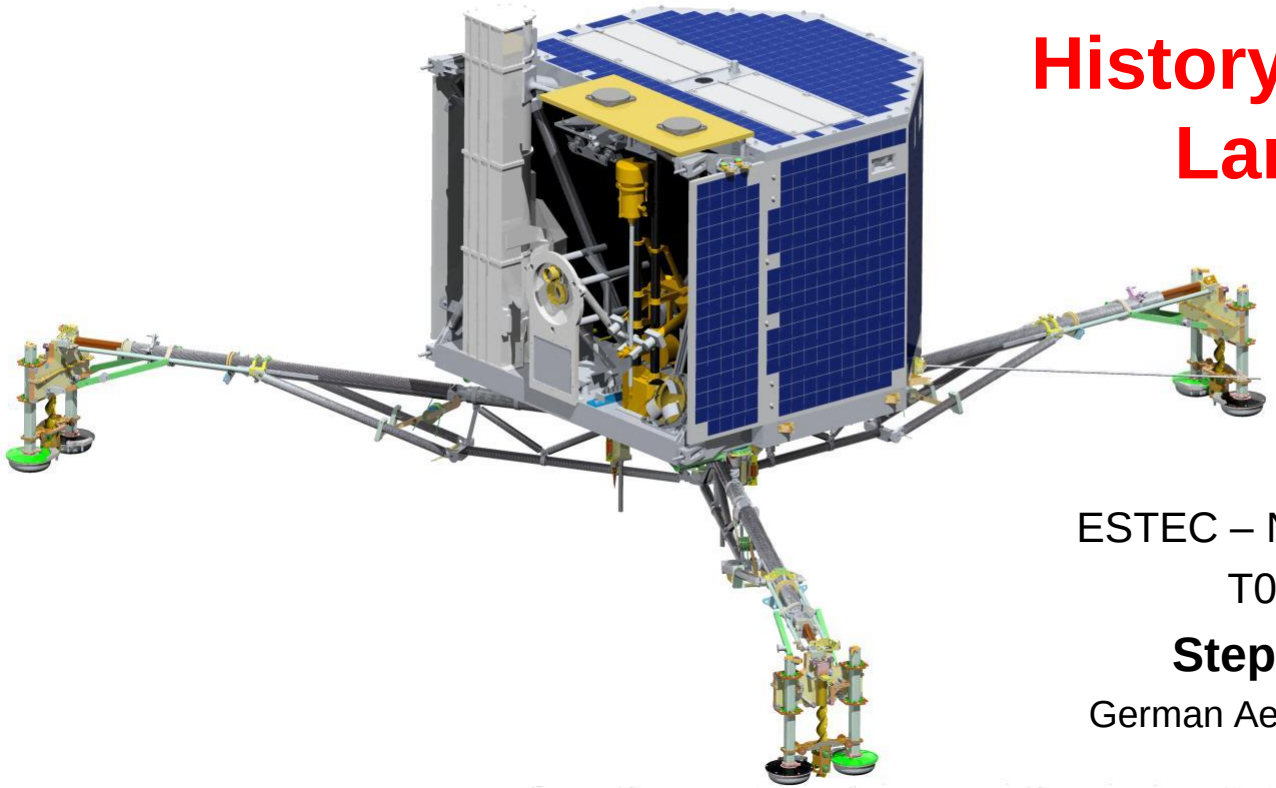


History of the Rosetta Lander Philae

ESTEC – November 12, 2024

T0 + 10 years

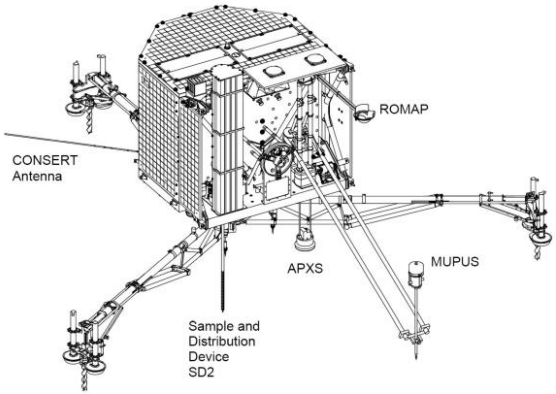
Stephan Ulamec

German Aerospace Center, DLR

„Historic assumption“ on how Philae would rest on the comet (image: CNES)

The Rosetta Lander - Philae

- An endeavor based on the common effort of a huge team with members in Austria, Finland, France, Germany, Hungary, Ireland, Italy, The Netherlands (ESA), Poland, Spain, United Kingdom and others
- Science teams from all over the world, contributing to development or data evaluation of the ten PI-led instruments

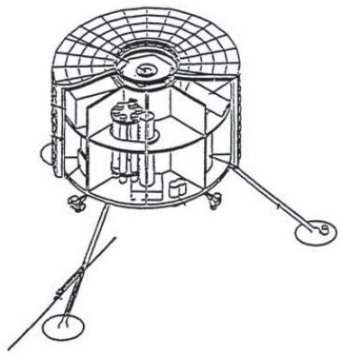


Rosetta AO, asked for SSP

- A Lander (SSP) although rated scientifically highly important, could not be fit into the ESA Rosetta Cornerstone financial frame
- Consequently, the AO asked for proposals for an SSP, analogous to Orbiter instruments and to be funded by national agencies
- This did include that compromises regarding reliability as well as documentation had to be accepted (standards as for instruments, not system)
- Two proposals have been submitted:
  RoLand and **Champollion**

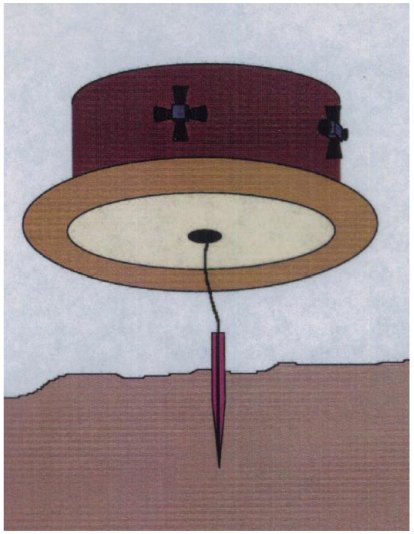
Rosetta + Philae: Over 40 years

- **1984** … Rosetta included in ESA „Horizons 2000“ programme
- **1994** … Proposal for RoLand submitted
  - **1995 „Final“ Proposals for RoLand and Champollion delivered to ESA**
- **2004** … Rosetta with Philae launched to 67P/C-G
- **2014** … Successful landing
- **2024** … here we are

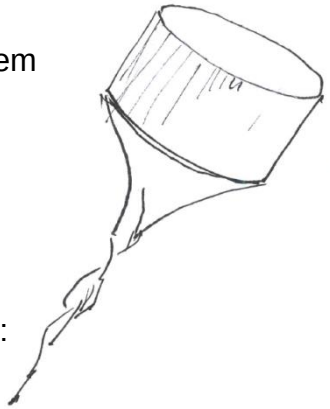


The Early Ideas for a Lander

- First Science Team
  - Already 1985, J. Geiss, H. Fechtig with A. Bar-Nun, W. Huebner, E. Jessberger, H.-U. Keller, K. Roessler, G. Schwehm, D. Stöffler, H. Wänke and E. Grün
  - Defining ESA/NASA CNSR Mission
- Early Teams to define SSP for Rosetta Rendezvous Mission
  - In Germany around H. Rosenbauer, E. Grün, D. Möhlmann, B. Feuerbacher, H. Fechtig and G. Schwehm
  - In parallel at JPL, led by. M. Neugebauer, „Champollion“,
    with CNES contributions, J.P. Bibring

