A Survey of IRS/Spitzer spectra of Protoplanetary disks in the Orion A Star-forming region

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Introduction :

- **The Orion A cloud**
  - Orion Nebular Cluster (***ONC***) :
    NGC 1977, OMC2/3, M43, M42, NGC1980
  - Lynds 1641 (***L1641***) :
    L1641N, V380, L1641C, L1641S)

- **Distance**
  - 400 – 500 pc (Muench et al. 2008)

- **Ages distribution**
  - ***ONC*** : median age < 0.8 Myr (Hillenbrand et al. 1998); a mild age distribution suggested (younger median ages closer to the cluster core) (Hillenbrand 1997)
  - ***L1641*** : L1641N : median age ~ 1 Myr (Galfalk & Olofsson 2008); L1641S : large populations with >1 Myr (Allen 1996)

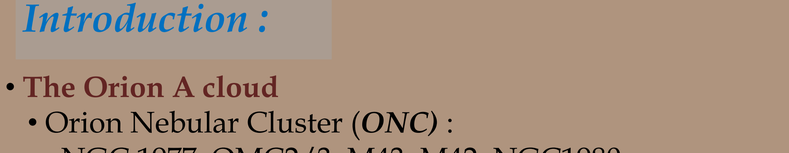

Fig 3. ***Median IRS spectra*** (K5-M2) comparison for L1641, ONC, and Taurus (left: normalized at the dereddened H-band median flux of Taurus; right : 10 μm silicate emission feature, after subtraction and division by a continuum fit).

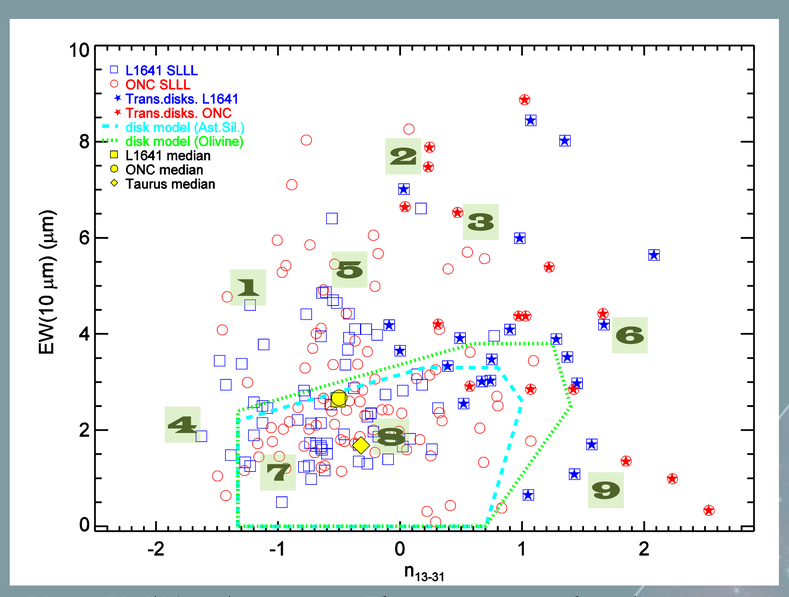

Fig 4. *EW*(10μm) vs. n_{13-31}. There are several outliers which cannot be accounted for by the standard accretion disk models (D'Alessio et al. 2006)

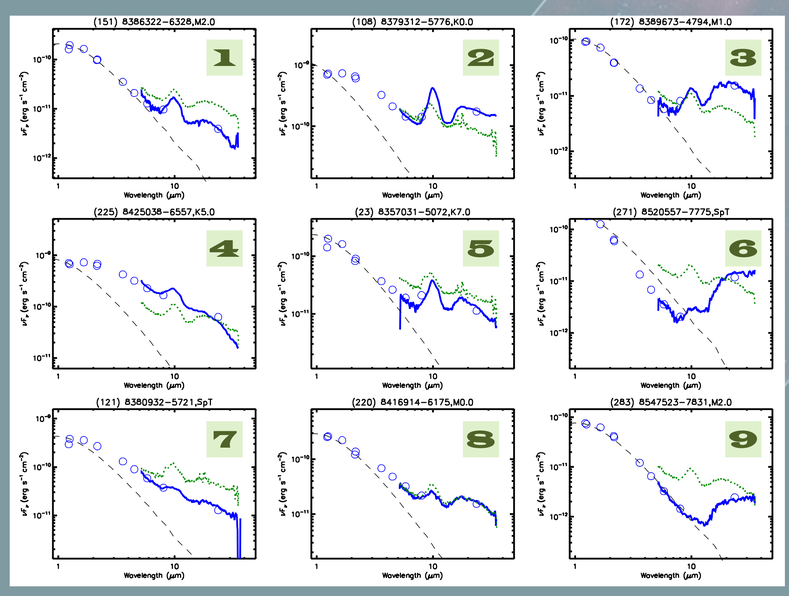

Fig 5. IRS spectra (blue) of the indicated in Fig 4. Also shown is the median IRS spectra (green) normalized to the H-band flux of each target for comparison.

