

DIGIT (Dust, Ice, and Gas in Time)

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DIGIT (Dust, Ice, and Gas in Time)

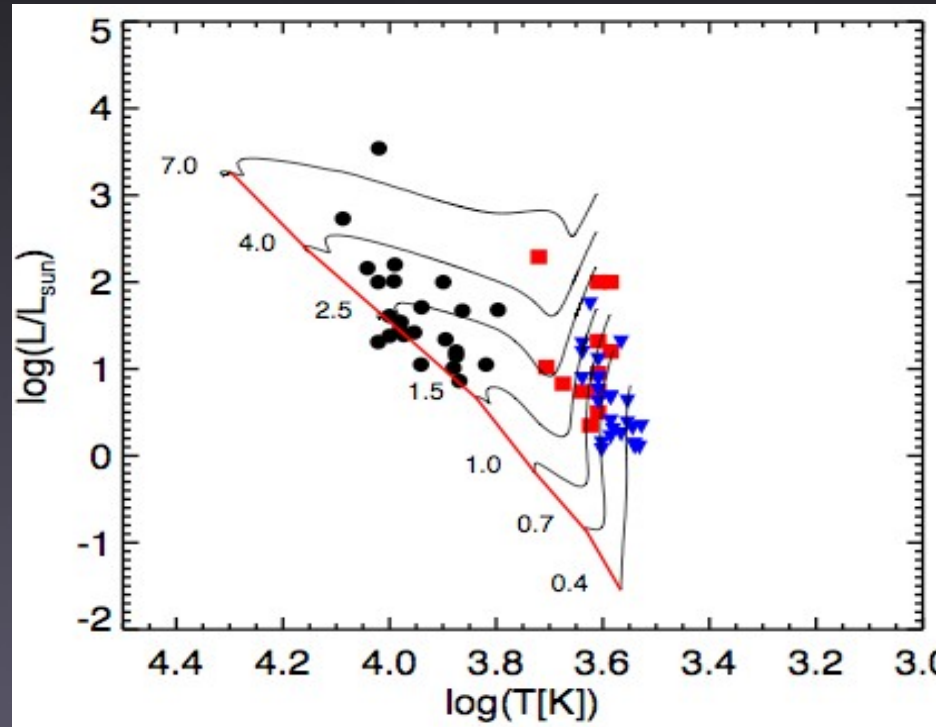
Open Time Key Project

- 250 hrs + followup
- 31 embedded protostars (full spectral scans)
- 63 disk sources ranging from B to M in spectral type (intermediate and low mass), selected from nearby (a few x 100 pc) molecular clouds (Tau, Oph, Cha, Per, Ser, Lup)
- PACS spectroscopy (52-210 μm), PACS photometry (WTTS only; 70, 100, 160 μm)
- SPIRE photometry (WTTS only)
- HIFI spectroscopy on 557 GHz H_2O
- Focus on evolution of chemical state during SF
- Spectral features of dust, ice, and gas
- OT2 Followup:
 - CO in protostars (COPSSPIRE spec. of protostars (PI: J. Green))
 - HIFI on CO J=16-15 (PI: L. Kristensen)
 - Serpens CO Line Map (PI: O. Dionatos)