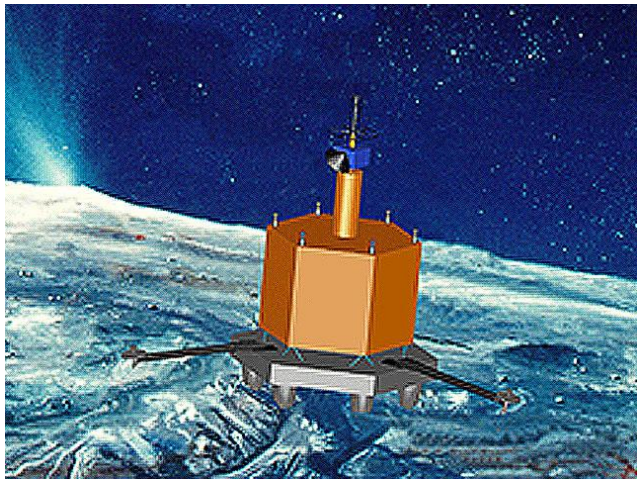


Early DLR idea,
with cold gas system

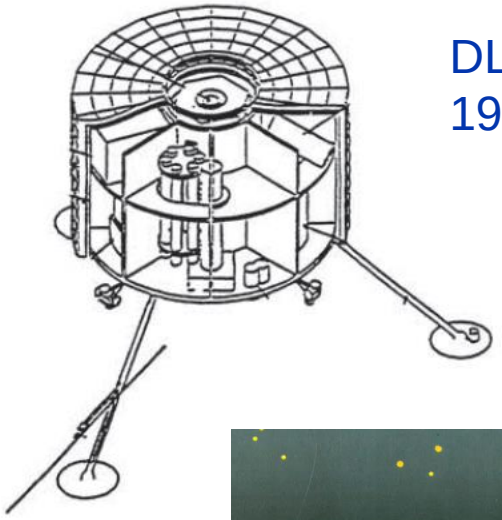


Early MPAe idea:
corc-screw

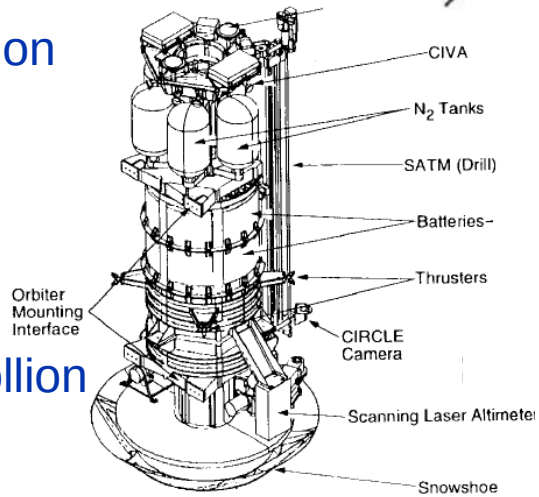
„Historic“ Designs



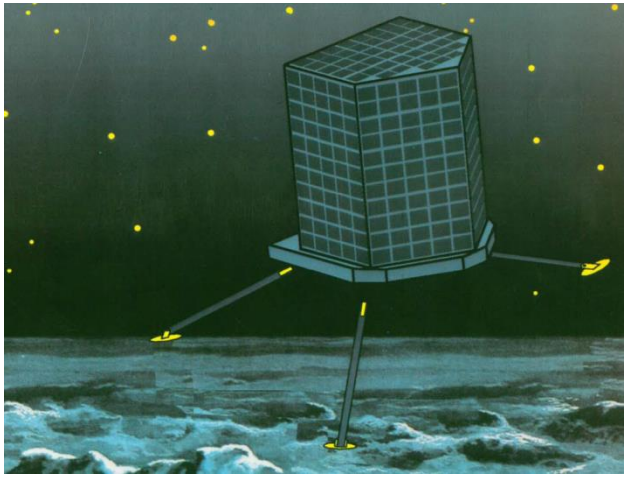
JPL/CNES Champollion
1994



DLR/MPAe/FMI RoLand
1994



JPL/CNES Champollion
1995



DLR/MPAe *et al*. RoLand 1995

PHILAE

RoLand Team
1995, in Cologne

Let´s remind and give our thanks and gratitude to

Dr. Helmut Rosenbauer
(former director of MPS, 1936-2016)

whose inspiration, persistence and wealth of ideas made the Rosetta Lander reality and ultimately led to the historic landing in November 2014

RoLand → Rosetta Lander→ Philae

- RoLand Proposal was clearly restricted to
  - Best effort basis (Design to Cost)
  - No exchange of funds
- After Champollion could not be realized (due to problems with funding timeline), the original RoLand design was enlarged (from 45 kg to 85 kg), and CNES become partner of “Rosetta Lander”
- Rosetta Lander consortium:
  DLR, MPAe (MPS), MPE, ASI, CNES, FMI, STIL, PPARC (UK-Space), KFKI (Wigner), IWF and ESA
- Lander still considered “one payload of many”!!

Development of consortium

Proposals
1994 and
1995

RoLand

MPG, DLR, FMI
with KFKI, ASI,
PPARC, STIL, IWF

Champollion

JPL with CNES

Amalgamation
1996

Rosetta Lander

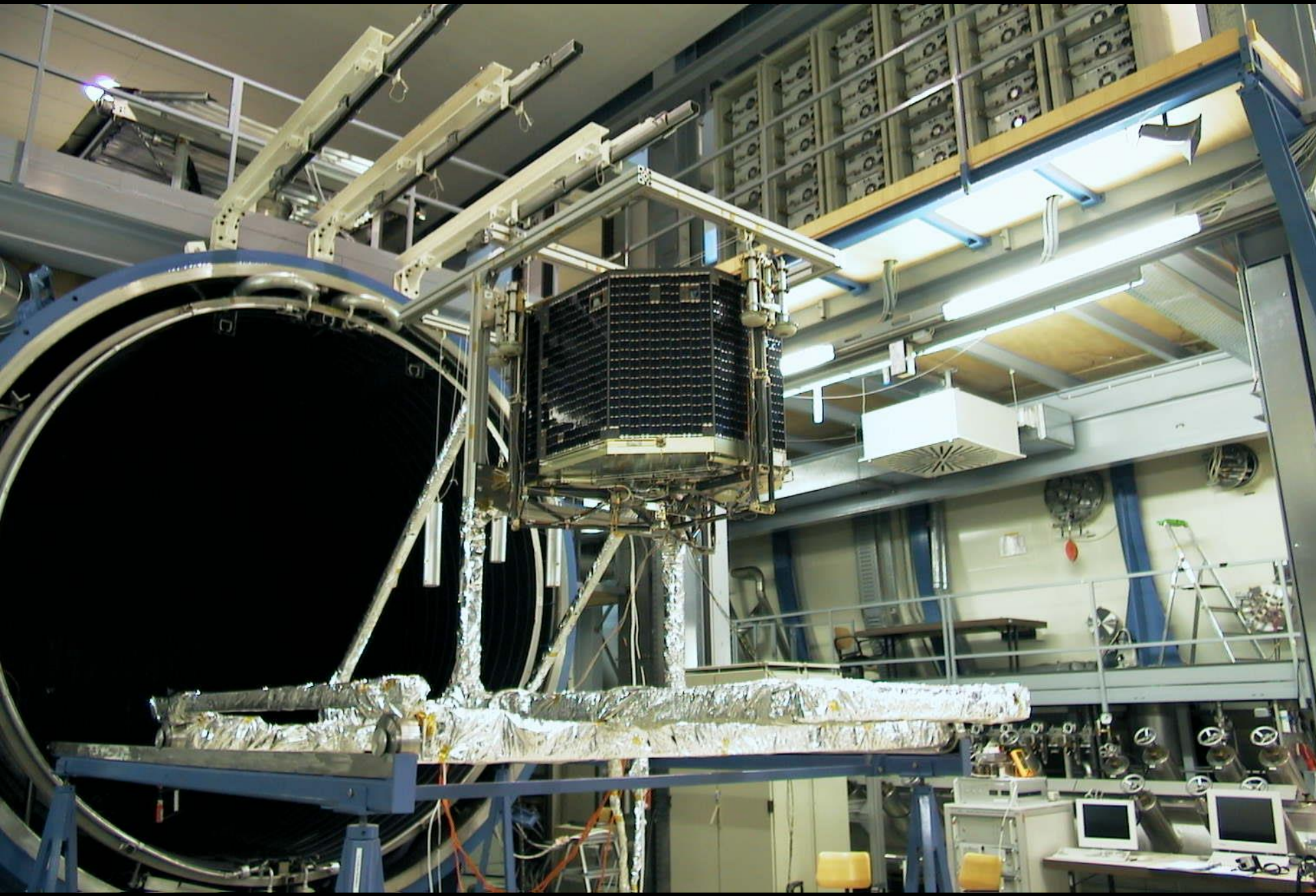
DLR, **MPG, ASI, CNES**, FMI
KFKI, ASI, PPARC, STIL, IWF

