

Herschel telescope discovered twisted ring of gas and dust at the centre of our galaxy

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The Herschel Space Observatory has identified a twisted ring of dust and gas at the centre of the Milky Way galaxy. Parts of the ring have been seen before but this is the first time it has been observed as a whole.

“We have looked at this region at the center of the Milky Way many times before in the infrared,” said Alberto Noriega-Crespo of NASA’s Infrared Processing and Analysis Center at the California Institute of Technology in Pasadena. “But when we looked at the high-resolution images using Herschel’s sub-millimeter wavelengths, the presence of a ring is quite clear.”

The ring structure is more than 600 light years across (one light year is the distance travelled by light in one year, or about 6 trillion miles) and appears to be in the form of a twisted ellipse. A band in the shape of an ellipse would normally lie in a flat plane but to understand the shape of this galactic ring imagine that the longer ends are twisted a little in opposite directions. It was described at first as resembling an infinity symbol, but this is only because it was viewed from the side.

The ring shown in yellow in the above image is made of dust and gas at a temperature of 15 degrees above absolute zero. Warmer gas and dust appear in blue, while colder regions are in red. Bright regions are the densest and are described as including some of the most massive and active sites of star formation in the galaxy.

Noriega-Crespo and Dr. Mark Thompson of the University of Hertfordshire in the UK are co-authors of a paper on the ring in the latest *Astrophysical Journal Letters*.

“It was not until the launch of Herschel, with its unparalleled wavelength coverage, that we could measure the temperature of the dust clouds and determine its true nature”, Thompson said.

“This is what is so exciting about launching a new space telescope like Herschel”, said Sergio Molinari of the Institute of Space Physics in Rome, Italy, lead author of the new paper. “We have a new and exciting mystery on our hands, right at the center of our own galaxy.”

The ring is a dense region of dust and gas with a mass of about 30 solar masses. Ground observations of the ring made at the Nobeyama Radio Observatory in Japan measured the speed of the denser gas in the ring and showed it is moving together as one body.

The Herschel Space Observatory is run by the European Space Agency with contributions from NASA. It is one of several dozen space telescopes that have been launched since the 1970s. But the Herschel Observatory is the first to be dedicated to observing the far-infrared and the sub-millimeter range of the electromagnetic spectrum.

The sub-millimeter wavelengths are between 0.3 of a millimeter up to one millimeter. This means that it can observe wavelengths between infrared and microwave radiation. Earth-based astronomy at these wavelengths is very difficult due to absorption by the atmosphere. Herschel has the largest single mirror ever built for a space telescope, 3.5 meters in diameter.

At these wavelengths, Herschel is used to study widely different regions of the universe. Within our galaxy it can penetrate through the dust that obscures the centre of the galaxy from observers on earth. Our sun is situated about two thirds of the way out from the centre of the Milky Way to its edge, a distance of about 26,000 light years. Looking toward the centre of the galaxy, the space telescope can observe new stars being formed as well as the interaction with dust and gas between stars.

Herschel is also used to observe very distant galaxies,

up to 10 thousand million light years away. Here it contributes to understanding galaxy formation in the early universe.

The Milky Way galaxy is of the spiral type, with spiral arms extending from a central bulge. The sun is on the inner edge of one of the arms. Like many other spiral galaxies, ours contains a linear, bar-shaped band of stars at its centre. The existence of the bar was confirmed by observations made by the Spitzer space telescope in 2005.

The twisted ring apparently lies at the centre of the bar, and such combinations of bars and rings have been seen in other galaxies, though never rings with a twist. How such bars and rings form is not fully understood, but computer simulations of galaxy formation do show that such structures can be formed through gravitational interaction.

The ring encircles the massive black hole that is believed to lie at the centre of the galaxy. A black hole is a region of matter that has become so massive that gravity prevents anything from escaping, including light. The existence of black holes follows from Einstein's theory of gravitation. Such supermassive black holes are thought to lie at the center of most galaxies. There is also strong evidence for "small" black holes, with a mass of five to 15 times the mass of our sun, which are the remnants of stars that have collapsed under their own gravity as they have burnt out.

In the case of our Milky Way galaxy, astronomers are confident that the region called Sagittarius A* is a supermassive black hole, particularly because of recent observations carried out by the Max Planck Institute for Extraterrestrial Physics and UCLA Galactic Center Group. These have tracked the movement of stars circling round the galactic centre over a decade, enabling good estimates of its size and mass—a radius of only 6.25 light hours (about the size of Uranus' orbit) but a mass of over 4 million solar masses.

What is surprising about the twisted ring observation is that its centre does not coincide with Sagittarius A* but is slightly offset. Noriega-Crespo said it is not clear why this is the case. "There's still so much about our galaxy to discover", he said.

Herschel could hardly be a more aptly chosen name for the ESA Observatory. Friedrich Wilhelm Herschel (15 November 1738 – 25 August 1822) was a German-

born British astronomer, technical expert, telescope maker, organist and composer who became famous for discovering Uranus. He discovered infrared radiation. Herschel was the best telescope-maker of his day. His observations revolutionised astronomy. Historian Richard Holmes explains that Herschel developed a new way of looking at the skies which enabled the universe to be understood in its historical development "nebula and star clusters were, in effect, like 'species of plants', at various stages of growth and decay". [1]

[1] Richard Holmes, *The Age of Wonder*, Harper Press, 2009, p 192.



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