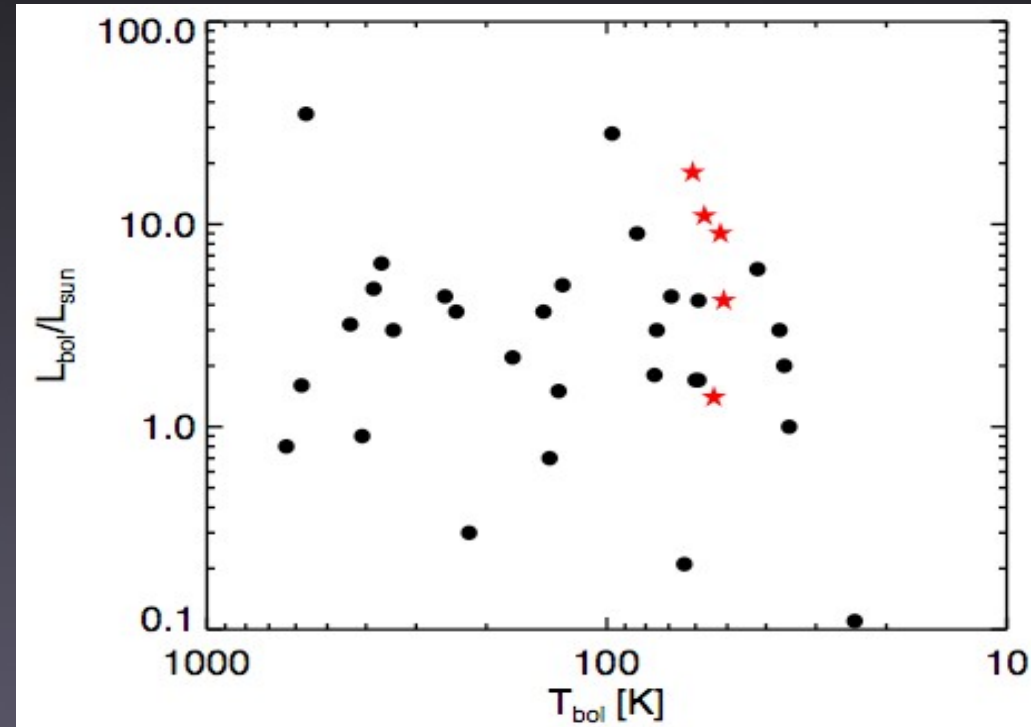


Distribution of Sources in L-T

Disk Sample



Embedded Sample



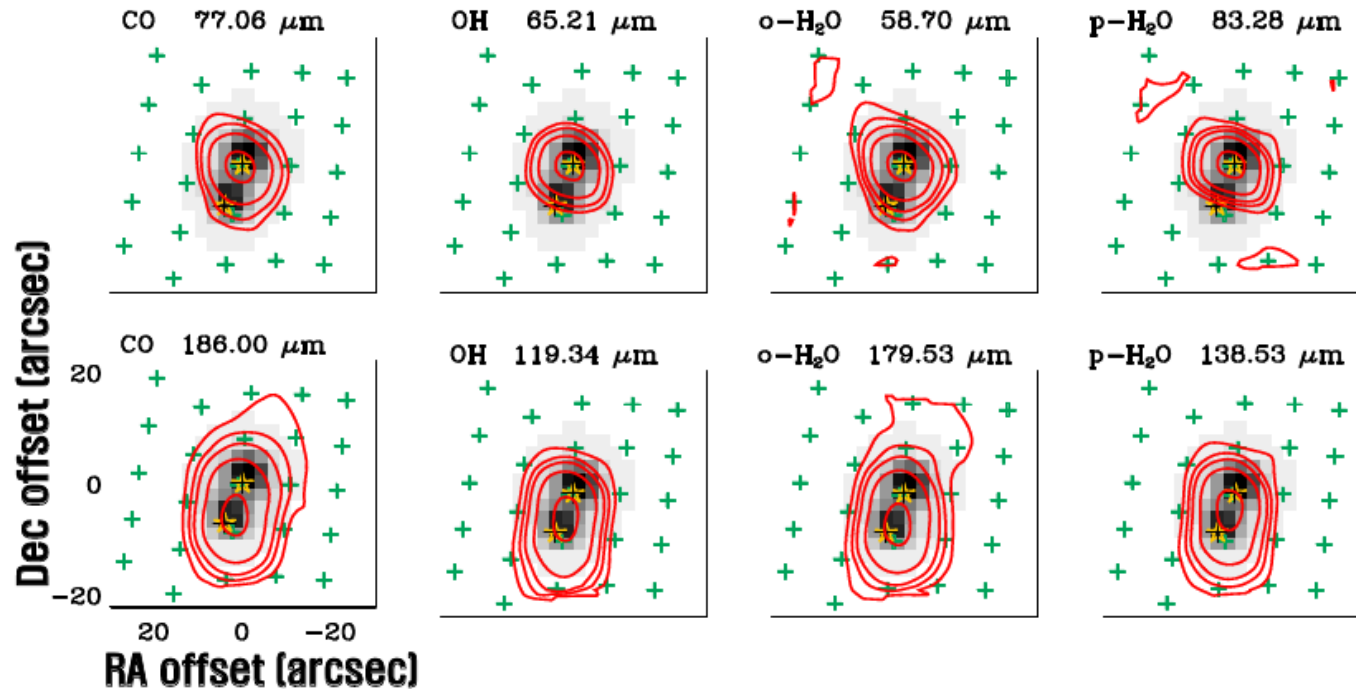
Embedded Sources

- Embedded objects (31)
- Complementary to WISH GTKP
- All full PACS scans
- 13 have HIFI 557 GHz H₂O line observation
- Common features seen so far
- Highly excited CO (up to $J \sim 40$)
- Higher states ($J \sim 30$) detected only half as often lower states ($J \sim 16$)
- CO detected in nearly all sources except VeLLOs
- Warm water and OH
- OI at 63, 145 microns
- Systematic effects in spectral response
- Cannot yet study dust, ice features

