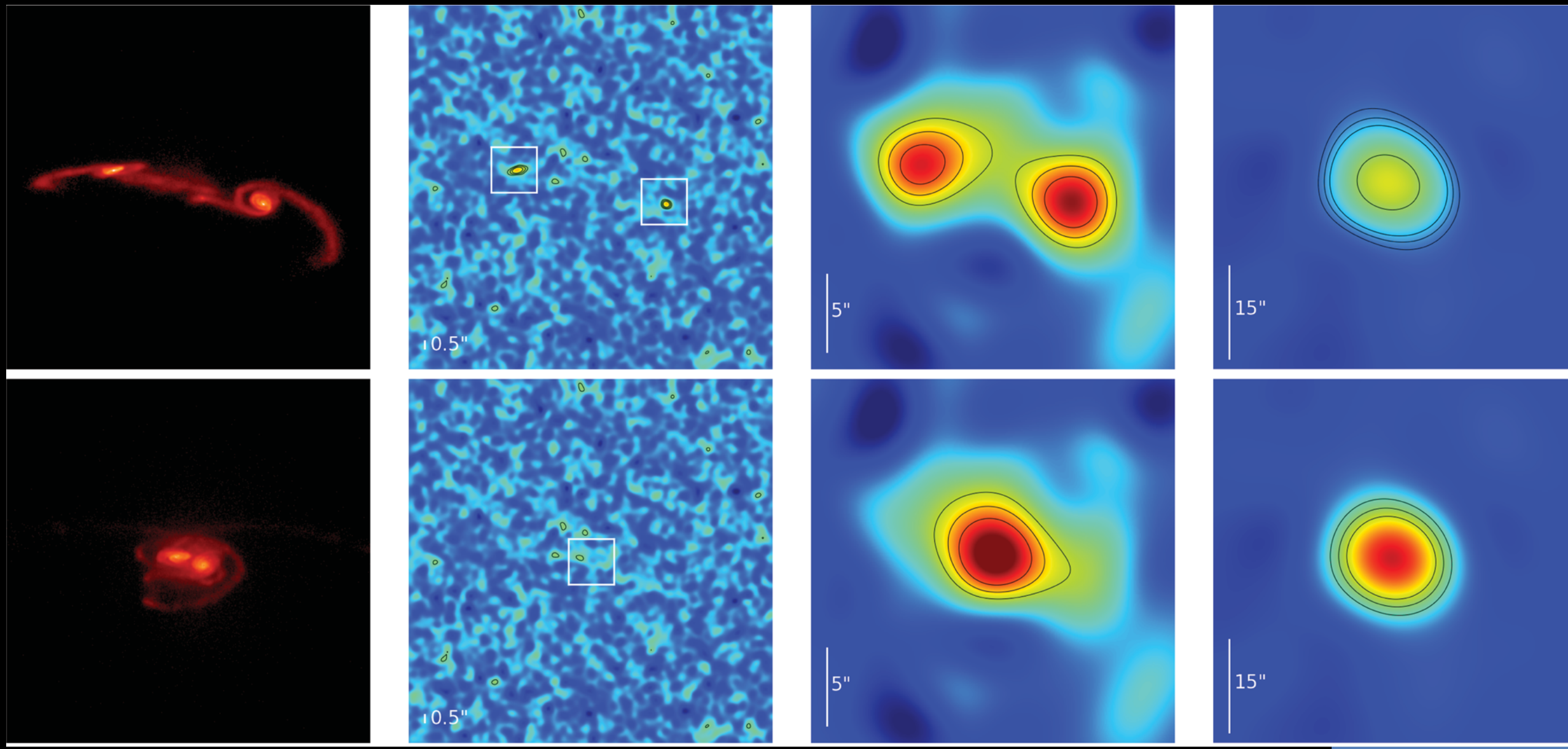
The physical nature of submm source multiplicity



Chris Hayward (Flatiron Institute)
SMG20, 1 August 2017

SIMONS FOUNDATION

CENTER MODULE
COMMONS . LOWER FLOOR

Darla J. Twale
Barbara M. De Luca

Faculty Incivility

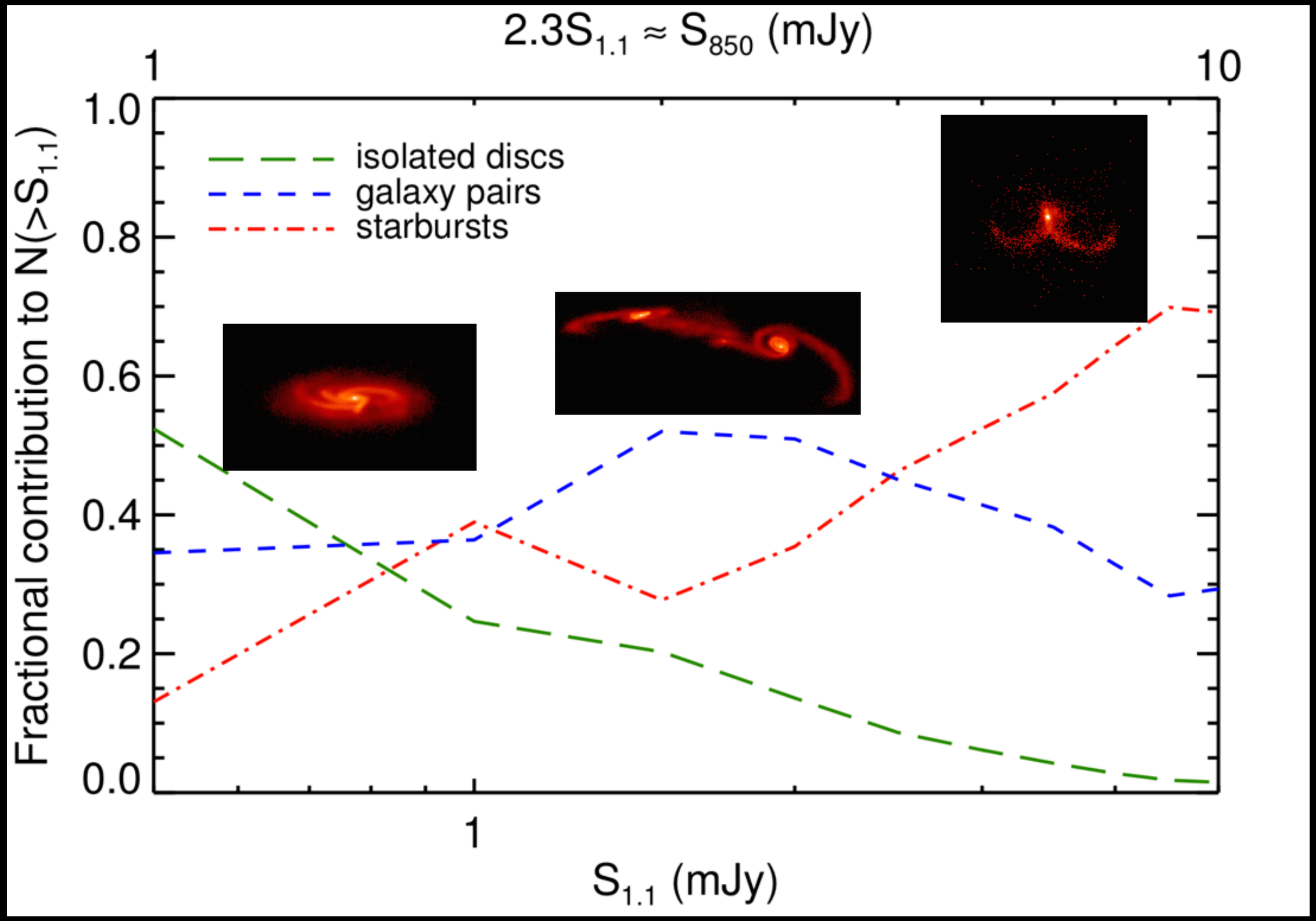
The Rise of the Academic Bully Culture and What to Do About It

