Summer School ISM

Dust continuum and [CII] emission in a z~4.56 normal star-forming galaxy from ALPINE

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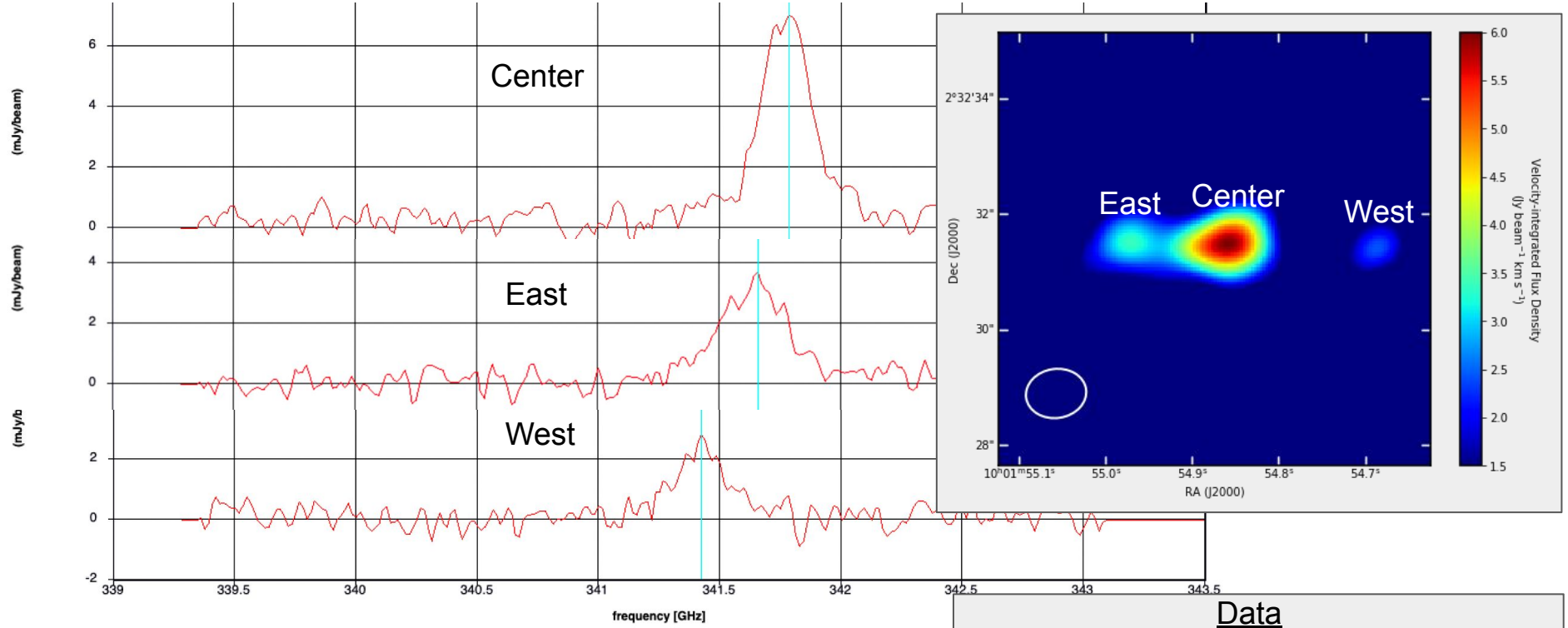


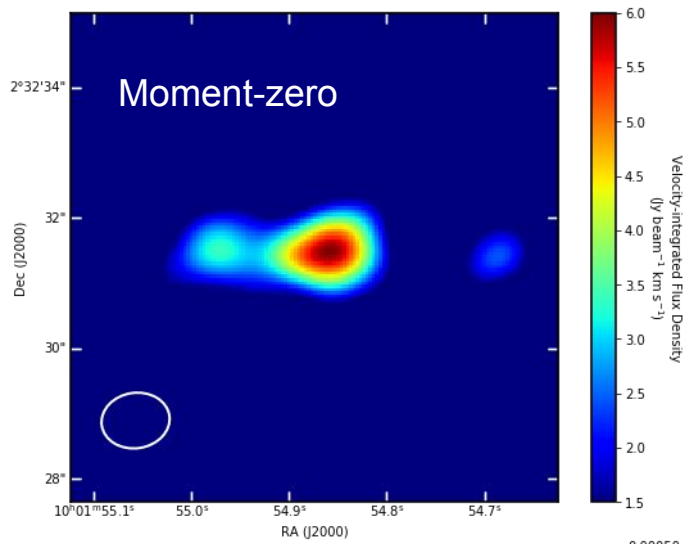
East
ν = 341.645 GHz
→ z=4.5629
Δv = 96 km s^{-1}

