Curtin University

Rapid follow-up of high-energy flaring stars with the Murchison Widefield Array

Research Field
Radio Astronomy

Project Suitability
PhD
Honours, 3rd year

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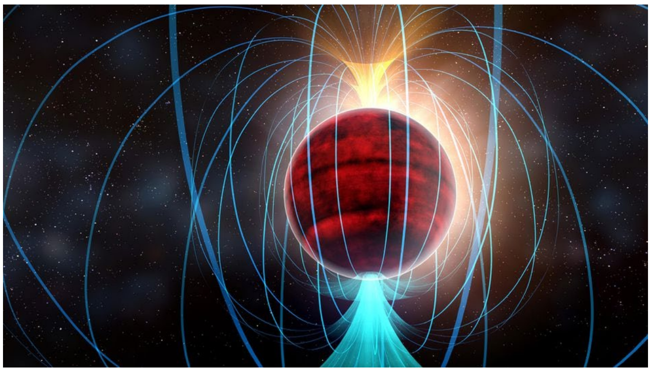
Some of the smallest stars in our Galaxy, with masses as low as one tenth of our Sun, can produce flares that are ten thousand times more powerful than the solar flares we see on the Sun. These “superflares” are extreme examples of stellar magnetic activity, and impact the atmospheres, habitability, and formation of the surrounding planets, motivating our desire to understand the emission mechanisms that produce these events. The most magnetically active stars produce powerful X-ray/gamma-ray (high-energy) superflares that are detected by telescope (satellites) such as *Swift* and *MAXI*. These space missions then send immediate alerts to a network on the ground, allowing telescopes such as the Murchison Widefield Array (MWA) to rapidly begin observing the event.

The MWA is a low frequency (80-300 MHz) radio telescope operating in Western Australia and the only operational Square Kilometre Array (SKA)-Low precursor telescope. The MWA is an entirely electronically steered instrument, meaning that it can ‘slew’ to any part of the sky nearly instantaneously. The MWA also has an extremely large field of view. The large field of view and fast slew time means that the MWA is uniquely placed to provide the fastest follow-up radio observations of transient (explosive or outbursting) events, including flare stars.

The MWA has been automatically responding to high-energy stellar superflares detected by *Swift* and *MAXI*, obtaining 30 minutes of observations following each outburst. If the candidate is interested in pursuing a PhD, they will also have the opportunity to process similar rapid-response data taken at higher radio frequencies with the Australia Telescope Compact Array (ATCA), allowing for a direct comparison of such flares at both high and low radio frequencies.

Using these triggered radio observations, you will investigate whether the same magnetic event that produces bright high-energy superflares can also produce low frequency radio flares, which will aid in providing a more unified understanding of plasma physics in these stellar systems. This project will therefore test transient strategies for the Square Kilometre Array by demonstrating the importance of radio telescopes having a rapid-response capability for fast transient follow-up.



Artist's impression of bright flaring activity from a magnetically active flare star
IMAGE: NRAO/AUI/NSF; DANA BERRY / SKYWORKS