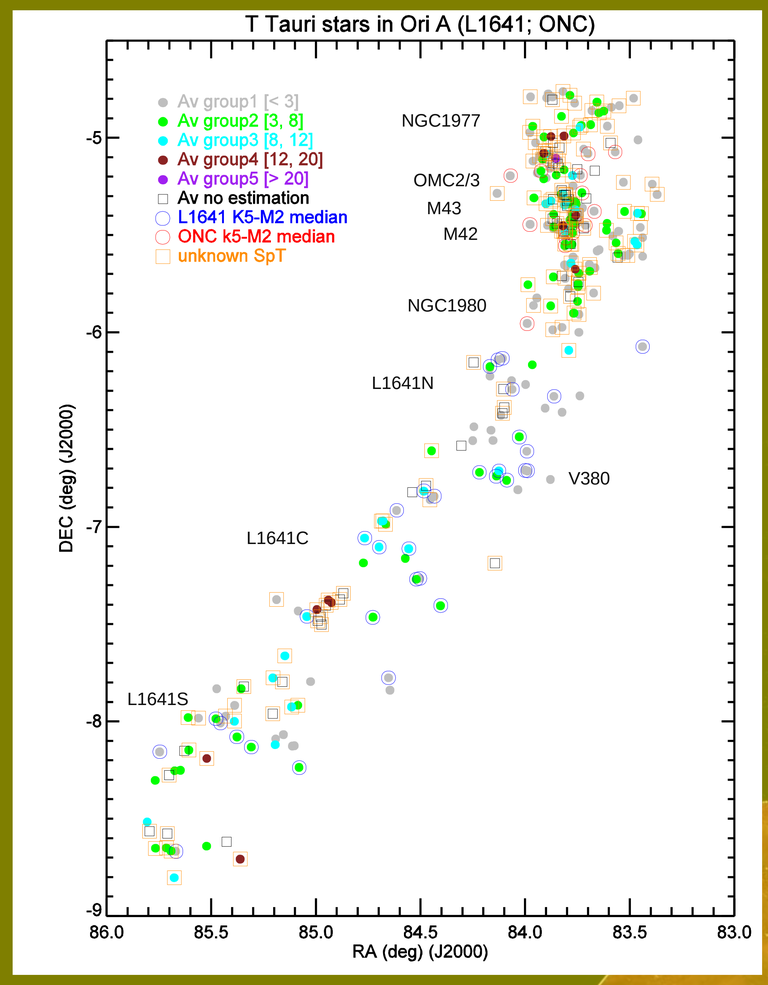

Fig 1. 303 Class II YSOs observed in Orion A (IRS/GTO)

Observation :

303 targets observed with either Short-Low [SL] and Long-Low [LL] mordules or the SL module only.

- SLLL : 241 targets (114 in L1641; 127 in ONC)
- SL only : 62 targets in Trapezium Cluster

Visual Extinction (A_v) :

- For 248 targets with good detection of 2MASS, A_v derived from E(J-H) and E(H-Ks) obtained using the intrinsic colors of CTTS (Meyer et al. 1997).
- IRS spectra and photometry dereddened using the average A_v derived from E(J-H) and E(H-K) and the extinction law from McClure (2009).

Spectral Type :

Number of targets with available *SpT* data
- L1641 : 70/114
- ONC : 46/127
- TC : 37/62

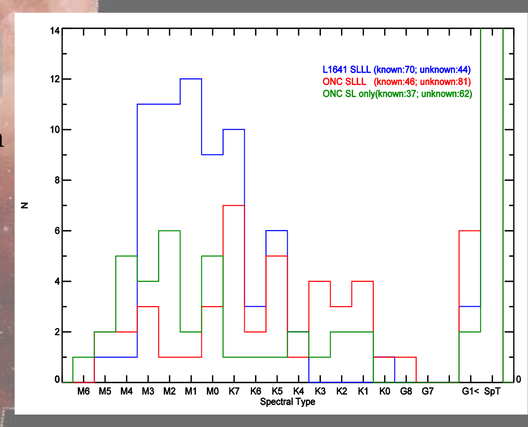

Fig 2. The distribution of *SpT*s for Orion A.

The spectral index ($n_{\lambda 1-\lambda 2}$) measure the slope of the SEDs between two wavelengths, λ_1 and λ_2 .

$$n_{\lambda_1-\lambda_2} = \frac{\log(\lambda_2 F_{\lambda_2}) - \log(\lambda_1 F_{\lambda_1})}{\log(\lambda_2) - \log(\lambda_1)}$$

The equivalent width of the 10 μm (*EW*(10μm)) is a measure for the amount of optically thin dust per unit area of optically thick disk .

$$EW(10\mu m) = \int_{8\mu m}^{13\mu m} \frac{F_\lambda - F_{\lambda.con}}{F_{\lambda.con}} d\lambda$$