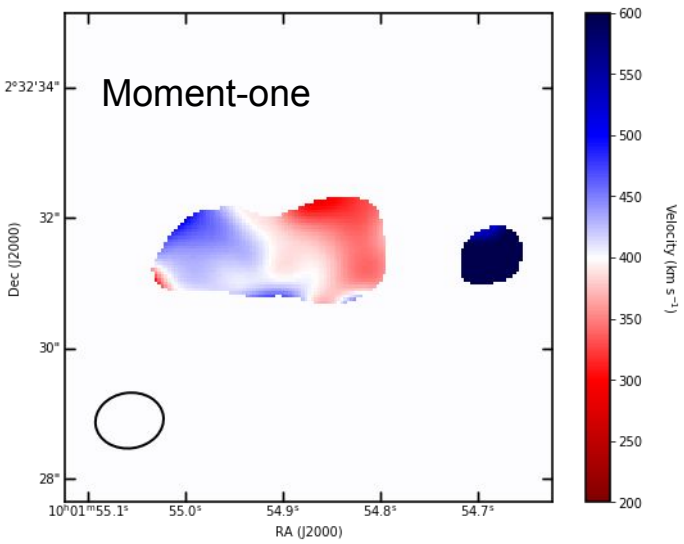
Center
ν = 341.786 GHz
→ z=4.5606

West
ν = 341.426 GHz
→ z=4.5665
Δv = 329 km s^{-1}

Data

- Clean interferometric data from ALMA
- Identify [CII] line (measure z)
- Create moment-zero and moment-one maps
- Create continuum map (without the emission line)

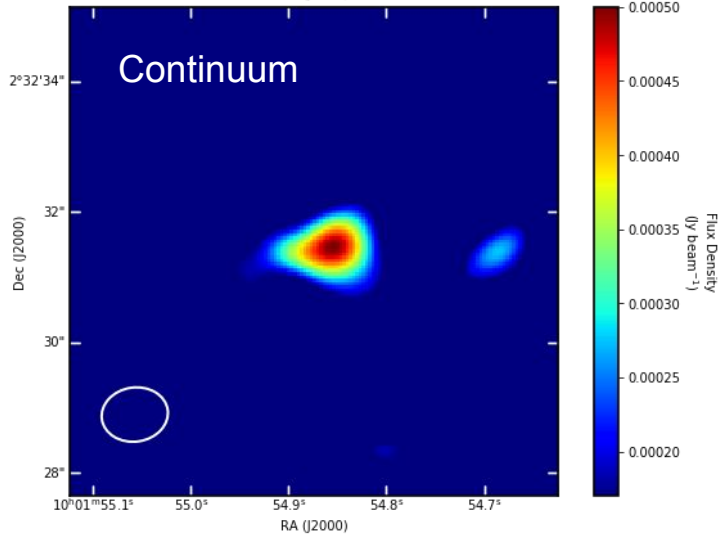


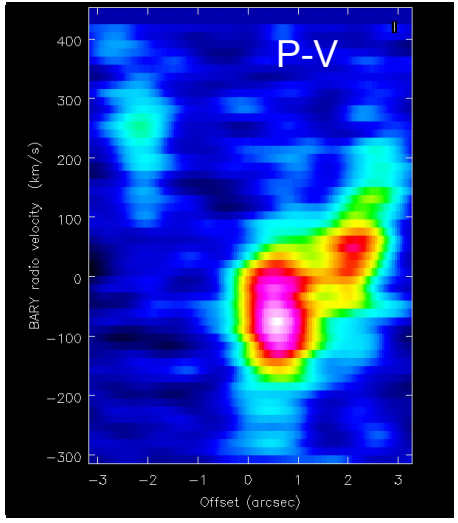


Moment maps:

$$M_0 = \int I_v dv$$

$$M_1 = \frac{\int v I_v dv}{\int I_v dv} = \frac{\int v I_v dv}{M_0}$$





[CII] luminosity

$$L_{line} = 1.04 \times 10^{-3} \times S_{line} \Delta v \, D_L^2 \, \nu_{obs} \, L_\odot$$