L1448-MM: binary YSO

<Lines>

Contour levels: 10, 20, 30, 50, and 90 % of the peak flux



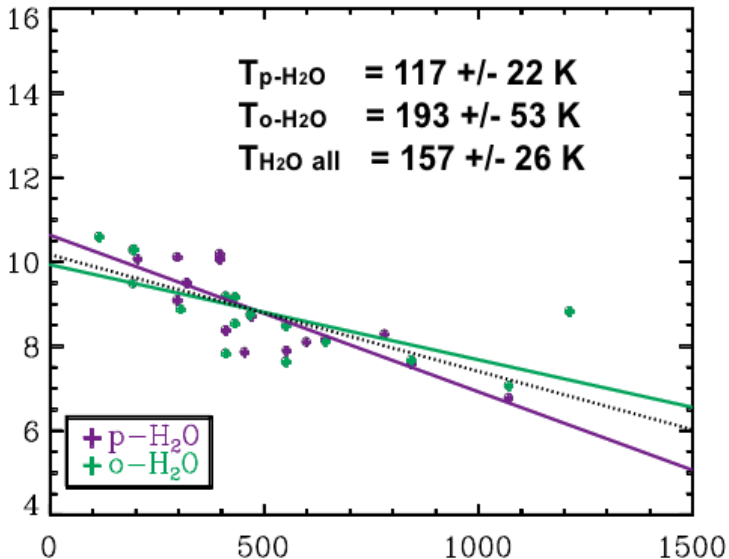
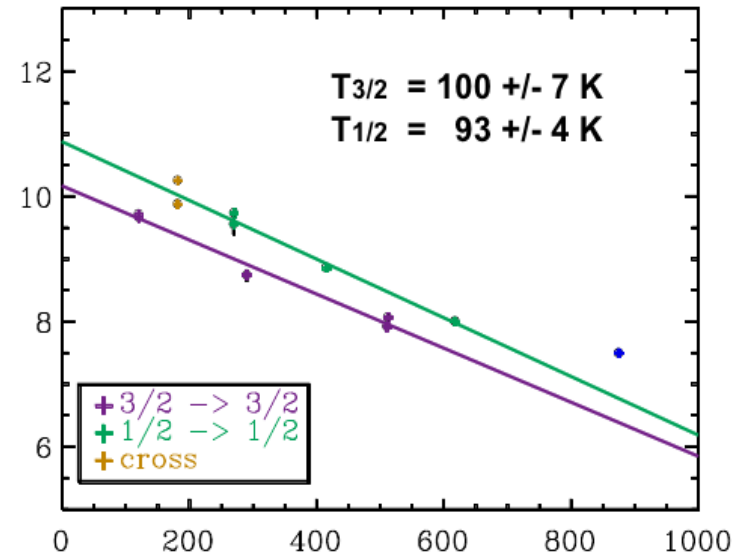
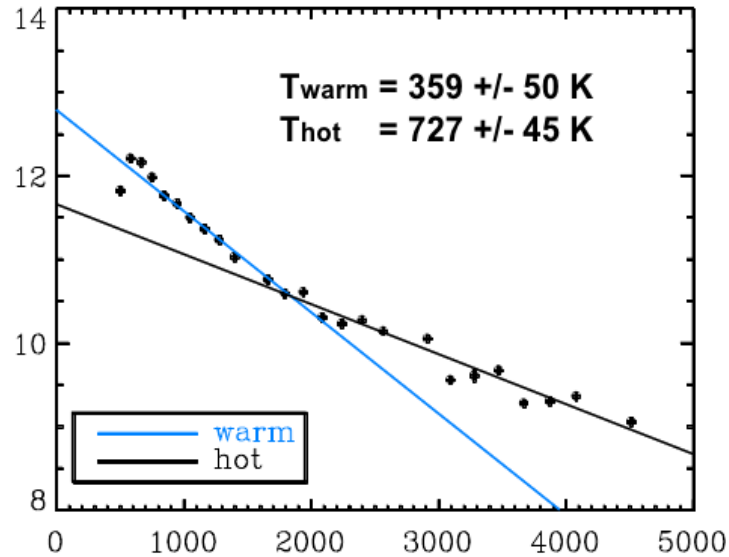
<Emission Peaks>

(1) higher energy levels : close to (A)

(2) lower energy levels : between (A)&(B) (distribute more broadly)

See poster by Jeong-Eun Lee

L1448-MM rotational diagram



J-E. Lee et al., in prep.

Warm CO,
Colder water and OH

C-shocks indicated over UV
irradiation from preliminary non-
LTE modeling of CO and OH

Protoplanetary disks

Posters by:

Gwendolyn Meeus

Koen Maaskant

Gijs Mulders (also talk)

Silvia Vicente

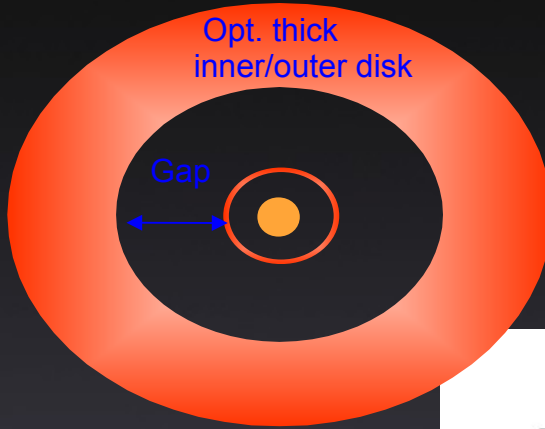
Armin Liebhart

T Cha

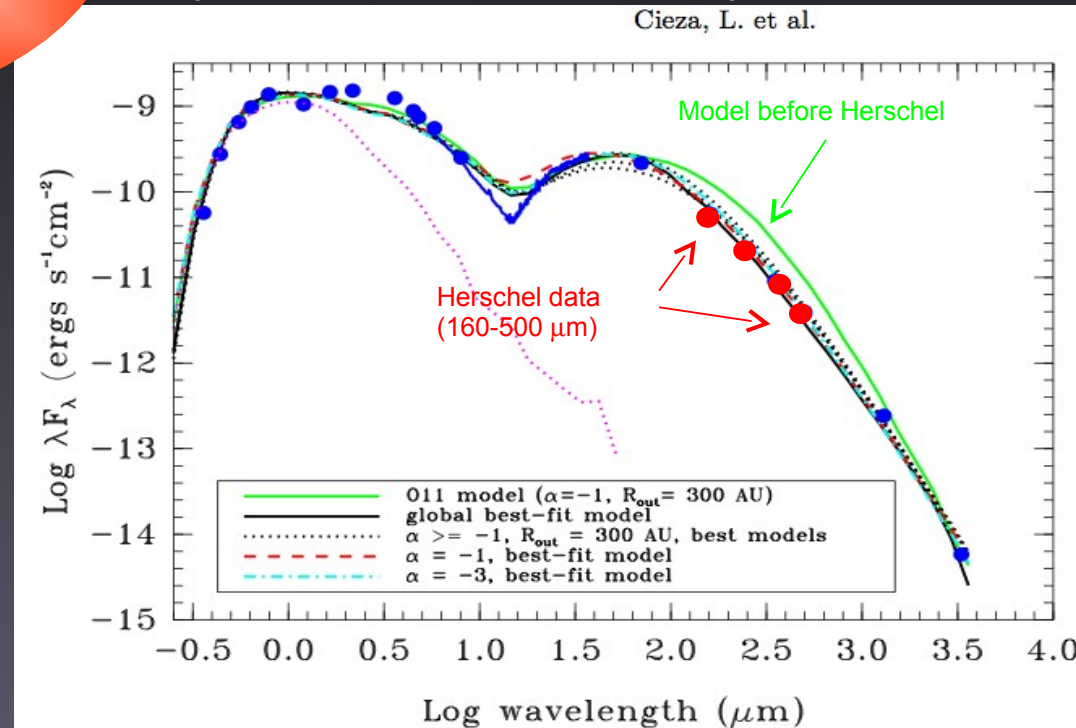
WTTS with “transition” disk with wide gap