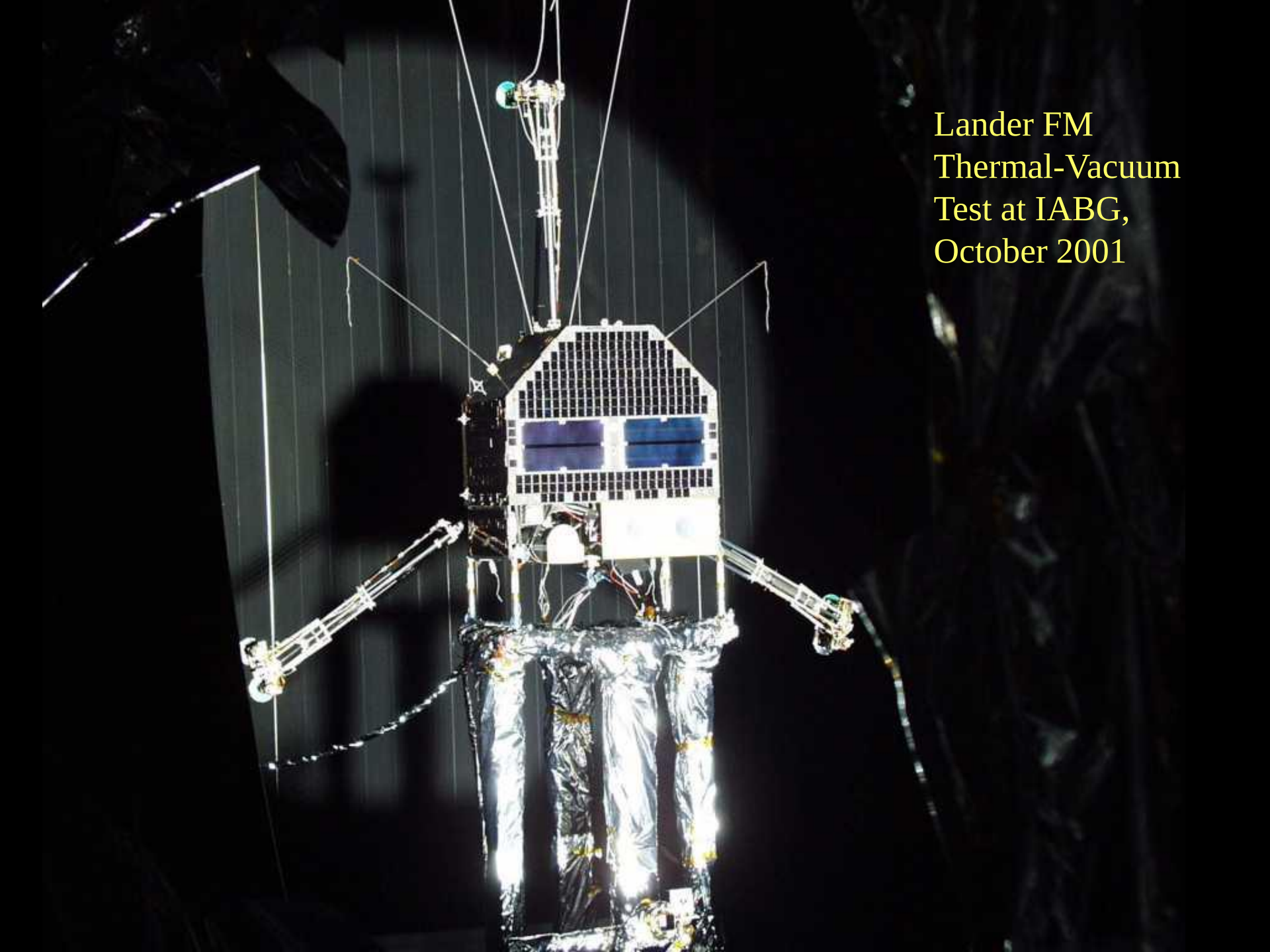
„Ringberg Meeting“
1999

Rosetta Lander

DLR, **MPG, ASI, CNES**, **ESA**, FMI,
KFKI, ASI, PPARC, STIL, IWF

Naming competition
2003
„Philae“





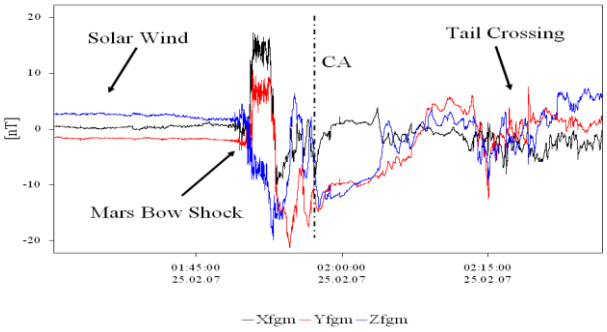
Lander FM
Thermal-Vacuum
Test at IABG,
October 2001

Rosetta Launch 02-03-04

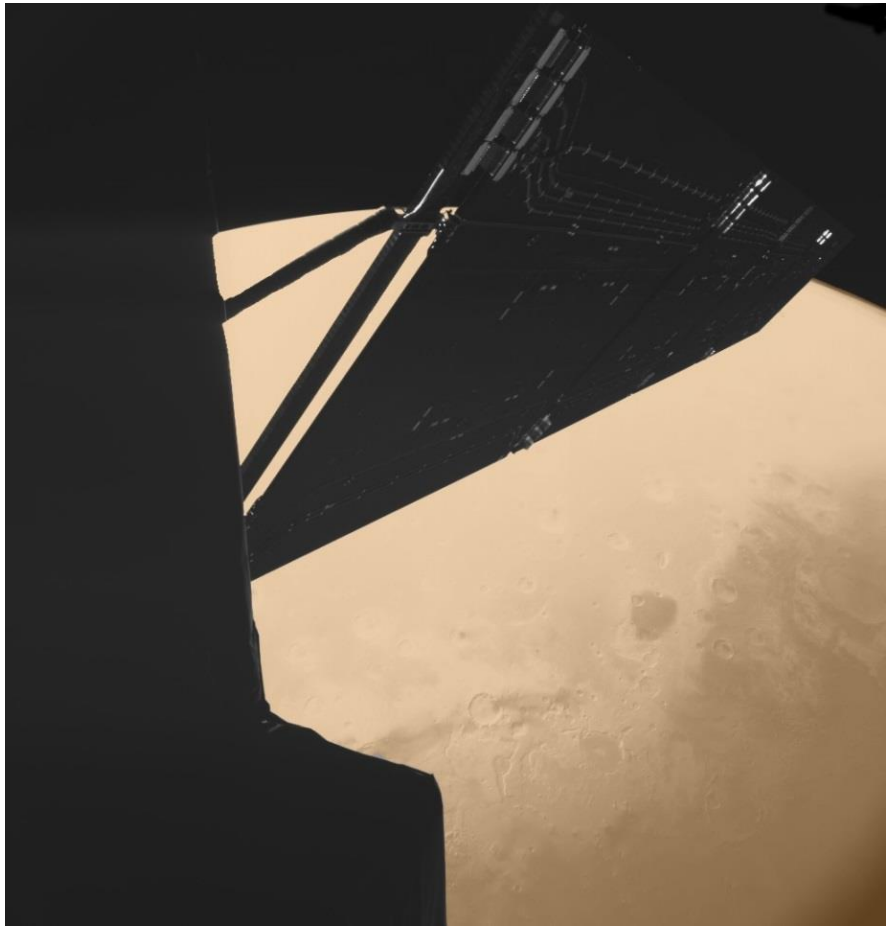
Images by OSIRIS

Philae Highlights during 10 years of Cruise

- Mars swingby, February 23rd 2007; CA: 250.6 km
- Šteins : September 5th 2008
- Lutetia: July 10th 2010
- 14 Check-out and Calibration sequences (PC 0 to 13)
- Hibernation: Dec 2010 - Mar 2014



