First detailed look at young dusty discs around ageing stars

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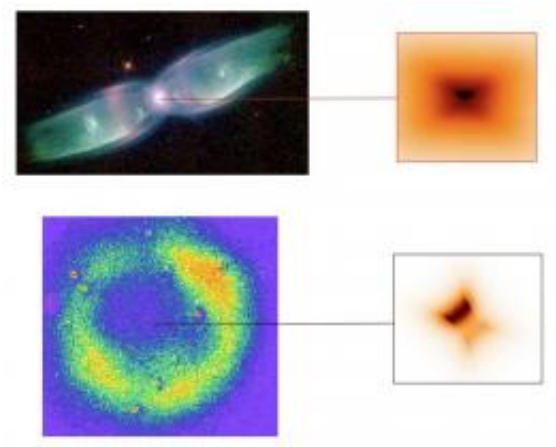

Top: Bipolar nebula M2-9 (image credit: B. Balick, HST) with a reconstructed image of its dusty disc observed by VLTI. Bottom: Round nebula around Sakurai's Object (image credit: A. Zijlstra, University of Manchester) with its corresponding disc.

(PhysOrg.com) -- Astronomers from the University of Manchester's Jodrell Bank Centre for Astrophysics and the Observatoire de la Cote d'Azur in France have used the Very Large Telescope (VLT) in Chile to discover discs of dust around ageing stars. The images will be presented by Foteini (Claire) Lykou on Wednesday 14th April at the RAS National Astronomy Meeting (NAM2010) in Glasgow.

"This is the first time we have ever observed in these dusty discs in such detail," said Ms Lykou.

Towards the end of its life, in around 5 billion years time, our Sun will evolve into a red giant star. The temperature near the core will rise and the outer layers will expand to form a tenuous atmosphere a few hundred times the current radius of the Sun. Dust, which forms in this cool atmosphere, along with gas, is expelled from these types of stars during the aging process and forms the raw materials for the next generations of stars and planets. As the dust flows out into space it is shaped into beautiful nebulae by mechanisms that are not yet fully understood. Dusty discs can be created as a by-product of those mechanisms. Ultimately, nuclear fusion shuts down and the core of the dead star becomes a white dwarf.

Although these dusty discs are more than a hundred thousand million kilometres across (almost a thousand times larger than the orbit of the Earth around the Sun) they lie at such large distances from us that their apparent size is tiny. The discs can only be observed using a special technique in which telescopes are combined together to act like a giant zoom lens, dramatically increasing the sharpness of view. The astronomers used the Very Large Telescope Interferometer (VLTI) at the European Southern Observatory in Chile. This combines four giant telescopes, each with an 8.2-metre mirror, to create a telescope with the sharpness of view of one with a diameter of up to 130 metres. The VLTI also has the advantage of observing in the infrared, the part of the electromagnetic spectrum where the dusty discs shine brightly.

"We've discovered discs at various stages of their evolution around the central stars in several nebulae. We are not sure exactly how long these discs survive - it could be hundreds of thousands or possibly millions of years. The images that I am presenting at NAM2010 show two discs, both at a relatively early stage of their life," said Ms Lykou.

The first disc was found in M2-9, a bipolar nebula (a gas cloud with symmetrical lobes) 4200 light-years away that has a binary stellar system

in its core. Both stars, a red giant and a white dwarf, are hidden inside the disc. The dust originates from the red giant, which is 15 000 degrees Celsius and 2 500 times more luminous than the Sun. The disc has an inner radius of 2250 million kilometres and an outer radius near 135 thousand million kilometres and is composed of dust grains made out of silicon and oxygen, similar to the dust found in our Solar System.

"The disc inside M2-9 is probably less than 2000 years old, making it a teenager in terms of the lifetime of these discs. It is still evolving due to the gravitational interactions of the binary stars," said Ms Lykou.

The second disc was found in Sakurai's Object, a round nebula that lies 11,400 light-years from Earth. The star is 12 000 degrees Celsius and 10 000 times brighter than the Sun. It is composed of amorphous carbon, a type of carbon that has no crystalline structure (coal and soot have this composition) and it is growing in size.

"The disc in Sakurai's Object was created within the last 10 years, so we have the opportunity to study a newborn disc. It is expanding radially - and rapidly - in space. During our observation period in 2007, we saw the disc extend from 10 thousand million kilometres to 75 thousand million kilometres," said Ms Lykou.

The most probable scenario for the distant future is that the discs may be destroyed by interstellar radiation breaking down the dust grains to their individual atoms and molecules, thus replenishing and enriching the Galaxy's interstellar medium with new materials.

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