PICO Legacy

S3/S4: strongly lensed galaxies

- Based on the counts of candidate strongly lensed galaxies detected by the SPT survey I estimate that also S3/S4 could detect a few thousands strongly lensed galaxies.
- Due to the shape of the dust emission SED, PICO will be more efficient at detecting objects at $z \leq\leq 2$, while the longer wavelength observations of S3/S4 will be more effective at detecting those at z>3. Thus the two surveys are largely complementary.
- The sub-mm PICO measurements will be essential to characterize the emission peak, hence to derive basic quantities like the total IR luminosity, hence the SFR.

S3/S4: protoclusters

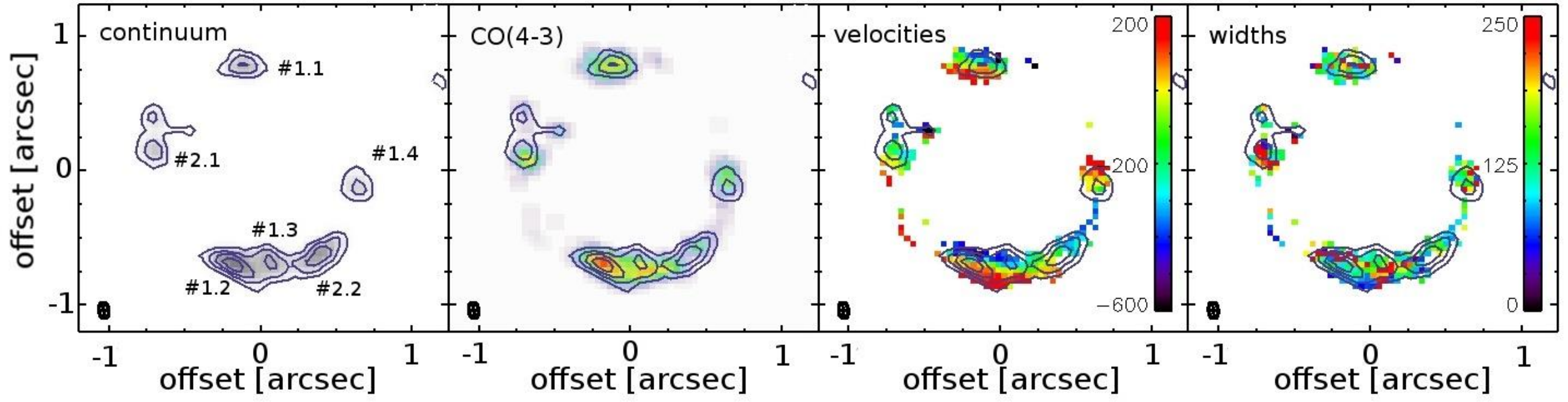
assumed dust temperature), the IR luminosity and the SFR of each source.

- The S3/S4 surveys also have a resolution well suited for proto-cluster detection. However, since most of detectable proto-clusters should be at relatively low redshifts ($z < 3$), their signal is much lower at the longer S3/S4 wavelengths.

- Thus proto-clusters are considerably easier to detect at the highest PICO frequencies.

- As in the case of strongly lensed galaxies, the S3/S4 data will contribute to determining the SED, hence the photometric redshift (for an assumed dust temperature), the IR luminosity and the SFR of each source.