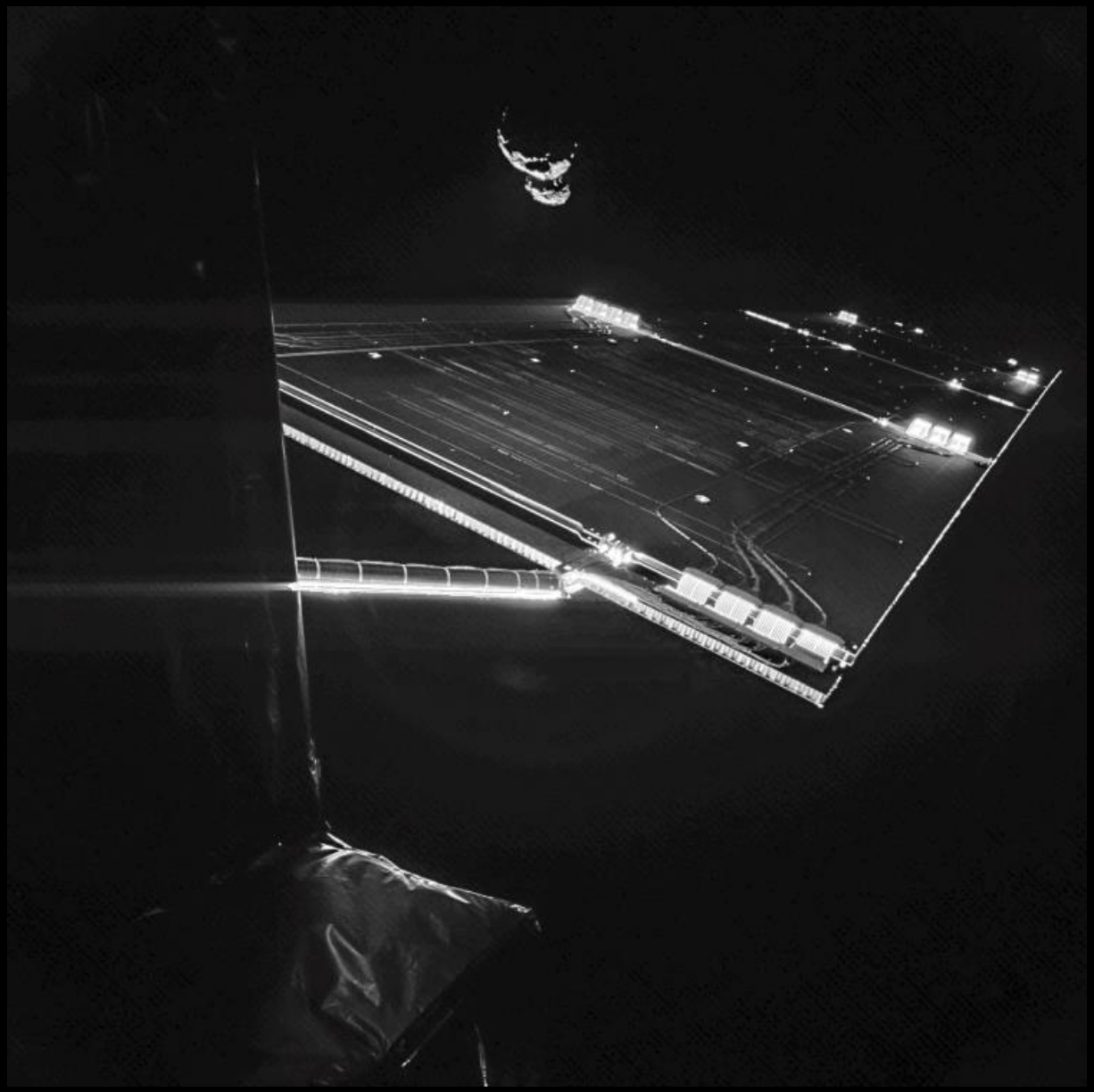
Bowshock at Mars; ROMAP



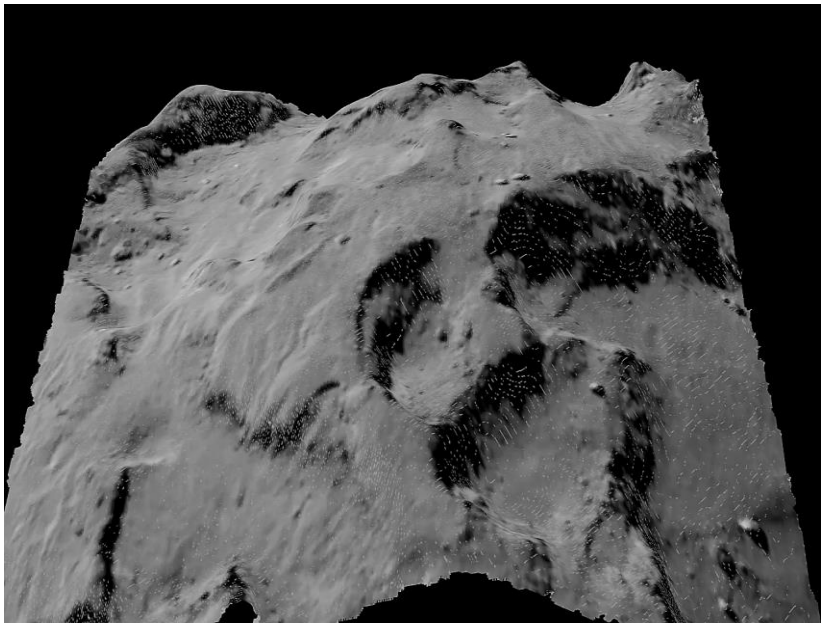
Mars as seen by CIVA

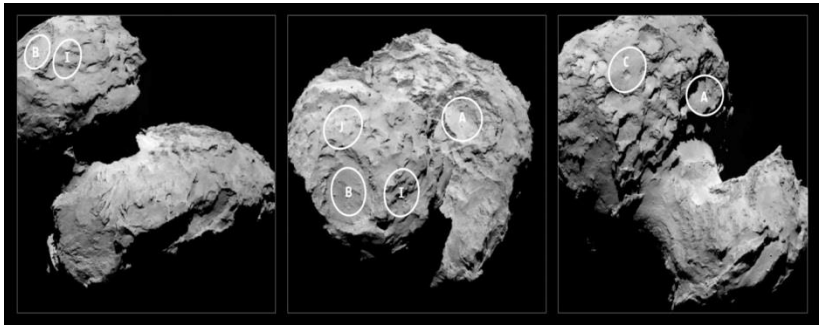
Images by OSIRIS

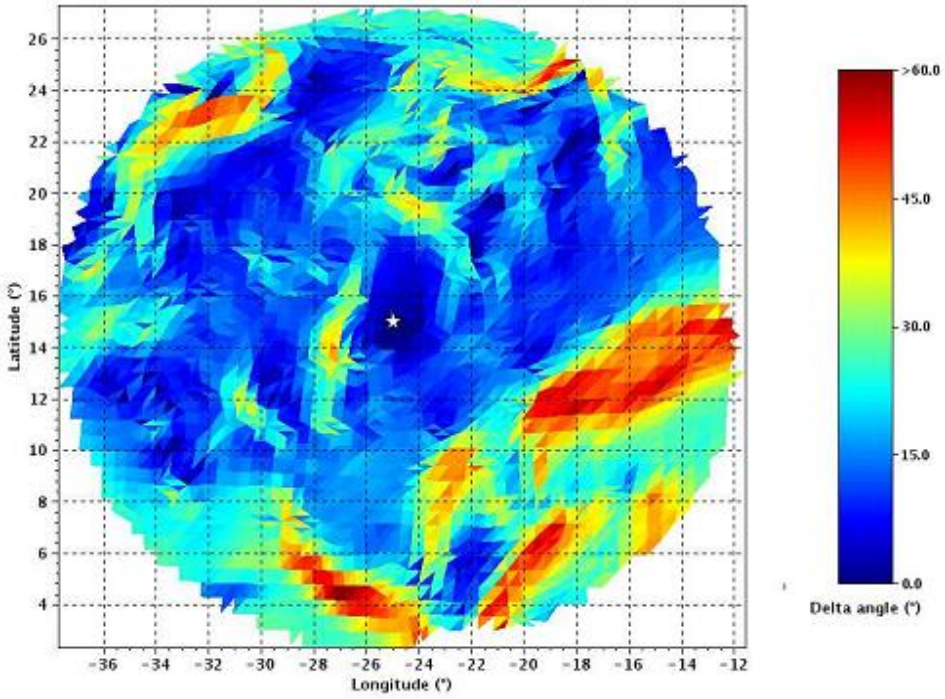
CIVA Image from 50 km



Reminder: our site J, (Agilkia)



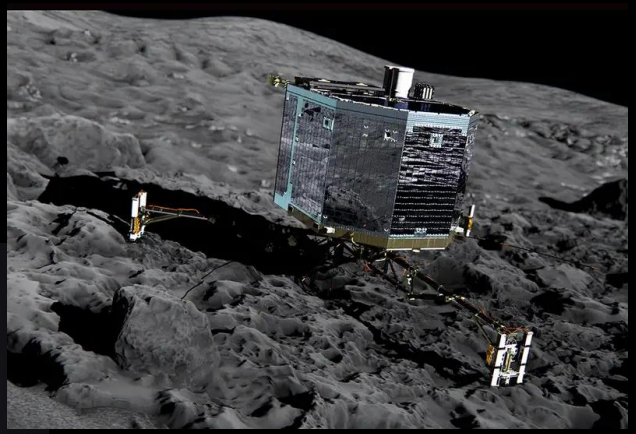


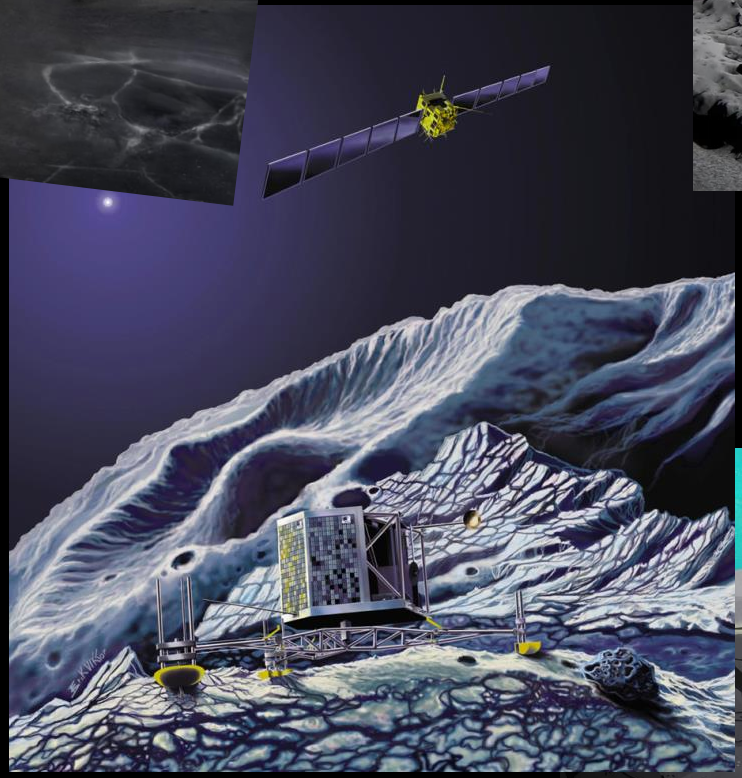


OSIRIS DTM

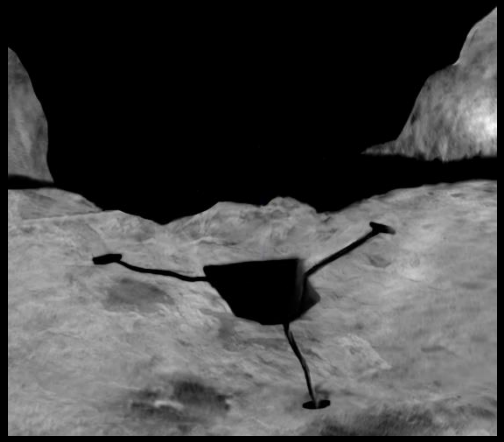
Philae on 67P – Artists Impressions

NASA/JPL assumption of safe landing

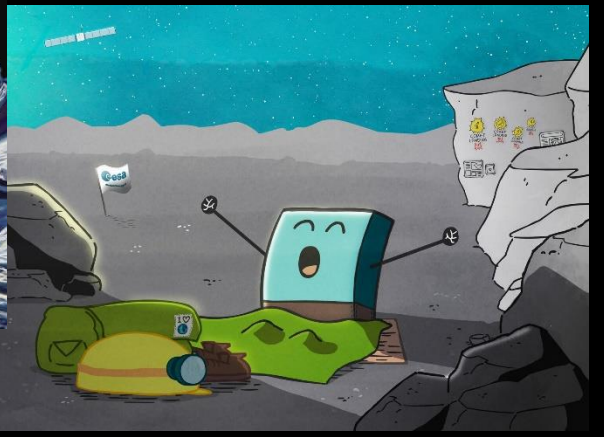




