



ALMA observations of [CII] line and dust emission in primeval galaxies

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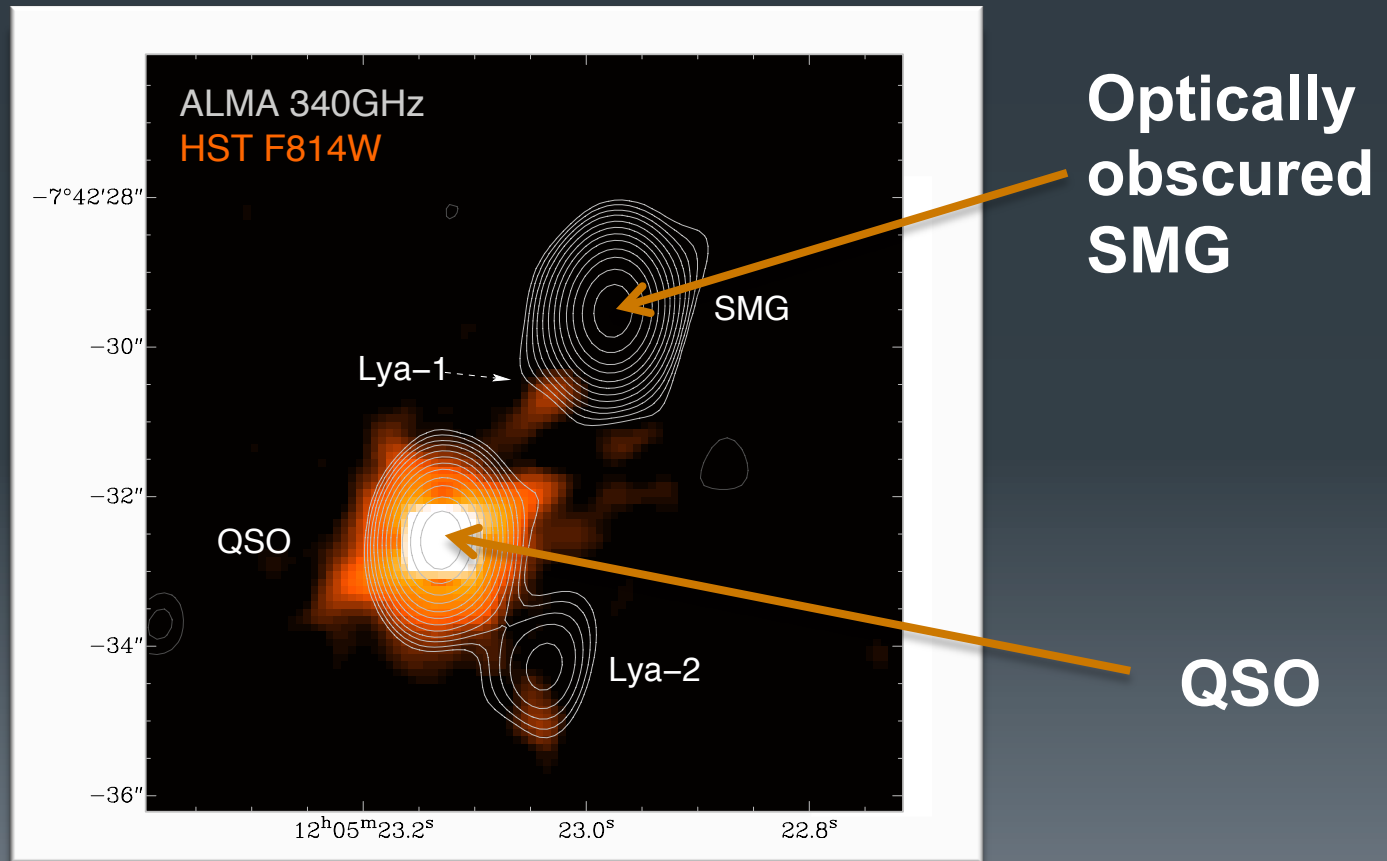
Collaborators:

A. Marconi, R. Maiolino, G. de Zotti, M. Negrello, R. Williams, G. Cresci, F. Mannucci, L. Testi, A. Biggs
G. Cupani, V. D'Odorico, E. Humphreys, R. Maiolino, P. Molaro, T. Nagao, M. A. Zwaan, K. Ota, C.
Carilli, K. Ohta, M. Bothwell, I. Jones, K. Sheth, A. Ferrara, A. Fontana, M. Castellano, S. Gallerani,
E. Vanzella, L. Pentericci, A. Grazian, S. Cristiani, P. Santini, L. Vallini and J. Wagg

BR1202 – 0725 ($z \sim 4.7$)

First ALMA detection of [CII]158 μ m at high- z (Wagg+12 & Carilli+13)

- 18 antennae with a maximum baseline of ~ 280 m
- Total exposure time ~ 25 min
- 4 papers on this data (Wagg+13, Carilli+13, Carniani+13, Williams+14)

