More Than Foregrounds:

AGN feedback with CO cross-correlations

arXiv: 1904.03197

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CITA

CCAT-prime Collaboration Meeting, 8 April 2020

CITA
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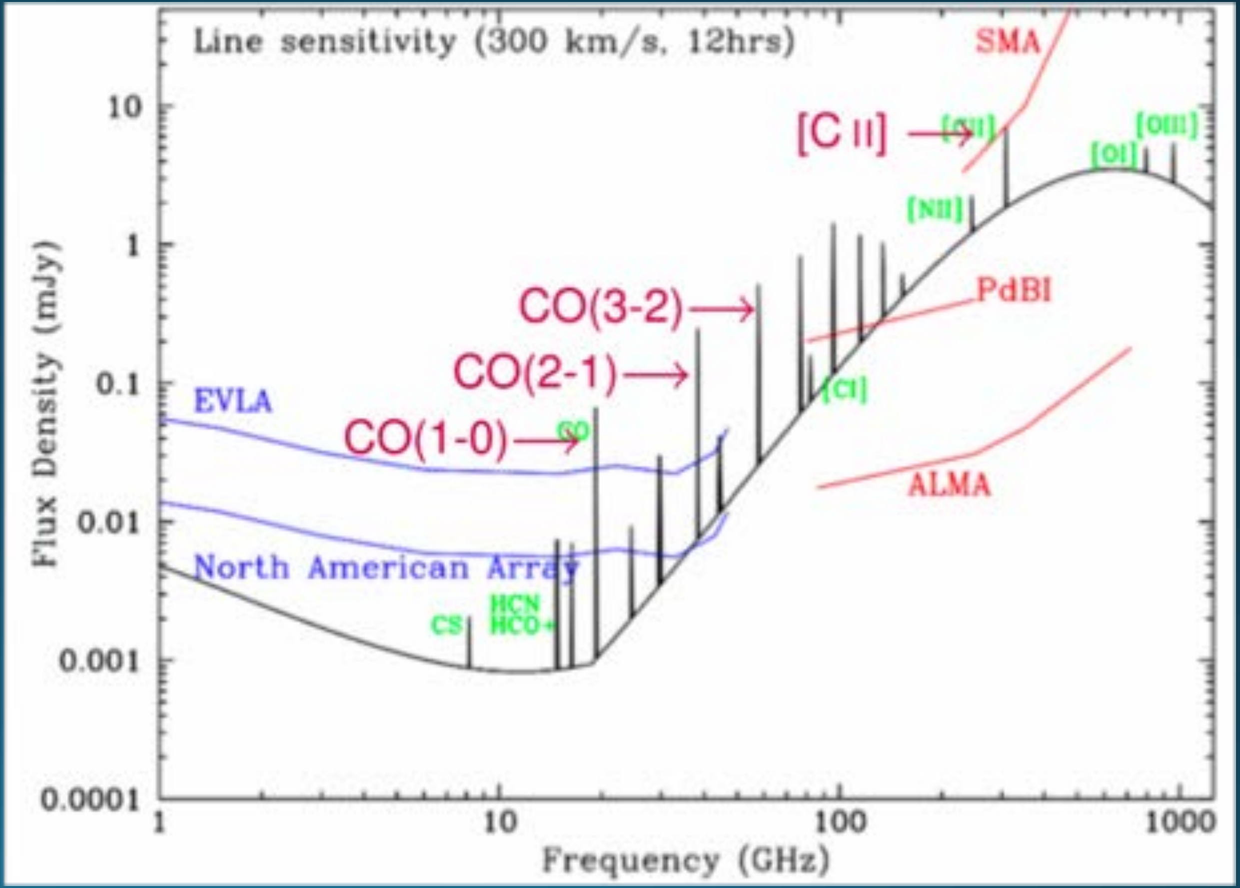
CO "Foregrounds"

- Several CO rotational lines fall into the CCAT band
- Act as foregrounds to primary CII IM science
- Also valid science targets in their own right
  - Comparatively bright at low *z*
  - Trace molecular gas and SFR
  - How to isolate -> cross-correlation