Rosetta Lander Proposal 1995



drawing by OU-Milton Kaynes

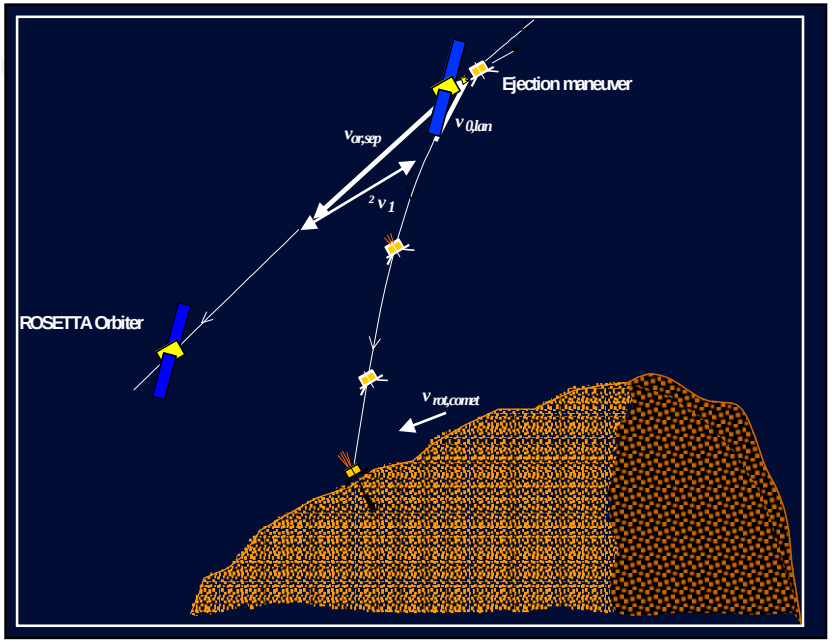


The week around Landing

- Landing Preparations
  - Lander switch-on: booting failed, at first attempt
  - In Cologne: Carnival season begins…..
  - ADS tank opening – failed
  - Situation critical
- Separation
  - ADS still closed
  - GO from Lander and Orbiter
  - 12.11.14, 08:35: separation! Perfect!
- Descent and (first) touchdown
  - RF link established 2h after separation
  - **Touchdown at 15:34:04**
  - We thought.. Everything was fine **or maybe not ??**

