The Rosetta Mission

Challenges in Space

Dipl.-Ing. Gunther Lautenschläger
Rosetta Project Manager, Airbus

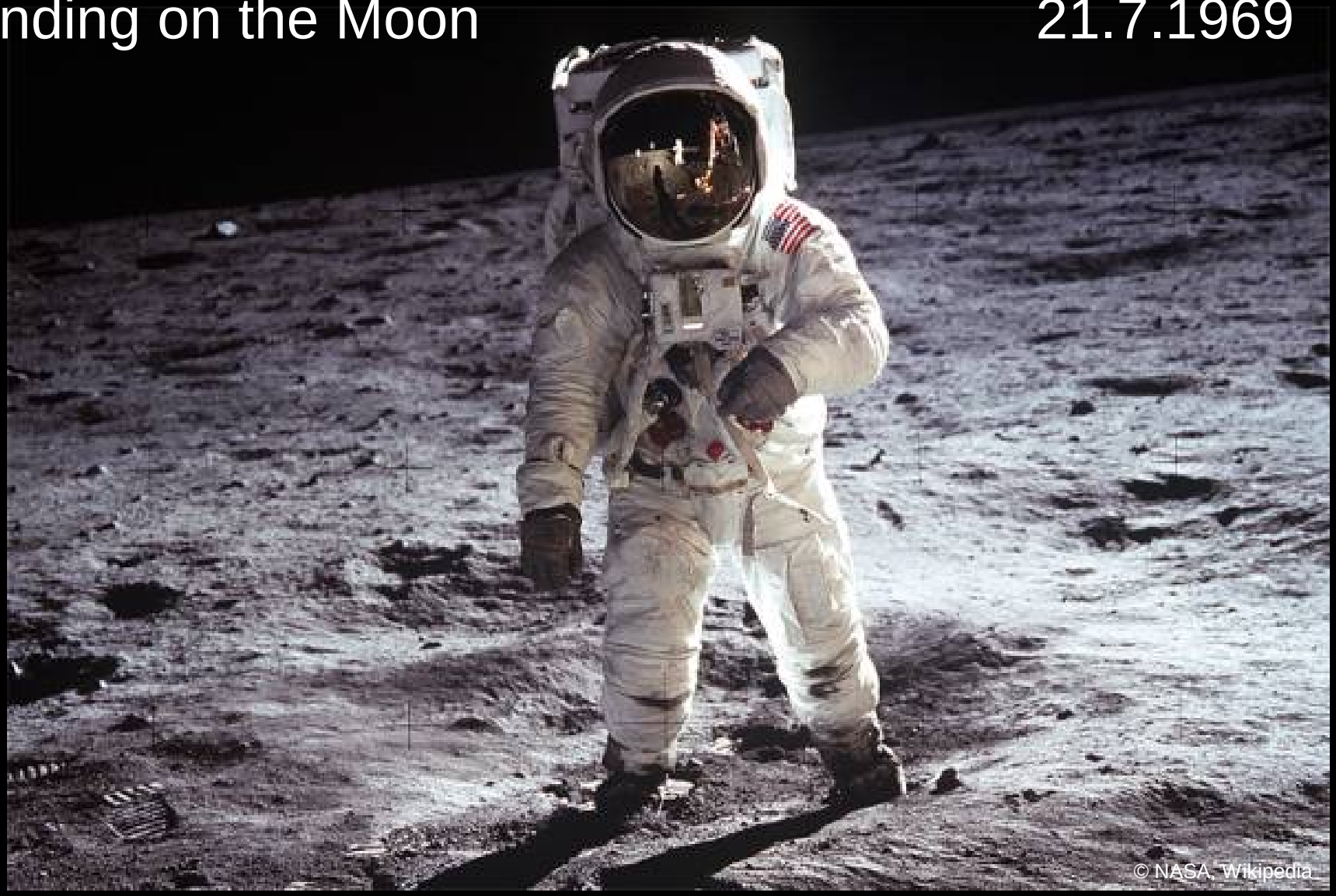
International Planetary Probe Workshop, Köln, Germany

18. June 2015

AIRBUS DEFENCE & SPACE

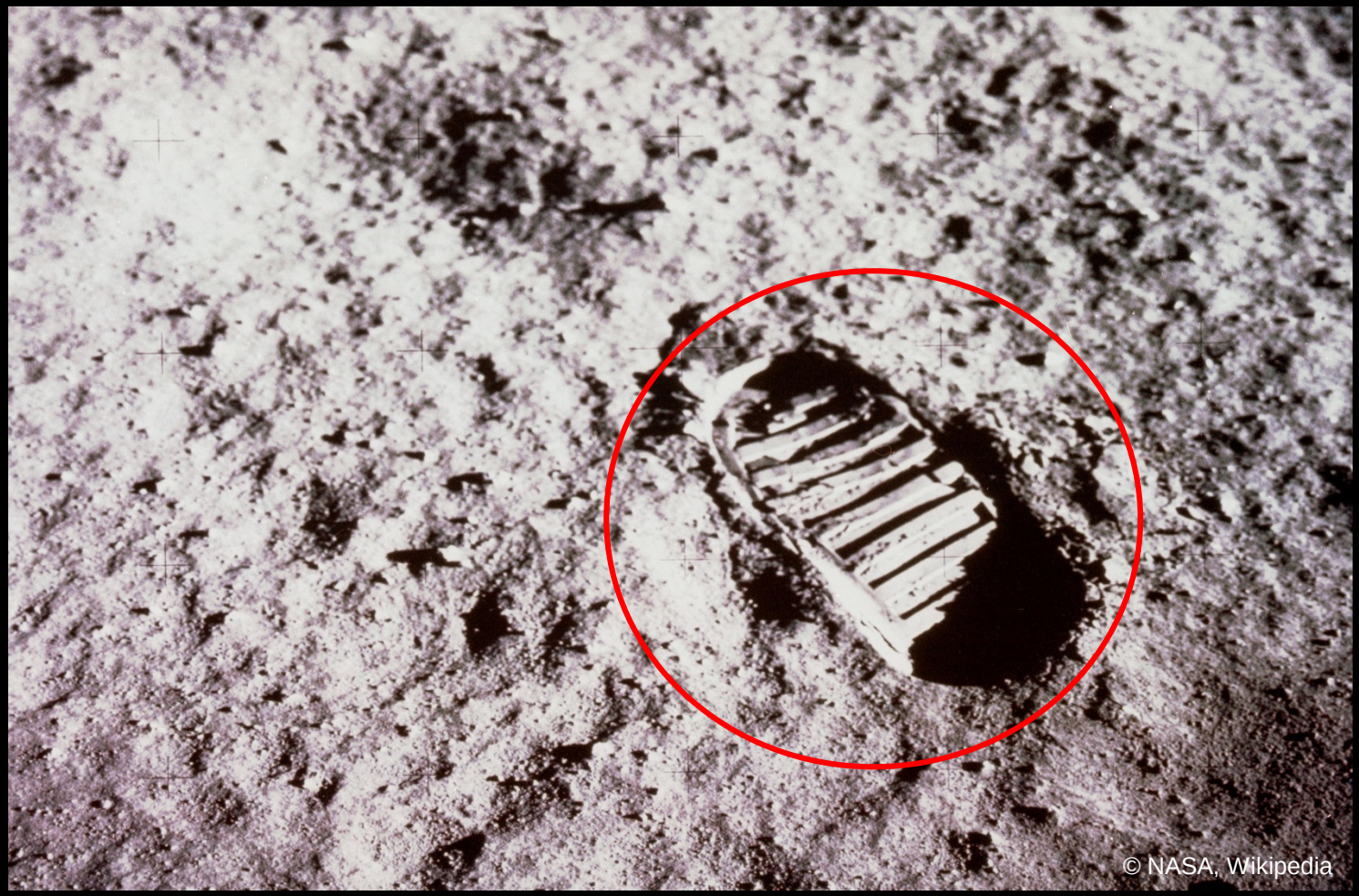
My Motivation

Landing on the Moon 21.7.1969



First Footprint on the Moon

Neil Armstrong 21.7.1969



The Rosetta Mission

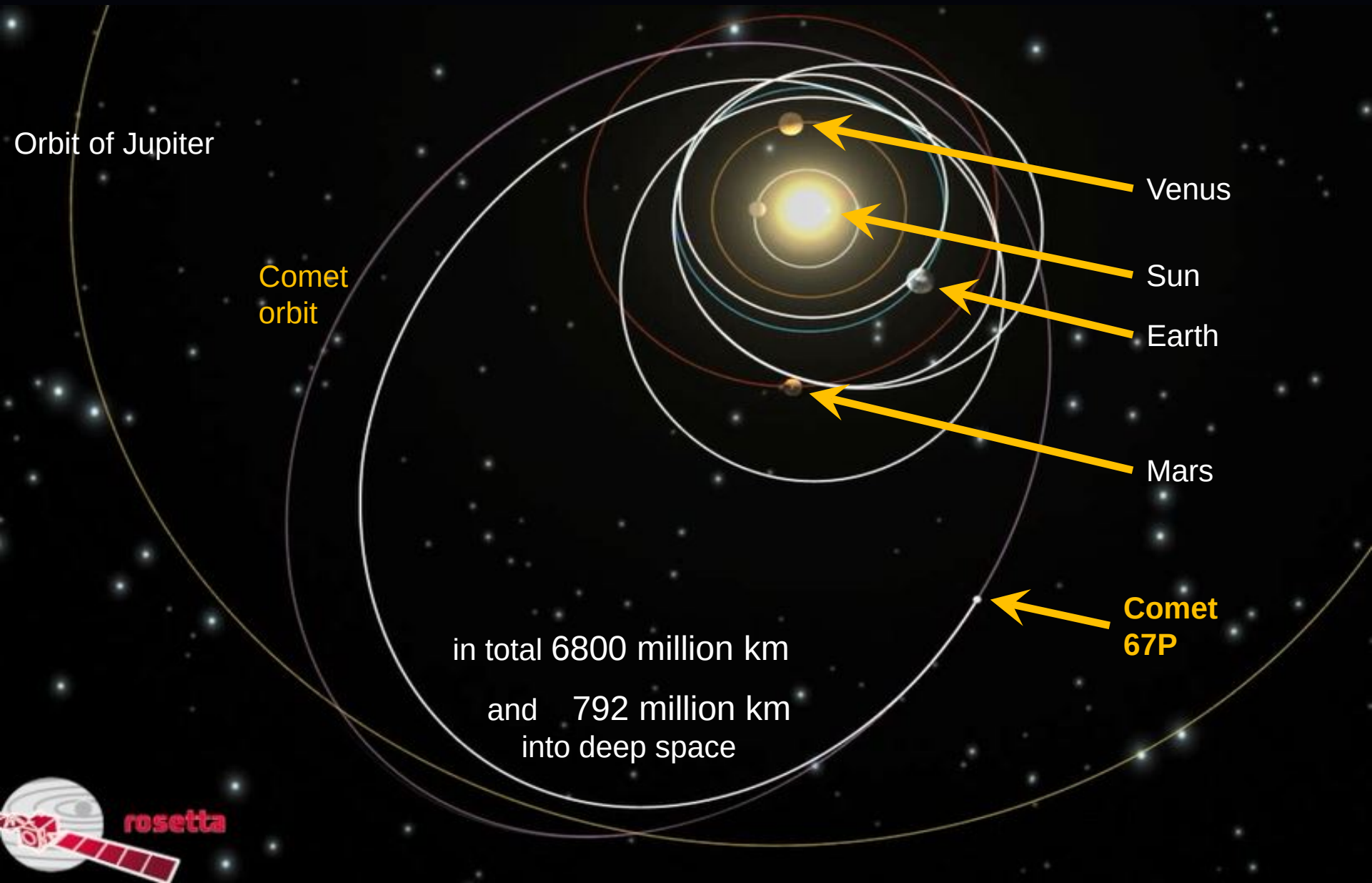
- In 1997 the European Space Agency ESA gave authorization to Airbus DS to design Rosetta