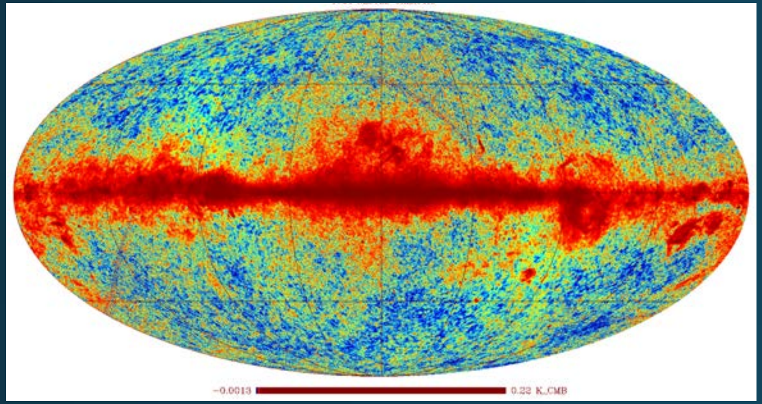


Carilli+ 2009

General IM/galaxy cross-correlations:

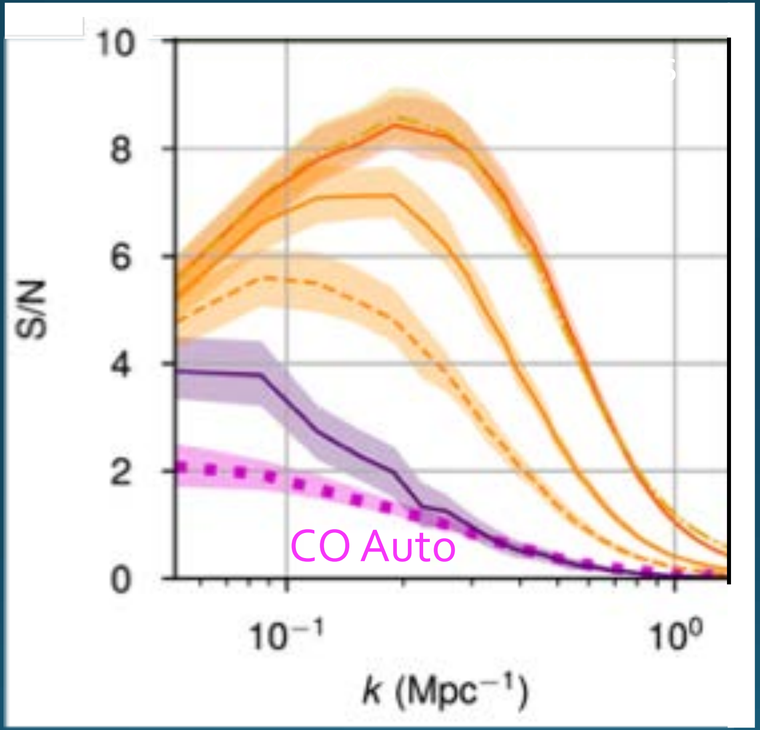
Chung et al. 2019, arXiv: 1809.04550

Advantages of Cross-Correlation



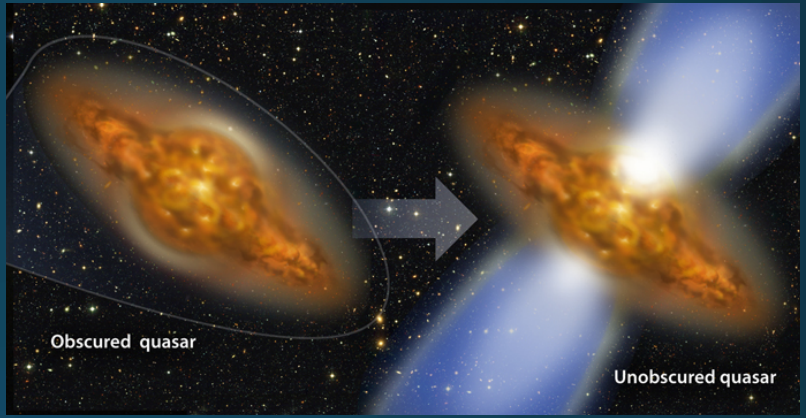
Foreground Removal

Cross-correlations are by nature less sensitive to foregrounds and systematics



Higher signal-to-noise

Additional data can improve detection significance (Chung+ 2018)

