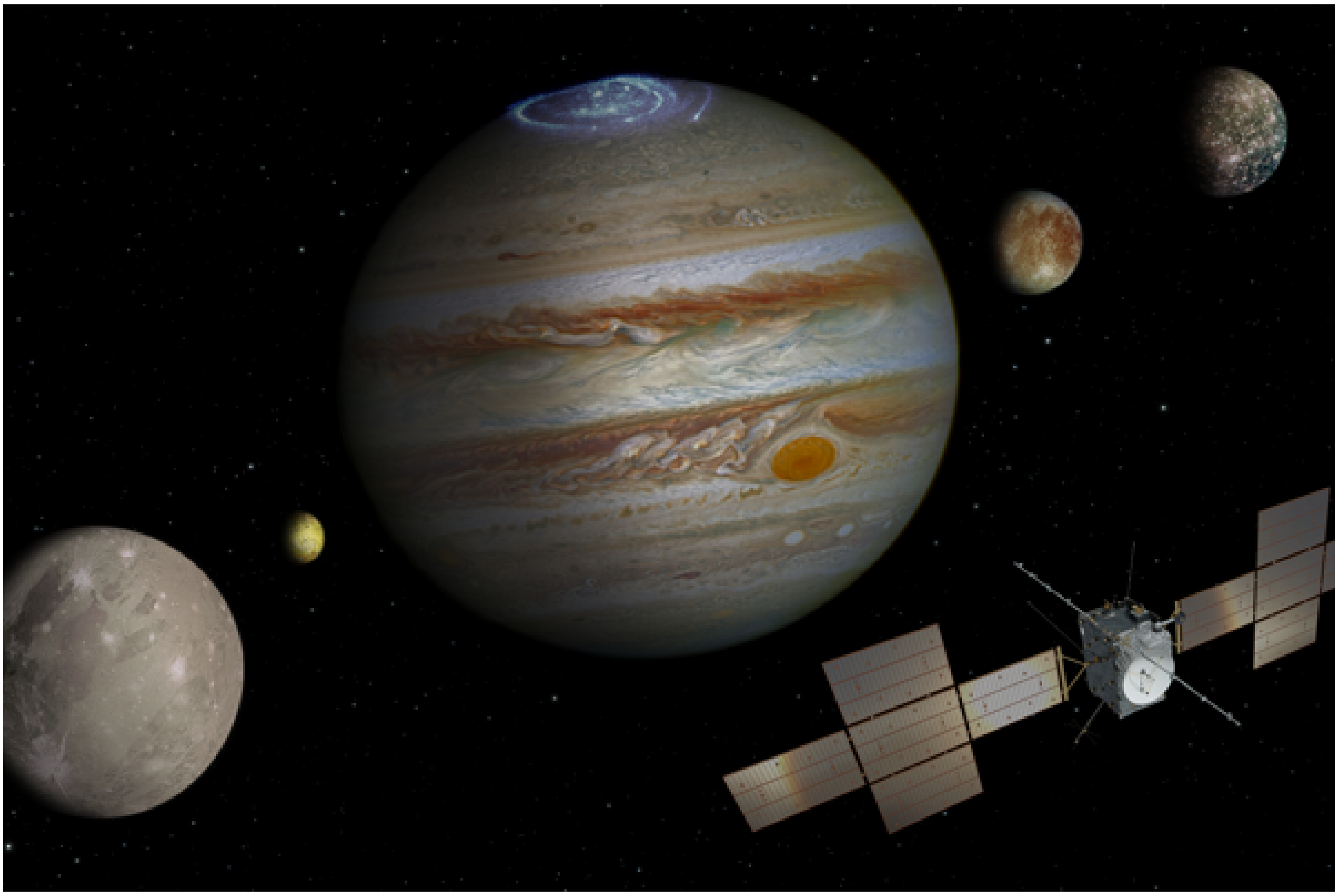
THE SLOVAK SPECTATOR
Items in shopping cart: View

20. May 2023 at 20:00

From Košice to Ganymede: Slovak engineers are leaving their mark in space

Slovaks are active participants in two ongoing space missions.

Matúš Beňo



Jupiter (centre) and its Galilean moons: from left Ganymede, Io, Europa and Callisto. Juice with deployed antennas and arrays is in the bottom right. (Source: ESA/NASA)

Although Slovakia does not have its own space programme and is yet to become a fully-fledged member of the European Space Agency (ESA), its scientists are already contributing in a range of ways to various space missions.

Currently, there are two interplanetary spacecraft hurtling through the expanse beyond Earth which were created in part by researchers and engineers from the Institute of Experimental Physics of the Slovak Academy of Sciences (SAV) in Košice.

