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The CHIME/FRB outrigger program for localization of Fast Radio Bursts

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1 Extended Abstract

Fast Radio Bursts (FRBs) are short-duration pulses of radio light of unknown extragalactic origin. Even though thousands of FRB events occur over the full sky every day, their detection with traditional radio telescopes is challenging due to the random, non-repeating nature of the vast majority of bursts. With its unique hybrid cylindrical design optimized for rapid wide-field imaging and a powerful transient-detection engine, the Canadian Hydrogen Intensity Mapping Experiment (CHIME) radio telescope is an excellent platform to study the time-variable sky, including the mysterious FRBs. Whereas it took a decade to amass a sample of 50 FRBs using single dish telescopes, CHIME has found roughly 700 in its first year of full operations, becoming the world's most powerful FRB detector [1].

Although these data already provide a wealth of information about the statistical properties of FRBs, CHIME alone does not have the ability to precisely localize these bursts, which is crucial to understand the physical environments and emission mechanisms that generate them. The CHIME/FRB collaboration is currently developing a large-scale program to build small CHIME-like outrigger telescopes for FRB localization using Very-Long-Baseline Interferometry (VLBI). The outriggers will be deployed at distances of thousands of kilometers from CHIME and pointed at its field-of-view. Upon receiving a trigger from the CHIME/FRB search engine, each telescope will transmit its locally buffered data to a correlation center, forming a dedicated FRB VLBI network that will detect hundreds of FRBs each year with milliarcsecond localization precision, and allowing unique identification of FRB environments within their galaxy hosts. In this talk I will introduce the CHIME/FRB outrigger program, discuss its goals and challenges, and report on the current status.

CHIME is a novel radio telescope now operating at the Dominion Radio Astrophysical Observatory (DRAO) in Penticton, British Columbia, Canada. It consists of four 20 m x 100 m fixed cylindrical reflectors, each equipped with 256 dual-polarization feeds sensitive to 400-800 MHz. The cylinders form a transit interferometer that continuously surveys the northern half of the sky. The CHIME digital correlator, the largest of its kind, processes 2048 inputs at an input data rate of 13.1 Tb s^{-1}, and has a specialized backend that triggers on high-dispersion radio transients to search for FRBs in real time [2, 3].

References

[1] E. Fonseca, B. C. Andersen, M. Bhardwaj, et al., "Nine New Repeating Fast Radio Burst Sources from CHIME/FRB," *ApJL*, vol. 891, p. L6, 2020.

[2] K. Bandura, A. N. Bender, J. F. Cliche, et al., "ICE: A Scalable, Low-Cost FPGA-Based Telescope Signal Processing and Networking System," *JAI special issue on Digital Signal Processing in Radio Astronomy*, vol. 5, p. 1641005, 2016.

[3] The CHIME/FRB Collaboration: M. Amiri, K. Bandura, et al., "The CHIME Fast Radio Burst Project: System Overview," *ApJ*, vol. 863, p. 48, 2018.