$F_{11.3}/F_{9.8}$ indicates ***the 10 μm profile shape***. It is a measure of the degree of dust processing (higher $F_{11.3}/F_{9.8}$, more dust processing) . (Kessler-Silacci et al. 2006)

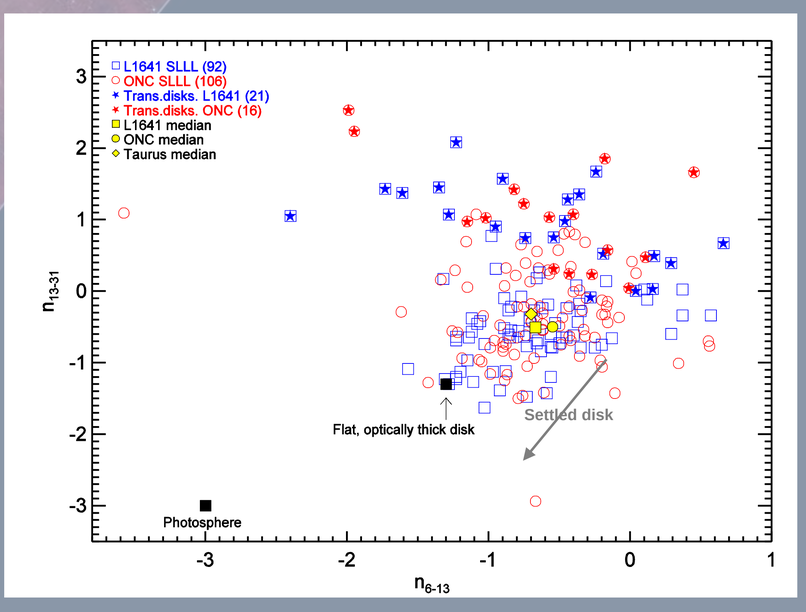

Fig 6. n_{13-31} vs. n_{6-13} : Settled disks lie in the direction of the arrow; Several flared disks also exist (higher n_{6-13} , higher n_{13-31}); Transitional disks are well separated from the main distribution.

Preliminary Results

- ❑ The median IRS spectra (K5-M2) of ONC and L1641 significantly differ from that of Taurus. (e.g. higher EW(10 μm), different 10 μm feature profiles)
- ❑ There are more well mixed (little dust settling) disks in Ori A (see Fig 6) than those in Taurus, Chameleon I, and Ophiuchus. This can also be seen from Fig 4 where there are several more objects in ONC and L1641 which occupy the right upper side of the model polygons than those in the nearby star-forming regions. (see Furlan et al. 2009)
- ❑ The fraction of outliers (in region 1 and 5 in Fig 4), whose disk structure cannot be described by the standard accretion disk models (D'Alessio et al. 2006), is higher in Ori A compared to those in the nearby star-forming regions. (Furlan et al. 2009)
- ❑ The distinctive distributions of transitional disks in L1641 and ONC in Fig 7 may indicate less dust processing in the protoplanetary disks in ONC than that in L1641 which is possibly due to the younger median age of ONC.

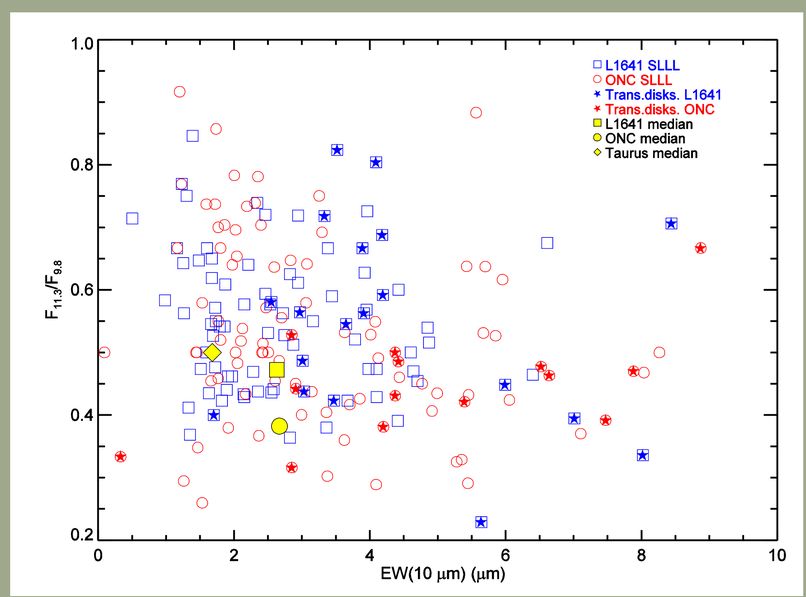

Fig 7. $F_{11.3}/F_{9.8}$ vs. *EW*(10μm): general negative trend; dust in ONC less processed than that of L1641; less dust processing in ONC and L1641 than Taurus.

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Background Image : Extended Orion Nebular Cloud [3.6 (B), 4.5(G), 5.8(O), and 8.0(R) μm at IRAC/Spitzer] (NASA/JPL-Caltech/T. Megeath (University of Toledo))