Durham University

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A new technique to understand the relation between star formation and molecular gas

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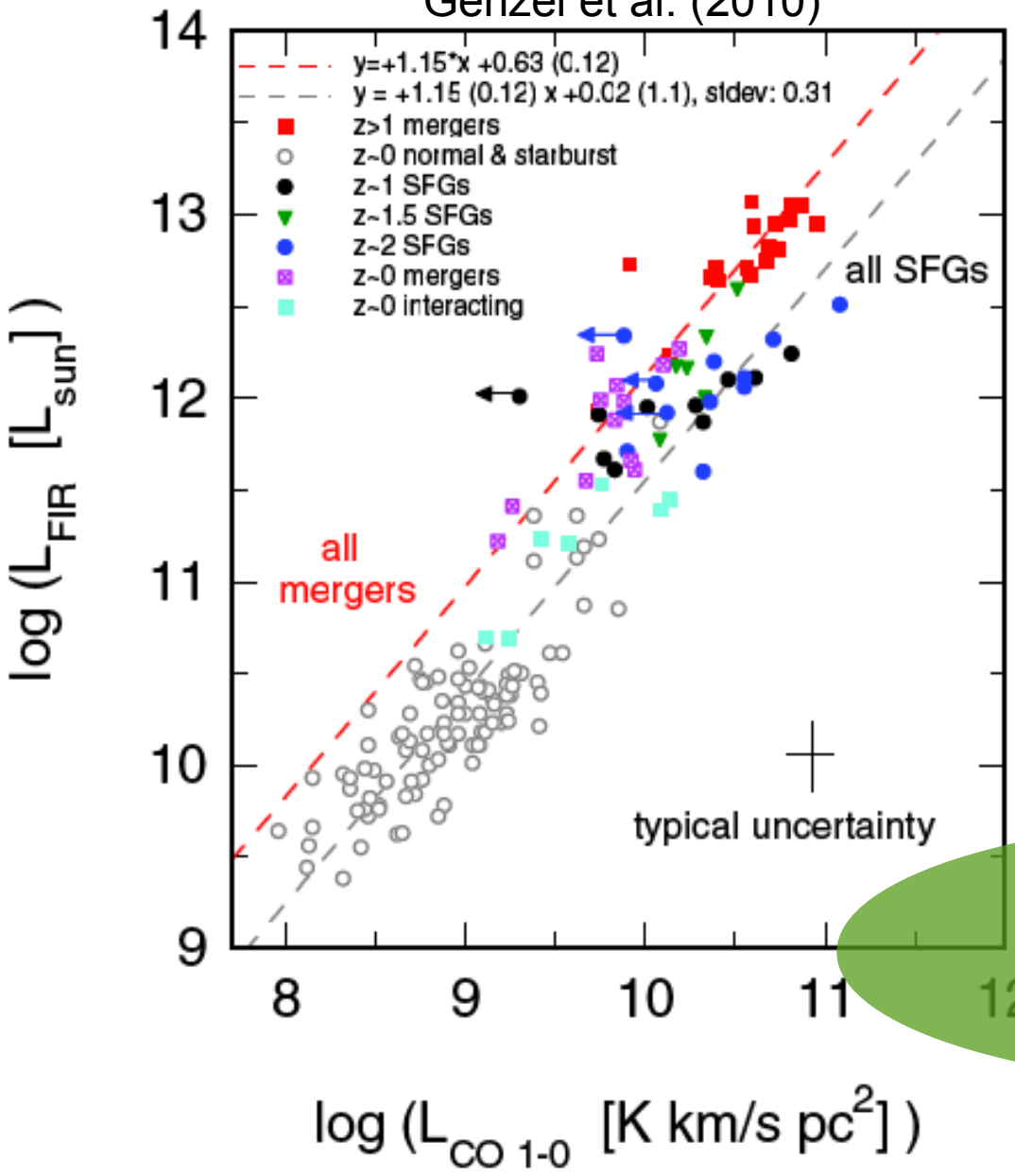
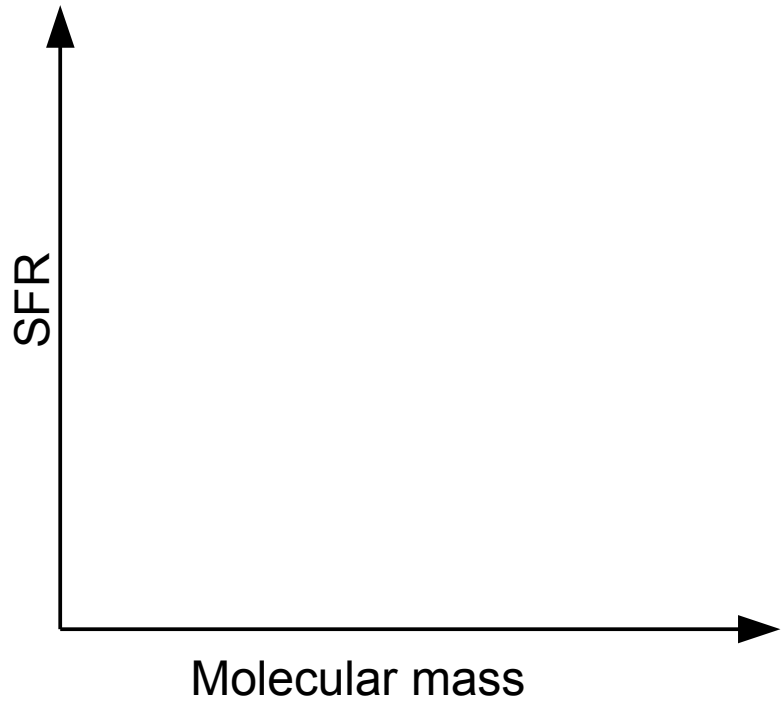
Observationally we study IR vs. CO

