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Article：New Dawn of Research Begins with Capture of First Black Hole Image in the Milky Way

Directions: Read the following article aloud.

Found in Earth's solar system, the imaging is expected to lead to new understandings of black holes, galaxies, and the laws of physics in space.

Among the black holes, the heaviest and most mysterious of celestial bodies in our universe is Sagittarius A*. It is the black hole at the center of the Milky Way galaxy, home to our solar system.

On May 12, an international team including the National Astronomical Observatory of Japan announced that they had taken an image of Sagittarius A* for the first time. Black holes attract all substances with their extremely strong gravity, so they are difficult to see. This is only the second successfully captured image of a black hole in the world, and the first in the Milky Way Galaxy.

The Japanese members of the team said at a press conference in Tokyo on the same day: "It will **lead to** an understanding of the variety of black holes and galaxies. A new dawn of research has begun."

Where is It?

Sagittarius A* is located about 27,000 light years from Earth and has a mass of 4 million times that of the sun. Its existence was confirmed by European and American researchers, and was the topic of the 2020 Nobel Prize in Physics.

However, it was impossible to take an image of it because it **absorbed** all light and was pitch-black.

The international team built a high-resolution observation system to address this problem. It is comparable to a giant Earth-sized telescope, made by linking the ALMA telescope in Chile, which was built partly by the National Astronomical Observatory of Japan, to other radio telescopes. A total of eight radio telescopes in six locations — including the United States, Europe, and the South Pole — are part of it.

After observing in April 2017 and analyzing the data, the scientists were able to capture the glowing of the surrounding gas, and a black-hole-like figure with a diameter of about 60 million kilometers emerged in the center.

Source：New Dawn of Research Begins with Capture of First Black Hole Image in the Milky Way
https://japan-forward.com/new-dawn-of-research-begins-with-capture-of-first-black-hole-image-in-the-milky-way/

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Article：New Dawn of Research Begins with Capture of First Black Hole Image in the Milky Way

Directions: Read the following article aloud.

Comparing the 2019 Discovery in the M86 Galaxy

The team used the same method in 2019 to create the world's first image of a black hole. The subject of this image was a supermassive black hole at the center of the M87 galaxy in Virgo, 55 million light years away, with a mass 6.5 billion times that of the sun. The observations were carried out at the same time as for Sagittarius A*, but the analysis for the M87 galaxy came first because the matter surrounding Sagittarius A* had fast and unstable motion.

The two have differing characteristics. The black hole of the M87 galaxy was confirmed to have a jet-like phenomena in which gas is ejected at a tremendous speed. But this is not the case for Sagittarius A*.

Professor Mareki Honma of the National Astronomical Observatory of Japan, representative for Japan in the international team, said: "Comparing the images in detail will help **clarify** the origin of the difference in activity and the effect on the galaxy. It will also help verify whether the familiar laws of physics hold in spaces with strong gravity."

How Black Holes Work

A black hole is a celestial body with an extremely large amount of matter stuffed in a small volume. It has an exceptionally strong force of gravity. Even light cannot escape, and the black hole sucks in everything, including the surrounding gas.

As light is not emitted, it is difficult to capture its figure. For that reason, observations consist of capturing the light, radio, and X-ray waves of the surrounding gas and stars.

Furthermore, all light is swallowed in the middle of the black hole, leaving a dark gap. The surrounding bright ring is radio waves emitted from the high-temperature plasma gas near the black hole.

Due to the strong gravity, the direction that the radio waves propagate is bent. That allows even those waves that initially weren't headed towards Earth to be seen here.

The Event Horizon Telescope (EHT) is built to be a giant, high-resolution observation system, essentially an Earth-sized telescope. By linking and synchronizing the ALMA telescope in Chile, partly built by the National Observatory, and other radio telescopes from all over the world, it becomes possible to image the region surrounding the black hole in high resolution.

The EHT has the resolving power **equivalent to** 2 million times that of a human's eyesight. Think of it as the equivalent of seeing a golf ball placed on the moon from Earth.

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2 Key phrases and vocabulary

Directions: First repeat after your tutor and then read aloud by yourself.

1. lead to (道などが)～につながる･通じる･至る、(物事を)～に導く、～を引き起こす、～の原因となる

・Higher demand for goods **leads to** higher imports from abroad.

2. absorb 吸収する、吸い上げる、自分の中に取り込む、受け入れる、身につける

・Children can **absorb** new words like sponges.

