[C II] EMISSION FROM **COLD GAS** IN **PRIMORDIAL GALAXIES**

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In collaboration with:
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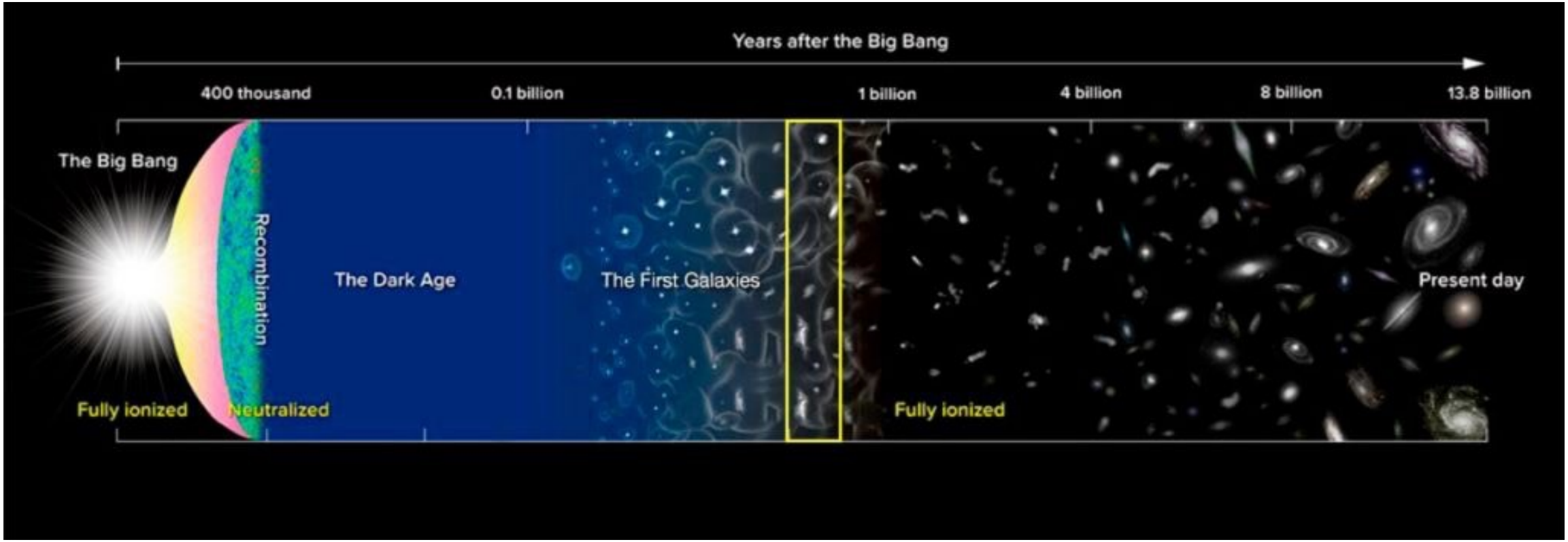
Céline Péroux (ESO)

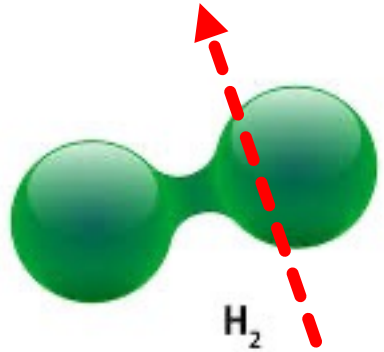
EPOCH OF REIONIZATION



https://simonsobservatory.org

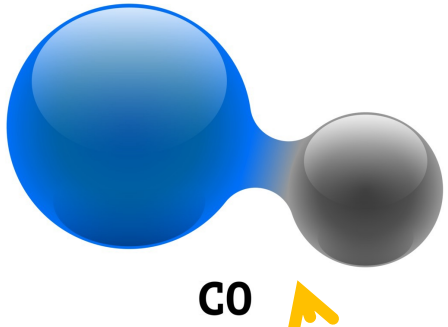
COLD GAS

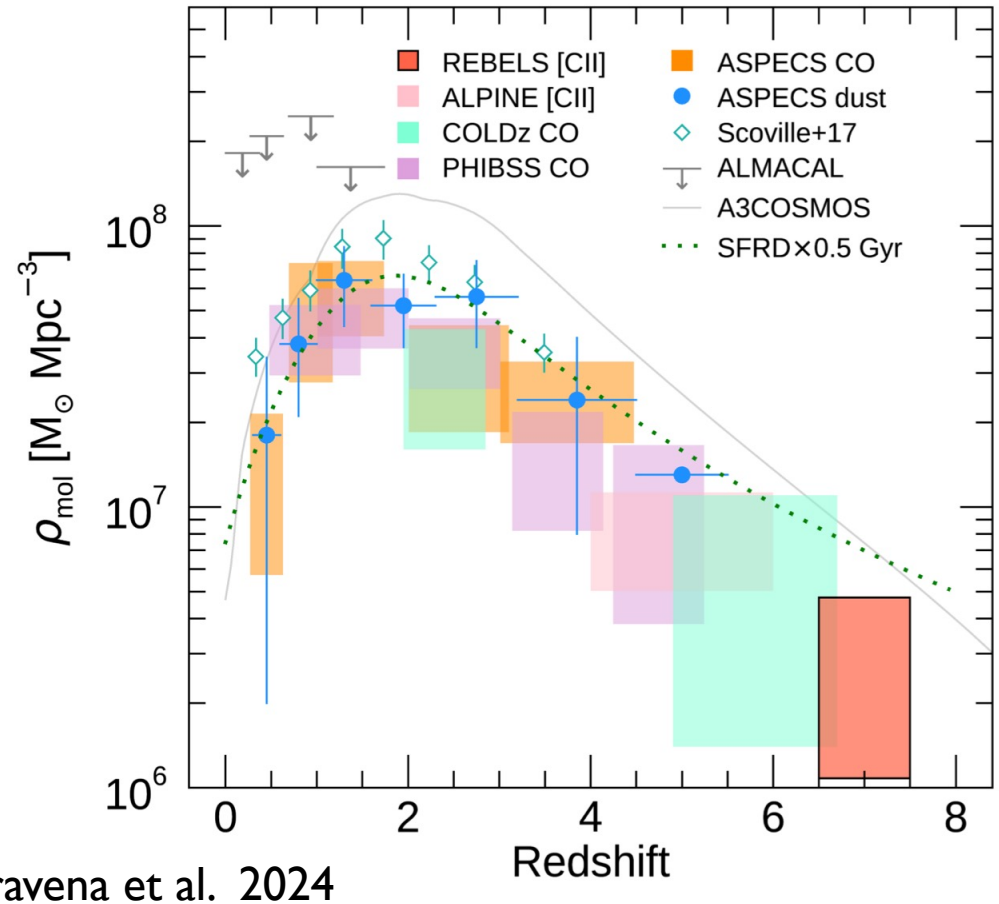
MOLECULAR GAS (H_2)



