3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

New Transient Populations in the Dynamic Radio Sky

Dillon Dong, Gregg Hallinan
Caltech, USA

The VLA Sky Survey (VLASS), is mapping > 80% of the 3 GHz sky at ~2 arcsecond resolution over multiple epochs, providing a ~2 order of magnitude increase in the volume available for blind radio transient searches. Through a comparison of the first two VLASS epochs and archival radio surveys, we have discovered thousands of radio sources that are strongly variable or transient on a timescale of ~years. Many of these sources can be associated with multiwavelength counterparts in archival and follow up data, providing important clues in revealing their physical nature. In this talk, I will highlight two emerging transient classes associated with local universe galaxies.

The first is population of supernovae interacting with dense shells of gas at large radii (~1017 cm) from the explosion site. These shells are too dense to explain with stellar winds and too extended to explain with most eruptive mass loss models. The best explanation for these shells is mass loss through non conservative mass transfer onto a binary companion in the centuries before explosion. In one case, we associated the supernova with an early relativistic jet, providing evidence for a scenario where the companion is a compact object that has spiraled into the core of the massive star.

The second is a new transient in a dwarf starburst galaxy with a spectral index of $\alpha = 0.35$ spanning over an order of magnitude in bandwidth. This spectrum is too flat to be explained with diffusive shock acceleration in standard conditions: the usual explanation for radio emission from explosive transients. Instead, we argue that the most plausible alternate models are a young, extremely energetic pulsar wind nebula emerging from within the free-free opacity of surrounding supernova ejecta, or a compact jet launched by an intermediate mass black hole. We also note the similarity between this flat spectrum transient and the persistent radio sources associated with repeating flat radio bursts.

Together, these results highlight the rapid recent growth in the field of blind radio transient detection driven by multi-epoch wide-field radio surveys such as VLASS. Within the newly accessible parameter space, there is great potential for discovering even more new transient populations and using them to study the astrophysics of their progenitors.