In April, the Jupiter Icy Moons Explorer – or Juice for short – launched and, as the name suggests, is set to reach and then study our solar system's largest planet as well as three of its moons in 2031.

Meanwhile, the other mission, BepiColombo, will perform a comprehensive study of Mercury, the smallest planet in the solar system.

The Slovak Spectator talked to engineer Ján Baláž, who has worked on devices for both missions.

Destination: Jupiter and its moons

The goal of the Juice mission is to make detailed observations of Jupiter and three of its so-called Galilean moons: Ganymede, Callisto and Europa. The three are believed to bear oceans under their thick crusts of ice. Upon reaching the Jupiter system, the spacecraft will study its complex environment and inspect it for possible habitability using a suite of remote sensing, geophysical and in situ instruments.

One such instrument is the Particle Environment Package, or PEP. The device is designed to study the magnetosphere of Jupiter and how it interacts with its moons.

A magnetosphere is a region of space surrounding an object in which charged particles are affected by the magnetic field produced by the object's core.

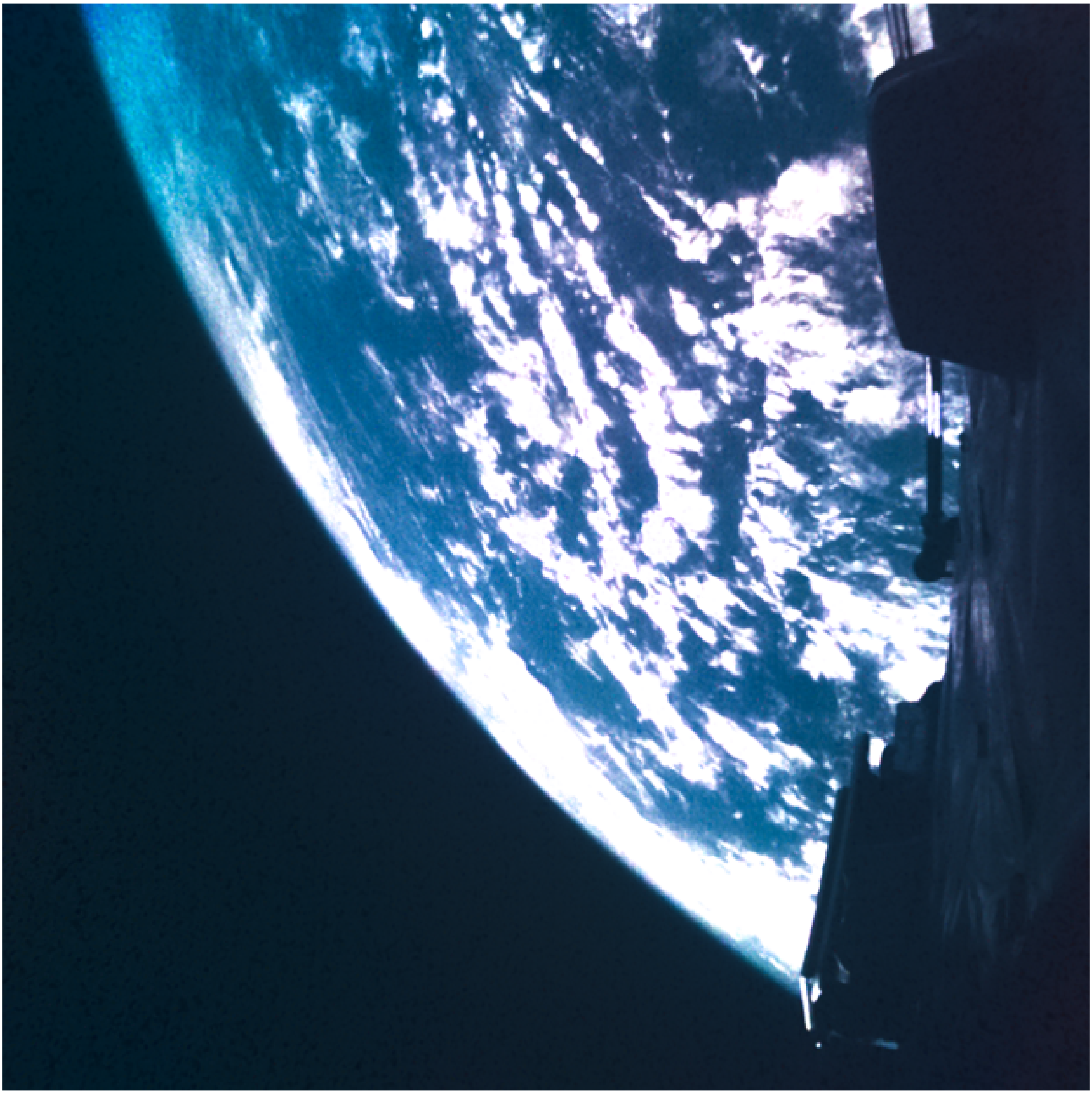
"Jupiter has a very strong magnetic field, about 20,000 times stronger than that of Earth. Such a strong field captures a large number of charged particles, mostly from the Sun, in the so-called Van Allen radiation belts," explains Baláž. These belts, named after their discoverer, are zones of charged particles held in position around the planet by its magnetosphere. Even Earth has its own such belts.

