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Black hole hunters set new distance record

Using the European Southern Observatory´s Very Large Telescope (VLT), astronomers from the University of Sheffield have detected a stellar mass black hole much farther away than any other previously known. The newly discovered black hole is in the spiral galaxy NGC 300, about six million light years away from the Sun. With a mass of about twenty times that of the Sun, it is also the second most massive stellar mass black hole ever found and it is entwined with a star that will soon become a black hole itself.

The team of scientists will publish their findings about this intriguing system in the journal Monthly Notices of the Royal Astronomical Society.

The stellar mass black holes [1] found in the Milky Way weigh up to ten times the mass of the Sun and are certainly not be taken lightly, but, outside our own galaxy, they may just be minor-league players, since astronomers have found another black hole with a mass over fifteen times the mass of the Sun. This is one of only three such objects found so far.

Paul Crowther, Professor of Astrophysics at the University of Sheffield and lead author of the paper reporting the study, said: "This is the most distant stellar-mass black hole ever weighed, and it´s the first one we´ve seen outside our own galactic neighbourhood, the Local Group."

The black hole´s curious partner is a Wolf–Rayet star, which also has a mass of about twenty times as much as the Sun. Wolf–Rayet stars are near the end of their lives and expel most of their outer layers into their surroundings before exploding as supernovae, with their cores imploding to form black holes.

The new data show that the black hole and the Wolf–Rayet star dance around each other in a diabolic waltz, with a period of about 32 hours. The astronomers also found that the black hole is stripping matter away from the star as they

The black hole inside NGC 300 X-1 (artist's impression). Credit: ESO/L. Calçada

NGC 300 X-1 in the spiral galaxy NGC 300. Credit: ESO/Digitized Sky Survey 2/P. Crowther

The surroundings of NGC 300. Credit: ESO/Digitized Sky Survey 2

orbit each other.

Note: there is no audio in this video.

Only one other system of this type has previously been seen, but other systems comprising a black hole and a companion star are not unknown to astronomers. Based on these systems, the astronomers see a connection between black hole mass and galactic chemistry. Astronomers believe that a higher concentration of heavy chemical elements influences how a massive star evolves, increasing how much matter it sheds, resulting in a smaller black hole when the remnant finally collapses.

In less than a million years, it will be the Wolf–Rayet star´s turn to go supernova and become a black hole.

Professor Crowther added: "If the system survives this second explosion, the two black holes will merge, emitting copious amounts of energy in the form of gravitational waves as they combine. It will take some few billion years until the actual merger, far longer than human timescales. Our study does however show that such systems might exist, and those that have already evolved into a binary black hole might be detected by probes of gravitational waves [2], such as LIGO or Virgo [3]."

Notes for Editors: [1] Stellar-mass black holes are the extremely dense, final remnants of the collapse of very massive stars. These black holes have masses up to around twenty times the mass of the Sun, as opposed to supermassive black holes, found in the centre of most galaxies, which can weigh a million to a billion times as much as the Sun. So far, around 20 stellar-mass black holes have been found.

[2] Predicted by Einstein´s theory of general relativity, gravitational waves are ripples in the fabric of space and time. Significant gravitational waves are generated whenever there are extreme variations of strong gravitational fields with time, such as during the merger of two black holes. The detection of gravitational waves, never directly observed to date, is one of the major challenges for the next few decades.

[3] The LIGO and Virgo experiments have the goal of detecting gravitational waves using sensitive interferometers in Italy and the United States.

This research was presented in a letter to appear in the Monthly Notices of the Royal Astronomical Society (NGC 300 X-1 is a Wolf–Rayet/Black Hole binary, P.A. Crowther et al.).

The team is composed of Paul Crowther and Vik Dhillon (University of Sheffield, UK), Robin Barnard and Simon Clark (The Open University, UK), and Stefania Carpano and Andy Pollock (ESAC, Madrid, Spain).

ESO, the European Southern Observatory, is the foremost intergovernmental astronomy

organisation in Europe and the world´s most productive astronomical observatory. It is supported by 14 countries: Austria, Belgium, the Czech Republic, Denmark, France, Finland, Germany, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland and the United Kingdom. ESO carries out an ambitious programme focused on the design, construction and operation of powerful ground-based observing facilities enabling astronomers to make important scientific discoveries. ESO also plays a leading role in promoting and organising cooperation in astronomical research. ESO operates three unique world-class observing sites in Chile: La Silla, Paranal and Chajnantor. At Paranal, ESO operates the Very Large Telescope, the world´s most advanced visible-light astronomical observatory, and VISTA, the largest survey telescope in the world. ESO is the European partner of a revolutionary astronomical telescope ALMA, the largest astronomical project in existence. ESO is currently planning a 42-metre European Extremely Large optical/near-infrared Telescope, the E-ELT, which will become "the world´s biggest eye on the sky".

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