The CHIME/FRB Outrigger Program
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The Canadian Hydrogen Intensity Mapping Experiment (CHIME) Fast Radio Burst experiment (CHIME/FRB) is currently the most successful FRB-detector in the world, discovering an average of three new FRBs each day. To date, CHIME/FRB has published spectra of hundreds of FRBs and identified dozens of new repeating FRBs, providing a large sample for study. The success of CHIME/FRB is owed, in large part, to its wide field of view, fast beamformer, and highly-optimized dedispersion search algorithm, all of which allow for large swaths of the sky to be searched in real time for FRB events.

On its own, CHIME can only achieve arcminute angular resolution, while arcsecond resolution is typically required to identify FRB host galaxies. Realtime FRB searches with sub-arcsec resolution typically operate in higher frequency bands, where the field of view is narrower, and hence have a slower detection rate. Milliarcsecond localization, as is typically achieved with very long baseline interferometry (VLBI), is required for detailed study the local environments of FRBs, but has only been applied to repeating FRBs, which can be targetted with VLBI observation campaigns.

By building three outrigger stations across North America, the CHIME/FRB Outrigger project aims to combine the detection rate of CHIME/FRB with the angular resolution of VLBI. Each outrigger dish maintains a buffer of baseband data, which can be written to disk on receiving a low-latency FRB candidate trigger from CHIME. Offline, the baseband data can be beamformed, cross-correlated, phase-referenced to a calibrator, and fringe-fitted to solve for geometric delays.

Each baseline provides a position constraint along a particular direction, such that only two baselines are required to fully constrain an FRB position (without complete imaging). KKO\(^1\), located 66 km west of CHIME, has already been demonstrated to achieve arcsecond scale constraints on FRB right ascensions, having been validated with localizing known pulsars. The second outrigger at the Green Bank observatory (GBO), has been in commissioning since April of 2023. Its 3333 km baseline with CHIME is theoretically capable of 10s of milliarcsecond angular resolution, sufficient to constrain both host galaxies and, for nearby sources, positions within host galaxies. The third outrigger is planned to be installed at the Hat Creek Observatory in northern California, and will form a 955 km baseline with CHIME, providing 10s of milliarcsecond constraints in the declination direction.

In this talk, I will give an overview of the CHIME/FRB Outrigger project. I will describe the overall system design, the challenges that have come up during the commissioning process, and recent successes. Looking forward, I will also discuss our expected rates of host galaxy identification and likely avenues for science results.

\(^1\)k’ni?atn k’l _ stk’masqt, an upper Similkameen word meaning “a listening device for outer space.”