Possibility of blended sources noted from the start

"at least some of the apparent sources in the map could consist of emission from more than one object… confusion is only a serious problem when there is a blend of one or more sources of similar flux"

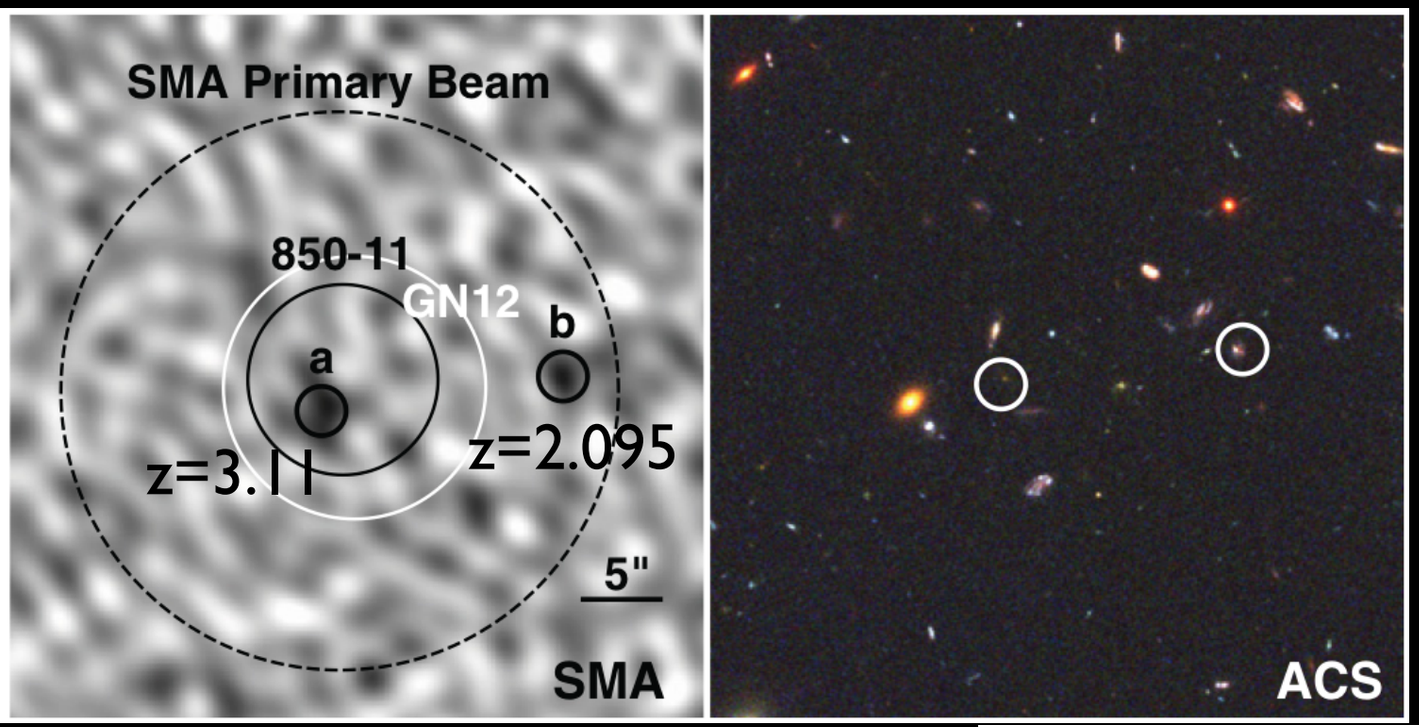
Hughes+98, *Nature*

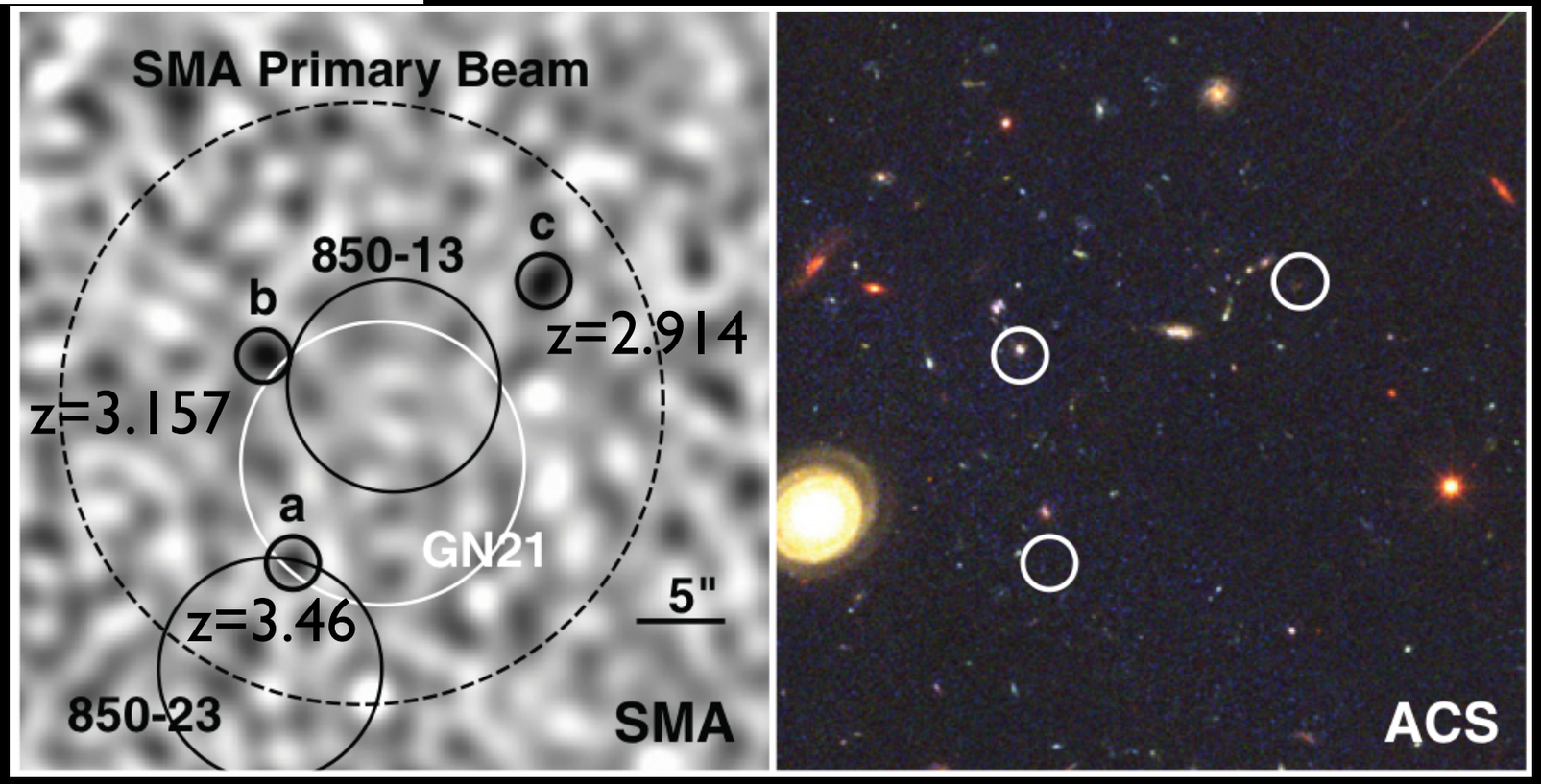
Mergers result in blended sources



CCH, Narayanan+13; also CCH+11, 12

Chance projections also possible





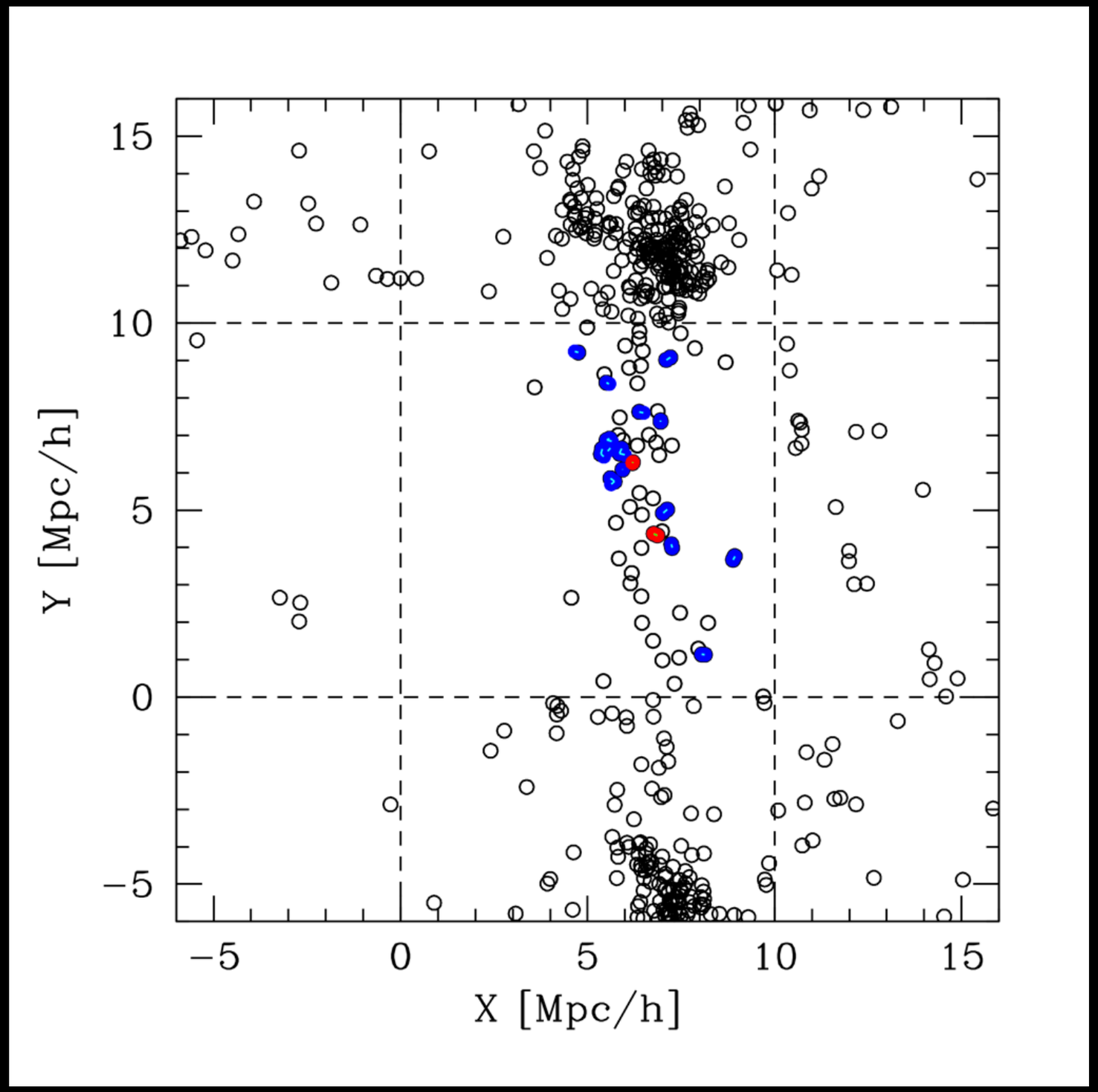
