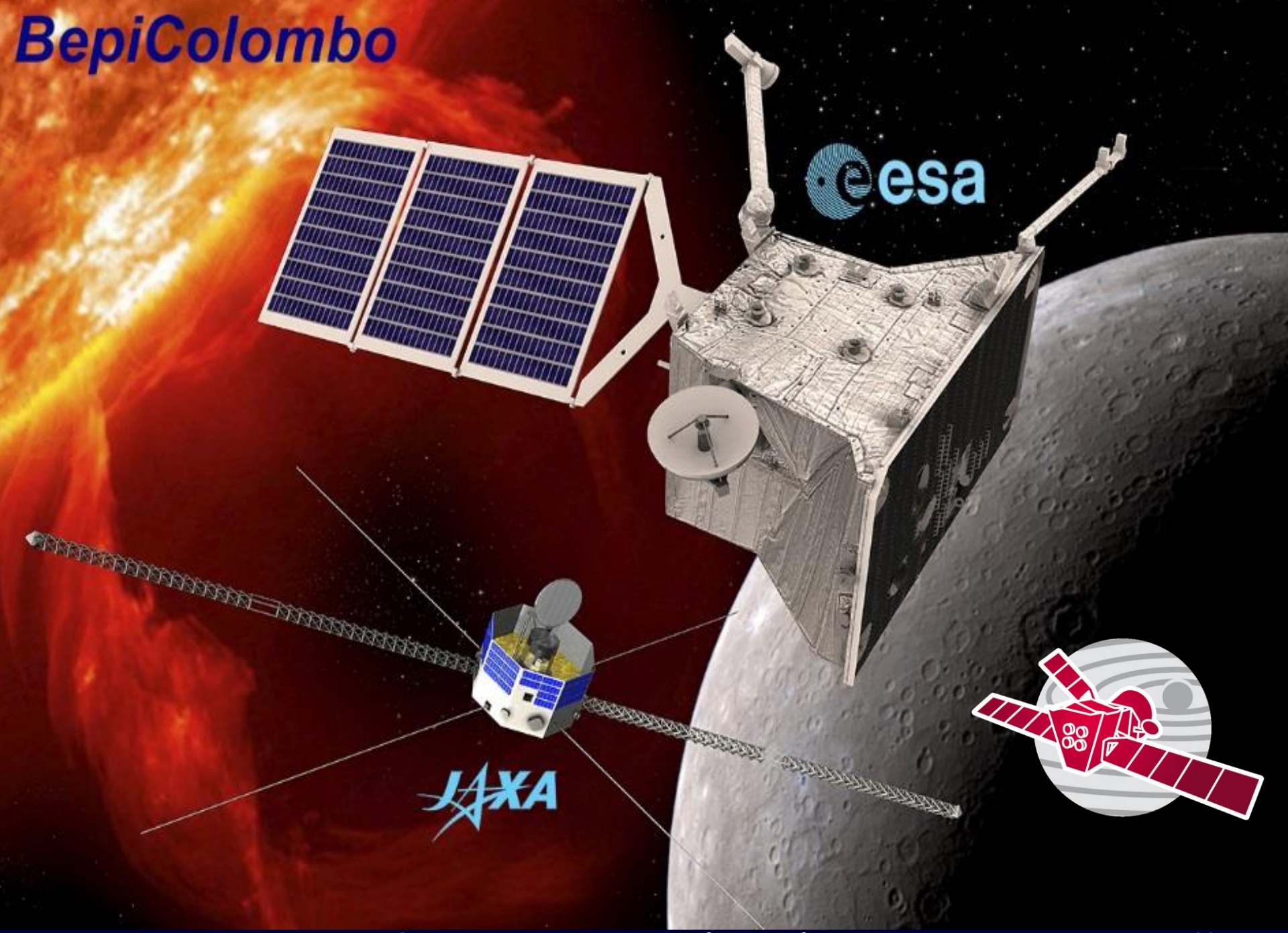
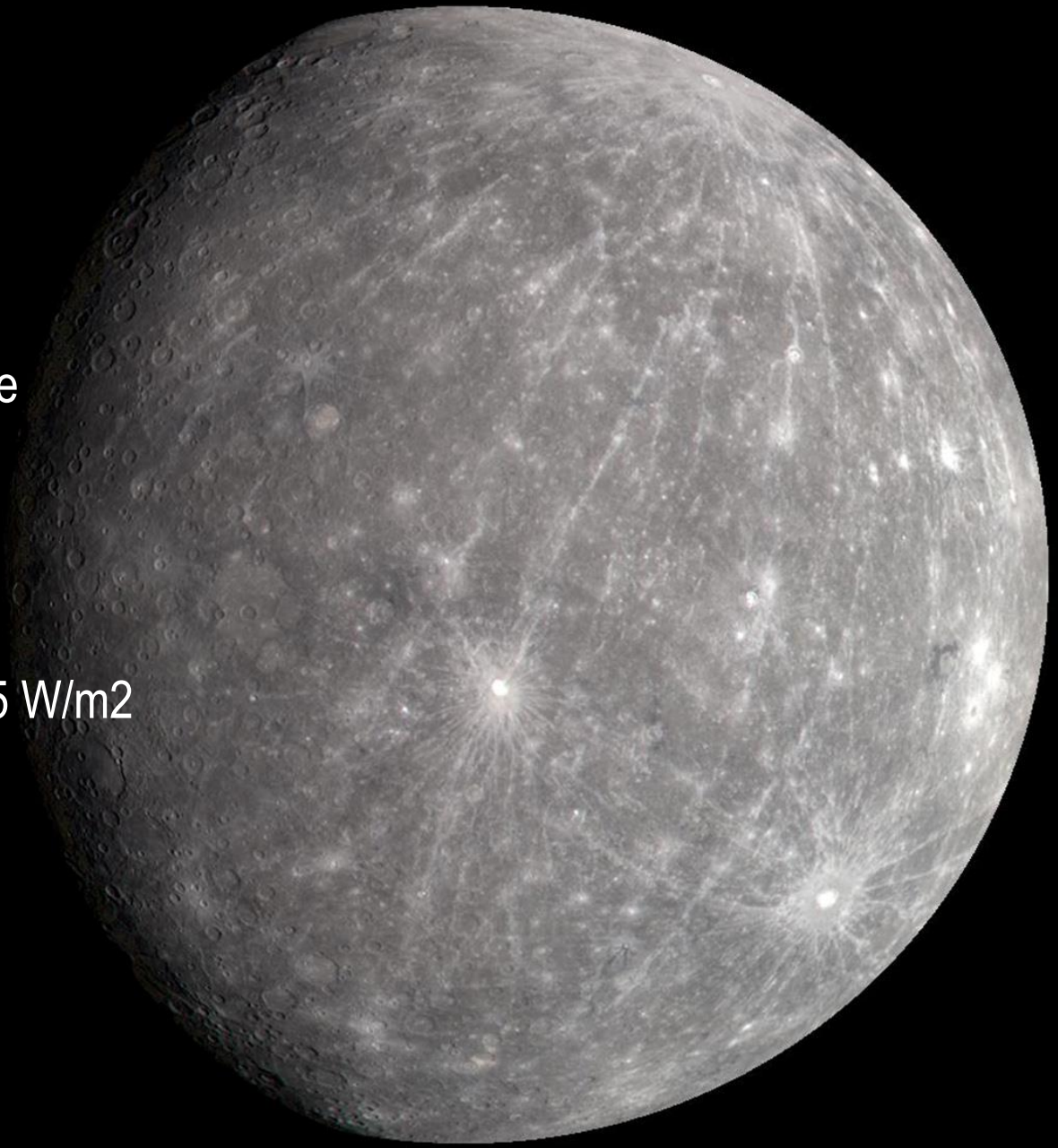
BepiColombo

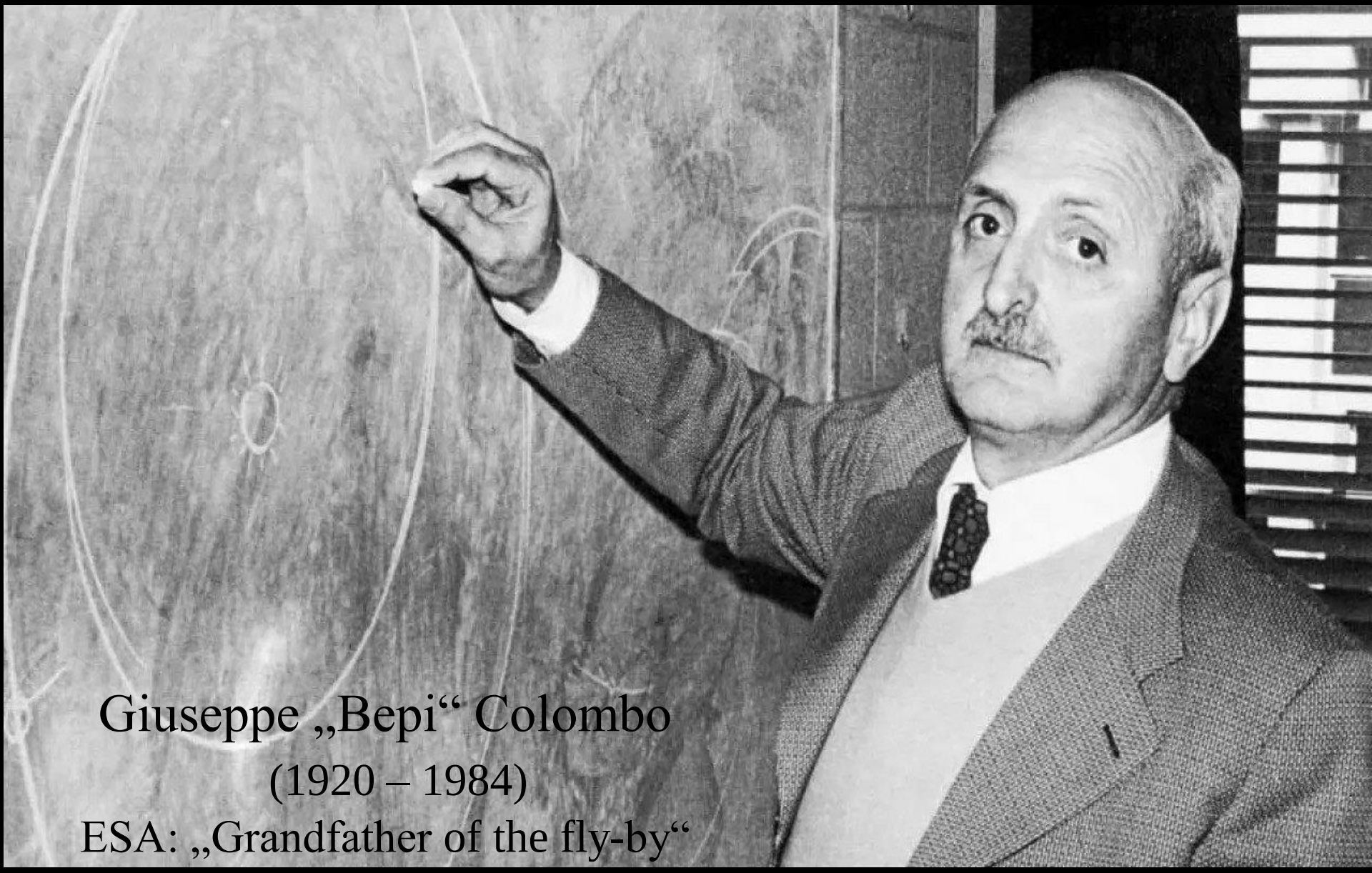


Merkúr



Najmenšia planéta
Najbližšia k Slnku
Má vlastné magnetické pole
Priemer: 4880 km
Orbita: 0,3 - 0,47 AU
Dĺžka dňa: 176 pozem. dní
Dĺžka roka: 88 pozem. dní
Slnečná konšt. 6288-14535 W/m2
Albedo: 0,088
Teplota deň: +427°C max
Teplota noc: -193°C min
Hustota: 5427 kg/m3
Kovové jadro >70% jeho hmotnosti

Prečo „BepiColombo“ ?



Giuseppe „Bepi“ Colombo
(1920 – 1984)
ESA: „Grandfather of the fly-by“

Vedecké zámery misie BepiColombo

- Pôvod a vývoj planéty v blízkosti materskej hviezdy
- Vnútorná štruktúra a zloženie planéty
- Charakterizovanie a pôvod magnetického poľa
- Povrchové procesy, krátery, tektonika, depozity a vulkanizmus
- Štruktúra, zloženie, pôvod a dynamika exosféry
- Štruktúra a dynamika magnetosféry
- Potvrdenie Einsteinovej Všeobecnej teórie relativity presným meraním orbity a polohy satelitu

Vedecký náklad (payload) MPO

1. BELA Laser Altimeter
2. ISA Radio science ACC: accelerometer
3. MERMAG Magnetometer
4. MERTIS IR spectrometer
5. MANGA Gamma ray and neutron spectrometer
6. MIXS X-ray spectrometer
7. MORE Radio science Ka-band transponder
8. PHEBUS UV spectrometer
9. SERENA Neutral and ionised particle analyser
10. SIMBIO High resolution camera-spectrometer
11. SIXS Solar monitor

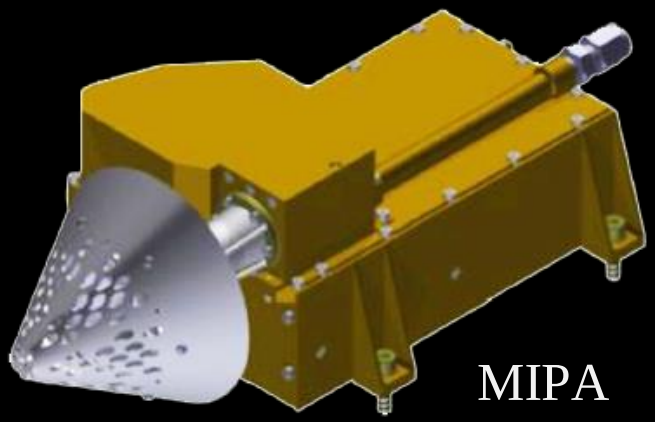
serena

Search for Exospheric Refilling and Emitted Natural Abundances

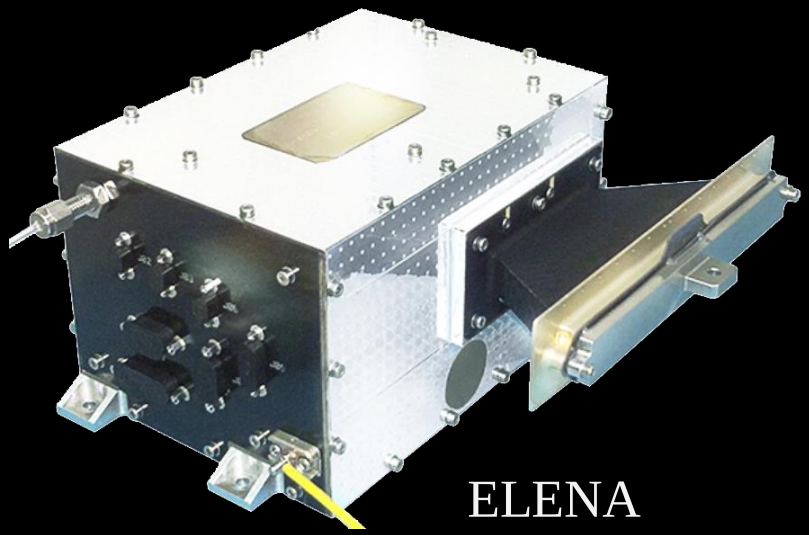
ELENA (Emitted Low Energy Neutral Atoms) INAF, Italy
MIPA (Miniature Ion Precipitation Analyzer) IRF, Sweden http://serena.iaps.inaf.it/
PICAM (Planetary Ion CAMera) carried out IWF, Austria
STROFIO (STart from a ROtating Field mass spectrOmeter) SwRI, USA

- Chemical and elemental composition of the exosphere
- Neutral gas density profiles and asymmetries
- Exo-ionosphere composition
- Exo-ionosphere spatial and energy distribution
- Ion precipitation rate
- Surface emission rate and release processes (both neutrals and ions)
- Particle loss rate from Mercury's environment
- Remote sensing of the surface composition
- Magnetosphere structure and dynamics
- Planetary response to solar wind variations
- ENA imaging applications for comparative solar-planetary relationship
- Heavy ion sputtering products

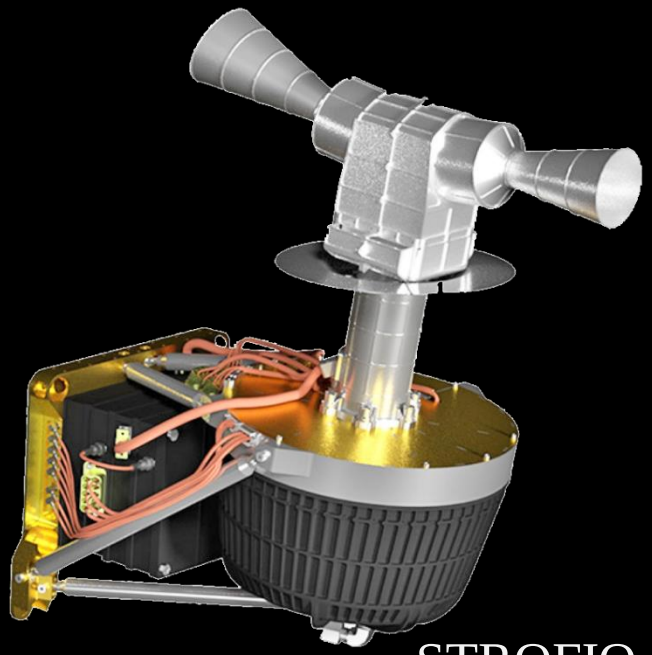
SERENA



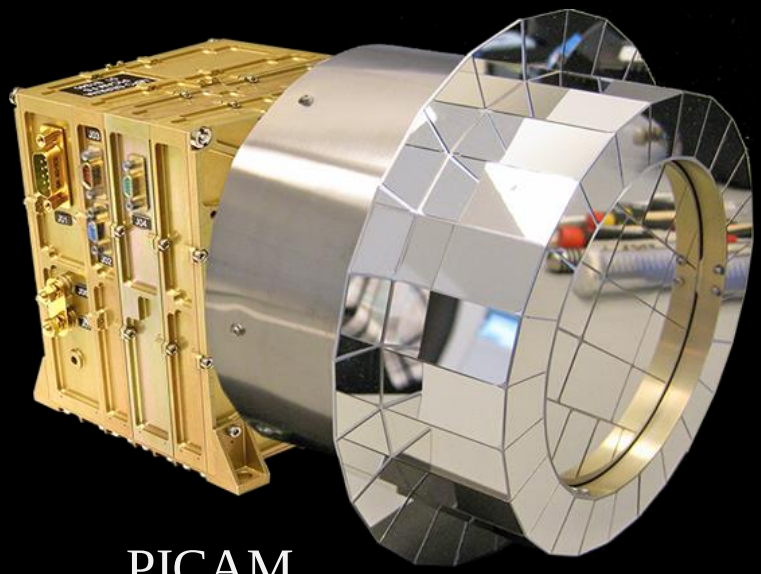
MIPA



ELENA



STROFIO



PICAM

SERENA v Space Science Review

Space Sci Rev (2021) 217:11
https://doi.org/10.1007/s11214-020-00787-3

SERENA: Particle Instrument Suite for Determining the Sun-Mercury Interaction from BepiColombo