(Planned) Landing Scenario

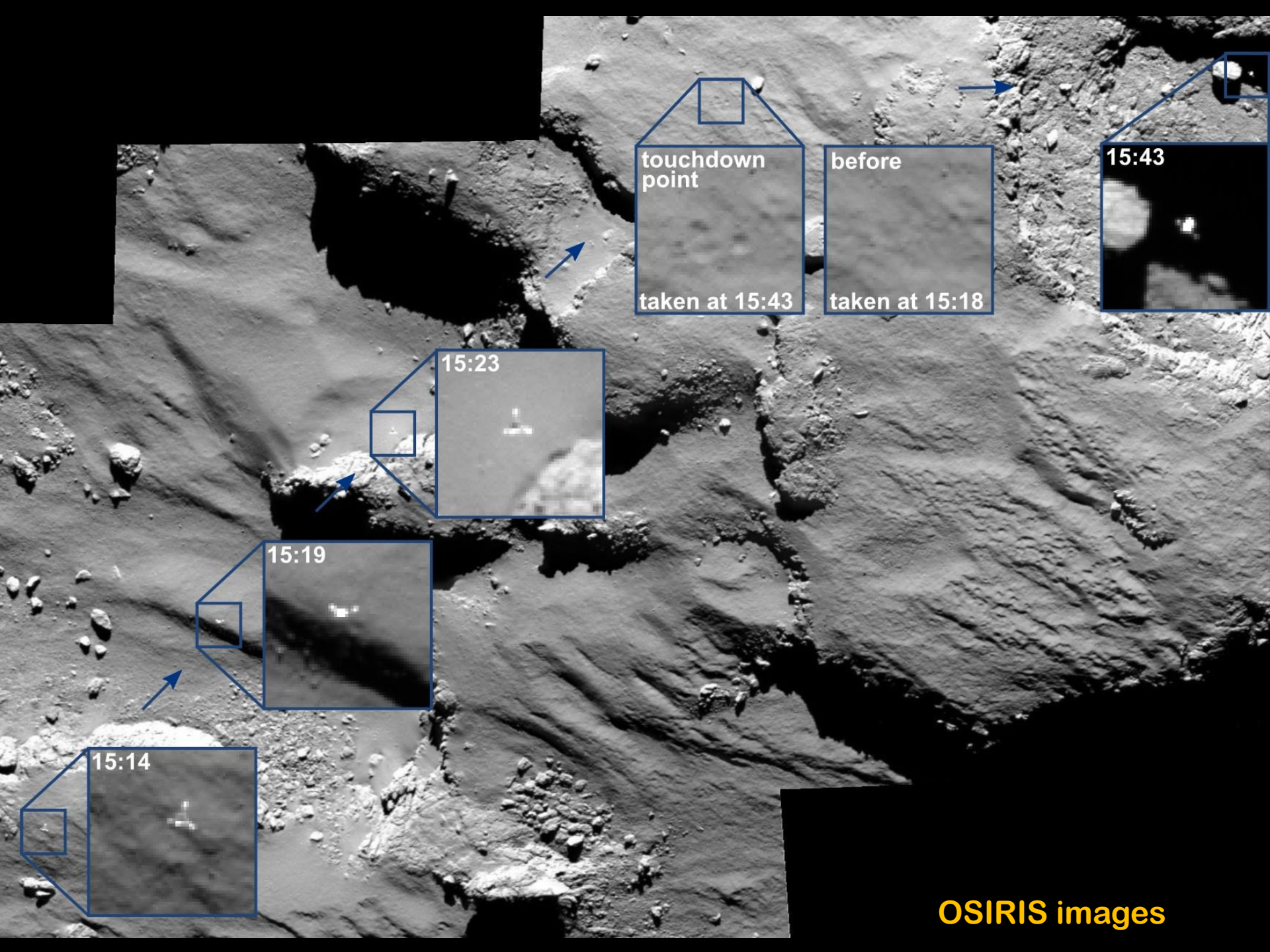
- Eject from Orbiter
- Descent (ballistic)
- Stabilization with flywheel
- *Activation of comt gas system (ADS)*
- *Anchoring*