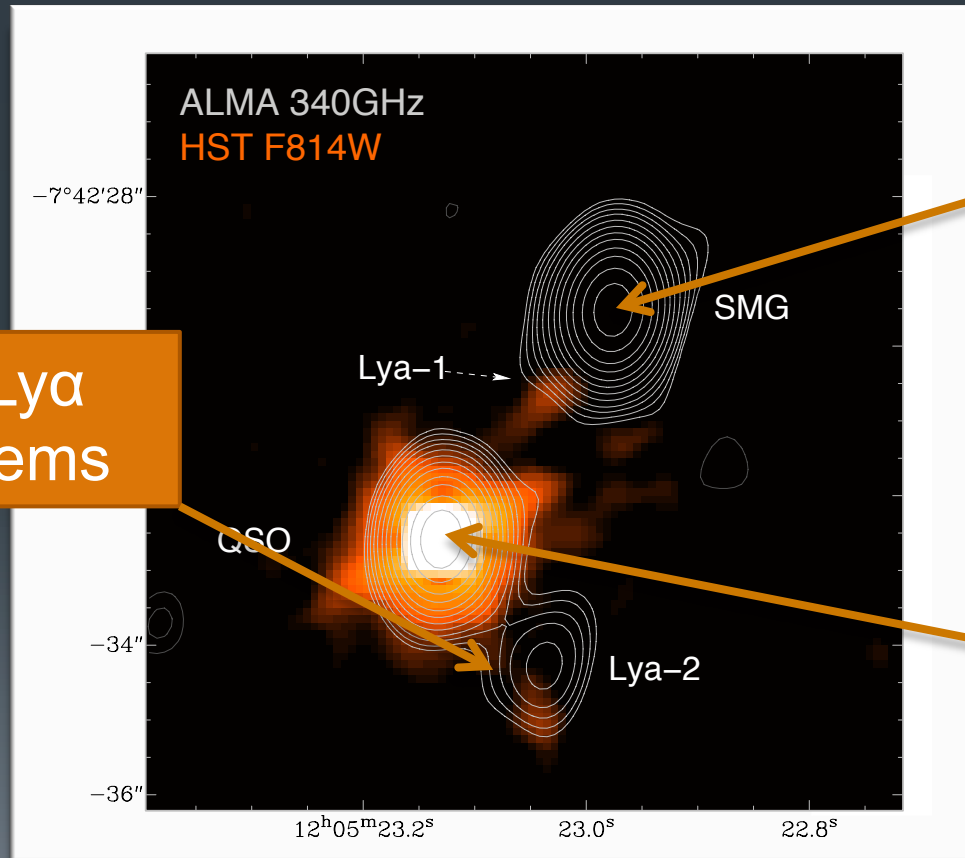


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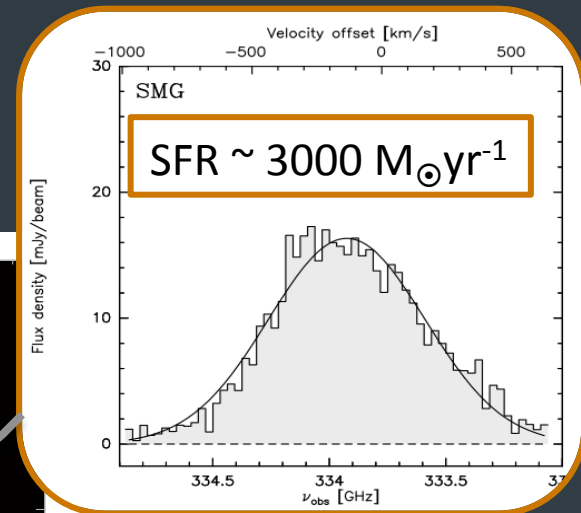
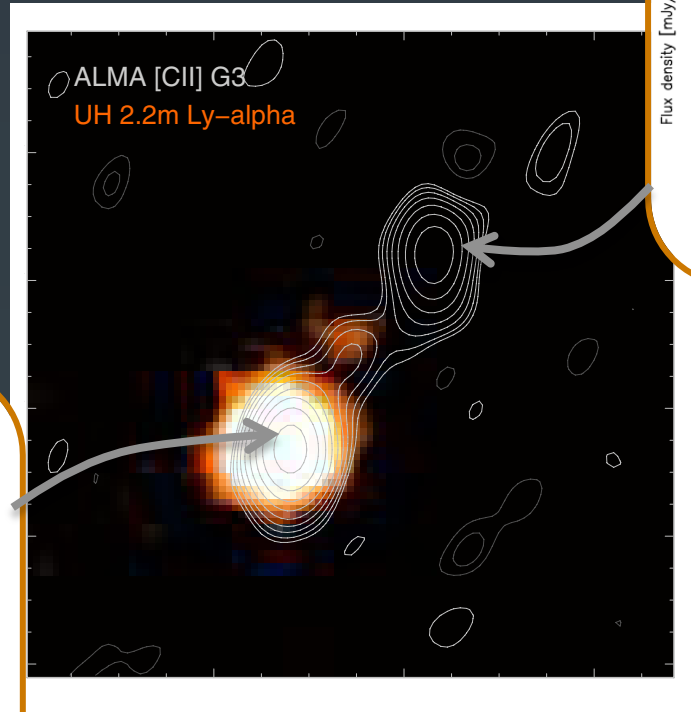
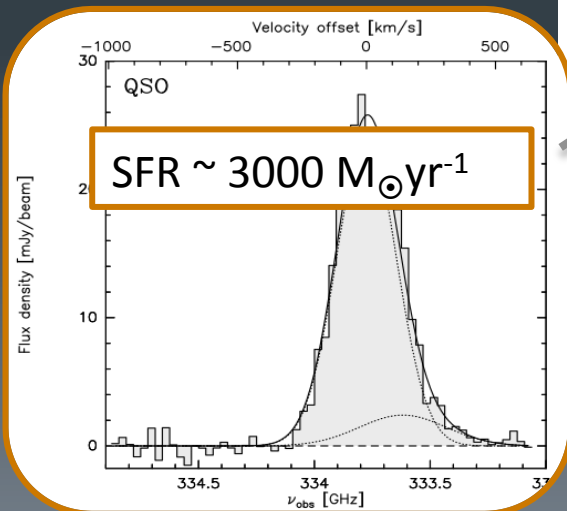
detection of Ly α
emitting systems



