Evidence of a discontinuous inner disc structure around the Herbig star HD 139 614

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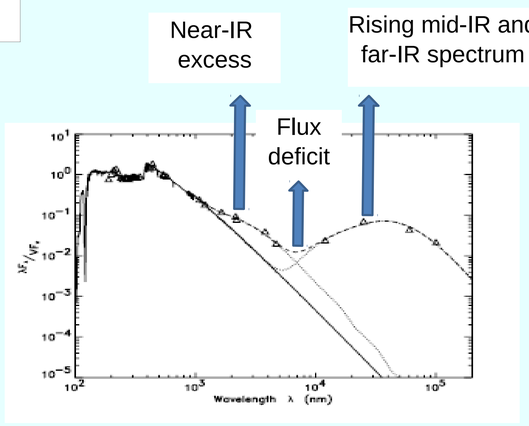
Messages of this poster :

- **First simultaneous modeling of SED and mid-infrared interferometric data of the Herbig star 139 614 using an analytical temperature-gradient model that includes dust opacity.**
- **A one-component model cannot reproduce both the SED and interferometric data.**
- **A two-component model (unresolved source at 1500 K + dust-depleted region + temperature-gradient disk starting at 5.9 AU) reproduces better the data.**
- **Our results suggest a discontinuous dust architecture: extended near-IR emitting region + gap + outer disc characterized by a hot inner edge and sharp temperature profile.**

I. Context and motivation

Pre-transitional discs

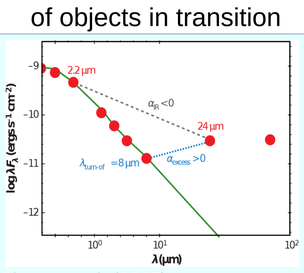
Typical SED →



Example of the Herbig star HD169142 (Malfait et al., 1998)

Motivation

Near and mid-IR SED shape of objects in transition

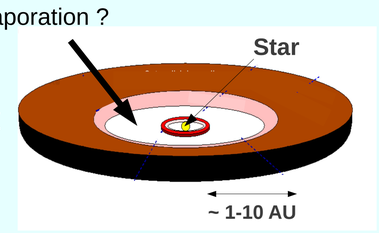


Cieaza et al. (2007)

→ **Pre-transitional objects have a mid-IR slope > 0**

→ **Steep radial dependence of dust opacity (gap ?)**

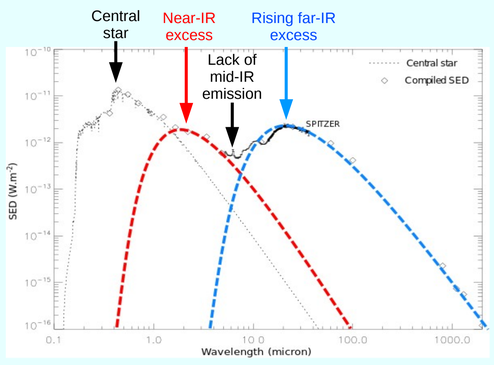
Pre-transitional structure → Diagnosis of inner disc clearing → Planet formation ? Photoevaporation ?



II.The case of HD 139 614

Features

- Class I Herbig star (Meeus et al., 2001) → Flared disc
- **Gas** : CO lines + PAHs features **Dust** : no significant amorphous silicate features
- Pre-transitional-like SED



→ **Inner disc clearing (first few AUs) ? Multi-component structure ?**

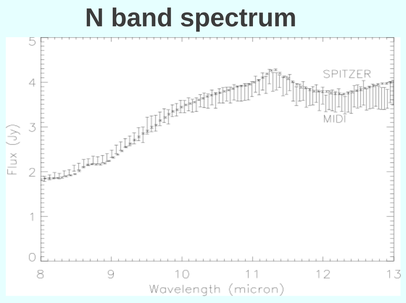
→ **Solution**

→ **Mid-infrared interferometric observations → inner regions of the disc (first few AUs)**

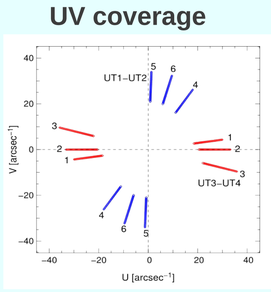
Observations

VLTI instrument MIDI (8 – 13 μm)

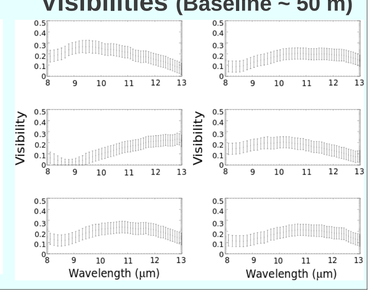
N band spectrum



UV coverage



Visibilities (Baseline ~ 50 m)