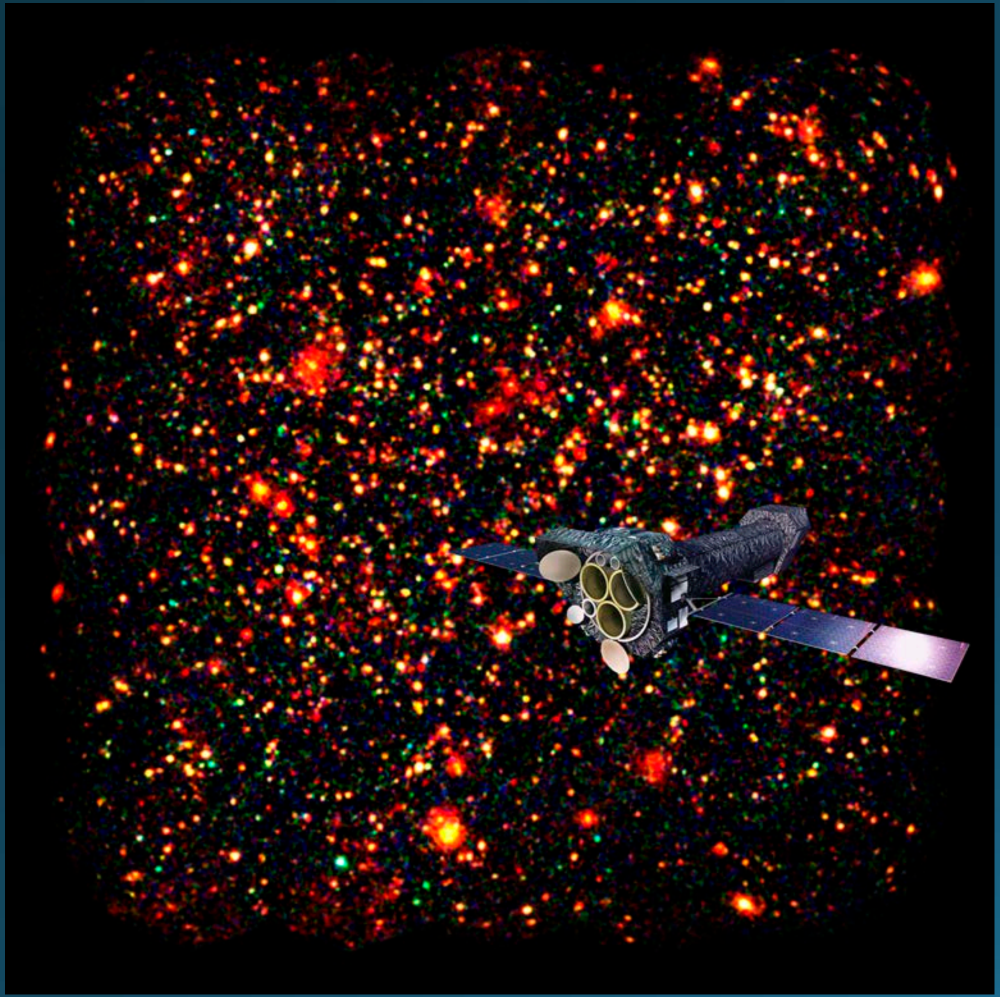


Additional Physics

Cross-correlations can isolate line emission properties of specific populations

E.g.- AGN feedback

AGN feedback with CCAT-p



- Cross-correlate with XMM-COSMOS AGN sample
- 2 deg^2 X-ray selected AGN sample, spectroscopic redshifts
- CO alone measures total SFR, CO × AGN measures SFR within AGN hosts