Optically
obscured
SMG

QSO

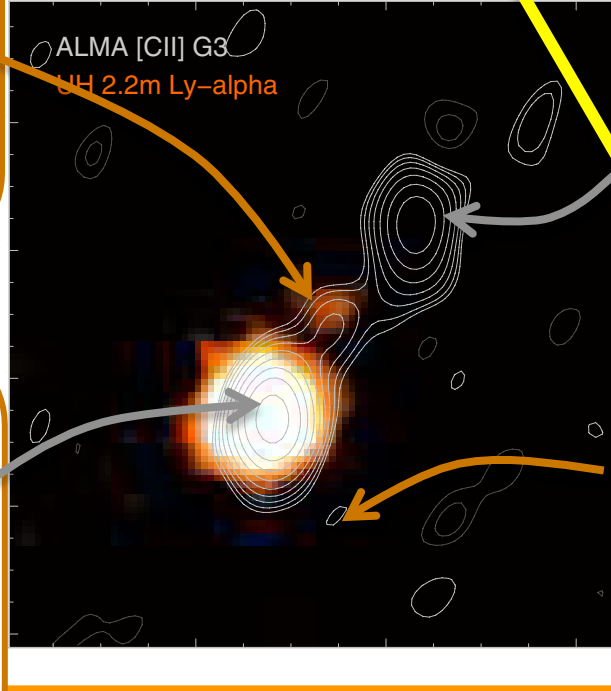
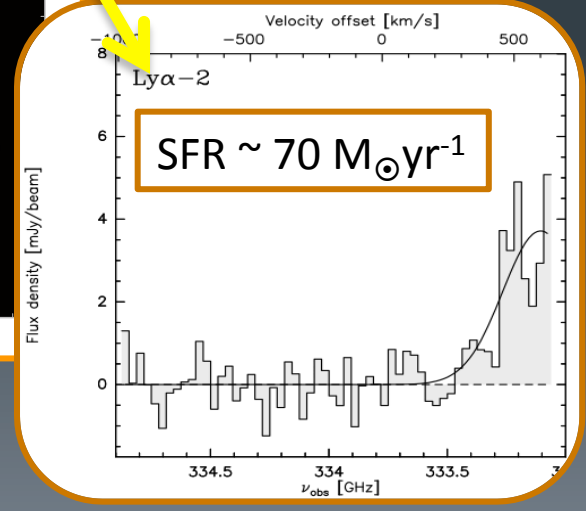
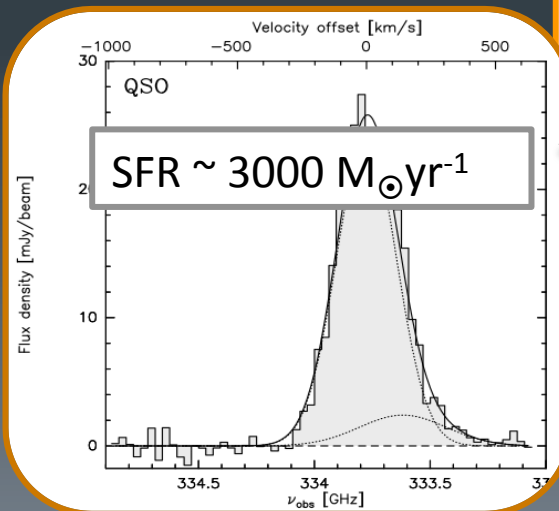
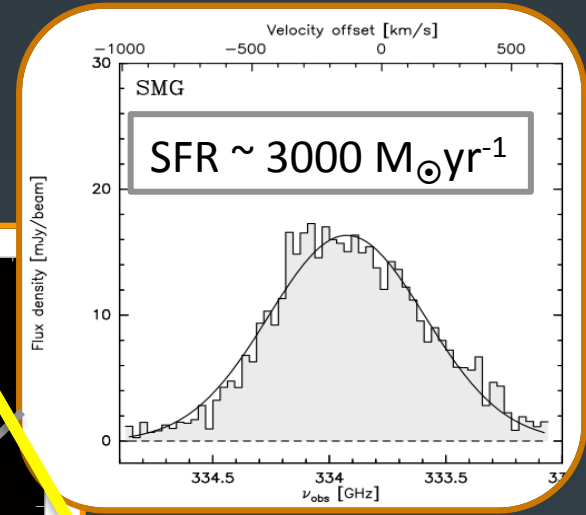
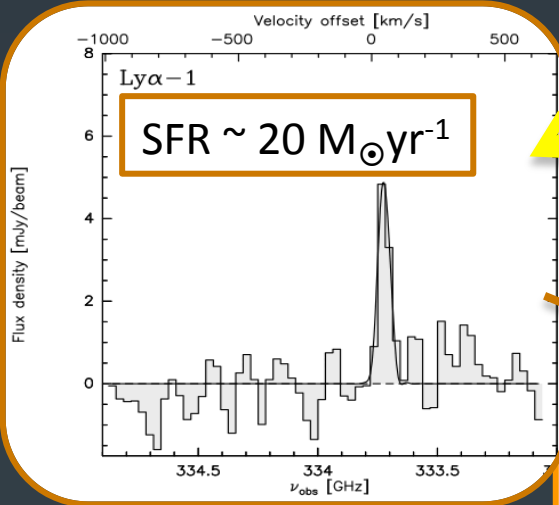
BR1202 – 0725 [CII] emission



Hu et al. 1996
Carilli et al. 2013

BR1202 – 0725 [CII] emission

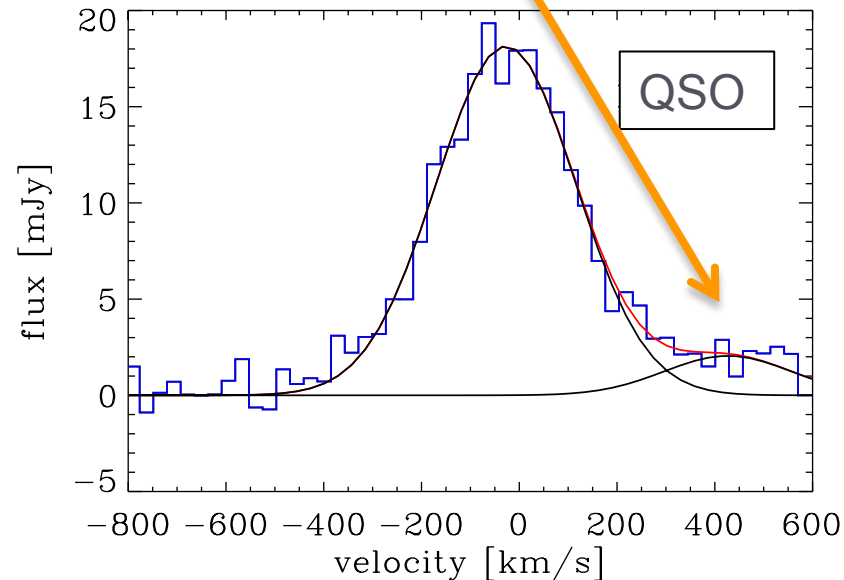
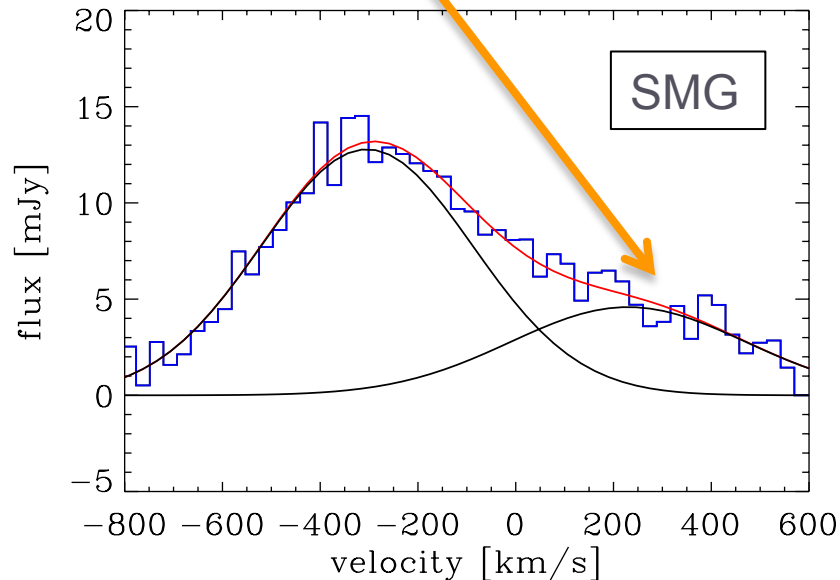
Star forming systems
more representative
of the bulk of the
population



