Black Hole Blows Bubble Between The Stars

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A team of astronomers from The Netherlands and the UK has discovered a vast "jet-powered bubble" formed in the gas around a black hole in the Milky Way.

The discovery means that for decades scientists have been severely underestimating how much power black holes pump back into the universe instead of merely swallowing material across their event horizons.

Jets of energy and particles flowing outwards at close to the speed of light are a common feature of all accreting black holes, ranging from supermassive black holes at the centres of active galactic nuclei to stellar-mass black holes in X-ray binary systems within our own Galaxy.

However, for the first time European astronomers have now discovered a large bubble surrounding an X-ray binary system. The bubble is approximately 10 light years across, and is predicted to be expanding with a speed of around 100 km per second (225,000 mph).

It appears to have been formed by the action of a powerful outflow or "jet" of energy and matter from the black hole over a time scale of about a million years.

The new, detailed radio observations of a black hole called Cygnus X-1 show a ring of radio emission around a bubble in the nearby interstellar gas - the result of a strong shock that develops at the location where the jet strikes the rarefied gas of the interstellar medium.

The jet that created the bubble seems to be carrying more than 100,000 times the total luminosity of our Sun, and yet the only evidence for this incredible flow of energy is its impact on the tenuous gas between the stars, resulting in the expanding bubble.

"We already knew that supermassive black holes at the centre of other galaxies produce enormous amounts of energy, but this finding proves that something similar is happening in our backyard," said Elena Gallo of the University of Amsterdam, lead author of the paper which will appear in this week's issue of Nature.

"Remarkably, it also means that, after a massive star dies and turns into a black hole, it is still capable of energising its surroundings, by means of completely different mechanisms."

"The importance of this result is that it demonstrates that black holes such as Cygnus X-1, of which there may be millions within our galaxy alone, do not swallow all of the infalling matter and energy, but rather redirect a considerable fraction of it back into space," added Rob Fender of the University of Southampton, second author on the paper.

"We knew about jets from black holes and expected to discover some interaction of the jet's energy with the gas in our Milky Way, but the size and energy content of this bubble came as a surprise," added co-author Dr. Christian Kaiser, also of the University of Southampton.

The team has ruled out the possibility that the ring might be the low-luminosity remnant of the supernova that spawned the black hole. Since Cygnus X-1 moves in the sky along a trajectory that is roughly perpendicular to the jet, it cannot possibly have been located in the centre of the ring.