- Rosetta was designed, built and integrated by:
  - 16 European countries + USA involving
  - 96 different companies contributing with their excellence

The Rosetta Mission

Rosetta's Journey

How to reach the comet ?

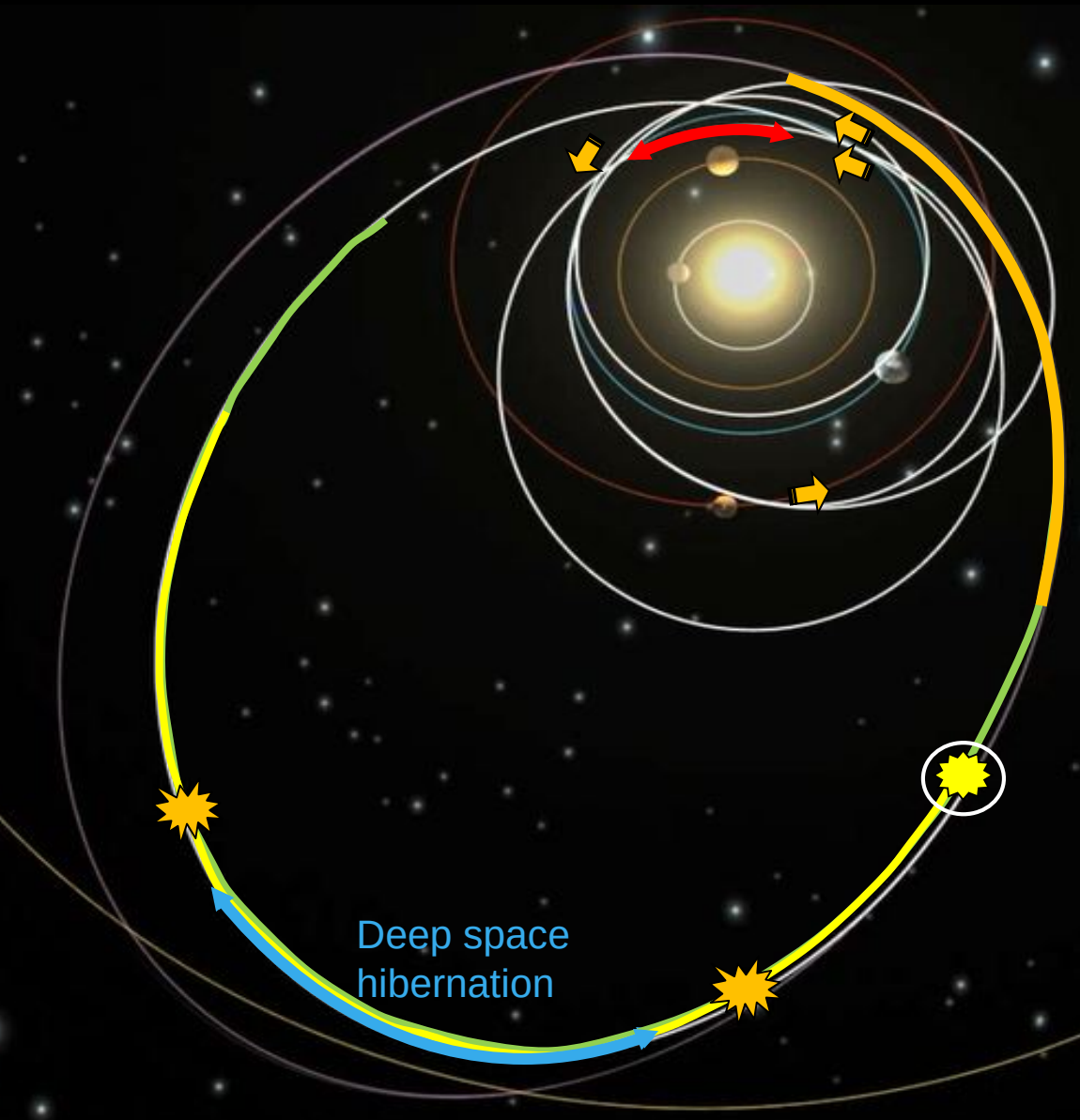


Rosetta's Journey

How to reach the comet ? ➔ Video

Rosetta's Journey

… challenges …



(1) Restricted mass
➔ 4*Swing-by

(2) Thermal design
hot and cold

(3) High distance
communication

(4) Solar Generator
high performance

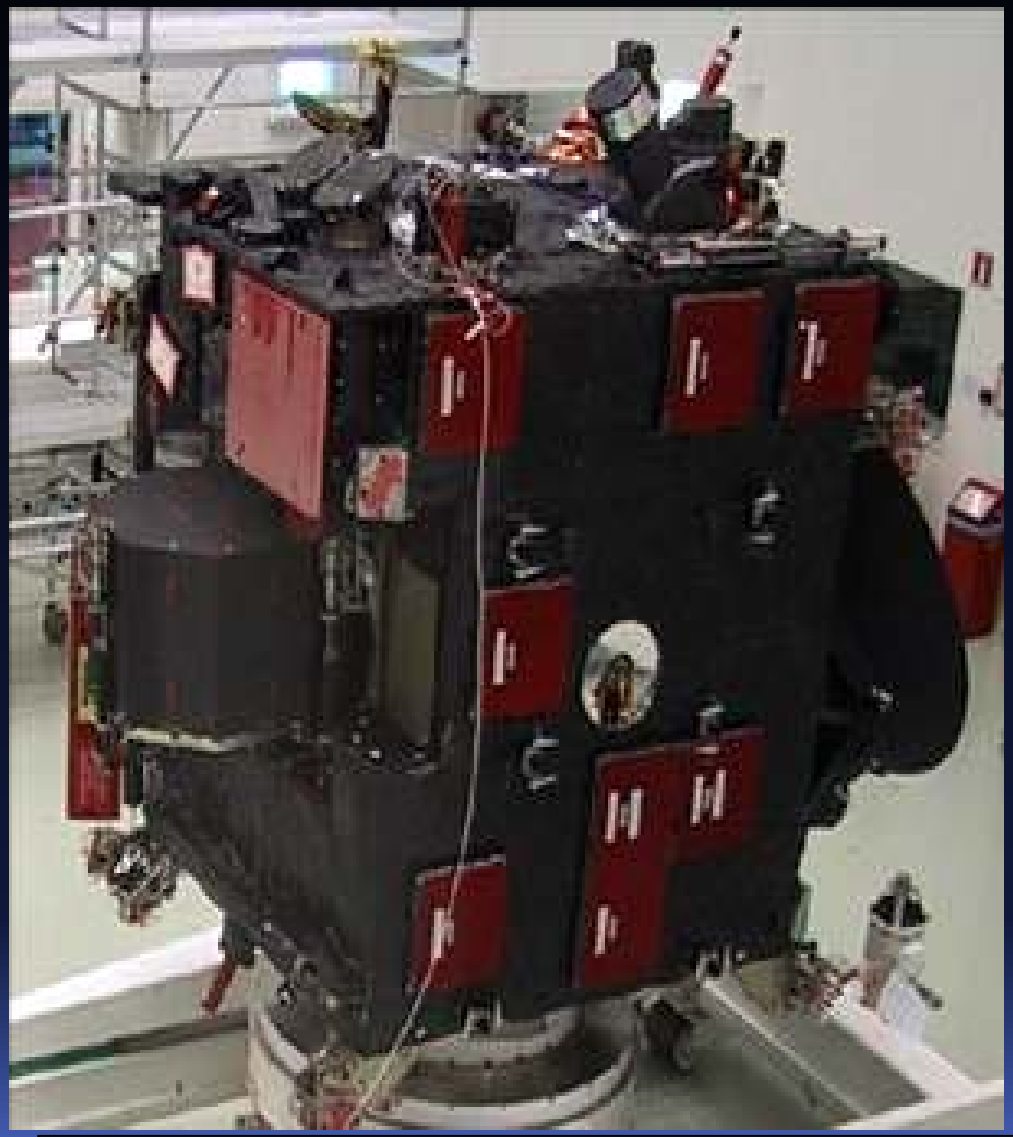
(5) Deep Space Hibernation

(6) Propulsion 7h burns

(7) Navigation close at the
comet

(8) Explore transformation of
the comet when
approaching the sun

The Rosetta Spacecraft



Square: 3.2 x 2.6 x 2.2 m^3

Dry mass:	**1351 kg**
Propellant:	**1653 kg**
Total mass:	**3004 kg**

ROSETTA integration; Quelle: Airbus DS GmbH

Rosetta, the Spacecraft

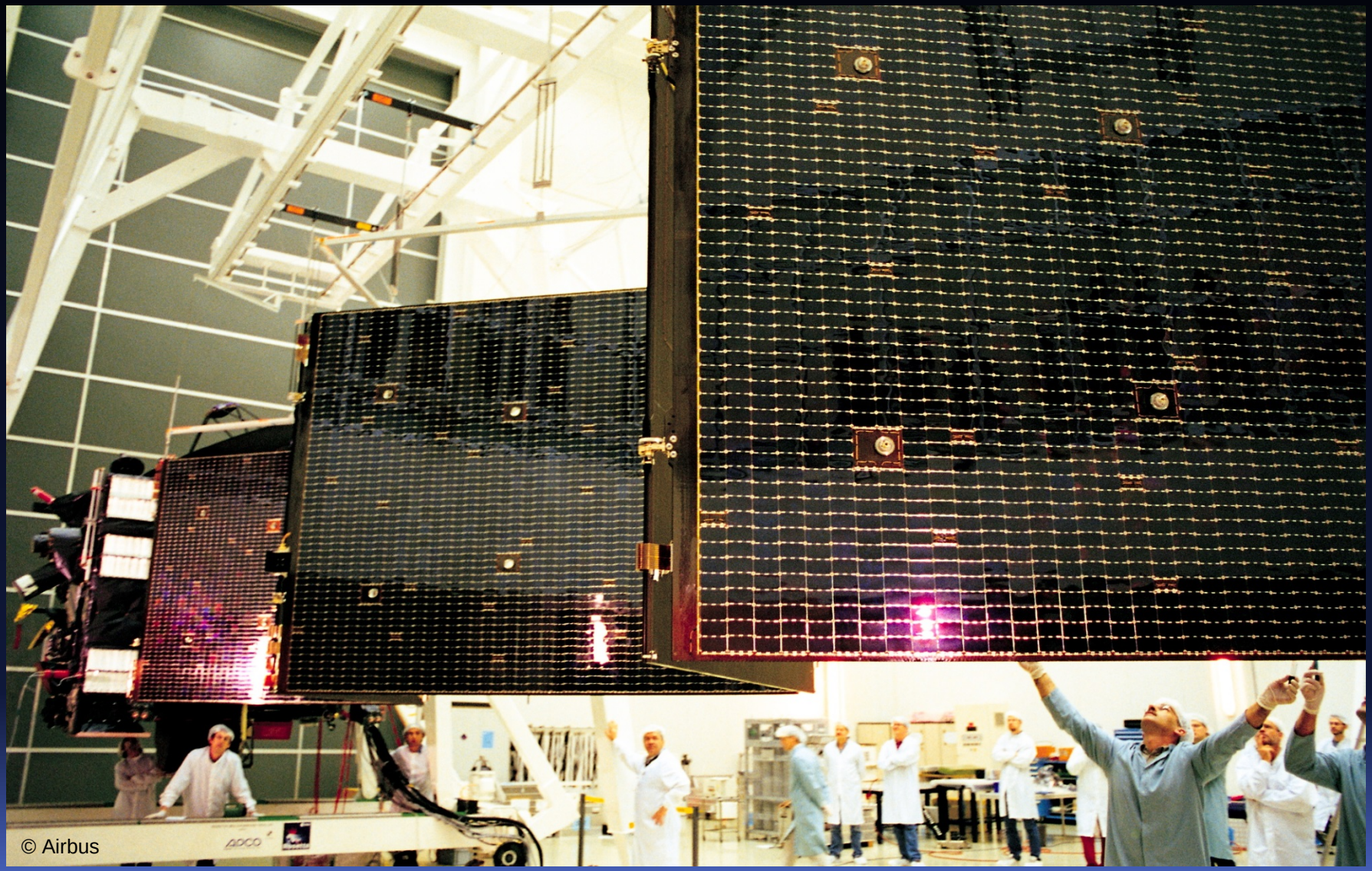
4 Main-Computers in 2 boxes

© Airbus

Rosetta, Design Challenge
High Gain Antenna (HGA)