Hu et al. 1996
Carilli et al. 2013

BR1202 – 0725 [CII] emission

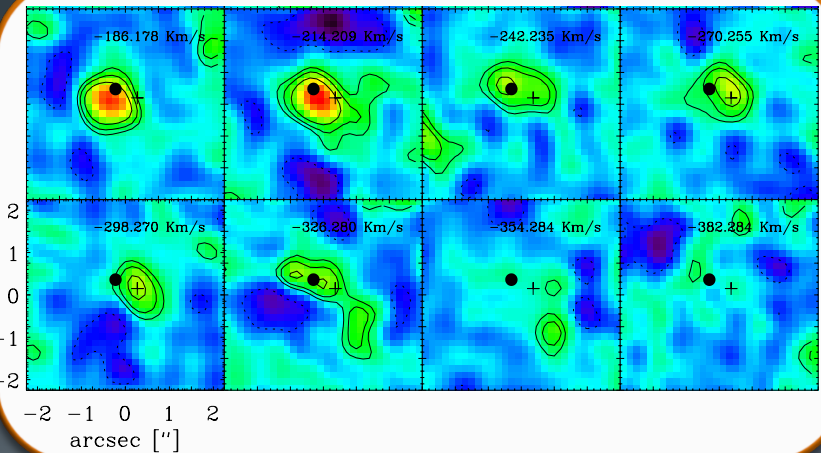
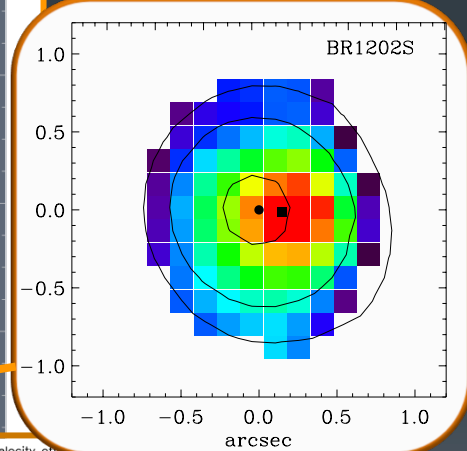
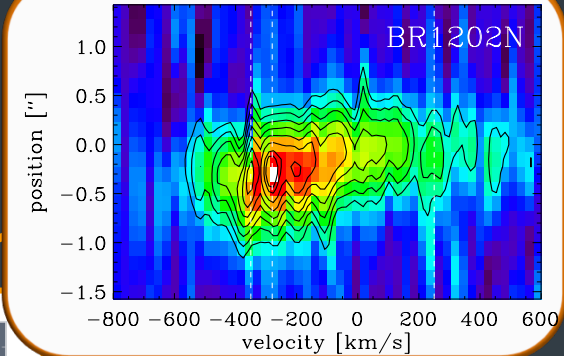
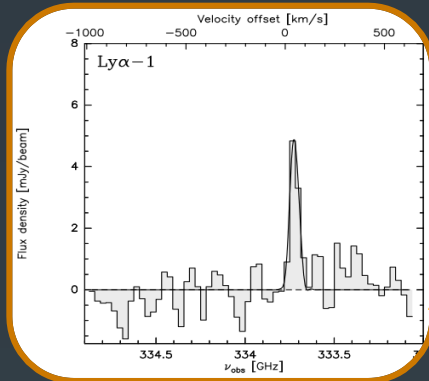
The asymmetry of the [CII] line emission suggests the presence of a companion



Carniani et al. 2013

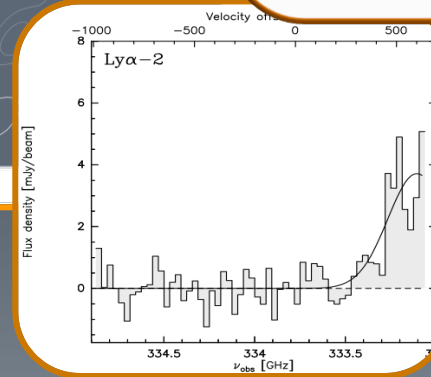
Major and Minor Merging ??