Planet candidate detected within gap

(Huelamo et al. 2011)



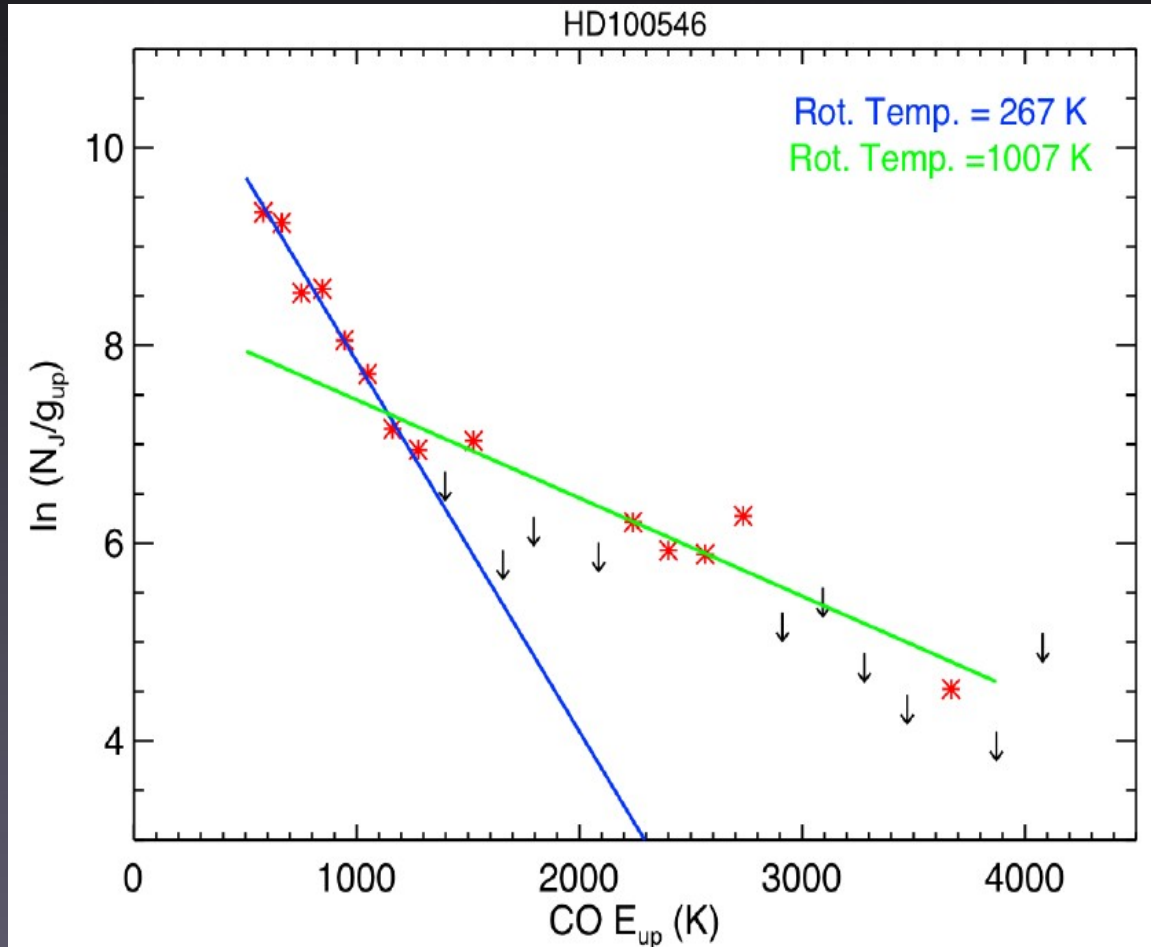
Cieza et al 2011



See also poster on HD169142 by Koen Maaskant

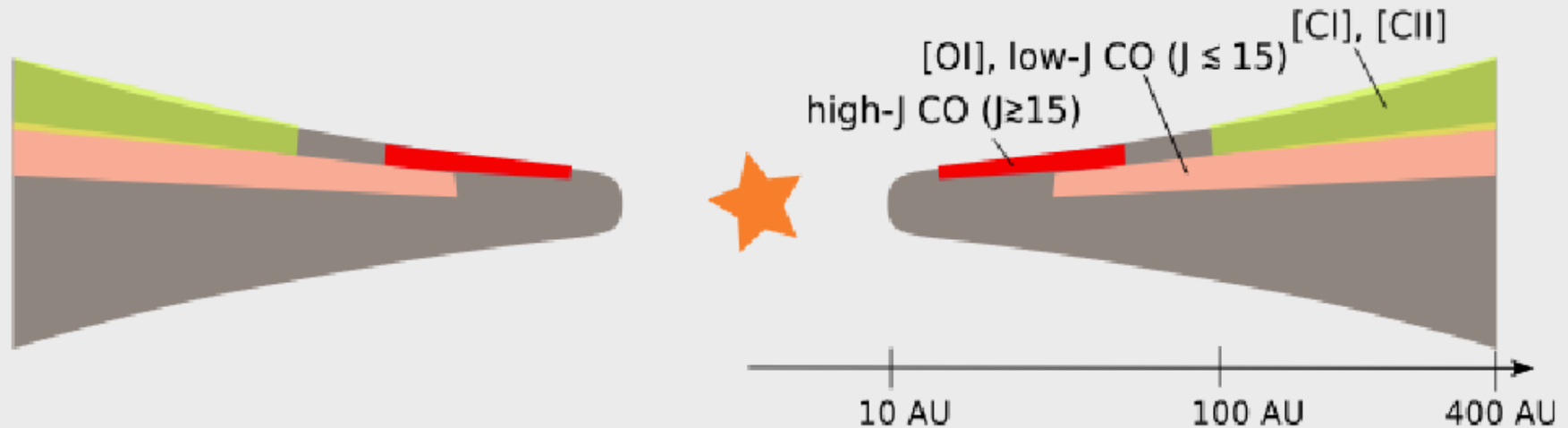
Herbig Ae/Be

CO has both warm and hot components



