Interferometry from near-infrared to mm-wavelengths

The transition disk around TW Hydrae

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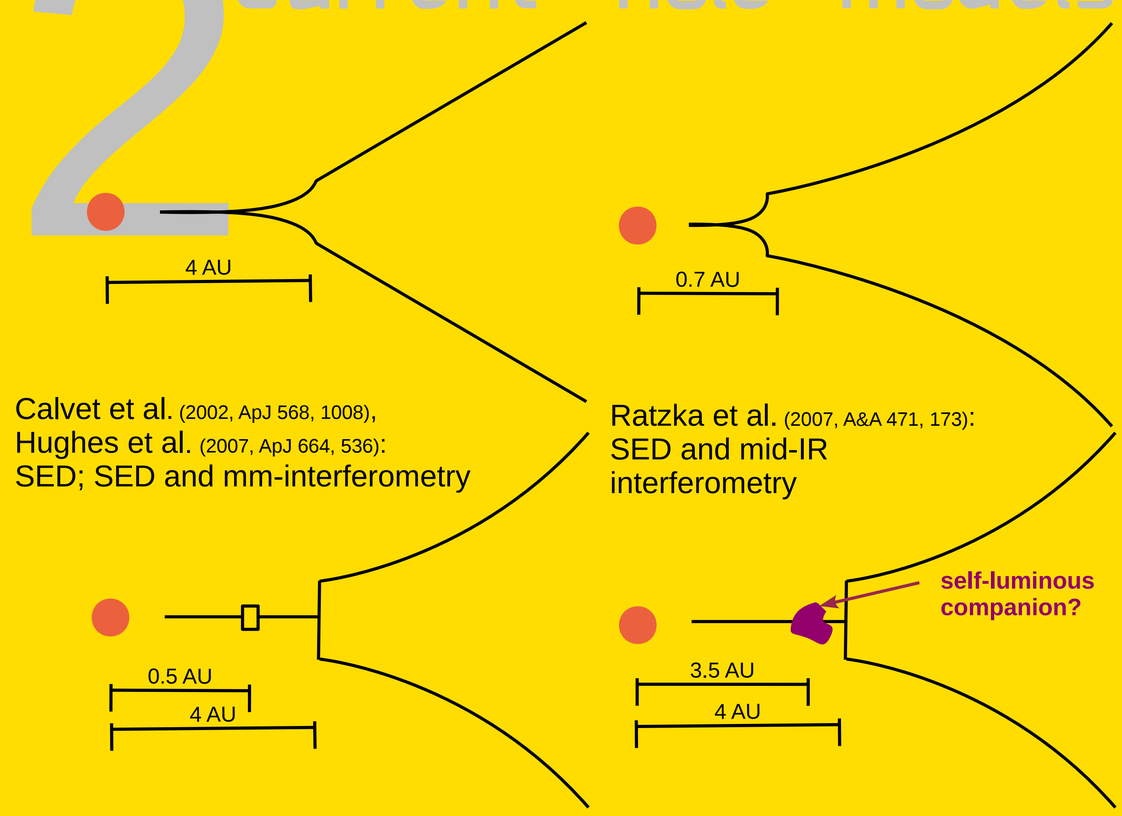
1 Intro

For over a decade, the structure of the inner hole in the transition disk around TW Hydrae (TW Hya) has been a subject of debate. Apparent "inconsistencies" in the proposed models might actually point to **radial changes in dust properties**, e.g. caused by dust growth or the disk interacting with a sub-stellar companion. We collected a large set of high-angular-resolution data for re-investigating the disk geometry.

2 Current "hole" models



3 Data

- *Near-infrared interferometry (PIONIER)*:
  high visibilities (V^2 = 0.97), resolved scattering outer disk
- *Mid-infrared interferometry (MIDI)*:
  consistent with i = 0°, characteristic scale ~0.7 AU
- *Sub-mm interferometry (SMA)*:
  sharp edge at ~60 AU, whereas scattered light > 200 AU
- *Mm interferometry (VLA)*:
  centrally concentrated, no confirmation of 4-AU visibility null

