The CHIME (Canadian Hydrogen Intensity Mapping Experiment) Instrument: A Novel Cylindrical Interferometer

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The CHIME (Canadian Hydrogen Intensity Mapping Experiment) instrument is a novel hybrid cylindrical interferometer designed to measure the large scale neutral hydrogen power spectrum across the redshift range from 0.8 to 2.5. The power spectrum will be used to measure the BAO (Baryon Acoustic Oscillation) scale evolution across this previously poorly probed redshift range across which dark energy begins dominating the content of the Universe.

The instrument itself revives the cylinder design in radio astronomy with a wide field survey as a primary goal. Modern low noise amplifiers and digital processing removes the necessity for analog beam-forming in previous designs. The instrument is a close packed set of 5 20m wide by 100m long cylinders oriented north-south for a total collecting area of 10,000 square meters. The cylinders are fixed with no moving parts, and form a transit instrument with an instantaneous field of view of ~90degrees by 1-2 degrees.

The CHIME instrument has a feed-line with feeds every ~30cm which will Nyquist sample the field for much of the frequency band. Each dual-polarization feed is then independently amplified, filtered to 400-800MHz, and directly sampled at 800Msps at 8 bits using the second Nyquist zone.

The correlator is an FX design, where the Fourier transform channelization is performed in FPGA's, and the correlation matrix is computed with a set of GPU's.

Currently under construction at the DRAO in Penticton BC is a 1/7th collecting area prototype version of CHIME consisting of two cylinders 37m long by 20m wide. The cylinders will be instrumented with the analog and backend electronics for a total of 128 dual-polarization feeds. This instrument is capable of making the first measurement of BAO at redshift of 1-2.