Carilli&Walter+13

Dust continuum

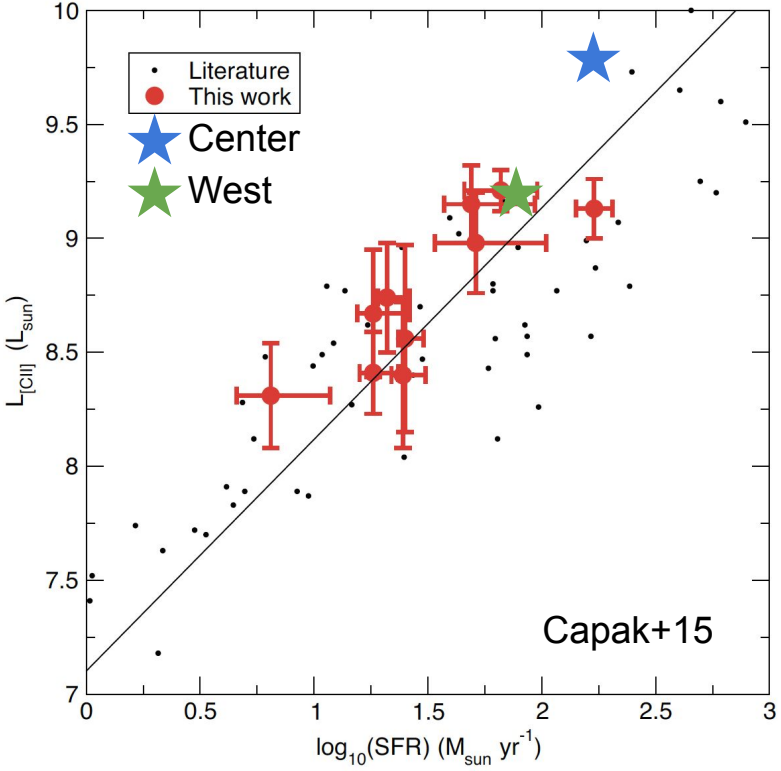
$\nu L_\nu \,/\, L_{IR} \;=\; 0.133$ Béthermin+20

Continuum → SFR:

$$SFR_{IR} = \mathcal{K}_{IR} \times L_{IR} \rightarrow 1.02{\times}10^{-10}\, M_\odot yr^{-1} L_\odot^{-1}$$

Madau Dickinson+14

Source	$L_{[CII]}$ ($10^9 L_\odot$)	SFR ($M_\odot$ yr^{-1})
West	2.0 ± 0.5	56
Center	6.0 ± 0.6	160
East	4.3 ± 0.7	Undetected



[CII] is a good tracer of star formation at *z*~4

Molecular mass

$L_{[CII]} \rightarrow M_{mol}$:

$$\log L_{[\mathrm{C\ II}]} = -1.28(\pm 0.21) + 0.98(\pm 0.02) \log M_{\mathrm{mol}}$$

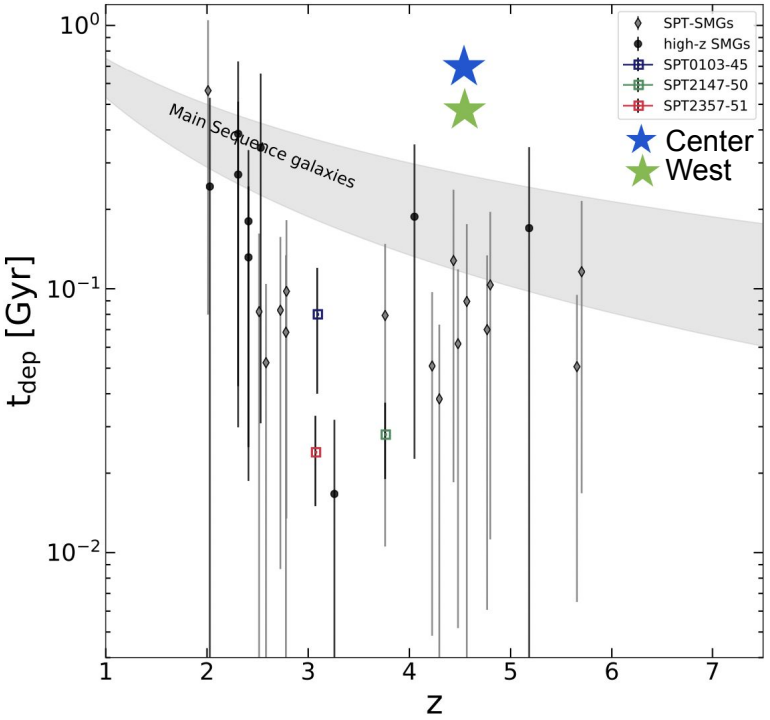
Zanella+18

Depletion time

$$t_{\mathrm{dep}} = 1/\mathrm{SFE}$$

SFE = SFR/M_{mol}

Source	M_{mol} (10^{10} $M_\odot$)	t_{dep} (Gyr)
West	2.4 ± 0.5	0.52
Center	12.7 ± 0.6	0.79
East	8.0 ± 0.7	-

