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IN THIS ISSUE

Biobots
The Pac-Man-shaped living robots that can self-replicate

Michael Mosley
Why your sense of balance matters

Androids
The engineer behind the robot that broke the internet

HEART AND HEAD
Raised heart rates may have link to dementia p18

OF MICE AND MALES
Gene editing creates same-sex mice litters p19

WE HAVE LIFT OFF
Secret behind pterosaur's flying ability cracked p20

FORESEE RESISTANCE
New way to predict a bacteria's resistance to antibiotics p21

DISCOVERIES

NASA's Parker Solar Probe is the first human-made object to encounter the Sun's corona

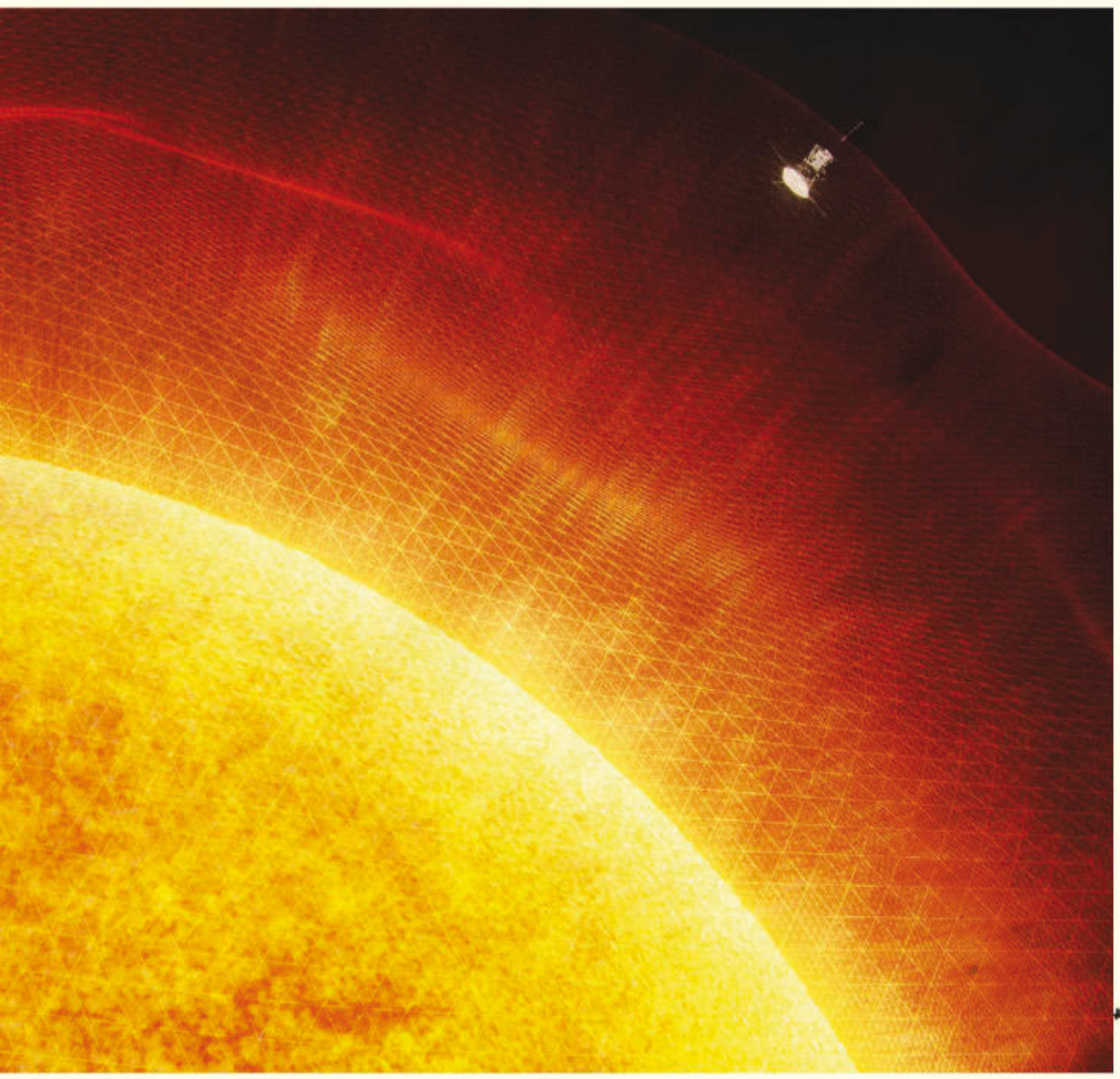
BEN SMIT/APPLIED PHYSICS LABORATOR/NASA

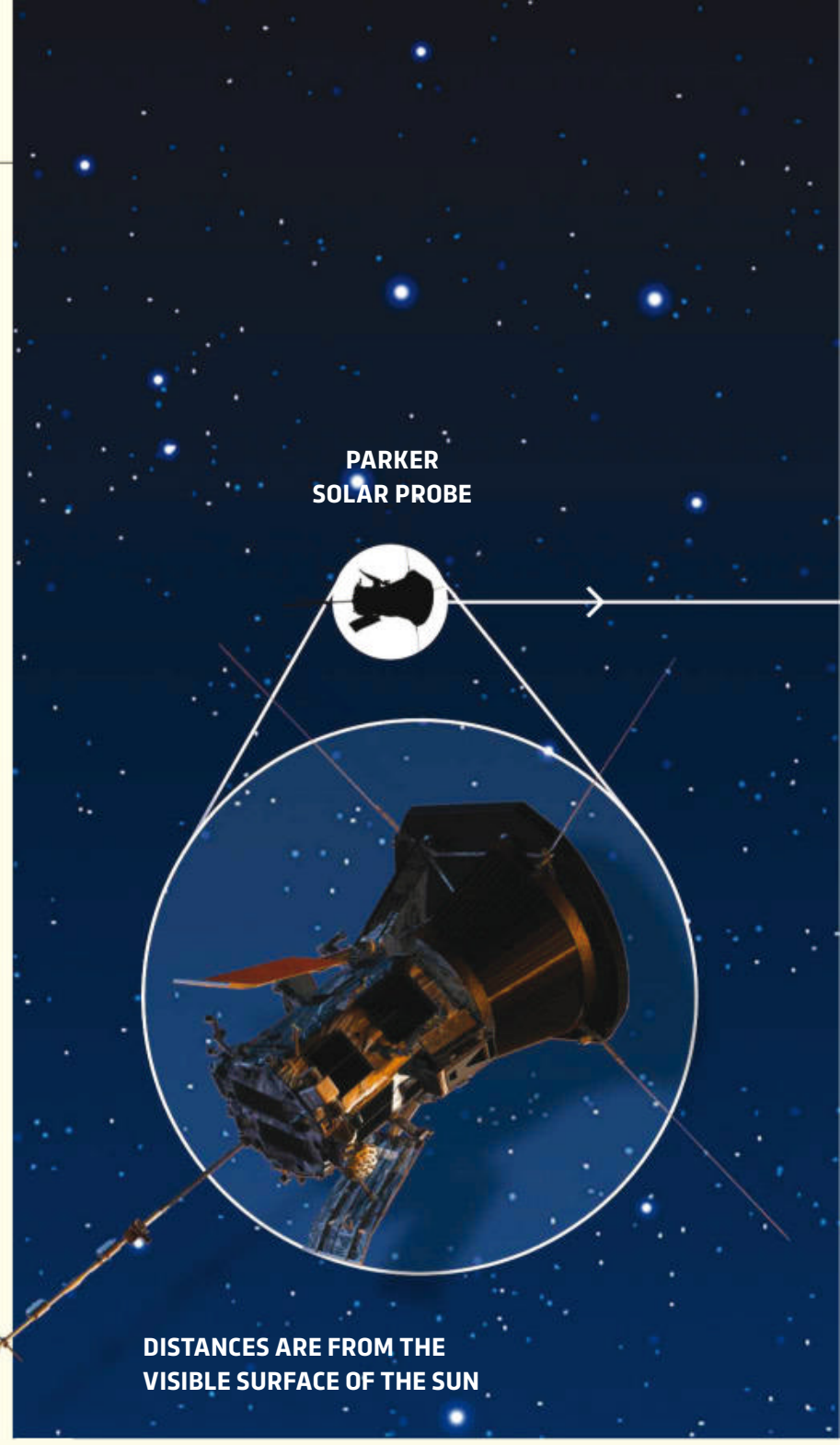
ASTRONOMY

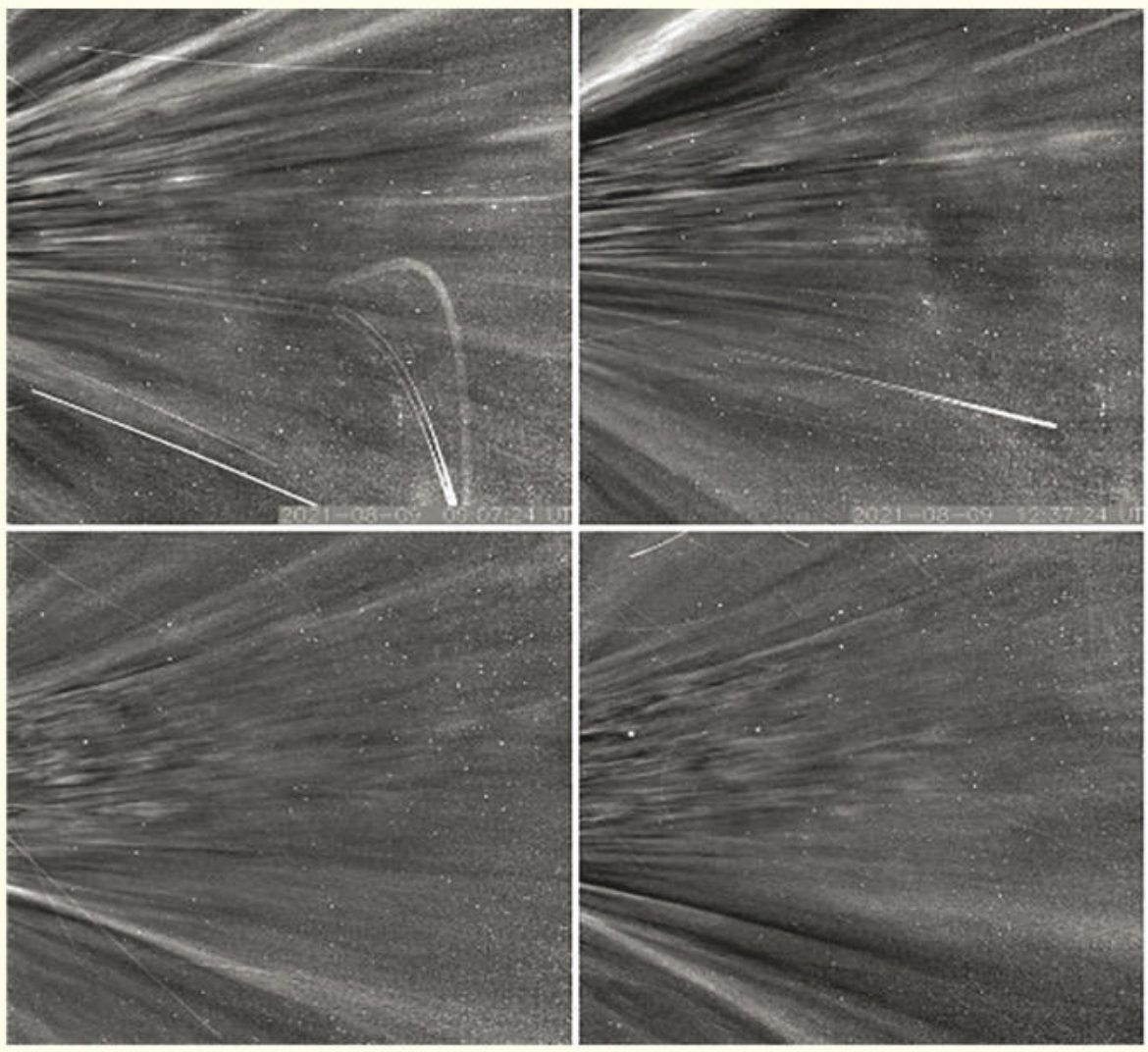
NASA'S SOLAR PROBE 'TOUCHES' THE SUN

The Parker Solar Probe is part of the way through its seven-year mission to investigate the inner workings of our nearest star