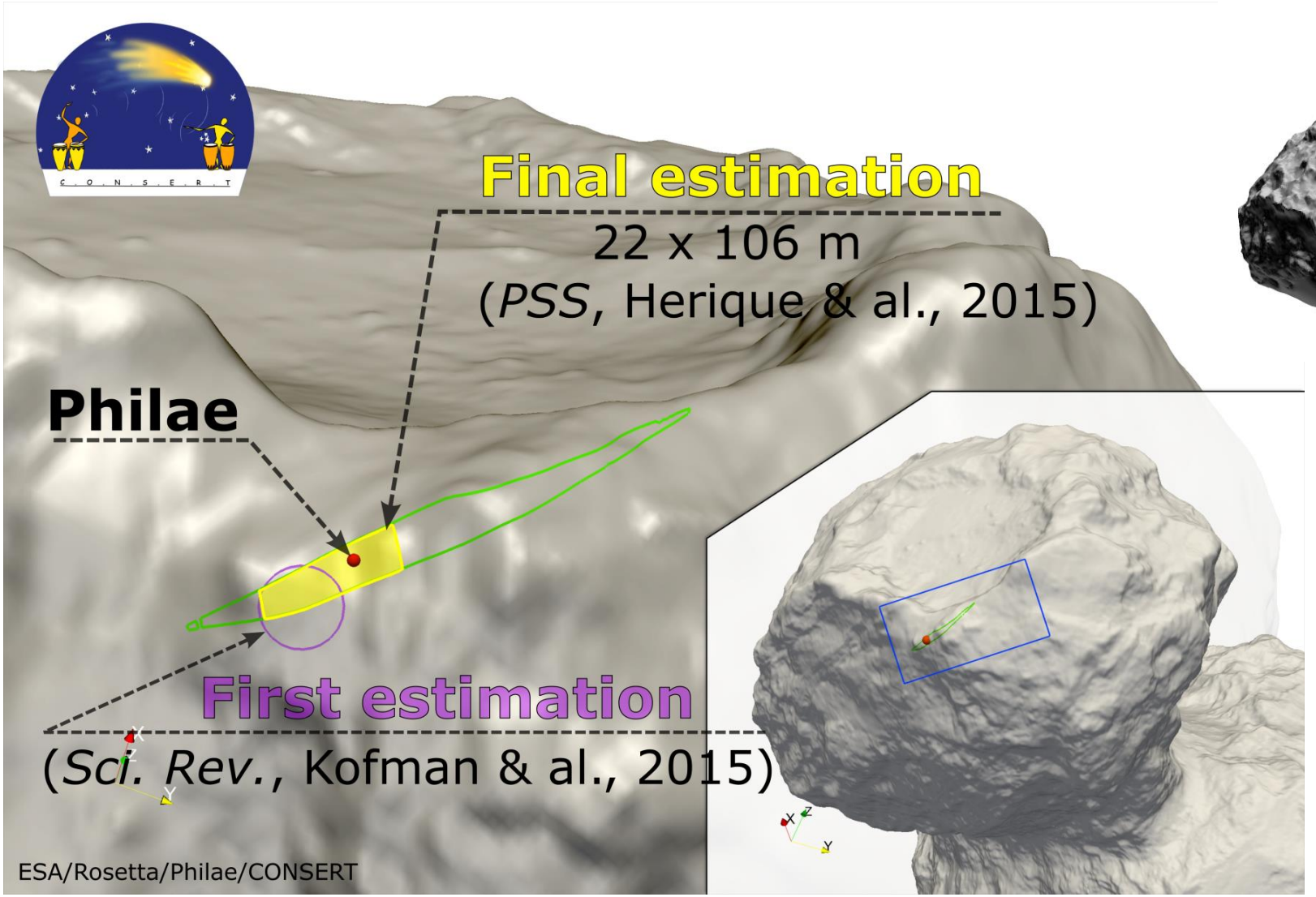


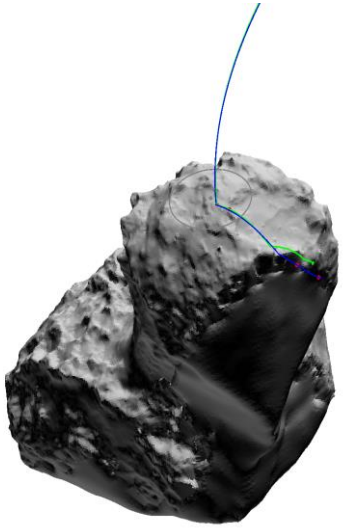
The moment of „first landing“, 12th of Novermber 2014

Landing, 12th of November 2014

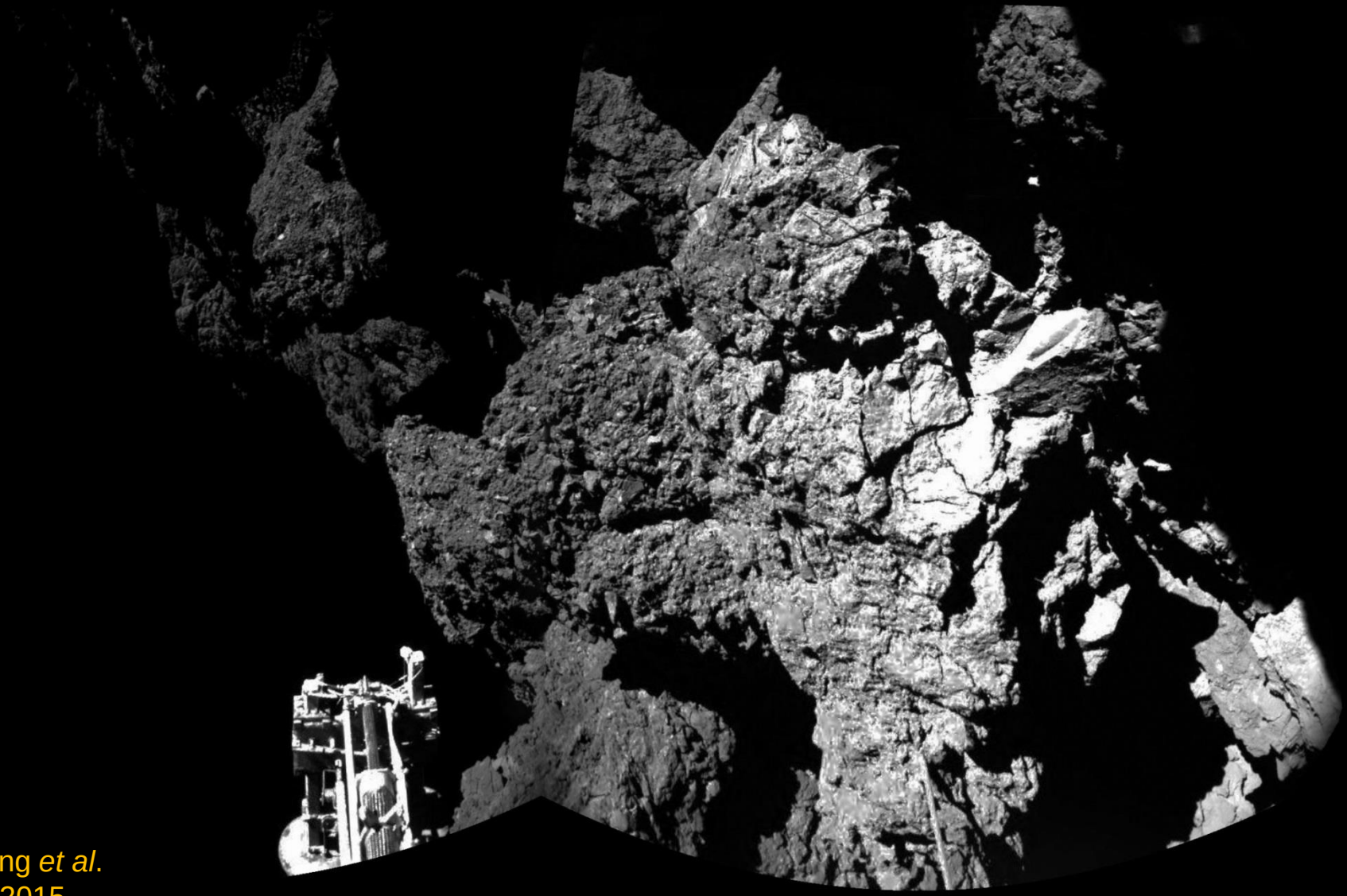
Lander Control Center - LCC, 12th of November 2014


touchdown point
taken at 15:43
before
taken at 15:18
15:43
15:23
15:19
15:14
OSIRIS images


Final estimation
22 x 106 m
(*PSS*, Herique & al., 2015)
Philae
First estimation
(*Sci. Rev.*, Kofman & al., 2015)
ESA/Rosetta/Philae/CONSERT