Wang+11

Pre-2013, chance projections not treated by any models

Model details

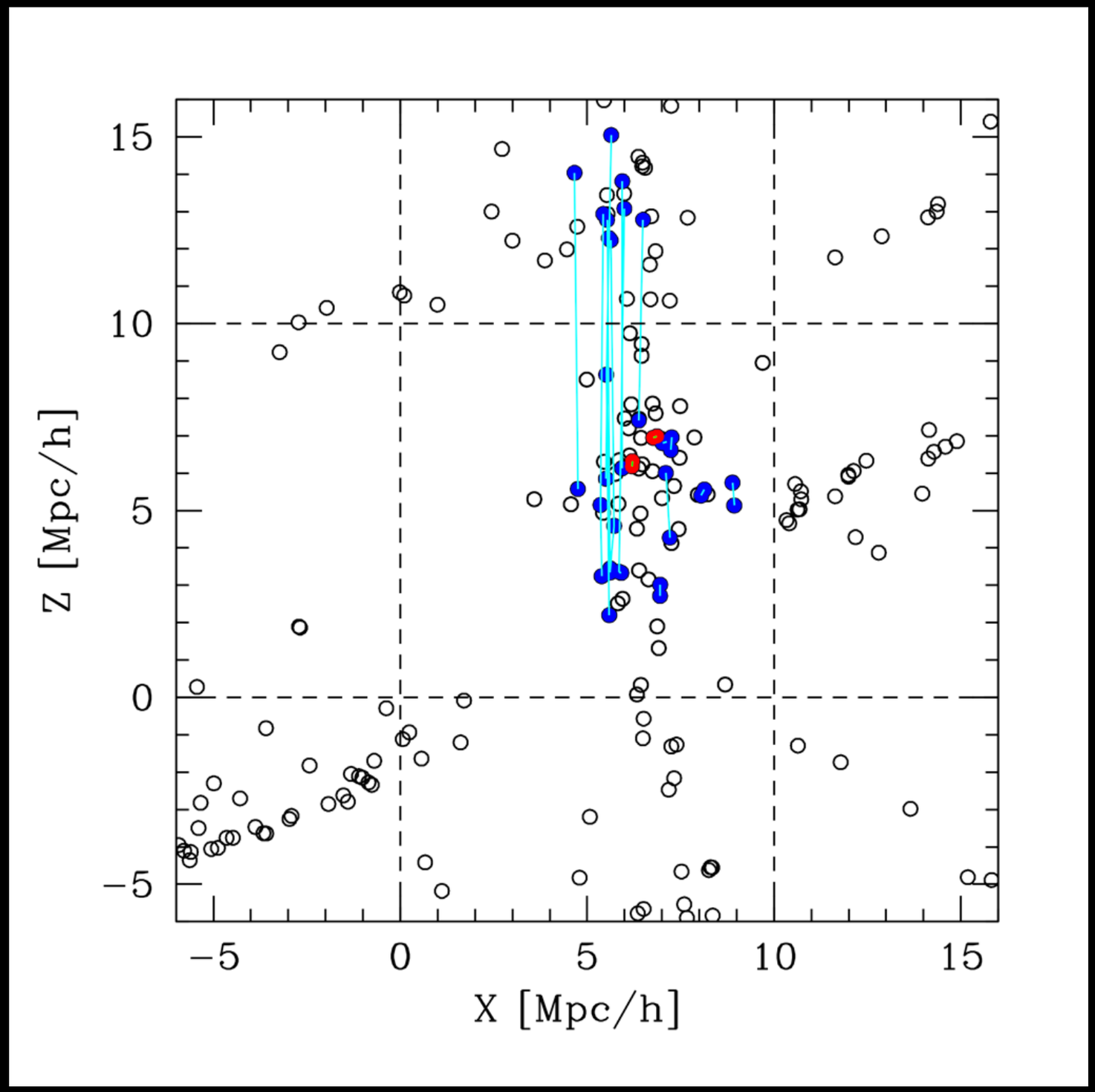
- Start with *Bolshoi* N-body sim
- Generate lightcones
- Assign properties such as M_{star} and SFR via abundance matching and other empirically calibrated relations
- Compute submm flux using scaling relations based on results of performing dust RT on hydro sims
- Blend mock SMGs
- See CCH, Behroozi+13 for details; also Cowley+15ab for similar analysis with very different model

