

ALMA 1.1 mm extragalactic survey in GOODS-South Field – First results

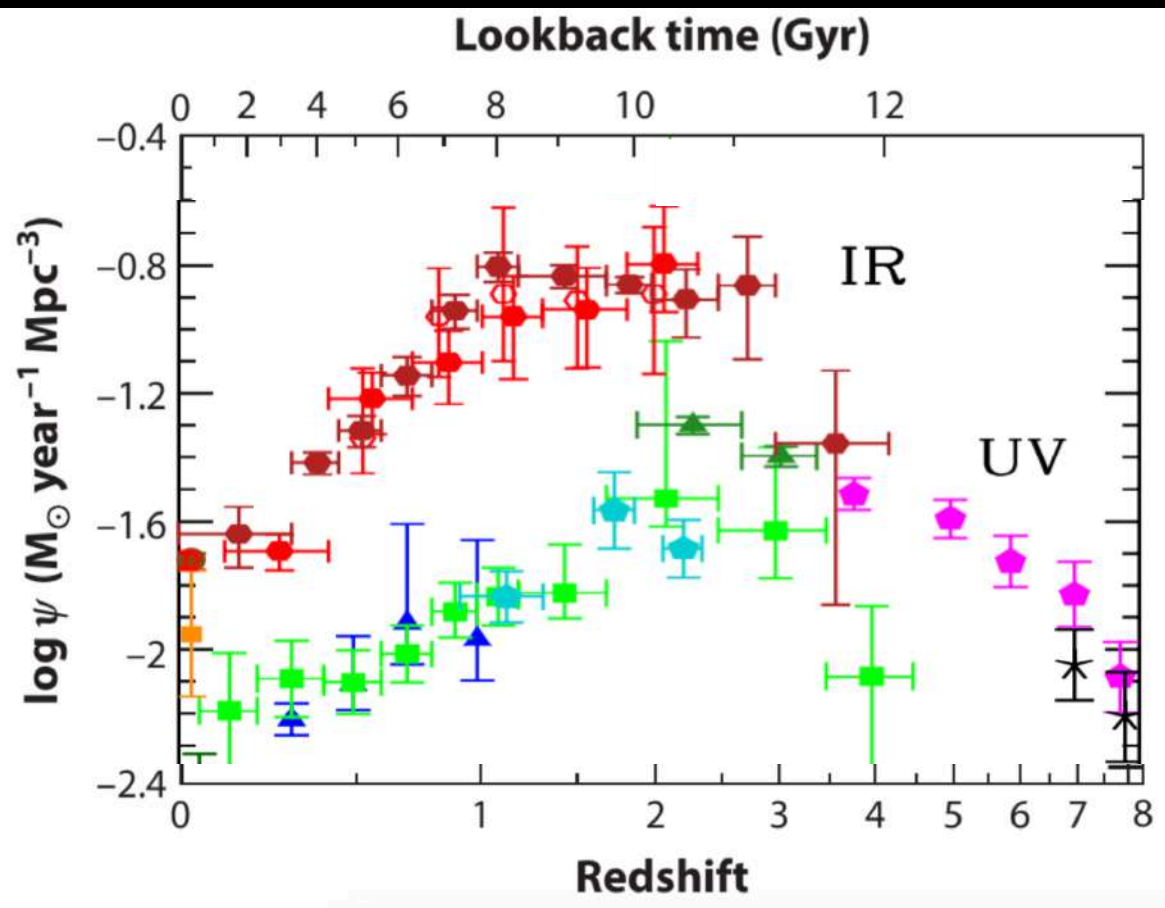
Maximilien FRANCO (SAP CEA-Saclay)



DE LA RECHERCHE À L'INDUSTRIE



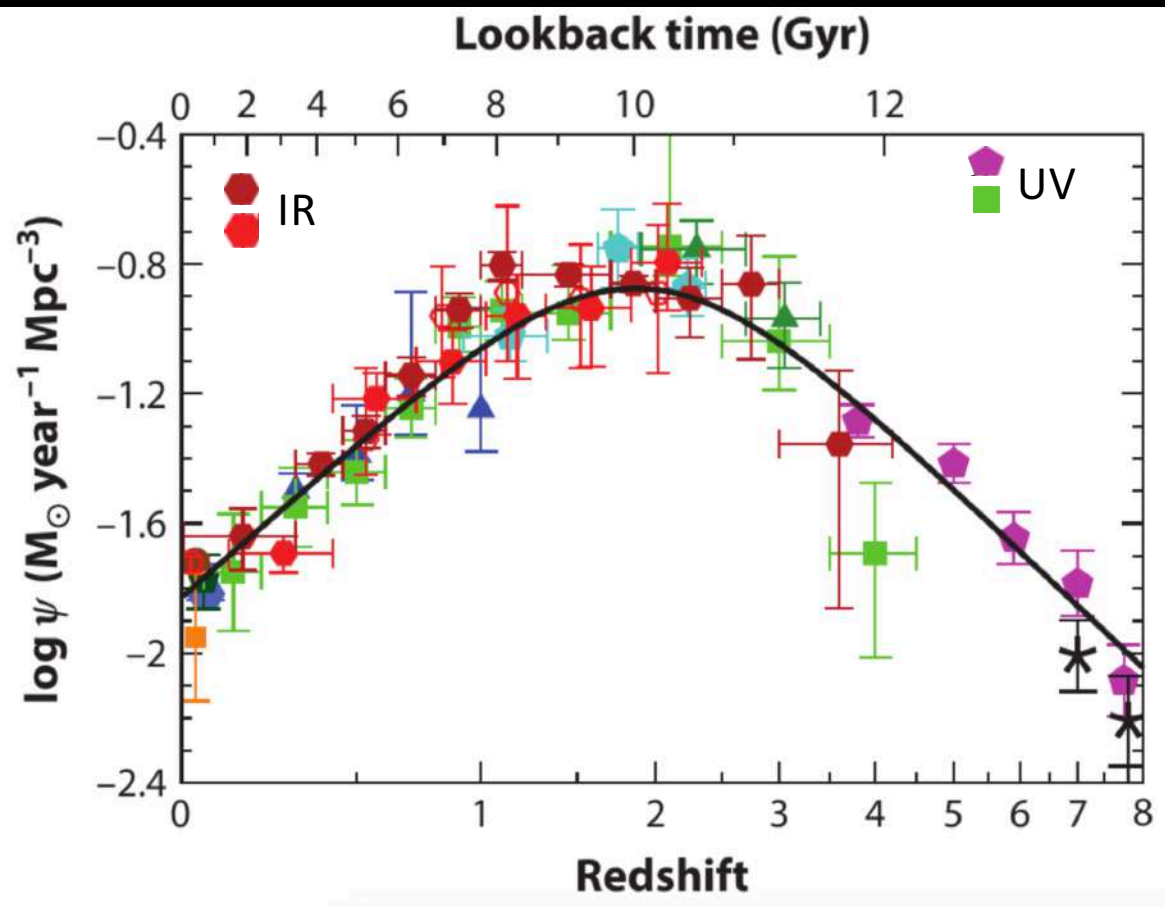
The cosmic star formation history



- Peak of the star formation density $z \sim 2$
- Then declined
- $z < \text{peak}$ constrained by MIR/FIR/radio observations
- $z > 3$ mostly based on solely UV-selected samples