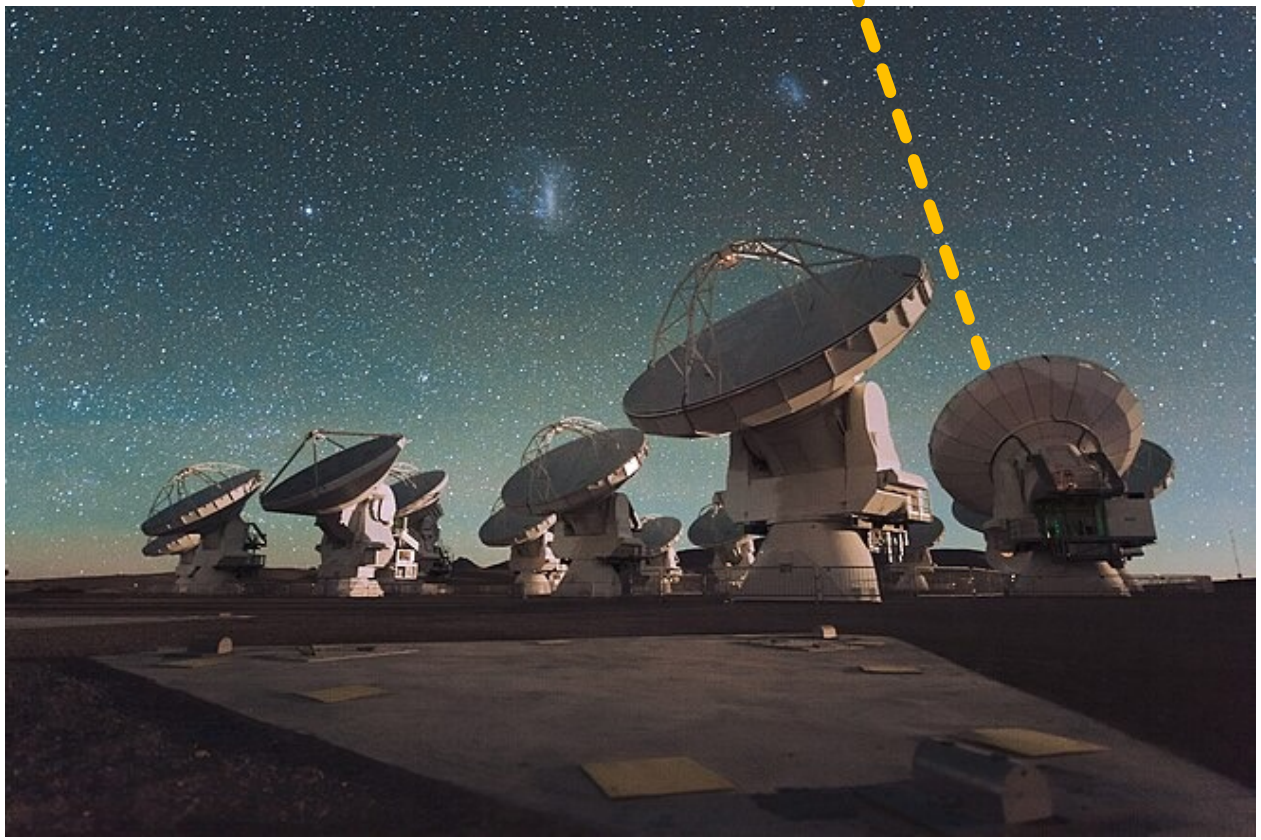
https://www.almaobservatory.org

MOLECULAR GAS IS TRACED BY CO



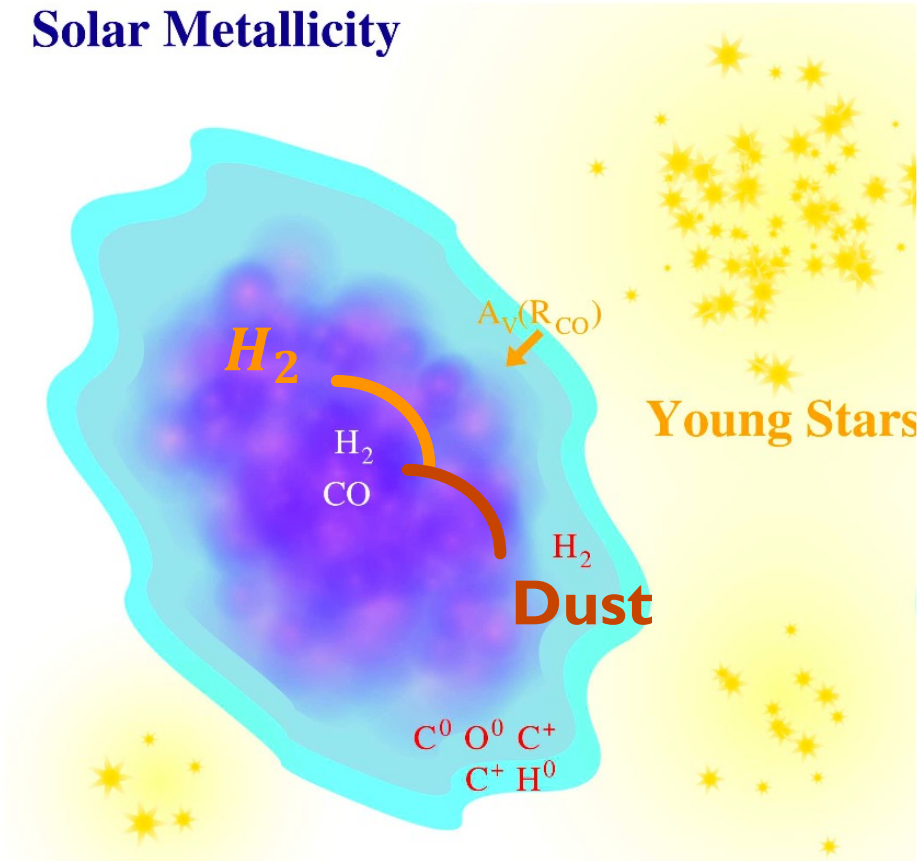


