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The CHIME data processing pipeline

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1 Extended Abstract

The Canadian Hydrogen Intensity Mapping Experiment (CHIME) is a radio interferometer designed to map the large scale distribution of neutral hydrogen gas in the universe by directly detecting its redshifted 21 cm radiation [1, 2]. By measuring the scale of the Baryon Acoustic Oscillations between redshifts 0.8 and 2.5 in both the angular and line-of-sight directions, CHIME will study the epoch when Dark Energy generated the transition from decelerated to accelerated expansion of the universe. Recently, the CHIME collaboration reported the detection of 21 cm emission up to redshift 1.3 by cross correlating CHIME data with galaxy and quasar catalogs from the Sloan Digital Sky Survey. This represents the highest redshift 21 cm intensity mapping detection thus far [3].

CHIME is located at the Dominion Radio Astrophysical Observatory near Penticton, B.C., Canada. It consists of four 20 m $\times$ 100 m cylindrical reflectors oriented north-south and instrumented with a total of 1024 dual-polarization feeds and low-noise receivers operating in the 400-800 MHz band. The cylinders are fixed with no moving parts, so CHIME operates as a drift-scan instrument that surveys the northern half of the sky every day with an instantaneous field of view of $\sim 120^\circ$ north-south by $2.5^\circ - 1.3^\circ$ east-west.

The CHIME digital correlator, the world's largest of its kind, processes 2048 inputs at an input data rate of 13.1 Tbit/s and computes a variety of data products for 21 cm cosmology and other scientific backends. For cosmology science, the correlator forms a full correlation matrix for each 390 kHz-wide frequency channel in the CHIME band at 31 ms cadence. A real-time processing pipeline applies calibration and flagging, averages over redundant baselines and integrates to 10 s to form redundant visibilties, the instrument's primary cosmological data product. An offline pipeline operates on redundant visibility data and stacks over sidereal days to generate foreground filtered data for 21 cm analysis as well as other science-ready data products like sky maps and bright point source spectra. In this talk, I will give an overview of the CHIME data processing pipeline and report on the status of the instrument characterization and data analysis.

References

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[2] The CHIME Collaboration. 'An Overview of CHIME, the Canadian Hydrogen Intensity Mapping Experiment', *in prep.*

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