Blowing Bubbles with Exploding Stars

Research Field

Radio Astronomy/Astrophysics

Project Suitability

PhD

Masters

Project Supervisor

Dr Natasha Hurley-Walker
nhw@icrar.org

Co-Supervisors

When a massive star uses up its hydrogen fuel, it rapidly undergoes collapse and then a violent explosion, known as a supernova. The outer layers of the star are cast off into space, creating an enormous rapidly-expanding bubble of bright X-ray and radio emission. This "supernova remnant" persists for ~one million years after the star has exploded. Simulations and star counts predict that there should be thousands of these remnants dotting our Milky Way galaxy, but only a few hundred are known, often the younger, brighter, and smaller objects. Where are the other remnants? What are we missing?

The Murchison Widefield Array (MWA) is a low-frequency radio telescope operated by an international consortium headed by Curtin University. This telescope was used to survey the whole sky, producing the GaLactic and Extragalactic All-sky MWA survey[1]. The wide bandwidth of the survey, across 72–231 MHz, allows us to determine the difference between thermal (blue in Fig. 1) and non-thermal (red/orange in Fig 1.) emission, and thus extract the SNRs from the images very easily. In these radio images, we found 27 of the "missing" SNRs, mostly older, larger, and dimmer sources than had been found before. However, the resolution of GLEAM was low, and this made it difficult to discriminate some sources against the confusing background of our Galaxy and find small or very faint SNRs. A new survey, GLEAM-X, has double the resolution, and five times the sensitivity. Observations have already been taken, and processing time secured on supercomputers at the Pawsey Centre.

Aims of project:

1) Transform the visibility data of the GLEAM-X survey in the region of the Galactic Plane into well-calibrated images across a wide frequency range;
2) Combine the data with existing GLEAM images to highlight extended emission;
3) Search the resulting images for previously-undetected SNRs;
4) Obtain follow-up/ancillary observations with X-ray, spectral line, and/or pulsar searches to better understand the astrophysics of these sources.

Requirements:

This project is suited to a student with a strong grounding in astrophysics and an interest in learning low-frequency data reduction, including bash scripting and python programming. The data volumes are large so organisation skills are essential.

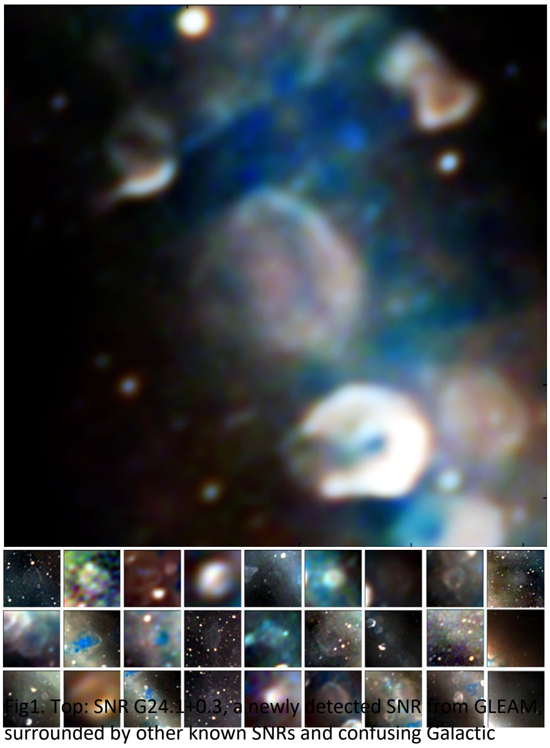

Fig1. Top: SNR G24.1+0.3, a newly detected SNR from GLEAM, surrounded by other known SNRs and confusing Galactic emission. Bottom: The 27 new SNRs detected using GLEAM.

[1] See this TED talk: http://bit.ly/nhwted