See poster G . Meeus

■ Origin of the far-infrared/submillimeter line emission in HD 100546



Bruderer et al. 2012

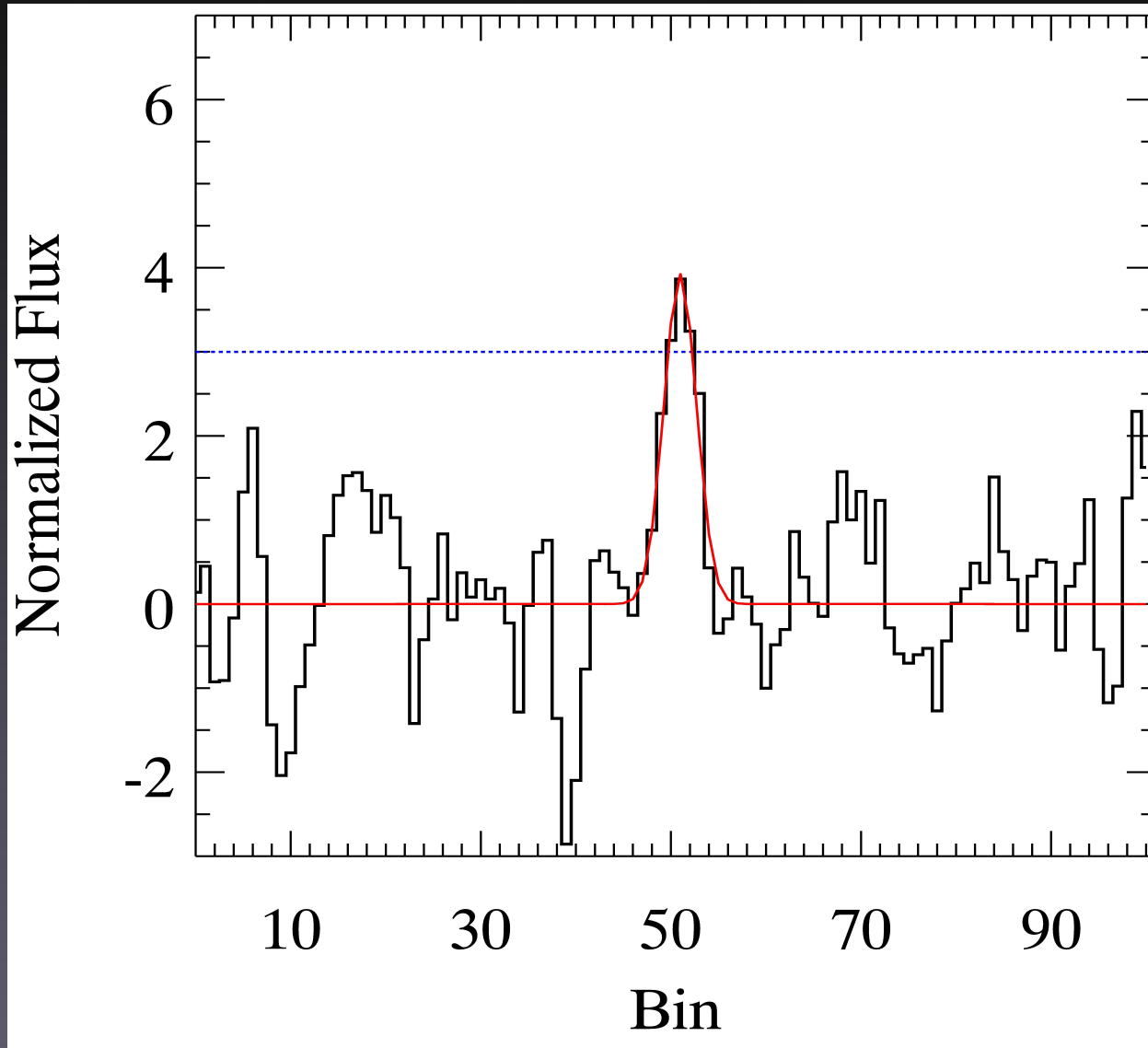
- Evidence that gas- and dust temperatures are decoupled in atmosphere
- Low amount of volatile carbon.

