Characterization of protostars using VOSA

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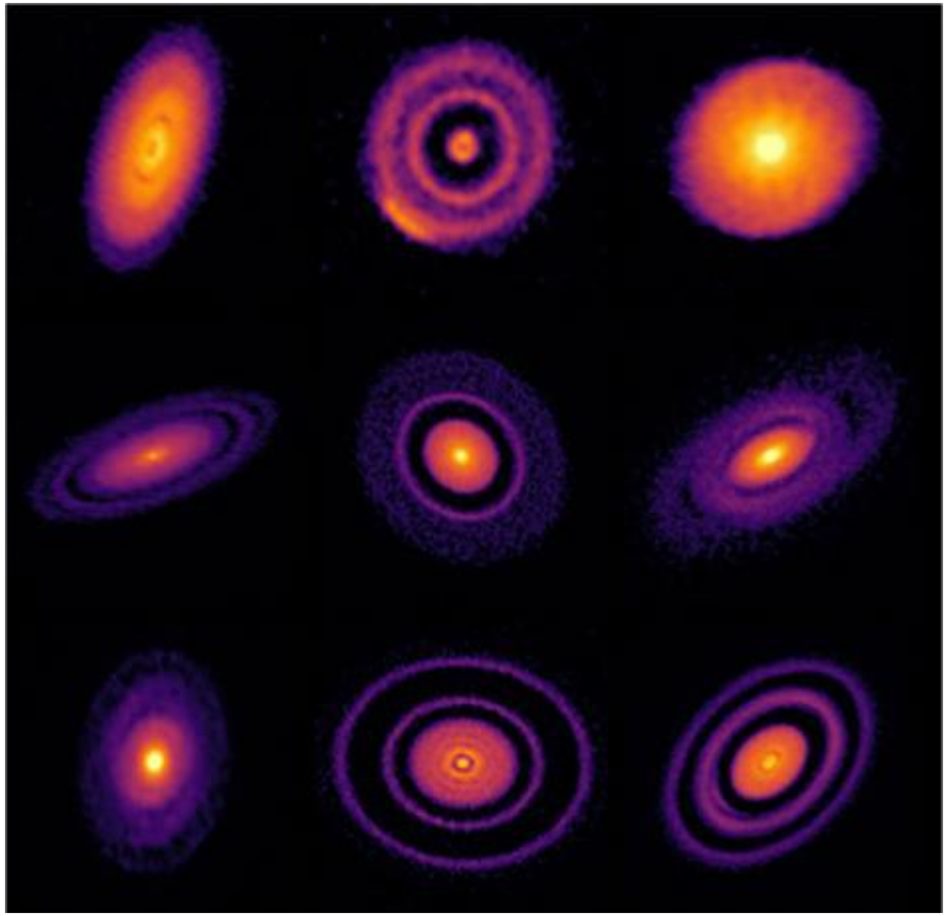
Context: the search of forming planets

- **Protoplanetary disks**:
  - Sites of planet formation.
  - Cavities, gaps/rings, spiral arms...