Fit as a butcher's dog Selective breeding may improve health of French bulldogs p22 **Dinosaur treasure trove** Palaeontologists find immaculately preserved fossils in Italy p24 **Bio-bots** Living 'robots' that can reproduce – as long as they look like Pac-Man p26







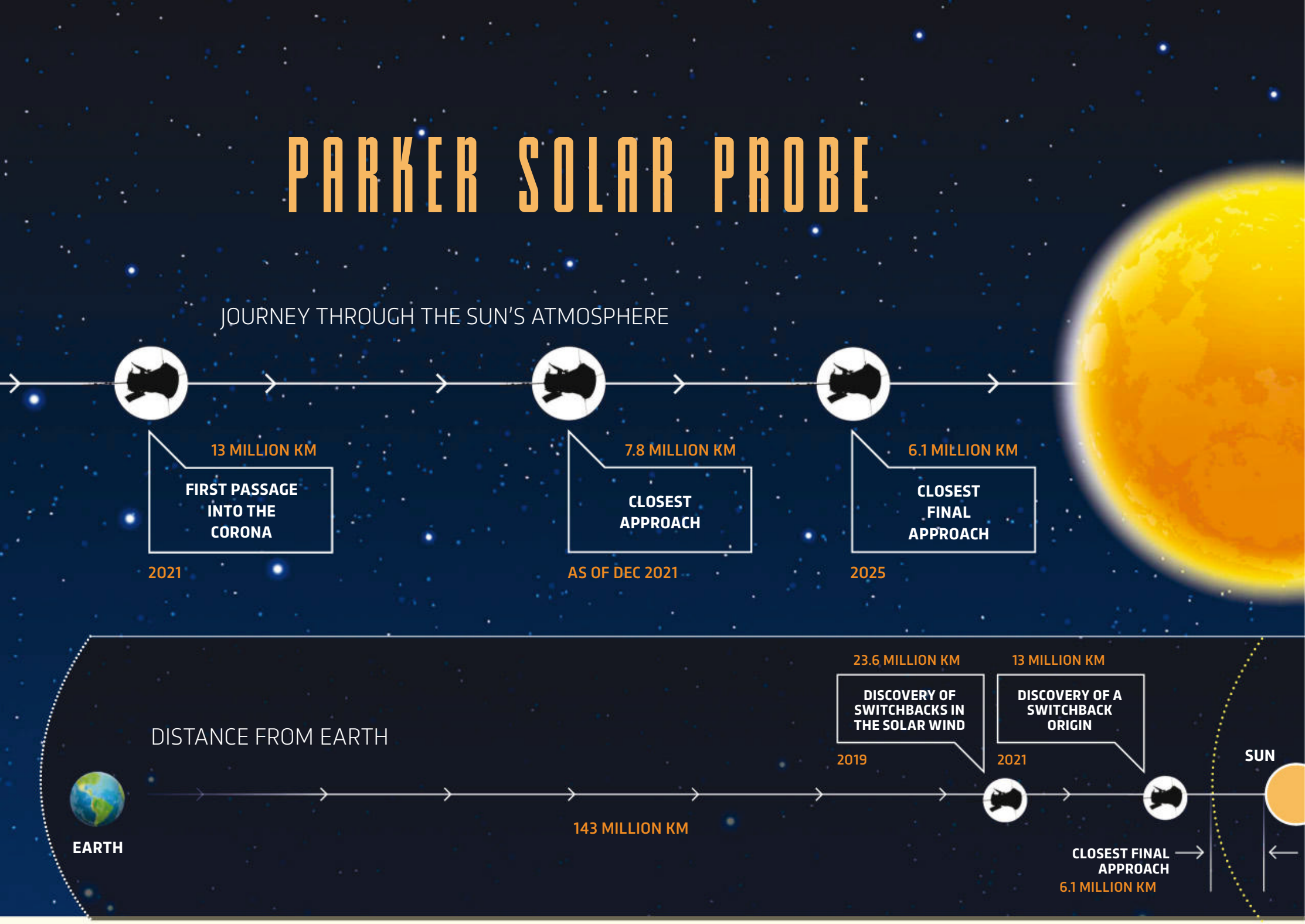
NASA's Parker Solar Probe has made history after becoming the first spacecraft to plunge into the Sun's atmosphere. The milestone journey was made on 28 April 2021, nearly three years after the probe's launch in August 2018. It happened during Parker's eighth flyby of the star at the centre of our Solar System. The probe spent a total of five hours travelling amid the plasma and solar winds in the Sun's upper atmosphere, or corona.