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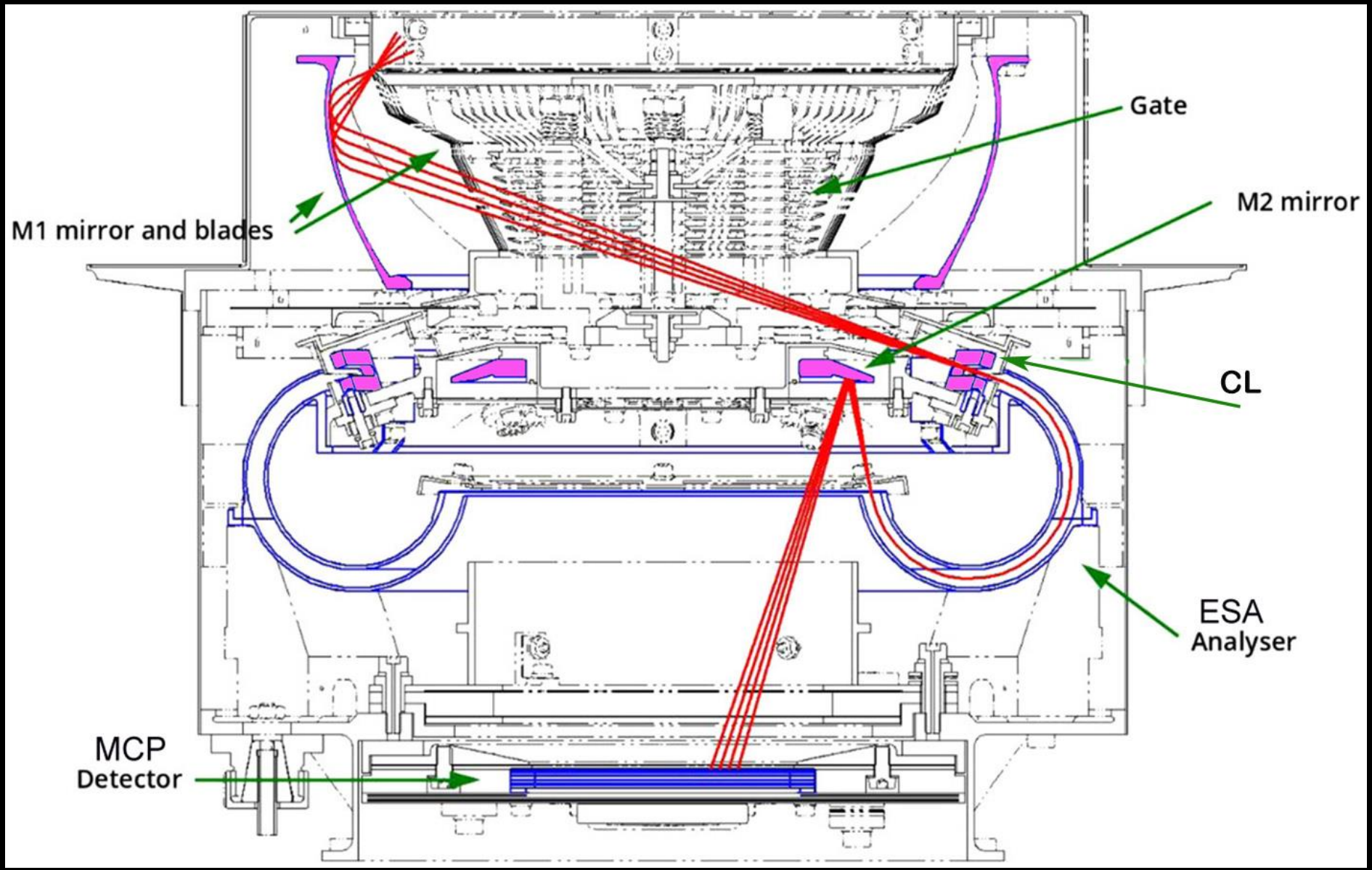
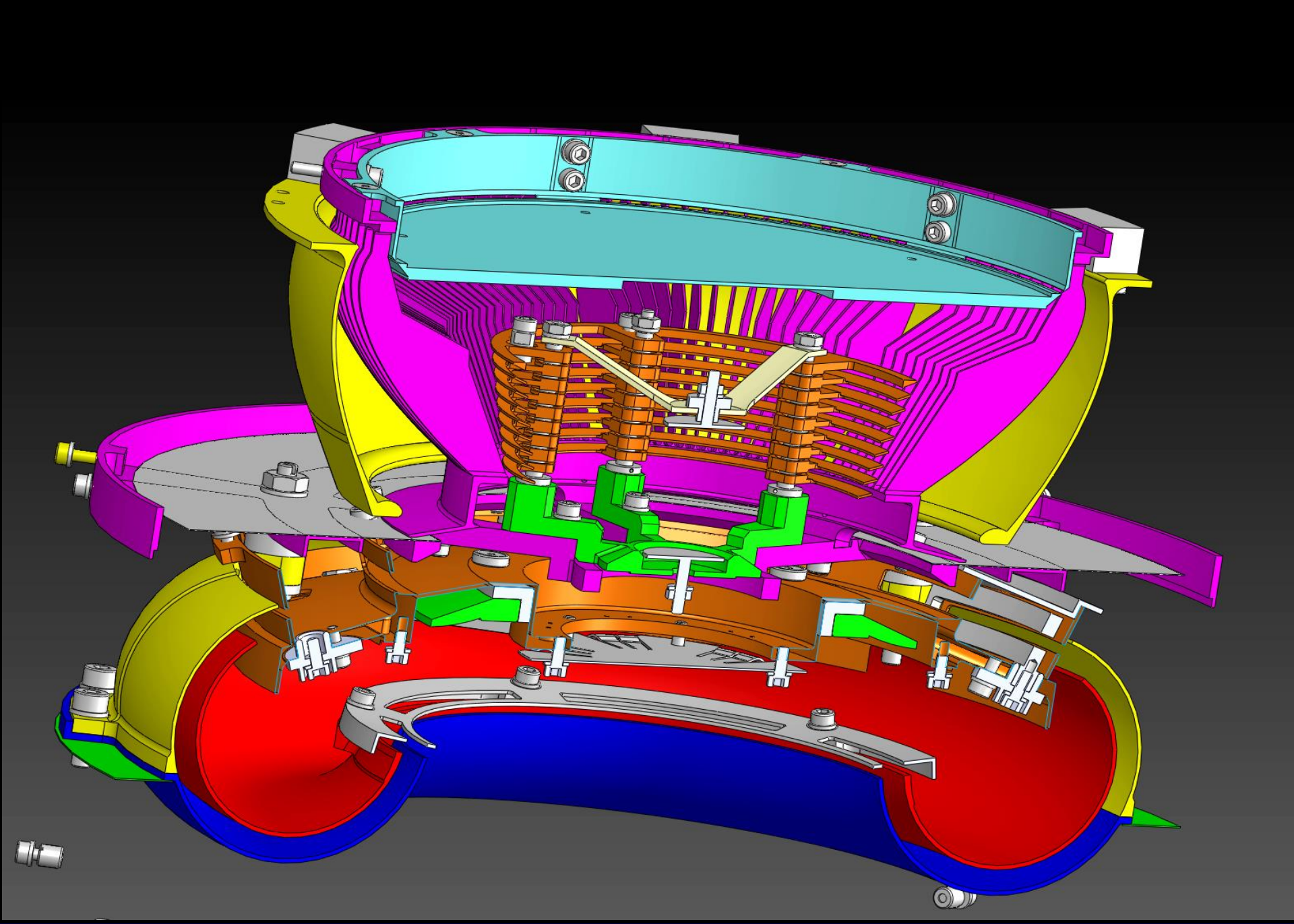
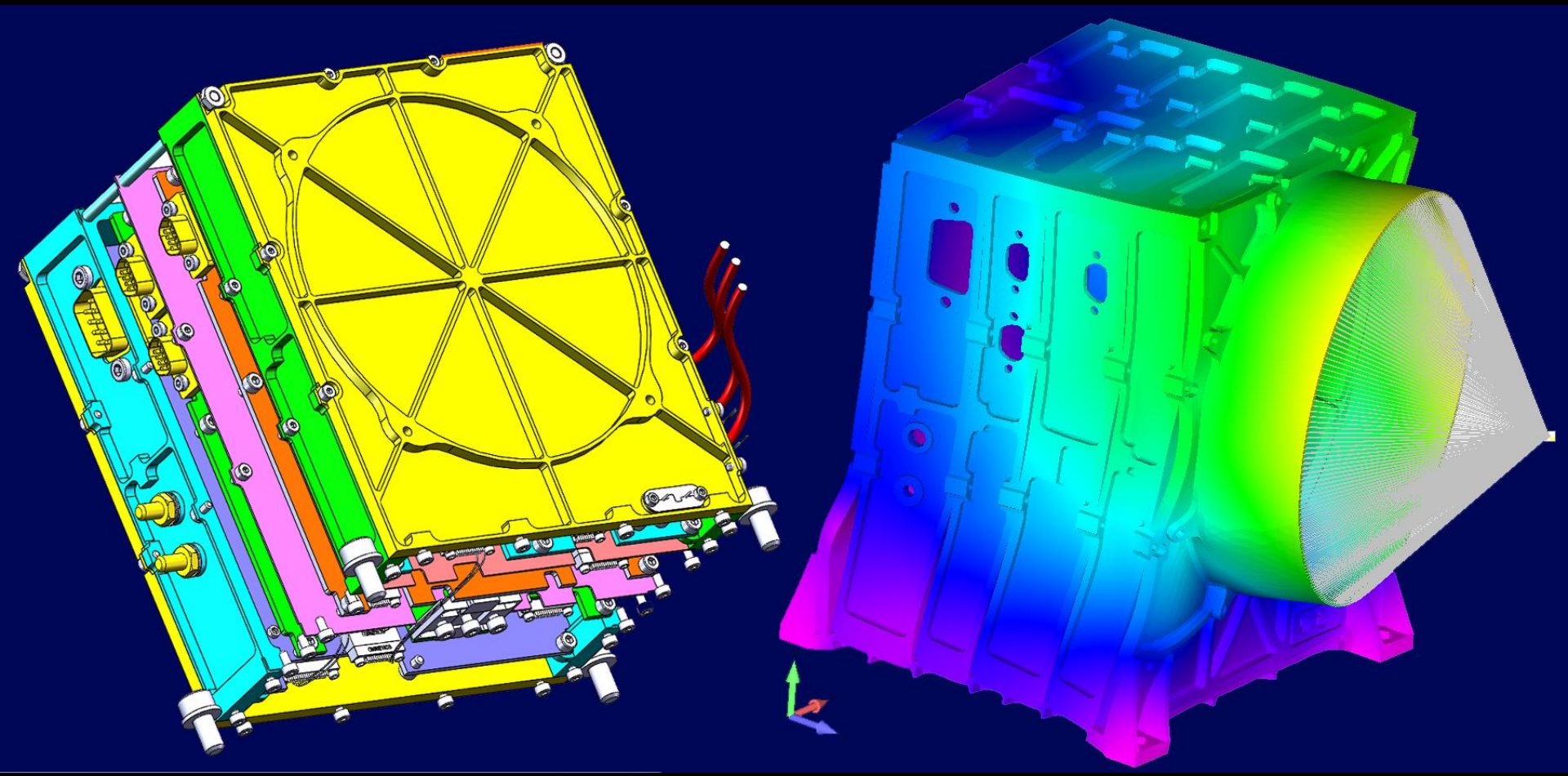
25 Institute of Experimental Physics SAS, Slovak Academy of Sciences, 040 01 Košice, Slovakia

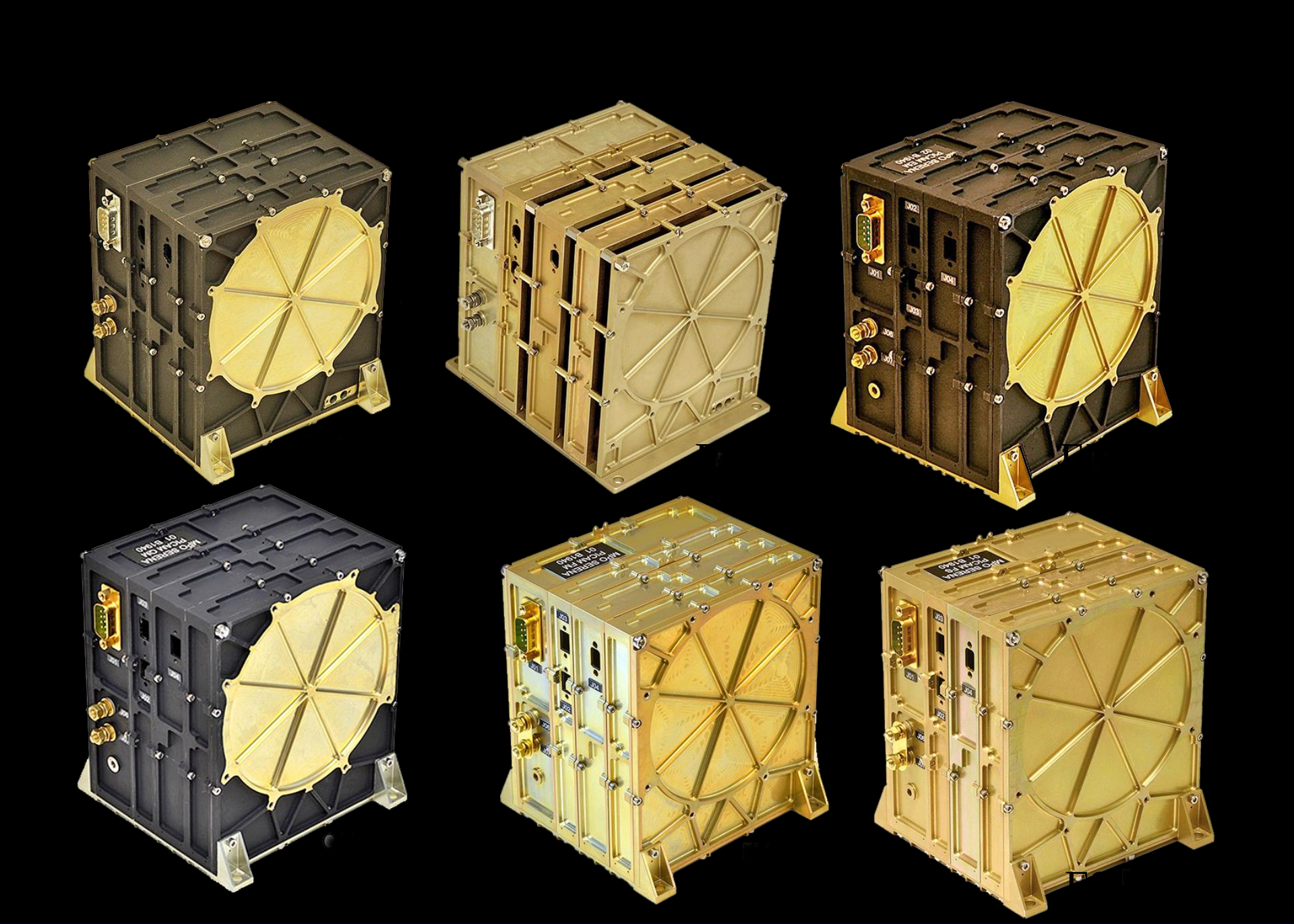
26 Istituto di Struttura della Materia (CNR-ISM), 00133 Roma, Italy

