Cutting edge

A glimpse at the forefront of research astronomy. By Chris Kitchin

This month: A giant supernova remnant

The integral fibre optic unit on the WHT. Photo Courtesy of the Integral Team, Isaac Newton Group of Telescopes, La Palma.

Astronomers using the UK's William Herschel Telescope (WHT) on the island of La Palma have found that the ultraluminous X-ray source (ULX) IC 342 X-1 is associated with a large and unusually energetic supernova remnant (SNR).

Twenty three years ago the Einstein spacecraft found a bright point source of X-rays on the Camelopardalis / Cassiopeia border. It was within the large spiral galaxy IC 342, some 3.9 megaparsecs (12.9 million lightyears) away, making it one of the nearest ULXs to us. However, finding an optical counterpart had to await data from the spacecraft ROSAT and, especially, Chandra with its positional accuracy of better than one second of arc. A faint nebula possibly associated with the ULX was thus observed in 2001 by a team from the Universities of Leicester and Southampton led by Dr Tim Roberts (Monthly Notices Roy Astron Soc **342**, 709, 2003). They used the integral fibre optic array at the Nasmyth focus of the 4.2-metre WHT to cover a small area centred on IC 342 X-1's position. The instrument has 189 fibres in a rectangular array to feed light from the object into a spectroscope. Another 30 fibres pick up light from the sky background for calibration purposes. Thus every pixel in the resulting image has its spectrum taken (a technique known as integral field spectroscopy).

The team found that the nebula was a SNR, 110 parsecs (360 lightyears) across. The remnants from 'ordinary' supernovae will fade before reaching this size, and the team concludes that the original supernova in this case must have been at least two to three times more energetic than normal. The ULX is thought to be a black hole X-ray binary. Given its almost certain physical link with the SNR, the complex may have originated as a gamma-ray burster some 100,000 years ago. Other possibilities for the SNR's origin include multiple ordinary supernovae, and a jet or wind from the ULX.

"We are interested in ULXs as their extreme X-ray luminosities may indicate that they are powered by a previously-unknown, middleweight class of black holes," says Dr Roberts. "The discovery of giant nebulae, such as this supernova remnant, around ULXs is an exciting new development which may eventually help us better understand the nature of the ULXs themselves."