Madau & Dickinson 2014

The cosmic star formation history

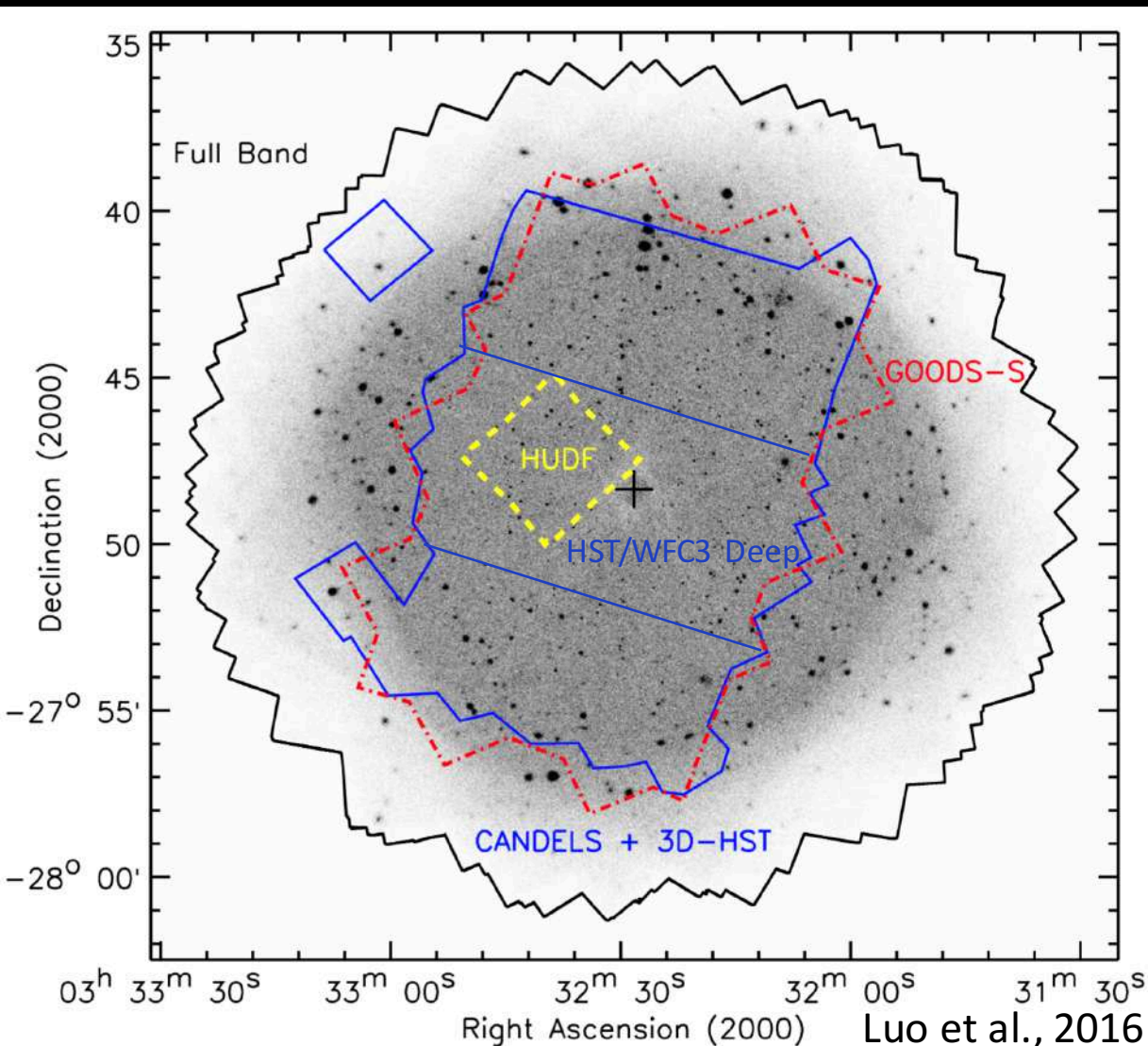


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The GOODS-South Field

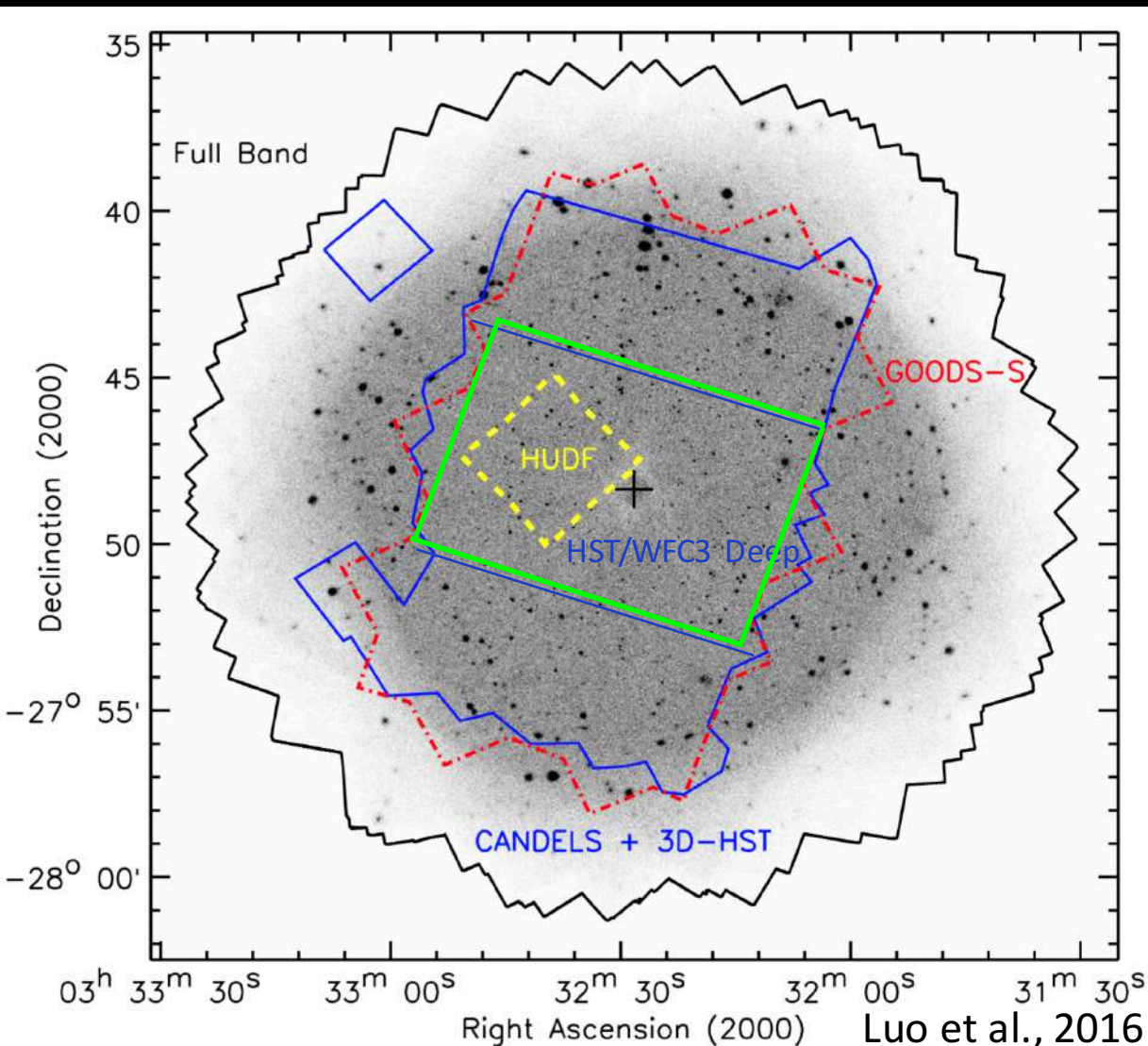
A multi-wavelength view



- Optical/near-infrared
 - WFC3/IR
 - ACS
 - HAWK-I Ks
 - ISAAC Ks
 - VIMOS U
 - FourStar
- Mid-Far IR
 - IRAC
 - MIPS
 - PACS
 - SPIRE
- Radio
 - JVLA (CO-I)
- X-Ray
 - Chandra 7Ms