Aravena et al. 2024



https://ww w.almaobservatory.org

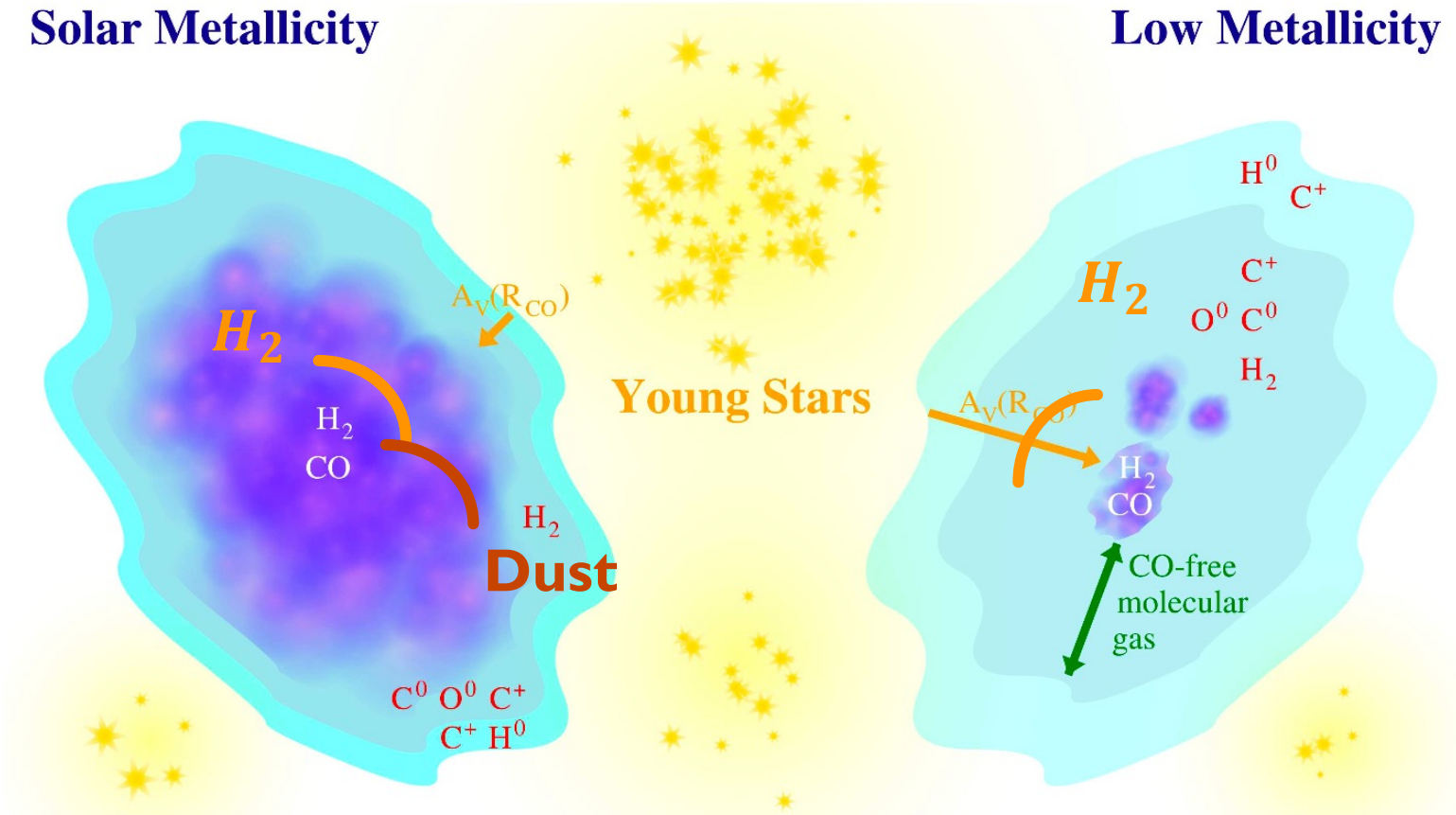
MOLECULAR GAS IS TRACED BY CO AT SOLAR METALLICITY