ALMA

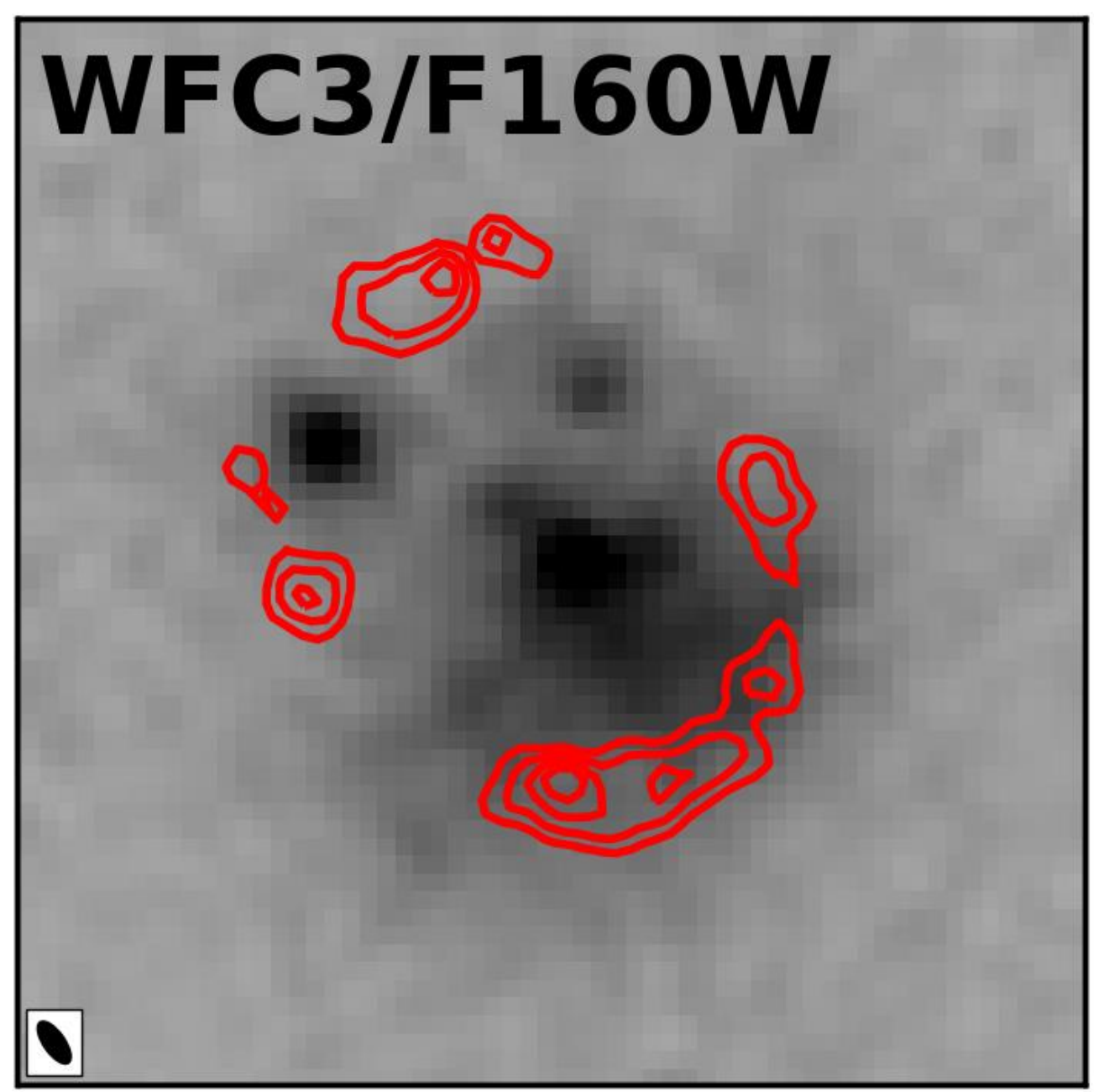


Continuum and CO(4-3) ALMA images of the strongly lensed galaxy PLCK_G244.8+54.9 at z ≈3.0 (Canameras et al. 2017) with an estimated magnification $\mu \approx 30$. The combination of extreme brightness, ALMA resolution (0.1″ in this case) and gravitational stretching of the images (by $\mu^{1/2}$, on average) results in a spatial resolution of ≈ 60 pc, substantially smaller than the size of Galactic giant molecular clouds.

Unlensed galaxies at this z are hardly resolved even by ALMA or by the HST.

CO spectroscopy has allowed the measurement of the kinematics of the molecular gas with a typical uncertainty of 40-50 km/s.

