# Observational constraints on gas and dust protoplanetary disc radii in the Taurus multiple systems

Alessia A. Rota*[1,2], Carlo F. Manara[2], Giuseppe Lodato[1], Anna Miotello[2]
* alessiaannie.rota@studenti.unimi.it
[1] *Università degli Studi di Milano, Milano, Italy*
[2] *European Southern Observatory, Garching bei München, Germany*

## Goal

The goal of our research is to estimate the radii of discs around multiple stellar systems. With this purpuse, we analysed new high-resolution Band 6 ALMA observations of line and continuum emission in seven multiple stellar systems in the Taurus region.

## ALMA view of gas discs in multiples systems

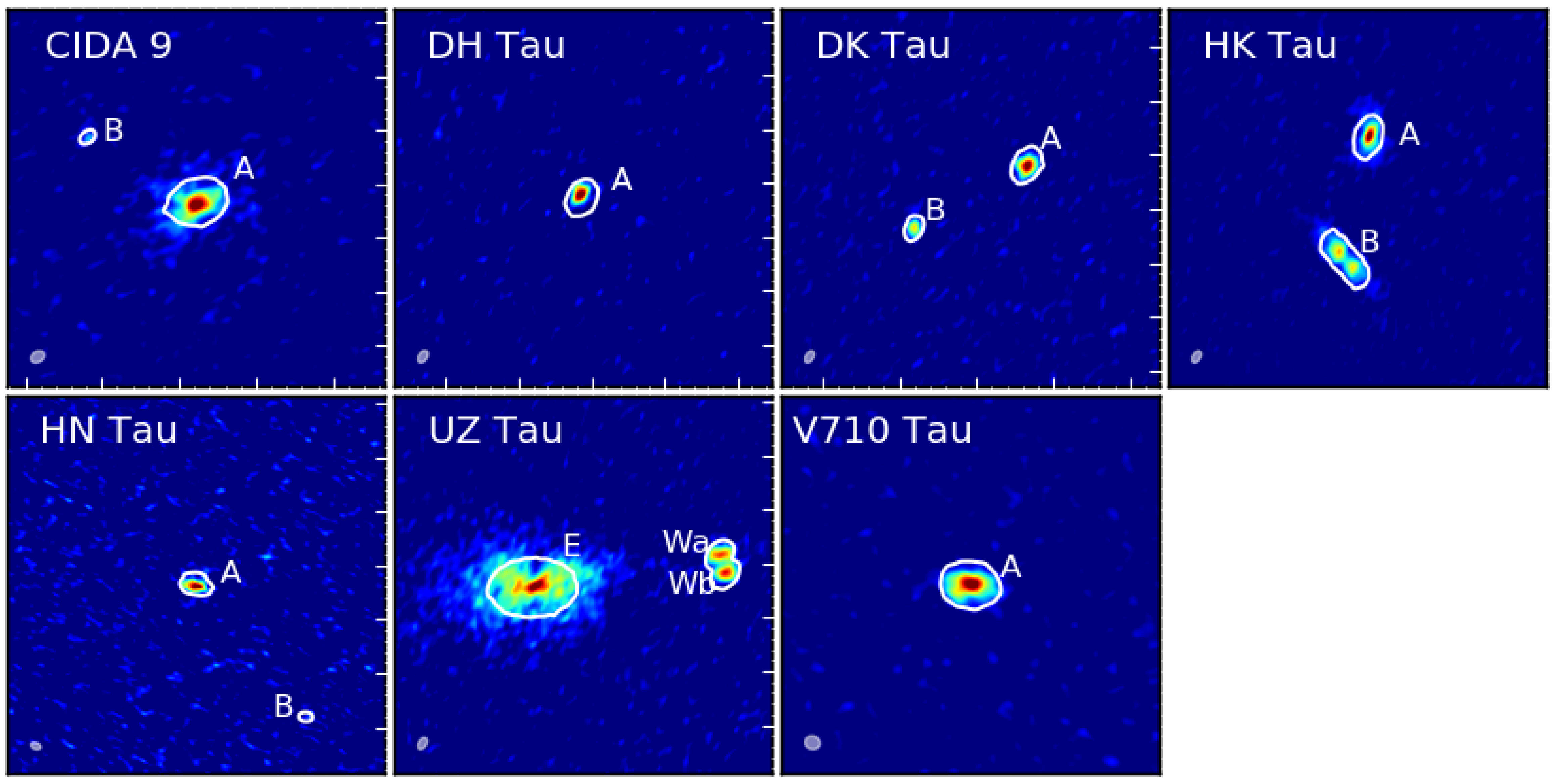


**Fig. 1:** *$^{12}$CO zeroth moment images. All images are 3″.5x3″.5 (∼ 525x525 au) and scaled so that the maximum is equal to the peak flux and the minimum is clipped at twice the image rms. White contours show 5 times the rms of the continuum emission.*

We analysed **7 multiple stellar systems**, with stellar **spectral type from K0 to M3** and **separation** between the component of **0".7– 3".5 (∼ 100–500 au)**. ALMA observation were conducted in **Band 6**, with **resolution of ∼ 0".15** and **integration time of ∼ 40 min/target**. Old observations of dust emission of the same target are presented in Manara et al. (2019), with resolution of ∼ 0".12 and integration time of ∼ 9 min/target.

## Method

We performed an **image plane analysis using the curve of growth method, computing aperture photometry** for each source using the CASA tool *imstat*. For each target we calculated the flux summing over concentric annuli centred in the source centre. We centred two ellipses, corrected for the angular position of the disc, and we calculated the flux in the annulus as the difference between the total flux in the outer ellipse and the total flux in the inner ellipse. We then computed the cumulative sum of the fluxes in the concentric annuli, creating the curve of growth of each target. In this way, we were able to estimate the total flux of each disc and **the disc radius $R_{disc}$ (or $R_{95}$) as the radius containing 95% of the total flux** (red line in Fig. 2) and the effective disc radius $R_{eff}$ (or $R_{68}$) as that containing 68% of the total flux (green line).