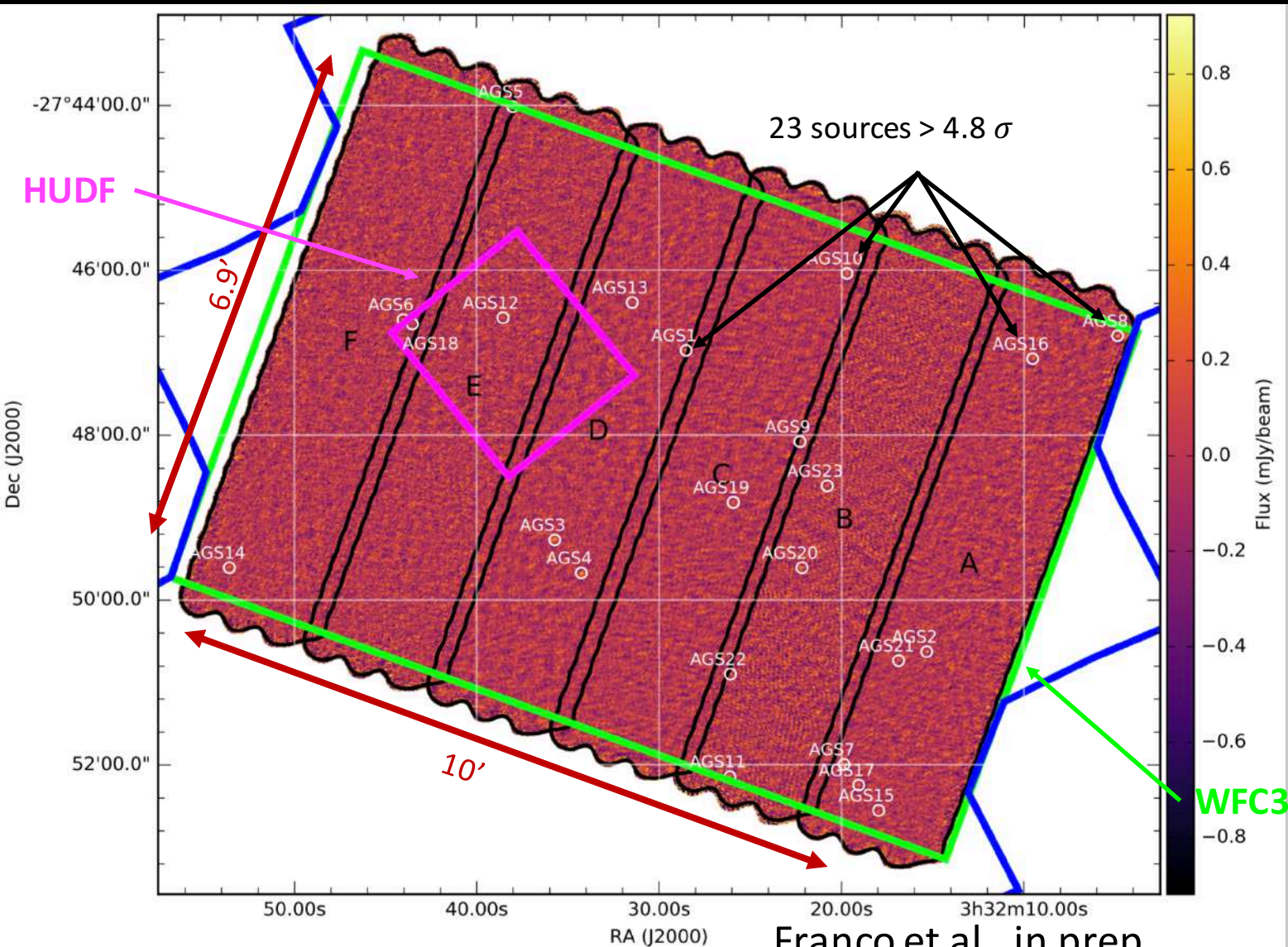
The GOODS-South Field

A multi-wavelength view



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Our ALMA 1.1mm survey



Observation:
~22 h

Size: 69' ■

Comoving scale
15.1 x 10.5 Mpc
at $z = 2$

Depth:
Rms ~ 0.185 mJy

Resolution:
Intrinsic
 $\theta = 0.2''$

Homogeneous
 $\theta = 0.29''$

Tapered
 $\theta = 0.60''$

Selection criteria

Determination of the detection threshold

Below this threshold :

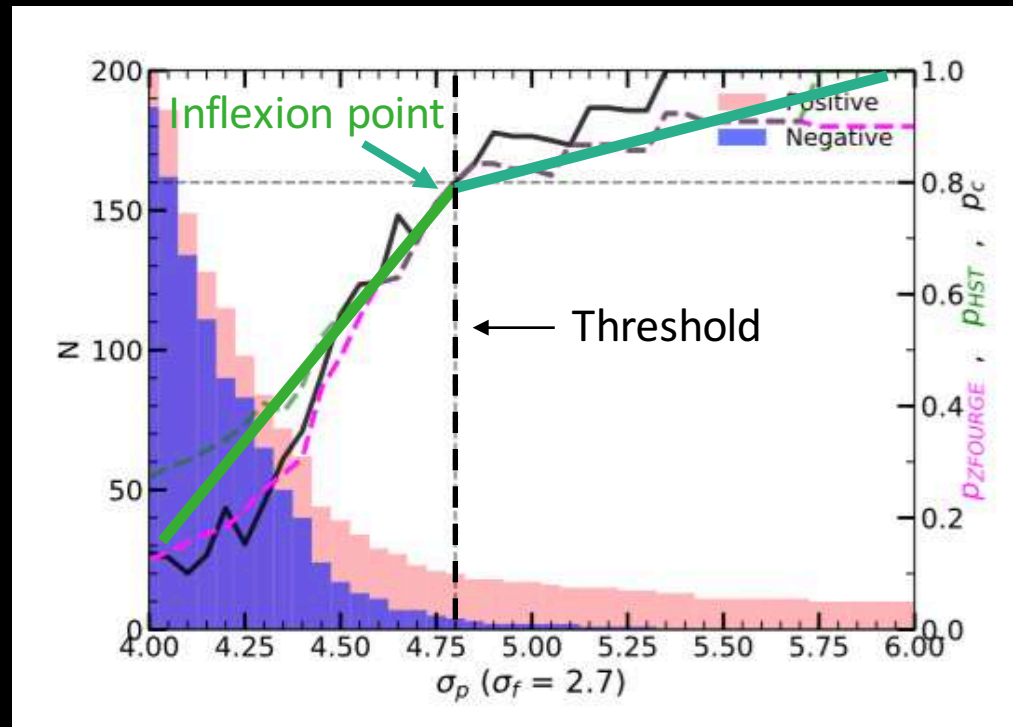
Higher proportion of sources without HST counterpart

Fidelity criterion = 80 %

HST counterparts = 80 %

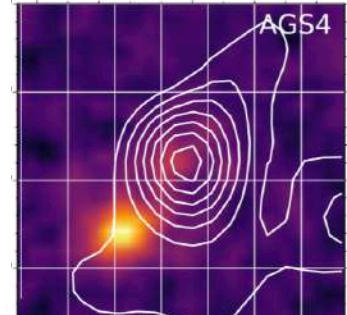
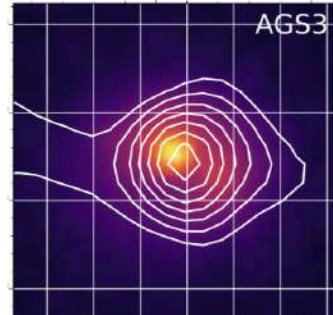
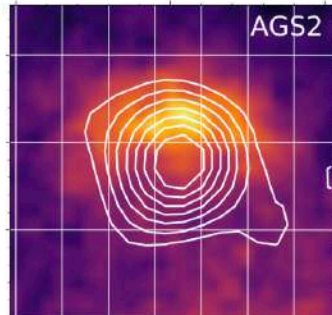
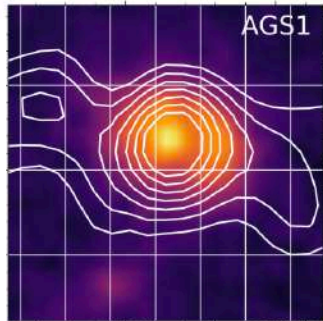
$$\text{Fidelity criterion : } P_c = 1 - \frac{N_n}{N_p}$$

$$\% \text{ optical counterpart } p_{\text{HST}} = \frac{N_{\text{HST}}}{N_{\text{total}}}$$