AGN Feedback

- SFR in most galaxies is much higher than naïve theory

- Predicted suppression by SNe at low mass, AGN at high mass

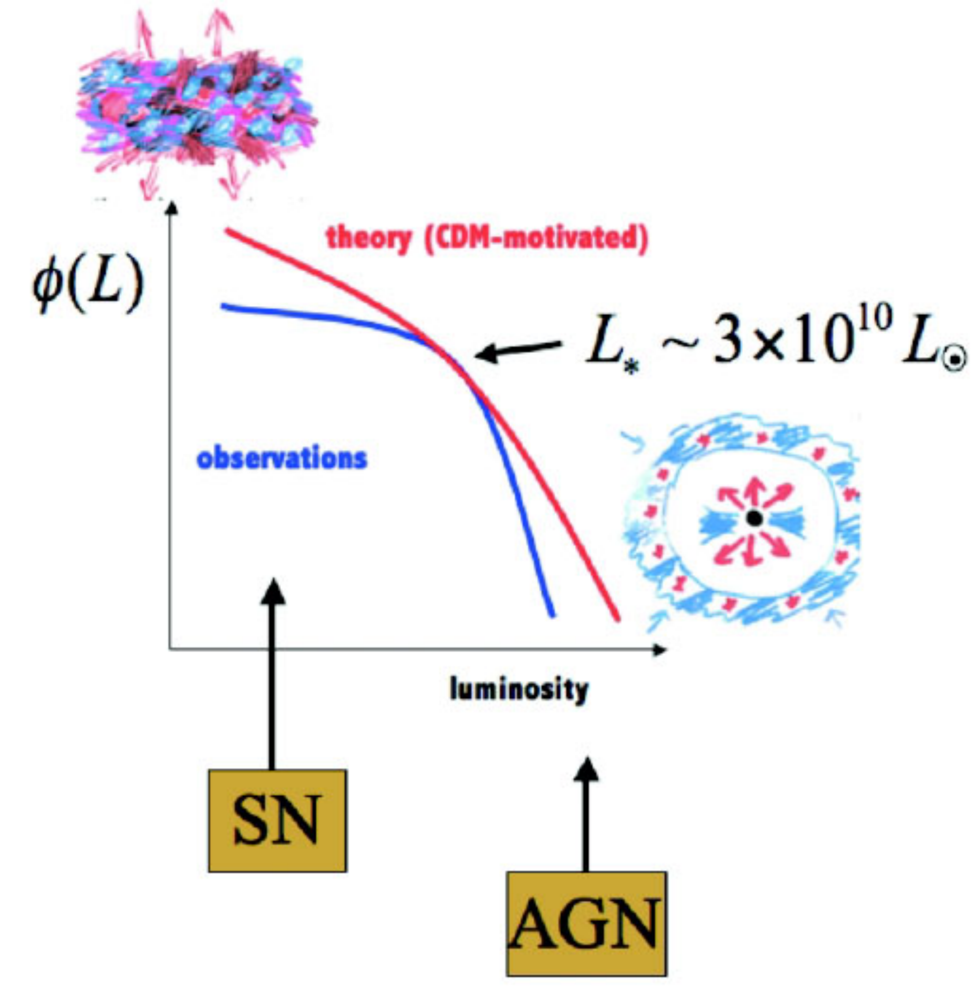


Image Credit: Joe Silk

The SCUBA-2 Web Survey: I. Observations of CO(3–2) in hyper-luminous QSO fields

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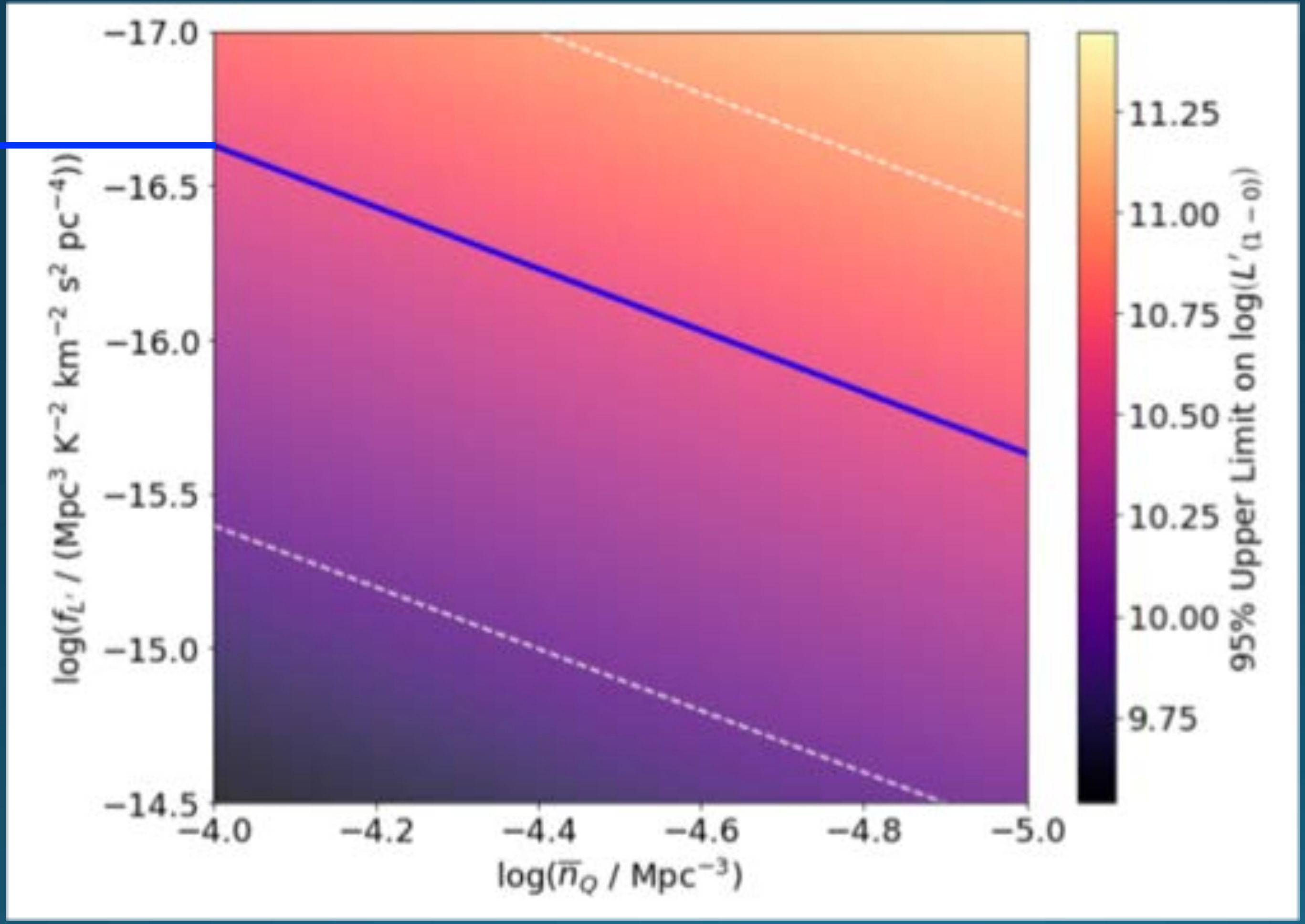
ABSTRACT

A primary goal of the SCUBA-2 Web survey is to perform tomography of the early inter-galactic medium by studying systems containing some of the brightest quasi-stellar objects (QSOs; $2.5 < z < 3.0$) and nearby submillimetre galaxies. As a first step, this paper presents a search for the best candidate systems and aims to characterize the galaxies that host the QSOs. To achieve this, a sample of 13 hyper-luminous

Results

Mean of directly-imaged quasar sample (z~3)