The Rosetta Spacecraft

Solar array deployment, 15 m one side



The Rosetta Spacecraft

Rosetta with deployed solar array

The Rosetta Spacecraft

Rosetta test in Thermal Vacuum Chamber

ROSETTA in Thermal-Vacuum-Chamber @ ESA

Rosetta's Journey

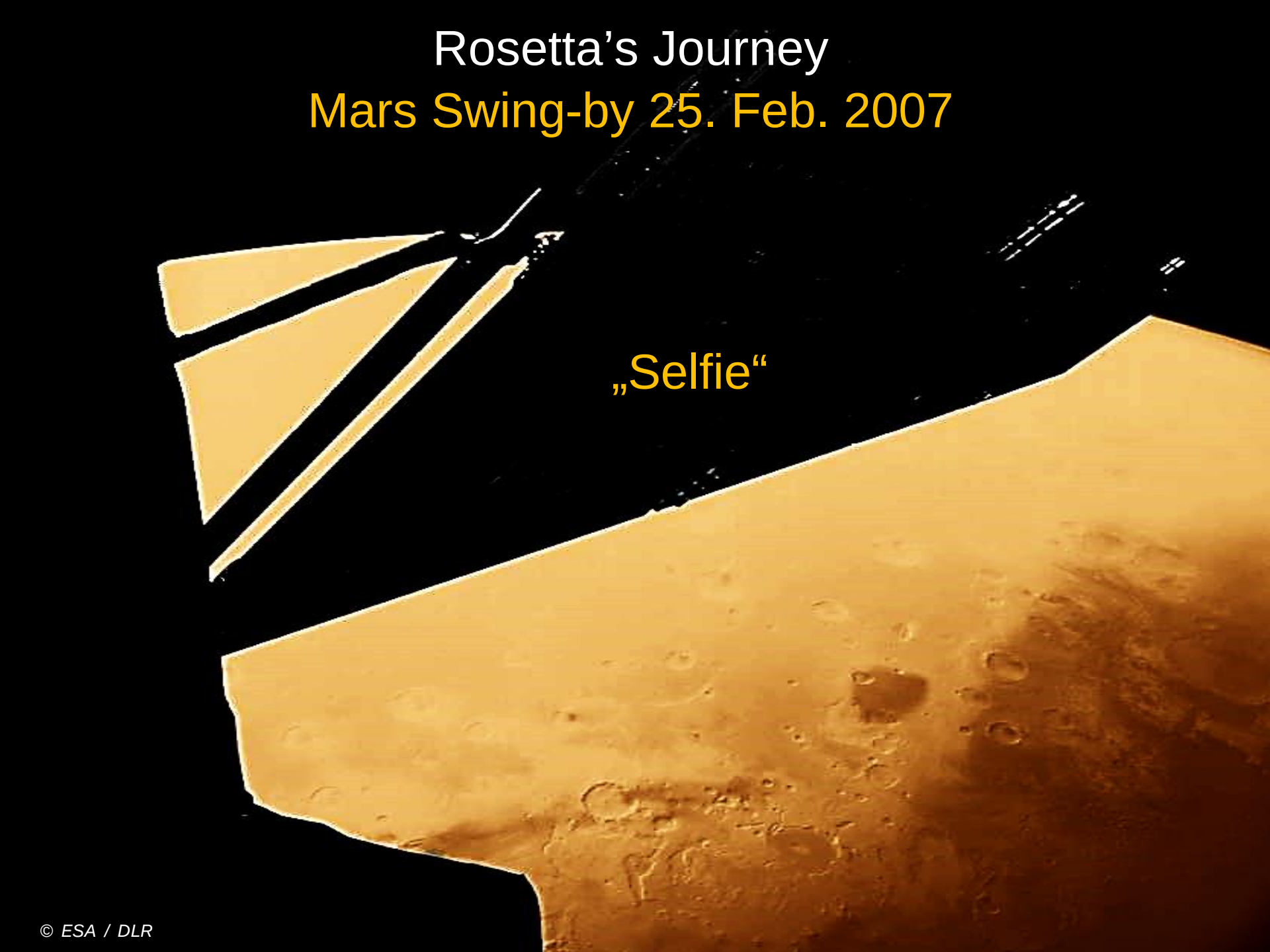
Start from Kourou 2. March 2004

Travelled: **6.8 billion km**

- Flight duration: **11 years**

Rosetta's Journey

Mars Swing-by 25. Feb. 2007



© ESA / DLR

Rosetta's Journey

Asteroid „Steins“ Fly-by 5. Sep. 2008

Autonomous tracking by Navigation Camera

Asteroid type: E

Asteroid size: 6 km

Distance: 800 km

Rel. speed: 8,6 km/s

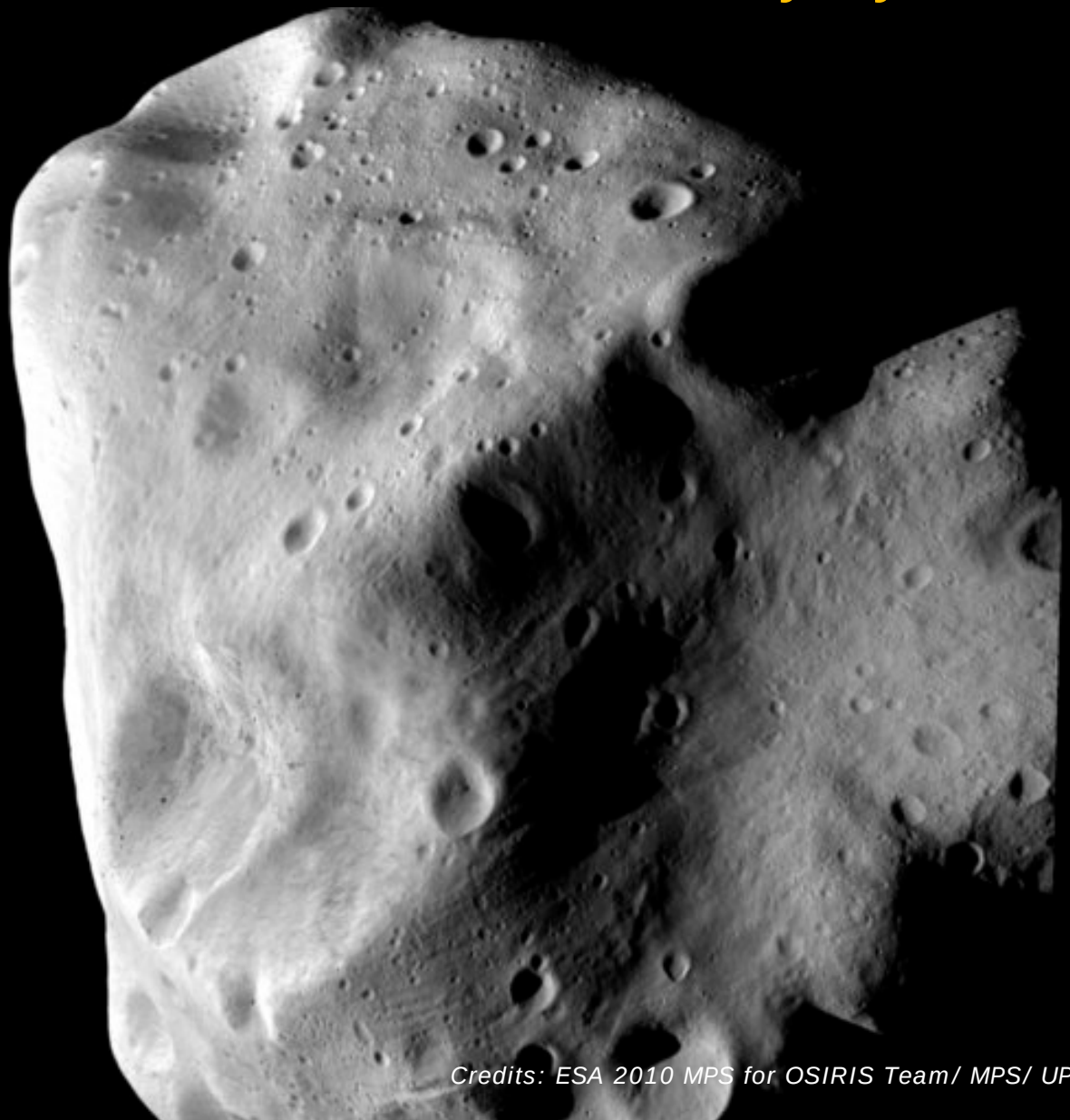
A Diamond in Space

Rosetta Steins flyby, 05 Sep 2008

© *ESA*

Rosetta's Journey

Asteroid „Lutetia“ Fly-by 10. Juli 2010



