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The Canadian Hydrogen Intensity Mapping Experiment (CHIME)

Cherry Ng*(1), on behalf of the CHIME collaboration
(1) Dunlap Institute for Astronomy & Astrophysics, ON, Canada, cherry.ng@dunlap.utoronto.ca

The Canadian Hydrogen Intensity Mapping Experiment (CHIME) is located at the Dominion Radio Astrophysical Observatory in British Columbia in Canada. Originally designed as a cosmology instrument, it was soon recognized that CHIME has the potential to simultaneously serve as a great radio telescope for Fast Radio Bursts (FRBs) [1] and pulsar science [2].

The construction of CHIME took over three years and was completed in late 2017. CHIME consists of four half-pipe like cylinders placed side by side, spanning an area of 100 m × 80 m. On each of the four focal lines is a linear array of 256 dual polarization clover-leaf antennas [3]. This telescope design provides a much larger field-of-view (FOV) compared to a single dish radio telescope of comparable sensitivity. This is one of the reasons why CHIME has been such a game changer in the study of FRBs: with the over 200-squared-degree FOV, CHIME has a proportionally higher chance in detecting FRBs bursting in *a priori* unknown location and time. Between July 2018 and July 2019, CHIME has discovered over 500 FRBs which has led to the first CHIME/FRB catalog [4].

The CHIME correlator follows a hybrid FX design. Custom FPGA boards (F-engine) [5] digitize and channelize these data to 1024 frequency channels via a 4-tap polyphase filter bank (PFB). Spatial correlation (X-engine) is performed in a Graphics Processing Unit (GPU) cluster that consists of 256 processing nodes each with 4 GPUs [6]. In the GPU cluster, visibility data is computed for the study of cosmology, while a Fast Fourier Transform (FFT) beamformer produces 1024 fan-beams for FRB search [7], and a tied-array beamformer generates 10 tracking beams mainly for known pulsar monitoring. Further downstream, the CHIME/FRB project is equipped with a real-time detection pipeline that is capable of saving buffered complex voltage data to allow for a detailed FRB burst characterization [1].

In this talk, I will review the telescope design of CHIME and present the latest progress of the three projects, including updates on our survey discoveries and highlights of interesting FRB events.

References

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