$L'_{(1\text{-}0)}$ upper limit, can compare different lines

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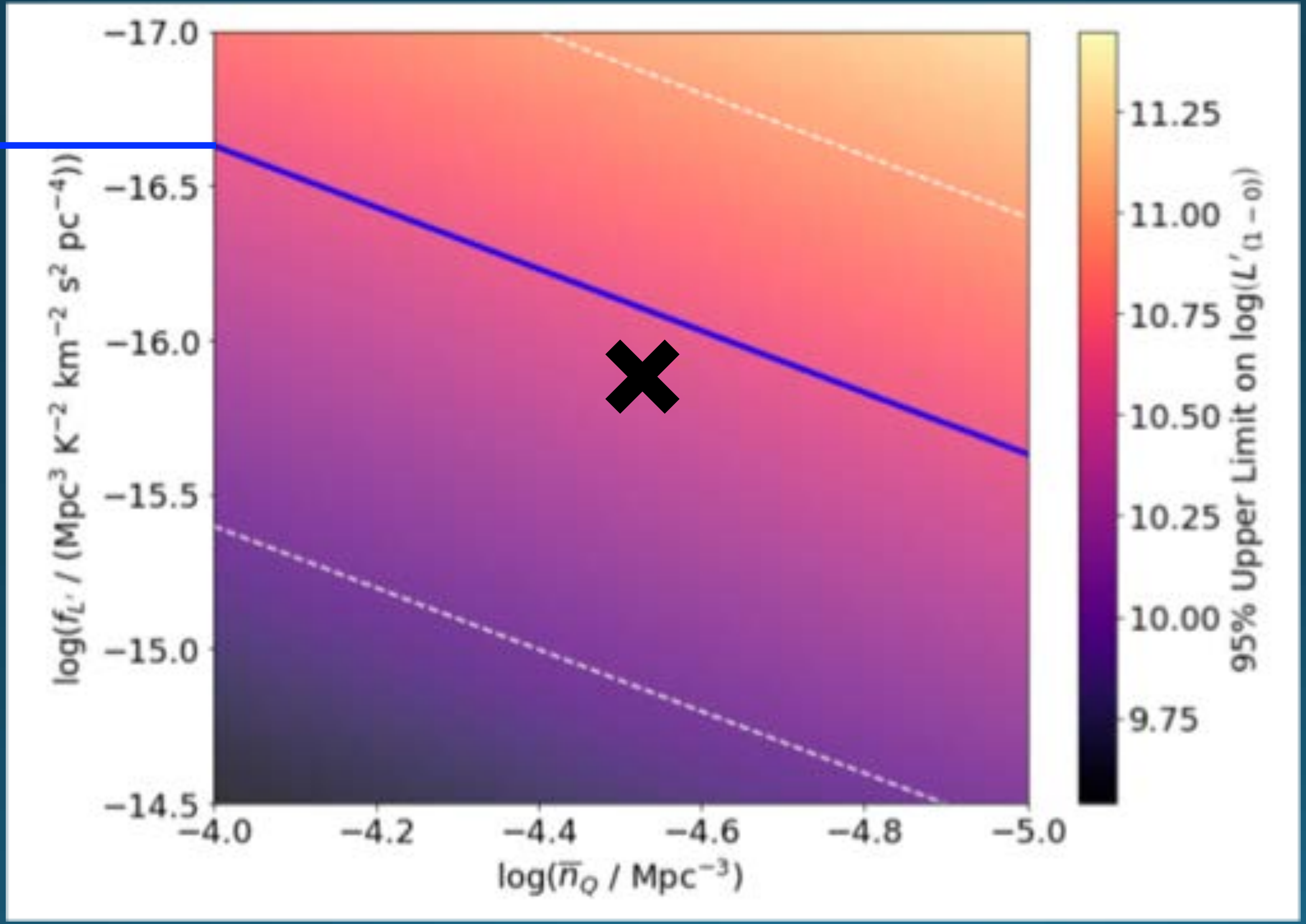

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If direct obs. are biased, X will place interesting upper limits