Asteroid type: M

Asteroid size: 100 km

Distance: 3162 km

Rel. speed: 15 km/s

Credits: ESA 2010 MPS for OSIRIS Team/ MPS/ UPD/ LAM/ IAA/ RSSD/ INTA/ UPM/ DASP/ IDA

Rosetta's Journey

Asteroid „Lutetia“ Fly-by 10. Juli 2010

Credits: ESA 2010 MPS for OSIRIS Team/ MPS/ UPD/ LAM/ IAA/ RSSD/ INTA/ UPM/ DASP/ IDA

Rosetta's Journey

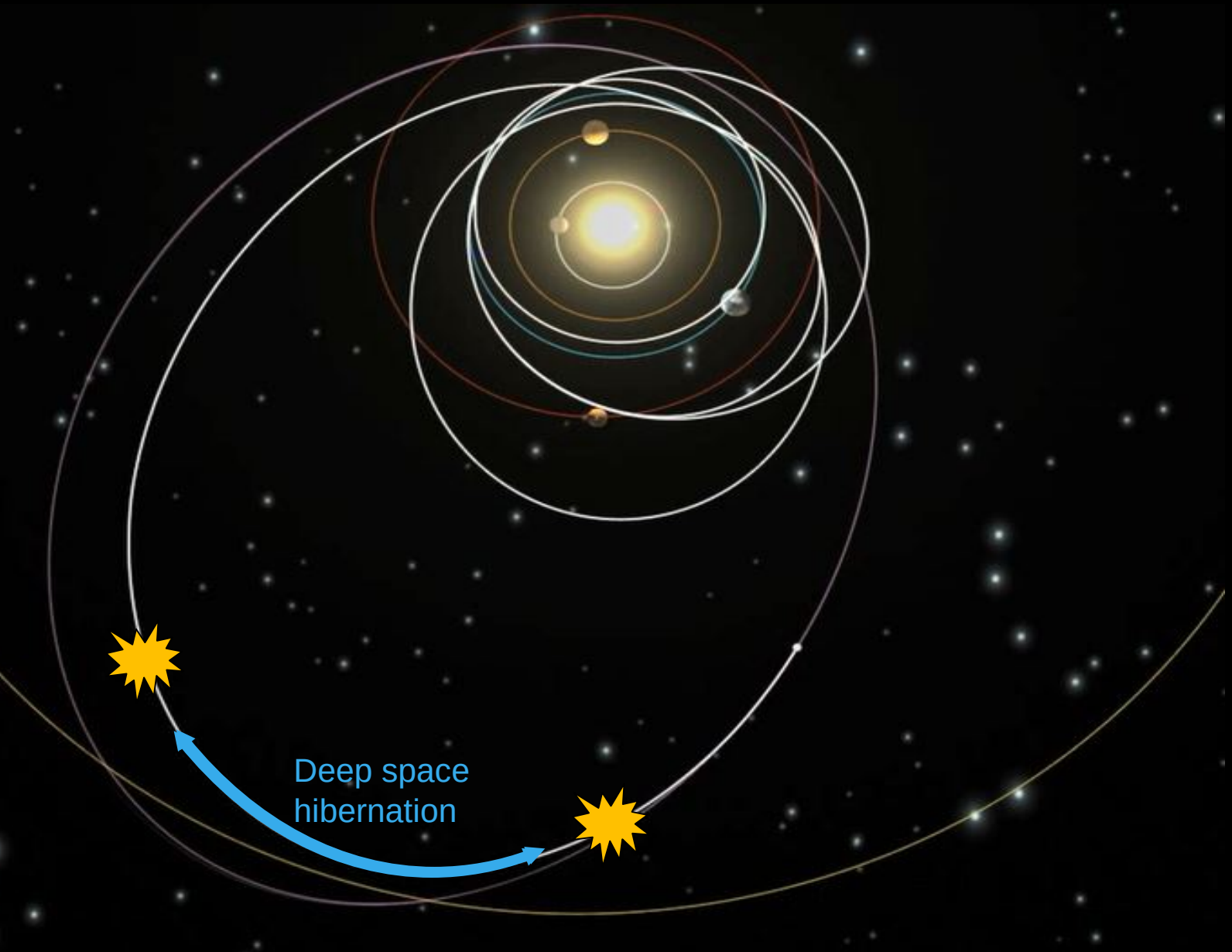
„Decreasing" Lutetia"

Goodbye Lutetia.

Credits: ESA 2010 MPS for OSIRIS Team/ MPS/ UPD/ LAM/ IAA/ RSSD/ INTA/ UPM/ DASP/ IDA

Rosetta's Journey

Rendezvous Maneuvers: 7h burns



Rosetta, Design Challenge

How to generate Electricity ?

Deep space missions
use nuclear power to generate electricity

We fly a „GREEN“ Spacecraft ☺

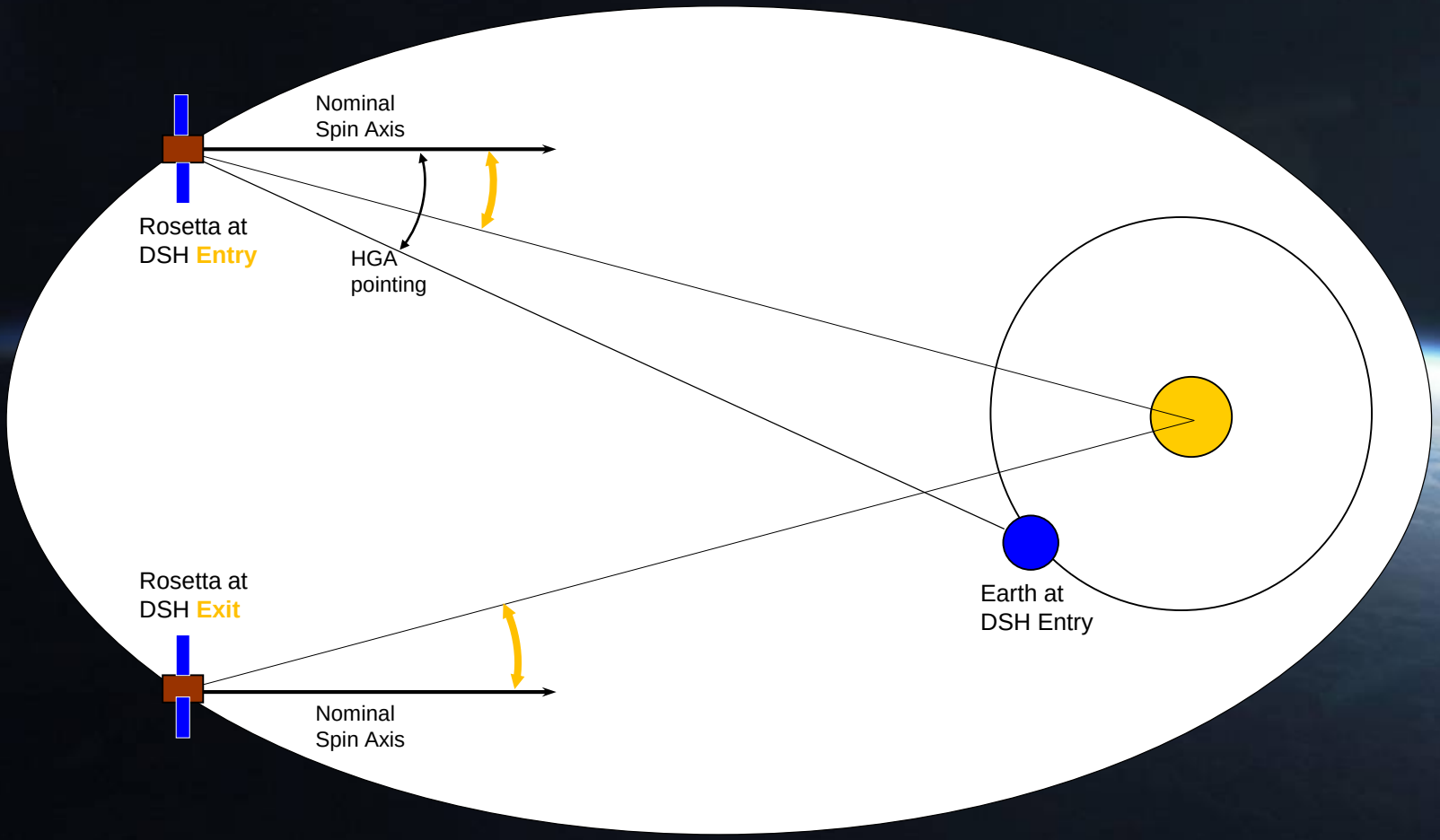
Rosetta, Design Challenge
How much Power do we get ?