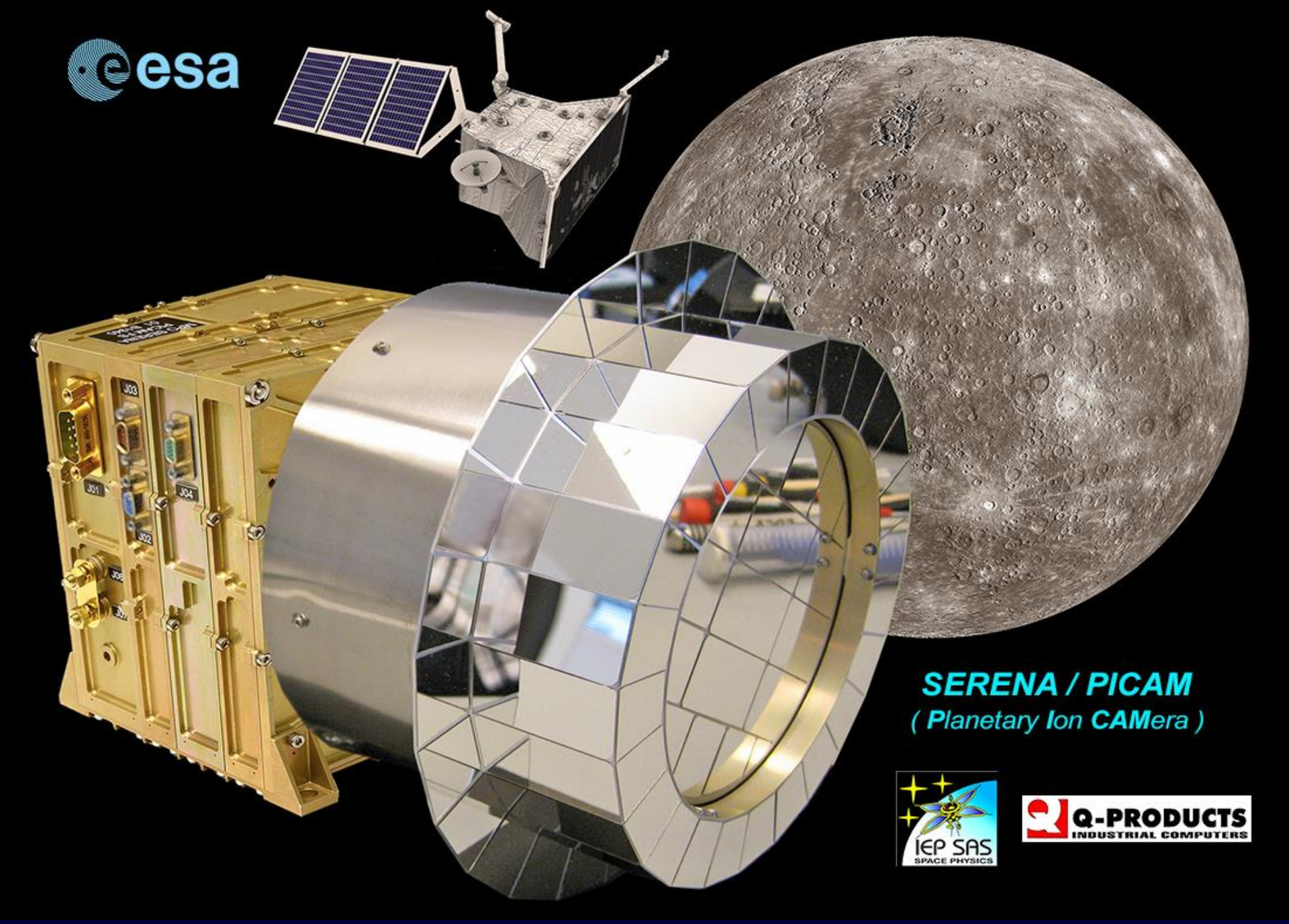
PICAM princíp činnosti









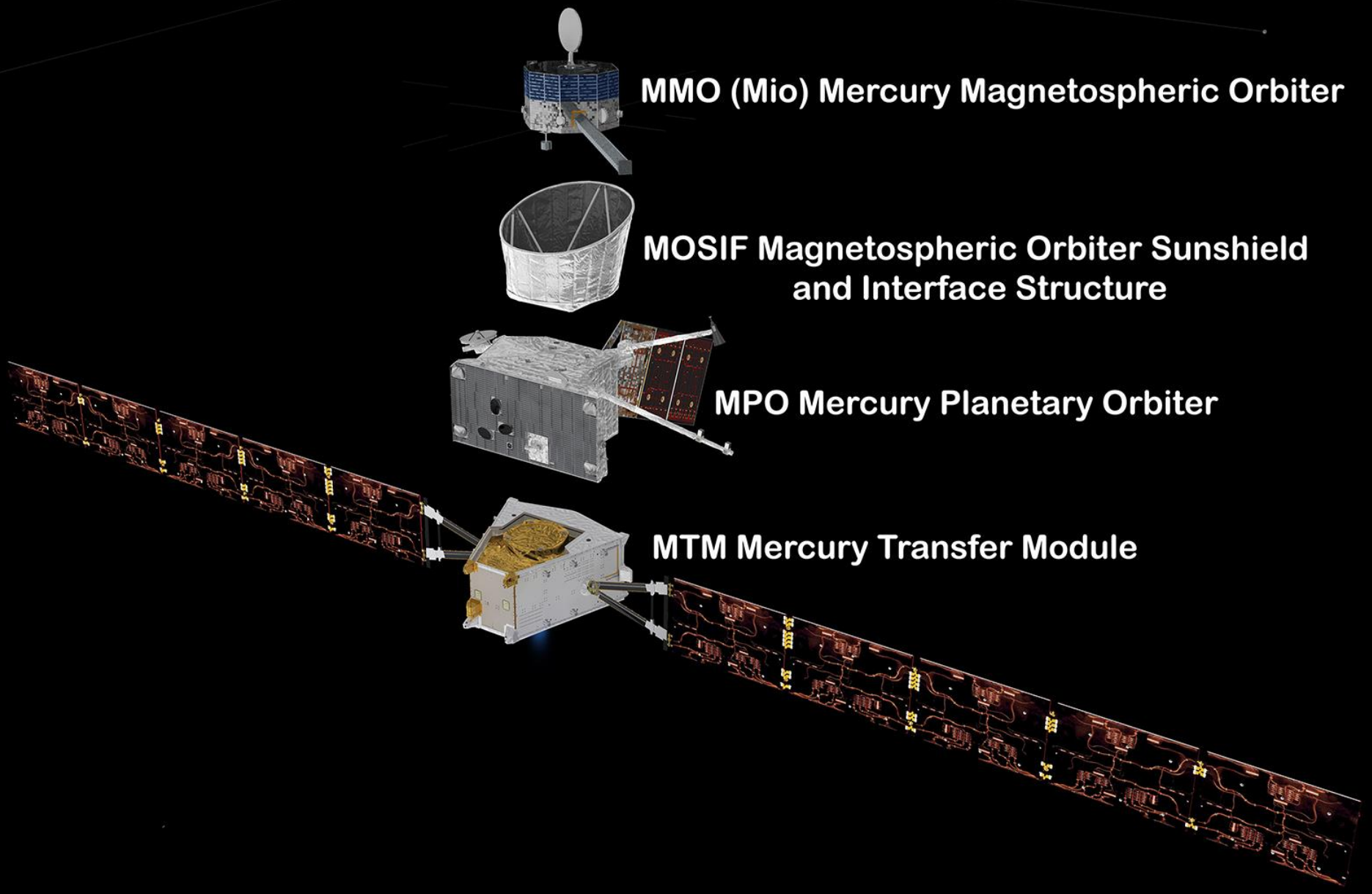

esa
SERENA / PICAM
(Planetary Ion CAMera)
IEP SAS
SPACE PHYSICS
Q-PRODUCTS
INDUSTRIAL COMPUTERS

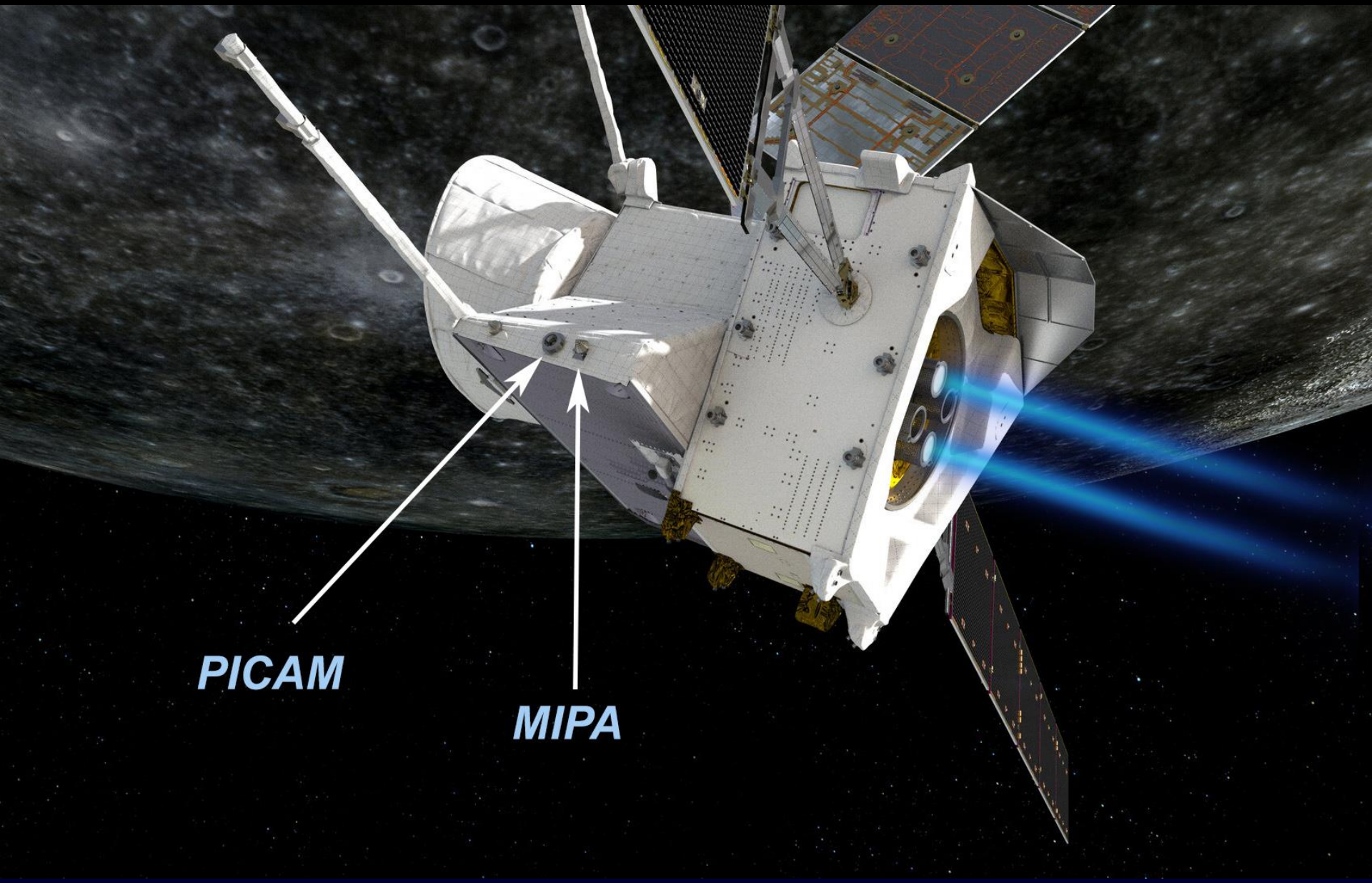
KEY MISSION DATES

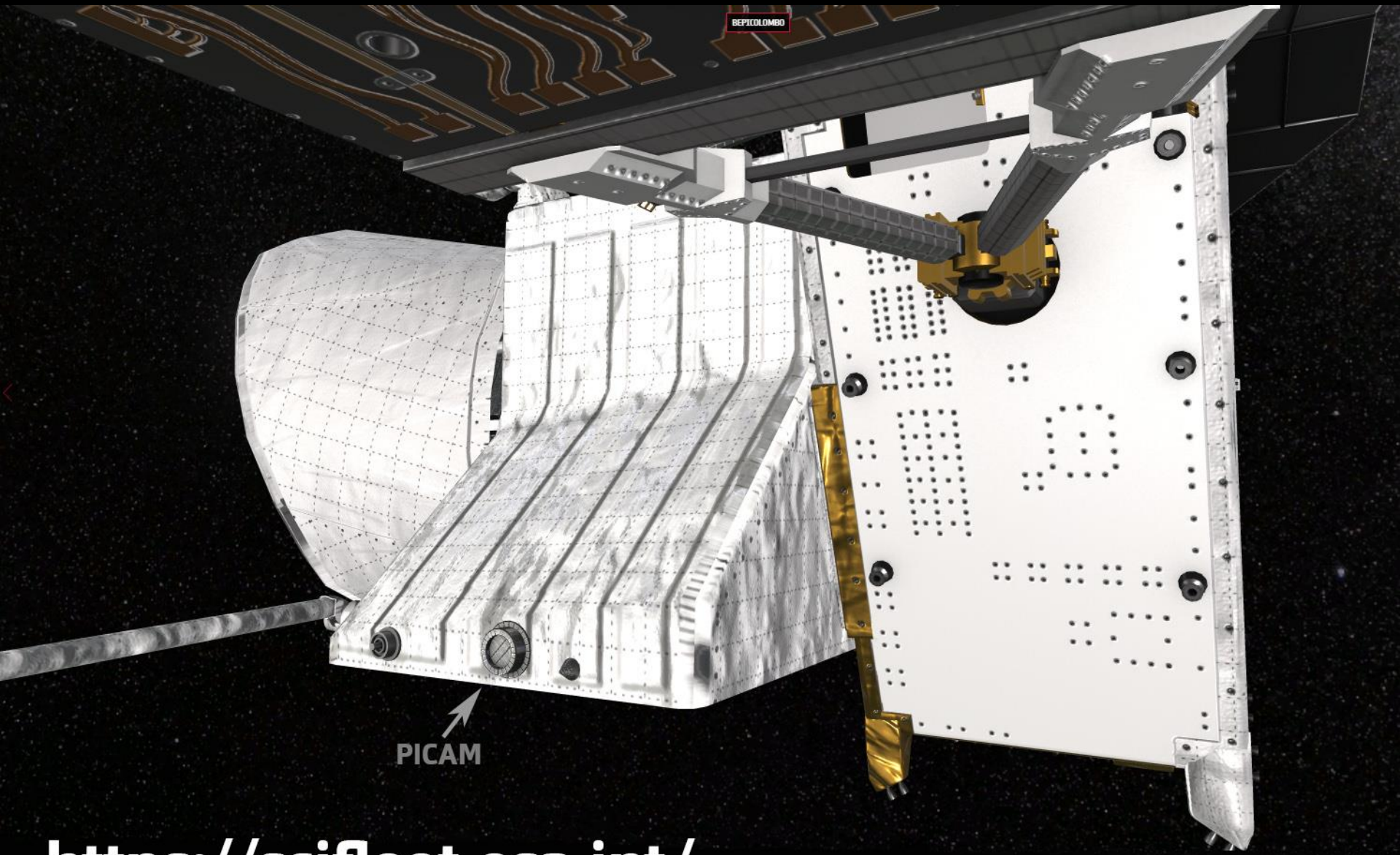
Date	Mission event
20 October 2018	Launch
13 April 2020	Earth flyby
16 October 2020	First Venus flyby
11 August 2021	Second Venus flyby
1 October 2021	First Mercury flyby
23 June 2022	Second Mercury flyby
20 June 2023	Third Mercury flyby
5 September 2024	Fourth Mercury flyby
2 December 2024	Fifth Mercury flyby
9 January 2025	Sixth Mercury flyby
5 December 2025	Arrival at Mercury
14 March 2026	MPO in final orbit
1 May 2027	End of nominal mission
1 May 2028	End of extended mission

BepiColombo

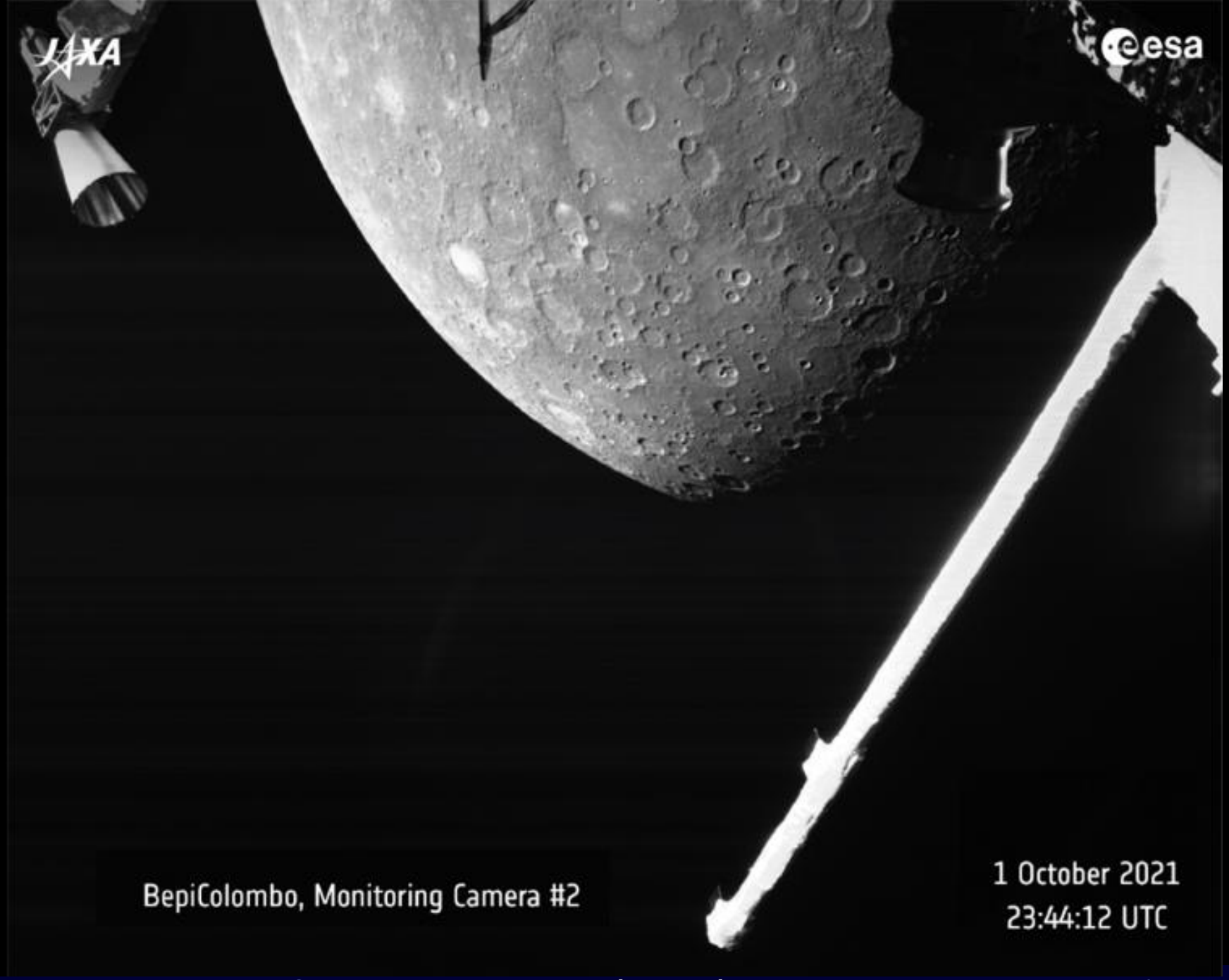
BepiColombo




PICAM
MIPA



https://scifleet.esa.int/


JAXA
esa
BepiColombo, Monitoring Camera #2
1 October 2021
23:44:12 UTC

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Inner southern magnetosphere observation of Mercury via SERENA ion sensors in BepiColombo mission

S. Orsini, A. Milillo, H. Lichtenegger, A. Varsani, S. Barabash, S. Livi, E. De Angelis, Nilsson, M. Phillips, A. Aronica, E. Kallio, P. Wurz, A. Olivieri, C. Plainaki, J. A. Slavin, I Raines, J. Benkhoff, J. Zender, J.-J. Berthelier, M. Dosa, G. C. Ho, R. M. Killen, S. McKe Vaisberg, F. Allegrini, I. A. Daglis, C. Dong, C. P. Escoubet, S. Fatemi, M. Fränz, S. Ivar Lammer, François Leblanc, V. Mangano, A. Mura, R. Rispoli, M. Sarantos, H. T. Smith A. M. Di Lellis, G. Fremuth, F. Giner, R. Gurnee, J. Hayes, H. Jeszenszky, B. Trantham, J. Balaz, W. Baumjohann, M. Cantatore, D. Delcourt, M. Delva, M. Desai, H. Fischer, A. Galli, M. Grande, M. Holmström, I. Horvath, K. C. Hsieh, R. Jarvinen, R. E. Johnson, A. Kazakov, K. Kecskemety, H. Krüger, C. Kürbisch, Frederic Leblanc, M. Leichtfried, E. Mangraviti, S. Massetti, D. Moissenko, M. Moroni, R. Noschese, F. Nuccilli, N. Paschalidis, J. Ryno, K. Seki, A. Shestakov, S. Shuvalov, R. Sordini, F. Stenbeck, J. Svensson, S. Szalai, K. Szego, D. Toublanc, N. Vertolli, R. Wallner & A. Vorburger — Show fewer authors

J. Balaz View ORCID ID profile

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Nature Communications **13**, Article number: 7390 (2022) | Cite this article

Niektoré závery z prvého preletu (Nature comm.)