Genzel et al. (2010)



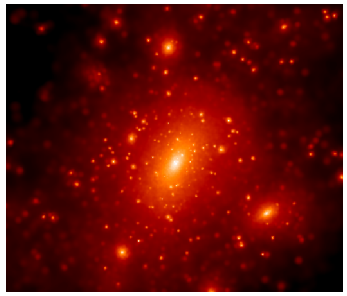


Need to assume a
CO(1-0) to H_2
and a
CO(J→J-1) to CO(1-0)

The paradigm of galaxy formation
(Lagos et al. 2011a,b)

Cosmological model

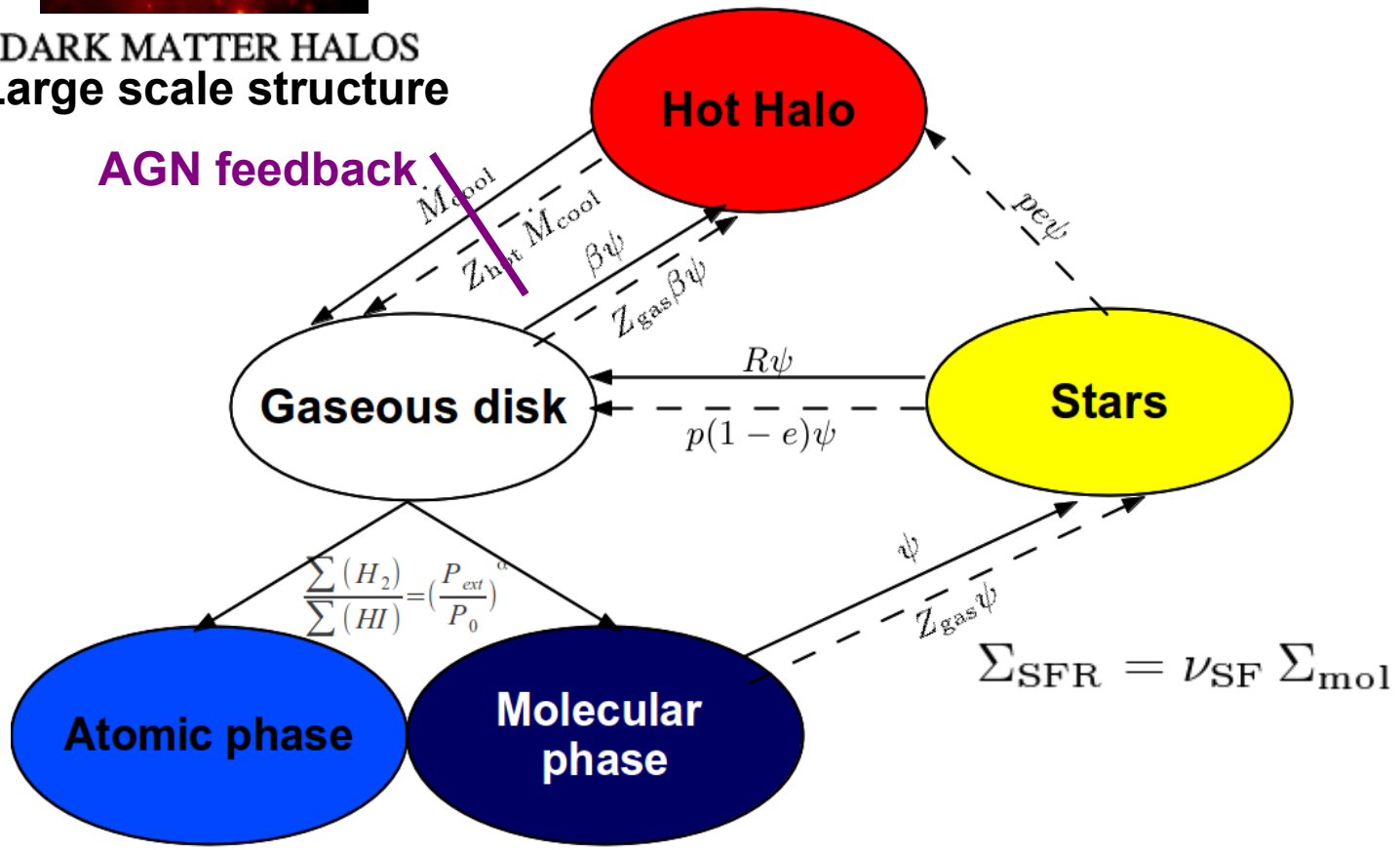
$\Omega_0, \Lambda_0, \sigma_8$, h, P(k)