Madden et al. 2020

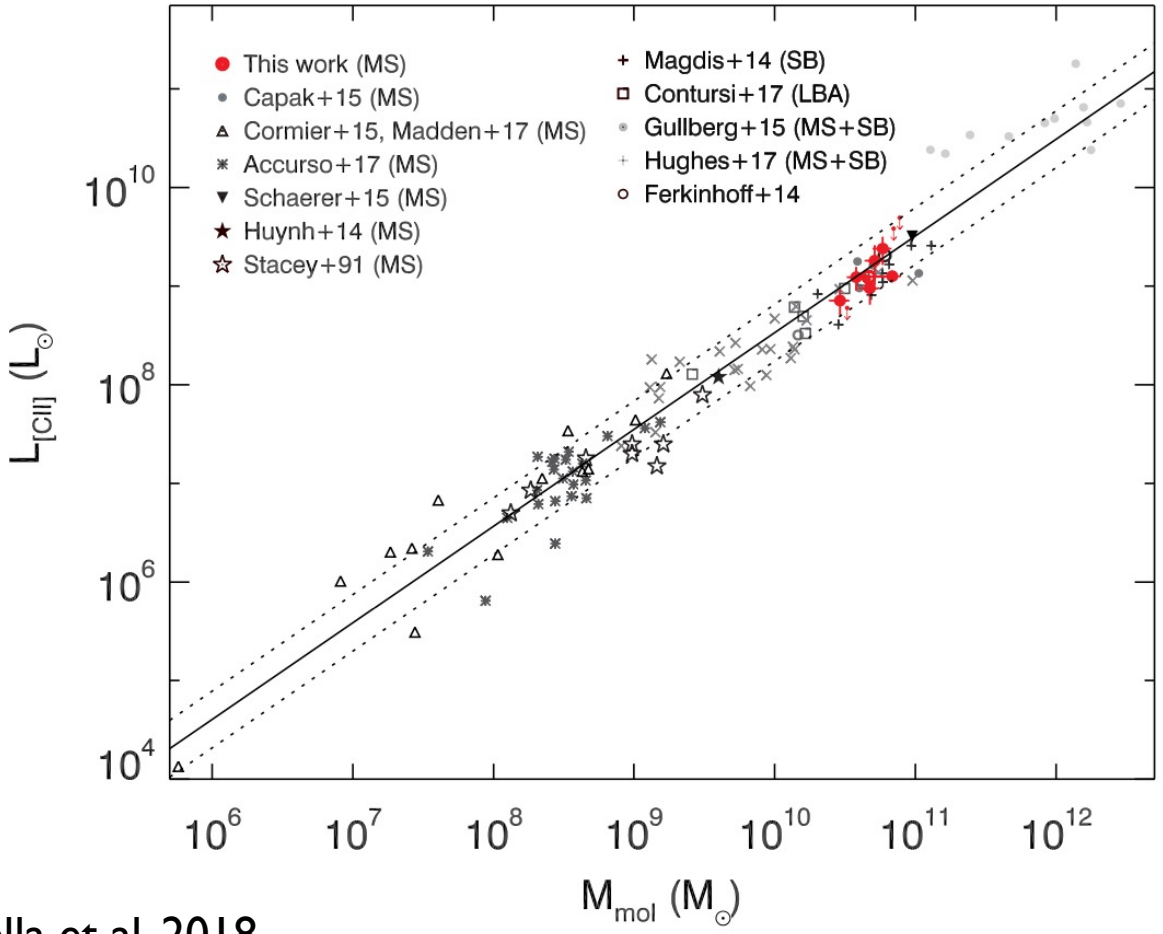
HOW TO TRACE MOLECULAR GAS AT LOW METALLICITY

With [C II]



Madden et al. 2020

LINEAR CORRELATION BETWEEN MOLECULAR GAS AND [C II] EMISSION AT LOWER REDSHIFTS

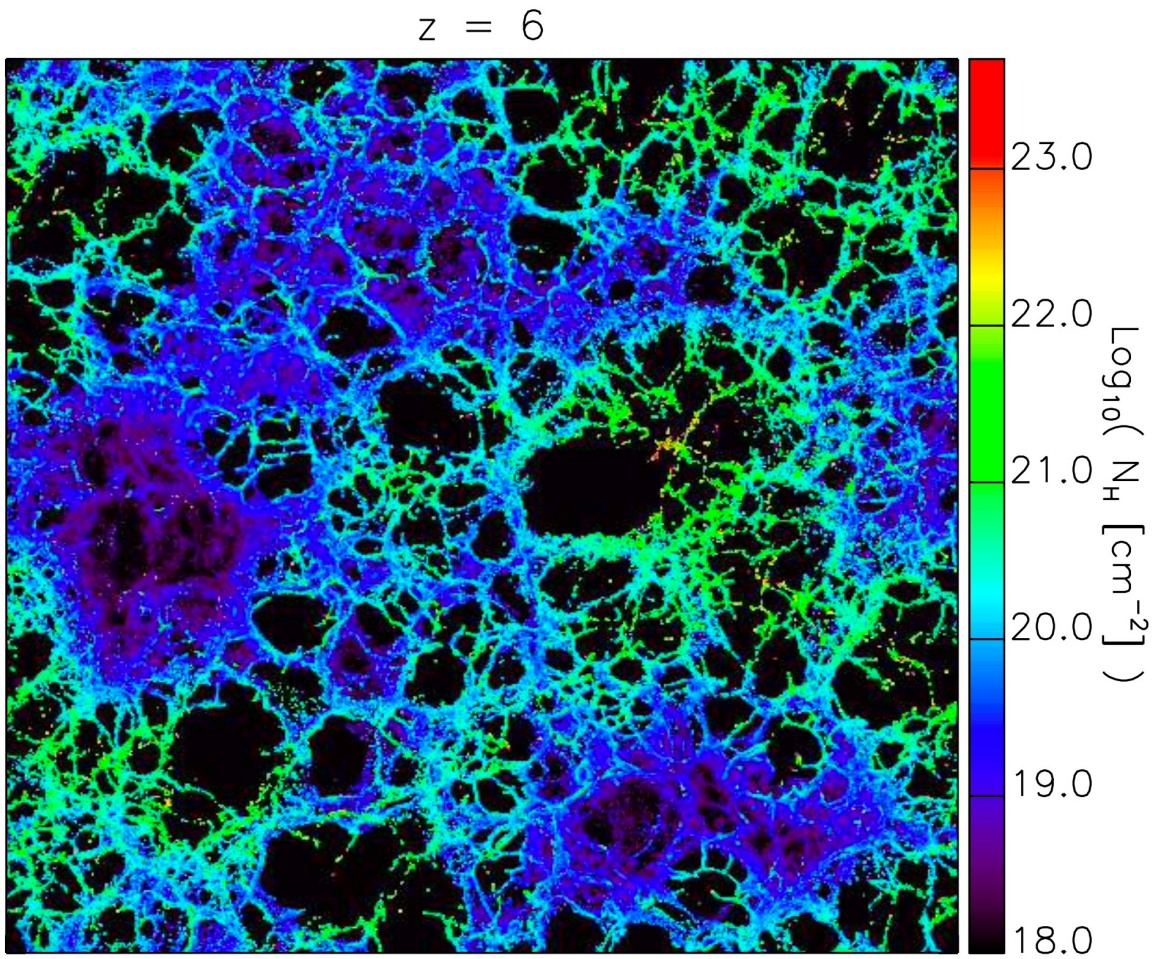


Zanella et al. 2018

MOTIVATION: AT THE EPOCH OF REIONIZATION…

1. DOES $L_{[C\ II]}$ TRACE STAR FORMATION?
2. DOES $L_{[C\ II]}$ TRACE COLD GAS MASS? (ATOMIC or MOLECULAR)
3. HOW TO CONVERT $L_{[C\ II]}$ INTO MOLECULAR GAS MASS?
4. WHICH PHASE OF THE GAS DOES $L_{[C\ II]}$ TRACE?

