Dusty disks around brown dwarfs

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Origins of brown dwarfs

‘in situ’ formation
- ultra-low-mass stars -

ejection as embryos
- failed stars -

signature of formation: binarity, kinematics, **accretion disks**
Planet formation?

brown dwarf disks: testbed for universality and efficiency of planet formation

inner disk clearing

grain growth
Brown dwarfs in T Tauri phase

1st part: fundamental disk parameters from mm fluxes
2nd part: disk evolution (dust settling, chemistry) from MIR SEDs
BD disks in the pre-Spitzer era

Mohanty et al. (2004)

constraints from MIR-SEDs: flared disk, flat disks, grain growth but only 1 object with SED from NIR to mm

Pascucci et al. (2003)
A 1.3mm survey in Taurus

IRAM 30m telescope with MAMBOII, Pico Veleta (Spain)

20 sources with SpT>M6, noise level <1mJy for all objects
Fluxes and disk masses

20 sources, 6 detections, flux levels: <0.7... 7 mJy
transformation to disk masses: <0.4... 2.4 Jupiter masses

relative disk masses comparable from 0.02 to 3 Ms
no trend to lower disk masses in the brown dwarf regime
Enter Spitzer

IRAC+MIPS available for all Taurus sources:
NIR (2MASS) + MIR (Spitzer) + mm (IRAM)

IRAC photometry: 3-8 \( \mu m \)
IRS spectroscopy: 8-13 \( \mu m \)
MIPS photometry: 24 \( \mu m \)
SED modeling

minimum outer disk radius for objects with mm detection: 10 AU

evidence for dust settling

>25% of the objects have disks with radii >10AU

Scholz, Jayawardhana, Wood 2006
Origins of brown dwarfs

signature of ejection: truncated disks (low masses, small radii)
no evidence for disk truncation from masses and radii
⇒ ejection probably not the dominant formation mode
Evolution of brown dwarf disks

Spitzer GO program to study 36 brown dwarf disks in Up Sco

IRS spectroscopy + MIPS photometry

Inner disk geometry and chemistry after 5 Myr

Preliminary results
Scholz et al., in prep.
Clear dichotomy: 33-36% objects with 24μm excess, i.e. disks
Young vs old: dust settling

2Myr: large diversity, flaring in many objects
5Myr: almost all disks have flat SEDs ⇒ dust settling finished

uniformity of SEDs: default disk at 5Myr
Young vs old: chemistry

Chal (Apai et al. 2005)

2Myr: strong and diverse Si, amorphous and crystallines

5Myr: weak or absent Si ⇒ grain growth and/or dust settling, processed dust (see poster, Meeus et al.)

UpSco
Conclusions

Brown dwarf disk properties from mm/MIR SEDs:

- brown dwarf disk masses: <0.4... 2.4 Mjup
- no trend in relative disk masses from 0.02 to 3 Msol
- disk radii >10AU for at least 25% of the objects
- ejection unlikely: the dominant formation scenario
- at 5Myr: disk frequency 33-36%,
- disk dissipation timescales comparable to stars
- uniform disk SEDs, most disks are flat
- dust settling, grain growth, dust processing
- prerequisites for planet formation