A New Class of Luminous Extragalactic Radio Source

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Summary

Despite an increasing array of fascinating discoveries, it is not yet clear what kind(s) of source emit FRBs. Aside from being a compelling mystery, this complicates efforts to use FRBs as probes. In the long-term, FRB science will be driven by their application to broader astrophysical problems, such as the "missing baryon problem", the search for primordial black holes, or in precision cosmology. However, these applications require interpreting the FRB dispersion measure (DM) as an extragalactic electron column density. Without knowing the nature of the FRB source or reliably classifying FRB environments, there are likely to be systematic effects that compromise their use as probes.

Two FRBs have been associated with a luminous persistent radio sources (PRS; Figure 1). These two FRBs are also known for having anomalously large DM that compromises their use as probes. The fact that both FRBs reside in low-metallicity dwarf galaxies with high specific star formation rate suggests they may represent a special formation channel or environment. However, it is not known what kind of source generates either FRBs, PRS, or why they are related. In this sense, the FRB/PRS sources represent a double mystery.

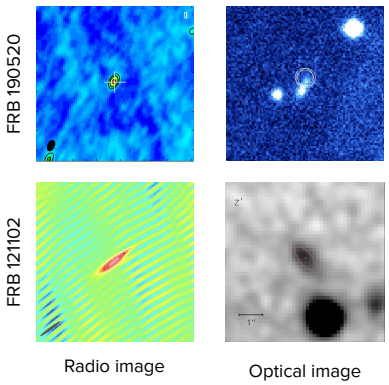

Figure 1: Grid of radio and optical images of FRBs 20121102A and 20190520B. Both are associated with PRS in dwarf galaxies.

With a luminosity greater than 10^{29} erg/s/Hz, PRS are detectable in the VLA Sky Survey at a distance of 300 Mpc. Traditionally, it has been assumed that the radio sky is composed of either star-forming galaxies and AGN. The volumetric density of PRS implies that they comprise as much as 1% of compact, luminous radio sources detected in the local universe. At this

density, these sources may confound the study of AGN in the local universe. More fundamentally, they change they way we think of the extragalactic sky.

The Cornell FRB workshop theme of "Plenty of Room at the Bottom" is highly relevant to the study of FRB origins and environments. In my talk, I'll share my analysis of the FRB and PRS populations, and efforts to identify FRB sources without FRBs (i.e., via their PRS).

Introduction

I am a Research Scientist in Caltech Astronomy and Leader of the Software and Algorithms Lab at the Owens Valley Radio Observatory. I studied at the University of Hawai'i and received my PhD from Northwestern University in 2007. I have held positions at the University of Amsterdam and UC Berkeley and am PI of *realfast*, a fast transient search instrument integrated with the Very Large Array. My interests include transients, data intensive astrophysics, software development, and civic engagement.

My research lies at the intersection of transient astrophysics and radio survey techniques. I am leading development or collaboration with major FRB observing systems, including VLA/*realfast*, DSA-110, OVRO-LWA, and CHIME/FRB. Ongoing programs at these facilities will discover, localize, and associate FRBs to host galaxies and other counterparts. Through my involvement in the VLA Sky Survey and the DSA-2000 project, I am also developing techniques for slow radio transient science; one effort led to the discovery of a likely orphan afterglow of a long GRB.