COLDSIM COSMOLOGICAL SIMULATIONS



CDM HR

Code: Gadget3

Side: 10 Mpc/*h*

$N_{part} = 2 \times 1000^3$

MAIN FEEDBACK PROCESSES:

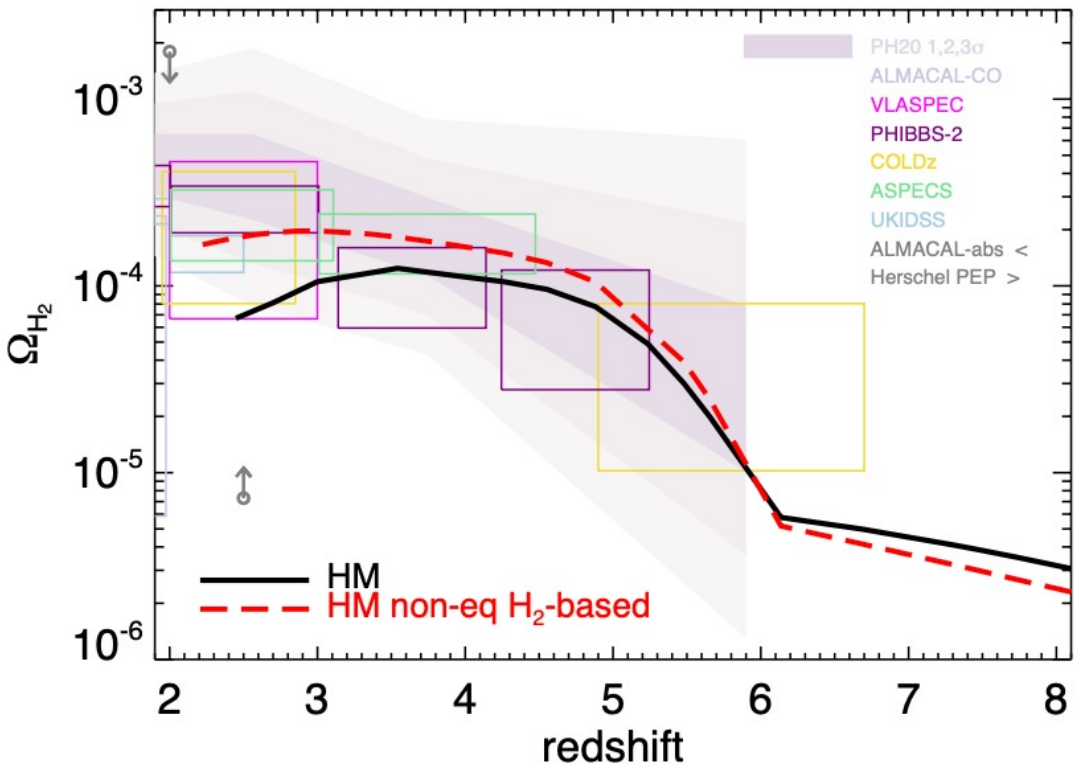
- UV radiation
- HI and H_2 self-shielding
- Photoelectric heating
- Cosmic-ray heating
- Stellar feedback
- …..

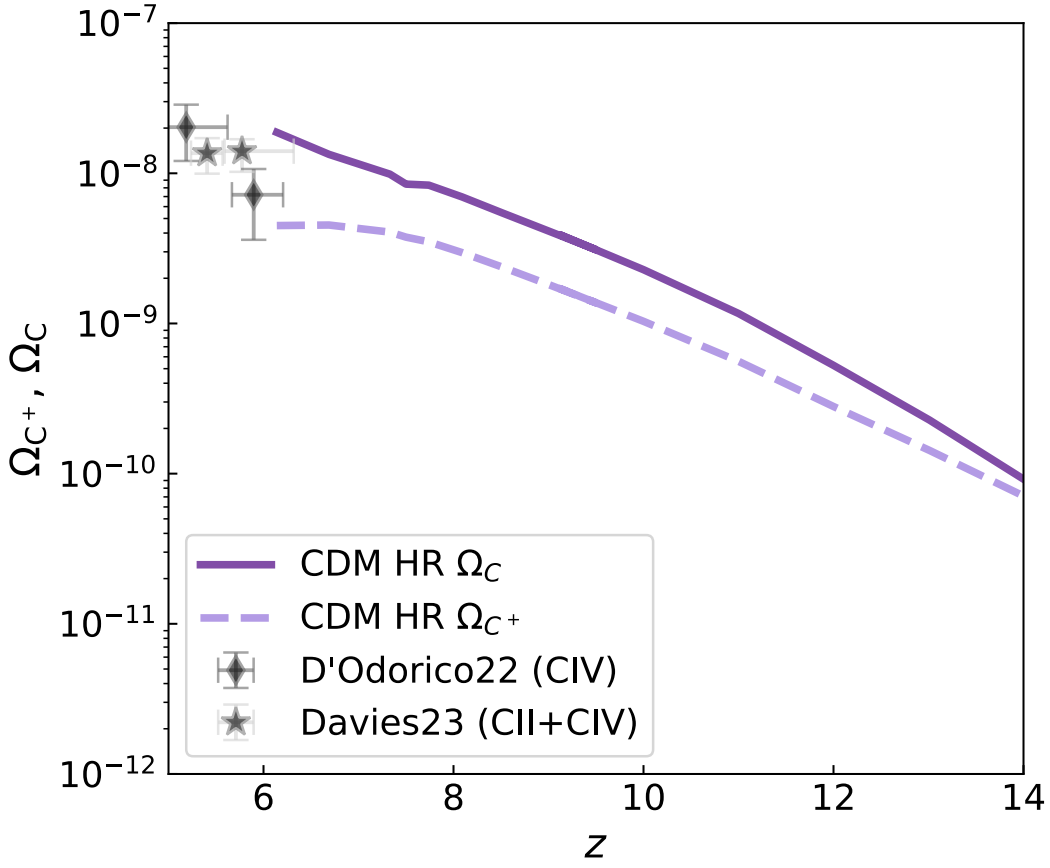
Time-dependent non-equilibrium network for PRISTINE CHEMISTRY:

$e^-, H, H^+, H^-, He, He^+, He^{++}, H_2, H_2^+, D, D^+, HD, HeH^+$

Casavecchia et al. 2024/aa50332-24, *accepted*

NON EQUILIBRIUM CHEMICAL NETWORK

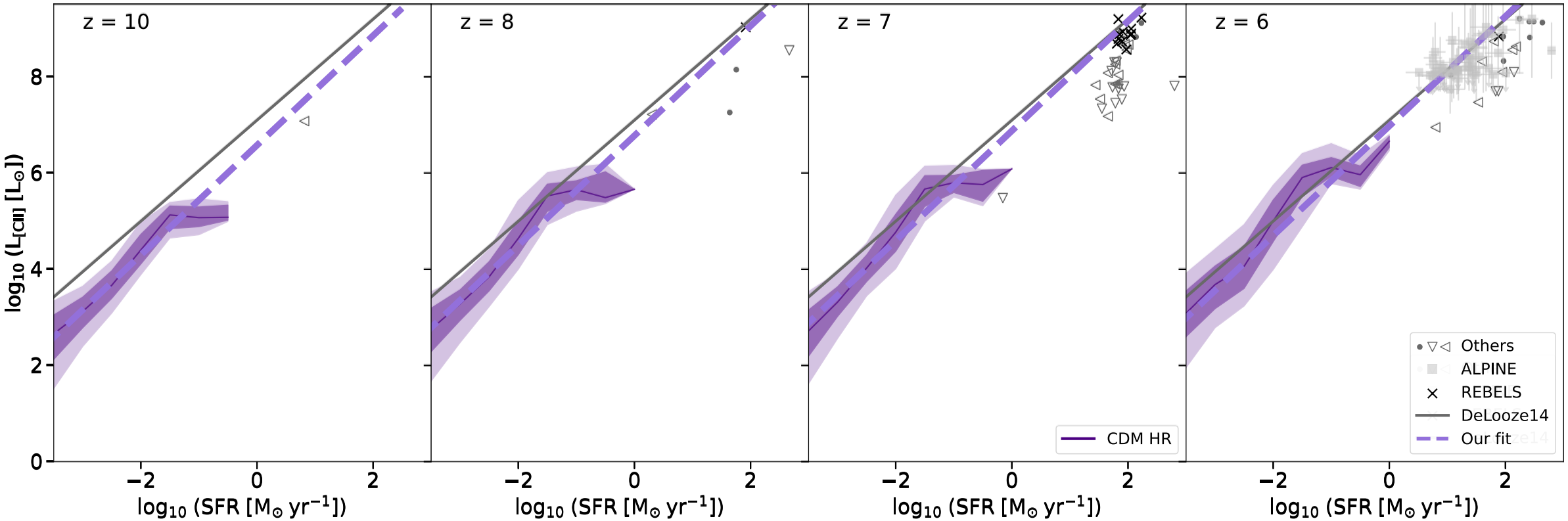




Casavecchia et al. 2024/aa50332-24, *accepted*

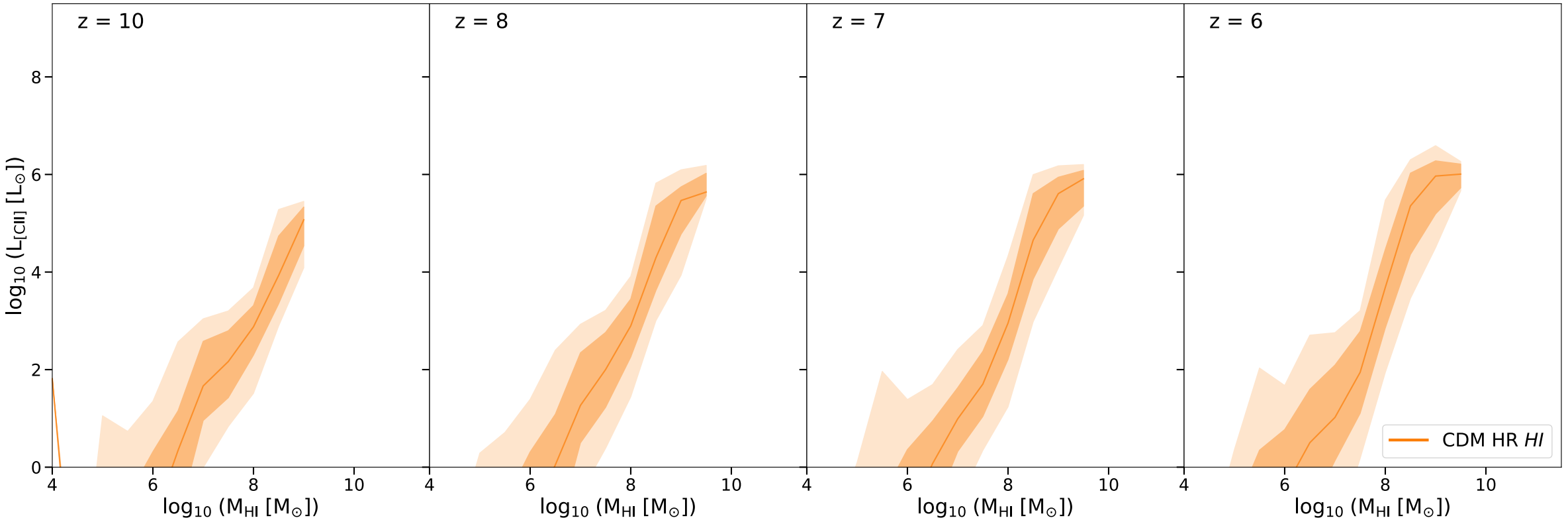
LINEAR RELATION BETWEEN $L_{[C\ II]}$ AND SFR

dependent on redshift!