- Rosetta's power is generated by solar cells
  - 68 m^2 big solar panels
  - 33 m span tip to tip

➔ 8.700 Watt at distance Earth (1 AU),
➔ but only 440 Watt at distance Jupiter (5 AU)

Rosetta, Design Challenge

Spin Stabilized for Deep Space Hibernation



Deep Space Hibernation

Switch OFF transmitter via Deep Space Network
➔ strobbing signal stopped. No signal for 2.5 years

Disable “normal” S/C Survival strategy
➔ **“do not disturb”**

➔ Now Rosetta is in Deep Space Hibernation !?

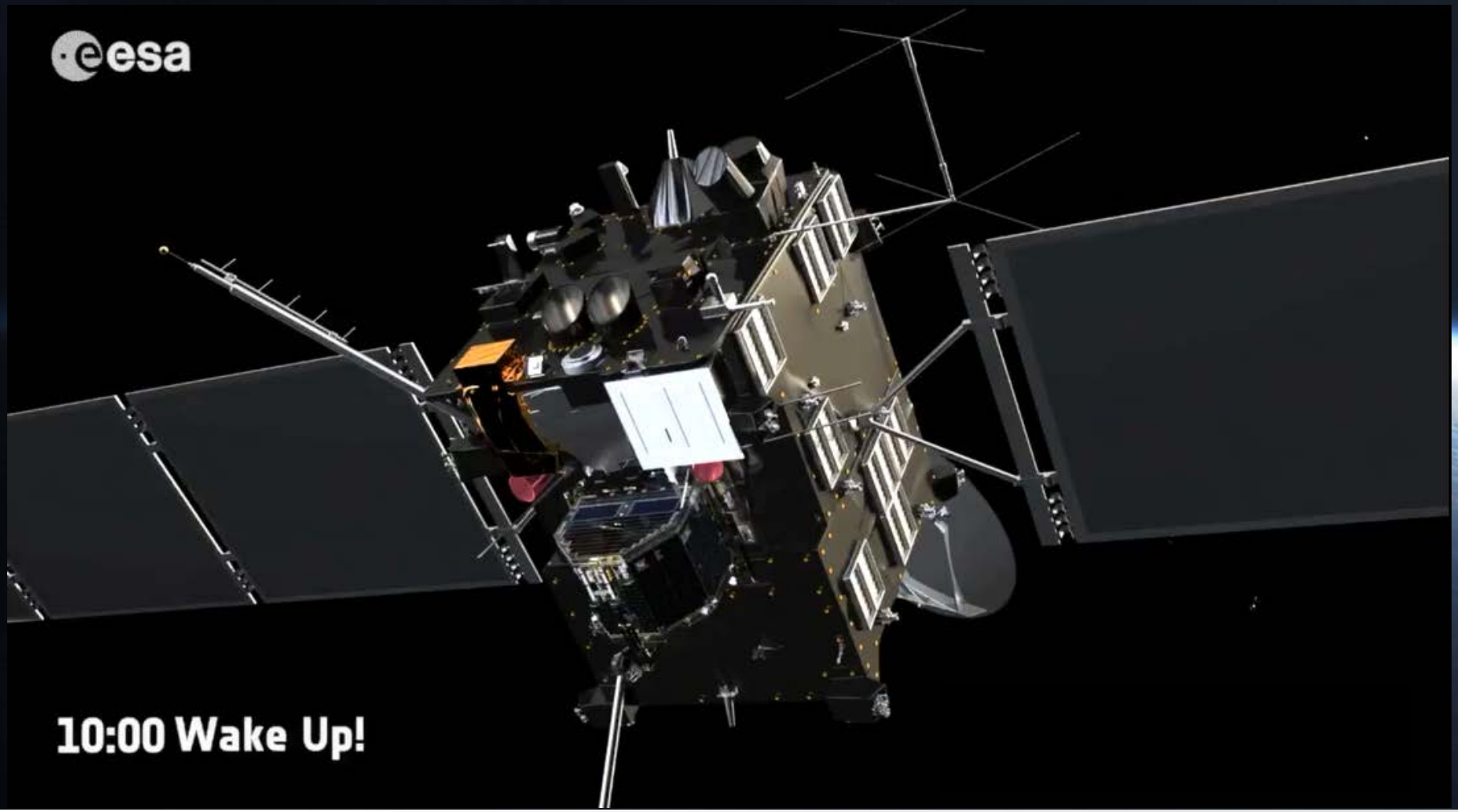
Exciting question:

“Is the light OFF in the fridge, when the door is closed ?”

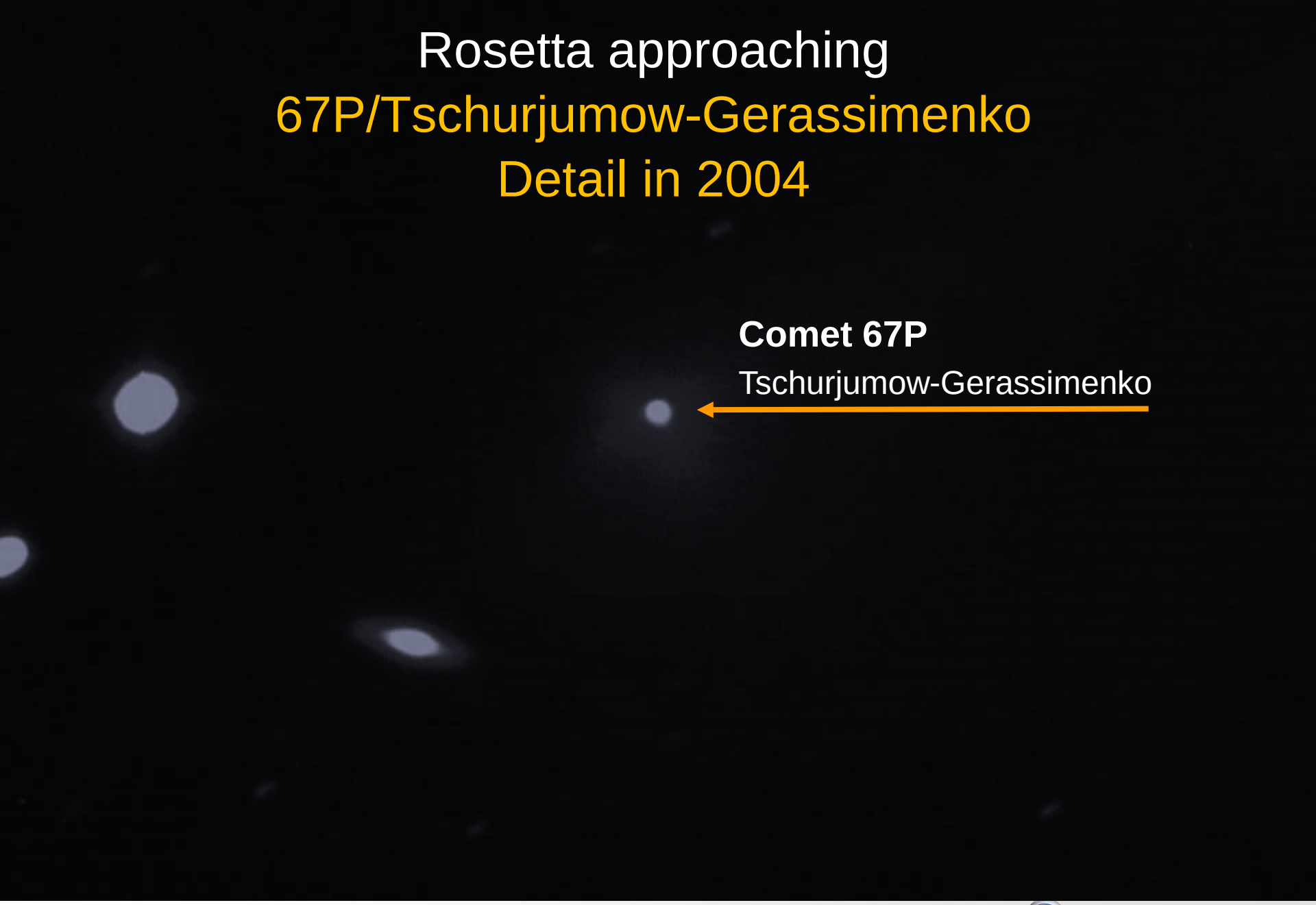
Rosetta's Journey
Deep space hibernation

Courtesy of Miguel Perez Ayucar

The Rosetta Mission at 20. Jan. 2014
Wake-up: 2 of 4 alarm clocks had to “ring”