- Prúdy protónov s energiou niekoľko keV na nočnej strane vnútri magnetosféry vypovedajú o distribúcii plazmy s charakterom prstencového prúdu.

- Magnetopauza a rázová vlna na dennej strane boli detegované oveľa bližšie k planéte, než sa očakávalo, čo svedčí o magnetosfére silne erodovanej slnečným vetrom.

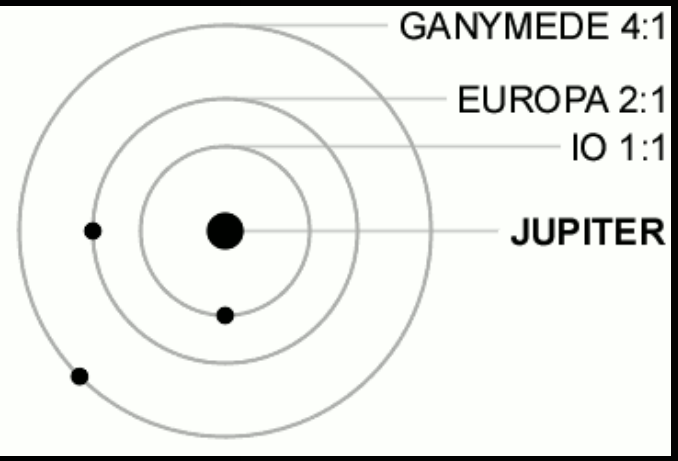
- Prístroje vedeckého komplexu SERENA, PICAM a MIPA detegovali rozličné plazmové oblasti v magnetosfére a odhalili detaily, ktoré ešte nikdy neboli pozorované

JUICE

***JU**piter*
***IC**y moons*
***E**xplorer*

Jupiter a jeho "galileovské mesiace"

(Galileo 1610)



Mesiac, 3474 km

Zem, 12742 km

Vj / Vz = 1321

Mj / Mz = 318

Callisto, 4820 km

Ganymedes, 5268 km

Europa, 3120 km

Io, 3643 km

Jupiter 140 000 km

rot ~10h

Galileovské mesiace

(známych mesiacov: 79)

Najnovšie už 92 !!!

Callisto, 1 882 700 km, 16.69 d

Ganymedes, 1 074 000 km 7,154 d

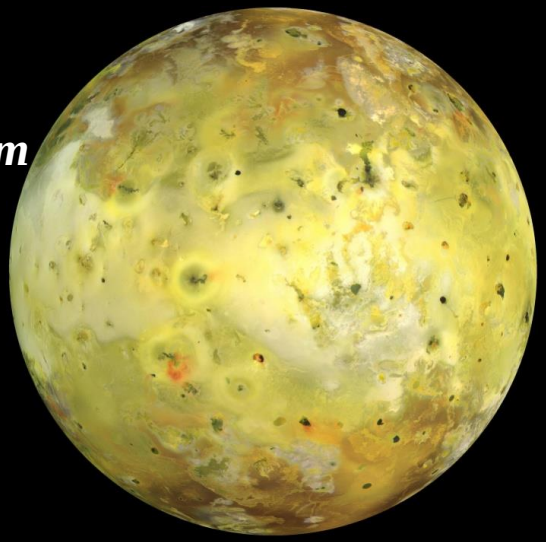
Europa, 670 900 km 3.55 d

Io 421 700 km 1,77 d

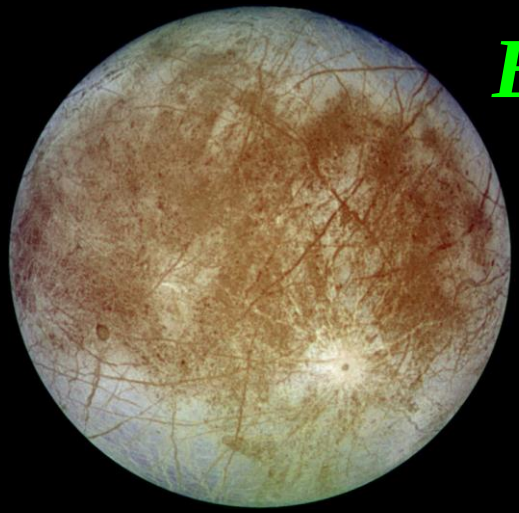
778 Mkm 11,86 r

Ganymedes
5286 km

Io
3643km



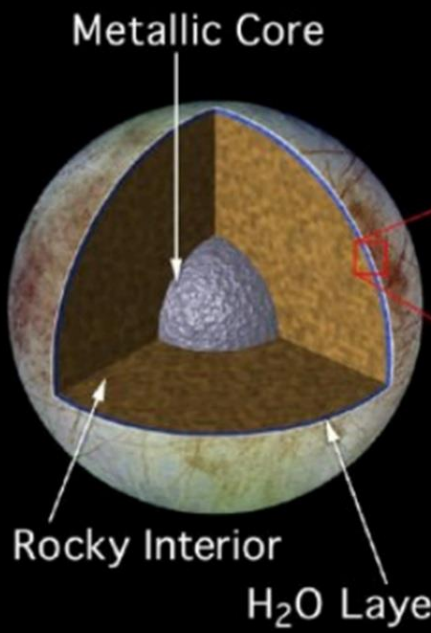
Kallisto
4820 km

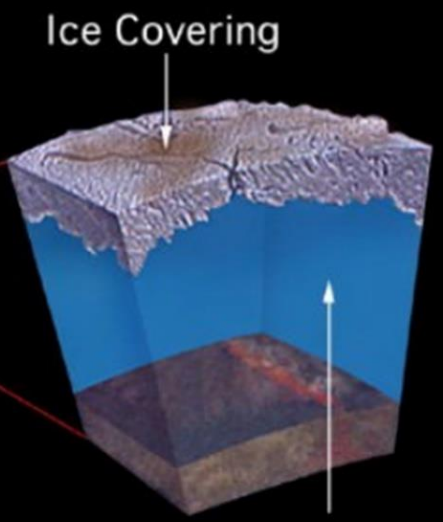


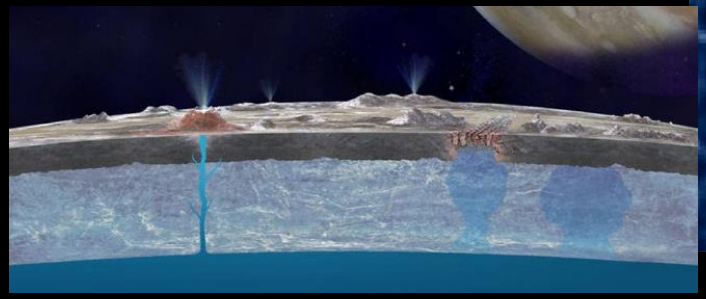
Európa
3120 km

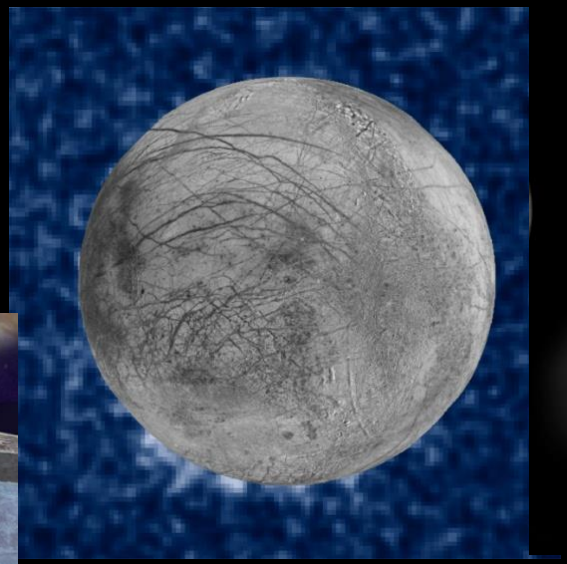
(Merkúr: 4880 km, Mesiac Zeme: 3475 km)

Európa



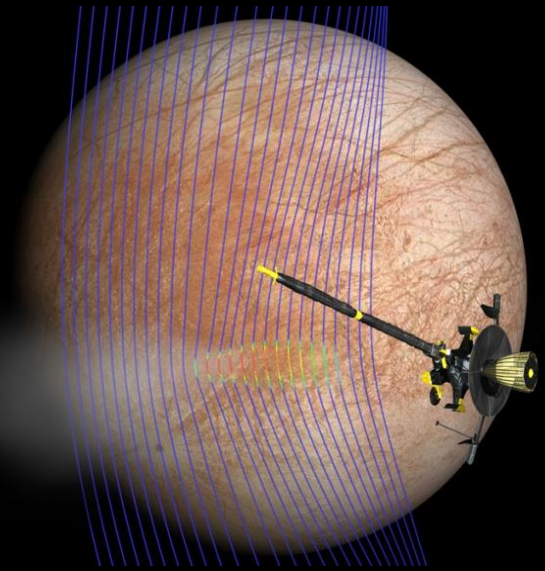






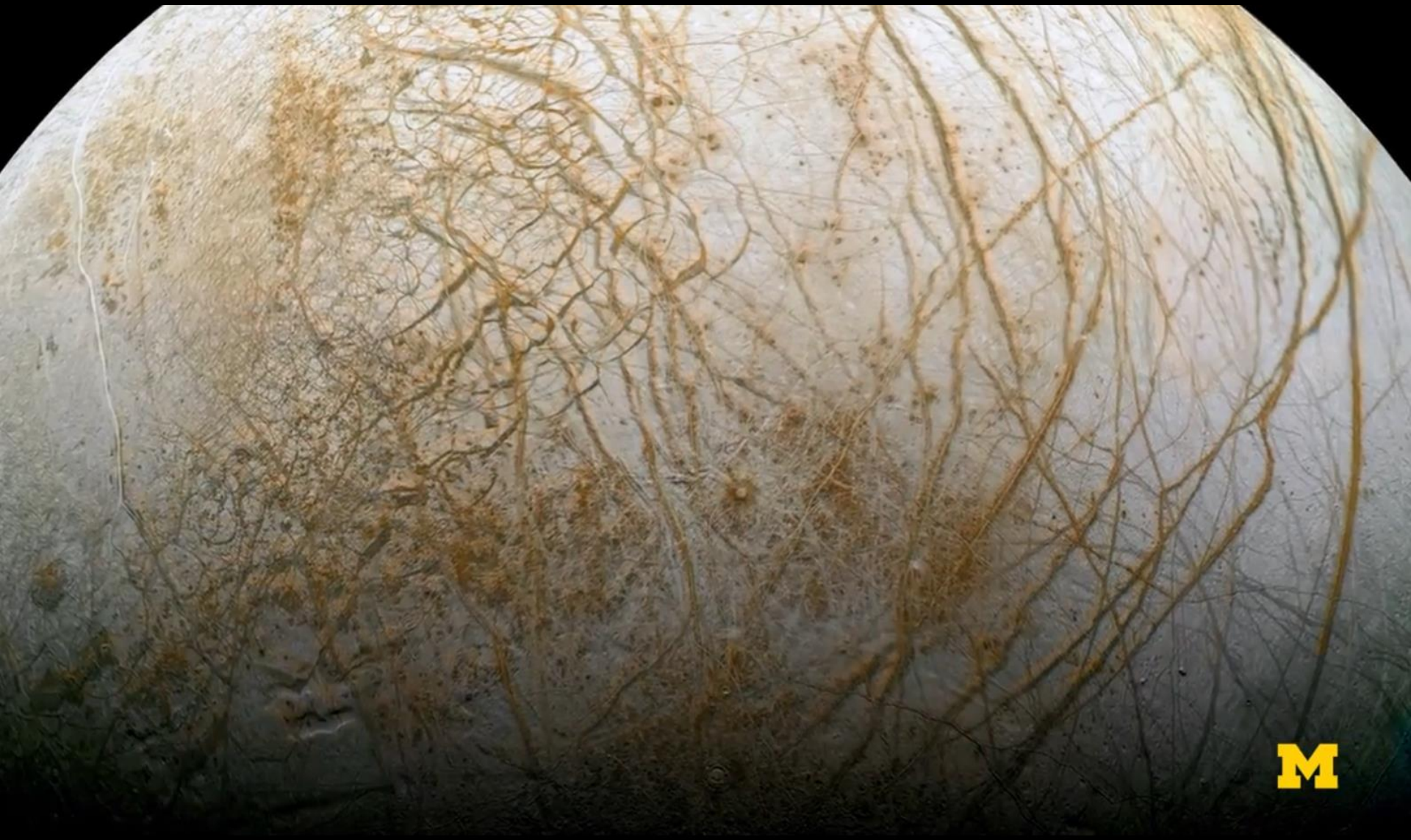
Hubble -HST

Výtrysky vodnej pary



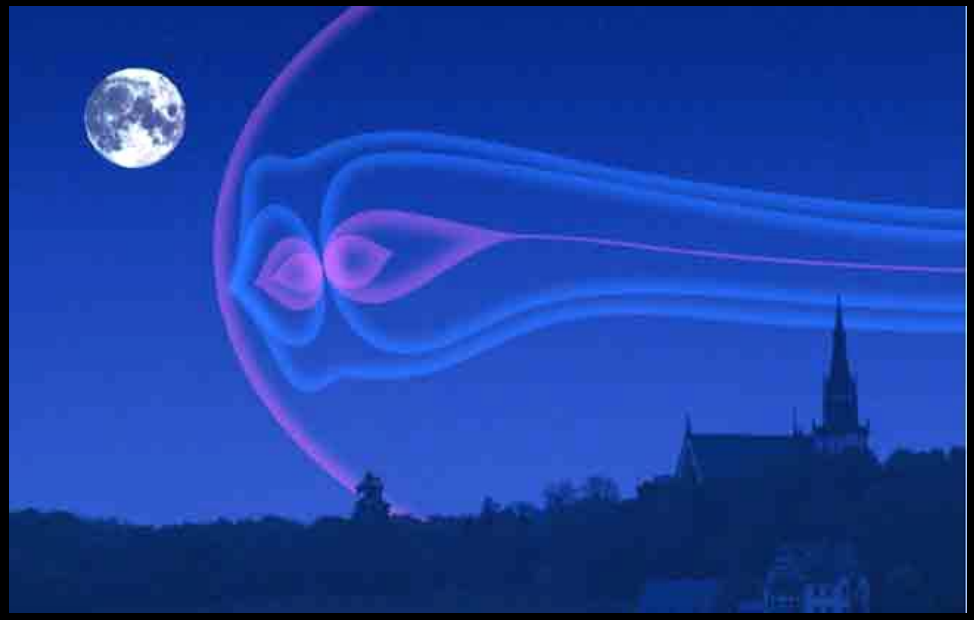
Galileo (1995-2003)

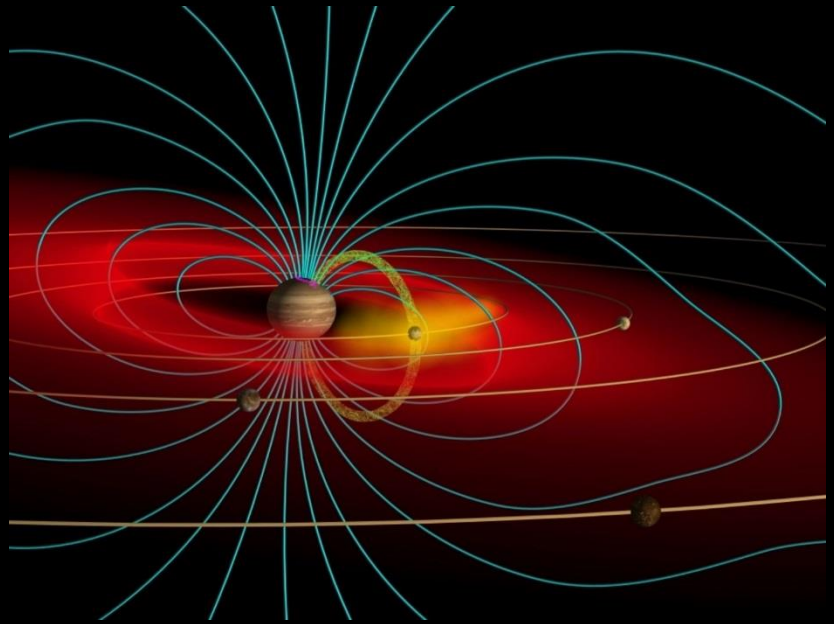
Európa



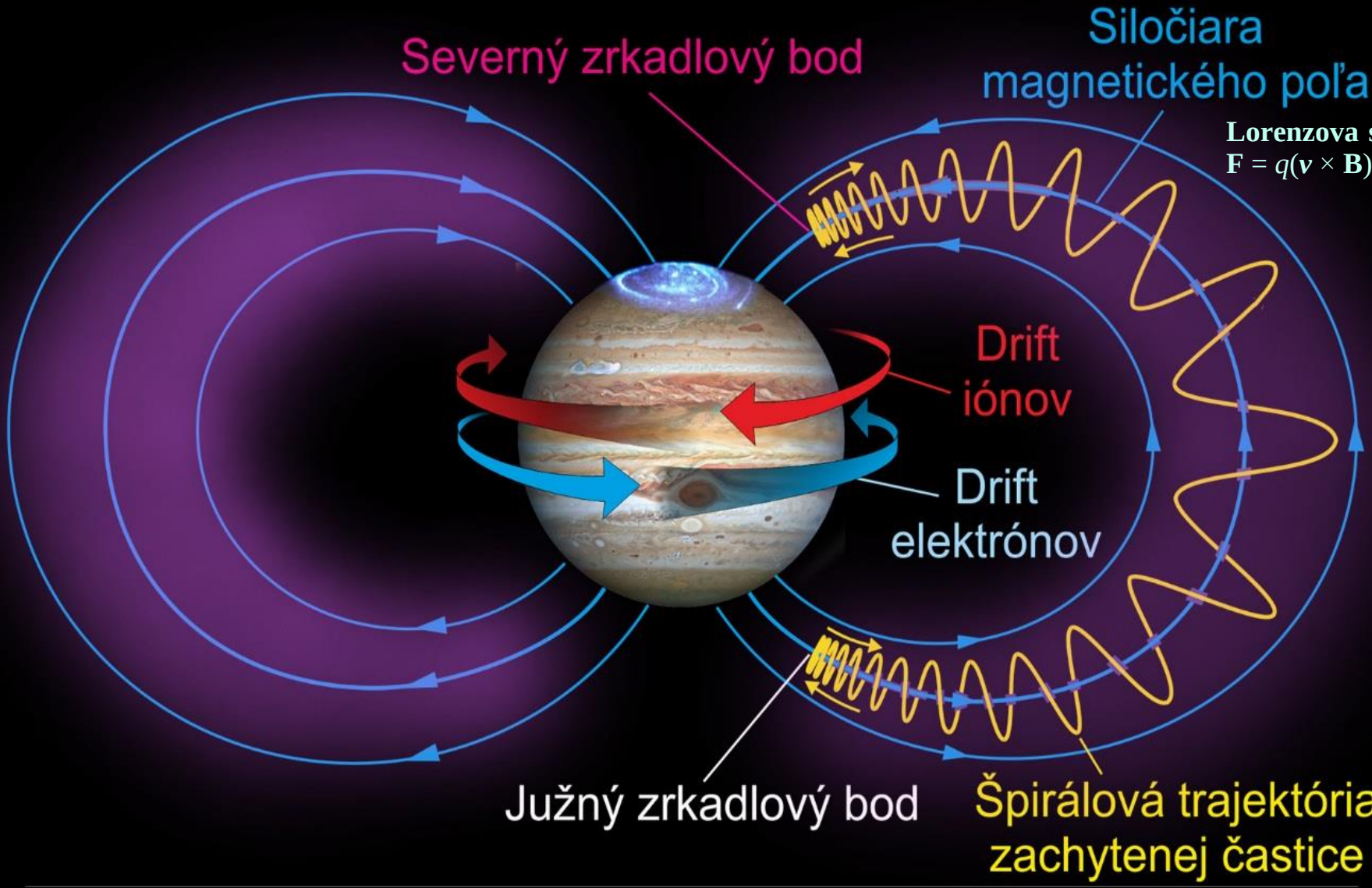
Magnetosféra Jupitera *(oblasť dominancie Jupiterovho mag. poľa nad mag. poľom Slnka)*