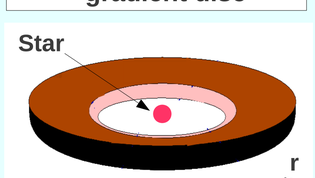
III. Modeling

Methodology

What ? **Dust architecture (~ 1-20 AUs)** → **How ?** **Temperature-gradient model** → **Observational Constraints ?** **Compiled broadband SED** + **mid-IR visibilities + spectrum (MIDI instrument)**

Temperature-gradient disc models

Basis : temperature-gradient disc



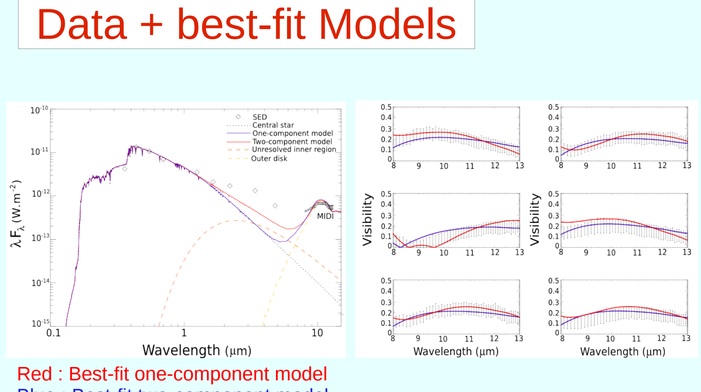
$\Sigma_r = \Sigma_0 r^{-p}$ **Surface density radial profile**

$T_r = T_0 r^{-q}$ **Temperature radial profile**

→ **One-component disc (Star+temperature-gradient disc)**

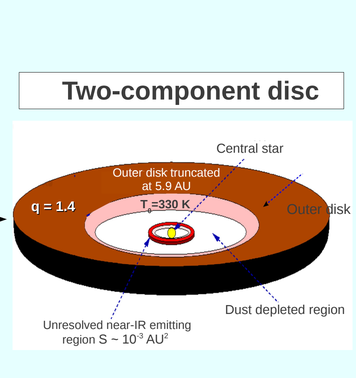
→ **Two-component disc (star + unresolved inner region at 1500 K + temperature-gradient disc)**

Data + best-fit Models



Red : Best-fit one-component model
Blue : Best-fit two-component model

Best model → **Two-component disc**

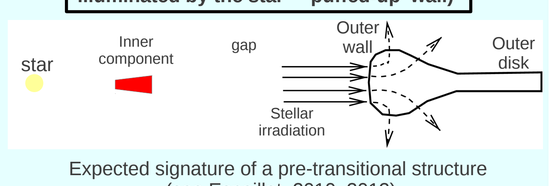


IV. A multi-component structure

Best-fit two-component model : results analysis

Unresolved inner component → Mid-IR visibilities OK ; Near-IR excess underestimated → **Near-IR flux cannot be contained in a confine inner region (hot inner rim)** **suggesting** → **Extended near-IR emiting region**

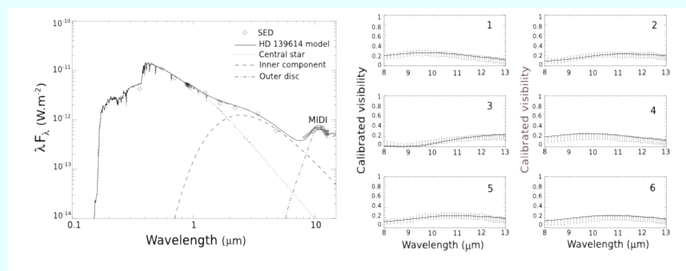
Outer disk → Very high temperature at the inner edge ; steep temperature profile **suggesting** → **Hot component (inner edge frontally illuminated by the star ~ 'puffed-up' wall)**

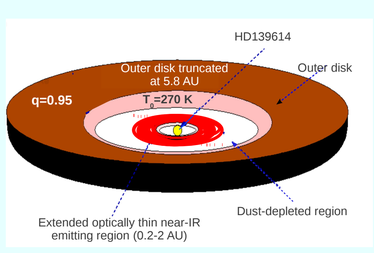


Expected signature of a pre-transitional structure (see Espaillat, 2010, 2012)

Qualitative modeling

To reproduce SED + mid-IR visibilities → **Possible solution** → **Extended near-IR emitting region at 1500K + Temperature-gradient outer disk**





→ **Good match with the whole set of data (near-IR SED + mid-IR spectrum + mid-IR visibilities)**

→ **Work on-going : radiative transfer modeling of near-IR + mid-IR interferometric data → confirmation of the pre-transitional structure + constraint on the near-IR emitting region**