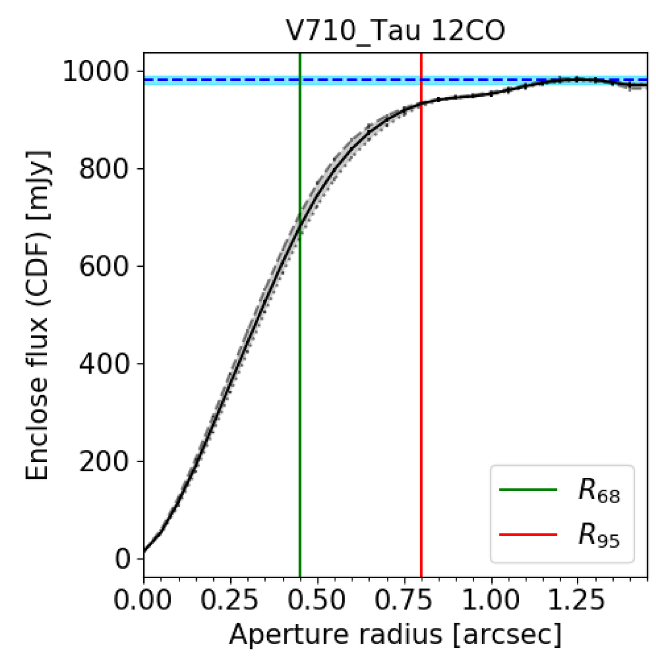


**Fig. 2:** *Example of curve of growth for the radii estimation*

## Results

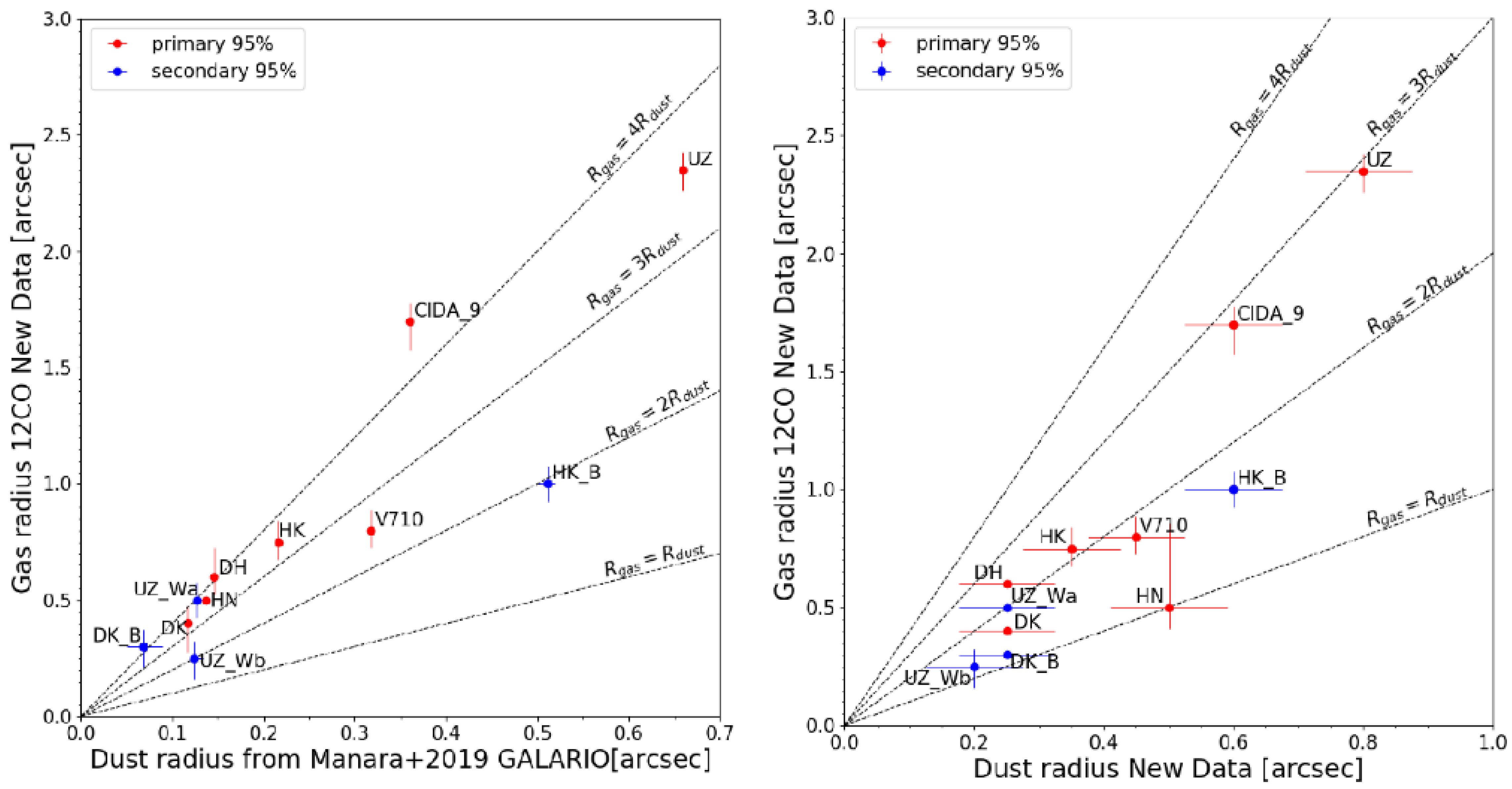


**Fig. 3:** *The measured gas radii as a function of dust disc radii.*

Fig. 3 shows the measured gas radii as a function of dust disc radii which are obtained in two different ways: (left) in the image plane with the curve of growth method applied on the zeroth moment of the new observations and (right) in the (u,v) plane with GALARIO-modelling presented in Manara et al. (2019) ⟹ **Gas radii in multiple systems are typically ∼ 2 − 3 times the dust radii, same as in singles** **(Ansdell et al. 2018, Sanchis et al. subm.).**

## Tidal truncation models

Fig. 4 shows with dots the measured gas radii as a function of the projected separation. The crosses show the discs radii expected by truncation models in the case of zero orbits' eccentricity. The longer the dashed line that link observed radii with models is, the less is the agreement with zero-eccentricity model ⇒ **The disc gas sizes is typically smaller than expectations from tidal truncation models at zero eccentricity, better agreement for $e \sim 0.3 - 0.5$.**

