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Multiple systems observed with ALMA.

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ABSTRACT

Here goes the abstract.

Keywords: wow much keywords

1. INTRODUCTION

Here goes the Introduction.

- Previously known binaries.
- Spirals and substructures
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2. HT LUP

What is already known from HTLup, context and previous researches. Add information about source.

3. AS205

What is already known from HTLup, context and previous researches. Add information about source, binary component in the secondary disk, previous CO map from collete.

4. DATA

The datasets presented here are part of the ALMA Large Program number XXX (citar paper) to observe with very high resolution 20 classical disks in band 6, including the molecular line 12CO 2-1 in one of the spectral windows. For AS205, we also used archival data corresponding to observations in band 6 from cycle 0? (PI: Collete Salyk 2014?).

We calibrated the observations following the standard procedure guidelines of this Large Program (cita). Before any treatment, for each source we flagged the channels that were $25 km\,s^{-1}$ around known systematic velocities, making a total width of $50 km\,s^{-1}$. Using the software CASA5.1 we applied the tasks `imfit`, `fixvis` and `fixplanets` to respectively find the 2D gaussian centroid of each disk, align it to the phase center in each observation, and then correct the coordinates positions of all observations with the centroid position of the longest baseline dataset, because of the highest angular resolution and signal to noise. For HT Lup, however, we faced the problem that the two closest disks observables in long baselines *** CORRECT USING THE TABLE NAMES *** are unresolved in the short baselines configuration, showing them as if they were just one disk. To solve this, we used the binary component located at 2.8arcsec as a reference to align the observations.

4.1. *HT Lup*

For HT Lup we had 4 observations in ALMA band 6. All of them had 4 spectral windows, where 3 were dedicated to observe continuum and 1 contained the 12CO 2-1 line. A summary of the observational setup can be found in Table 1.

4.2. *AS205*

For AS205 we had 6 observations, 3 from Colette (agregar cita) and 4 from our ALMA Large Program. Because of climatological conditions, only 1 of our ALMA Large Program observations were executed in configuration [Long baseline configuration], corresponding to the largest baselines, and the remaining 3 with [Short Baseline configuration]. We self-calibrated the [short baselines datasets] before concatenating them to the [LB data] to take advantage of the bigger beam and highest signal to noise. After joining all datasets, we performed 4 phase and 2 amplitude self-calibrations (more details in apendix).

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Table 1. Observational setup for both sources.

Source	Date	Antennas	Resolution	Spw
AS 205	2012-03-27	13	$\sim 0.''5$	1 continuum, 12CO 2-1,
		56013.944	$0''0$	
		56014.984		
		56016.978		
HTLup				

[a] At exposure start.

5. RESULTS

5.1. *HT Lup*

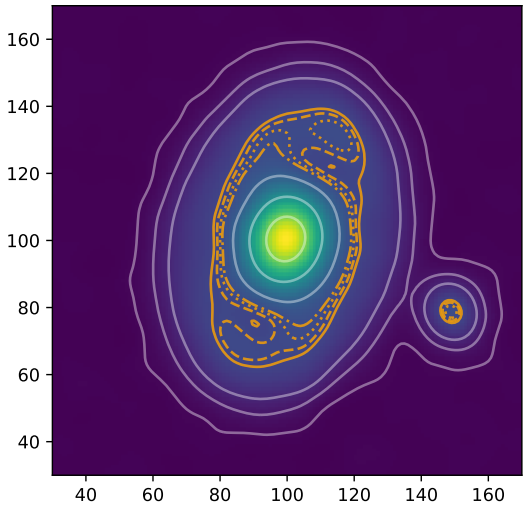

Figure 1. HTLup continuum. Not the final image.

For HT Lup we could spatially resolve the close companion that were first detected with speckle imaging in the K band by (Ghez et al. 1997). Figure 1 shows the high resolution continuum map obtained from our data calibration, while [figure b] show the same image, but with unsharp filter and contour levels to show the spiral structure of the main disk in the continuum.