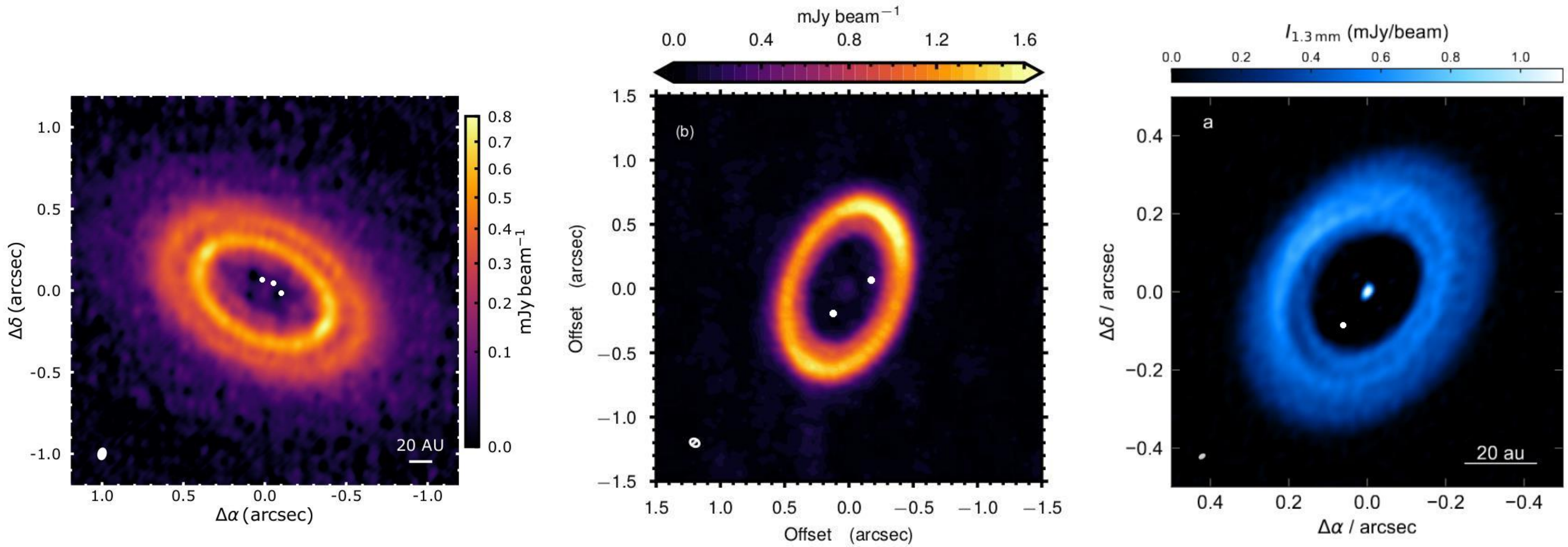
- **Detection of forming planets**: challenging!
  - **Close to host star** (~0.1 – 0.5 arcseconds).
  - Bright/**detectable in NIR** (~1–5 μm).
  - **Can be confused with/outshined by dust** close to the star (reflected starlight + NIR thermal emission).

- My research: **NIR interferometry + radiative transfer modeling** (high angular-resolution + dust properties).



Protoplanetary disks as seen by ALMA (1.25 mm).

