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

A. Matter1, L. Labadie2, A. Kreplin3, B. Lopez1, S. Wolf1, G. Weigelt1, S. Ertel1, J.-U Pott1, and W.C. Danchi2

1 Max Planck Institut für Astronomie, Königstuhl 17, D-69117 Heidelberg, Germany ; 2 Laboratoire Lagrange, CNRS UMR 7295, UNS-Observatoire de la Côte d’Azur B.P 4229, F-06304 Nice Cedex 4, France ; 3 Astrophysik, Leibnizstr. 15, 24098 Kiel, Germany ; 4 Universität zu Köln, Zülpicher Str. 77, 50937 Köln, Germany ; 5 Universität zu Kiel, Institut für Theoretische Physik und Astrophysik, Leibnizstr. 15, 24098 Kiel, Germany ; 6 Max Planck Institut für Astronomie, Königstuhl 17, D-69117 Heidelberg, Germany ; 7 NASA/GSFC, Greenbelt, MD 20771, USA

Messages of this poster :
• First simultaneous modeling of SED and mid-infrared interferometric data of the Herbig star HD 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

II. The case of HD 139 614

Features

Class II Herbig star (Meeus et al., 2001) → Flared disc
Gas : CO lines + PAHs features Dust : no significant amorphous silicate features

Pre-transitional-like SED

Observations

VLTI instrument MIDI (8 – 13 μm)
N band spectrum
UV coverage
Visibilities (baseline ~ 50 m)

III. Modeling
Methodology

What ? Dust architecture (~ 1-20 AU)

How ? Temperature-gradient model

Observational Constraints ? Compiled broadband SED

Mid-IR visibilities + spectrum (MIDI instrument)

Temperature-gradient disc models

Basis : temperature-gradient disc

Star

Rising mid-IR and far-IR spectrum

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

Steep radial dependence of dust opacity (gap ?)

Pre-transitional structure

Diagnosis of inner disc clearing

Near and mid-IR SED shape of objects in transition

Near-IR excess

Planet formation ?

Photoevaporation ?

IV. A multi-component structure model : results analysis

Best-fit two-component model : result analysis

Unresolved inner component

Near-IR flux cannot be contained in a confined inner region (hot inner rim)

Mid-IR visibilities OK

Near-IR excess underestimated

Extended near-IR emitting region

Outer disk

Very high temperature at the inner edge

Extended mid-IR emitting region at 1500K

Temperature-gradient outer disk

Possible solution

To reproduce SED + mid-IR visibilities

Extended near-IR emitting region at 1500K + Temperature-gradient outer disk

Qualitative modeling

Great 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

Data + best-fit Models

Two-component disc

Best model