Rosetta approaching 67P/Tschurjumow-Gerassimenko Detail in 2004



Rosetta approaching
67P Tschurjumow-Gerassimenko
Details June 2014

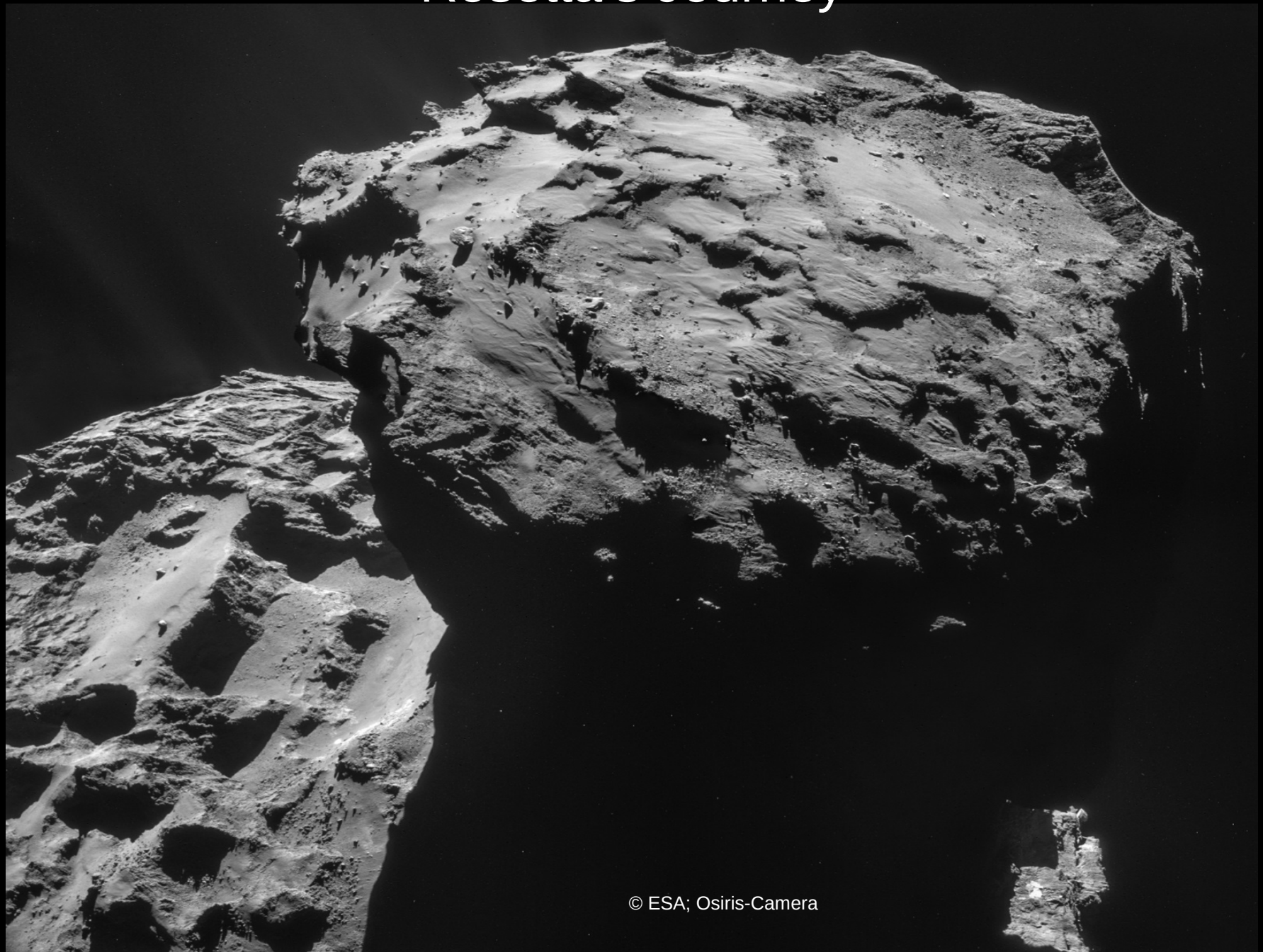
Rosetta's Journey

No easy soft snowball

but a hard surface
with cliffs and boulders

© ESA; Osiris-Camera

Rosetta’s Journey

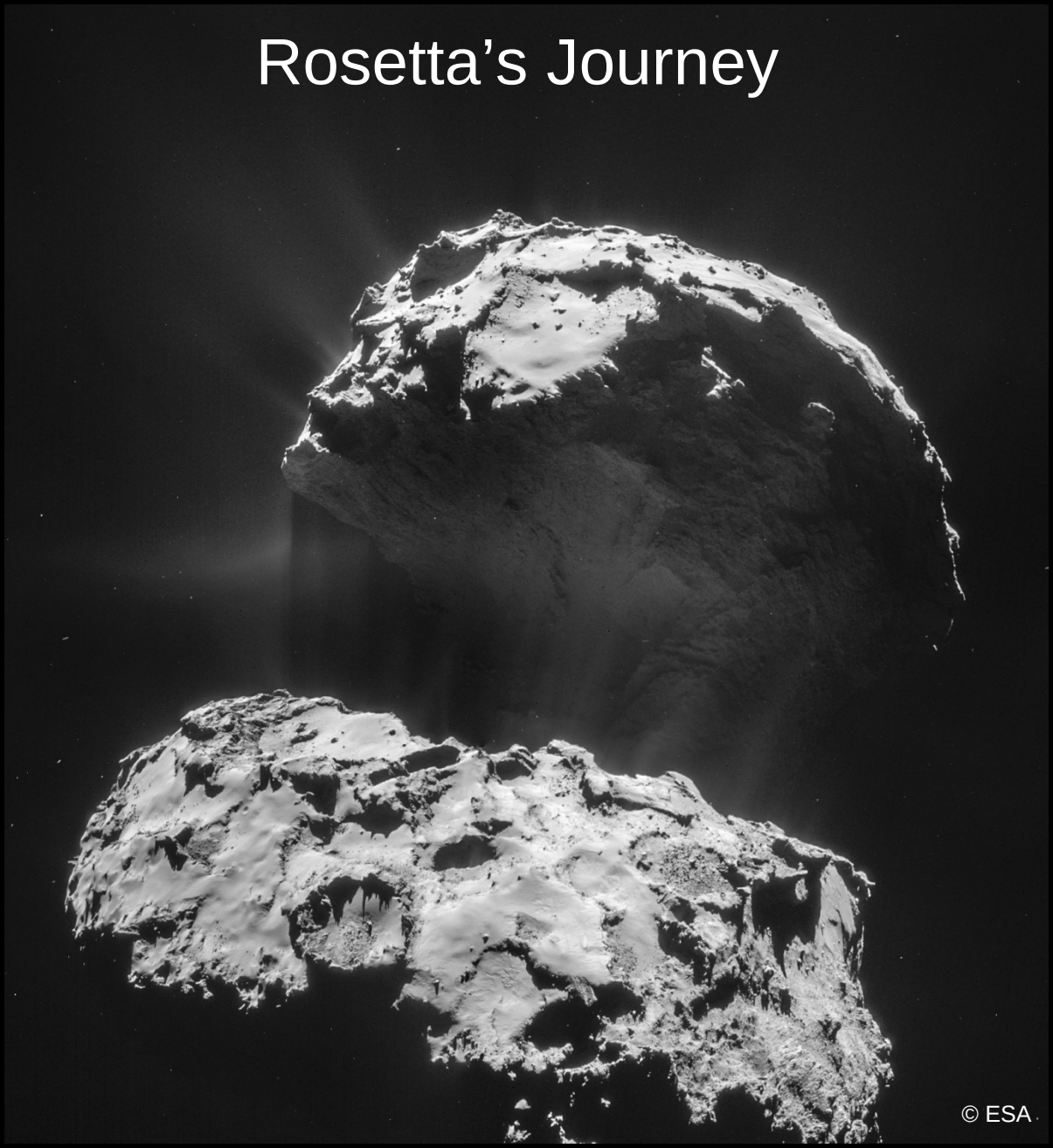


Rosetta’s Journey

© ESA; Osiris-Camera

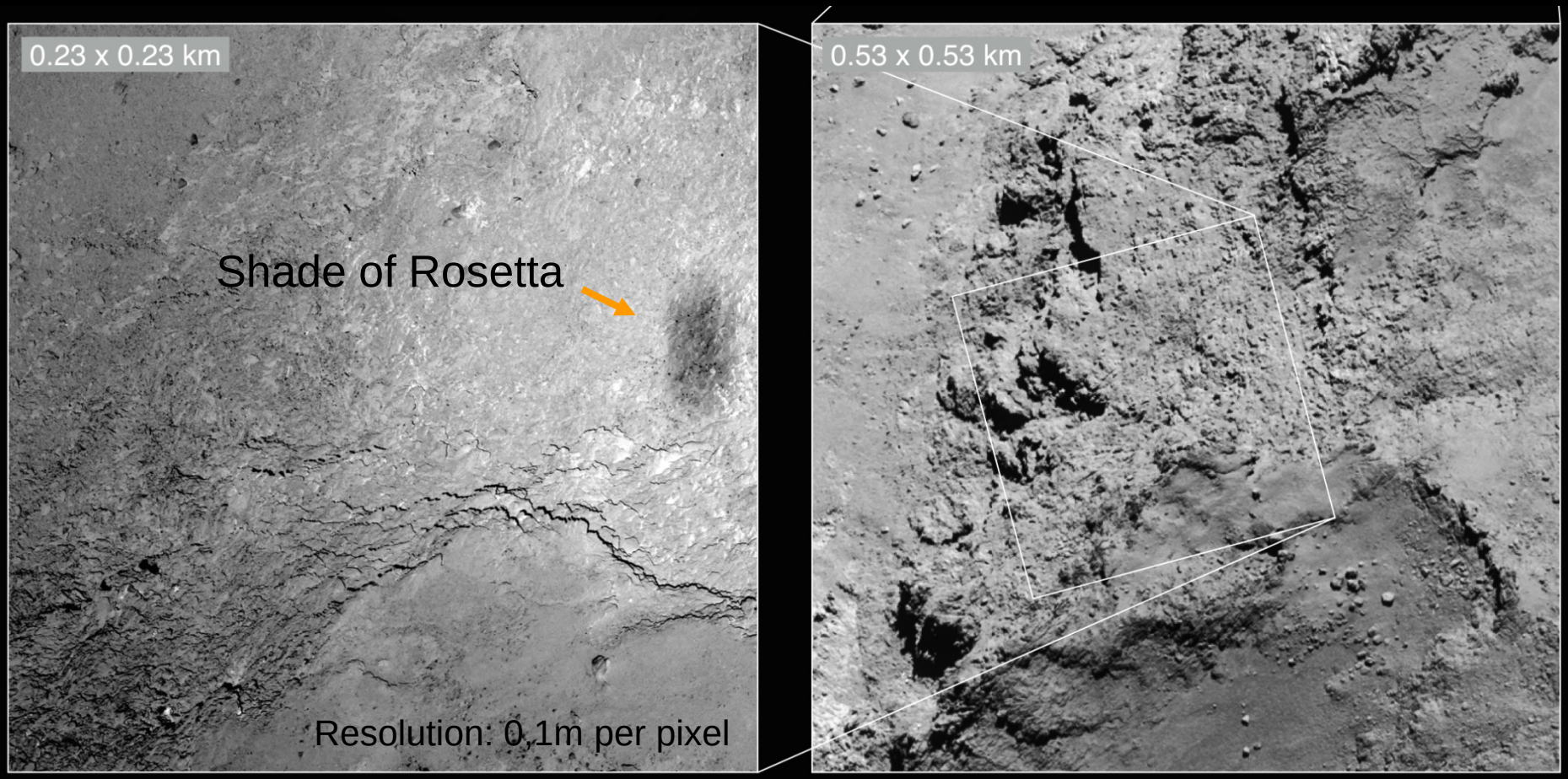