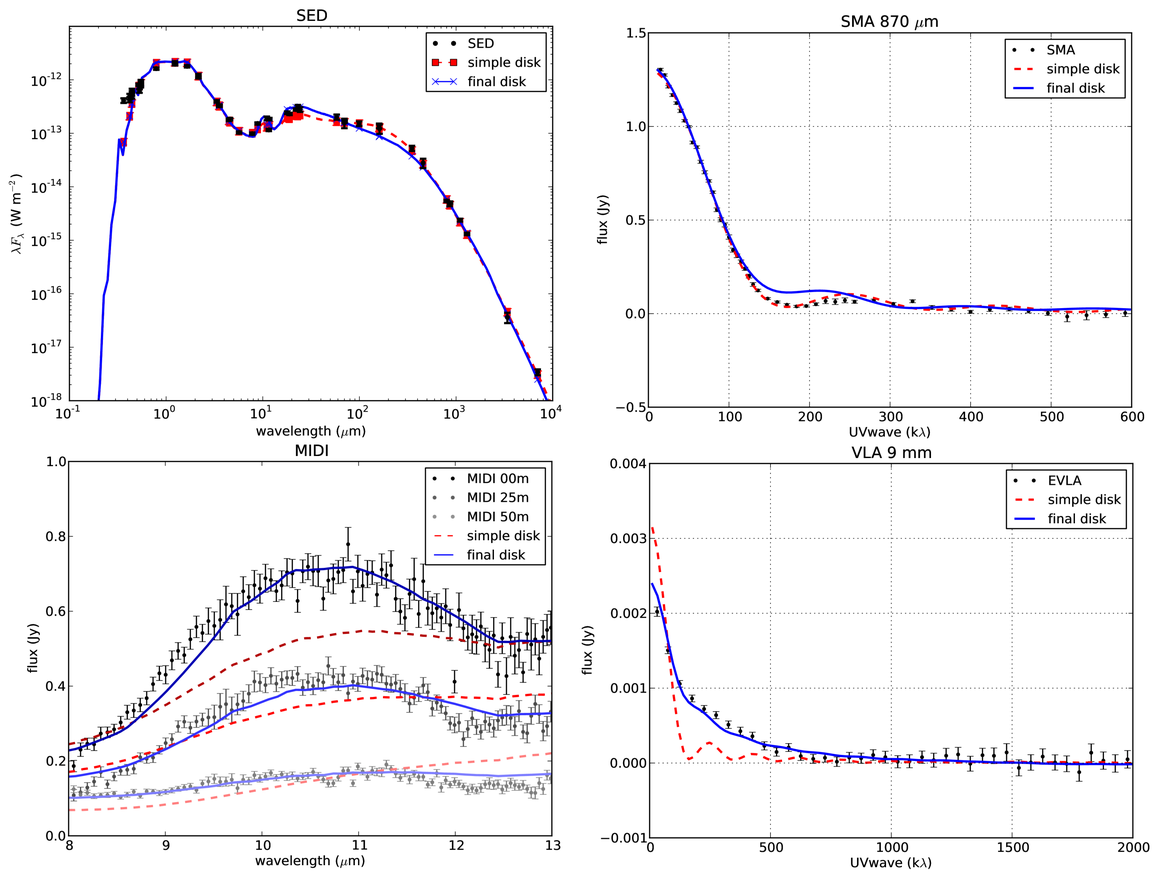
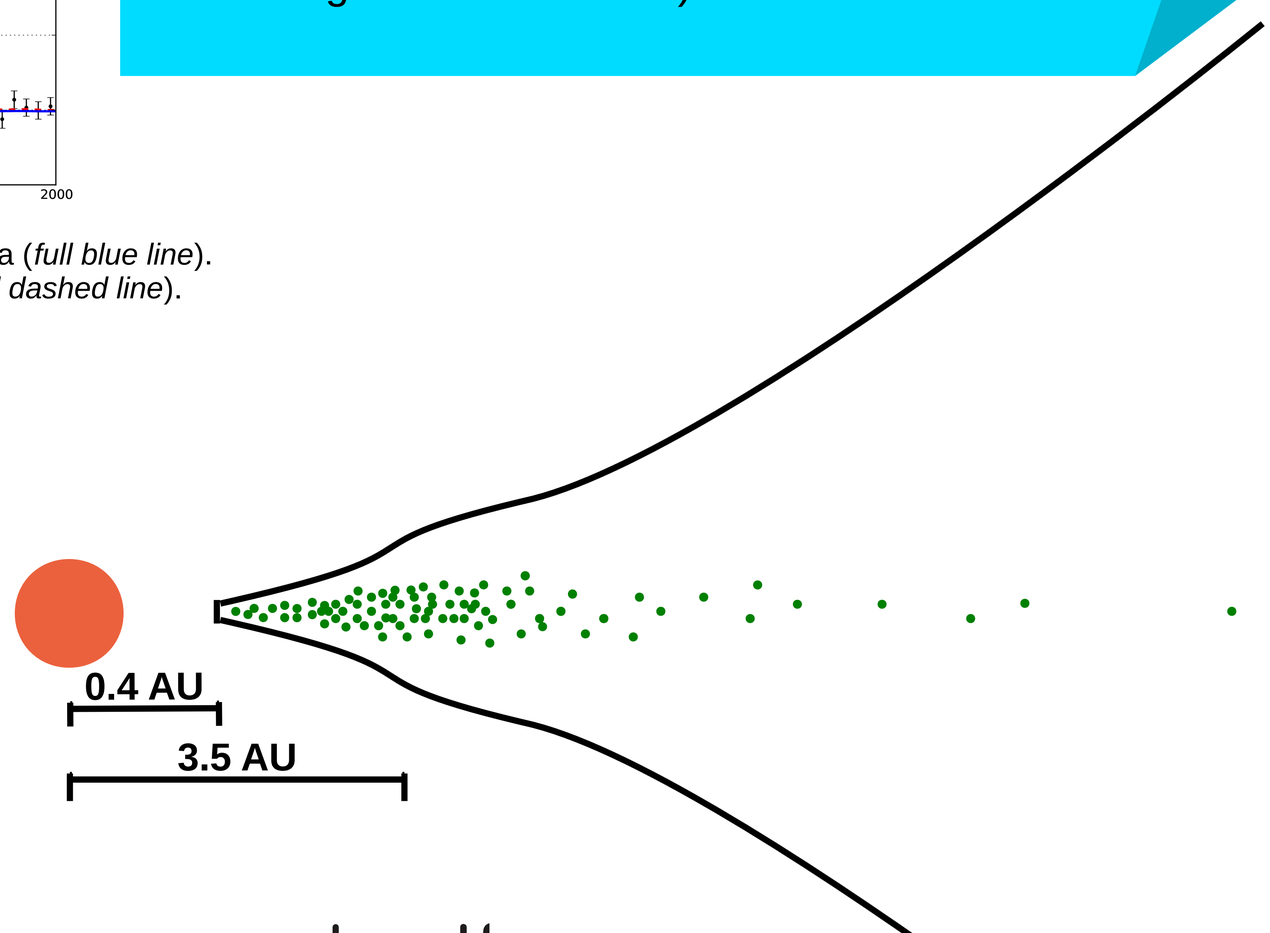


Fig.: SED and interferometric data sets compared with new disk model for TW Hya (*full blue line*). A model with a simple disk (vertical rim, empty hole) is shown for comparison (*red dashed line*).

4 Modeling

We develop a **self-consistent radiative-transfer model**, making use of a **genetic fitting algorithm** to adjust the fit parameters. A simple disk model with a vertical rim (+ an empty central hole) and a homogeneous dust composition from small to large grains does not successfully reproduce the data. We apply two modifications:

1. rounding the inner rim, by exponentially reducing $\Sigma(R)$. The shape follows from hydrodynamical modeling of a disk interacting with a companion (Mulders et al. 2013b, A&A, in press)
2. concentrating the >100-μm grains towards the center. Different grain sizes probe different dust growth regimes throughout the disk (drift-dominated vs. fragmentation-limited).



5 Conclusion

TW Hya can be modeled as having a disk with a **smooth inner rim** and a **centrally concentrated large-grain population**, properties that can directly be linked to physically relevant processes prevailing in disks (interaction with a possible companion and inhomogeneous dust growth, resp.). The model integrates data from near-infrared to millimeter wavelengths, and confirms scales found previously.