CTTS Excess Emission from 0.8 to 2.4 μm

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Abstract

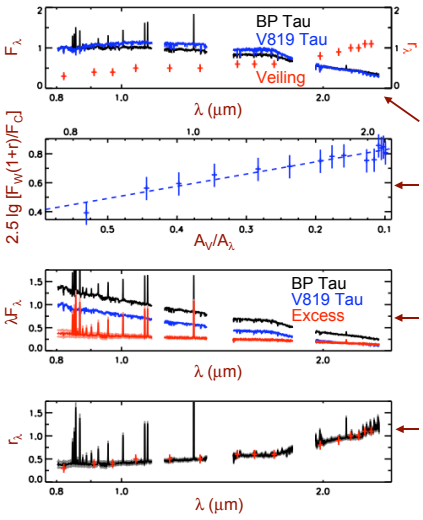
We present the first-ever CTTS excess emission SEDs between 0.8 μm and 2.4 μm. With SpeX on the IRTF, we obtained medium-resolution (R=2000) spectra of 16 CTTS spanning a broad range of mass accretion rates. Here we present the excess SEDs of a 7-star subsample with spectral types of K7/M0 for which the WTTS V819 Tau is a suitable template. We find more emission than expected from the sum of the accretion-heated photosphere that dominates shortward of 0.5 μm [1] and warm dust from the dust sublimation radius in the inner disk that dominates beyond 2.2 μm [4], consistent with our earlier finding [2] that the 1 μm veiling exceeds the contributions from these 2 sources. Accounting for this emission may require modification of the magnetospheric accretion scenario and revision of accretion luminosities in CTTS.

I. Data & Initial Sample

- **SpeX:** 0.8 < λ (μm) < 2.4; 26-27 Nov 2006; R = 2000
- **Calibration for short-λ veiling:** 30 Nov - 1 Dec 2006
  - **HIRES:** r_B; R = 34,000 **NIRSPEC:** r_Y; R = 25,000
- Established r_Y / Paγ relation [2] supports change in r_Y over 3-4 day interval (SpeX vs. NIRSPEC)

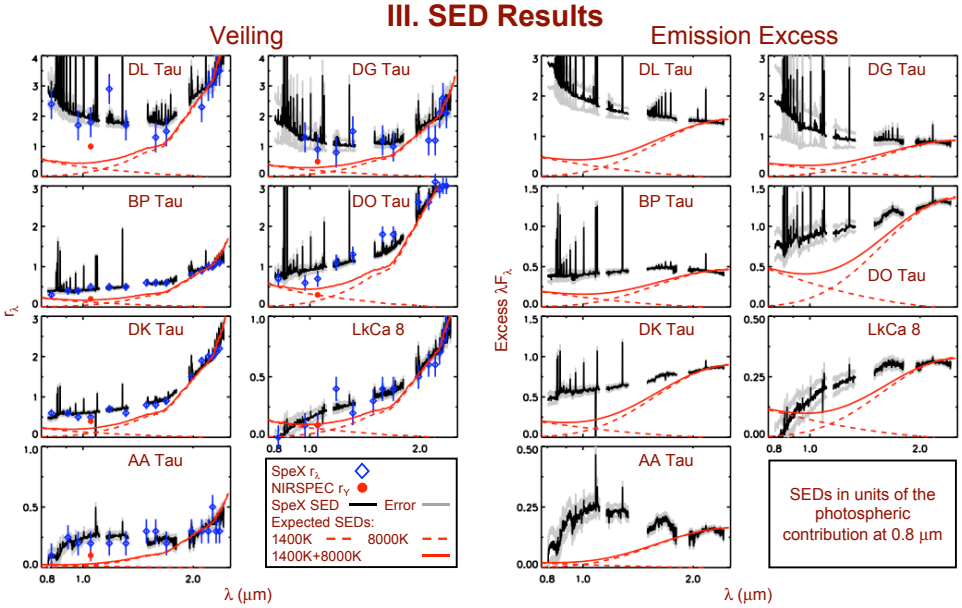
CTTS	SpeX r_Y	SpeX Paγ EW (Å)	*SpeX / NIRSPEC r_Y Ratio*	*SpeX / NIRSPEC Paγ Ratio*
DL Tau	1.8	16.7	*1.8*	*1.0*
DG Tau	0.9	10.6	*1.8*	*1.2*
BP Tau	0.5	6.8	*2.5*	*1.4*
DO Tau	0.7	6.2	*2.3*	*0.7*
DK Tau	0.5	3.5	*1.3*	*1.4*
LkCa 8	0.1	1.0	*1.0*	*1.7*
AA Tau	0.2	0.9	*2.0*	*4.5*

II. SED Determination



1. **Veiling:** Compare photospheric lines of CTTS and WTTS in 15 regions
2. **Reddening:** Determine A_V of WTTS from comparison to unreddened standard; find ΔA_V between CTTS and WTTS from ratio of veiled WTTS to CTTS vs wavelength [3]
3. **Emission Excess SED:** Deredden CTTS & WTTS; subtract scaled WTTS from CTTS; normalize fluxes to photospheric λF_λ at 0.8 μm
4. **Veiling SED:** Compute ratio of excess to WTTS

III. SED Results



Expected Veiling/Excess: Cool component (1400 K) scaled to SpeX r_K
Hot component (8000 K) scaled to HIRES r_B, assumed constant over 3-4 day interval

IV. Conclusions

- Excess emission from 0.8 to 2 μm exceeds expectations in all 7 CTTS
- Excess shape and strength correlate with Paschen series
  1. *Strong Paschen lines (DL Tau, DG Tau):* SED rises toward shorter λ; 0.8 μm excess exceeds photosphere
  2. *Intermediate Paschen lines (BP Tau, DO Tau, DK Tau):* SED relatively flat; 0.8 μm excess comparable to photosphere
  3. *Weak Paschen lines (AA Tau, LkCa 8):* SED falls toward shorter λ; 0.8 μm excess much weaker than photosphere
- Possible causes:
  1. Multi-temperature accretion spots
  2. Additional emitting region with 1400 K < T < 8000 K
- Likely requires revision of previously derived accretion luminosities

References

[1] Calvet & Gullbring 1998, ApJ, 509, 802
[2] Edwards et al. 2006, ApJ, 646, 319
[3] Gullbring et al. 1998, ApJ, 492, 323
[4] Muzerolle et al. 2003, ApJ, 597, L149