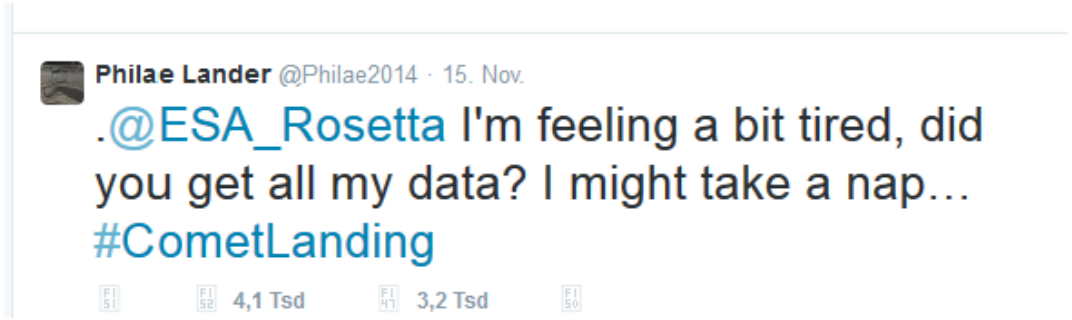
CIVA panoramic at final TD site

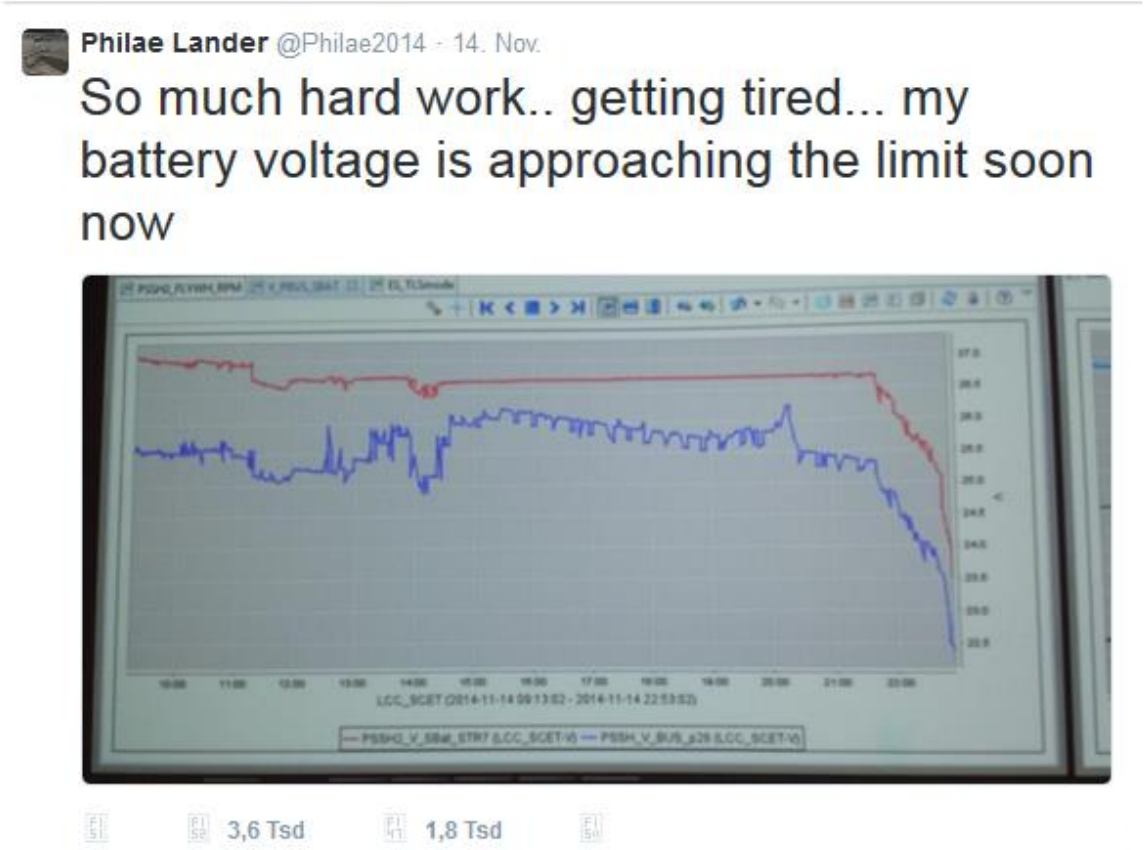


See Bibring *et al*.
Science, 2015

Improvised FSS

- Block 1 (ROMAP, CONSERT COSAC/Ptolemy sniffing)
- safe blocks 1-4, (COSAC/Ptolemy sniffing, ROMAP, SESAME, MUPUS-TM)
- updated block 6, (CIVA, MUPUS-PEN, APX), CONSERT sounding
- updated block 8, (SD^2, COSAC), CONSERT sounding
- „final ops“ (LG, carousel, PTOLEMY, ROLIS CUC, CONSERT, last science
- All instruments activated !
- TM 15.11., 00:15 G.. AMST-0, all data saved to EEPROM .. battery empty and LOS at 15.11., 00:36 UTC (ground).
- Battery life: 63.73h





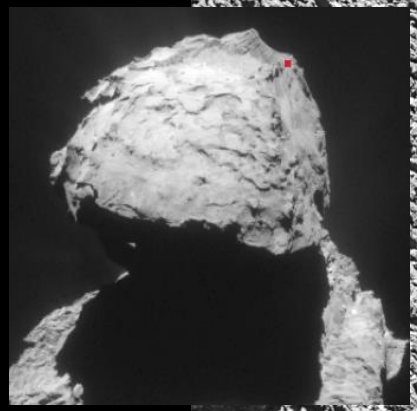
Battery depleted and Philae switched off on November 15, 00:08
(63:44 h after separation)

LOWG, 15th of November 2014

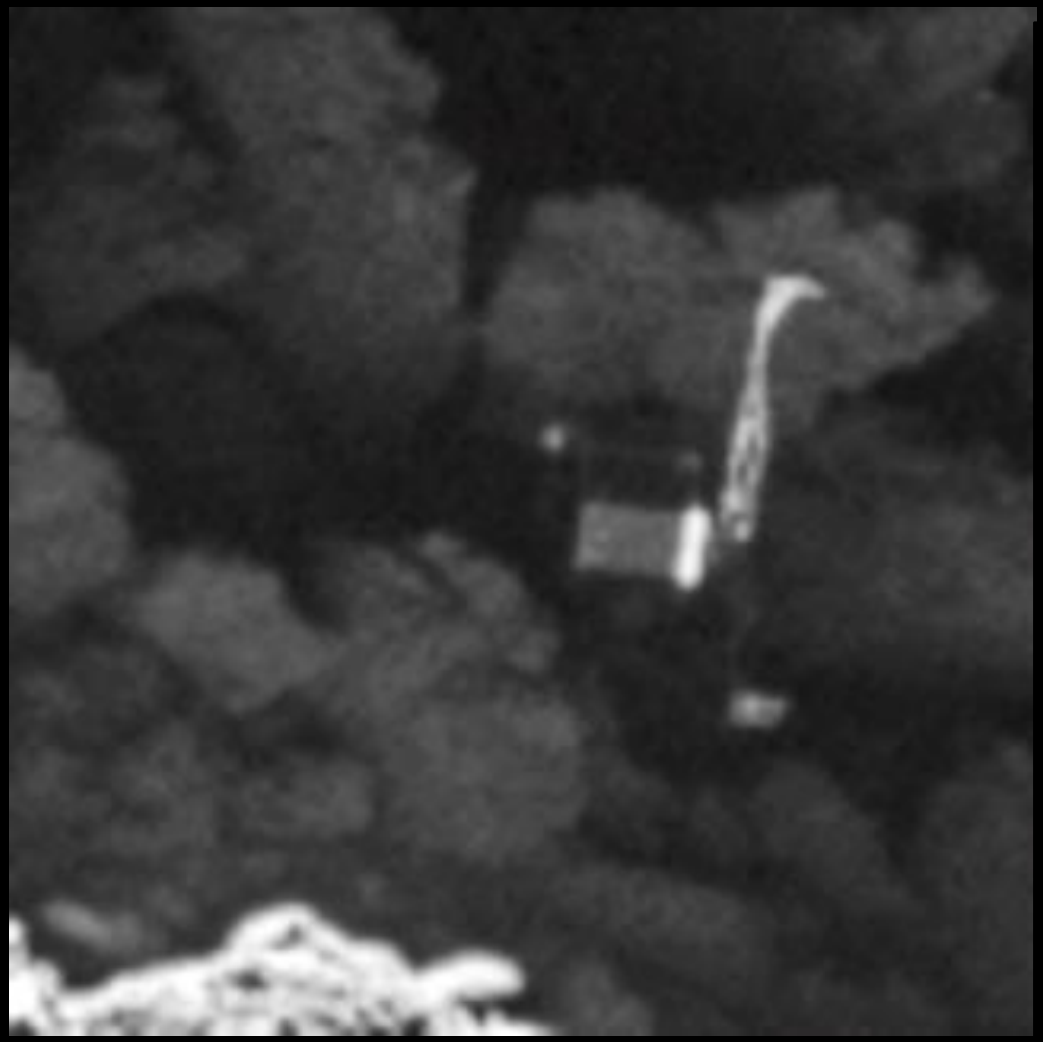
Situation for Long Term Science

- First contact: June 13 (20:28 UTC) for about 85 sec
  - About 340 HK packets transmitted
  - Mass memory full (Lander awake since early May !)
- More RF coms on June 14,19, 20 and 24
  - All slots were short. All showed link breaks.
- Last communications on July 9th, 2015
  - Around perihelion: Rosetta far from the nucleus
  - Geometry better in November and December

- Lander at a location with limited illumination and “some” antenna obscuration
- Attempts for “blind commanding” (TCBM) until end of 2015 incl. attempt to spin up flywheel
  - Unfortunately, no more sign of life



Philae – Final Position



- Rosetta and Philae have provided us a wealth of scientific information and changed our view of comets and the solar system.
- The Mission also brought the fascination of space science to a very wide public and inspired young people!
- **Let´s celebrate this event and the achievements we reached**