DARK MATTER HALOS

Large scale structure

AGN feedback



Mass exchange

Chemical exchange


@Daniel Farrow, Pan-STARRS

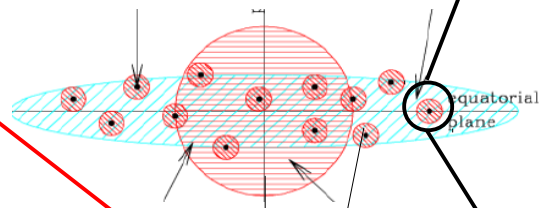
Predicting the CO emission of galaxies: combining GALFORM with the UCL_PDR RT

(Lagos et al, 2012, arXiv:1204.0795 & Bayet et al., 2011)

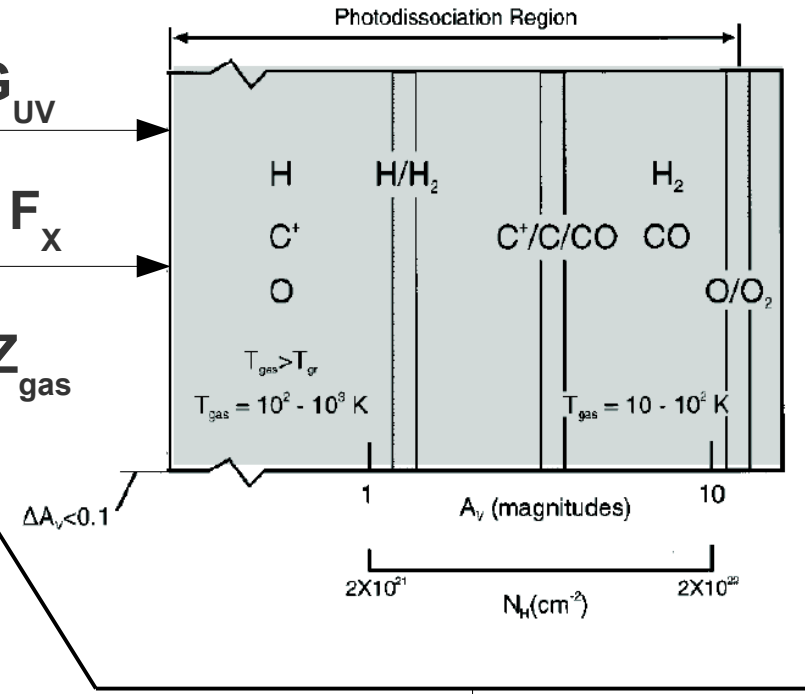
→ A novel approach to estimate the CO emission of a large sample (millions) of simulated galaxies.

