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THE SCIENCE OF EVERYTHING

ISSUE 102

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SPACE

Second OMG cosmic ray particle breaks physics again



Extremely high energy cosmic ray zips through Utah.



AUTAH telescope has spotted the second-largest cosmic ray ever detected, leaving astronomers stumped.

Cosmic rays are highly energetic streams of subatomic particles that travel at nearly the speed of light. These particle streams are constantly raining down on Earth, and when they collide with atoms in upper atmosphere, they create new particles like positrons, muons, pions and kaons.

In 1991, astronomers detected the highest-energy cosmic ray ever seen. It was dubbed the “Oh-My-God” particle because nothing in the galaxy had the power to produce it and it had more energy than theoretically possible for a cosmic ray travelling from another galaxy: 320 exa-electron volts (320 with 18 zeroes after it). For reference, a single exa-electron volt (EeV) is about a million times larger than the energy generated by the most powerful particle accelerators made by humans.

No cosmic ray came close to the Oh-My-God particle, until one measuring 244 EeV struck the Telescope Array experiment in Utah, US, in May 2021. A paper detailing the discovery was recently published in the journal *Science*.

“No promising astronomical object matching the direction from which the cosmic ray arrived has been identified, suggesting possibilities of unknown astronomical phenomena and novel physical origins beyond the Standard Model,” says study leader Toshihiro Fujii from Osaka Metropolitan University.

NATURE

Wheee! Bird takes
1,000-km spin
through typhoon

A SEABIRD fitted with a tracking device has been observed zipping around a typhoon five times, covering a distance of 1,146km in 11 hours.

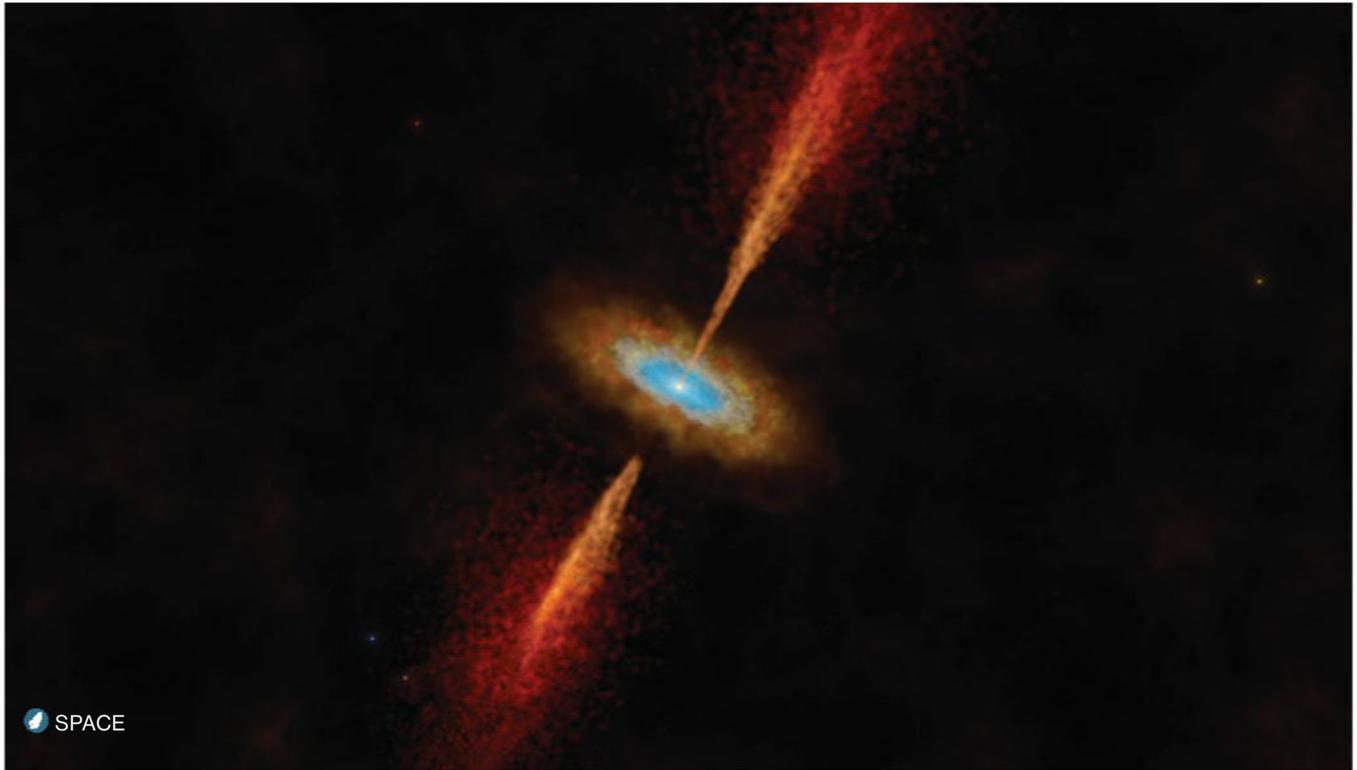
The streaked shearwater (*Calonectris leucomelas*) has a usual speed of 10–60km/h in flight, at altitudes below 100m. But during its typhoon ordeal, the shearwater clocked