Cumulative number of positive (red histogram) and negative (blue histogram) detections

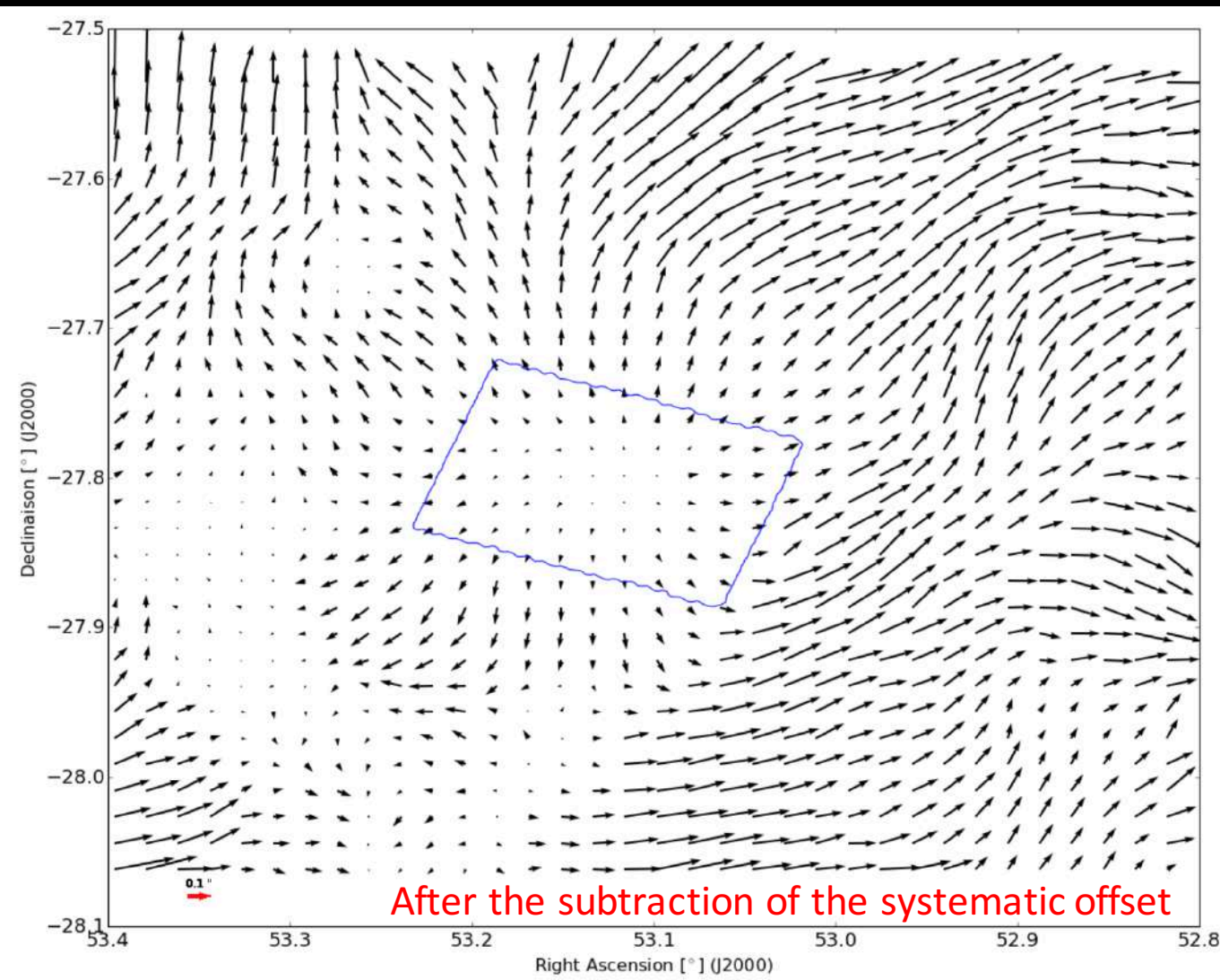
ALMA detections



1.8''

Franco et al. , in prep

GOODS-South ALMA-HST offset



Systematic offset

Previously found :

$$\Delta\alpha = 80 \pm 110 \text{ mas}$$

$$\Delta\delta = -260 \pm 130 \text{ mas}$$

(Rujopakarn et al. (2016))

This work :

$$\Delta\alpha = 94 \pm 42 \text{ mas}$$

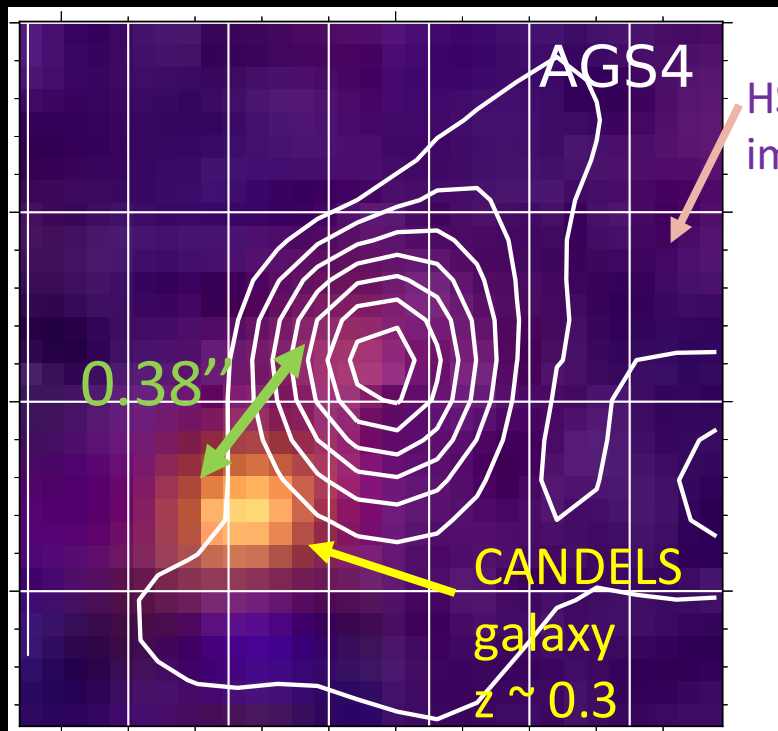
$$\Delta\delta = -262 \pm 50 \text{ mas}$$

(Franco et al. , in prep)

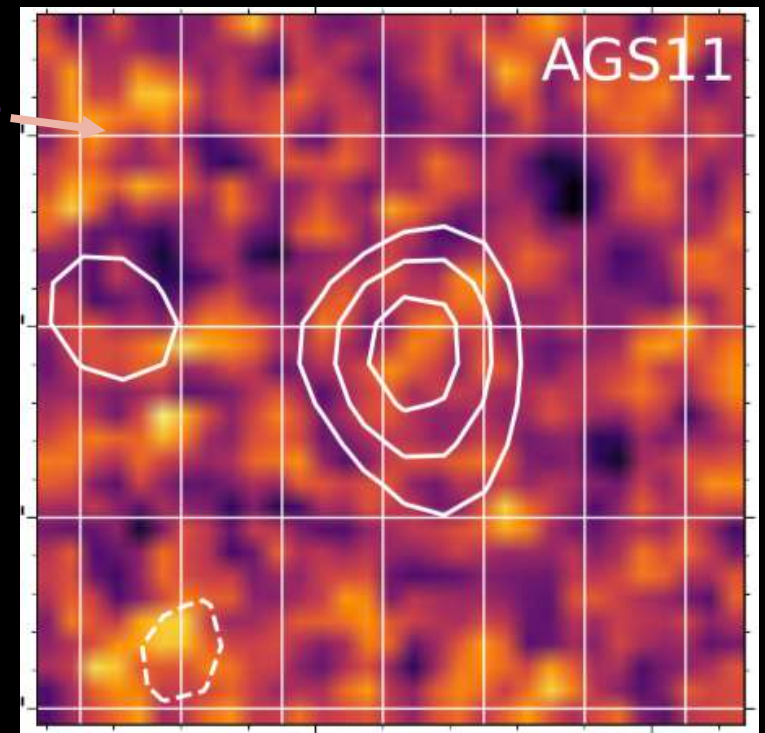
After the subtraction of
the systematic offset