QSO & SMG
+
5 faint [CII] sources



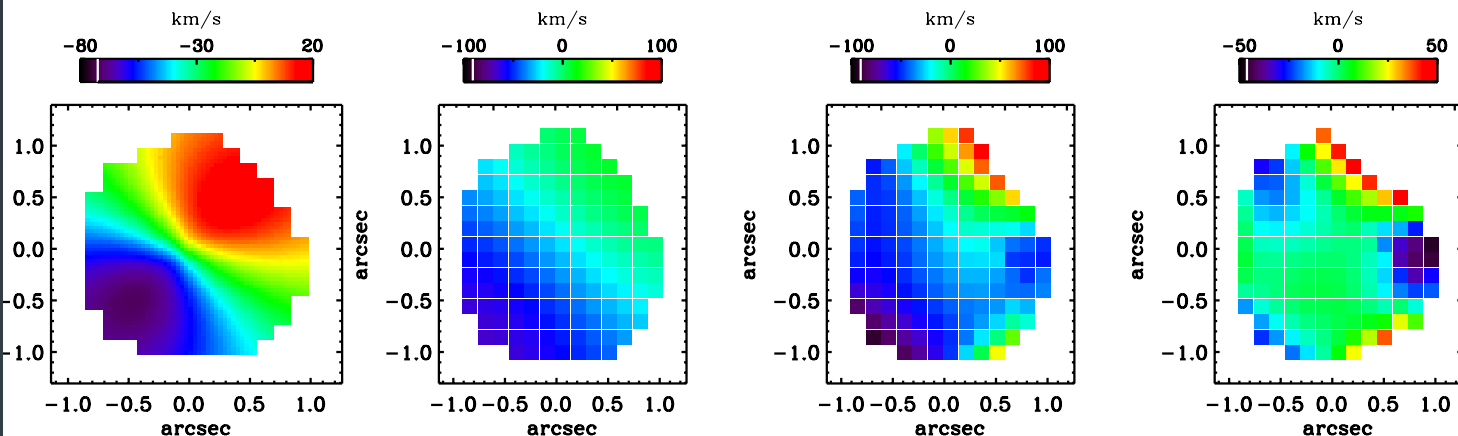
Carniani et al. 2013

Hu et al. 1996
Carilli et al. 2013



Kinematic Analysis of [CII]

Carniani et al. 2013



$M_{\text{dyn}} \sim 10^{10} M_{\odot}$

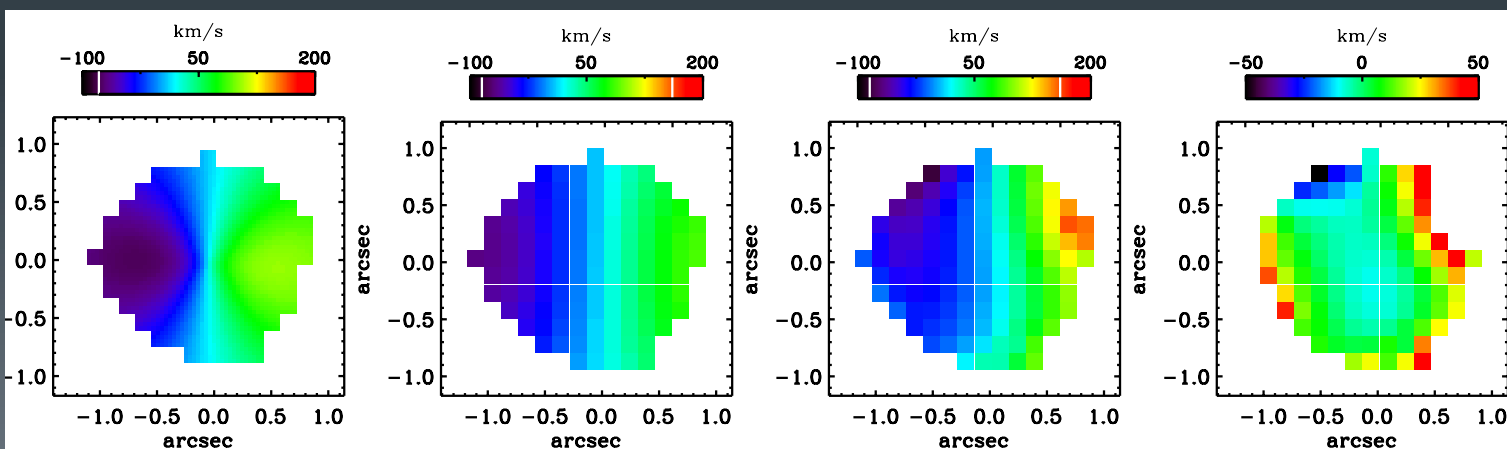
$\text{inc} \sim 15^{\circ}$

Model

Model $\otimes$ PSF

Velocity map

Residual

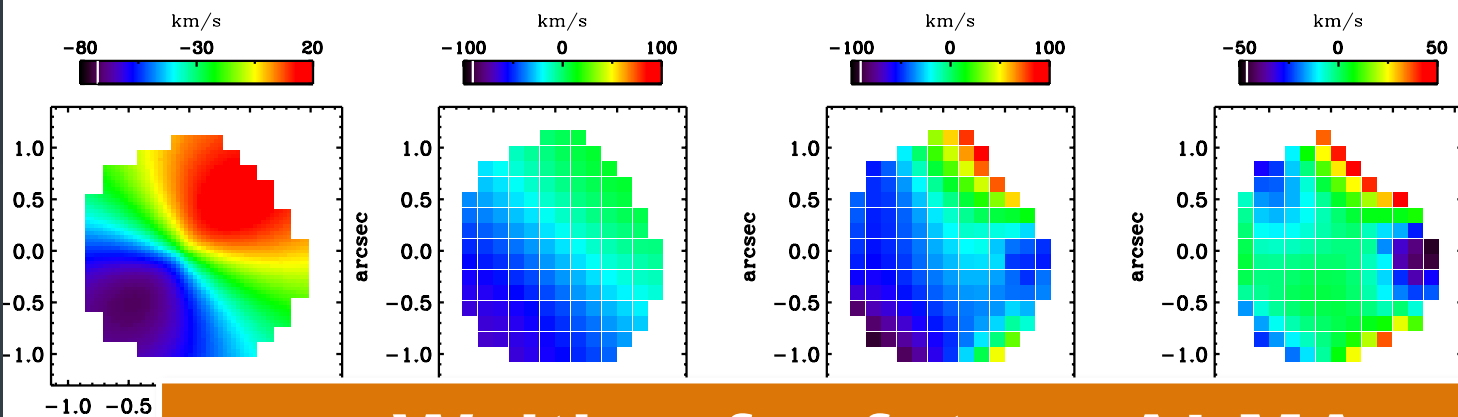


$M_{\text{dyn}} \sim 10^{10} M_{\odot}$

$\text{inc} \sim 25^{\circ}$

Kinematic Analysis of [CII]