3. clarify 明確にする、はっきりと説明する、解明する、浄化する

・Can you **clarify** what their proposal could mean to us?

4. equivalent to ～と同等である、～と等しい、～に相当する、～に匹敵する

・This amount of exercise is **equivalent to** walking about an hour.

3 Questions

Directions: Read the questions aloud and answer them.

1. **What image did the team including the National Astronomical Observatory of Japan successfully captured?**
2. **Why is it so difficult to capture an image of a black hole?**
3. **Do you think Japanese government should spend more money on space exploration?**
4. **Have you ever dreamed of becoming an astronaut or traveling to outer space?**

4 日本語関連記事：天の川のブラックホール初撮影　「研究の新たな幕開け」

宇宙で最も重く、謎に包まれた天体であるブラックホールのうち、太陽系がある天の川銀河の中心に位置する「いて座Aスター」の撮影に成功したと、国立天文台などの国際チームが12日、発表した。非常に強い重力であらゆる物質をのみ込むため、姿を見ることが困難なブラックホールの撮影成功は世界で2例目で、身近な天の川銀河では初。

国際チームの日本メンバーは同日、東京都内で記者会見し「ブラックホールや銀河の多様性の理解につながる。研究の新しい幕が開ける」と語った。

いて座Aスターは、地球から約2万7000光年の距離で太陽の400万倍の質量を持つ。その存在は欧米の研究者が観測で指摘し、2020年のノーベル物理学賞に輝いた。だが、光さえ引き込まれて出てこないことから真っ暗で、撮影はできていなかった。

そこで国際チームは、国立天文台などが建設した南米チリのアルマ望遠鏡や米欧、南極など6カ所計8基の電波望遠鏡を連携し、地球サイズの巨大な望遠鏡に匹敵する高解像度の観測体制を構築。

17年4月に観測を行いデータを解析した結果、周囲のガスが引き込まれる際に輝く様子を捉え、直径約6000万キロの明るい円形の中央部に、「黒い穴」のような姿を浮かび上がらせることに成功した。

国際チームは同じ手法で19年、世界初のブラックホールの撮影成功を発表している。対象は、5500万光年離れたおとめ座のM87銀河の中心にあり、太陽の65億倍の質量を持つ巨大ブラックホールだった。観測時期は同じだが、いて座Aスターは周囲の物質の動きが速く不安定なため、M87銀河の解析が先行した。

M87銀河のブラックホールは、ガスが猛スピードで噴出するジェットという現象が確認されているが、いて座Aスターにはなく、両者は特徴が異なる。国際チームの日本代表を務める国立天文台の本間希樹（まれき）教授は「画像を詳しく比較すれば、活動性の違いの起源や銀河に与える影響の解明につながる。重力が強い空間で既存の物理法則が成立するかどうかの検証にも役立つだろう」と話している。

出典：天の川のブラックホール初撮影 「研究の新たな幕開け」
https://japan-forward.com/japanese/102095/

4 日本語関連記事：天の川のブラックホール初撮影　「研究の新たな幕開け」

地球サイズの巨大望遠鏡で観測、撮影

ブラックホールは、非常に大量の物質が狭い領域に押し込められた天体だ。重力は非常に強い。光さえも抜け出すことができず、周囲にあるガスなど、あらゆるものを吸い込んでしまう。光も発しないため、姿をとらえるのは難しく、観測は周囲にあるガスや星が放つ光や電波、X線などをとらえていることで成り立っている。

また、ブラックホールの中央部は光が飲み込まれ、黒い穴のようにみえる。周囲にある明るい環（わ）はブラックホール周辺にある高温のプラズマガスから発せられた電波だ。電波は強い重力の影響で進行方向が曲げられ、本来は地球とは別の方向に向かっていた電波も地球まで届くという。

イベント・ホライズン・テレスコープ（EHT）は、国立天文台などが建設したチリのアルマ望遠鏡や米欧、南極など世界各地の電波望遠鏡を連携し、地球サイズの巨大な望遠鏡に匹敵する高解像度の観測体制を構築。そのことによって、ブラックホールのごく近くの様子を高解像度で画像化が可能になった。EHTの視力は人間の約200万倍にもおよび、月に置いたゴルフボールが地球から見える視力に相当する。

出典：天の川のブラックホール初撮影 「研究の新たな幕開け」
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