Discovery of a local offset

ALMA unveils a new population of HST-dark galaxies ($\sim 15\%$)

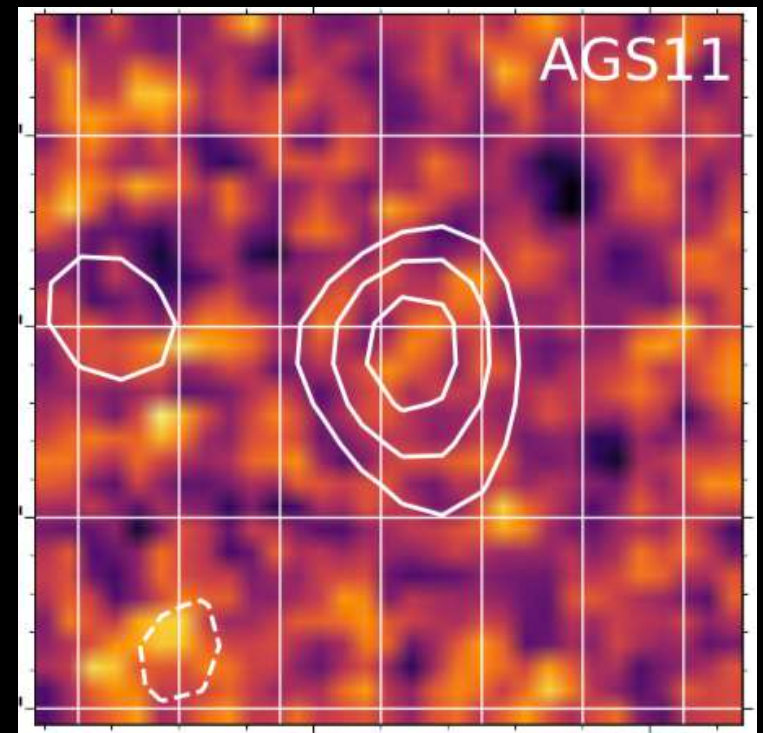
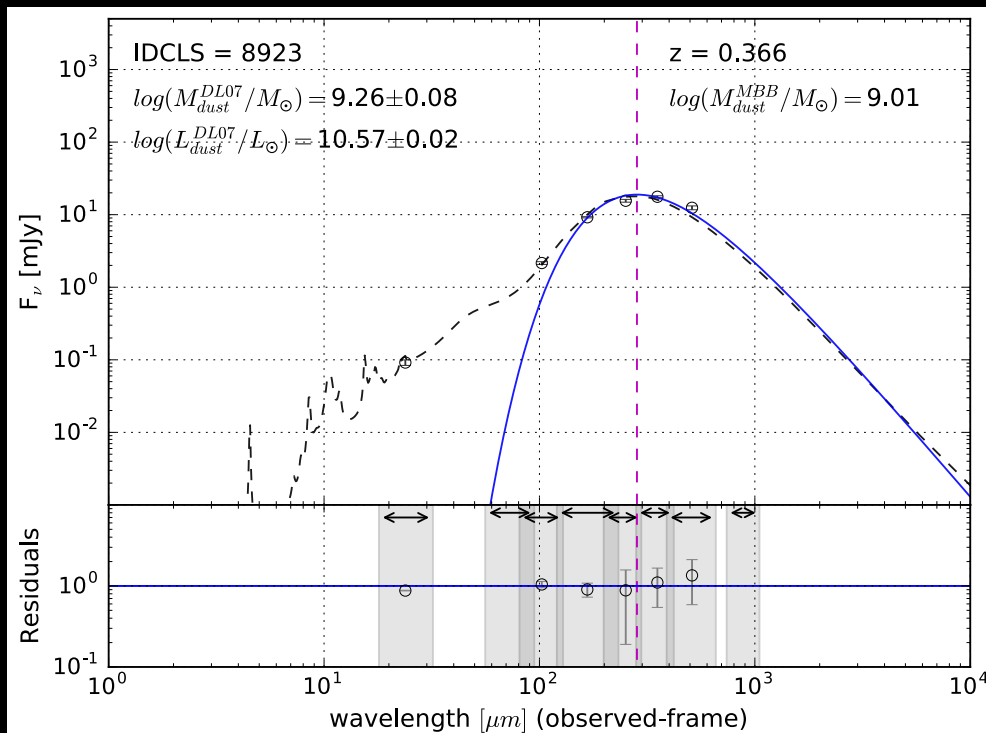


1.8"



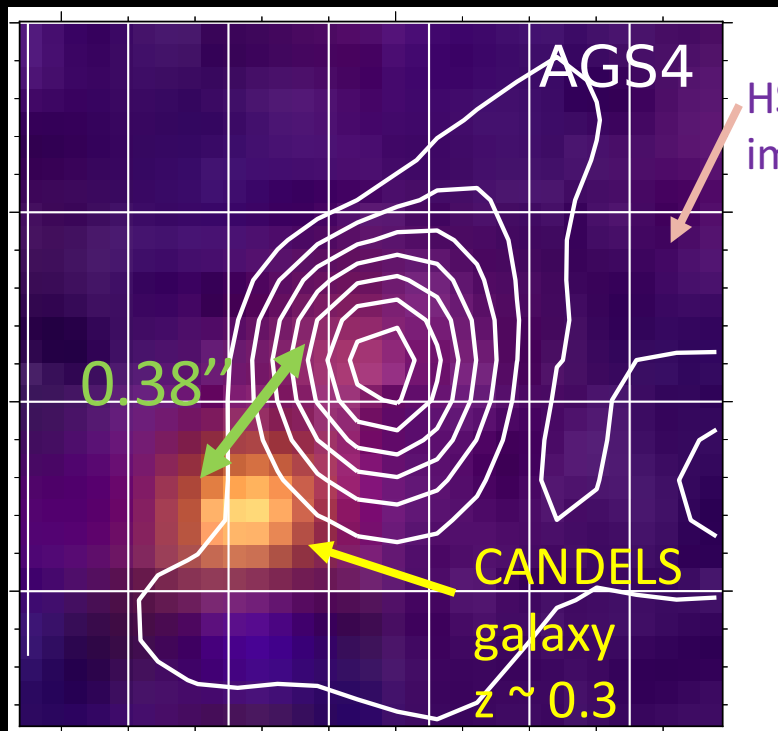
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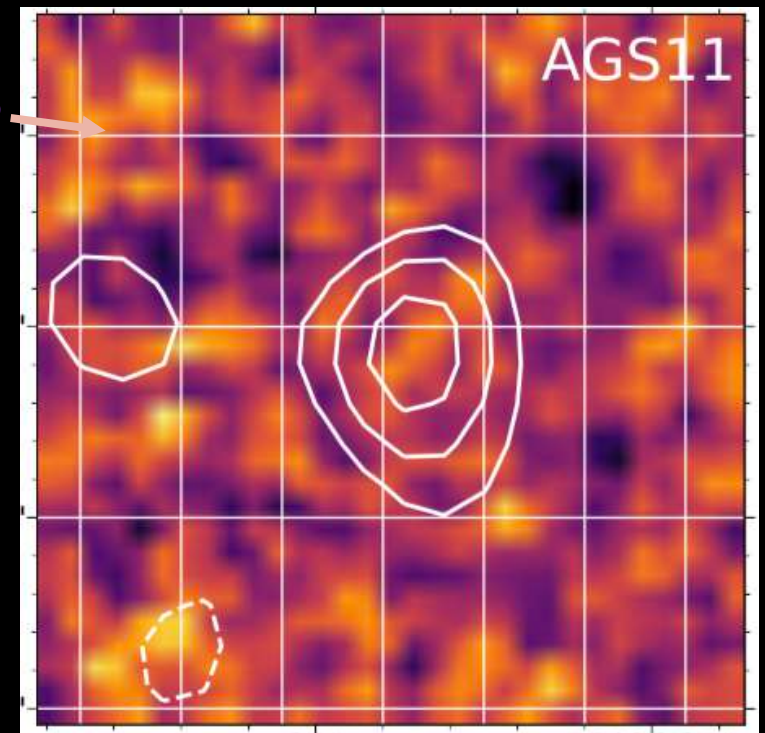