Real vs. projected multiples



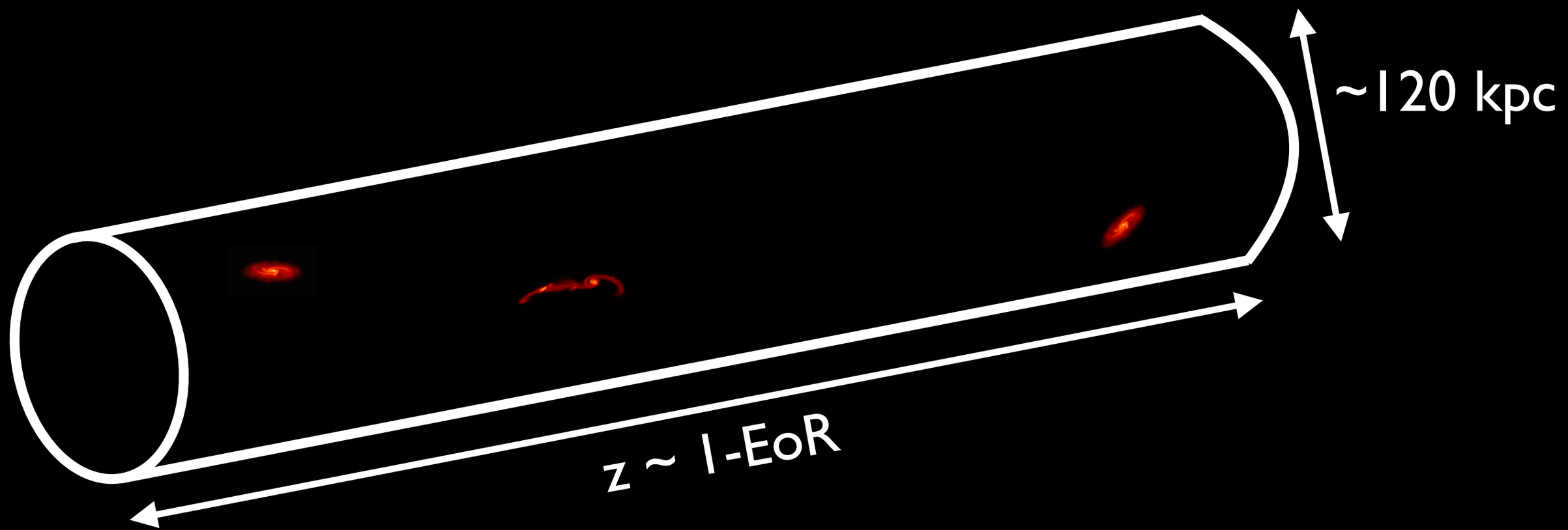
CCH, Behroozi+13

Real vs. projected multiples

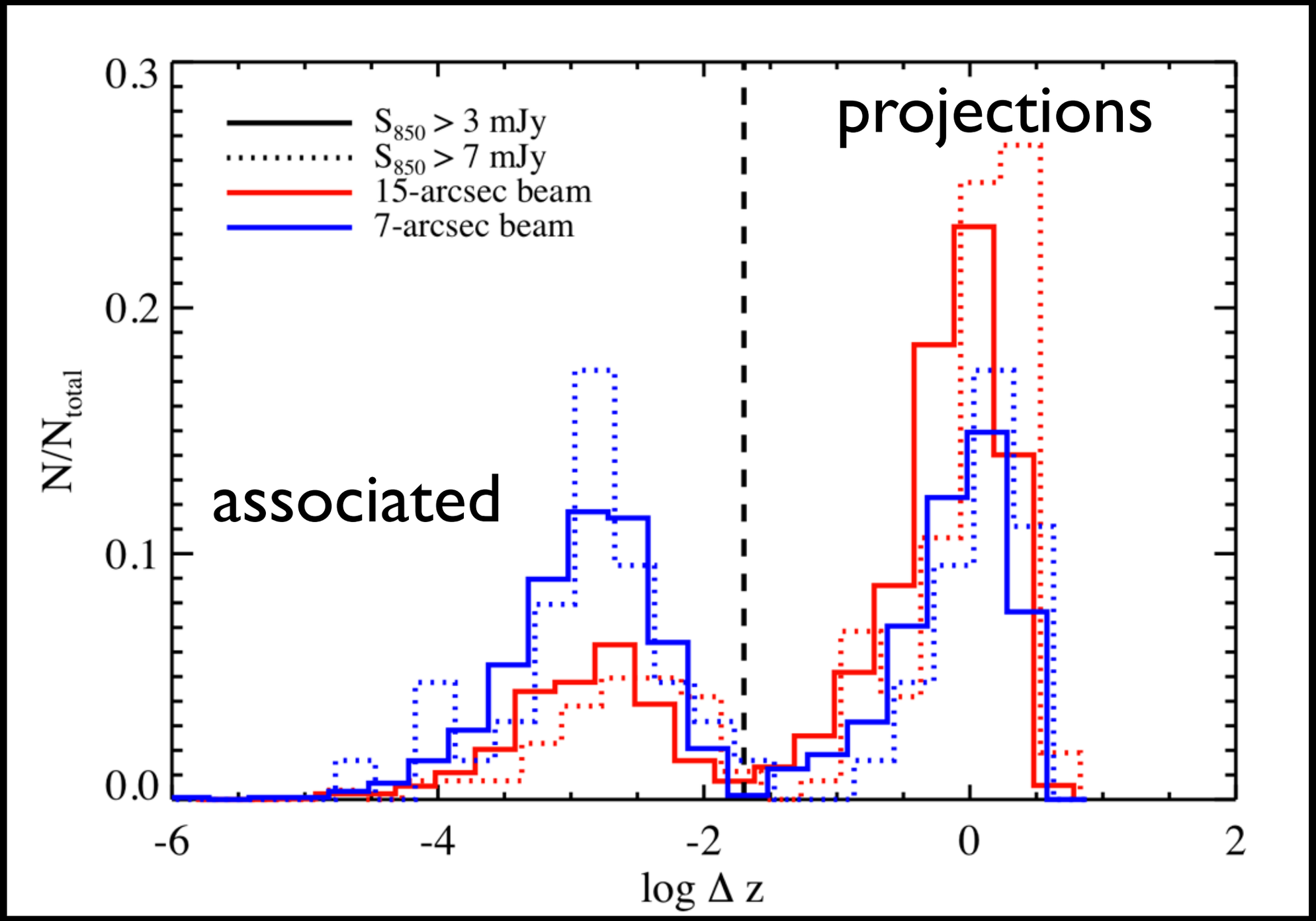


CCH, Behroozi+13

Why chance projections should be common in submm