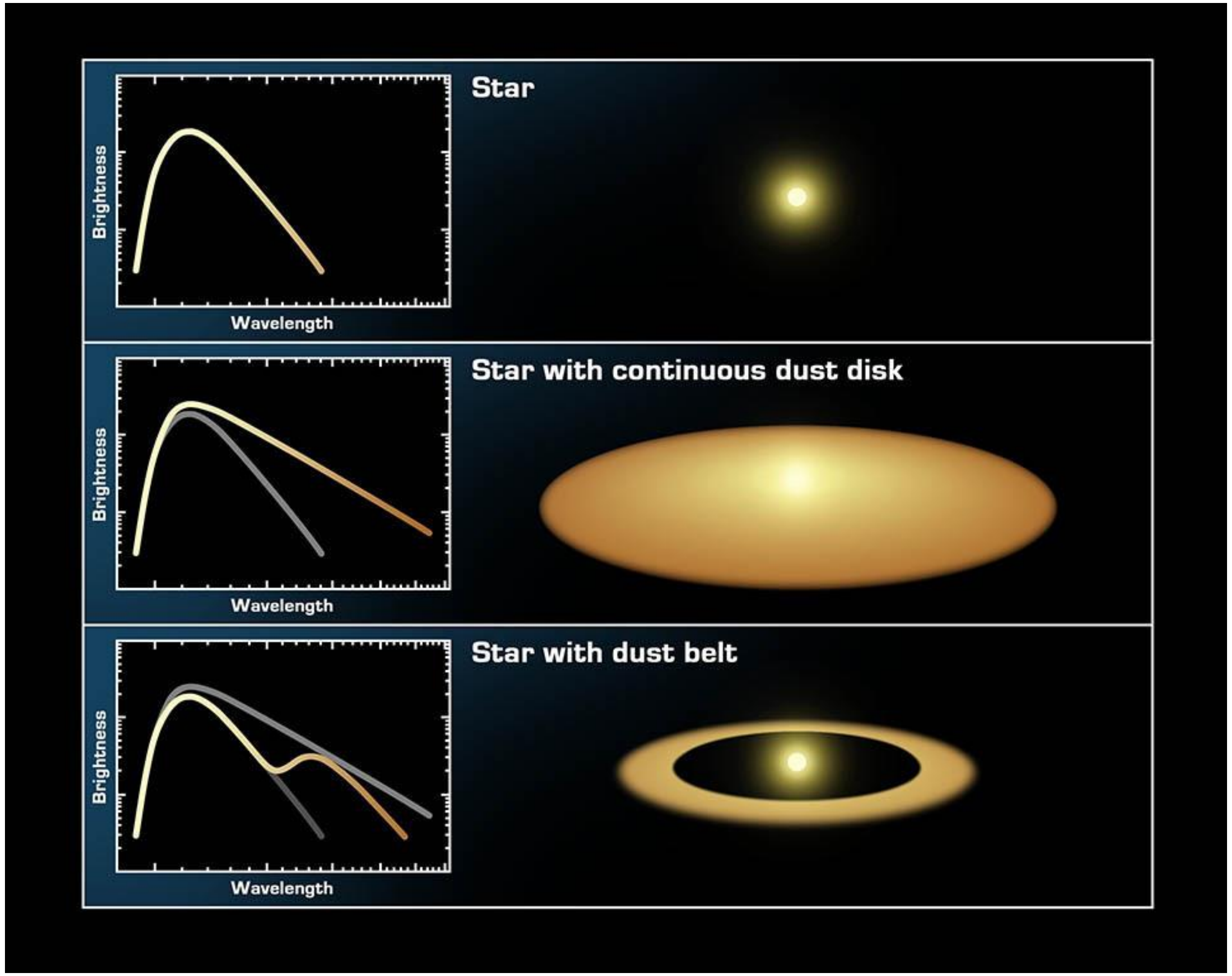
Context: the search of forming planets



Dust continuum emission of three protoplanetary disks.
Left: *LkCa 15 (1.3 mm, Facchini et al. 2020).* ***Middle:*** *PDS 70 (~1 mm, Keppler et al. 2019).* ***Right****: HD 100546 (1.3 mm, Pérez et al. 2020).*

Science case: characterization of protostars hosting dust disks

- The **SED of protoplanetary disks** can reveal information of their structure.
- **VOSA (VO SED Analyzer)** helps to model the SED of the host star and derive some of its properties.
- **Derived stellar parameters** can be used as input for radiative transfer models of the star + disk system.