5.1.1. *Spirals*

In the image continuum, we calculated the mean radial profile of the main disk, and substracted it until deprojected X AU, that mark the point were the main disk finishes and start the secondary one. The spiral is very low contrast, in fact, the differences for a fixed radius are in the order of [X percent] (as it can be observed in the [figure X]), so the contribution of this substructure in the mean radial profile negligible, and therefore we can substract it from the deprojected continuum image to enhance the assymetries.

The deprojected spirals are displayed in figure X, where the mean radial profile was substracted. The pitch angle of each spiral is .....

5.1.2. *Mass ratio*

The peak of the secondary is located at $0.1''$ from the peak of the main disk, which is [35 AU] in projected distance, deprojecting using the inclination and position angle of the main disk. We threw a line between the peaks and calculated the luminosity profile along the line, presented in figure X. From the contour levels it can be seen that each object holds its own disk, and they interact surrounded by a cloud of X flux, and the line that separates them is X of the flux. From this, we use the formalism of roche lobes to calculate an approximation of the mass ratio between the disks. (I have to explain that the radiative profile of each disk is decreasing, so the minimum point between them must be related to the L1 point). From this, we obtain a mass ratio of q=13.

Previous photometric studies took HT Lup as if it were just one source (), calculating a photometry of X in the band K. from Ghez1997 we now that, roughly, the flux ratio between the sources is X, so we can use it to calculate the corrected magnitudes in K band, which are X for the main source, and X for the secondary. Using as the age X Myr from XX et al, by the position in the HR diagram, the masses of the sources is approximately X and Y, which is in good agreement to the mass ratio calculated from the roche lobes approximation.

5.1.3. *Terciary Component*

The terciary component is found at $2.8''$ from the peak of the main disk. This binary was already known (citas citas citas)

5.1.4. *CO map*

We found the CO map to be highly contaminated by the cloud contribution.

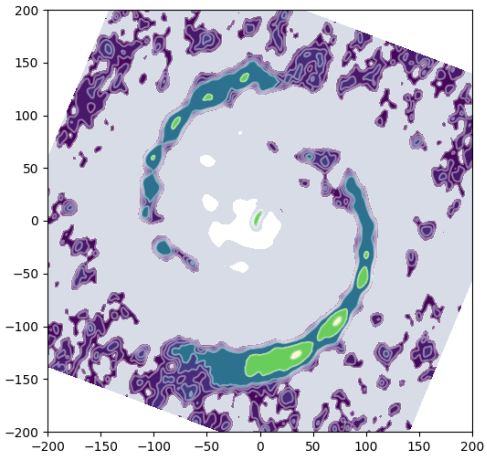

Figure 2. AS205 main disk, with the mean radial profile substracted.

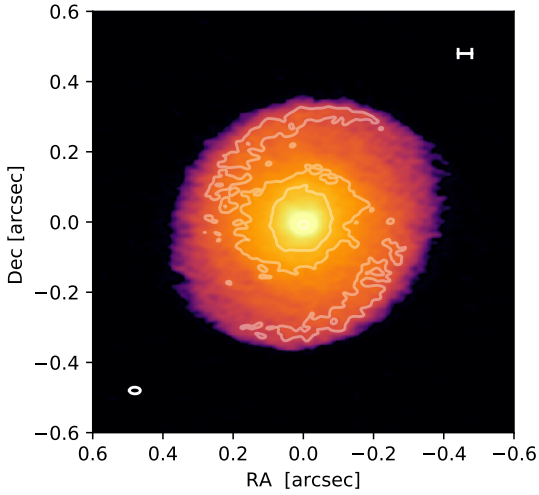

Figure 3. AS205 main disk in logarithmic scale, the contour levels correspond to X sigmas