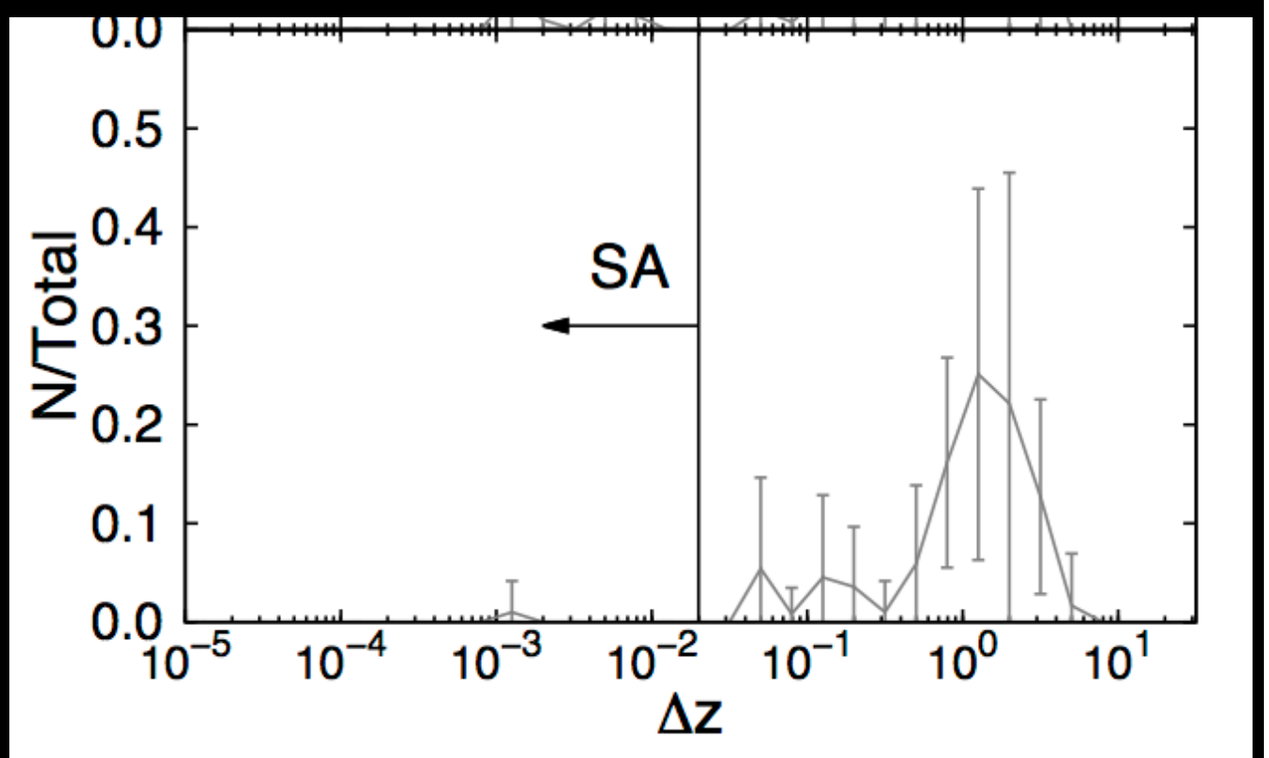


Model predicts chance projections common

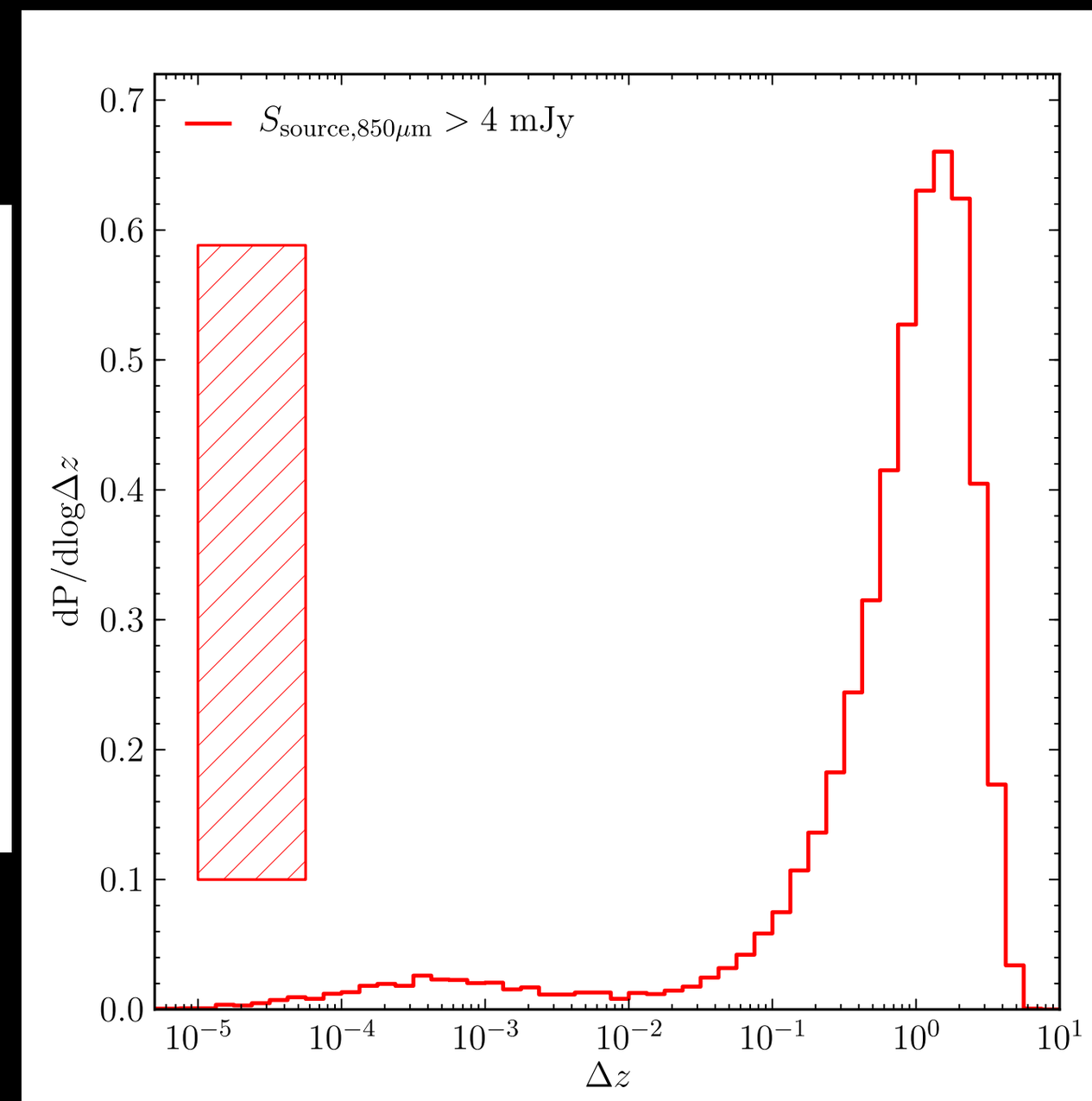


CCH, Behroozi+13

Also predicted by subsequent models



Muñoz Arancibia+14



Cowley+15

But what about the real Universe?