- Jupiter má veľmi silné magnetické pole, predpokladá sa, že je generované tokom elektricky vodivého, tzv. kovového vodíka.
- Magnetosféra Jupitera je radiačne najdrsnešie prostredie z celej slnečnej sústavy
- Mesiace Jupitera efektívne interagujú s jeho magnetosférou, Ganymedes má aj vlastné magnetické pole

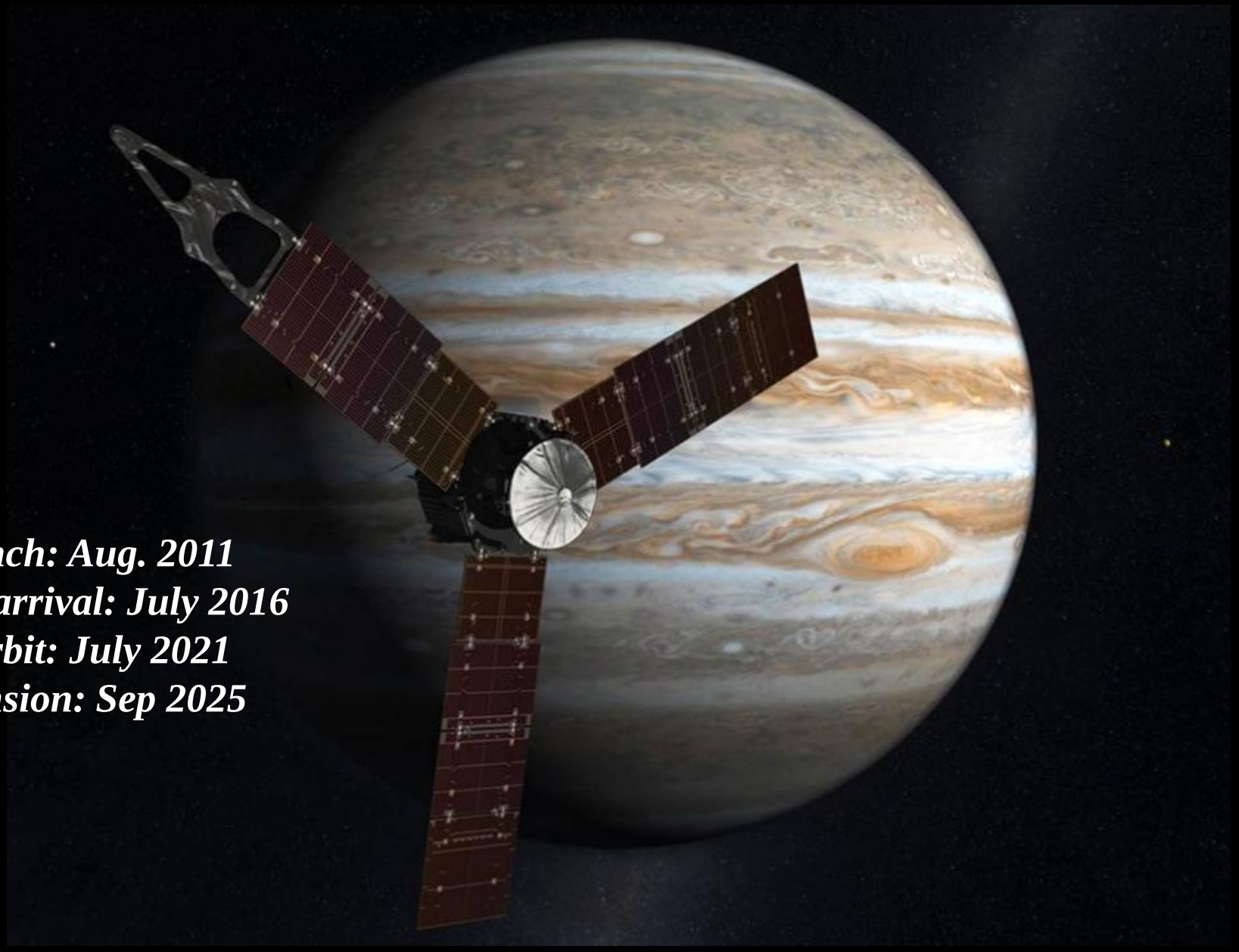




Magnetosféra Jupitera *(zachytená radiácia – Van Allenove pásy)*



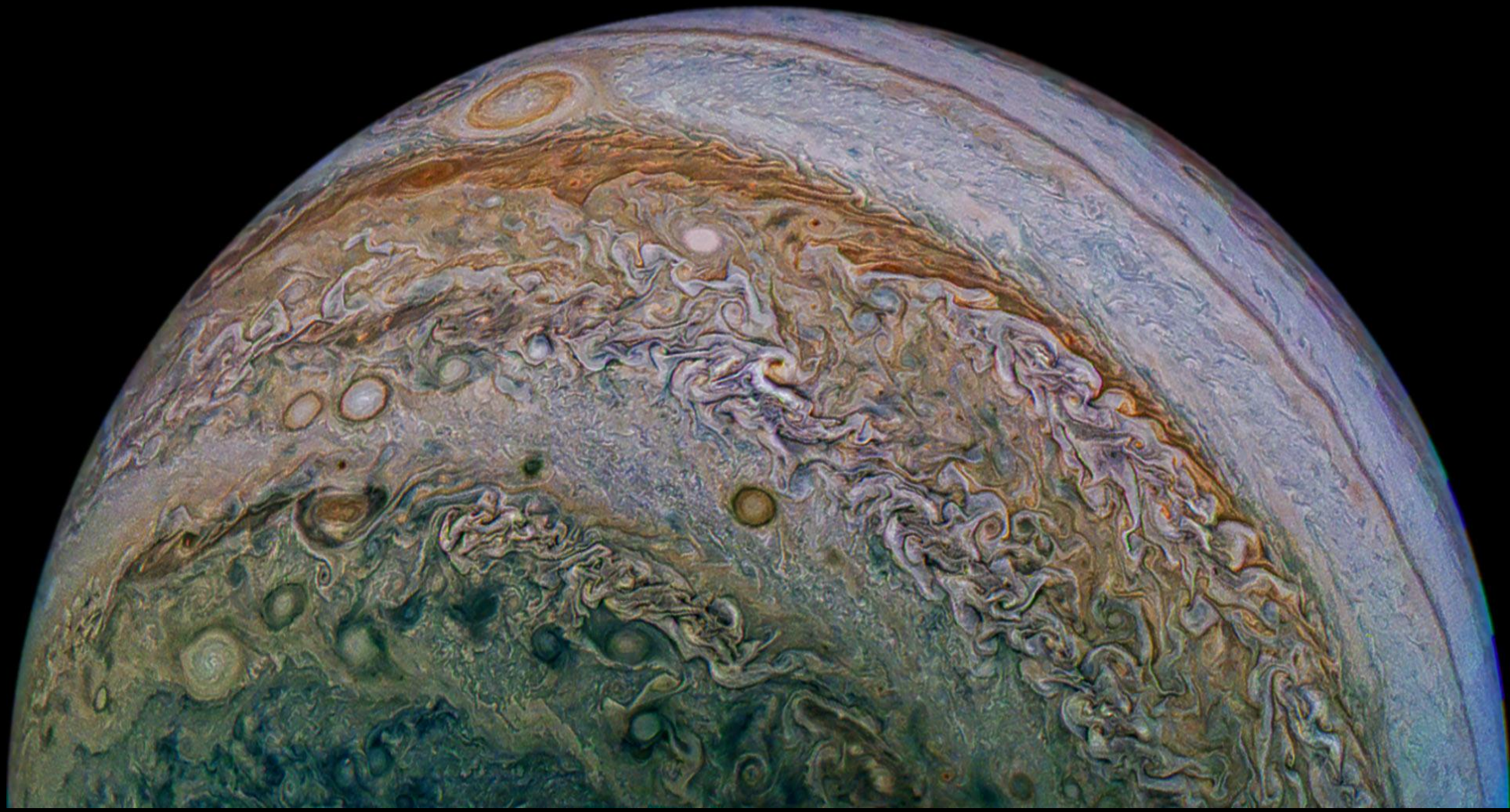
Misia NASA-Juno



Launch: Aug. 2011
Jupiter arrival: July 2016
Deorbit: July 2021
Extension: Sep 2025

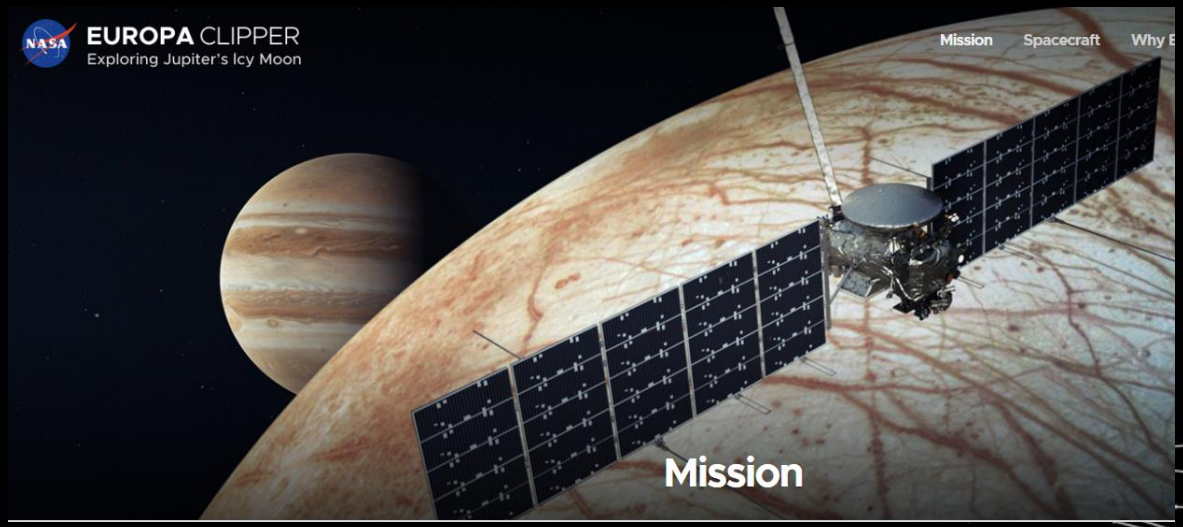
Misia NASA-Juno

Misia NASA-Juno

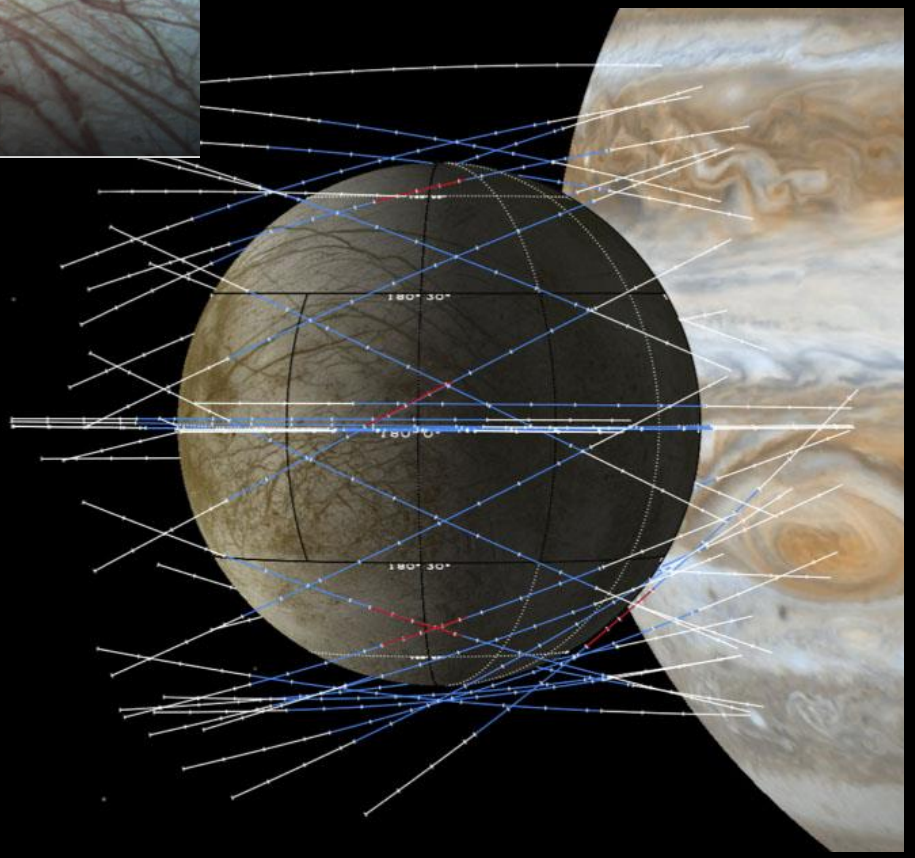


Misia NASA-Juno Ganymede flyby

Misia NASA-Europa Clipper

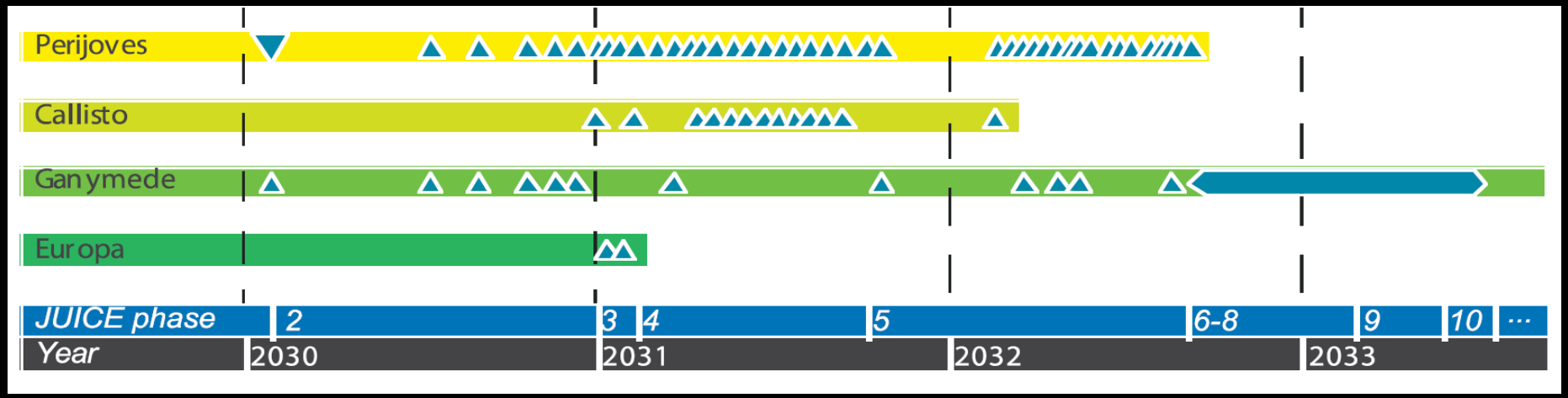


Launch: 10.10.2024
Arrival : 11.4.2030
40-50 flybys
2700-25 km altitude



Misia ESA JUICE

- **JUICE** (**JU**piter **IC**y moons **E**xplorer) je najvýznamnejšia „large-class“ misia ESA v rámci programu Cosmic Vision 2015-2025.
- Rozpočet misie je 1,6 miliardy EUR
- Štart 14.4.2023, prelet Z->J 8 rokov, s grav. asistenciami Zem(3x) a Venuša(1x)
- Orbitu okolo Jupitera dosiahne v júli 2031, vedecký program na 3.5 roka, 27 preletov okolo mesiacov Európa, Ganymedes a Kallisto
- Záver misie - orbita okolo Ganymeda cca 1 rok, zánik riadeným nárazom



Sonda JUICE

Solárne panely
85 m², 820W,
SC_J= 46W/m²
(SC_E = 1360 W/m²)

High gain antenna
D = 2,6 m

Hmotnosť pri štarte: 5963 kg
Palivo: 3650 kg
Sonda netto: 2420 kg
Max. rozmer: 27 m
Hlavný motor: 425 N