Herbig Ae/Be preliminary conclusions

- CO mid to high J detections:
 - flared discs: 4 (out of 11 sources)
 - flat discs: no detection (out of 9 sources)
- Highest J found in HD100546, has hot inner wall, source with highest UV flux
- Sources with mid-J CO detections have high UV fluxes (= sources with high T_{eff})
- Sources with mid-J CO detections have PAH bands
- CO and [OI]63 line fluxes tend to be correlated

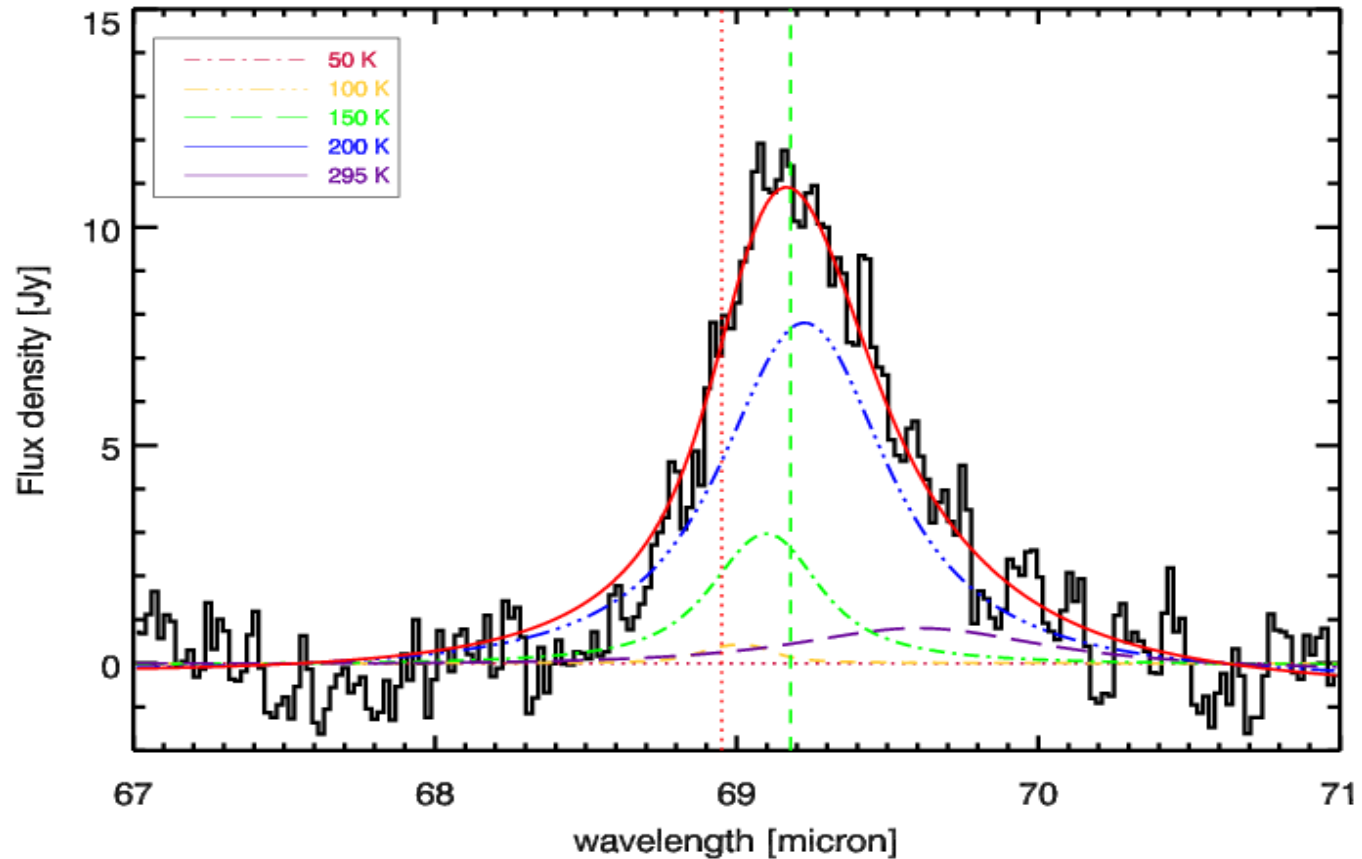
See poster G . Meeus

