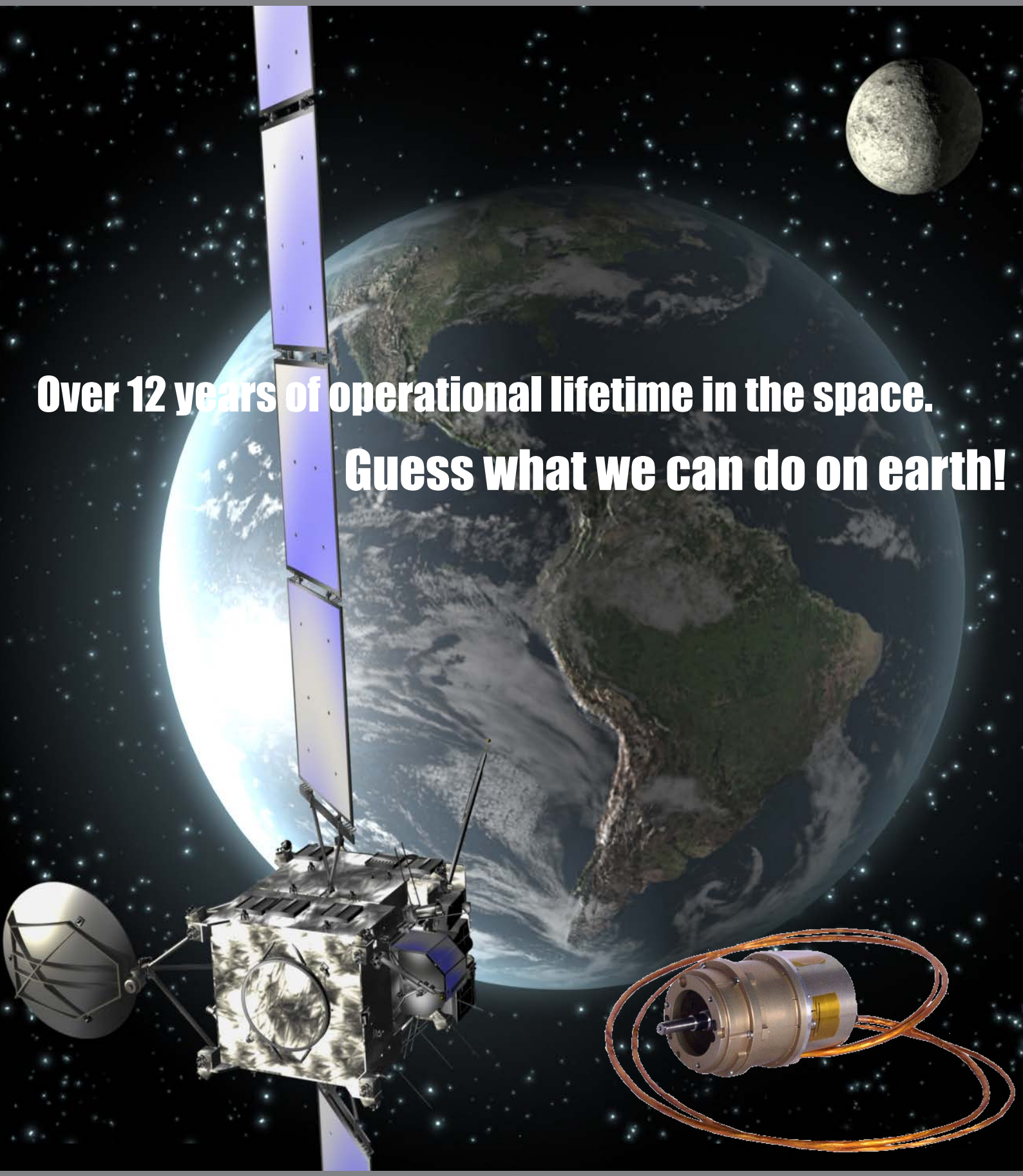
Lika encoders & the Rosetta Mission



@ESA_Rosetta @LikaElectronic

Lika Electronic, heading for space

ROSETTA pioneering spacecraft: a 12-year long story

Rosetta was the ESA's (European Space Agency) scientific project involving a consortium of more than 50 contractors (private companies, institutes and universities) in Europe and the United States. **It was the first mission planned to orbit and land on a Comet.** It ended September 2016.
Rosetta probe (Fig. 1) was launched on 2 March 2004 by Ariane 5 spacecraft from Europe's Spaceport in Kourou, French Guiana.
It arrived at Comet 67P/Churyumov-Gerasimenko in August 2014 after a 10-plus-year journey and a series of gravity assist manoeuvres needful for gaining enough orbital energy, with three swing-bys at Earth (March 2005, November 2007 and November 2009; see Fig. 2) and one at Mars (February 2007). En route to the Comet, the star rover flew by asteroids Steins (September 2008) and 21 Lutetia (July 2010). Rosetta spacecraft carried eleven science instruments to probe the Comet's nucleus and map its surface in fine details.