GALFORM

Sizes, luminosities, molecular, atomic gas masses, UV flux, gas metallicities, AGN luminosity



UCL_PDR

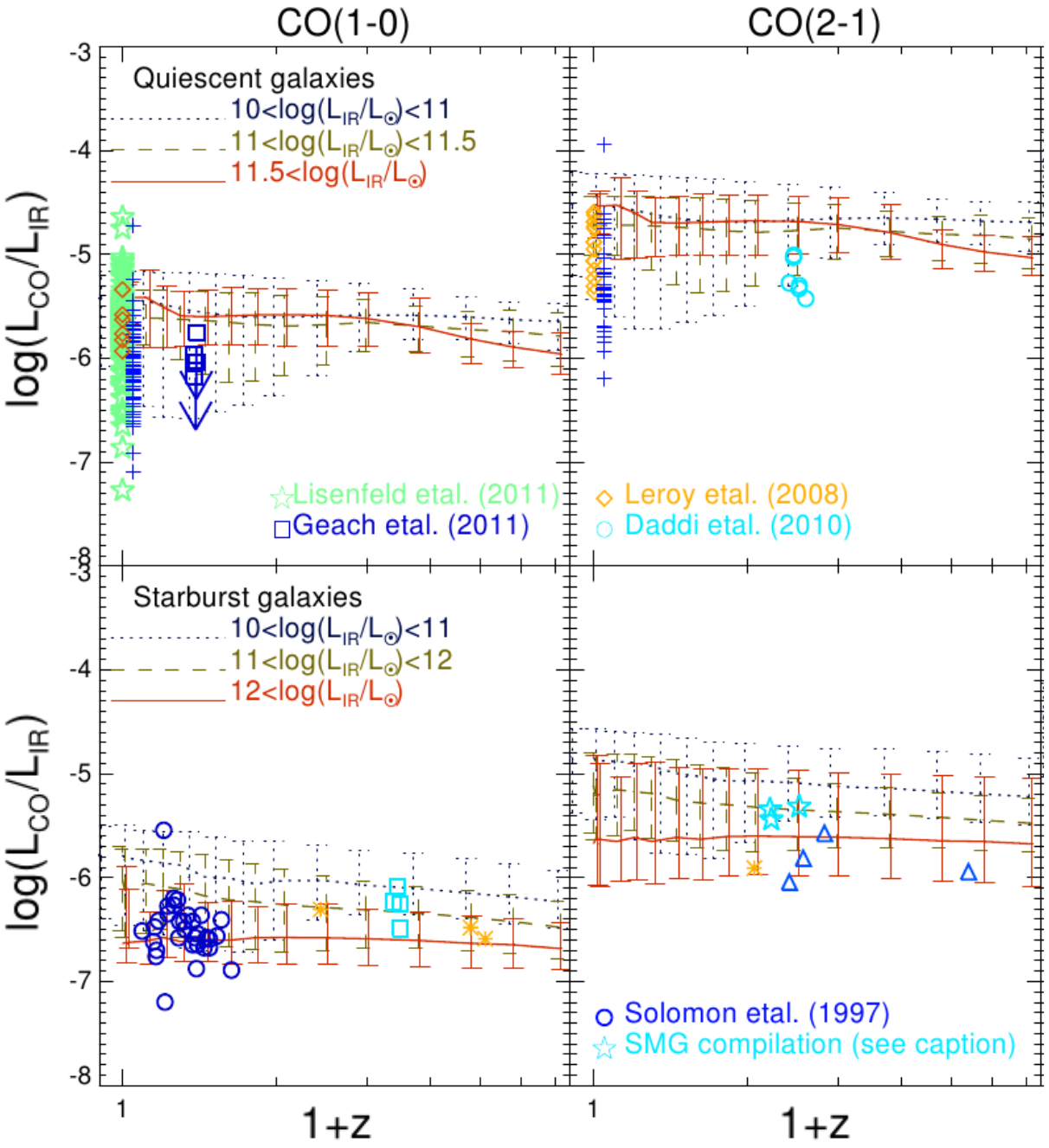


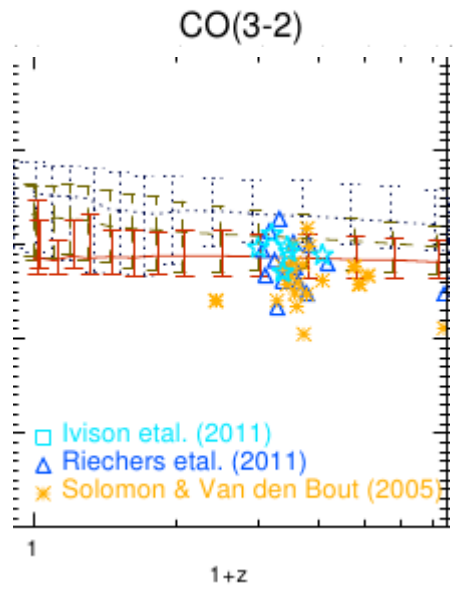