HST/JWST

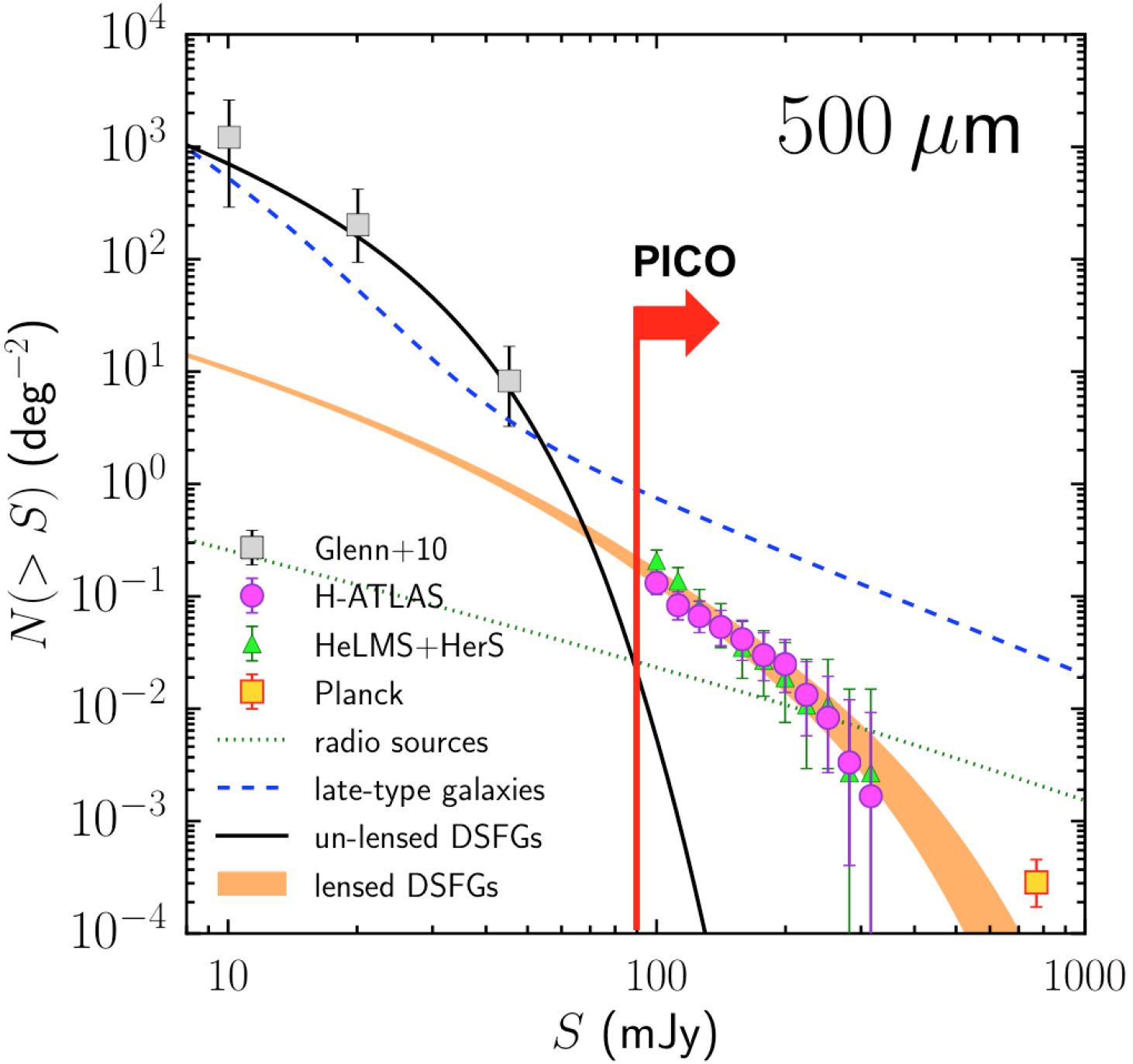


ALMA observations allow us to determine the galaxy morphology to

- investigate the mechanisms driving the star-formation: in situ processes? interactions? mergers?
- resolve star-formation regions, determining their shapes, sizes and surface brightnesses.

HST images of the lens, a red galaxy at z=1.525, have yielded the first direct constraint on the IMF in a z=1.5 galaxy which is not a cluster central galaxy. A detailed study of the total mass density profile is also possible. For comparison, the redshift distribution of deflectors of optically selected lensed galaxies peaks at z≈0.4.

Large-area redshift surveys



PICO will also detect tens of thousands dusty galaxies at z ≤0.1, providing a complete census of cold dust in the local universe, complementing the IRAS survey, sensitive to warmer dust.

Ongoing or forthcoming wide-angle redshift and photometric surveys (TAIPAN, LoRCA, SPHEREx, …) will provide distance information for the majority, if not all, such galaxies.

PICO will add a significant contribution to the characterization of the properties of local galaxies complementing that from radio, IRAS, AKARI, WISE, Euclid, GALEX, ROSAT, eROSITA …