Water detection in Herbig Ae disk through line stacking



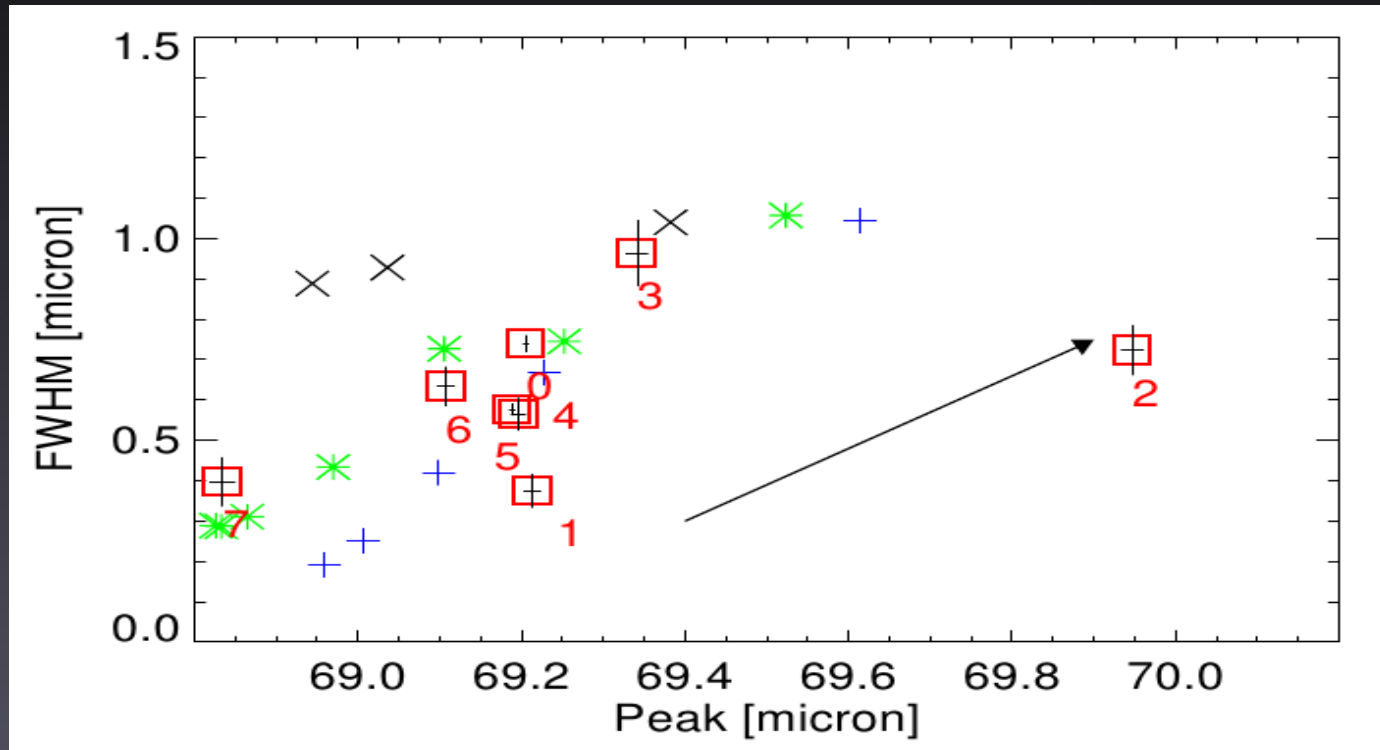
Dust and Ice in protoplanetary disks?

The 69 micron Forsterite feature



(Sturm et al 2010, 2012 in prep; see also de Vries et al)

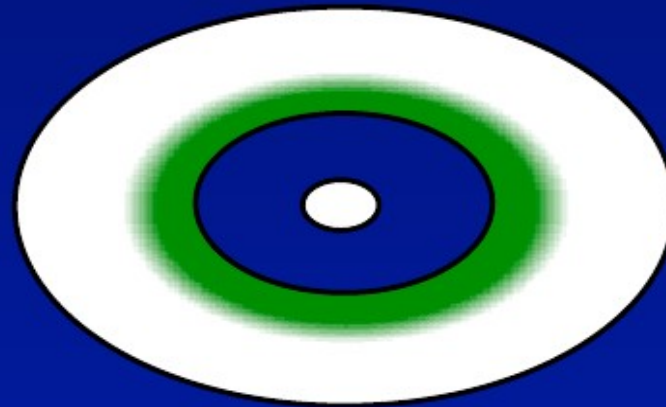
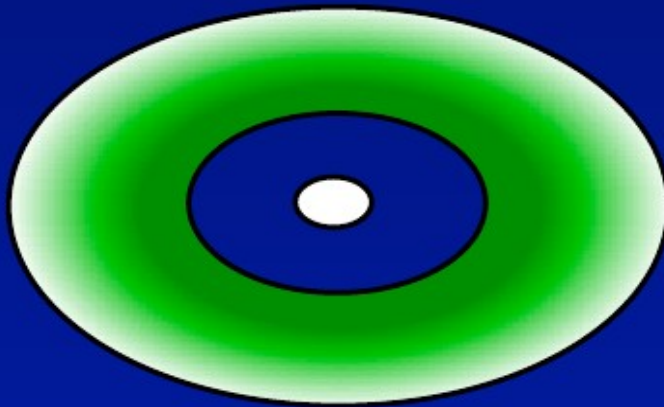
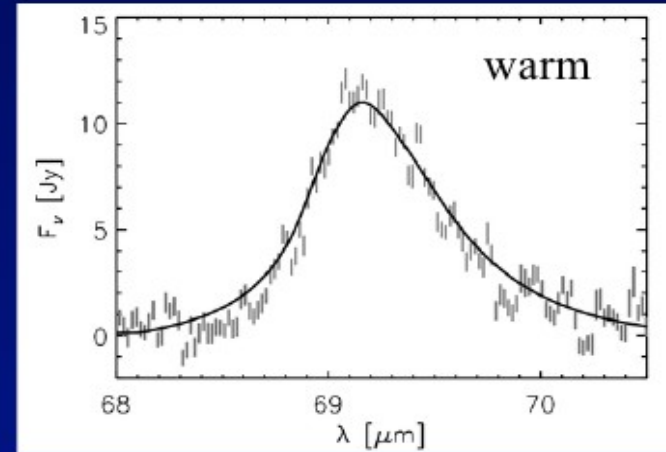
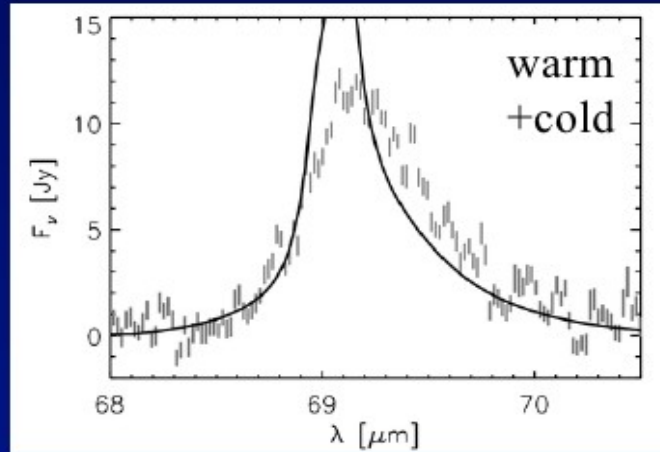
Influence of the temperature and iron content on the 69 micron Forsterite feature