Allows 2 SF gas phases

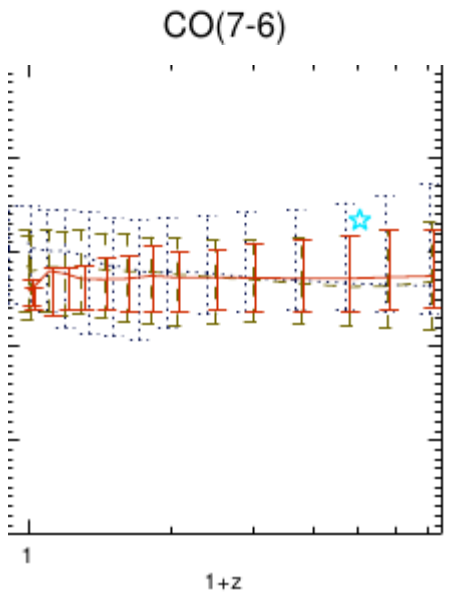
X_{CO} T_{gas}

The CO-to-IR luminosity ratio evolution

(Lagos et al, 2012, arXiv:1204.0795**)**

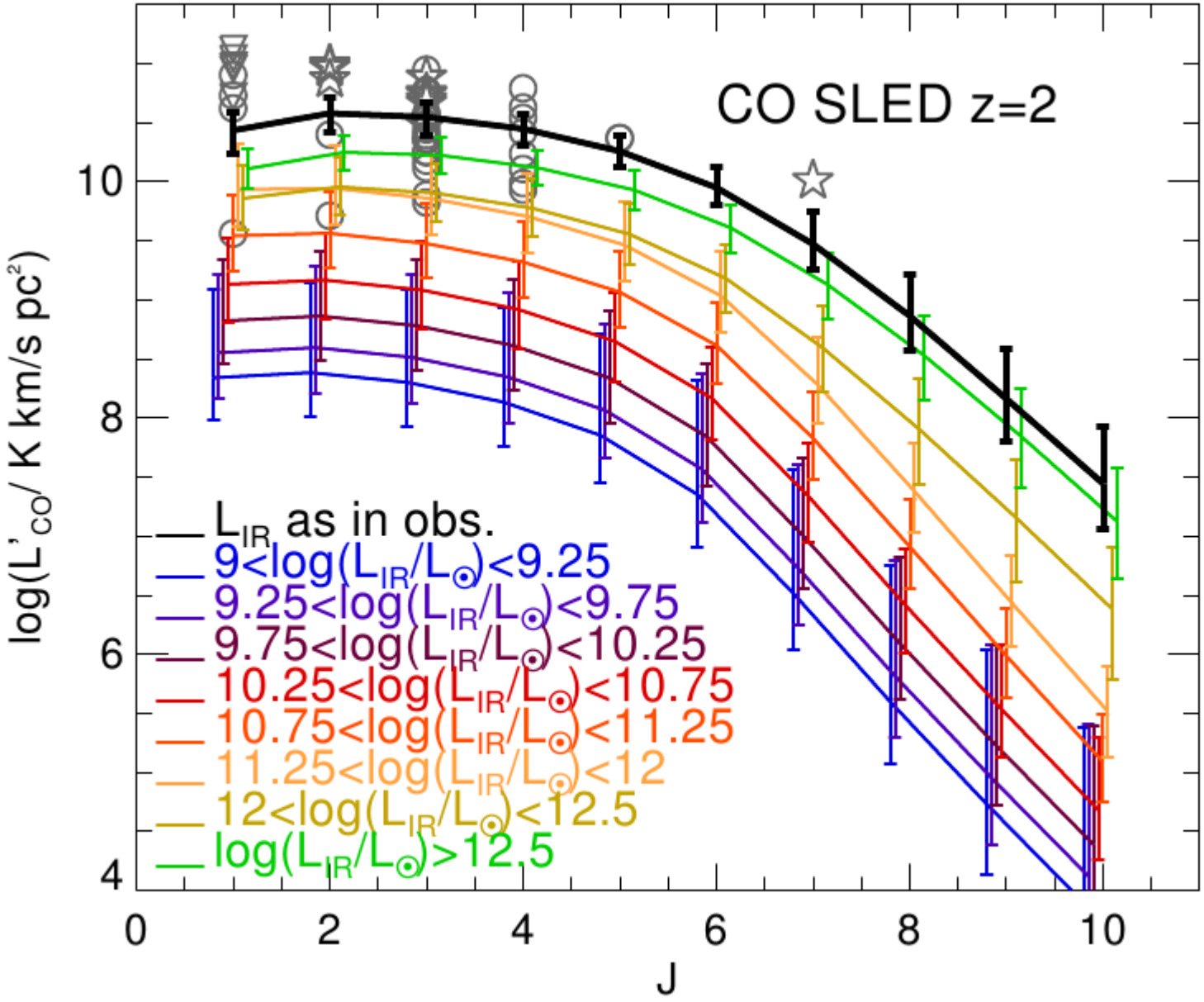






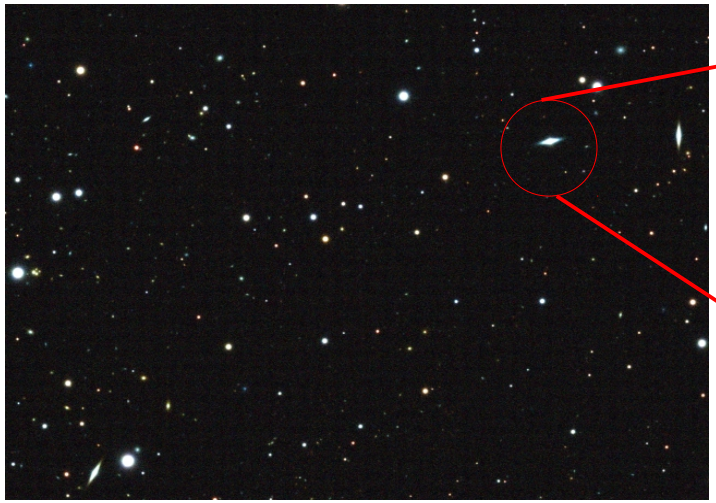
The CO SLED of high-z SMGs

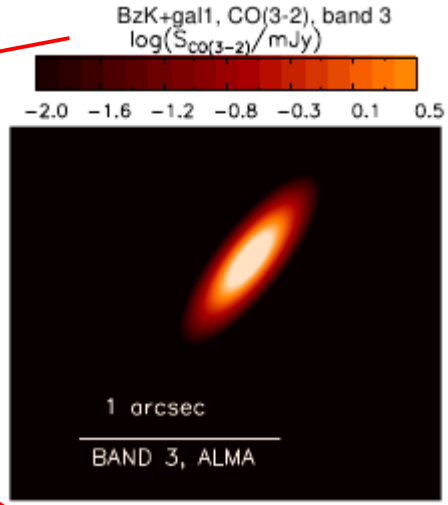
(Lagos et al, 2012, arXiv:1204.0795)

