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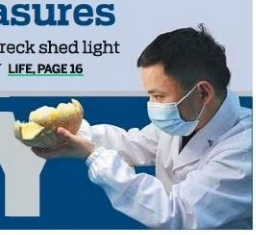

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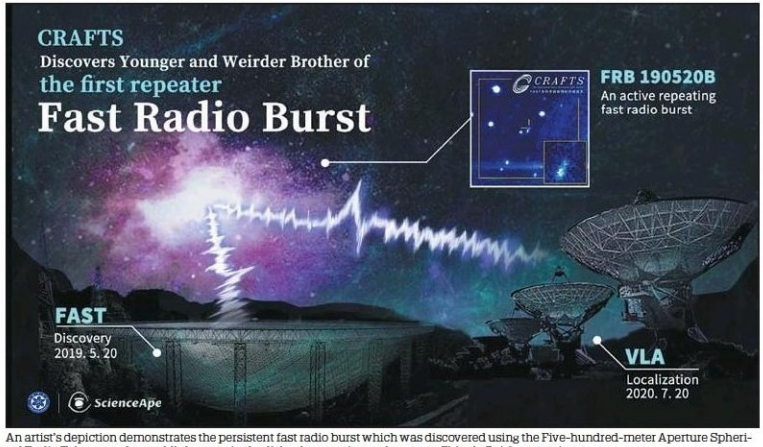

An artist's depiction demonstrates the persistent fast radio burst which was discovered using the Five-hundred-meter Aperture Spherical Radio Telescope, the world's largest single-dish telescope, in southwestern China's Guizhou province.
PROVIDED BY NATIONAL ASTRONOMICAL OBSERVATORIES, CAS

New type of fast radio burst discovered

By ZHANG ZHIHAO
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An international team led by Chinese astronomers has discovered a new type of fast radio burst, extremely brief but bright flashes in the universe that mysteriously keep exploding about once every 10 to 15 minutes on average, according to a study published in the journal Nature on Wednesday.

Scientists said this extraordinary find has challenged the conventional understanding of this celestial event and may cast light on the mysteries surrounding the origin and potential evolution of these bursts, which are capable of releasing as much energy as the sun does in a year within a few thousandths of a second.

The discovery was first made using the Five-hundred-meter Aperture Spherical Radio Telescope, the world's largest single-dish telescope, located in southwestern China's Guizhou province, during the Commensal Radio Astronomy FAST Survey program.

Afterward, researchers from China, the United States, Canada, Germany, Japan and Australia, along with several observatories around the globe, collaborated to study this one-of-a-kind specimen.

Since their discovery in 2007, fast radio bursts have been a hot topic of discussion in astronomy circles. These events are notoriously difficult to detect because many originated outside of our galaxy and exist only for a very brief moment.

With the aid of highly sensitive telescopes, scientists have now discovered around 500 FRBs, most of which are one-off events. But 24 of them, for reasons that remain unknown, can repeat their explosions during a certain active phase and then take a break before the next active period.

"The fascinating part of the newly discovered fast radio burst is that it seems to be always active. It doesn't take breaks like other repeating FRBs, and it just keeps on going," said Li Di, chief scientist of FAST and the lead scientist of the international team.

The persistent fast radio burst, named FRB 20190520B, was discovered on May 20, 2019, by Niu Chenhui, a post-doctoral fellow at the National Astronomical Observatories of the Chinese Academy of Sciences.

"I find it somewhat romantic that this FRB was discovered on May 20, the unofficial day of love for Chinese netizens," Niu said. "In a way, it is like a love letter from the cosmos to the global astronomy community, enthralling us to be amazed and fall in love with what the universe has to offer."

After Niu made the initial discovery, astronomers from the California Institute of Technology and the University of Tokyo worked together to locate this unique celestial event and study its properties.

The source of FRB 20190520B was located within a dwarf galaxy about 3.3 billion light years from Earth. Scientists found that the dwarf galaxy has the most complex electromagnetic environment of all known FRB host galaxies to date.

Niu said FRB 20190520B shares many similarities with the first repeating fast radio burst discovered, called FRB20121102A, except that the former seems to have endless exuberance and resides in a more complex local environment.

"Could it be that the newly discovered repeating FRB is a younger brother of the first one? Can FRBs evolve? These questions are very interesting and may help us unravel more secrets behind these mysterious events," he said.

Scientists have hypothesized that the sources of FRBs may be remnants of supernova explosions, black holes, or an extremely magnetic and dense stellar object known as a magnetar. However, none of these candidates have been confirmed conclusively by scientists yet.

Jonathan Katz, a physics professor at the Washington University in St. Louis who was not involved in the new study, said FRB 20190520B has been shown to be immersed in a dense cloud of gas, and its persistent outbursts may be powered by a massive black hole hidden nearby that is consuming the gas at extreme speed and creating enormous heat in the process.

Duncan Lorimer, a professor at West Virginia University who discovered the first fast radio burst, said the latest discovery has challenged the conventional view of FRBs and their host environments.

Lorimer, who was not involved in the study, said he believed FRBs may have multiple sources, and as the number of discovered FRBs increases, scientists will get closer to understanding this intriguing phenomenon.

VIEWS

Quentin Parker

China flies high on space science

Spending on scientific leadership and building international research partnerships and collaborations do not mean pouring money into a figurative black hole. Instead, they mean oiling the engine room of scientific discovery. Such spending is the harbinger of productive joint endeavors for mutual advancement in understanding on multiple levels, not just science. It can and has produced spectacular results.

Indeed, the recent image of the black hole (or rather the material swirling just outside it) at the center of our galaxy comes from one such partnership. It has captured the imagination of millions across the world. It is a stunning scientific achievement from the "whole Earth" event horizon telescope (EHT).