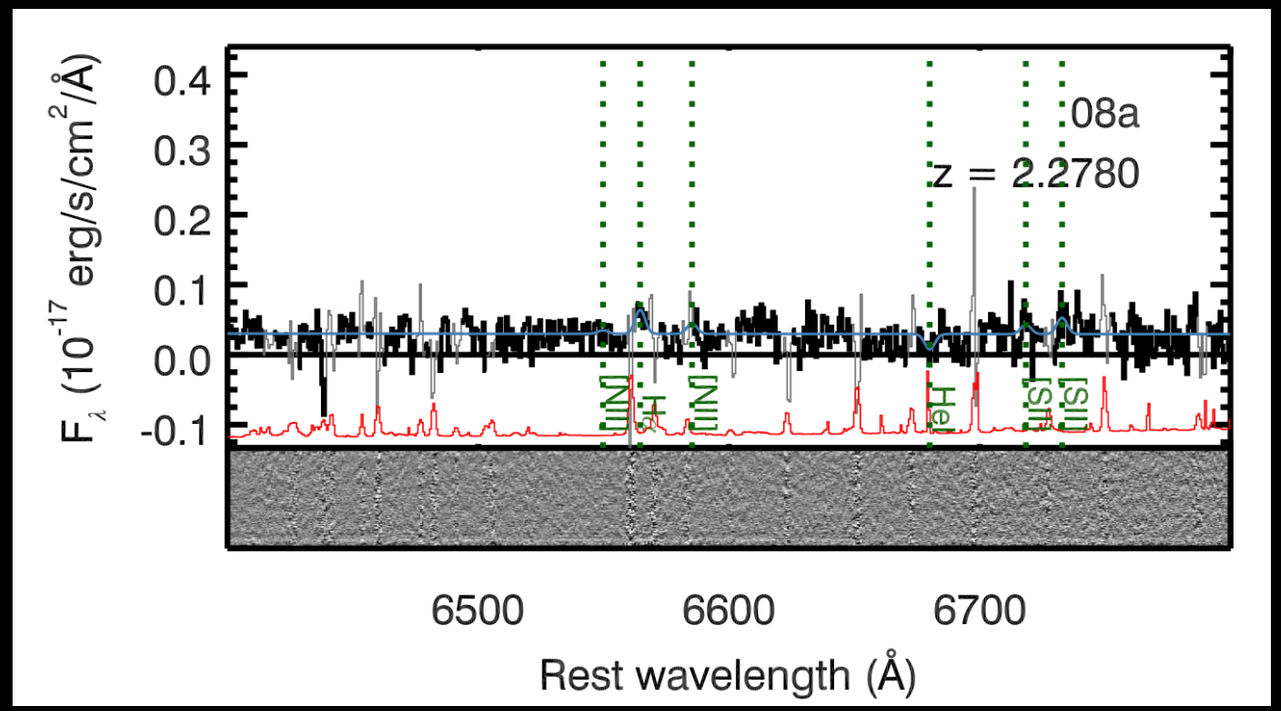
“You’re at Caltech. You should put in a Keck proposal.”

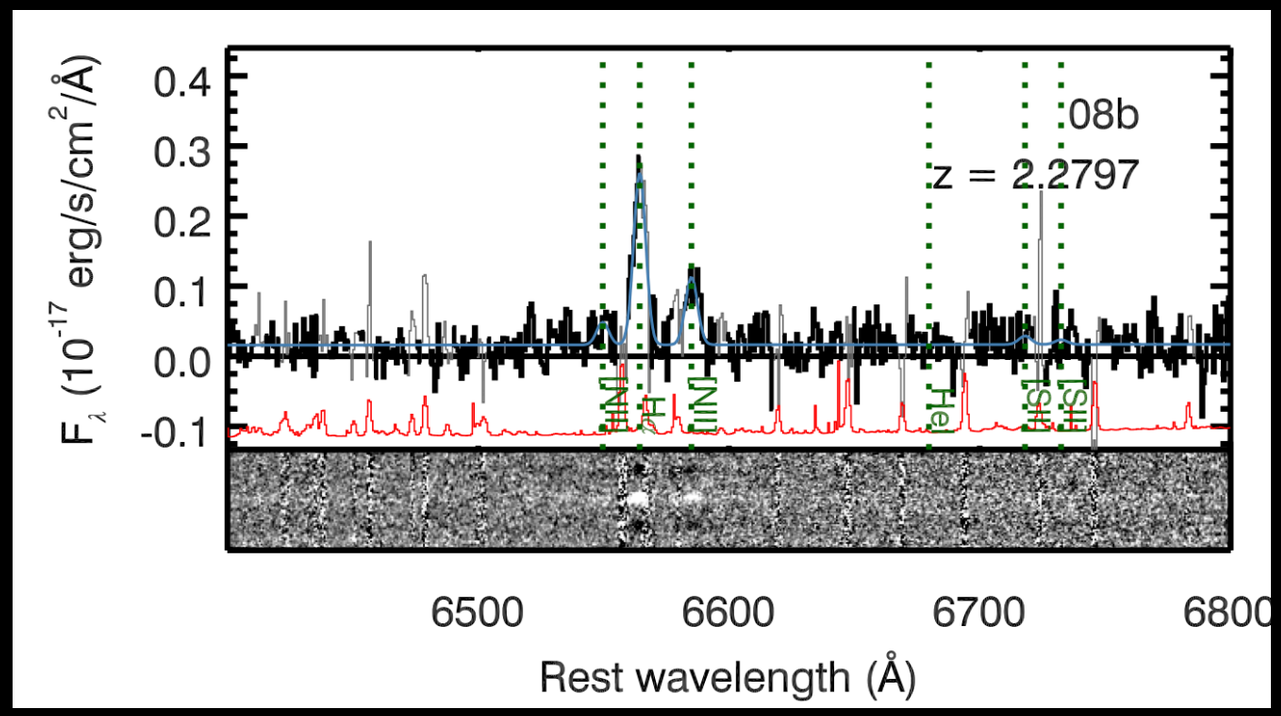
— Nick Scoville

“If you see an observational paper with a theorist as lead author be very afraid.”