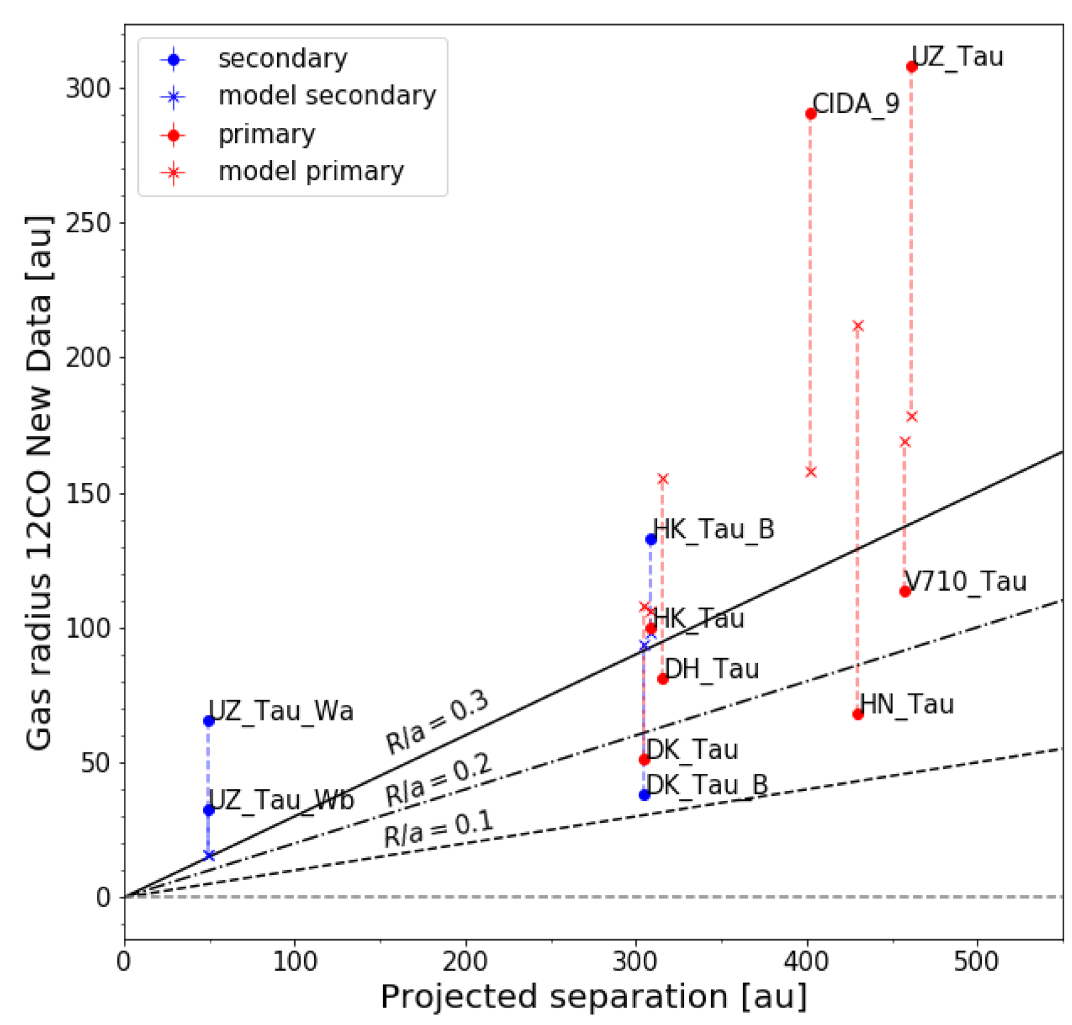


**Fig. 4**

## References


- Manara et al., A&A, 628, A95 (2019)
- Ansdell et al., ApJ, 859, 21A (2018)


## Conclusion

**The ratio of gas to dust radii is similar in multiple and single systems, in possible agreement with truncation models.**