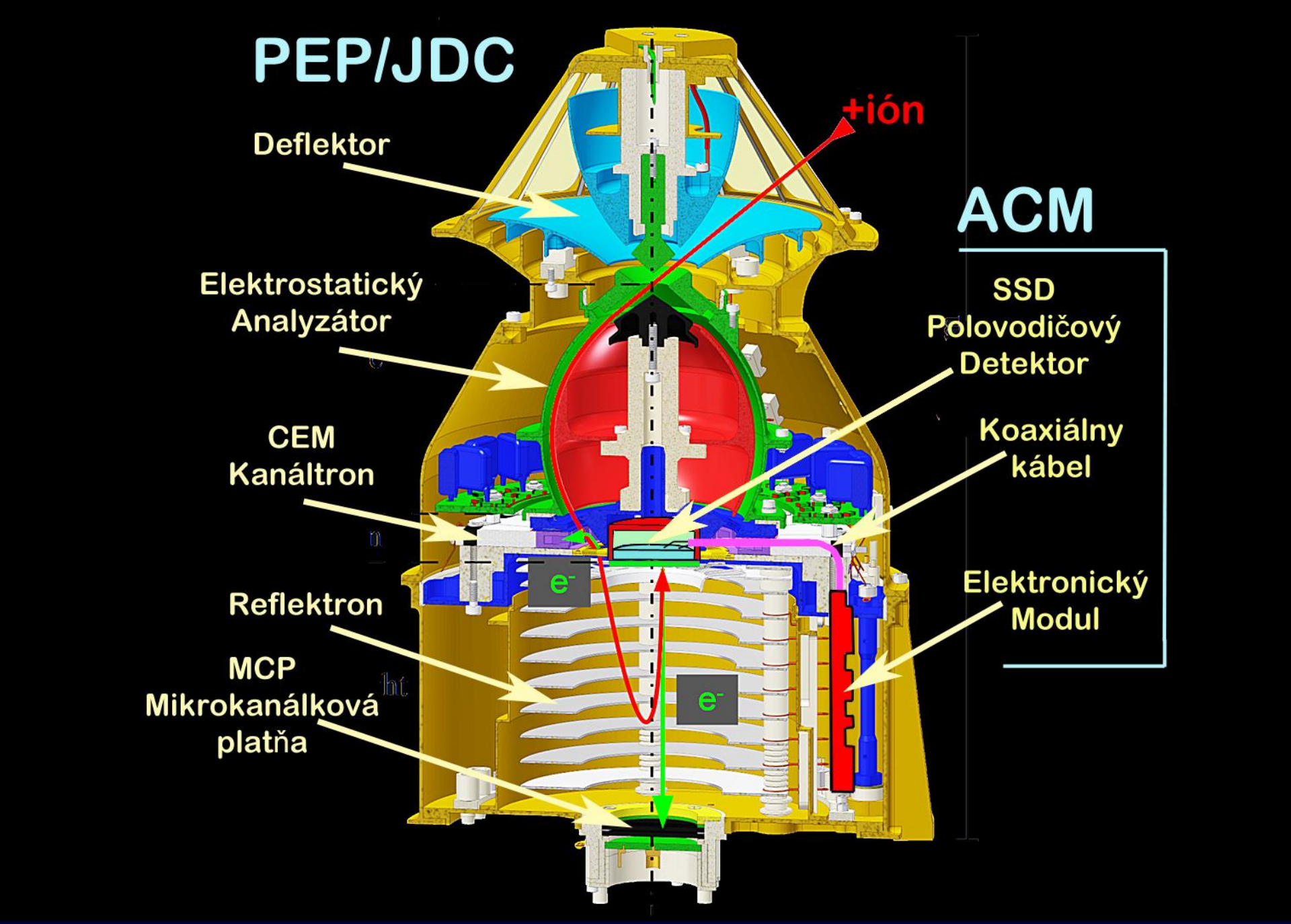
Vedecký náklad sondy JUICE

1. **JANUS** - Camera system optical camera
2. **MAJIS** - Moons And Jupiter Imaging Spectrometer
3. **UVS** - UV imaging Spectrograph
4. **SWI** - Sub-millimeter Wave Instrument
5. **GALA** - GAnymede Laser Altimeter
6. **RIME** - Radar for Icy Moons Exploration
7. **J-MAG** - JUICE MAGnetometer instrument for
8. **PEP** - Particle Environment Package
9. **RPWI** - Radio & Plasma Wave Investigation
10. **3GM** - Gravity & Geophysics of Jupiter and Galilean Moons
11. **PRIDE** - Planetary Radio Interferometer & Doppler Experiment

PEP (Particle Environment Package)

1. **JDC** - Jovian plasma **D**ynamics & **C**omposition IRF Kiruna
2. **JEI** - **J**ovian **E**lectrons & **I**ons MPS Göttingen
3. **JoEE** - **Jo**vian **E**nergetic **E**lectrons JHU APL Maryland
4. **JENI** - Jovian **E**nergetic **N**eutrals & **I**ons JHU APL
5. **JNA** - Jovian **N**eutrals **A**nalyzer IRF Kiruna
6. **NIM** - **N**eutrals & **I**ons **M**ass spectrometer Uni Bern

IRF Kiruna


PEP/JDC
+ión
Deflektor
ACM
Elektrostatický
Analyzátor
SSD
Polovodičový
Detektor
CEM
Kanáltron
Koaxiálny
kábel
e-
Reflektron
Elektronický
Modul
MCP
Mikrokanálková
platňa
e-

ESA PECS kontrakt (Plan for European Cooperating States)

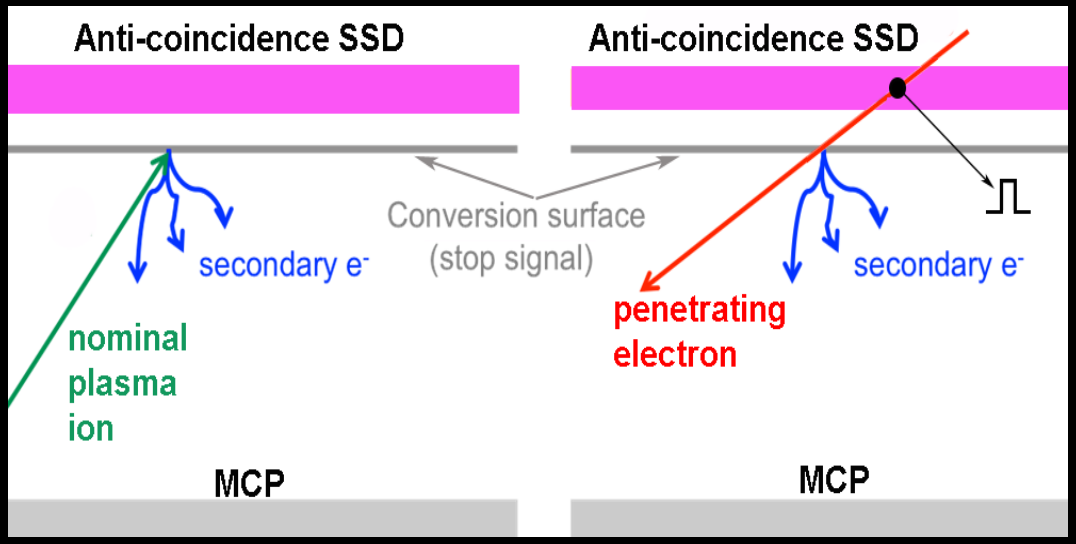
ESA Contract No. 4000125788/18/NL/SC

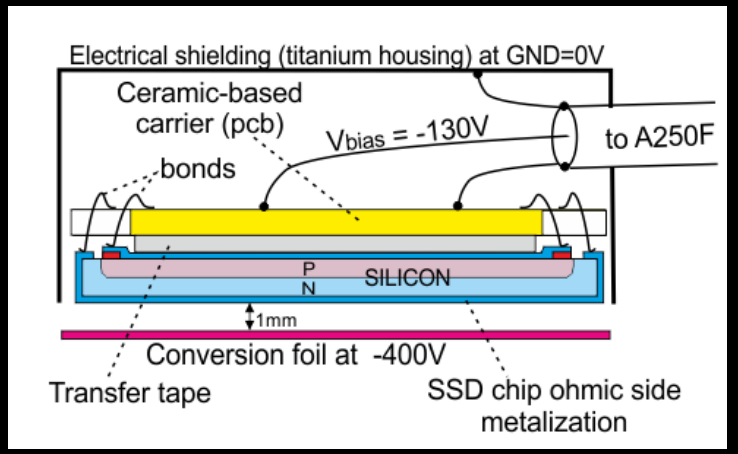
with

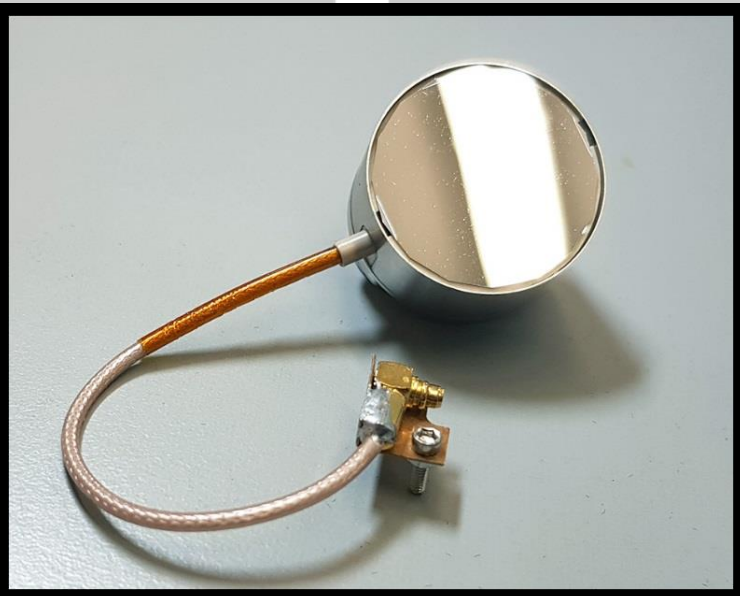
Institute of Experimental Physics,
Slovak Academy of Sciences

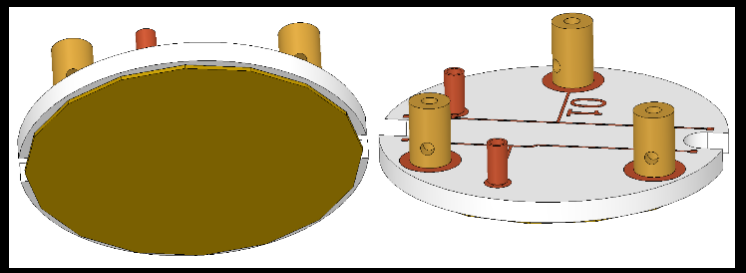
Slovak contribution to ESA-JUICE mission:
Development of Anti-Coincidence Module ACM for Particle Environment Package PEP

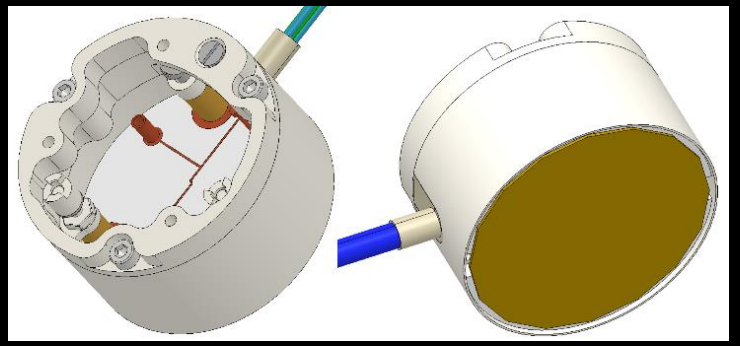
ACM - Anti Coincidence Module of PEP/JDC