— Ian’s Fifth Rule of Observational Cosmology

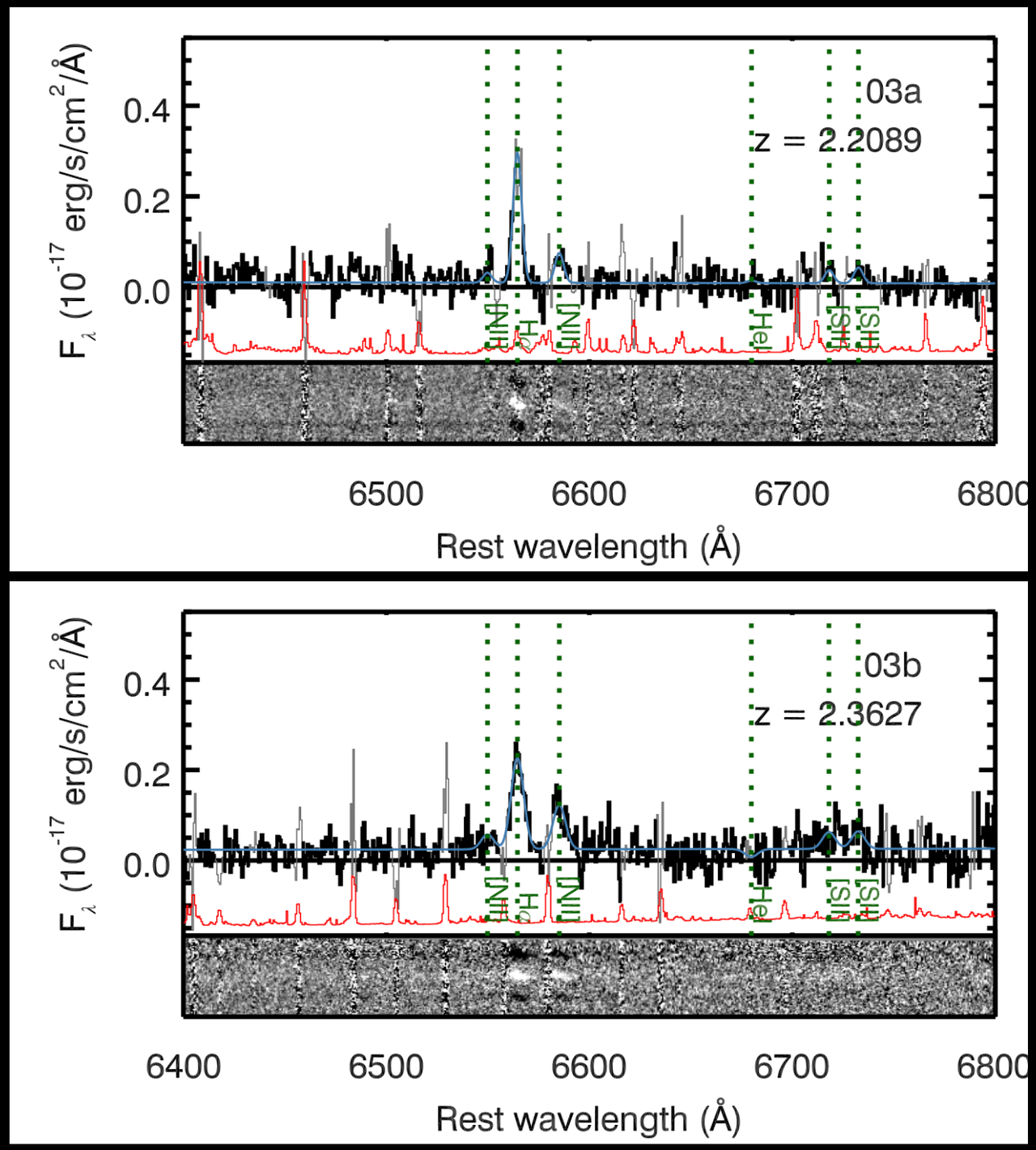
Examples: association (but not merger)