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The importance of global cooperation

By its very nature, the EHT is predicated on international cooperation across countries and continents to be able to create such a stunning image. It is unprecedented in human history, and has been years in the making. The EHT partnership began in 2015 by combining the distributed power and effective resolution made possible by the linking together of a global array of submillimeter-wavelength radio telescopes to form a powerful single observatory. It is this entity that can do new science with 300-plus scientists from all over the world working hard behind it.

Germany, France, the Netherlands, the United States, Japan and China's Taiwan make up the EHT consortium and, via the inclusion of the East Asian Observatory (EAO), also the Chinese mainland, the Republic of Korea, Thailand and even the University of Hong Kong (which became an associate member of the EAO in November 2020). The University of Hong Kong, via the Laboratory for Space Research, became an associate member of the EAO on behalf of all universities of the Hong Kong Special Administrative Region and makes its share of time on the James-Clerk Maxwell millimeter-wave telescope (JCMT) available to all Hong Kong-based astronomers for no charge.

Indeed, the EAO plays a pivotal role, as it controls the JCMT, the largest-single dish radio telescope in the world at sub-mm wavelengths.

The EAO was established in 2014, one year before the EHT, and is the brainchild of Japanese astronomer Norio Kaifu. He had a vision to develop an Asia-focused international observatory to rival that of the great European Southern Observatory (ESO), which was established in 1954. The ESO is a stunning international success with a suite of some of the most powerful, productive and impactful optical telescopes in the world, producing more than 1,000 research papers in 2021 alone.

Need to further develop East Asian Observatory

The ESO, an international treaty organization, has a current annual budget of €135 million ($144.73 million) and has 16 member states. It is currently building the 30-meter extremely large telescope (ELT). The EAO, on the other hand, though established with a truly lofty ambition, has sadly not progressed beyond infancy. It has a modest budget, a single telescope and lately severely shrinking finances. Where did it all go wrong with Kaifu's vision?

I believe the bold vision was just ahead of its time and that finally its time may be dawning. A re-imagined, re-invigorated EAO vision is possible if the opportunity is grasped across the current partnership and strong leadership is demonstrated thanks to the emergence of Beijing as a major science power over the last 10 years in particular with the capacity, financial clout and promise to deliver great things on the global stage as already encapsulated in its bold space program.

However, a true EAO needs top level national engagement and serious funding across the partnership but with perhaps just one bold mover to show the way. I believe China can play that role.

Some say it is too early — that China first needs to build up more capacity and expertise in astrophysics. I say capacity and expertise can develop more rapidly and securely as a result of linking up with international partners wherever possible. China can learn and excel from outside coupling not just from within, not standing alone when it can stand together with others on the scientific world stage. The Five-hundred-meter aperture spherical radio telescope (FAST) shows what China is capable of and what it can offer. There is talk of building several FASTs — I would suggest China build the EAO instead.

Others say the current geopolitics and tensions between China and certain Western countries, including those in the EHT and EAO partnerships — exacerbated by the Russia-Ukraine conflict — make reaching out and building links problematic and undesirable. But for me this makes such things even more important when understanding and trust building are essential to avoid a downward spiral that can have catastrophic consequences for us all.

For me it is about bringing three things together: funding, facilities and family.

Without funding, nothing is possible and even the grandest visions can crumble to dust. The funding must be shared but that does not need to be equal. It can depend on the capacity to pay, by population and GDP or other factors such as leadership where generosity of spirit is paying forward for future returns.

The current EAO budget is shrinking because partner countries are working in tight fiscal envelopes within broad internal astronomy budgets. Also, they prefer to protect their own facilities and budgets. They currently do not consider the EAO as offering such great value invested in a single high-quality, though aging, facility. To succeed, the EAO needs a ring-fenced independent and realistic budget in national accounts that does not impact national research institutes funding.

So it makes an excellent and non-controversial focus for international cooperation and partnership around which trust, collaborations up to government level can develop and grow.

EAO needs to attract more organization

As for facilities, they matter a lot. The ESO runs seven major telescopes and many smaller ones for its user community while the EAO offers basically a single non-optical telescope in the JCMT. It is hard to attract interest and members with a one-trick pony. The EAO needs to build a stable of facilities to make it attractive and worthwhile as an organization that both developed and developing Asian countries would like to aspire to join.

At present, EAO members China and Japan have the strongest suite of facilities. They are the two most powerful EAO countries, and in the best position to make the biggest impact for a re-invigorated and freshly emerging EAO. Offering fractions of such national facilities to the EAO, offset by fresh compensating EAO funding, could be a suitable model to build up a valuable facility portfolio for EAO member states. Modest EAO access to FAST and the Chinese Space Station Telescope could show the way forward.

Finally, when it comes to family, I mean a family of member countries. Asia is a worthy construct around which to build an international observatory to eventually rival the ESO. China, India, Japan combined are the most powerful and rich nations in Asia and account for 37 of the world's population. They are the engines for global development and growth. Getting India to join the EAO under an invigorated program, funding and vision would be a great first step, especially because it already has observer status in the EAO.

Astrophysics is seen as a benign endeavor whose research and discoveries enrich us all. So it makes an excellent and non-controversial focus for international cooperation and partnership around which trust, collaborations up to government level can develop and grow. Families are made up of young and old, rich and poor, small and large members with diverse skills and qualities but at the base level they are family. Constructing such a mindset among the Asian "family of nations" would, in my view, be a very good thing indeed.

The author is a professor at the Faculty of Science at the University of Hong Kong and the director of its Laboratory for Space Research.