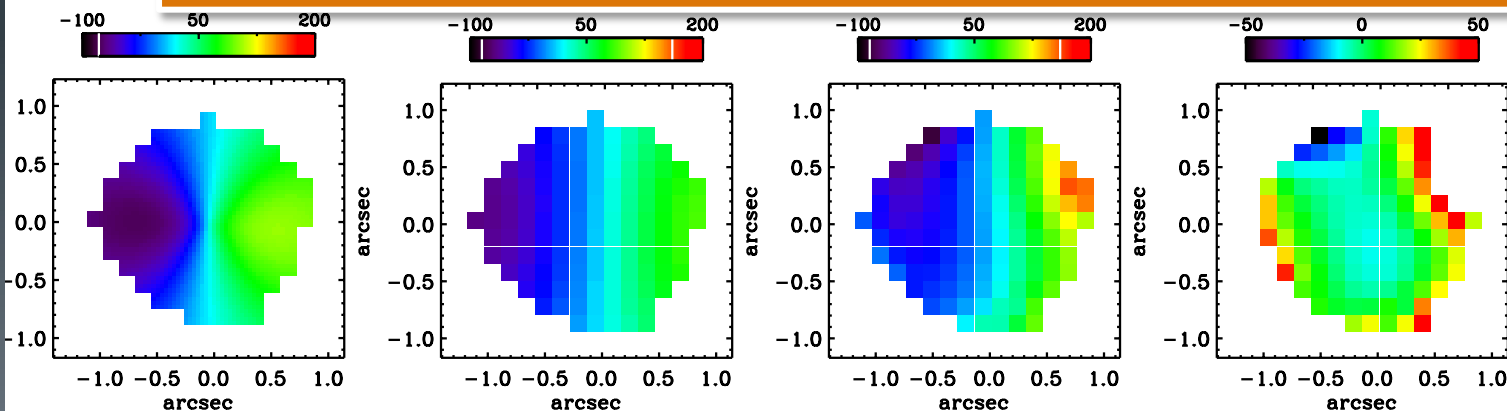
Carniani et al. 2013



$M_{\text{dyn}} \sim 10^{10} M_{\odot}$

$\text{inc} \sim 15^{\circ}$

Waiting for future ALMA
observations...stay tuned



$M_{\text{dyn}} \sim 10^{10} M_{\odot}$

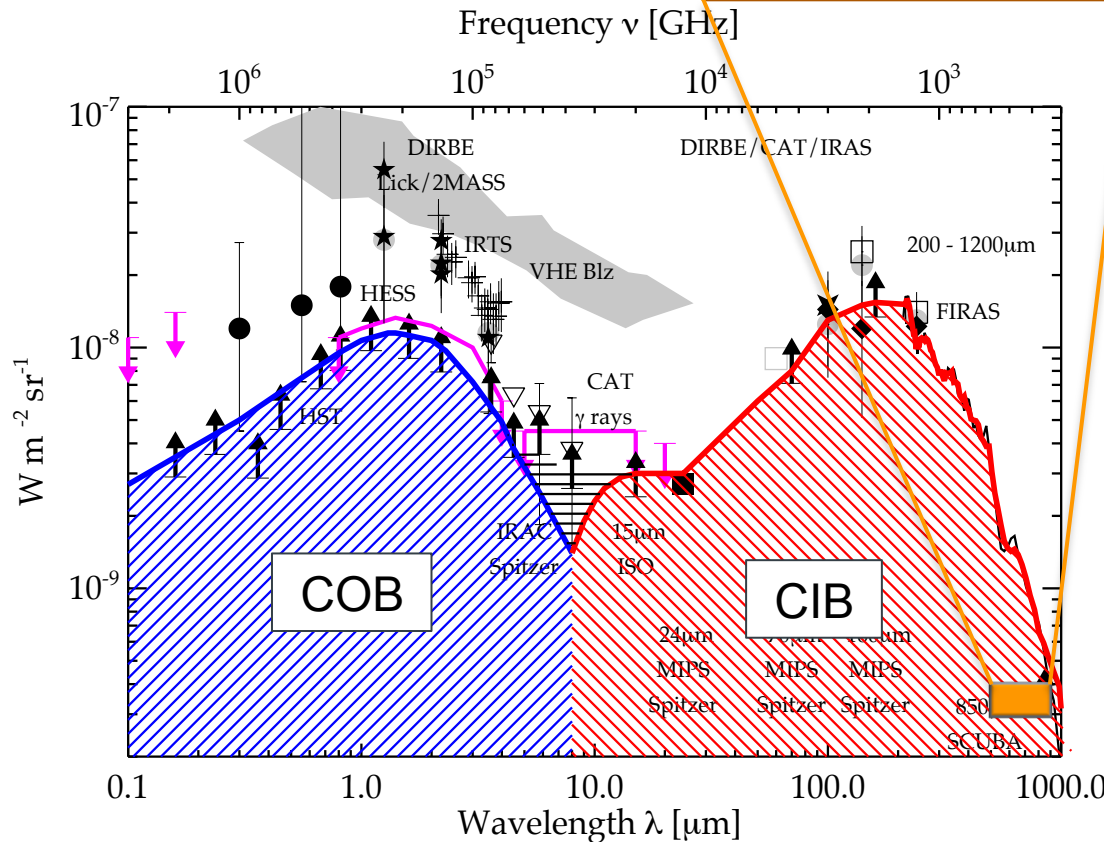
$\text{inc} \sim 25^{\circ}$

Cosmic Infrared Background

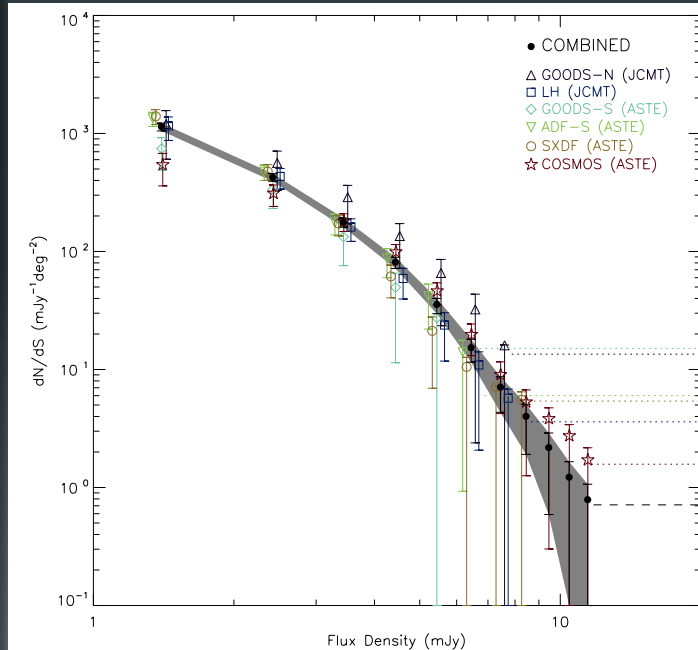
The CIB is due to UV light absorbed by dust and re-radiated in the infrared wavelength range

Dole et al. 2006

~ 7% is resolved



Scott et al. 2012



Source Extraction

Carniani et al. (in prep.)