The three moons that are being studied orbit Jupiter within its radiation belts and are intensively bombarded by the particles.

"Europa, which is believed to have more water than Earth and is completely covered by it, is subject to such intense radiation from the particles that an astronaut on its surface would receive a fatal dose in just one day." However, there is no radiation under the thick ice crust, and the vast ocean could, in theory, harbour some life forms.

Ganymede has its own magnetic field, which interacts with that of Jupiter and could even protect the surface of the moon from the energetic particles surrounding it.

In space, the particles are long-lived. However, some of them enter Jupiter's atmosphere, where they cease to exist and create a very intense aurora.



Shortly after launch on 14 April, ESA's Juice captured this view of Earth. The image was taken by Juice monitoring camera 1 located on the front of the spacecraft and looks diagonally up into a field of view that will eventually see deployed antennas, and depending on their orientation, part of one of the solar arrays. (Source: ESA/Juice/JMC)

Necessary detector

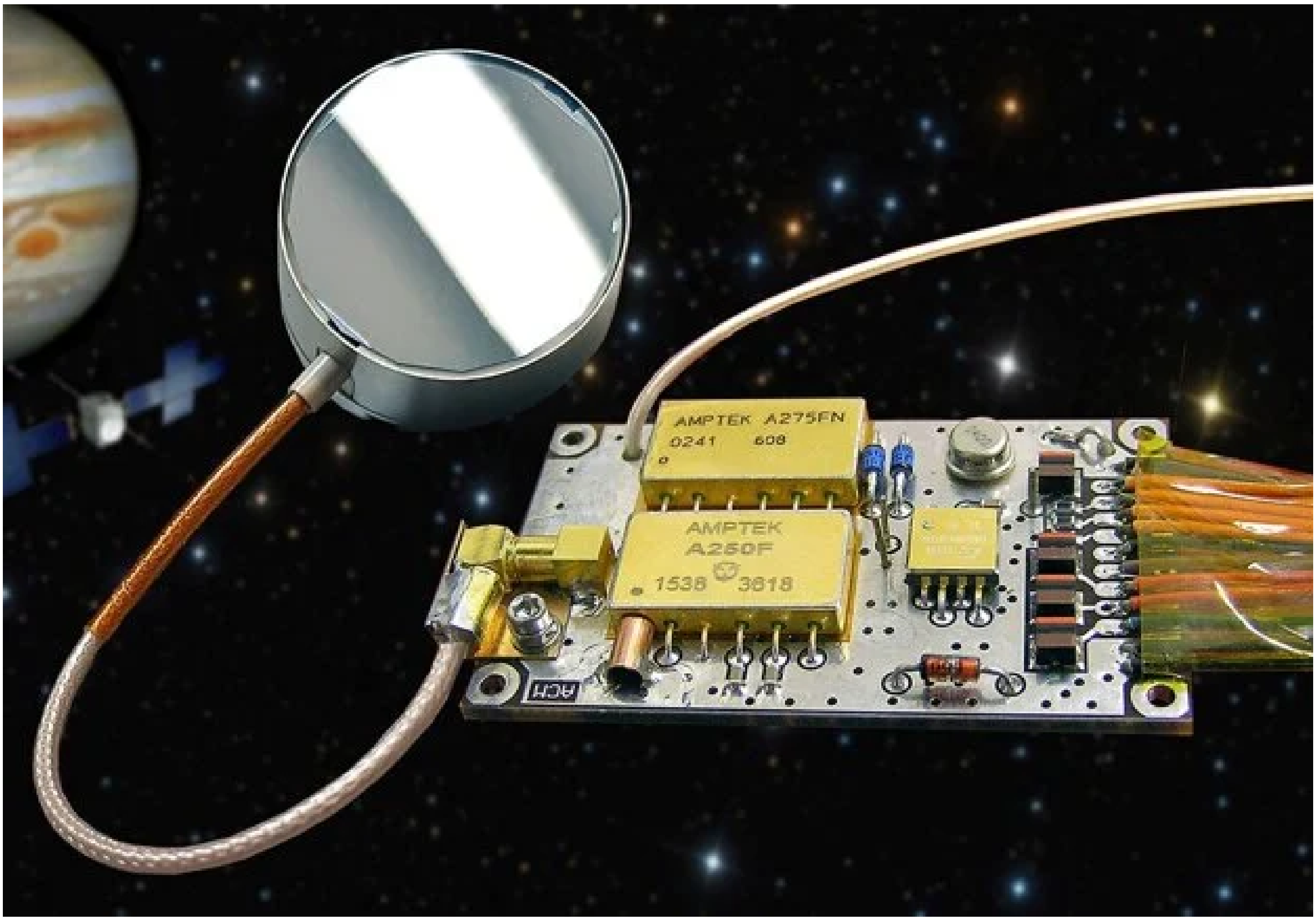
Not only living organisms would be endangered by such strong radiation; the same applies to the spacecraft itself and the instruments onboard. Obviously, these will be shielded.

