FRB Detection and Characterization at the Dawn of the CHIME Era

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The Canadian Hydrogen Intensity Mapping Experiment (CHIME) is a new radio telescope that detects and analyzes sky radiation in the 400-800 MHz range, and operates at the Dominion Radio Astrophysical Observatory in Kaleden, British Columbia, Canada. CHIME consists of four contiguous, half-cylindrical reflectors that are each spanned by 256 dual-polarization, clover-leaf antennae (Deng et al. (2017, arχiv:1708.08521). The 2,048 input signals are processed through a powerful "FX" correlator at an input data rate of 13.4 Tb s^{-1} (Bandura et al., 2016, arχiv:1608.06262; Denman et al., 2015, arχiv:1503.06202).

The design of CHIME reflects the original goal of generating wide-field sky maps for measurement and characterization of baryon acoustic oscillations in the Universe within a redshift range of 0.8 to 2.5. However, with its wide field of view and 2.56-μs time resolution, CHIME is also an exceptional instrument for the detection of radio-transient phenomena, such as millisecond radio pulsars and the mysterious fast radio bursts (FRBs). FRBs are a recently-discovered phenomenon that are extragalactic in origin, though little else is known about the mechanism(s) that produce FRB emission and the environments in which FRB sources reside. Here we report on an effort by the CHIME/FRB collaboration to search and detect FRBs using the CHIME telescope.

The CHIME/FRB collaboration has developed a search engine that processes data from the CHIME telescope in real time for FRB signatures (*ApJ*, 863, 48, 2018). The CHIME/FRB backend receives 1,024 digitally-formed beams from the FX correlator, giving an approximately 200 square-degrees instantaneous field of view on the sky. Each beam consists of 16,384 frequency channels of total-intensity data sampled at a 0.983-ms cadence (Ng et al., 2017, arχiv:1702.04728). To process and search a total input data rate of 142 Gb s^{-1}, we have developed a custom codebase for real-time dedispersion, localization, and classification. The CHIME telescope saw first light in September 2017, with first light for the FRB backend (using a single formed beam) following in December 2017. By September 2018, we have successfully scaled up the FRB system to process the full 1024 beams in real time.

CHIME/FRB detected its first FRB on 25 July 2018 (Boyle & the CHIME/FRB Collaboration, 2018, *Astronomer's Telegram* #11902). Since then, our system detected additional FRBs with a variety of dynamic spectra and frequency-dependent shapes, and across different parts of the sky. Signals classified by CHIME/FRB as Galactic in origin, and yet unassociated with known Galactic sources, have been detected as well. In this talk, we provide an overview of examples that reflect our growing FRB sample and highlight important technical features that render CHIME/FRB a powerful instrument for understanding the FRB population.