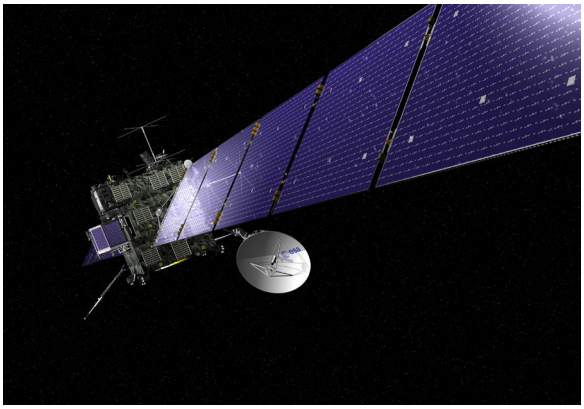


Fig. 1 - Rosetta probe (Image courtesy of ESA © J. Huart)

Fig. 2 - Earth's picture
After its closest approach to Earth, Rosetta looked back and took a number of pictures using the OSIRIS Narrow Angle Camera (NAC). Acquired on 15.11.2007 at 03:30 am CET
Image courtesy: ESA © 2005 MPS for OSIRIS Team

The mission was planned to deploy a lander module called Philae to make first controlled landing on a comet. It was delivered to the surface on 12 November 2014. Not everything went right, the lander bounded twice before coming to rest, wedged in a dark crack between some rocks and unable to operate as planned. During its short operating time it succeeded in taking soil and gas samples in order to provide clues to the physical and chemical processes at work during the formation of planets, beginning 4.6 billion years ago. The end of mission occurred on 30 September 2016 after some months of orbital spaceflights few hundreds of kilometres far from the comet. After 786 days in orbit around comet 67P Rosetta probe made a slow, but terminal, descent onto the comet's dusty surface and captured a number of stunning views of 67P before landing at 11:19 UTC.
The probe and its lander are now "part of the Universe".
Among the instruments on board was **OSIRIS**, the Optical, Spectroscopic and Infrared Remote Imaging System. OSIRIS was the eye and the imaging recorder of the Comet chaser throughout its long journey to the 67P Comet. It combined a **Wide Angle Camera (WAC) and a Narrow Angle Camera (NAC)** and was intended to capture high-resolution images of both the flight and the Comet.
Cooperation between Lika and CISAS (Interdepartmental Centre for Studies and Space Activities) of the University of Padua resulted in the development of an ultra-reliable and high-performance encoder for controlling the movement of the shutter motors in both WAC and NAC thermostated telescopes. This project enabled Lika Electronic to be **recognized as the first company** in Italy and the second in Europe to manufacture an encoder intended for space applications.

I38 space encoder

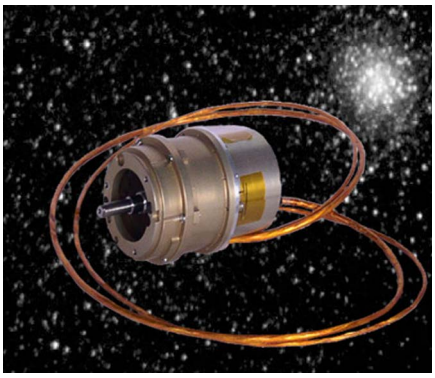


Fig. 3 - I38 Space encoder made of Titanium with Kapton cables. Brushless motor assembled on the front.

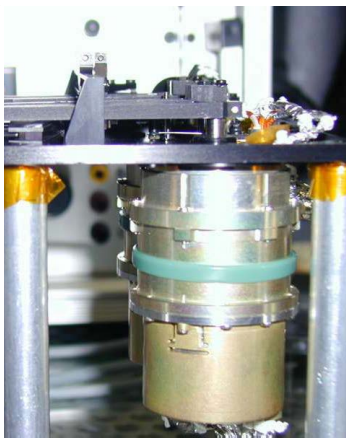
Fig. 4 - Assembly of the OSIRIS shutter system.
The mechanism includes two shutters for exposure monitoring and protection of the cameras.
Image courtesy of CISAS University of Padua.

Fig. 5 - Side view of OSIRIS mechanism.
The encoder with integrated brushless motor is installed on the base plate and shows the shutter arm directly connected to the shaft.
Opening and closing movement is carry out in less than 10 ms.

I38 SPACE incremental encoder was integrated into the brushless motors mounted on the shutter mechanism of both the WAC and NAC cameras (Fig. 4, 5). This very compact (Ø38 mm, 36 mm depth, 55 g weight) and very low power consumption (200 mW max.) optical encoder had a resolution of 14,400 PPR and an accuracy finer than ±10° el.
It was designed to control the sophisticated movement of the shutter and was capable of monitoring exposure times shorter than 10 msec. and ensuring a lifespan longer than 500,000 cycles at least.
Sure enough, malfunctions were not acceptable throughout the very long mission (over 12 years).
Furthermore it was expected to operate at extreme conditions of low temperatures and outer space vacuum.
Because of the wide temperature fluctuations and radiations, it was equipped with selected components and assembled without using any glue. Along with technical issues, also costs were a key factor: as CISAS stated "Lika encoders proved to be about 5 times more cost effective than similar high-tech space encoders from specialist competitors".
This project meant a great deal to Lika Electronic, to its new daily experiences and the future endeavours and could positively vouch for the technical competence and the high-tech ingenuity of a forward thinking innovative and global company.

Fig. 4 - Top view

Fig. 5 - Side view



rosetta

→ RENDEZVOUS WITH A COMET

2 March 2004
ESA Rosetta launch from Kourou, French Guiana.
18 minutes later Rosetta was released into space

25 February 2007
Mars flyby. OSIRIS "camera" equipped with Lika encoders takes spectacular images of the planet

8 June 2011
All electronics were switched off for 31 month long hibernation

20 January 2014
Rosetta wake-up. Exit deep-space hibernation

May-July 2014
Rendezvous manoeuvres & start of close comet observation

August-September 2014
Rosetta's 67P/Churyumov-Gerasimenko comet orbit insertion.
Start of close surface mapping with OSIRIS WAC-NAC cameras

November 2014
Philae lands on the comet's surface, but hits into some snags.
It's able to take some samples, materials & chemical components from the comet's surface and the subsurface before switching off

14 June 2015
Miracle awakening of Philae, for a few minutes only

13 August 2015
Perihelion, closest approach of the spacecraft to Sun

30 September 2016, 11:19 UTC
Rosetta probe ends its mission by "crash-landing" into the comet