Rosetta’s Journey

Rosetta’s Journey



Rosetta's Journey

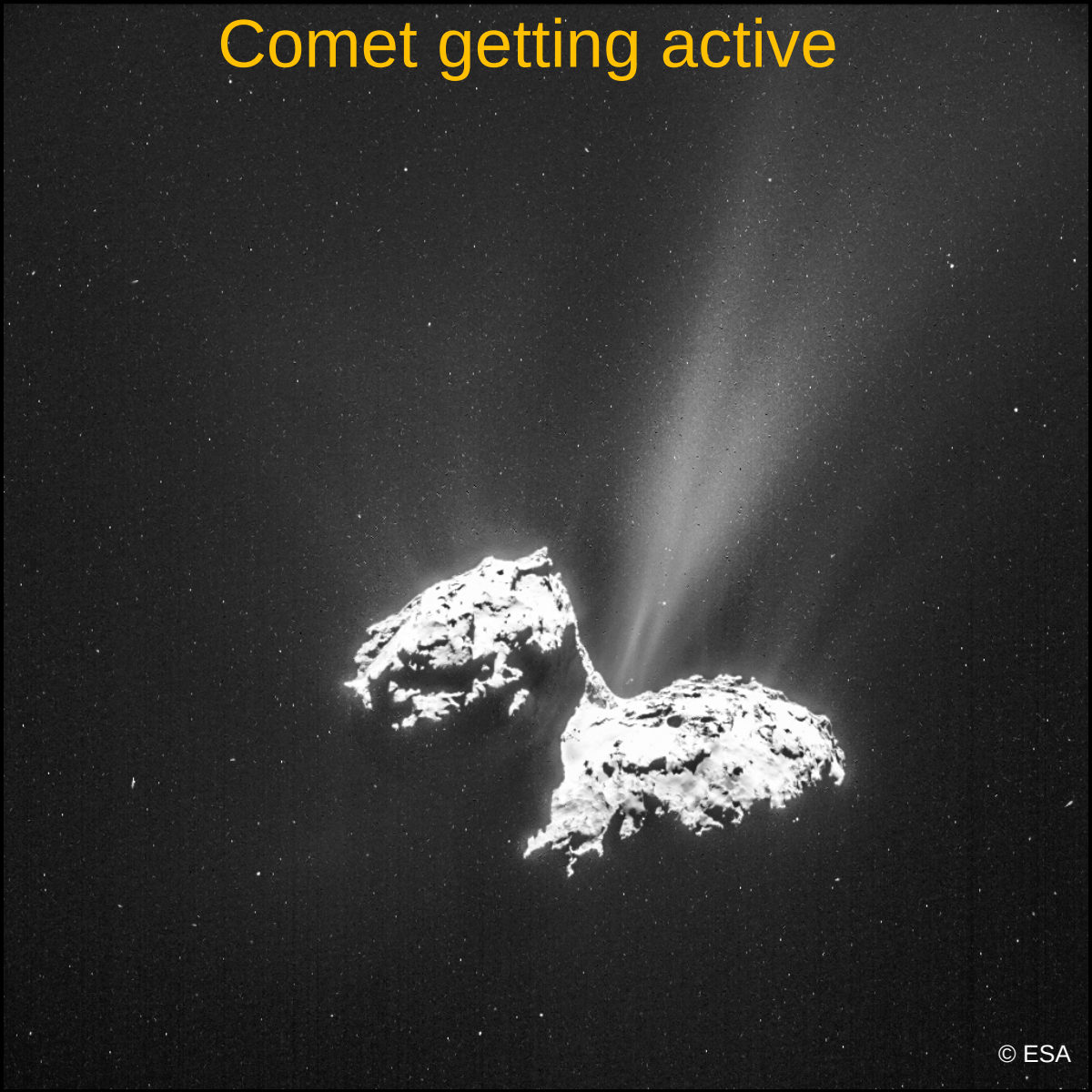
Close fly-by with high resolution OSIRIS-Camera



© ESA; OSIRIS-Camera

Rosetta’s Journey

Comet getting active

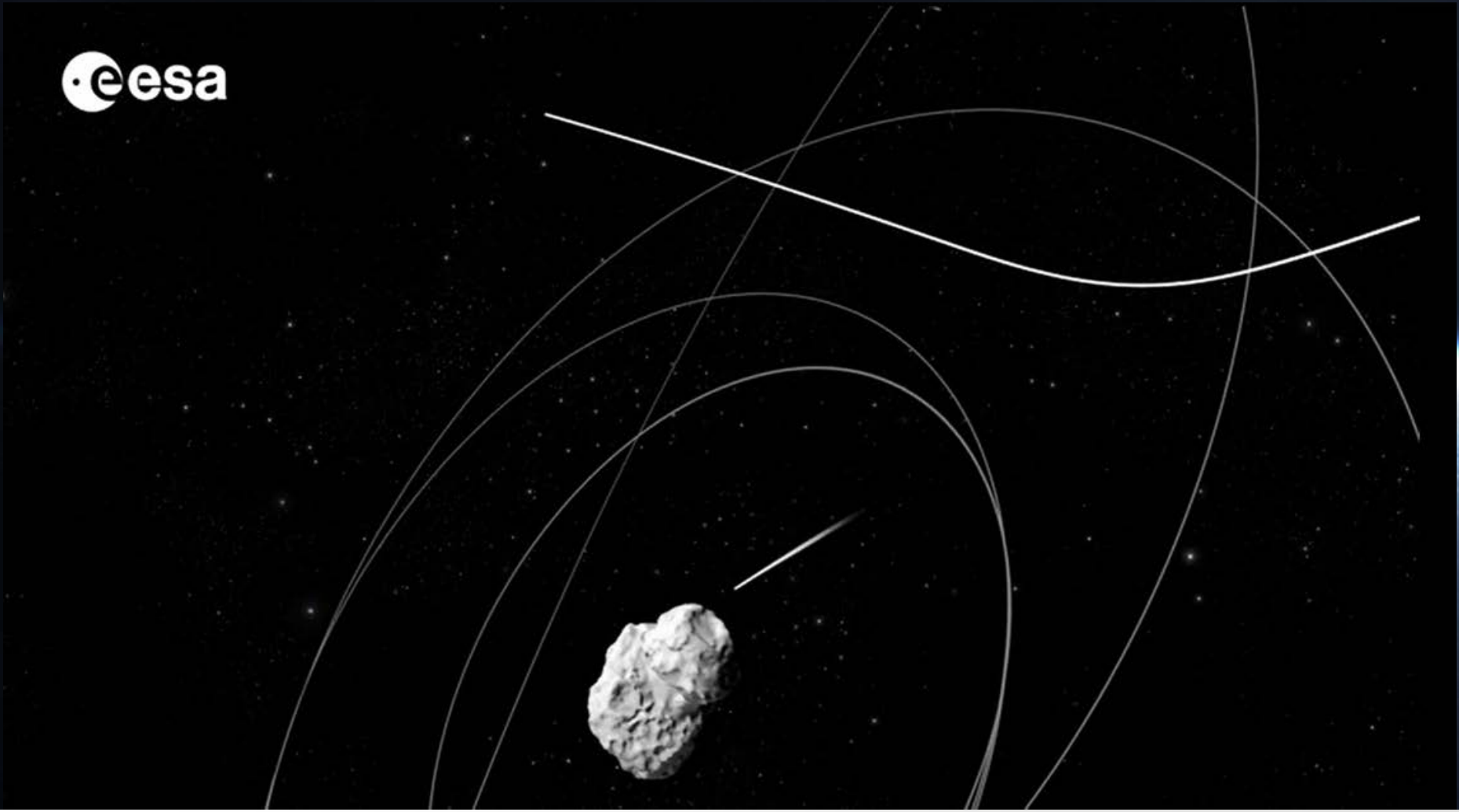


Rosetta’s Journey

Landing on the comet

© Airbus

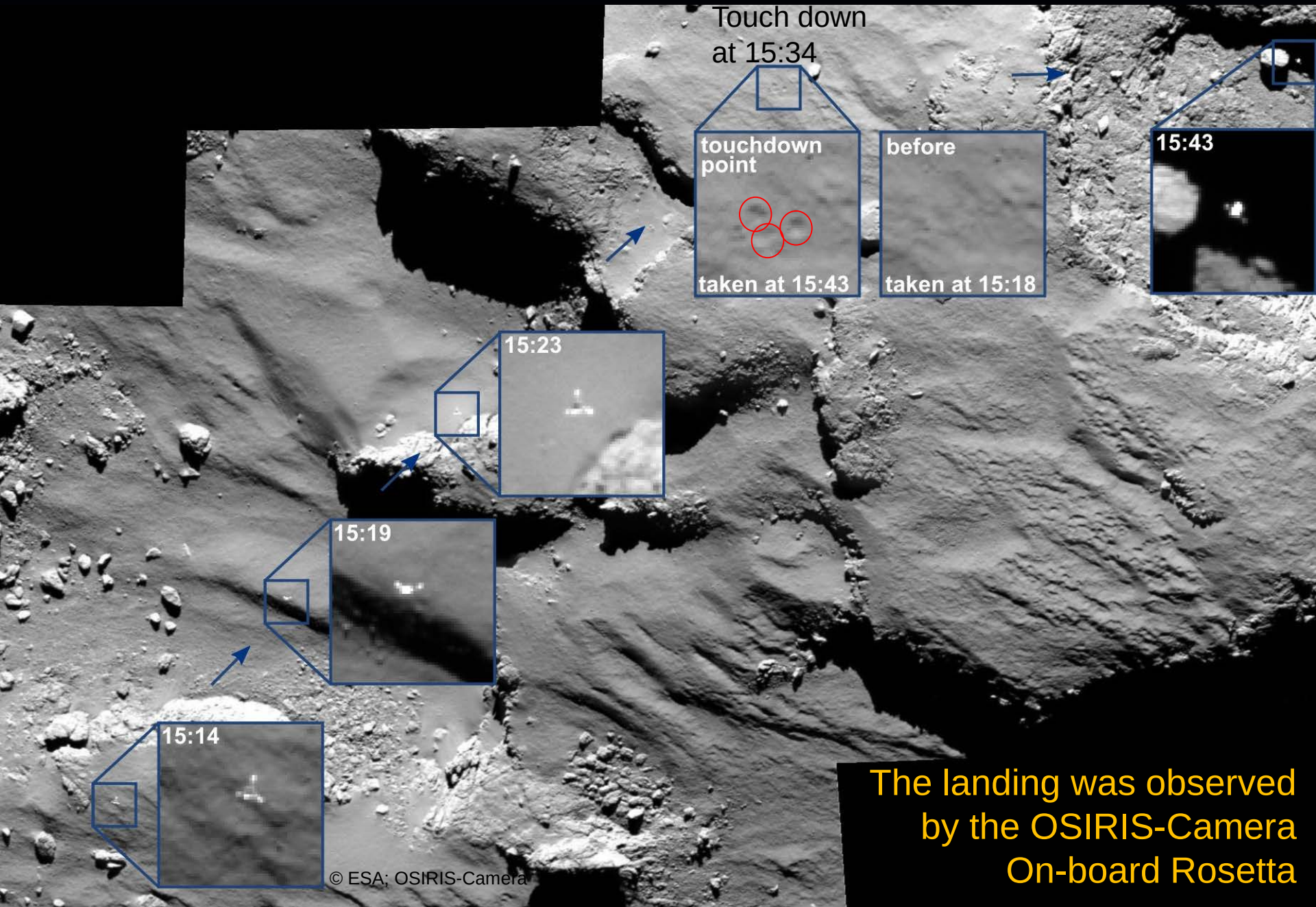
Rosetta's Journey
Orbit and Lander ejection