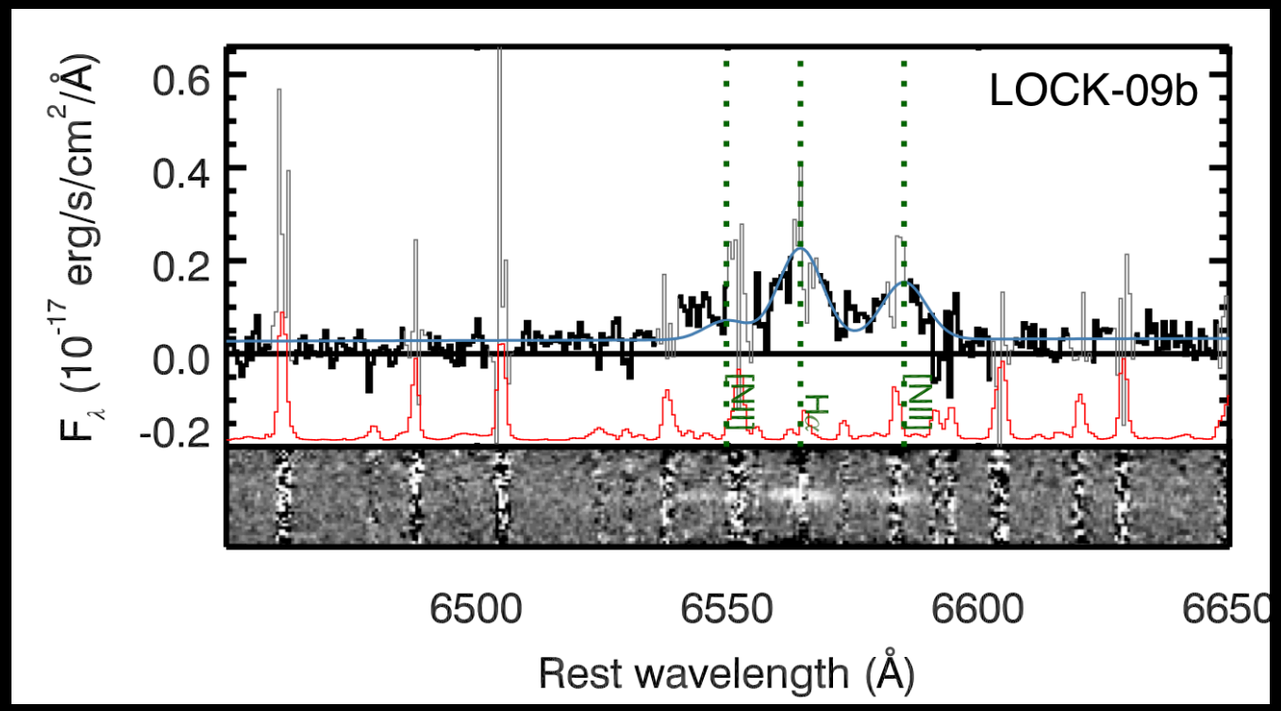
CCH, Chapman, Steidel+, in prep

Examples: projection

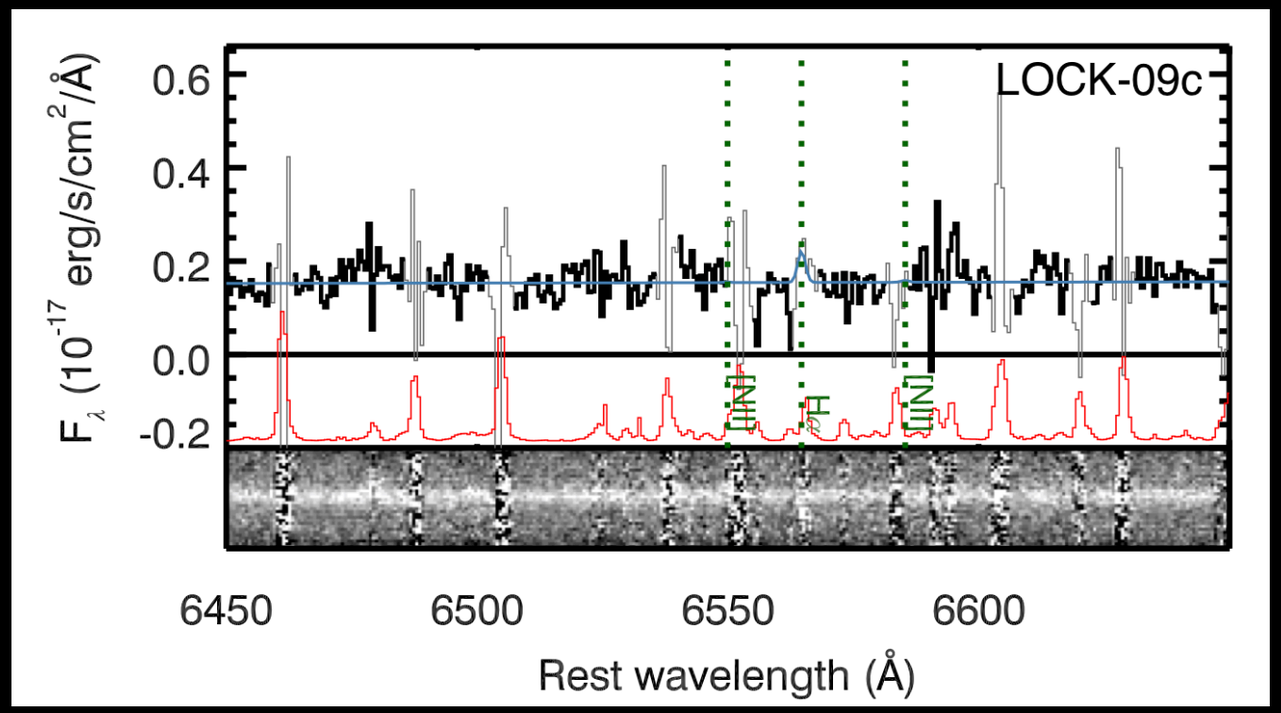


CCH, Chapman, Steidel+, in prep

Examples: ambiguous (but likely projection)



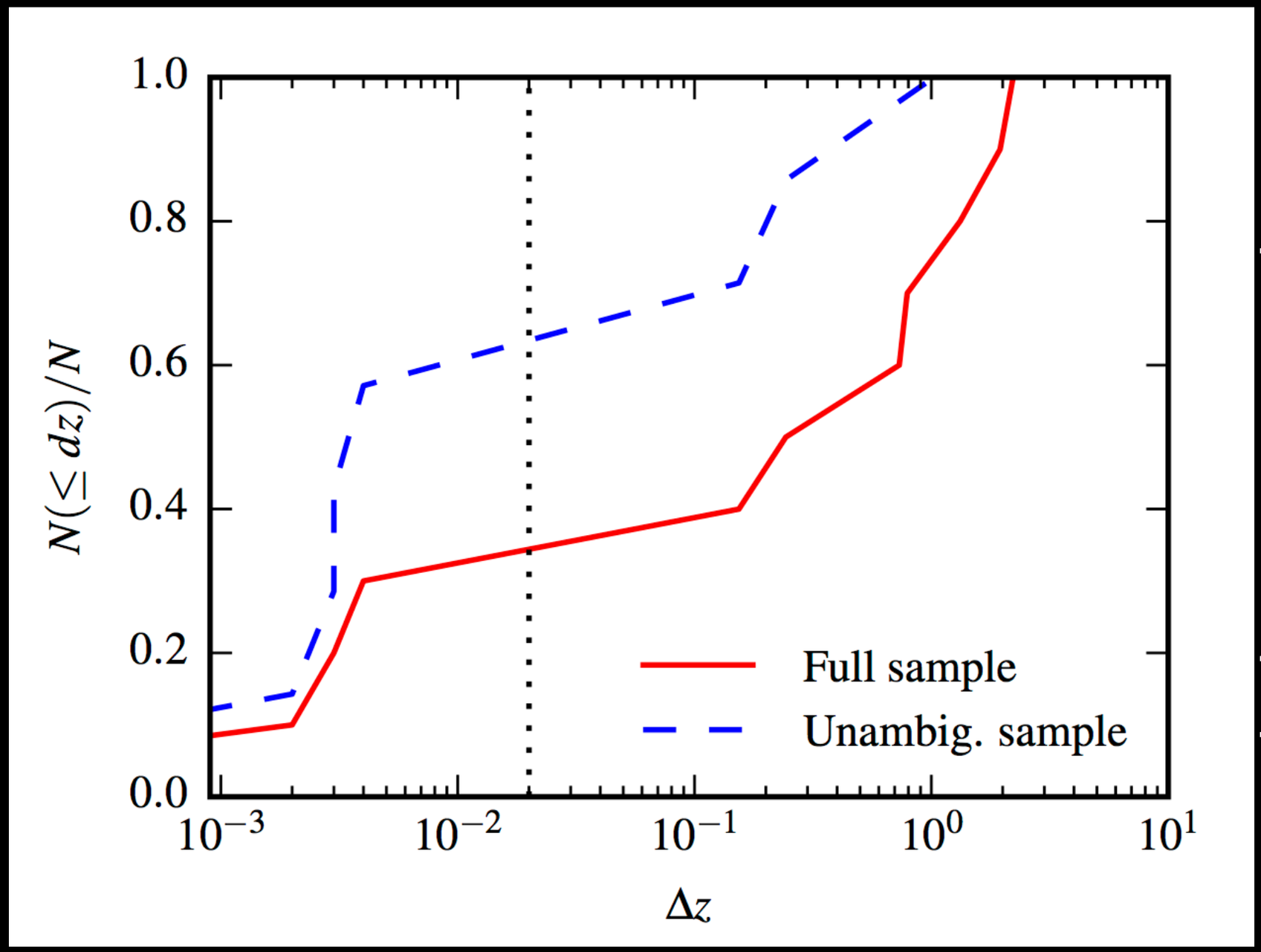
z = 1.6324
SFR_{850} ~ 500 M_{sun}/yr
$SFR_{H\alpha}$ = (5.6+/-0.2) M_{sun}/yr



z_{phot} = 0.90+/-0.05
$SFR_{H\alpha}$ < 0.5 M_{sun}/yr (3σ)

CCH, Chapman, Steidel+, in prep

How common are chance projections?



CCH, Chapman, Steidel+, in prep

Majority of our submm sources contain at least one unassociated SMG; more consistent with CCH, Behroozi+13 than Cowley+15 (but small sample)

Summary

- Multiple very different theoretical models predict chance projections should be common
- Reasons: (1) large beam, (2) negative K-correction, & (3) mergers only weakly submm boost flux
- Spectroscopic followup of resolved submm sources indicates that majority are comprised of at least one unassociated SMG, in qualitative agreement with model predictions
- Open question: our sample is small and likely biased; what chance projection fraction will larger, unbiased studies find? How does it depend on e.g. single-dish submm flux?