

The First Billion Years

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2011 August 22

Discussion of observational requirements

- What requirements do the science goals set on a CO mapping instrument?
- Before we design an instrument, we need a well-defined target
 - Can we agree on the parameters?
- Not a discussion of technology
 - ground/space, interferometer/FPA



CO intensity mapping

- Direct detection
- Statistical detection (power spectrum)
- Cross-correlation of different CO lines
- Cross-correlation with HI and other tracers
- *Secondary science: Galactic foregrounds (spinning dust)*



Observational requirements

- Frequency range
 - CO $J=1 \rightarrow 0$ and $J=2 \rightarrow 1$ at $z = 6 - 10$
- Dual frequencies
 - 10 – 16 GHz and 21 – 33 GHz
- Instantaneous frequency coverage
 - is the whole band needed?
- Sky coverage
 - 10 – 40 deg FWHM ($> 100 \text{ deg}^2$)
- Resolution (multipole range)
 - 3 – 10 arcmin (1–10 cMpc) to $\sim 10 \text{ deg}$ (matched at both frequencies)
- Spectral Resolution
 - $\sim 100 \text{ MHz}$ (= 10 Mpc, $\Delta z \sim 0.04$ at $z=7$) ?
 - $\sim 10 \text{ MHz}$ for RFI



Observational requirements

- Sensitivity
 - $T_B \sim 1 \mu\text{K}$, rms $\sim 0.1 \mu\text{K}$ on 10-arcmin scale (“order of magnitude uncertainty”)
 - survey $\sigma < 0.1 \mu\text{K}$ implies ≥ 1000 detectors
 - more work needed on cross-correlations (expected signal)
- Polarization?
- Calibration and systematic error budget
 - Dynamic range $\sim 10^6$?
- Foreground separation, point sources, line confusion
 - independent measurements needed?
- Instrument location
 - north or south
 - matching other instruments (LOFAR, MWA?)
 - atmospheric requirements