Rosetta’s Journey

Orbit and Lander ejection => video

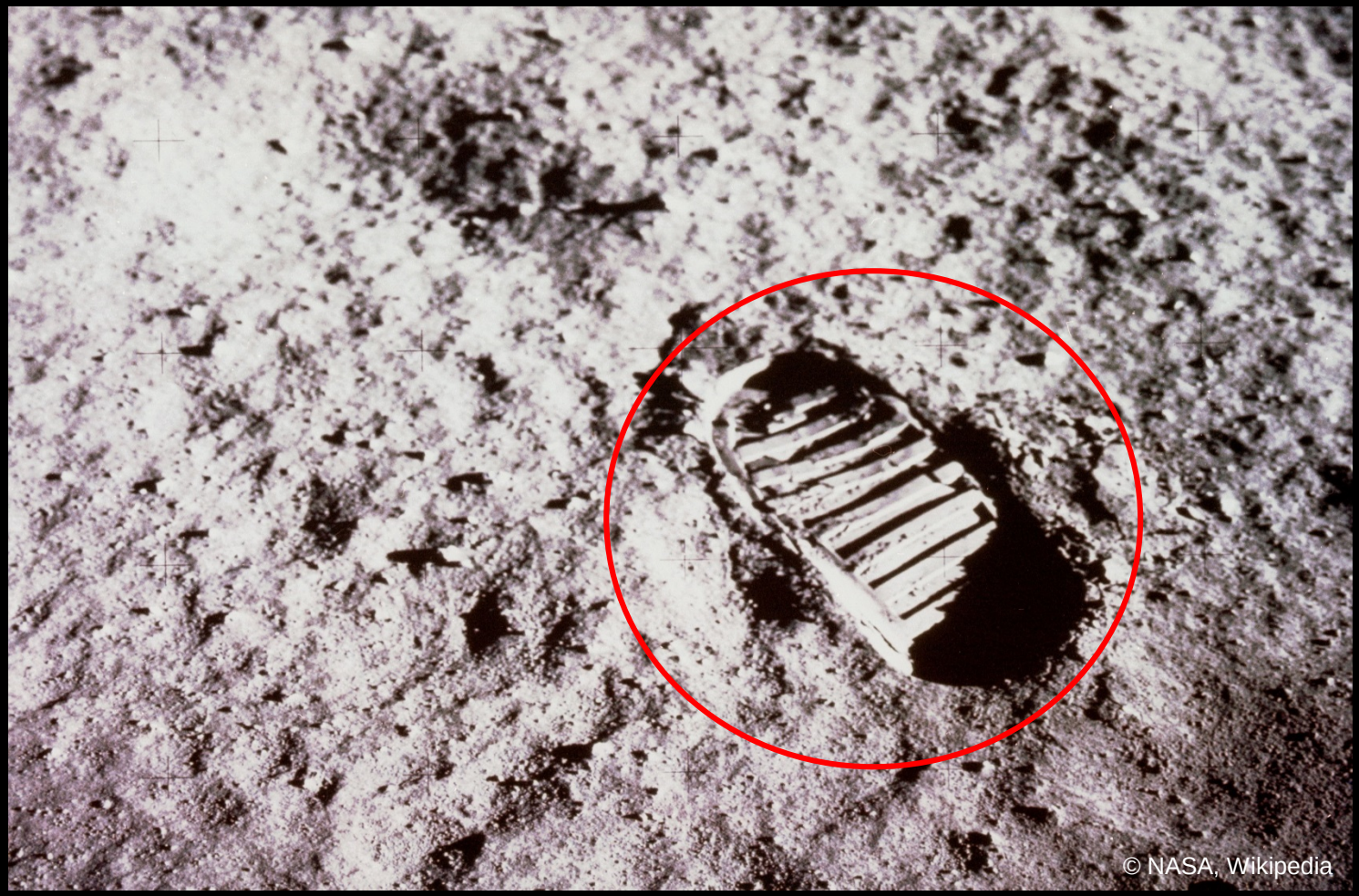
Philae's Landing on Comet 67P.



The landing was observed
by the OSIRIS-Camera
On-board Rosetta

First Footprint on the Moon

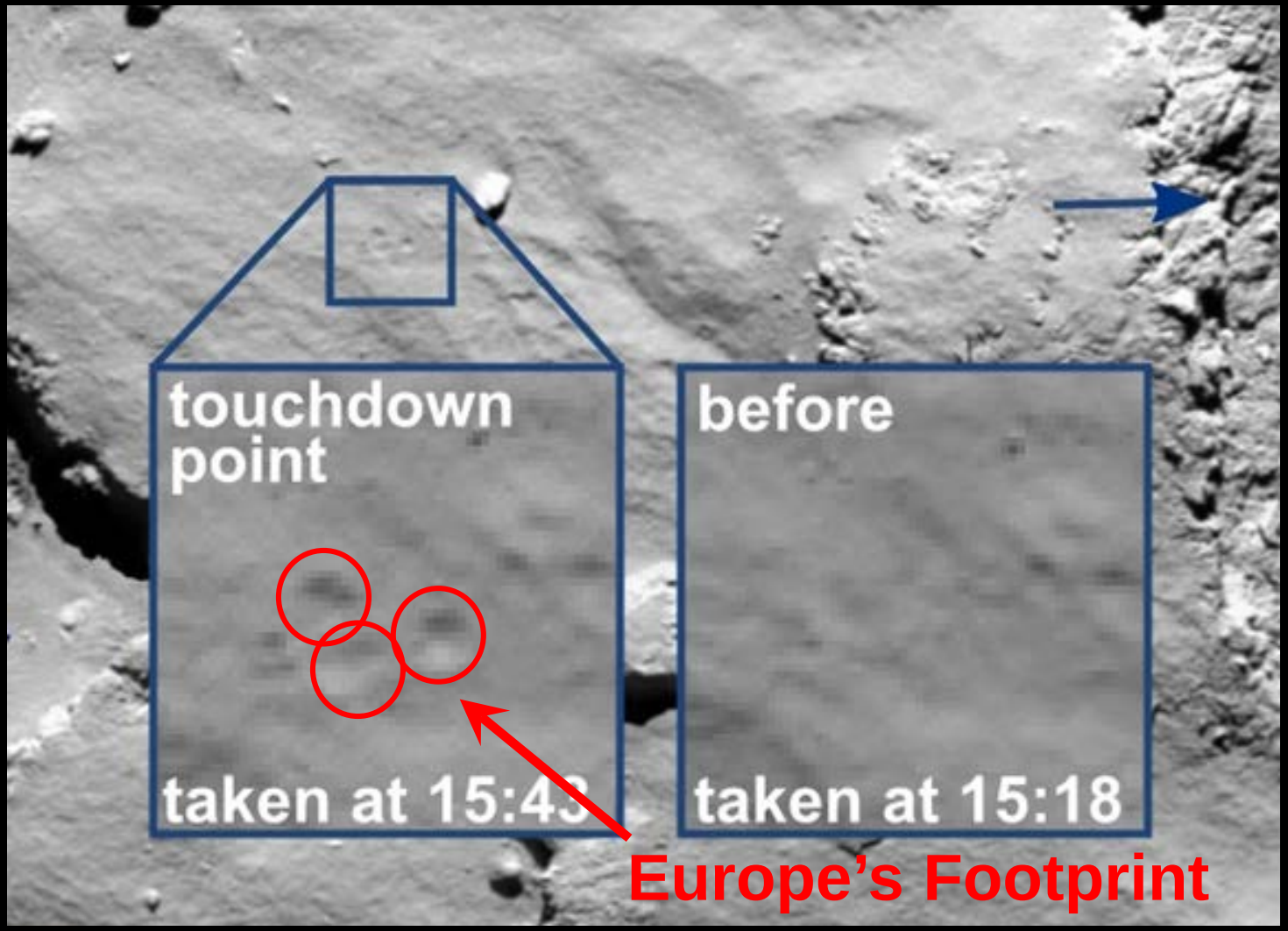
Neil Armstrong 21.7.1969



First Footprint on a Comet

Philae

12.11.2014



The Rosetta Mission
Conclusion

- Rosetta was designed and built by Airbus DS
  - 16 European countries + USA involved
  - 96 different companies contributed with their excellence

- Rosetta is now the first spacecraft

  to follow a comet

  to closely orbit around a comet

  … and even delivered a Lander on the comet

The Rosetta Mission

Yes, Europe, we made it !

Thank you
for your attention !

Mission Impossible

Rosetta Video 2

Rosetta Video 1