1.8''

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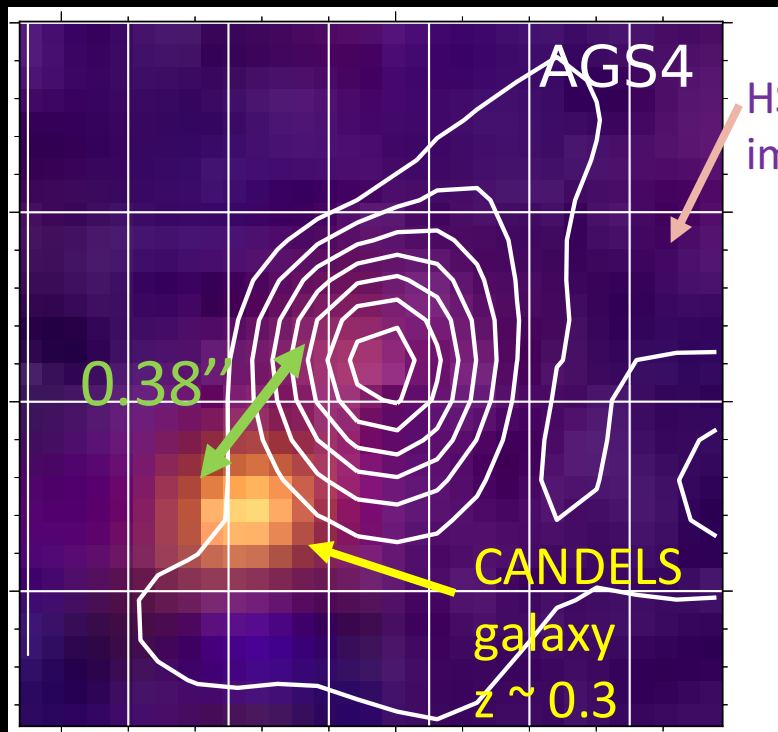


1.8"

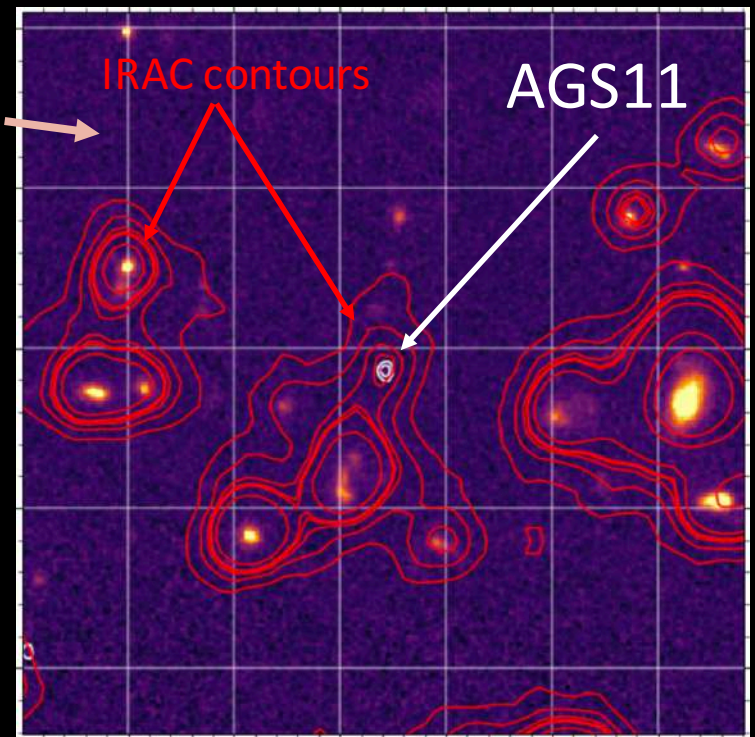


1.8"

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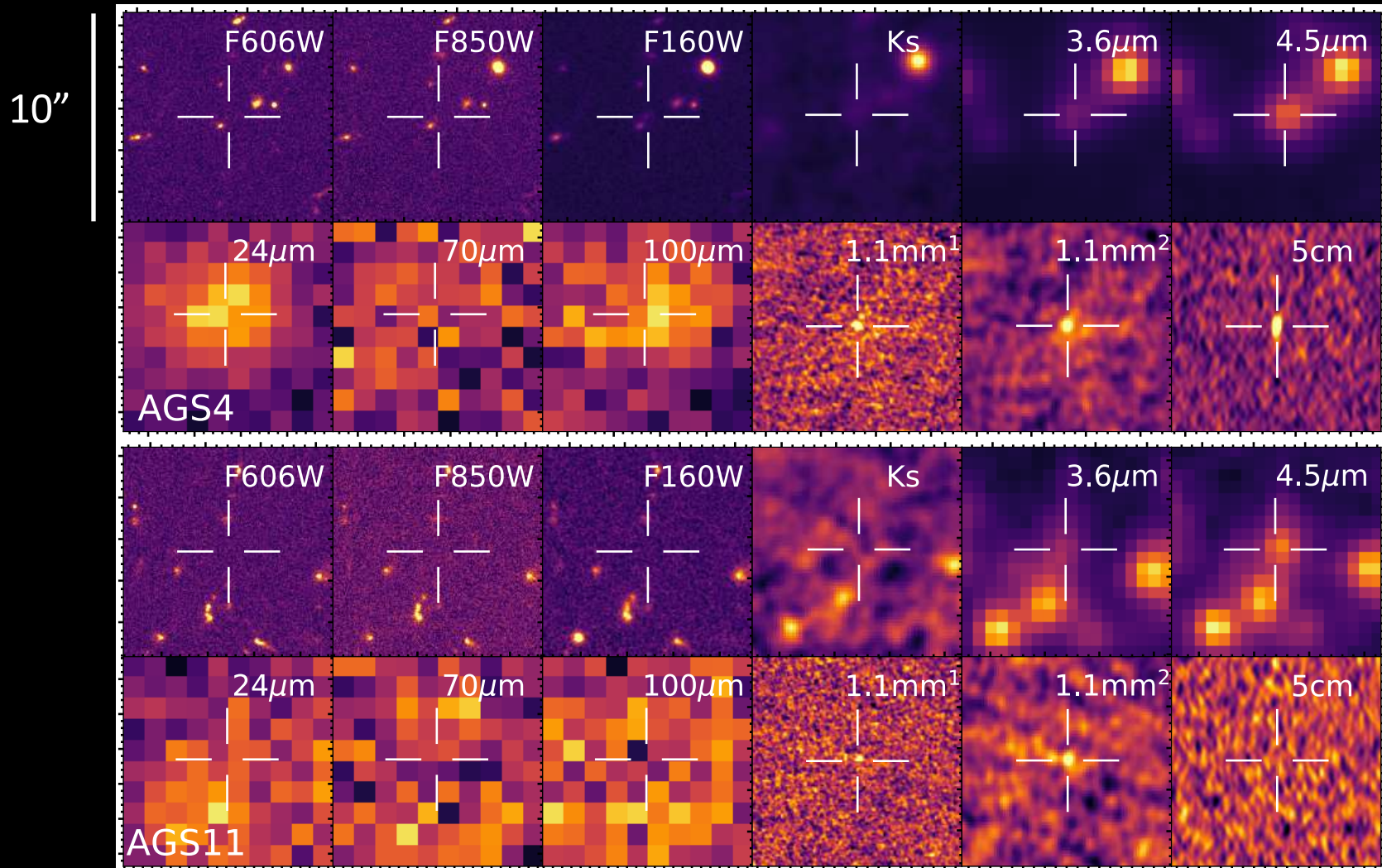