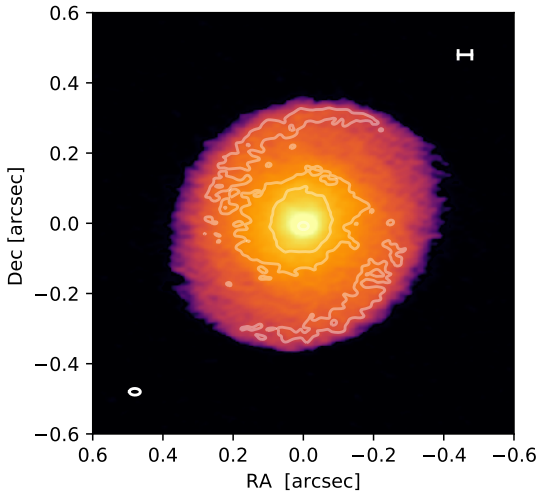

Figure 4. AS205 main disk in logarithmic scale, the contour levels correspond to X sigmas

5.2. *AS205*

In AS205 we are able to resolve at a scale of X projected AU two disks, with peaks located at a distance of X''. Their continuum maps are shown in Figure X and Y, and in the apendix can be found a figure of both disks together.

5.2.1. *Main disk*

We applied a 2D gaussian fit using `imfit` in CASA5.1 to find the inclination and position angle of the main disk, and we found the values $i = X$ and PA $= X$ for the main disk. Similar to the main disk in HT Lup, we also found here a spiral structure of very low contrast, that can be seen deprojected in polar coordinates in figure X.

In this paragraph I have to analize the spirals of AS205.

5.2.2. *Secondary disk*

Even when the secondary disk is well resolved, it luminosity peak is only X percent of the main disk peak, and this faintness only allow us to study the substructures by azimuthally averaging. Differently from the previous disk, this one shows a central disk and a ring-like structure, separated by a cavity that is not empty in continuum emission. The mean radial profile is shown in figure X.

6. DISCUSSION

- GAIA distances.
- AS205 Secondary disk, binary component. high CO speeds around them.
- Interactive closest disks in HTLup: discuss about the orbit plane.
- Spirals origin, compare with other known spirals.
- HTLup CO, compare with simulations.
- Next steps: Hydrodynamic simulations, other lines observations.

7. CONCLUSION

8. ANEXOS

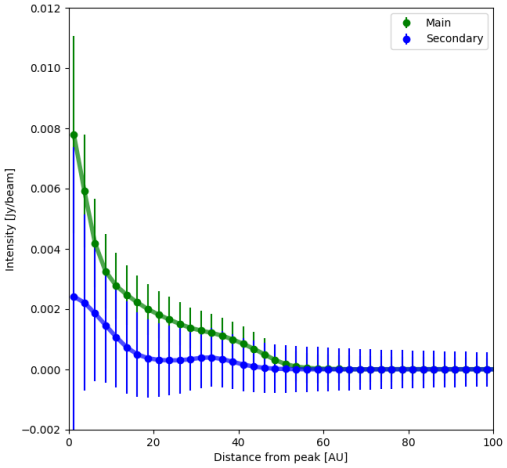

Figure 5. Azimuthal profiles of both AS205 sources

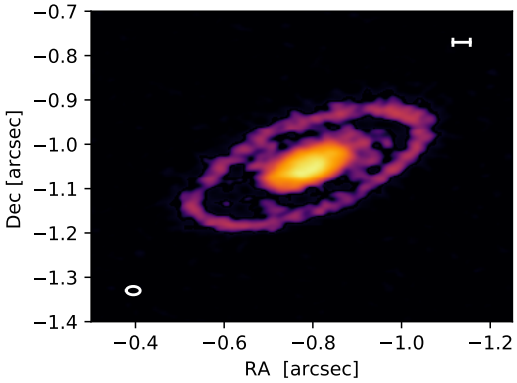

Figure 6. Secondary disk in AS205, logarithmic scale and unsharp filter applied.