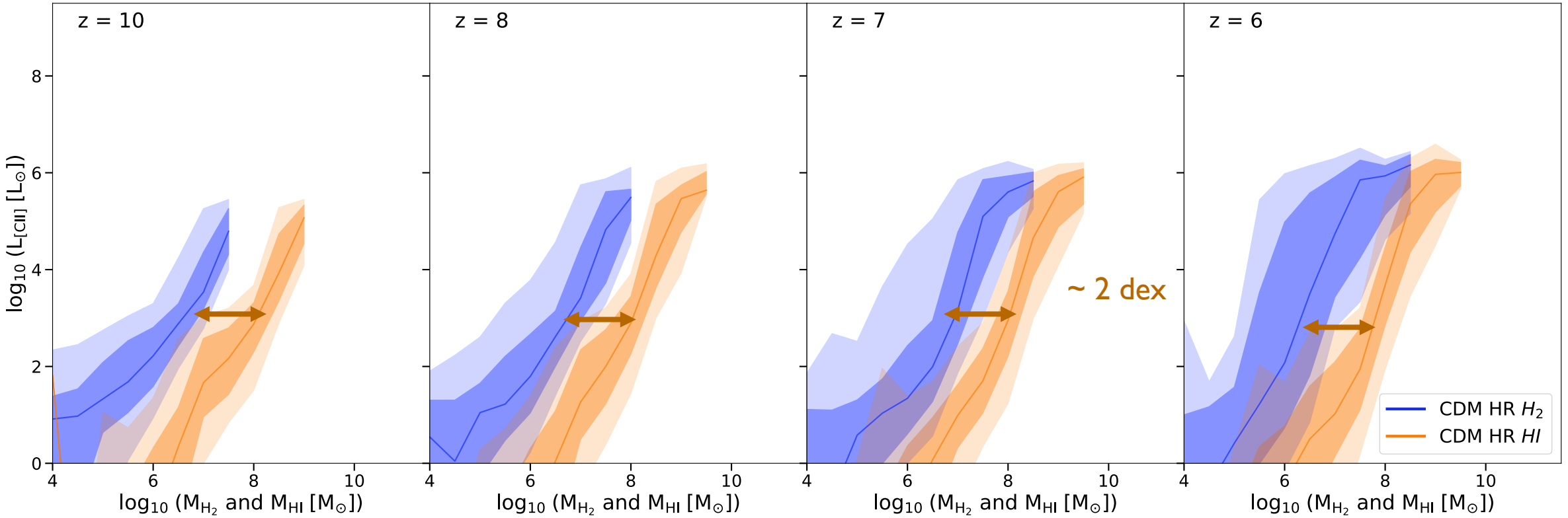


Casavecchia et al. 2024/aa50332-24, *accepted*

LINEAR RELATION BETWEEN $L_{[C\ II]}$ AND ATOMIC GAS MASS

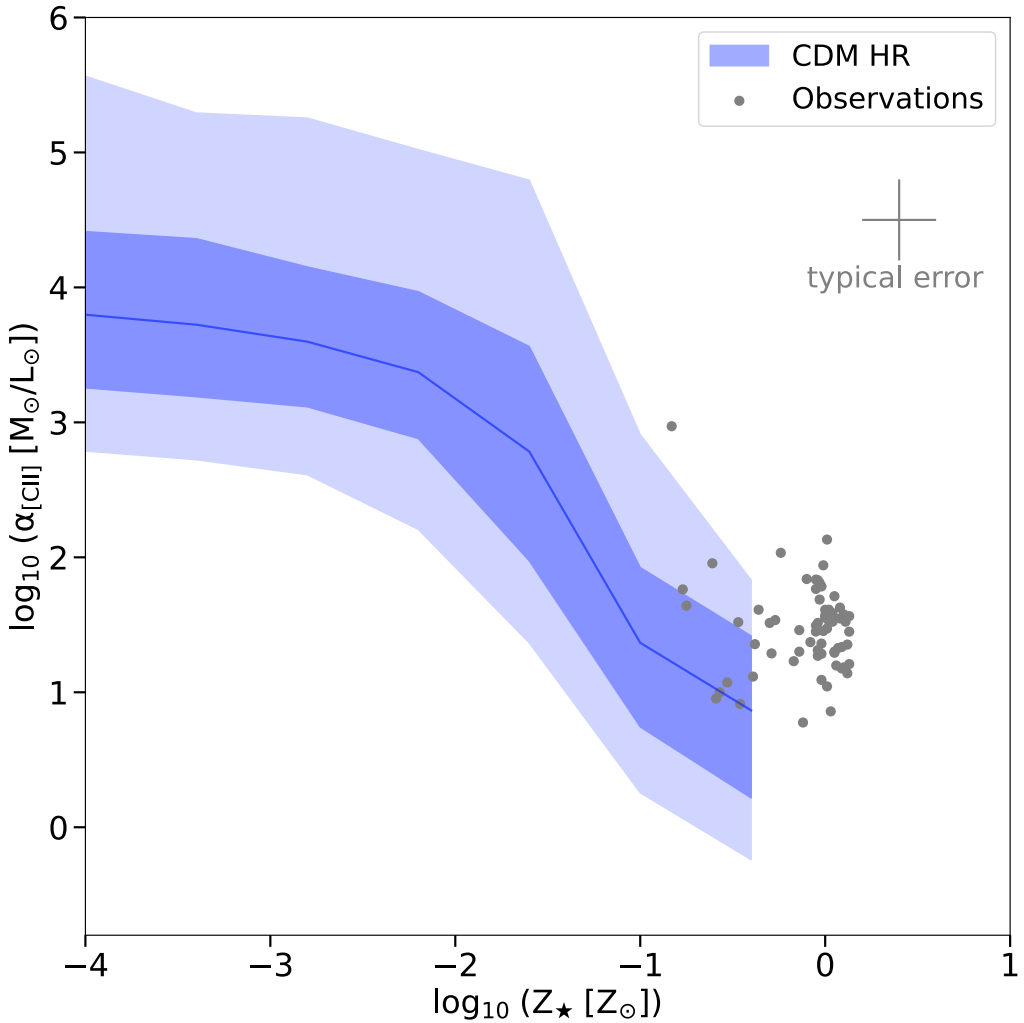


LINEAR RELATION BETWEEN $L_{[C\ II]}$ AND ATOMIC GAS MASS AND MOLECULAR GAS MASS



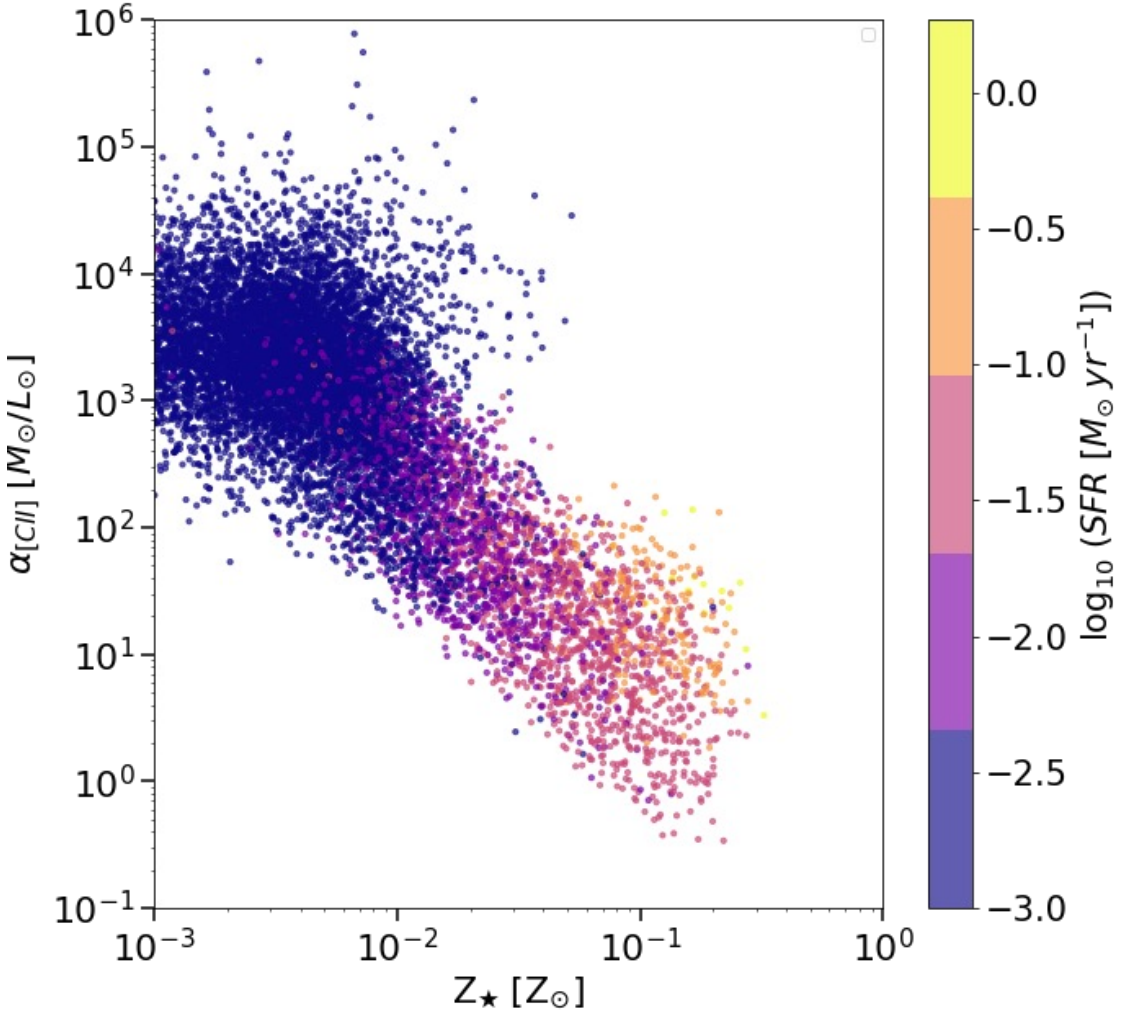
Casavecchia et al, *in prep.*

CONVERSION FACTOR DEPENDS ON METALLICITY



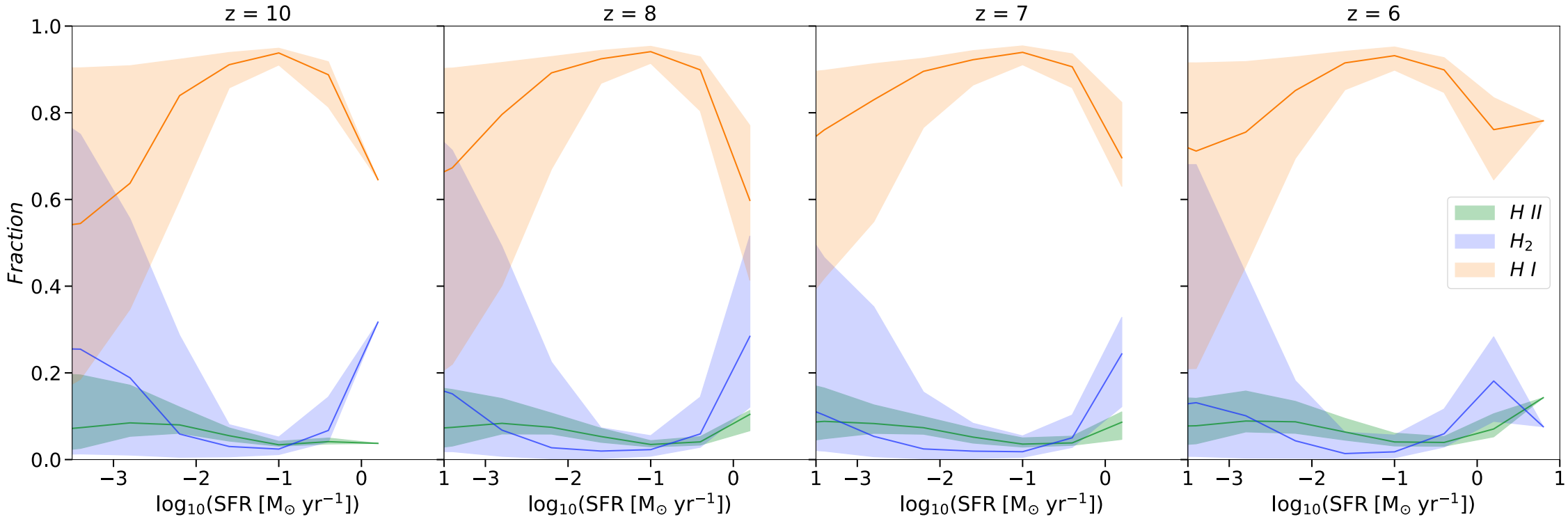
Casavecchia et al, *in prep.*

CONVERSION FACTOR DEPENDS ON METALLICITY AND SFR



Casavecchia et al, *in prep.*

ATOMIC GAS DOMINATES [C II] EMISSION



Casavecchia et al, *in prep.*

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SUMMARY

1. DOES $L_{[C\ II]}$ TRACE STAR FORMATION? ✓

Yes, **$L_{[C\ II]}$ correlates linearly with SFR**. (⚠ Redshift evolution in the relation.)

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By using a convertion factor $\alpha_{[C\ II]}$ that dependens on metallicity and SFR.

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Atomic HI (~80-90%)