1.8"



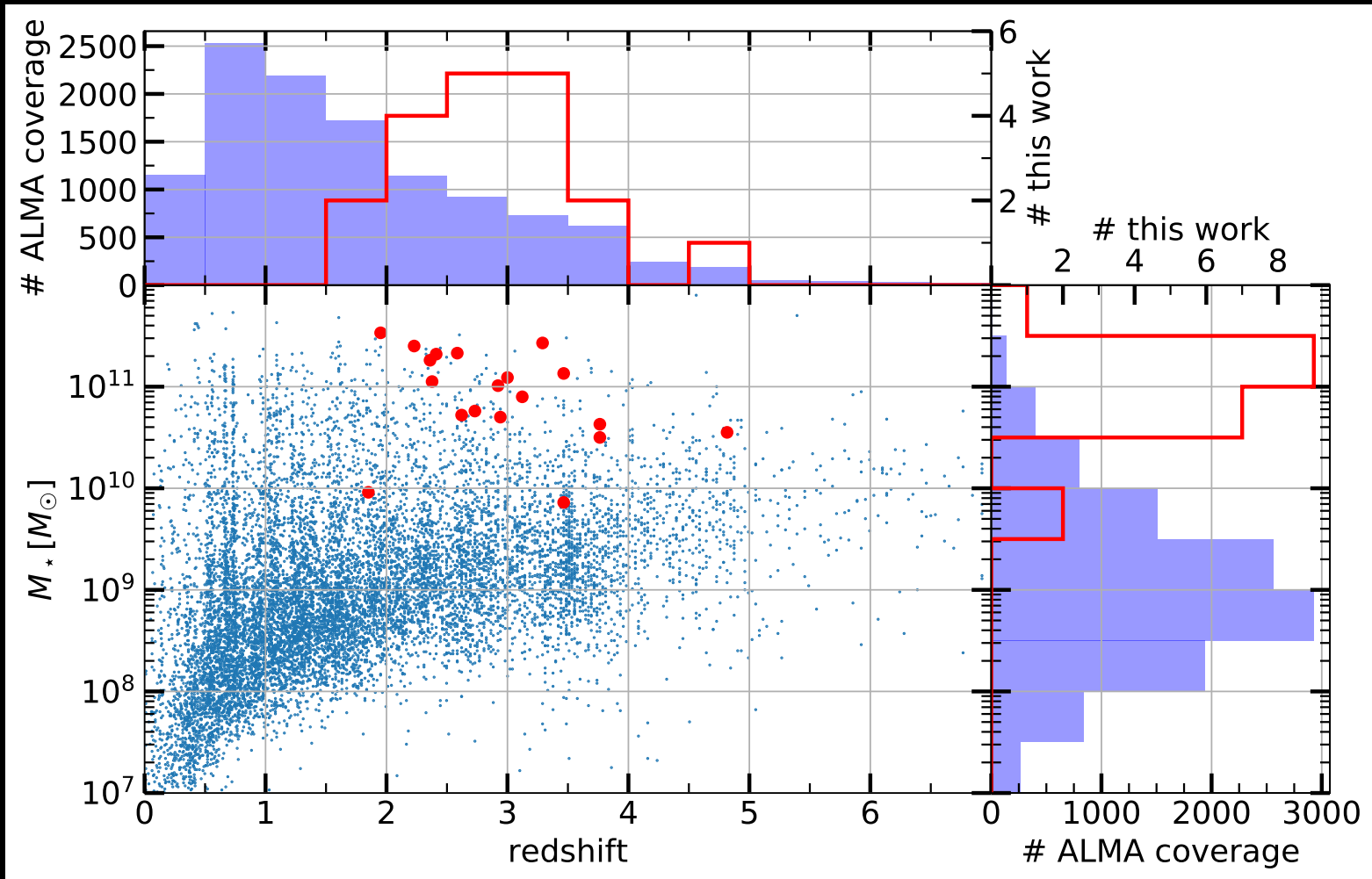
18"

ALMA unveils a new population of HST-dark galaxies ($\sim 15\%$)

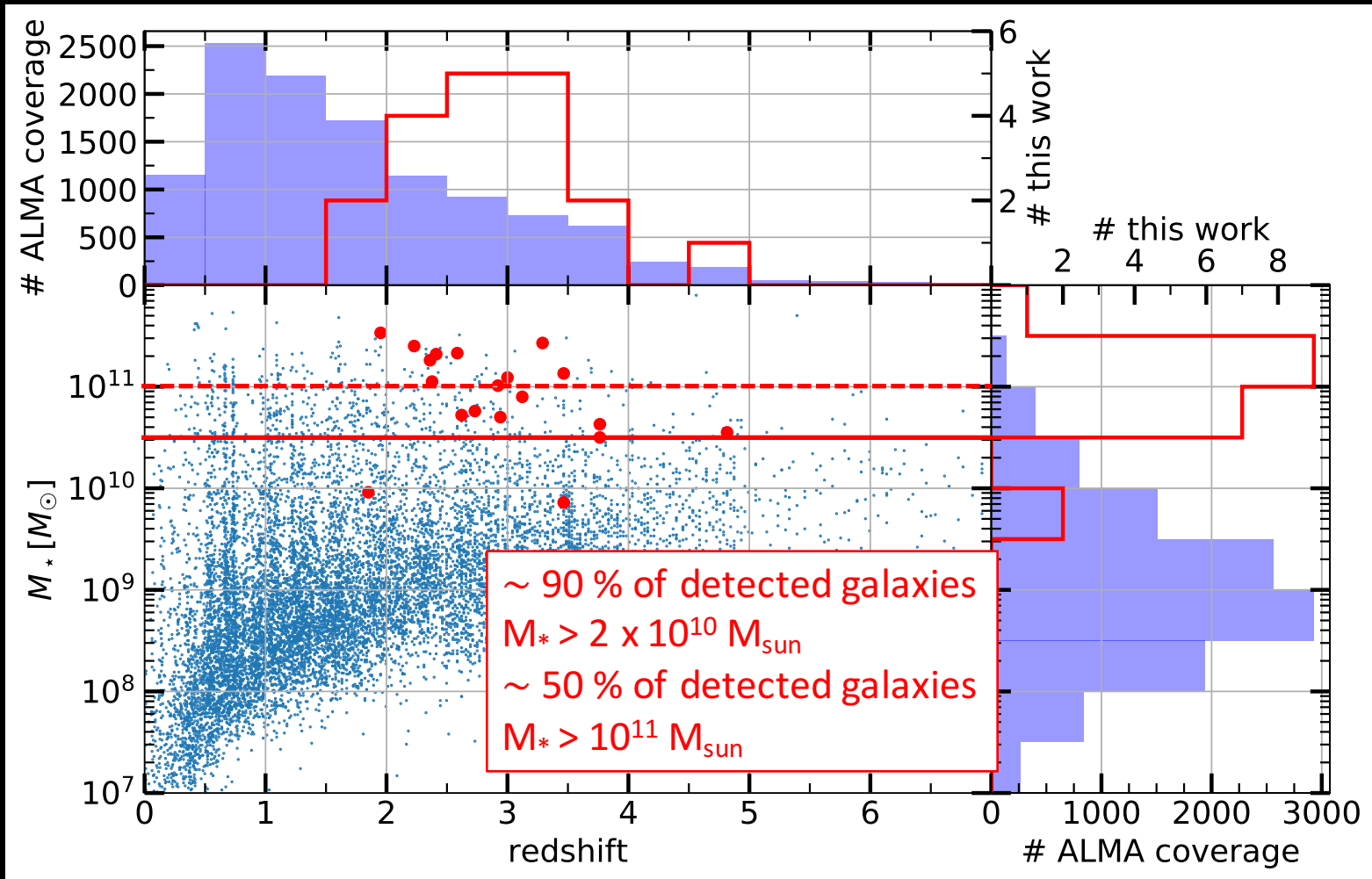


What is the nature of the ALMA
detected galaxies ?