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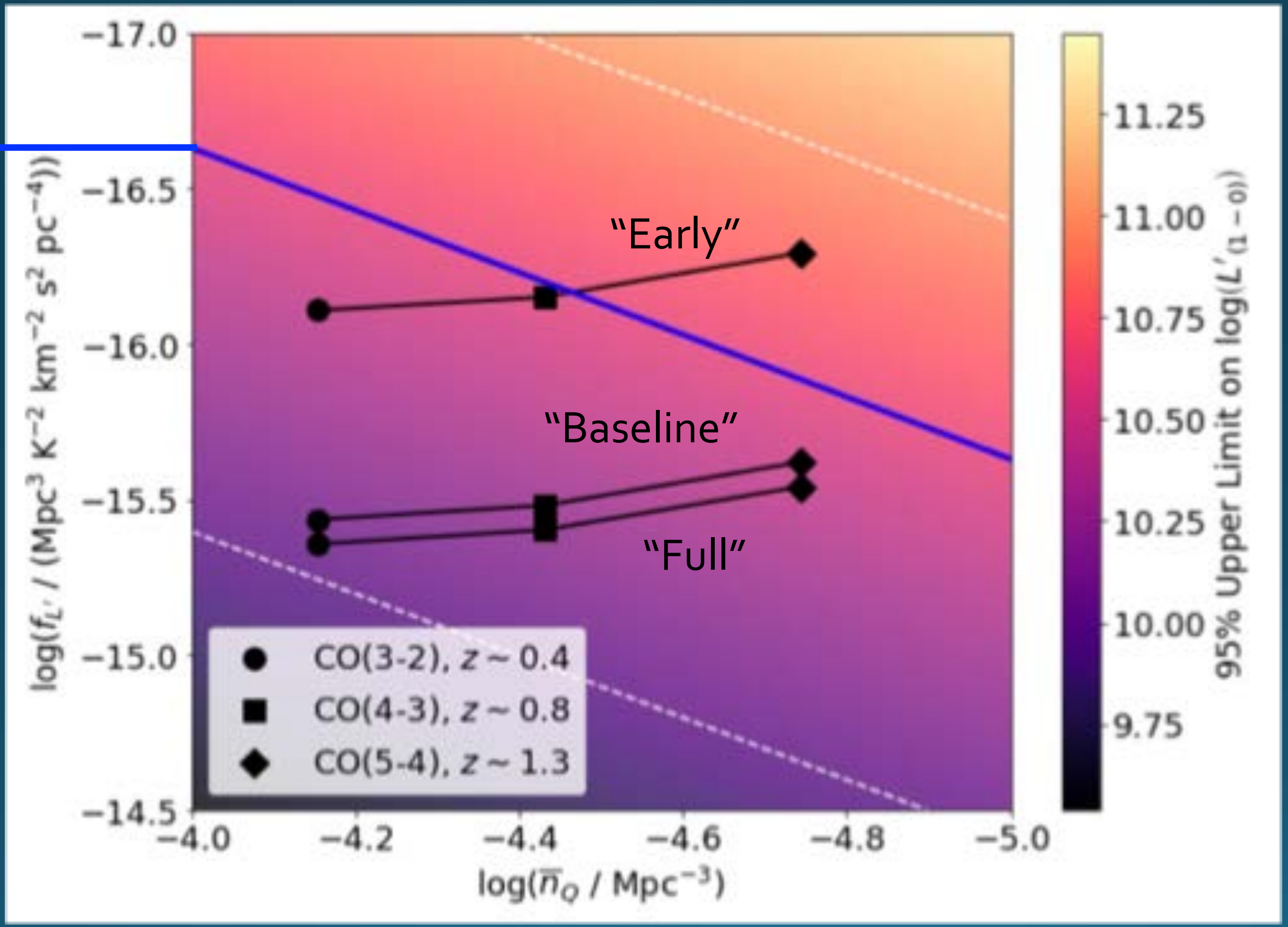

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If AGN are bright in CO CCATp can detect them and measure their mean SLED

If AGN are faint in CO CCATp can prove direct measurements are biased and show evidence for feedback

Takeaways for CCATp

- Lots of potential "free" science
  - If we need galaxies at CO redshifts to mask foregrounds, we can cross-correlate to measure CO physics
  - AGN only one possibility- can split up galaxies in other ways
- Optimization is different from auto-spectrum
  - Best spectroscopic surveys currently cover relatively small footprints (COSMOS is 1.7 deg^2)
  - Lose sensitivity to cross-correlations by increasing survey area
- This is just one possible cross-correlation
  - Significant potential value in exploring others