Data:

**ALMA band 6 & 7 cycle 0 & 1
18 continuum maps**

Area:

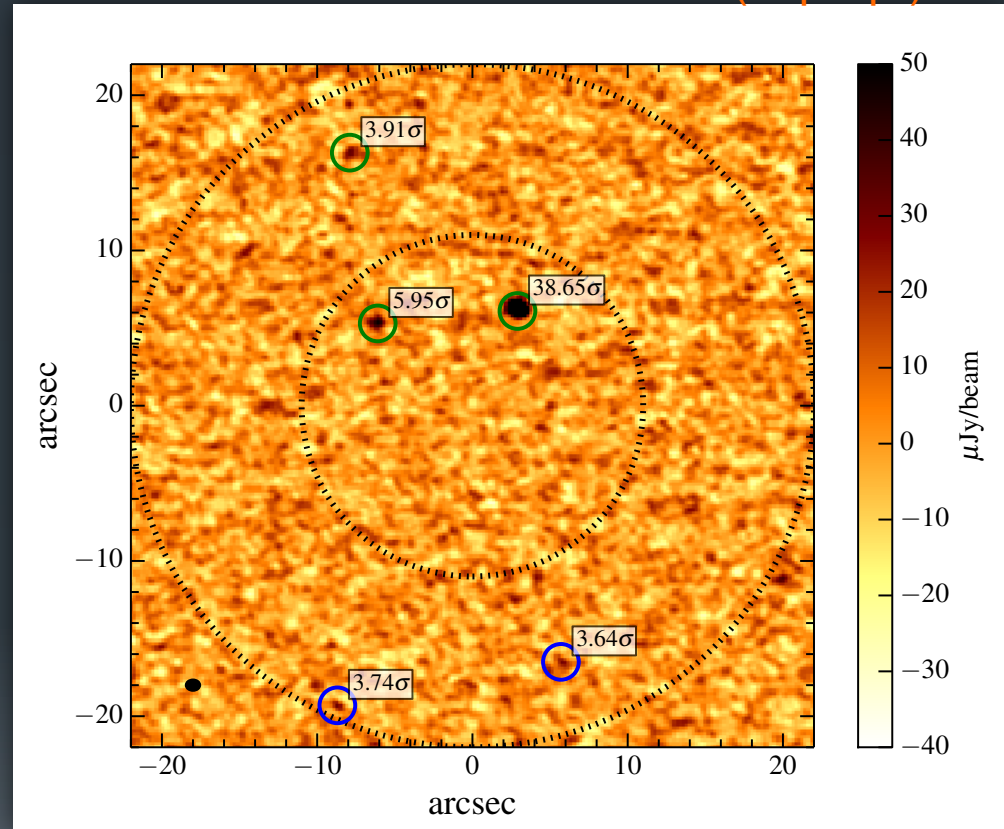
2 primary beams

Source extraction requirements:

- 1. $S/N > 3.5$**
- 2. size source $\approx$ ALMA beam**

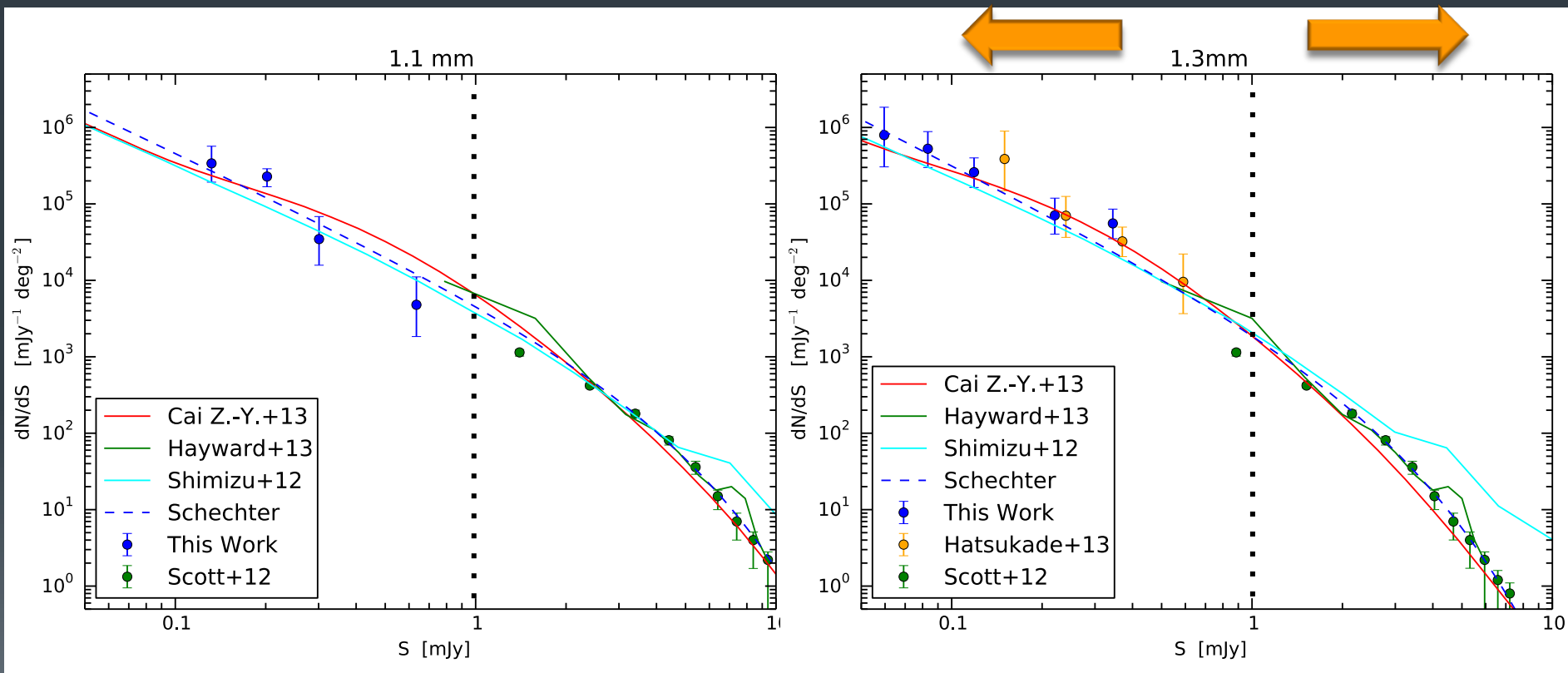


50 sources with flux densities down to $60 \mu\text{Jy}$



Number Counts

The differential number counts increase with decreasing flux density down to 0.1 mJy at 1.1 mm and to 0.06 mJy at 1.3 mm