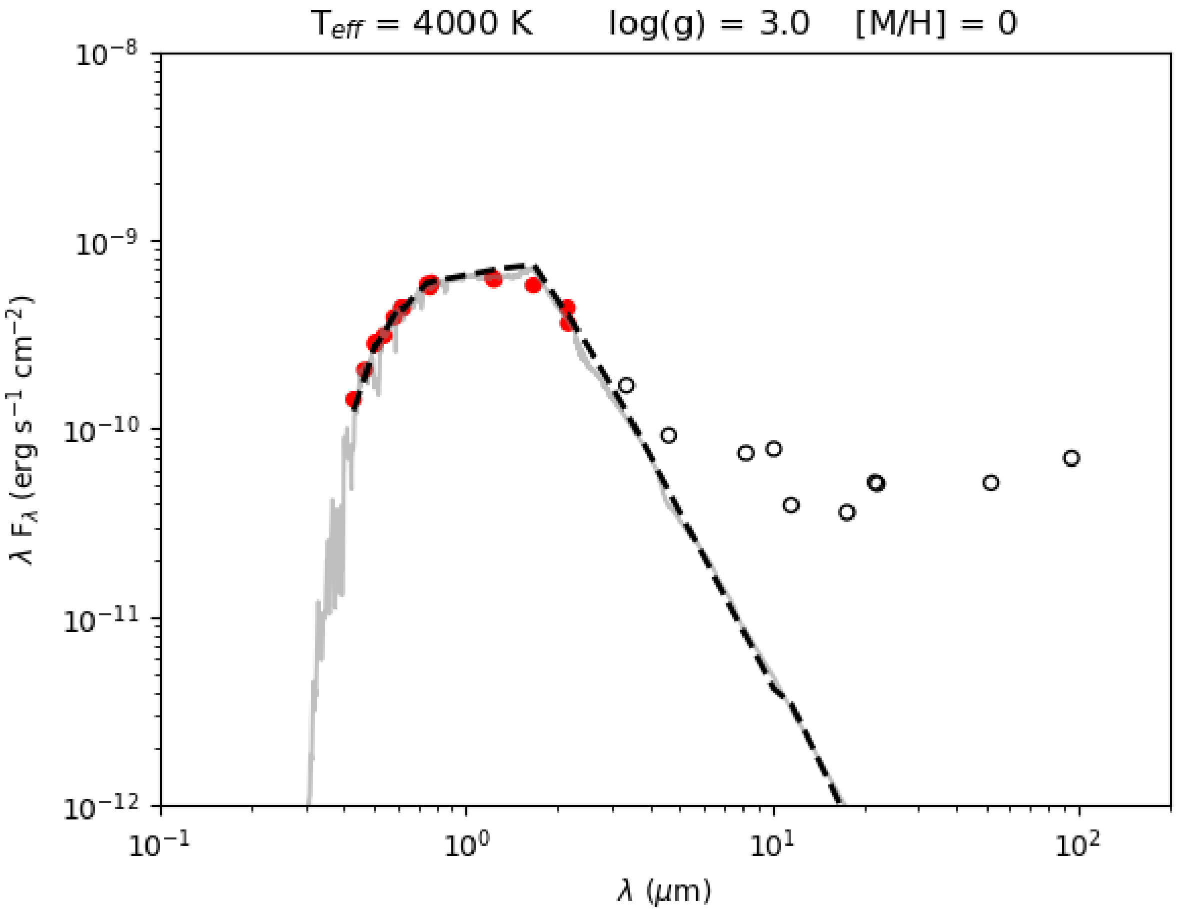


How the shape of the SED changes depending on the object.

Stellar parameters derived by VOSA: PDS 70

- Assumed solar metallicity
- Kurucz models + Kesseli templates (chi2 fit)
- Siess isochrones & evolutionary tracks (HR diagram)

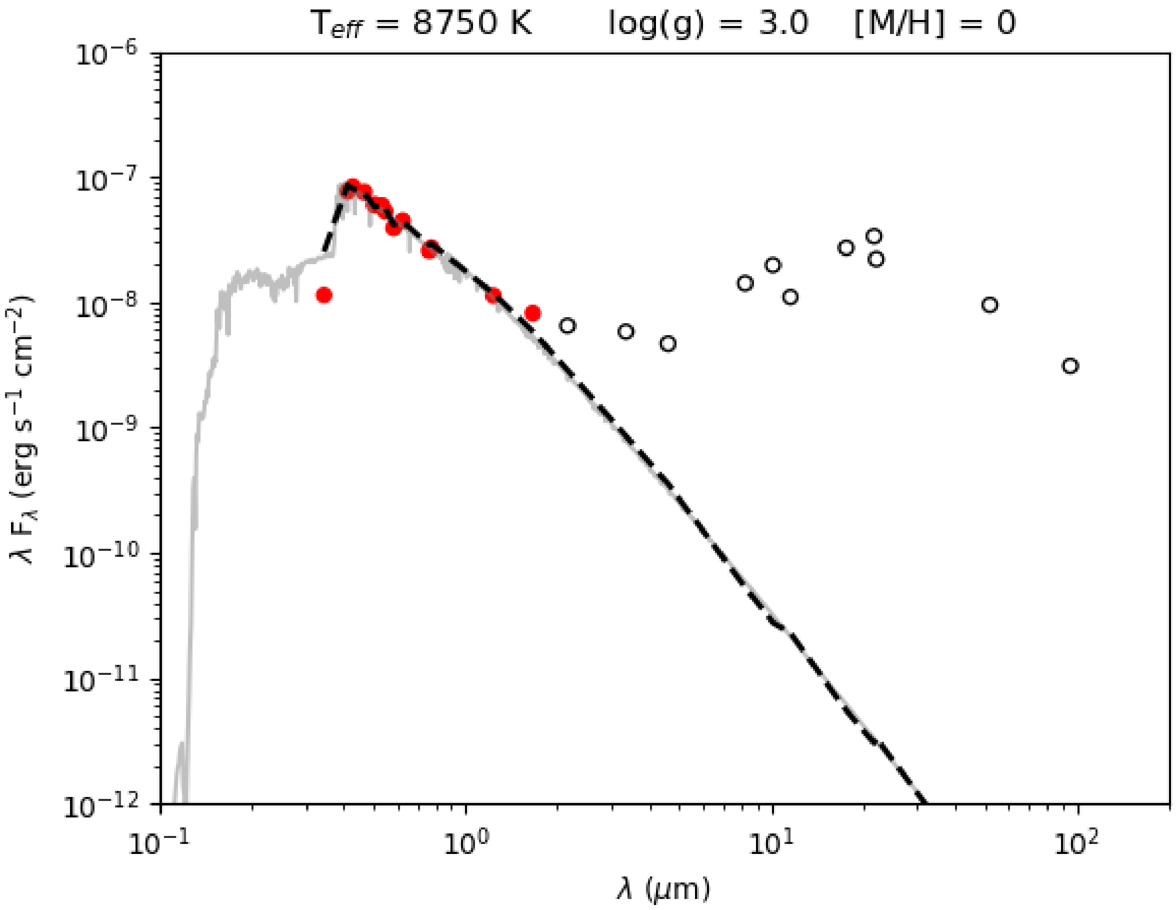
	Literature	Best-fit
Teff [K]	3700 – 5100	4000 +- 125
Log(g)	3.99 - 5.00	3.00 +- 0.25
Radius [R⊙]	0.95 - 1.41	1.32 +- 0.09
Mass [M⊙]	0.57 - 0.78	0.73 (0.60 - 0.89)
Age [Myr]	5 – 10	5.7 (3.3 - 9.2)
SpecType	K5 – K7 (K7)	K7