speeds of 90–170km/h and heights of more than 4,700m above sea level.

Kozue Shiomi, a seabird biologist at Tohoku University in Japan, observed the joyride in September 2019, two weeks after fitting GPS tracking devices to 14 streaked shearwaters to study their homing behaviour. Most of the shearwaters avoided the

typhoon but one appeared to fly right in the middle, making five anticlockwise circles 50–80km in diameter. It landed on the ocean 11 hours later and rested for five hours before flying again.

“It remains unknown whether the bird could not or chose not to escape from the typhoon,” Shiomi writes in her paper, now published in *Ecology*.



Planet-forming disc around star seen beyond our galaxy for first time

First insight into planet formation in other galaxies.

ASTRONOMERS PEERING into the nearby galaxy known as the Large Magellanic Cloud have spotted something that has never been seen outside our own Milky Way: a disc of gas and dust around a young star.

The disc is identical to those which form planets within our galaxy over millions of years. As a young star grows, its gravity accretes matter from its surroundings to form a rotating accretion disc, also called a proto-planetary disc because clumps formed within it are believed to be the seeds of planets.

Detection of the intergalactic proto-planetary disc in the Large Magellanic Cloud was made using the

Atacama Large Millimeter/submillimeter Array (ALMA) in Chile. It turned its eyes to the young star system after the European Southern Observatory's Very Large Telescope spotted a powerful jet of matter emerging from the star: a signpost of disc formation.

"When I first saw evidence for a rotating structure in the ALMA data, I could not believe that we had detected the first extragalactic accretion disc," says lead author Anna McLeod, an extragalactic astronomer at Durham University, UK. "We know discs are vital to forming stars and planets in our galaxy, and here, for the first time, we're seeing direct evidence for this in another galaxy."

▲ Artist's impression of the jet launched from the HH 1177 system in the Large Magellanic Cloud.

McLeod and team determined that the matter around the star was rotating by analysing the wavelength of light coming from the disc.

"The frequency of light changes depending on how fast the gas emitting the light is moving towards or away from us," explains co-author Jonathan Henshaw, a research fellow at the UK's Liverpool John Moores University. "This is precisely the same phenomenon that occurs when the pitch of an ambulance siren changes as it passes you and the frequency of the sound goes from higher to lower."

If the disc is rotating faster closer to the star, this indicates to astronomers that an accretion disc is present.

"We are in an era of rapid technological advancement when it comes to astronomical facilities," McLeod says. "Being able to study how stars form at such incredible distances and in a different galaxy is very exciting."

The discovery is detailed in a paper published in *Nature*.