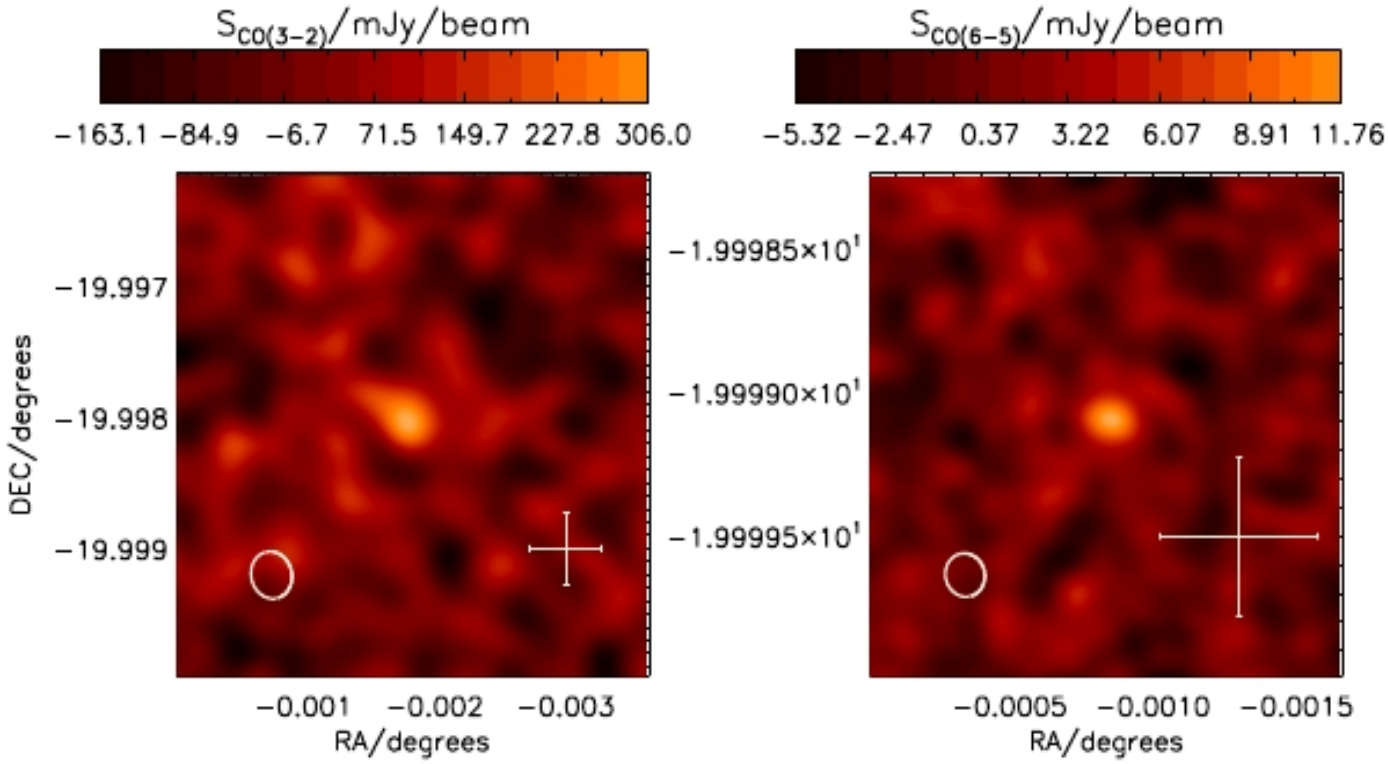


Simulating observations for ALMA

(Lagos et al, 2012, arXiv:1204.0795)







Conclusions

Lagos et al. (2011a), Lagos et al. (2011b), Lagos et al. (2012, arXiv:1204.0795), Bayet et al. (2011, 2012, in prep.)

- SAM: Powerful tool to study the connection SF/H2/HI. Self-consistent use of parameter free SF law.

