

Astrowatch

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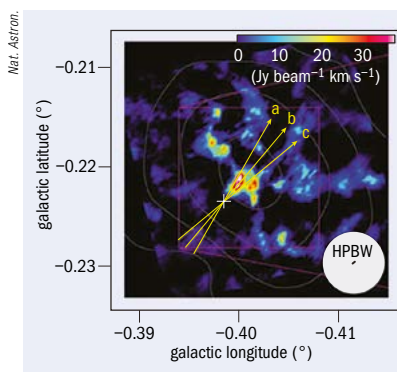
First intermediate black-hole candidate

Since the prediction of black holes a century ago, numerous black-hole candidates have been found. These consist of both low-mass black holes, which have several times the mass of the Sun, and supermassive black holes (SMBHs), which are billions of times heavier. While many candidates exist for stellar-mass black holes and SMBHs, the latter being thought to occupy the centres of galaxies, candidates for black holes in the intermediate mass range were lacking.

A group of researchers from Keio University in Japan has now shown strong evidence for the existence of an intermediate-mass black hole (IMBH) within the Milky Way, which could shed light on the formation of black holes and of our galaxy.

While there is a consensus that stellar-mass black holes form when massive stars die, the source of SMBHs – one of which is thought to be at the centre of the Milky Way – is not well known. It is believed that large galaxies such as the Milky Way grew to their current size by cannibalising smaller dwarf galaxies containing IMBHs at their centres. Finding a candidate IMBH would provide evidence for this theory.

First, using the Nobeyama radio telescope, the team detected a gas cloud in the Milky Way with a peculiar velocity



Integrated emission from the gas cloud, where the cross marks the black hole and the arrows indicate the measured velocity directions. The white filled circle and black filled ellipse show the beam sizes of ASTE and ALMA, respectively.

profile, hinting that an IMBH exists near the centre of our galaxy. This then prompted a more precise observation of the area using the Atacama Submillimeter Telescope Experiment (ASTE) and Atacama Large Millimeter/submillimeter Array (ALMA) in Chile. The cloud, named CO-0.40-0.22, was found to consist of one dense cloud

in the centre with a large velocity profile, surrounded by 20 smaller clouds, the velocity profiles of which are aligned. Since the probability of these clouds being aligned by chance is less than one part in 10^8 , it suggests there is some other object close to the cloud interacting with it. Within the gas cloud the data also revealed a point source emitting weak electromagnetic radiation at submillimetre wavelengths and none at higher wavelengths, ruling out a massive star cluster.

Based on these striking observations, the group simulated the gravitational interactions of the cluster and found that the measured velocity profiles are consistent with a gravitational kick by a dense object of 10^5 solar masses. Combined with the lack of high-energy emission and the spectrum of the object measured in radio wavelengths, the object matches all the characteristics of an IMBH – the first one ever observed. Two further IMBHs are now under study. The finding opens a new research avenue in understanding both massive and supermassive black holes, and strengthens the hypothesis that our galaxy grew by cannibalising smaller ones.

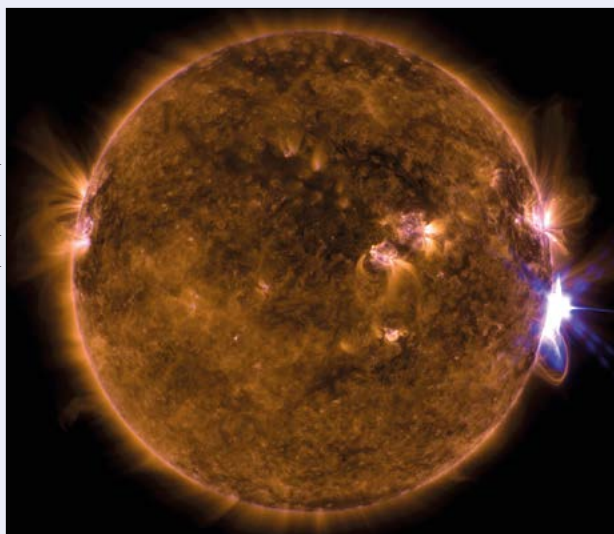
● Further reading

T Oka *et al.* 2017 *Nat. Astron.* 1 709.

Picture of the month

This image of the Sun shows a large solar flare (on the right side of the picture) coming from a giant active region called AR2673 just as the region is about to disappear behind the solar horizon. Since 6 September, AR2673 has been responsible for several flares including the largest seen in more than a decade. The large flare shown here, captured in ultraviolet by the Atmospheric Imaging Assembly on the Solar Dynamics Observatory mission, was followed by a large coronal mass ejection (CME) on 10 September. While solar flares are responsible for emission in the ultraviolet and X-ray regions, gamma-rays with an energy of several GeV have been measured in the past by the Fermi-LAT satellite. CMEs, which often follow solar flares, are responsible for the ejection of high-energy electrons and protons into the solar system resulting in the Northern Lights. Although the CMEs coming from this region resulted in spectacular Northern Lights, much stronger CMEs have occurred in the past. In 1859 a CME was strong enough to cause auroras to be visible at latitudes as low as Cuba, while the results of a very strong solar event in the year 775 are thought to be responsible for a large carbon-14 surplus found in tree rings around the world.

NASA, SDO, and the AIA, EVE and HMI science teams



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