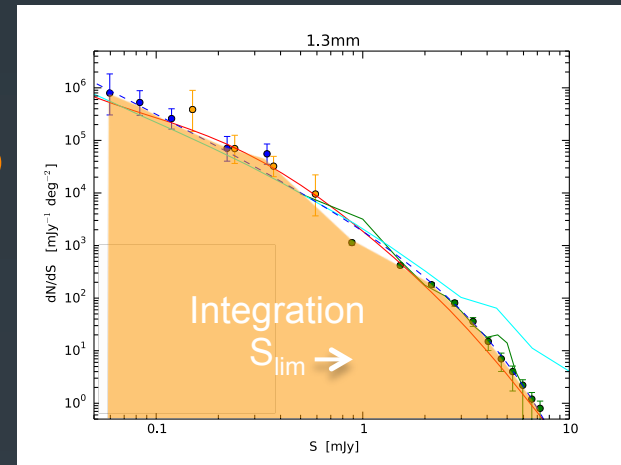


Carniani et al. (in prep)

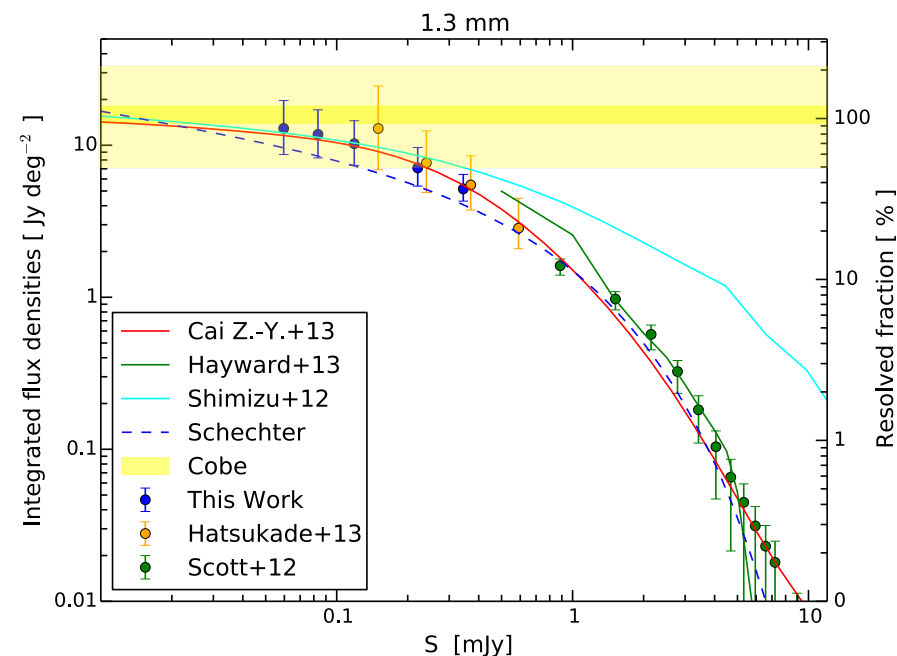
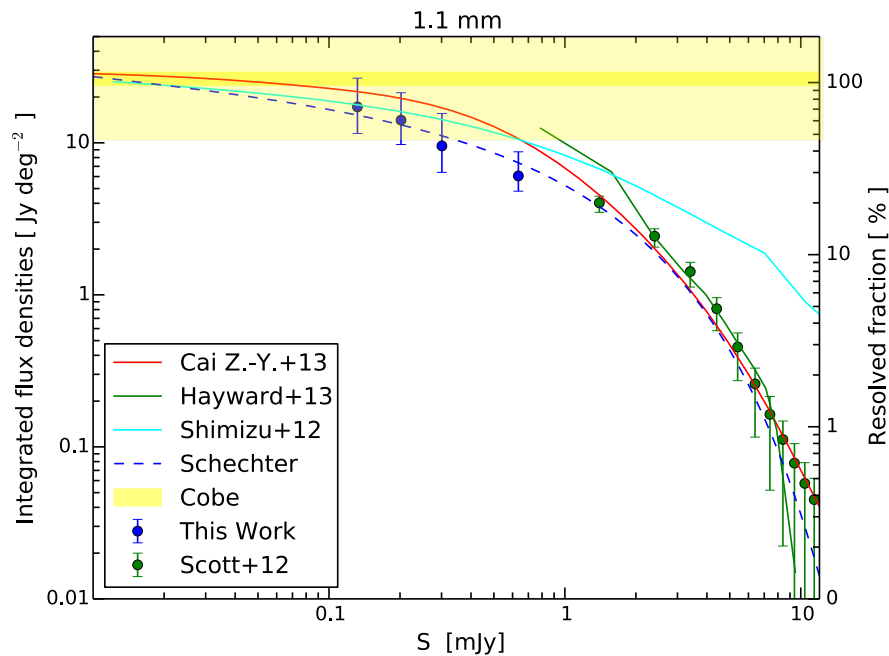
Resolving the CIB

Integrated flux density $\int_{S_{\text{lim}}}^{\infty} \frac{dn}{dS} S dS$

- Contribution from faint sources is larger than the one from bright ($> 1\text{mJy}$) objects



Carniani et al. (in prep)



Conclusions

BR 1202-0725 system (Carniani et al. 2013) :

- First [CII] detections of faint galaxies at $z \sim 4.7$
- Strongly star-forming rotating disks in a complex merging system

CIB observed with ALMA (Carniani et al. in prep.) :

- 50 sources detected at 1.1 and 1.3 mm
- $\sim 75\%$ of the CIB is due to sources with $\text{SFR} > 40 \text{ M}_{\odot}/\text{yr}$