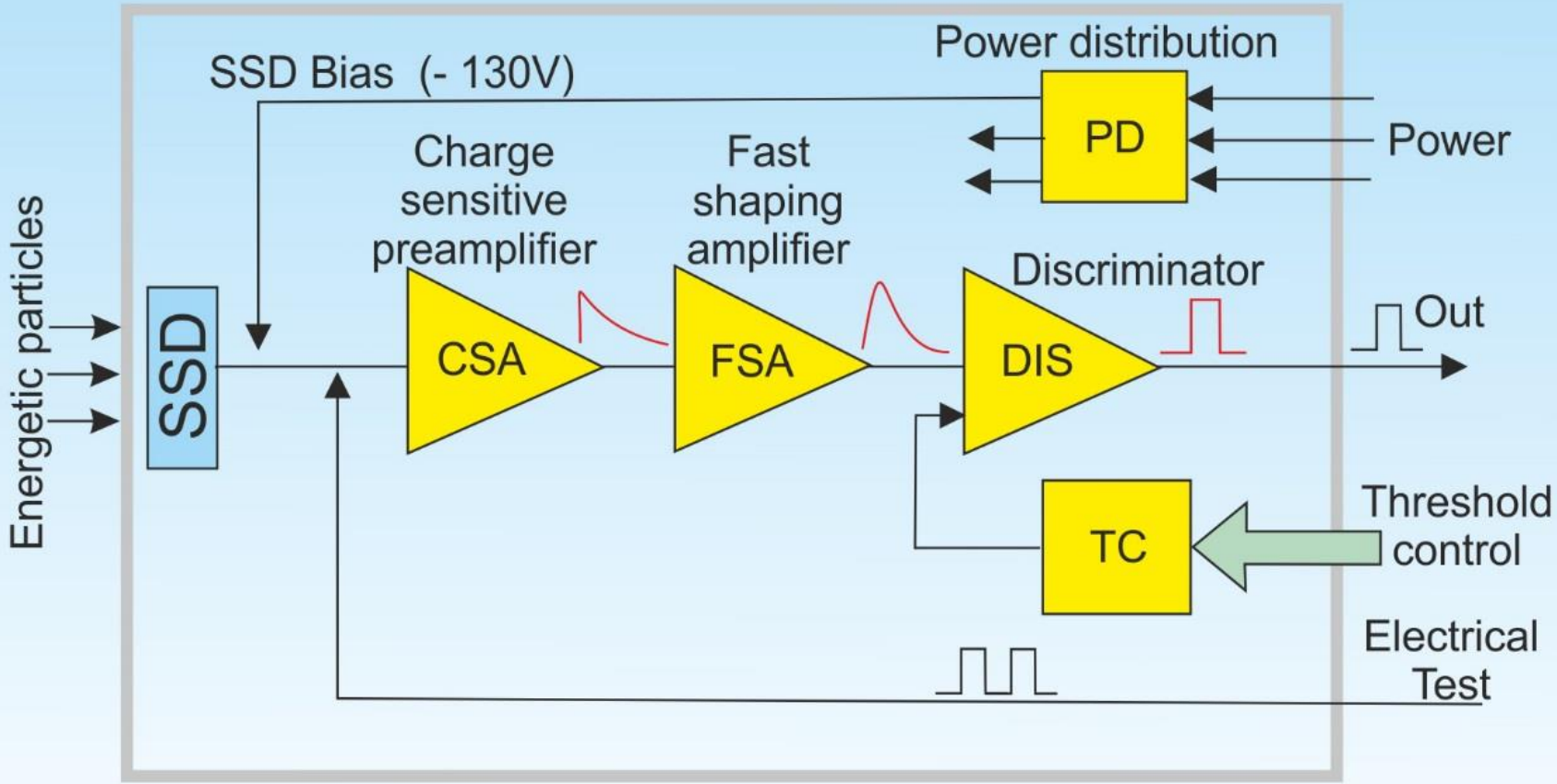






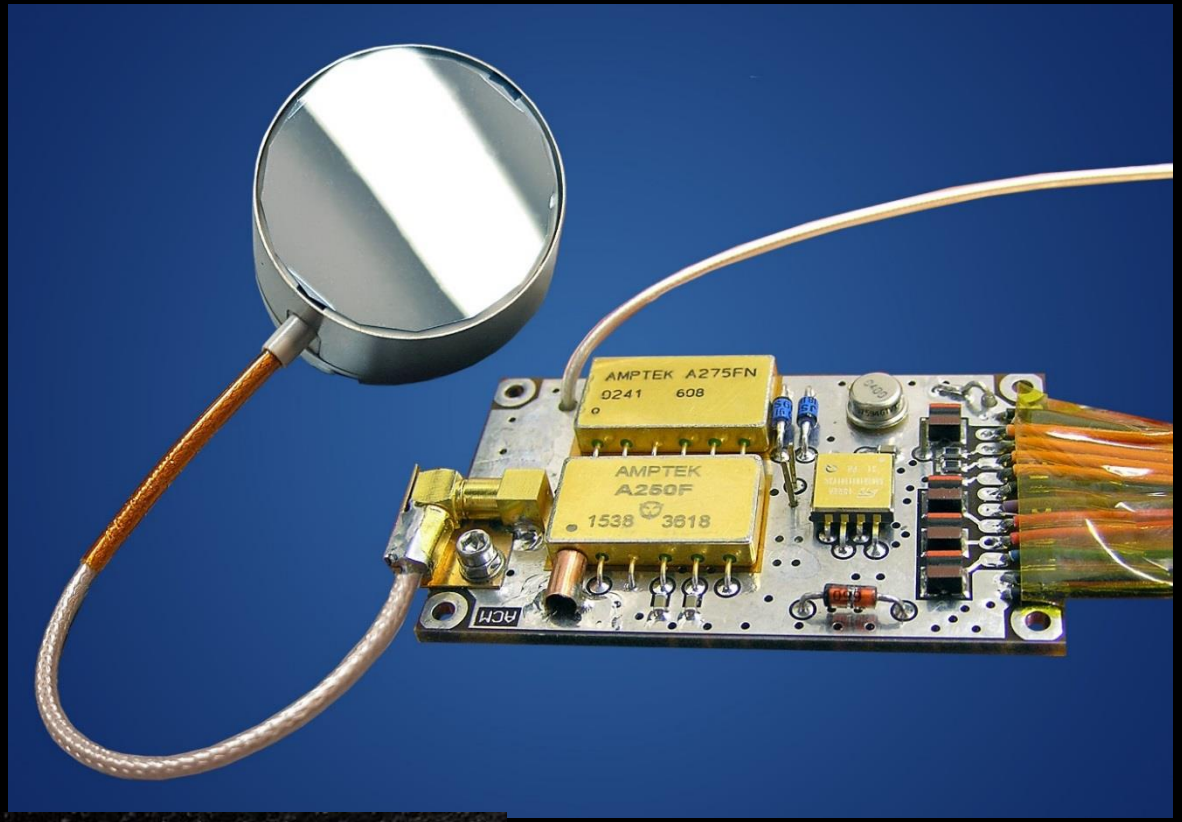


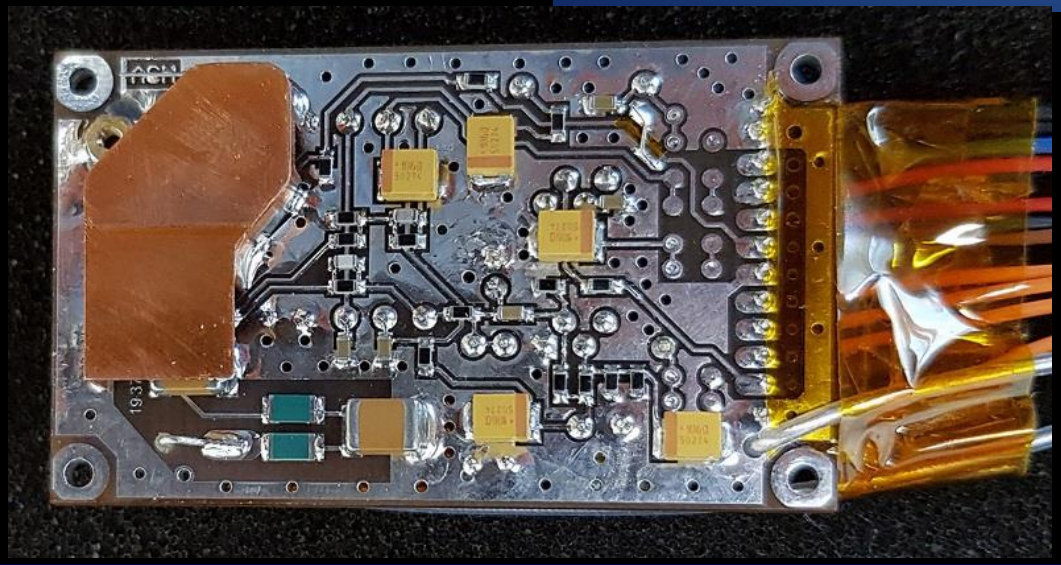
ACM funkčná bloková schéma



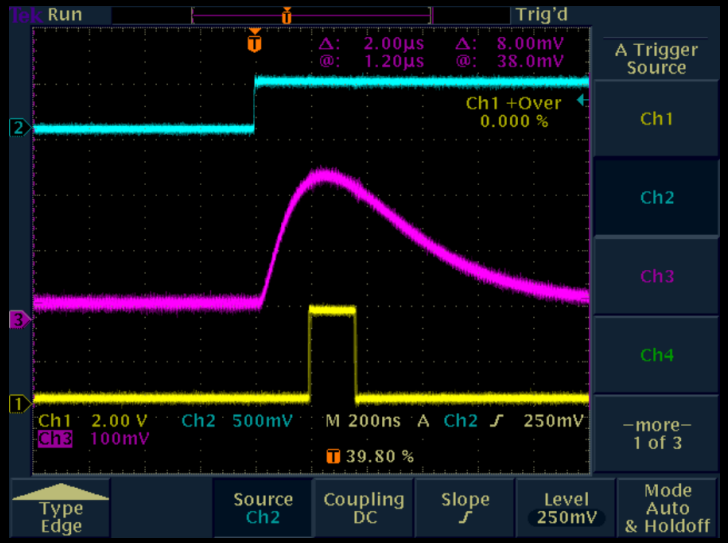
ACM -

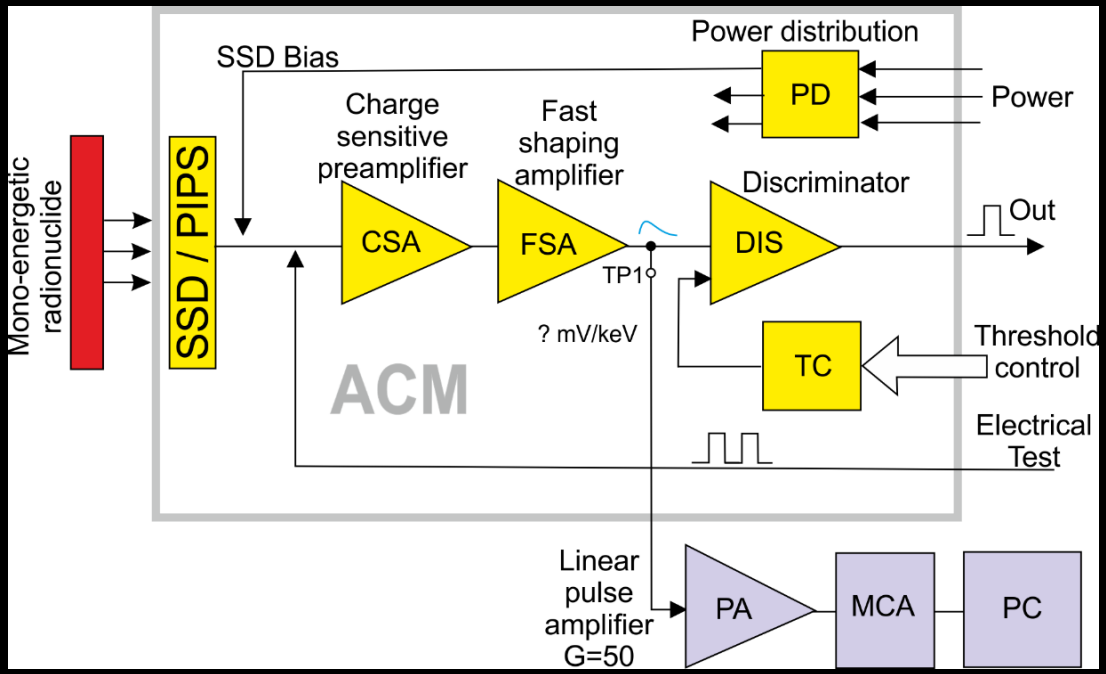
Anti Coincidence Module

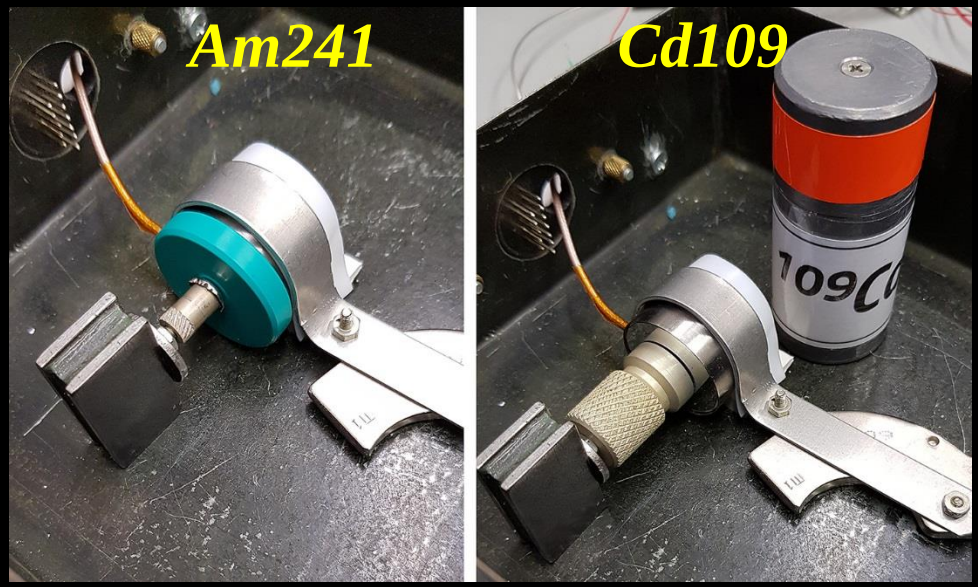




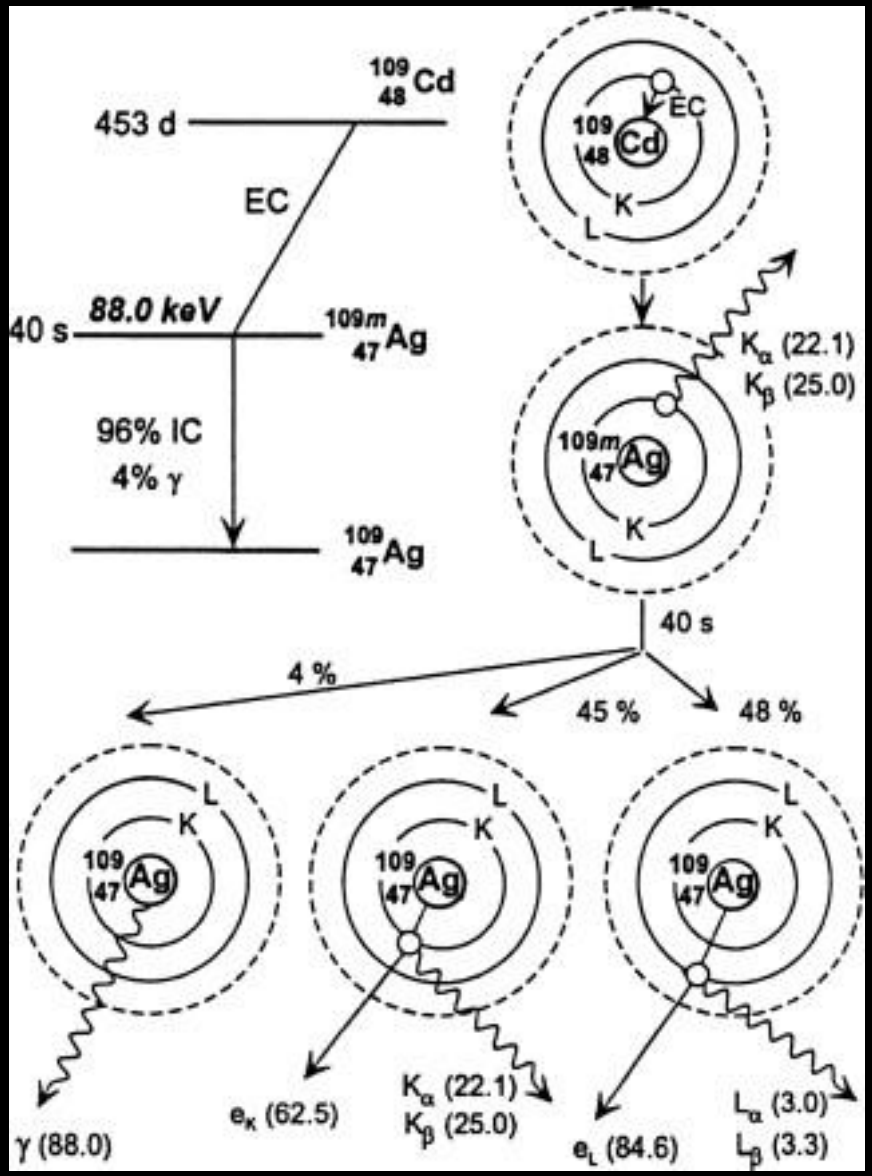
Kalibrácia ACM

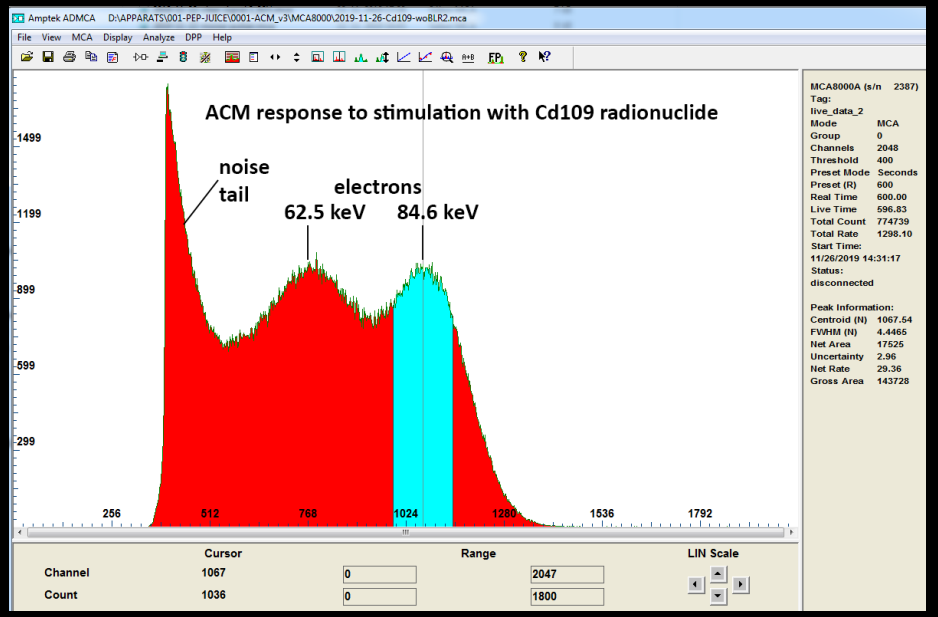


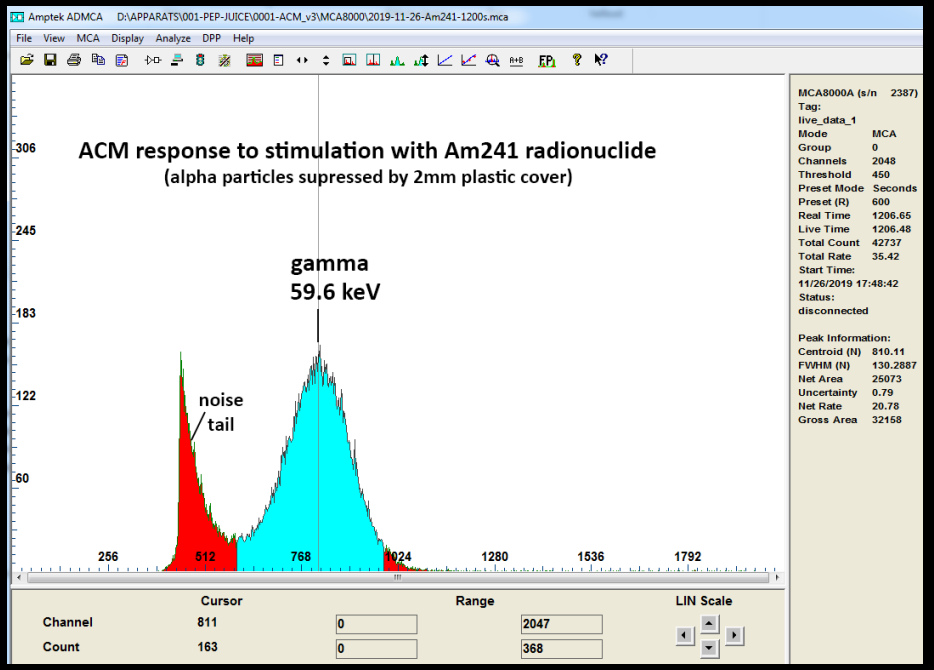




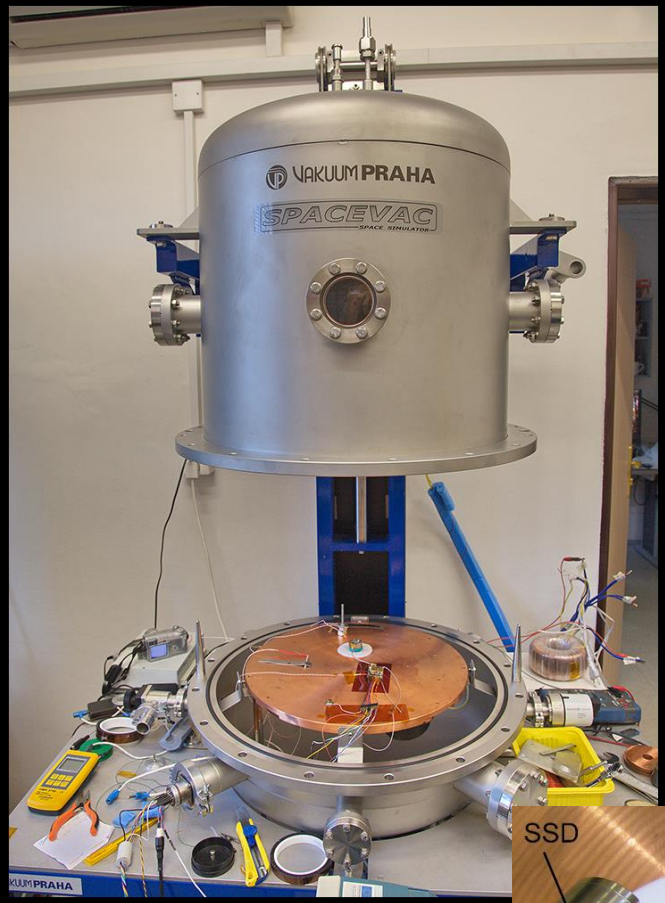
Kalibrácia ACM



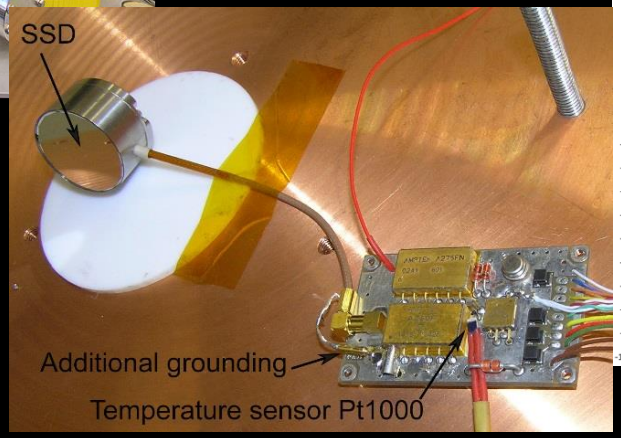


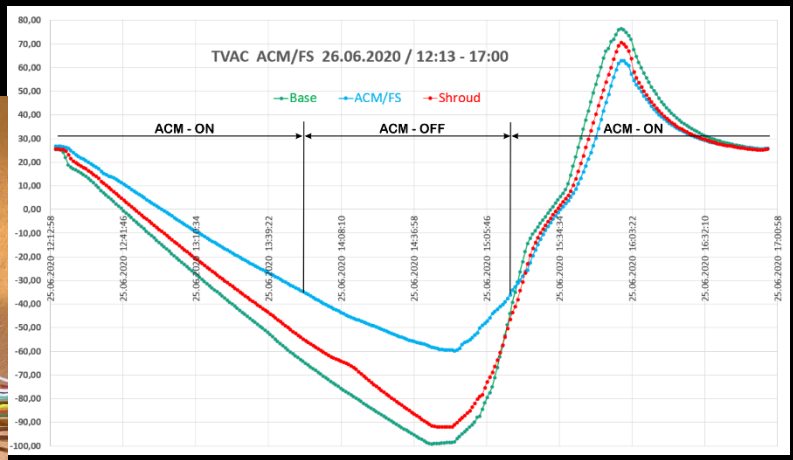


TVAC


VAKUUM PRAHA
SPACEVAC
SPACE SIMULATOR

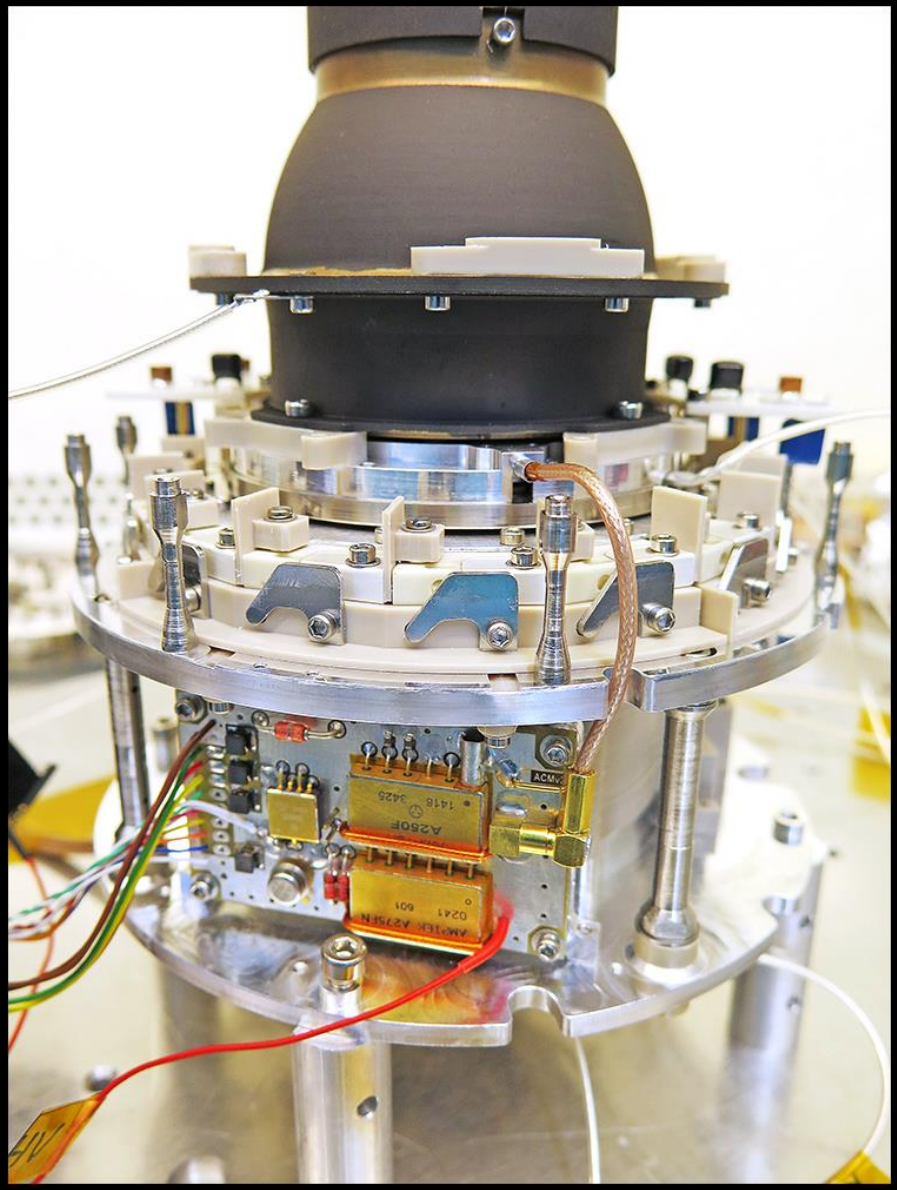

VAKUUM PRAHA

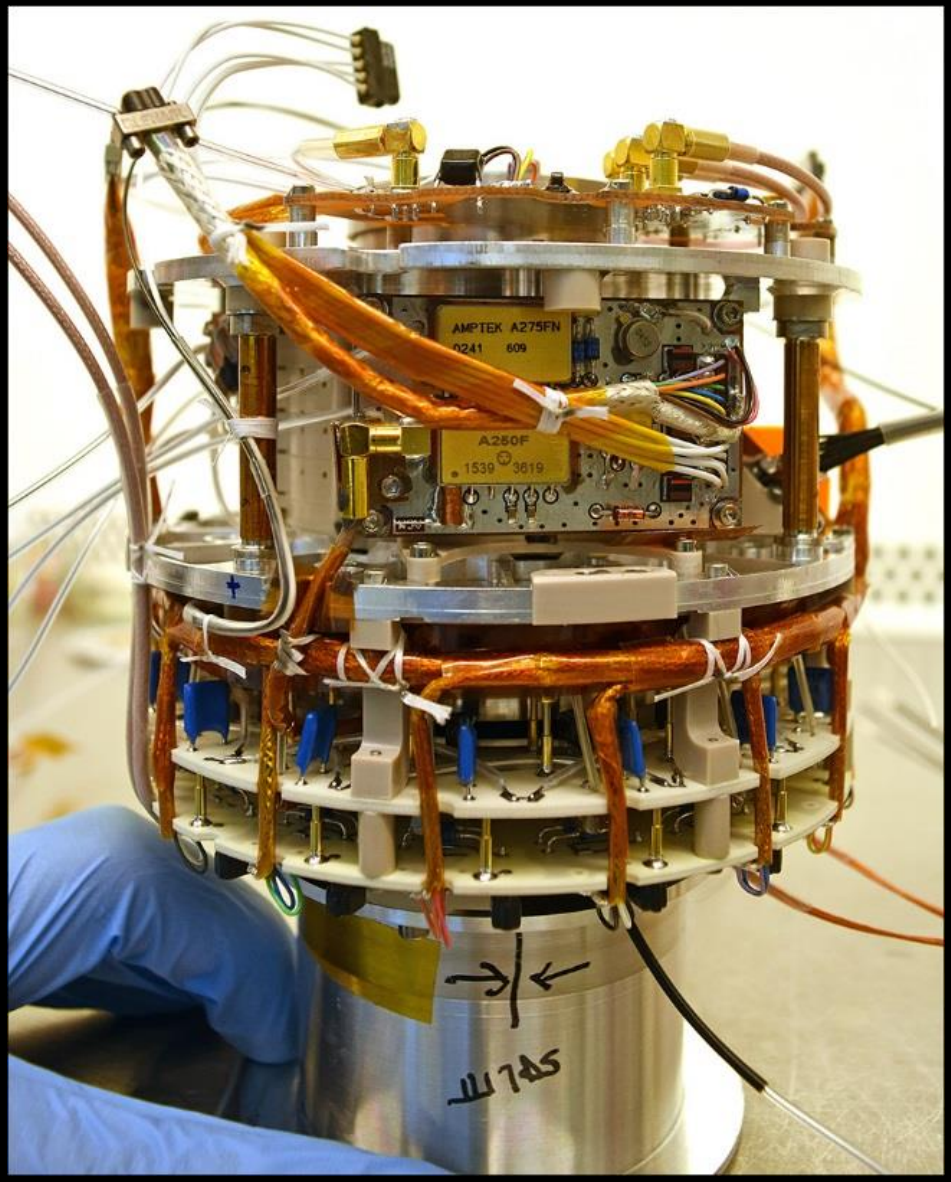

SSD
Additional grounding
Temperature sensor Pt1000


TVAC ACM/FS 26.06.2020 / 12:13 - 17:00
Base
ACM/FS
Shroud
ACM - ON
ACM - OFF
ACM - ON