- 8 out of 34 sources show 69 forsterite feature
- All crystalline olivine grains are iron poor! (~1% or less) with only 1 source (AB Aur) having ~4% at most.
- Condensation at high temperature?

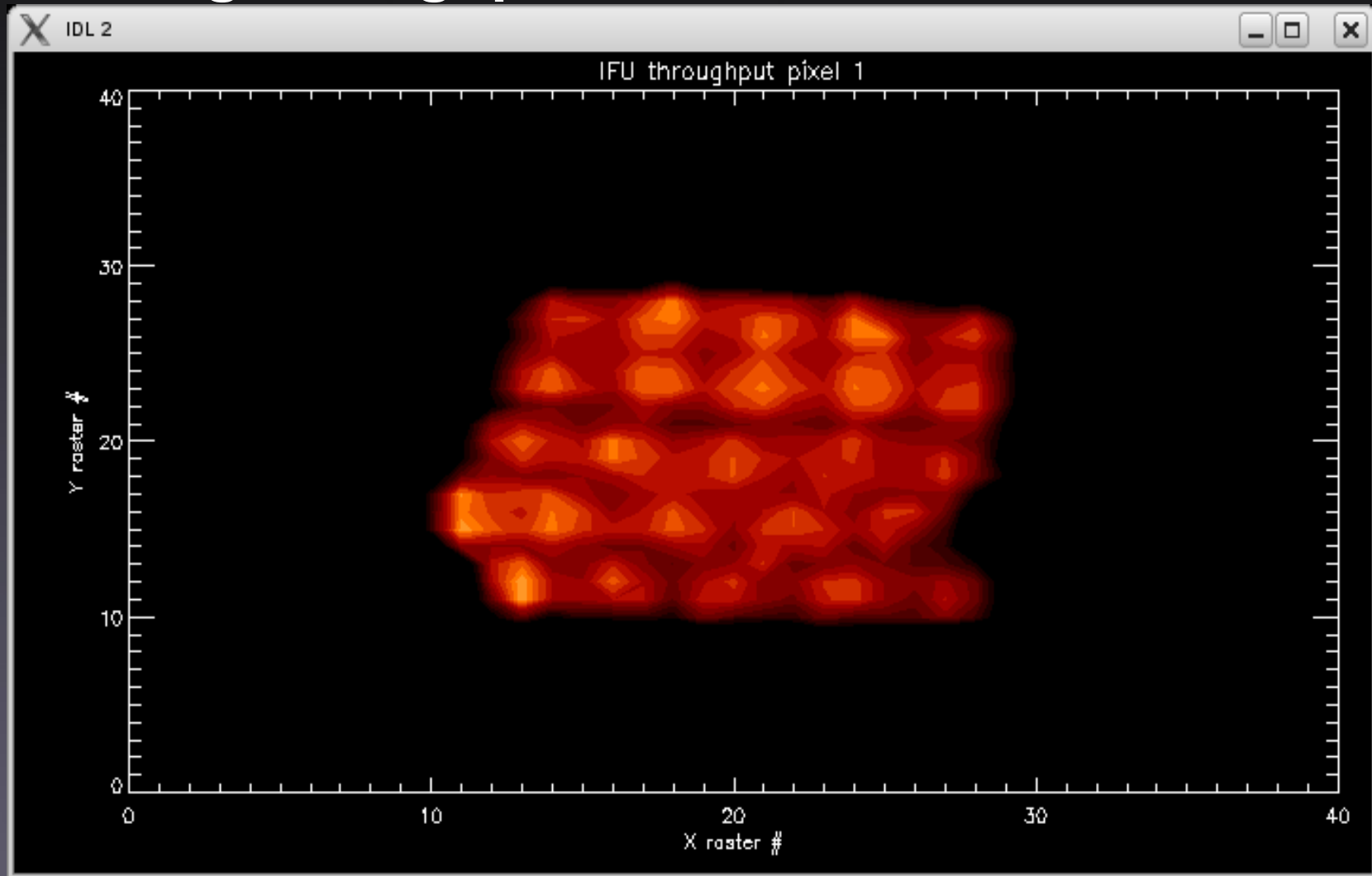
Sturm et al 2012 in prep

Location of the Forsterite in HD100546



2D RT: located close to disk wall (13-20 AU). Low total mass (0.5-0.8%), but strong features. Origin related to disk gap
Mulders et al. 2011

Detecting other dust and ice features: solving throughput variations of the PACS IFU



Summary: see Digit Posters by

Gwendolyn Meeus

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Jeong-Eun Lee