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MODELING THE DUST EMISSION OF THE L 1551 IRS 5 BINARY SYSTEM AT DIFFERENT SCALES

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We present a self-consistent model to investigate the physical properties on different scales of the circumstellar material around the Class I source L 1551 IRS 5.

The well studied source L 1551 IRS 5 contains two protostars, each surrounded by a circumstellar disk (Rodríguez et al. 1998), both encircled by a circumbinary disk (Looney, Mundy, & Welch 1997), and each disk surrounded by an extended infalling envelope. We calculate the spectral energy distribution (SED) of all these components (Figure 1) assuming a flattened envelope, such as those described by Hartmann, Calvet, & Boss (1996), and flared disks, which include the heating by the irradiation of the envelope using a treatment similar to that given by D'Alessio, Calvet, & Hartmann (1997).

We compare the predicted SED with the observations, taking into account the most recent data of water ice (SpeX; Osorio et al. 2003) and silicate features (*ISO*; White et al. 2000). We take as additional constraints the spatial brightness distribution of the extended emission given by SCUBA maps and the spatial intensity distributions of the binary disks (see Osorio et al. 2003). The wealth of the observational data available for L 1551 IRS 5 has enabled us to constrain its luminosity, geometry, mass and mass accretion rate (Table 1). We find that the circumstellar disks are optically thick in the millimeter range, having larger accretion rates than the typical Classical T Tauri disks, but lower than the envelope infall rate. This probably results in the accumulation of material in the circumbinary disk, possibly with occasional cascades of mass accretion into the binary system to produce FU Orionis eruptions.

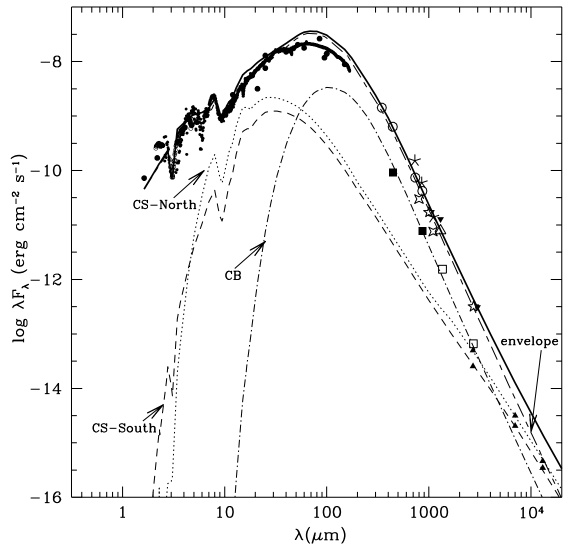

Fig. 1. Composite SED (envelope + circumbinary disk (CB) + circumstellar disks (CS)) for a model with the parameters listed in Table 1 (solid line). The contribution from individual components is also shown.

TABLE 1

PARAMETERS OF THE MODEL

Envelope		
Luminosity ($L_\odot$)		25
Inclination (degrees)		50
$\dot{M}_{\rm infall}$ (10^{-6} $M_\odot$ yr^{-1})		70
Centrifugal Radius (AU)		300
Outer Radius (AU)		8000
Mass ($M_\odot$)		4.4
Circumbinary Disk		
Inclination (degrees)		50
Inner Radius (AU)		120
Outer Radius (AU)		300
Mass ($M_\odot$)		0.02–0.4
Circumstellar Disks	N	S
M_* ($M_\odot$)	0.3	0.3
R_* ($R_\odot$)	1.4	1.4
Inclination (degrees)	60	62
$\dot{M}_{\rm acc}$ (10^{-6} $M_\odot$ yr^{-1})	2	2
Outer Radius (AU)	13	12
Mass ($M_\odot$)	0.25	0.1

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