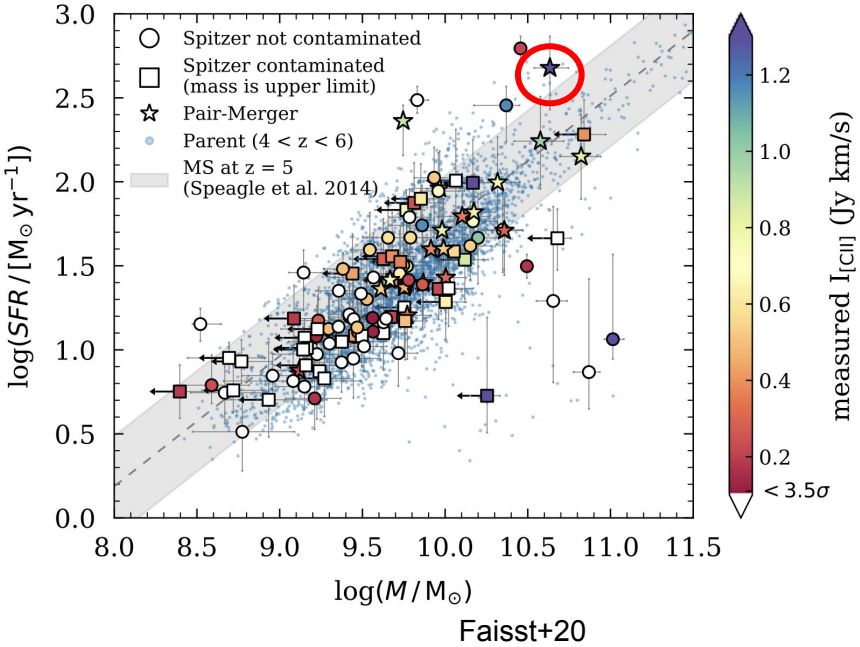


Gururajan+in prep.

No starburst

Molecular gas fraction

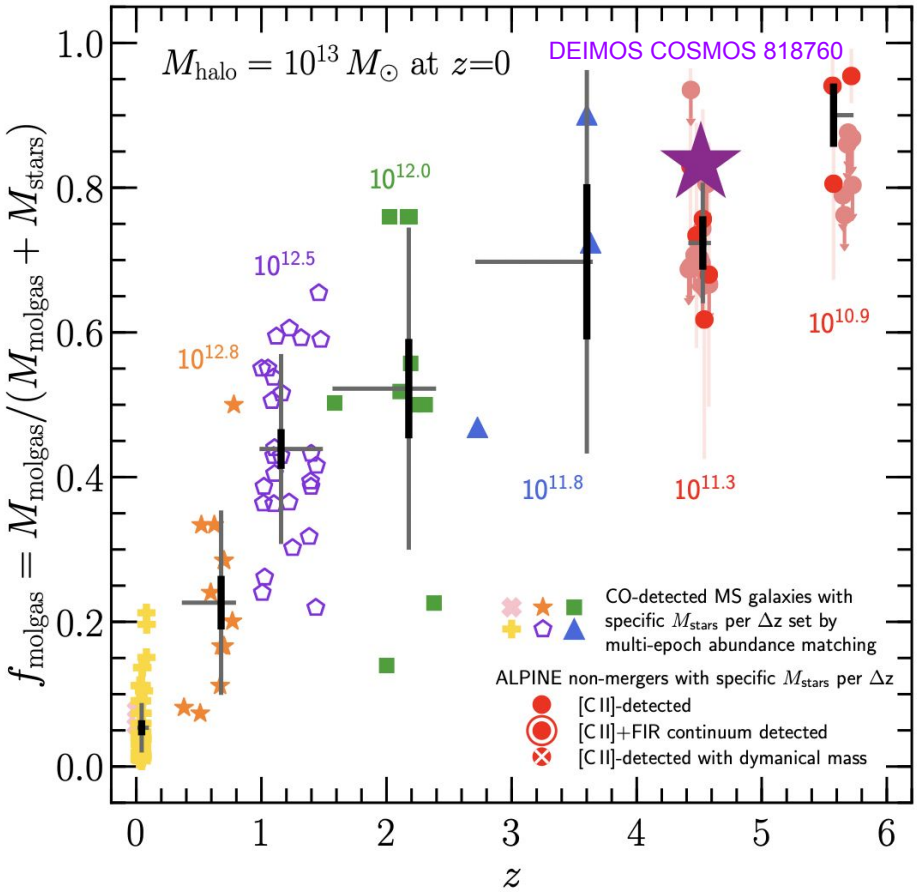
Stellar mass: $\log(M_*/M_\odot)=10.6 \pm 0.1$ (Jones+20)



Faisst+20

Total M_{mol} ($10^{10}\,M_\odot$)= 23.2 → f_{molgas} =0.85

Gas rich



Dessauges-Zavadsky+20