Still, some particles are capable of penetrating the shielding and causing false detections by the sensitive instruments. This is where the device created by the Slovak space engineers comes in. They developed what is called an anti-coincidence detector (ACM) that will ensure effective detection of less energetic particles against the background of strong radiation.

In other words, the ACM will allow false detections to be discounted by revealing that an energetic particle has hit the instrument and may have produced incorrect readings.

Slovak researchers got involved in the mission in 2014 when they were asked to develop the ACM by the Swedish Institute of Space Physics.

“Previously, we worked with them on the Double Star space mission, where we demonstrated our considerable experience with the application of semiconductor detectors in space,” says Baláž. Later, they were also awarded a project, supported by ESA, for the development of the ACM.



The detector developed by the Slovak engineers. (Source: Archive of J. B.)

A temporary in-flight setback

Although the mid-April launch of the spacecraft was a success, once in space the probe hit a snag when it tried to extend its ice-penetrating antenna. Fortunately, after more than three weeks the 16-metre long boom was unstuck, allowing it to deploy fully.

According to Baláž, the ESA engineers had lots of ideas up their sleeves for resolving the hitch, for example by shaking Juice using its thrusters. Even if they had not been able to fully release the antenna, it would still have been able to function, but in a more limited mode.

Now, various instruments are being prepared for the long journey ahead. There will be several gravity assist manoeuvres to set the spacecraft on the right trajectory.

At the end of 2035, by which time it will have consumed all its propellant, Juice will impact Ganymede. Baláž jokes that their detector began its journey in Košice and will end it approximately 630 million kilometres away from Earth on the surface of Ganymede.

When this happens, one could say that Slovaks will have left their mark on a celestial object. But in fact, it will not be the first time such a thing has happened.

In 2016, the Rosetta space probe ended its mission with a hard landing on comet 67P/Churyumov-Gerasimenko, which it had previously been orbiting and on which it had landed a module, Philae. Ján Baláž worked on a crucial communication system without which the landing – the first of its kind – would not have been possible. In total, he has participated in 17 missions.

Dust and cosmic rays on the surface of the comet in 2016, with stars moving in the background. Filmed by Rosetta's OSIRIS instrument. CLICK TO PLAY. (Source: ESA/Rosetta)

To study Mercury

As for the BepiColombo mission, which is currently en route to make its third flyby of Mercury this June, SAV engineers were part of a broad multinational collaboration that constructed its Planetary Ion Camera or PICAM.

PICAM is an ion mass spectrometer, a device intended to study the particle environment of Mercury - specifically, its magnetosphere and how it interacts with the solar wind from the Sun, which is particularly strong around Mercury as it is the closest planet to the star. Moreover, it will also study the surface composition of the planet. Mercury's bombardment by solar radiation ejects ionised atoms from the surface, which the probe can capture and analyse to discover their chemical composition, among other things.

Together with the company Space Technology Ireland and the Space Research Institute in Austria, the Slovak engineers designed and developed precise mechanical parts for the electronics box of the instrument.

So far, thanks to several gravity assists from Earth and Venus, the probe has accomplished two flybys of Mercury, passing within 200 kilometres of its surface. During its first flyby the spacecraft managed to obtain new data that has already been published in a study in the Nature Communications journal, with Ján Baláž as one of its co-authors.

RELATED ARTICLE

Slovak space engineer receives one of the highest astronautics awards (interview)

Read more →

Parts of the PICAM device were developed by Slovak engineers. (Source: Archive of J. B.)