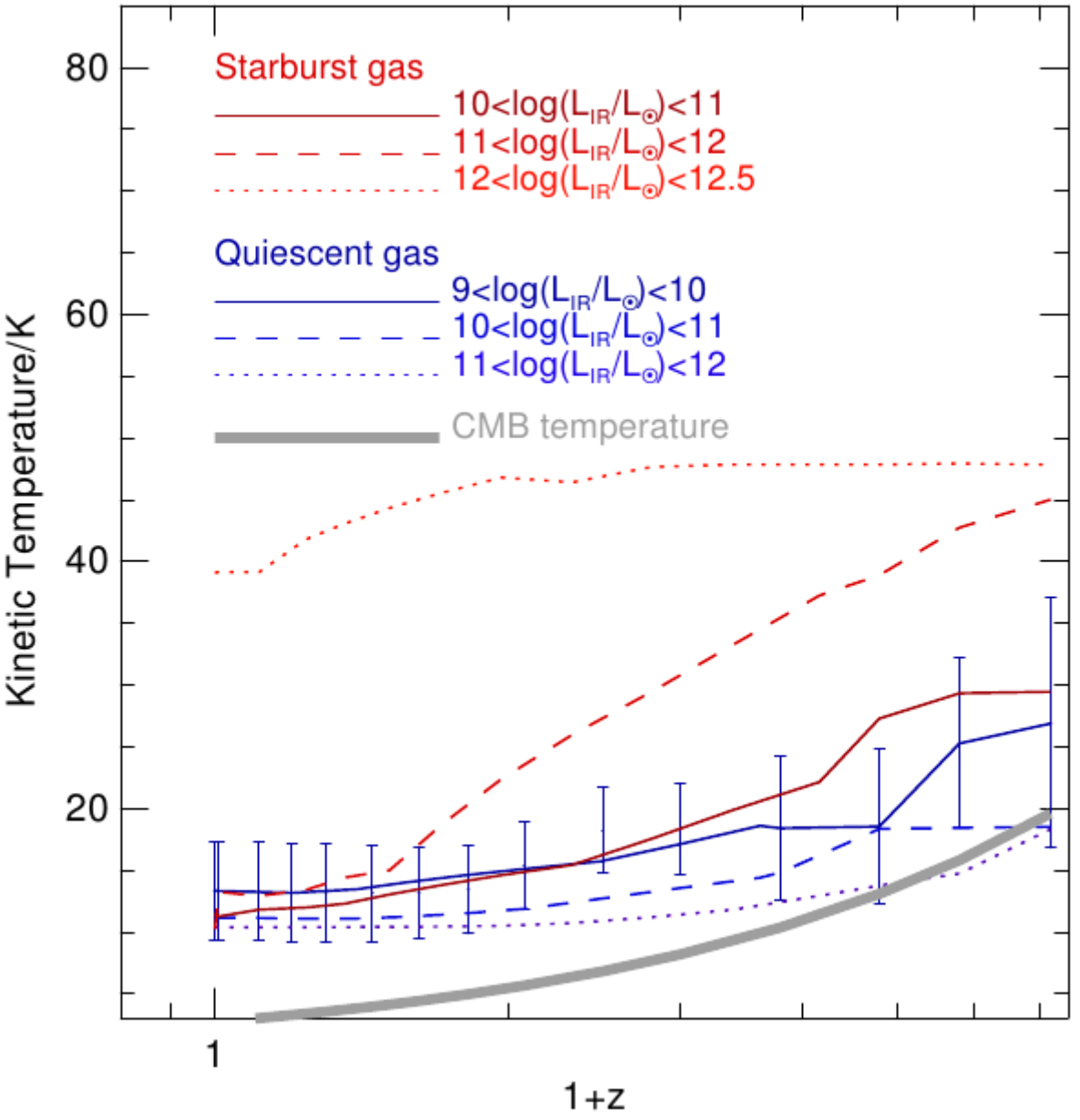
- **GALFORM+UCL_PDR**: predictions in good agreement with obs.
  → CO(1-0) luminosity function
  → CO-IR luminosity relation of local and high-redshift galaxies
  → CO SLEDs of LIRGs and SMGs.

- **Predictions for ALMA: simulate CO observations**
  → CO catalogues of galaxies to simulate obs.
  → *Diagnose the observability* of e.g. BzKs, LBGs, etc.

Gas kinetic temperature evolution
(Lagos et al, 2012, arXiv:1204.0795)

→ **Starbursts tend to have temperatures higher than normal star-forming galaxies**

→ **Temperature tends to increase with redshift (effect of lower metallicities and higher SFRs)**



Evolution of molecular gas fractions
(Geach et al. 2011)

- Strong molecular fraction evolution explained by higher ISM pressure (Lagos et al. 2011b)