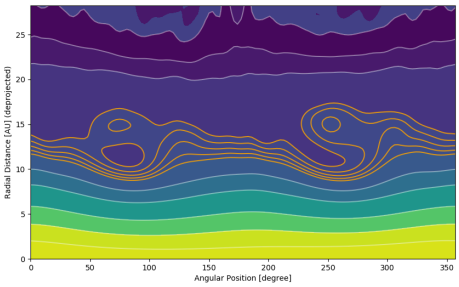

Figure 7. Polar deprojection of HTLup main disk.

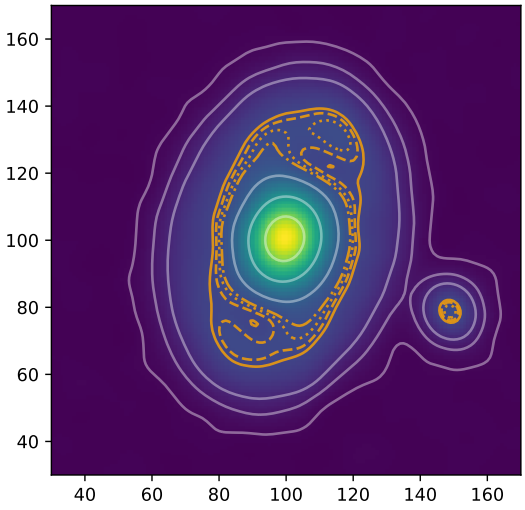

Figure 8. HTLup main disk.

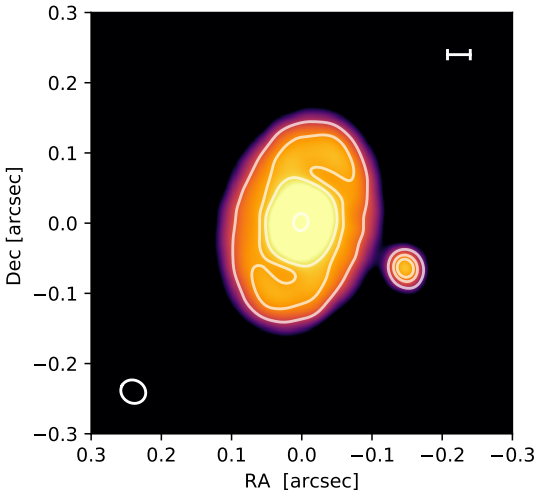

Figure 9. HTLup main disk in logarithmic scale.

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Ghez, A. M., McCarthy, D. W., et al., 1997. MNRAS

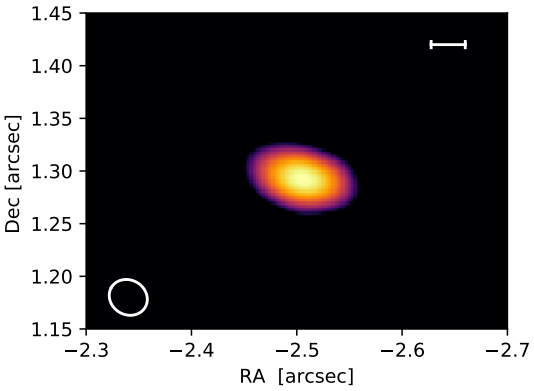

Figure 10. HTLup previously known binary component, in logarithmic scale.

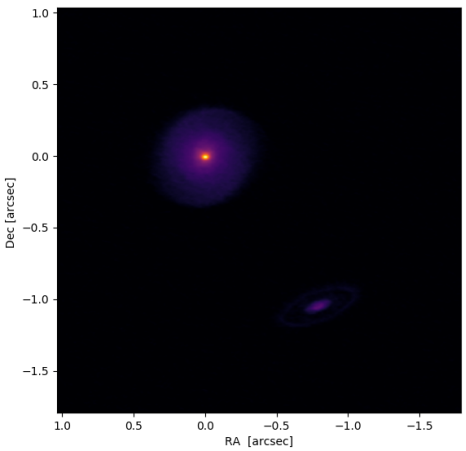

Figure 11. AS205 system.