Cesta ACM z Košíc na Ganymedes začína …

Integrácia ACM do JDC

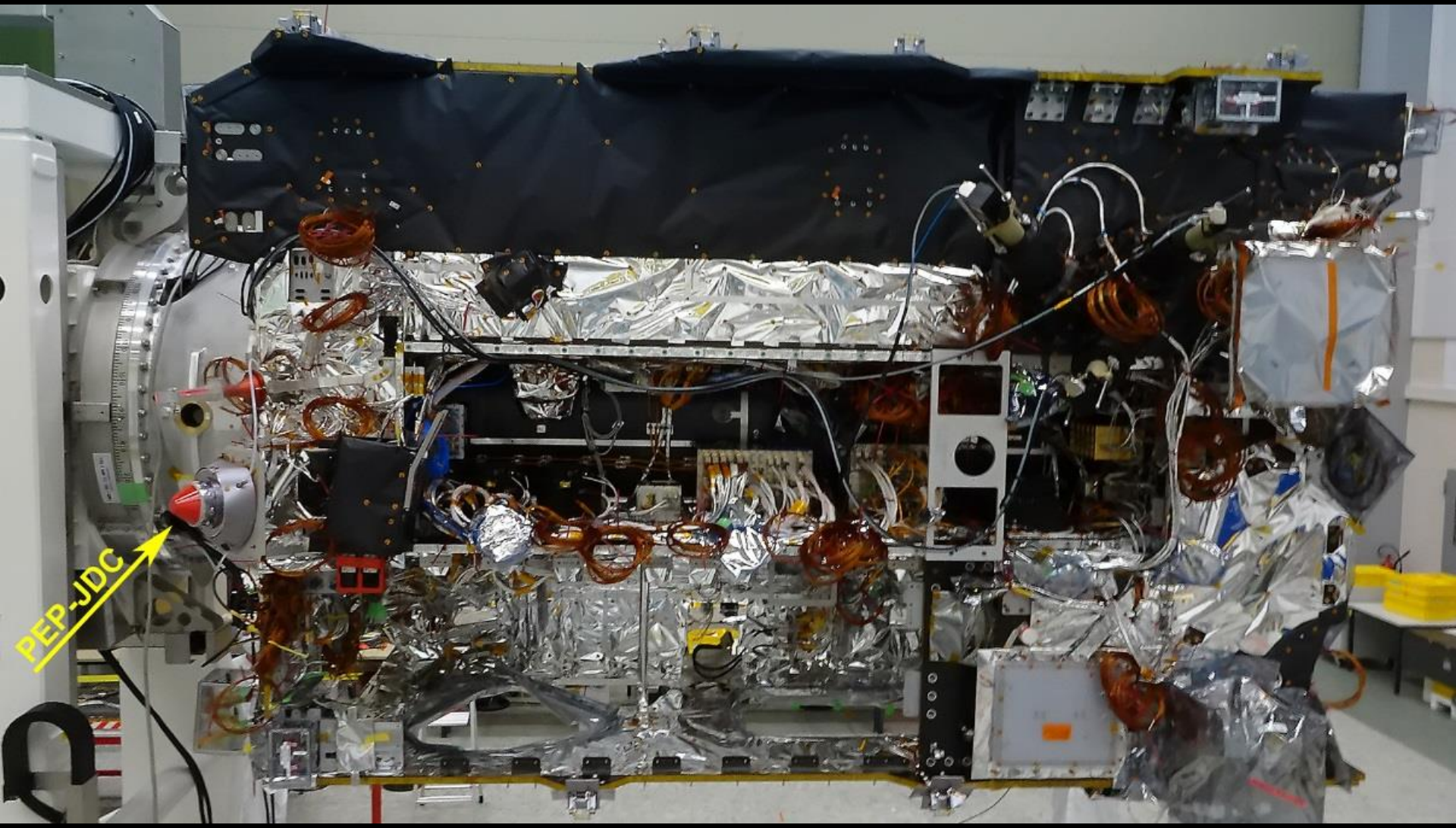




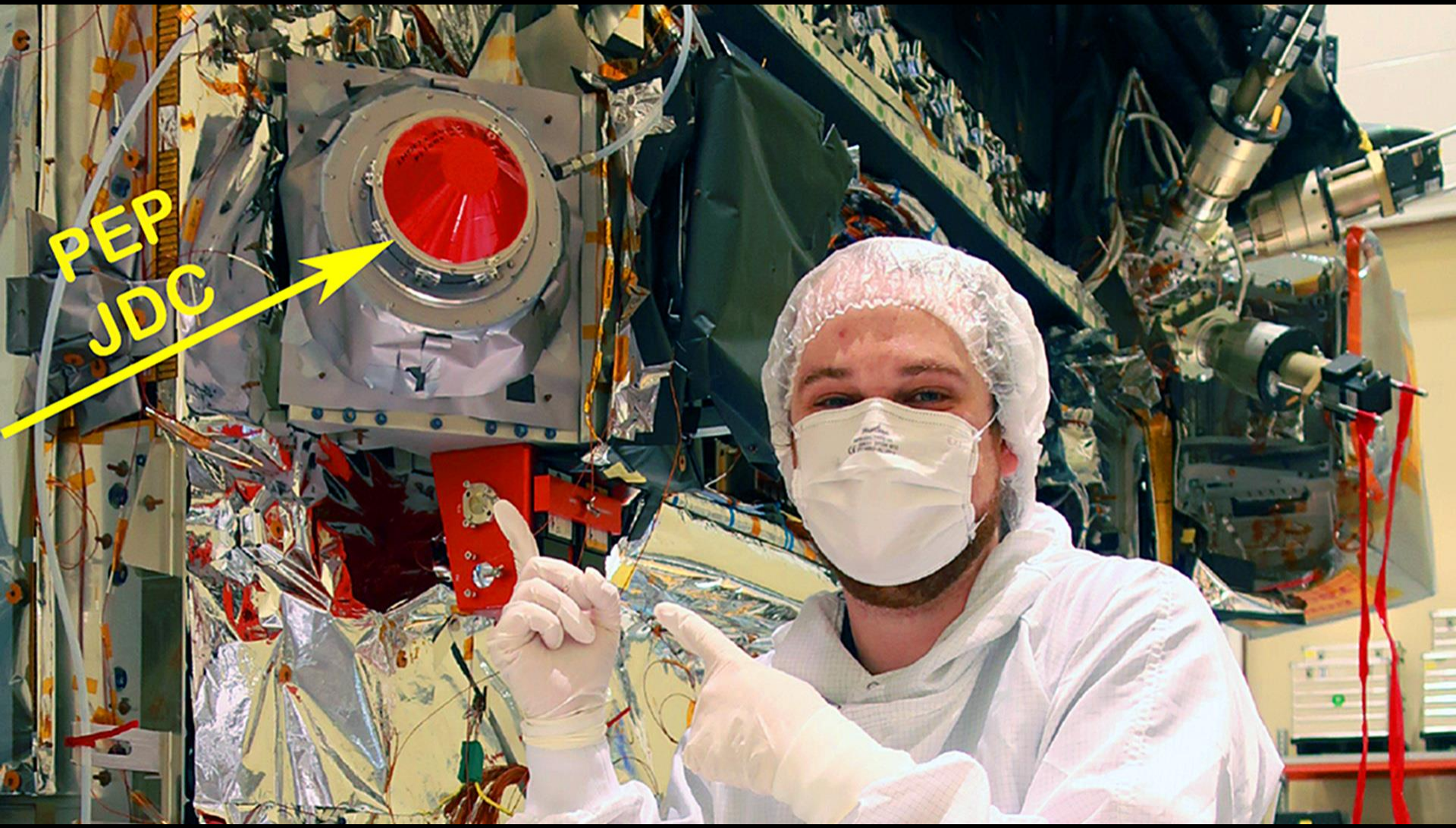
JDC

Konečná podoba s tieniacim štítom (W + Al)

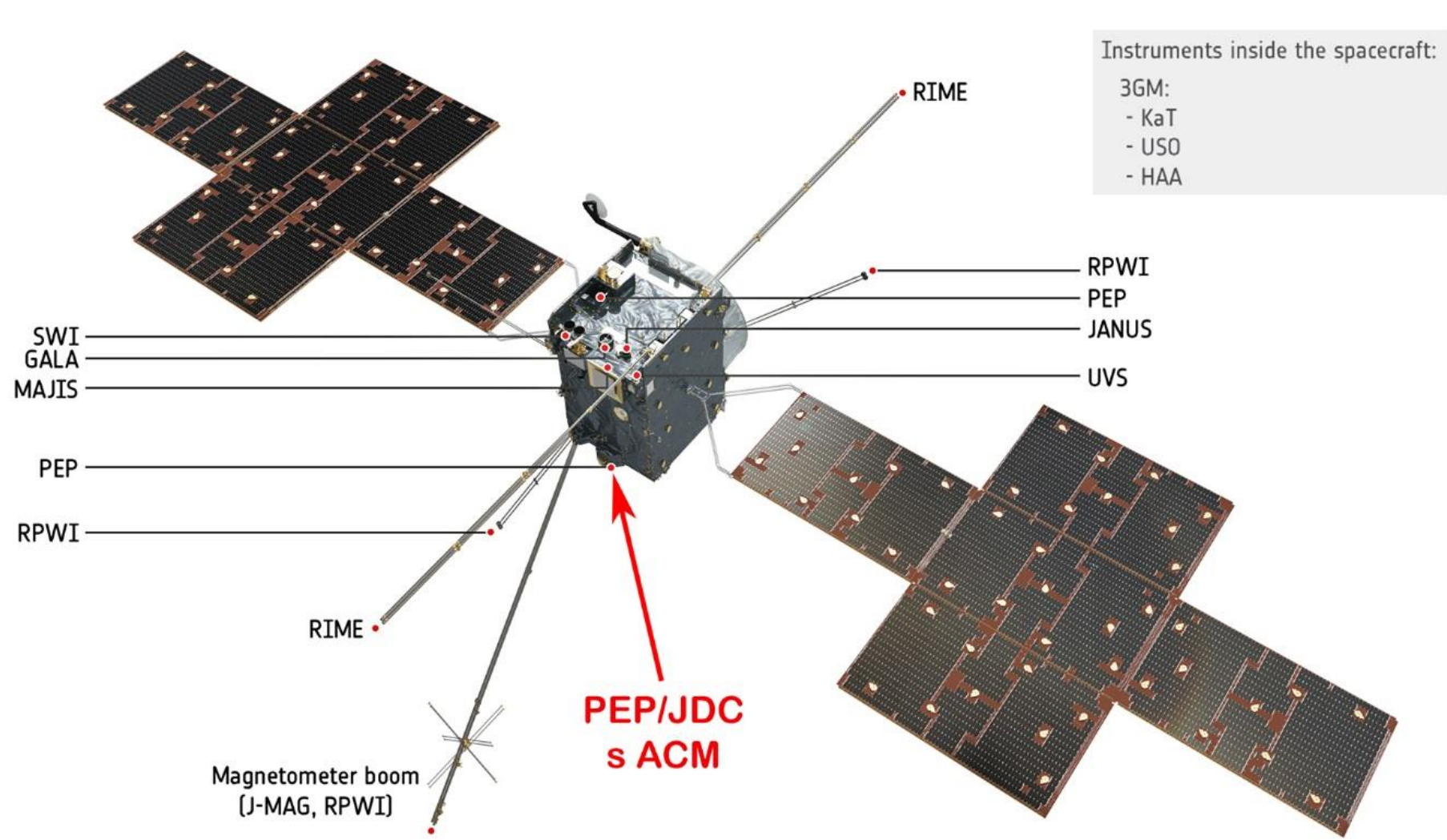
JDC na palube



JDC na palube



JDC na palube JUICE



PEP-Lo


AIRBUS
AIRBUS
REMOVE BEFORE FLIGHT
REMOVE BEFORE FLIGHT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esa
juice

JUICE launch 14.04.2023 14:14:00


esa
EUROPEAN SPACE AGENCY
Presents this certificate to
Jan Balaz
In recognition of your outstanding contribution made
to the Juice mission
Launched on the 14 April 2023
Europe's spaceport in Kourou, French Guiana on Ariane 5 flight V260
G. Sarri
Juice Project Manager
M. Healy
Head of the Projects Department
Directorate of Science
C. Mundell
Director of Science
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Ďakujem za pozornosť !