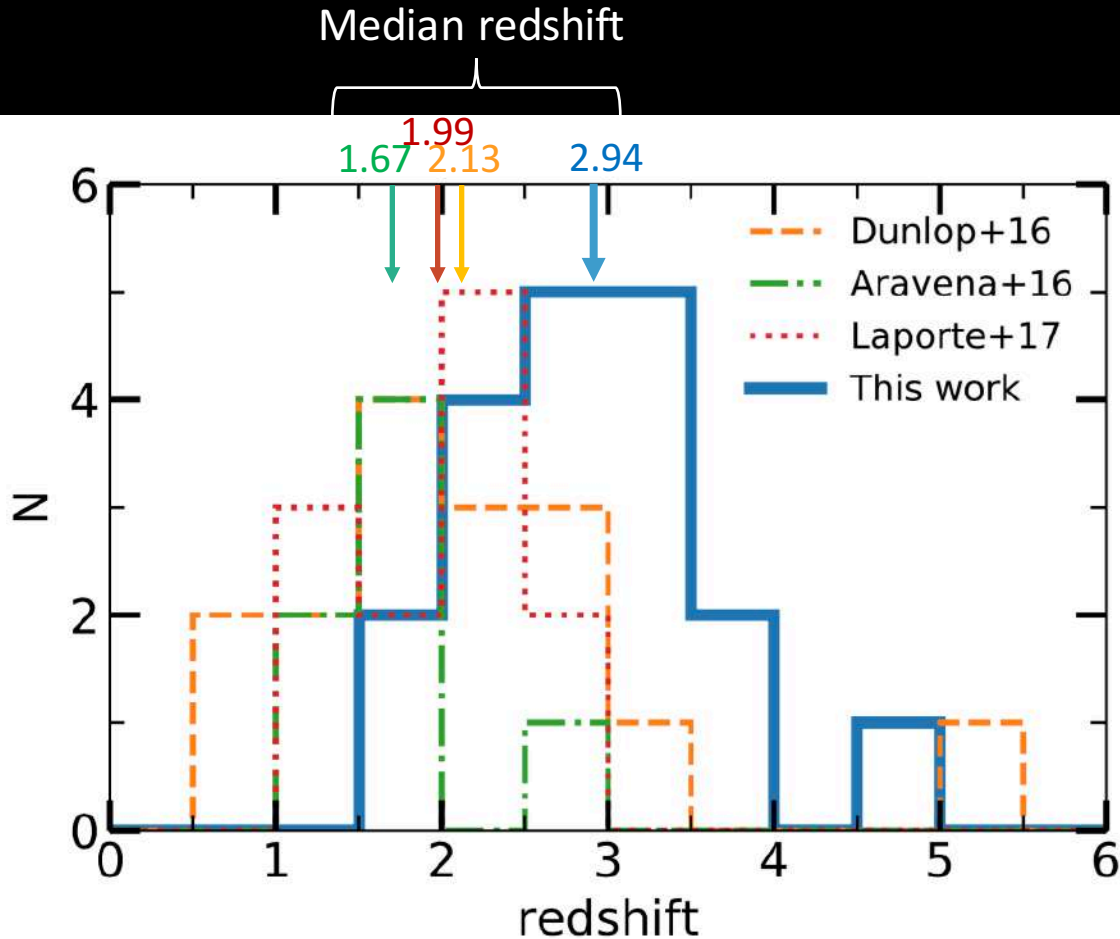
ALMA detects distant massive SFGs



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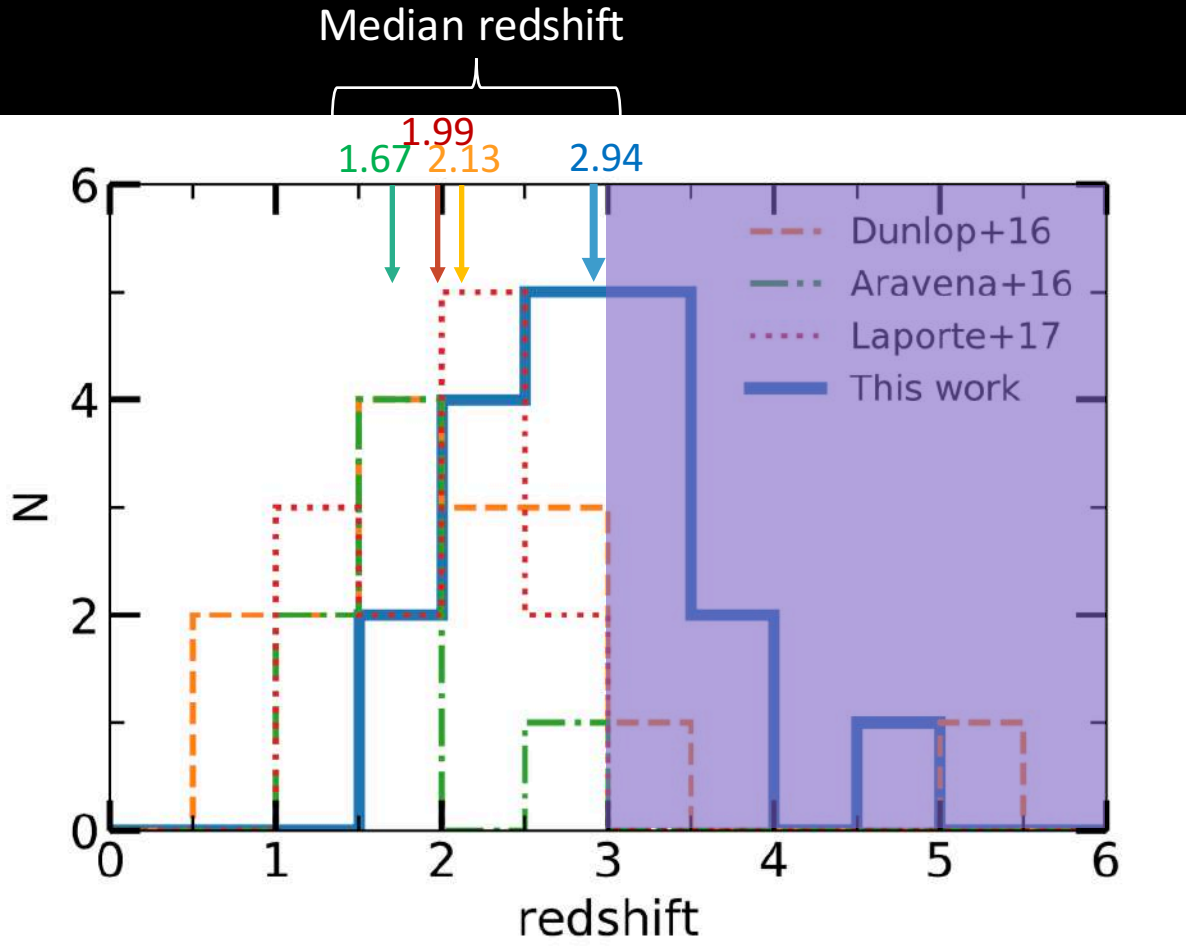
Redshift distribution



Opening of a new parameter space at $z > 3$

Partly or totally missed in smaller blind survey

Redshift distribution



Opening of a new parameter space at $z > 3$

Partly or totally missed in smaller blind survey

Summary

- Largest ALMA blind survey
- Unbiased survey

- Median redshift $z \sim 2.9$
- Median stellar mass $\sim 10^{11.13} M_{\text{sun}}$

- Reveals a population of HST-dark galaxies