Pulsar and Fast Radio Burst Science:
The CHIME Telescope and the PALFA Survey

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Over the past several decades, the high-time-resolution radio sky has proven to be a realm rich in discovery, though not without significant challenges to overcome. New pulsars are still being found consistently with major ongoing surveys, and recently members of a new, still mysterious class of transients known as fast radio bursts (FRBs) have been seen in various radio surveys. These millisecond-timescale bursts seem to occur only once, and the frequency-dependent delay that is typical of radio signals traversing the ionized interstellar medium is so large that it suggests an extragalactic, possibly cosmological, origin.

There are still many reasons to search for new pulsars, not least of which is the chance of finding bright, stable millisecond pulsars that can contribute to the current efforts of pulsar timing arrays (PTAs) searching for a background of nanohertz-frequency gravitational waves caused by in-spiraling supermassive black holes. I am involved PALFA, a pulsar survey using the Arecibo L-Band Feed Array (ALFA), in particular finding clever ways to cope with the millions of pulsar candidates our pipeline produces, as well as studying several millisecond pulsar systems discovered in the survey. In addition to periodic signals, the PALFA pipeline searches for single-pulse events, and among other objects, one FRB has been found (Spitler et al., 2014, ApJ 790, 101).

A major leap forward is expected soon both for the discovery of FRBs, and for high-cadence pulsar observations. The Canadian Hydrogen Intensity Mapping Experiment (CHIME) is a cosmology experiment being constructed at the Dominion Radio Astrophysical Observatory site in British Columbia, measuring baryon acoustic oscillations between redshifts 0.8 to 2.5. It constantly observes a strip of 4 by 256 dual-polarization beams along the north-south meridian, seeing the entire northern sky once per day in the 400-800 MHz range. This instrument happens to be well-suited for transient science, notably the study of radio pulsars and FRBs. Additional backends are being built to handle the unique and significant data-processing requirements for each of these areas, both of which will operate alongside the primary cosmology instrument.

Because of CHIME's sensitivity and sky coverage, we expect to see dozens of FRBs every day—more each day than the total number of FRBs currently published. This will allow statistical population studies and fast follow-up in hopes of finding counterparts in other bands, or associated galaxies. The pulsar system will enable us to constantly observe up to 10 pulsars simultaneously, allowing a broad range of pulsar science, including measuring small changes in the timing of PTA pulsars in order to increase our sensitivity to gravitational waves. I will talk about my work on the real-time signal processing system for the pulsar backend as well as efforts to identify FRBs in real-time and localize them using multi-beam information.