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A gas-rich disk around DX Cha

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Abstract. DX Cha (HD 104237) is a southern, optically bright Herbig Ae star with an infrared excess, that is part of a small stellar group younger than 5 Myr. We used the APEX and ASTE submillimeter telescopes in Chile to search for continuum and gas emission around this system. Using LABOCA on APEX we detect strong continuum emission around HD104237-A and system component HD104237-E. Our ASTE spectrum detects a double-peaked ^{12}CO(3-2) line profile towards the system, typical of a rotating disk. The new data are used as constraints with MCFOST to produce a disk model that fits the entire SED as well as the observed CO line profile.

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1. Introduction

DX Cha (HD 104237) is the optically brightest Herbig Ae star (A4-A8Ve) in the sky. At 115 pc, it is part of the young ϵ Cha stellar group (3-5 Myr; Feigelson *et al.* 2003). At least five stars are found within 15 arcseconds, and of these two are lower-mass stars that have IR excesses and emission lines, associated to T Tauri type stars (Grady *et al.* 2004). The brightest member, DX Cha (or HD 104237A), is actually a binary system, where the secondary is a K3 star (HD104237b) at 0.2 AU separation (Böhm *et al.* 2004). Recent modeling of the optical to mid-infrared SED by Fang *et al.* (2013) supports the earlier Meeus *et al.* (2001) interpretation of HD104237's SED as a star being surrounded by a self-shadowed (i.e., non-flared) dust disk. Here we present submillimeter data of the dust and gas disk surrounding DX Cha together with radiative transfer modeling efforts to fit the data.

2. LABOCA Imaging

The LABOCA 870 microns continuum map of HD 104237 (Figure 1) shows a clear detection of the primary disk, but also significant extension to the southeast that is consistent with emission from a second disk around the D or E components in the system. Based on the mid-IR detection of a disk around the E component by Grady *et al.* (2004), we have extracted fluxes using a model of two point sources separated by the 14.9” A-E separation vector (Figure 1). From this method we obtain 870 μm fluxes of 154 mJy and 91 mJy for the A and E components. Due to the system configuration, any flux from the

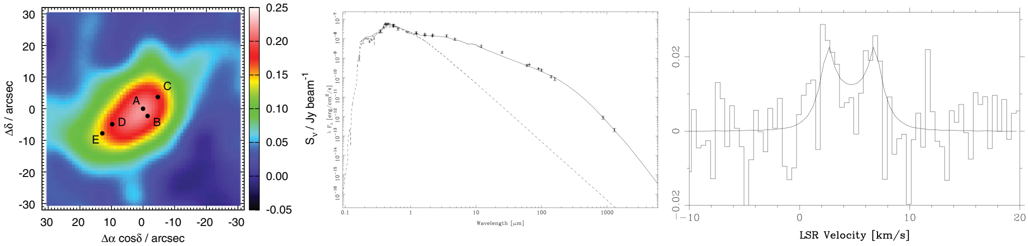

Figure 1. *Left:* LABOCA map of HD 104237 smoothed with half-beam Gaussian (FWHM = 9.3″), with stellar component positions plotted. *Middle:* Observed SED of HD 104237 (black points with error bars) plotted against the MCFOST disk model that fits the optical to submillimeter data (solid line). *Right:* MCFOST CO model of HD 104237 (solid line) fits well the ASTE line, data. Units are in antenna temperatures (T^*_A).

Table 1. HD104237 disk model

Physical parameter	Value	Reference
Disk total mass: ($M_\odot$)	$100\times M_d$	
Disk dust mass M_d ($M_\odot$)	4×10^{-4}	
Inner Rim: R_{in} (AU)	0.45	Tatulli *et al.* (2007)
Characteristic radius R_C (AU)	90	
Characteristic height h_C (AU)	6	
Surface density exponent: γ	0.8	
Flaring exponent: ψ	0.0	
Inclination angle: i (deg)	31	
Systemic Velocity: $v_{\rm lsr}$ (km/s)	4.2	

D component will mostly be incorporated in the E component flux, and any emission from the B and C components will be included in the A component flux.

3. Results and Conclusions

The 3D radiative transfer code MCFOST (Pinte *et al.* 2006) was used to model the SED and the molecular emission of HD104237A, assuming that both the infrared excess and $^{12}CO(3\text{-}2)$ emission stem from a circumstellar disk (Figure 1). We find the SED and CO line can be well fit by a non-flared disk 90 AU in radius and of 4×10^{-2} $M_\odot$ total mass. The parameters of this representative model are shown in Table 1. The CO surface brightness distributions predicted by the standard model over predicts the disk intensity by factors of 2-3 (assuming CO/H_2 ratios of 10^{-4}). By also incorporating the freeze-out of ^{12}CO molecules into dust grains at $T < 20$ K, however, the model fits well the line data. HD 104237 is a unique laboratory to study the extreme of SED-predicted flat disks. Resolved submillimeter images with existing interferometers (e.g. ALMA) are required to further constrain the physical and chemical structures of the disk.

References

Böhm, T., Catala, C., Balona, L., & Carter, B. 2004, *A&A*, 427, 907
Fang, M., van Boekel, R., Bouwman, J., *et al.* 2013, *A&A*, 549, A15
Feigelson, E. D., Lawson, W. A., & Garmire, G. P. 2003, *ApJ*, 599, 1207
Grady, C. A., Woodgate, B., Torres, C. A. O., *et al.* 2004, *ApJ*, 608, 809
Meeus, G., Waters, L. B. F. M., Bouwman, J., *et al.* 2001, *A&A*, 365, 476
Pinte, C., Ménard, F., Duchêne, G., & Bastien, P. 2006, *A&A*, 459, 797
Tatulli, E., Isella, A., Natta, A., *et al.* 2007, *A&A*, 464, 55

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