The landmark event was not announced until 14 December because the data recorded by the probe took several months to reach Earth, and then several more to be processed and analysed by scientists.

"We were fully expecting that, sooner or later, we would encounter the corona for at least a short duration of time," commented Dr Justin Kasper, lead author of the paper that announced the historic flyby, published in *Physical Review Letters*. "But it is very exciting that we've already reached it," said Kasper, who is associate professor of climate and space sciences and engineering at the University of Michigan.

"This marks the achievement of the primary objective of the Parker mission and a new era for understanding the physics of the corona."

BEN SMIT/APPLIED PHYSICS LABORATORY/NASA, NASA/JOHNS HOPKINS APL/ILLO BY TIDYDESIGNS



ABOVE LEFT An artist's impression of the Parker Solar Probe's first passage into the Sun's corona

LEFT Parker caught images of streamers (the bright features moving upwards through images in the top row and downwards in the bottom). These magnetic 'ribbons' in the Sun's corona are only usually visible during solar eclipses

Parker spent five hours exploring the Sun's atmosphere beneath a boundary known as the Alfvén critical surface – the point at which the star's powerful gravitational and magnetic fields are no longer strong enough to prevent solar winds from escaping out into the Solar System, to Earth and beyond. During this time, the craft passed above and below the boundary a total of three times.

"We have been observing the Sun and its corona for decades, and we know there is interesting physics going on there to heat and accelerate the solar wind plasma. Still, we cannot tell precisely what that physics is," said Dr Nour E Raouafi, the Parker Solar Probe project scientist at Johns Hopkins University's Applied Physics Lab. "With the Parker Solar Probe now flying into the magnetically dominated corona, we'll get the long-awaited insights into the inner workings of this mysterious region."

Until now, researchers were unsure exactly where the Alfvén critical surface lay. Early results from Parker show that it lies about 13 million kilometres above the nearest thing the Sun has to a surface. The data show the Alfvén critical surface is wrinkled and suggest that these wrinkles may be caused by a pseudostreamer – a giant magnetic formation that rises above the Sun's 'surface' and can be seen from Earth during solar eclipses.

This first passage through the corona is just one of many planned for Parker. It's hoped that the probe will continue to spiral closer to the Sun, eventually coming to within six million kilometres of its 'surface'.

Upcoming flybys, the next of which is planned for January 2022, will likely bring Parker into the corona again.

"I'm excited to see what Parker finds as it passes through the corona in the years to come," said Dr Nicola Fox, director of NASA's Heliophysics Division. "The opportunity for new discoveries is boundless."

The size of the corona is also driven by solar activity. As the Sun's 11-year activity cycle reaches its peak, the corona will expand, giving the Parker Solar Probe a greater chance of being inside the Sun's atmosphere for longer periods of time.

"It's a really important region to get into because we think all sorts of physics potentially turn on," Kasper said. "Now we're getting into that region and will hopefully start seeing some of these physics and behaviours."