Stellar parameters derived by VOSA: HD 100546

- Assumed solar metallicity
- Kurucz models + Kesseli templates (chi2 fit)
- Siess isochrones & evolutionary tracks (HR diagram)

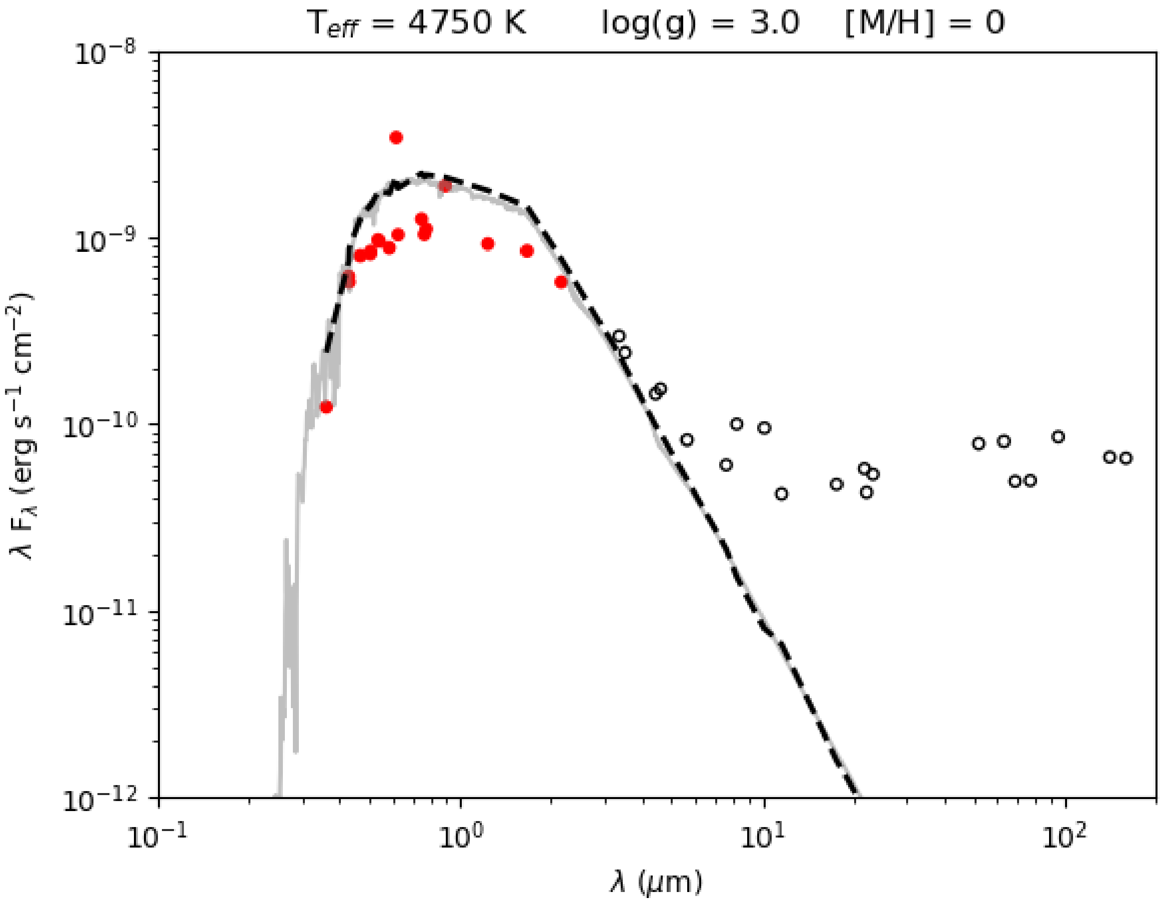
	Literature	Best-fit
Teff [K]	8900 – 11750	**8750 +- 125**
Log(g)	3.50 - 4.60	3.00 +- 0.25
Radius [$R_\odot$]	1.80 - 1.90	2.21 +- 0.07
Mass [$M_\odot$]	2.30 - 3.00	2.20 (2.18 - 2.20)
Age [Myr]	5 – 15	**6.0 (6 - 500)**
SpecType	B9 - A0	**A3**



Stellar parameters derived by VOSA: LkCa 15

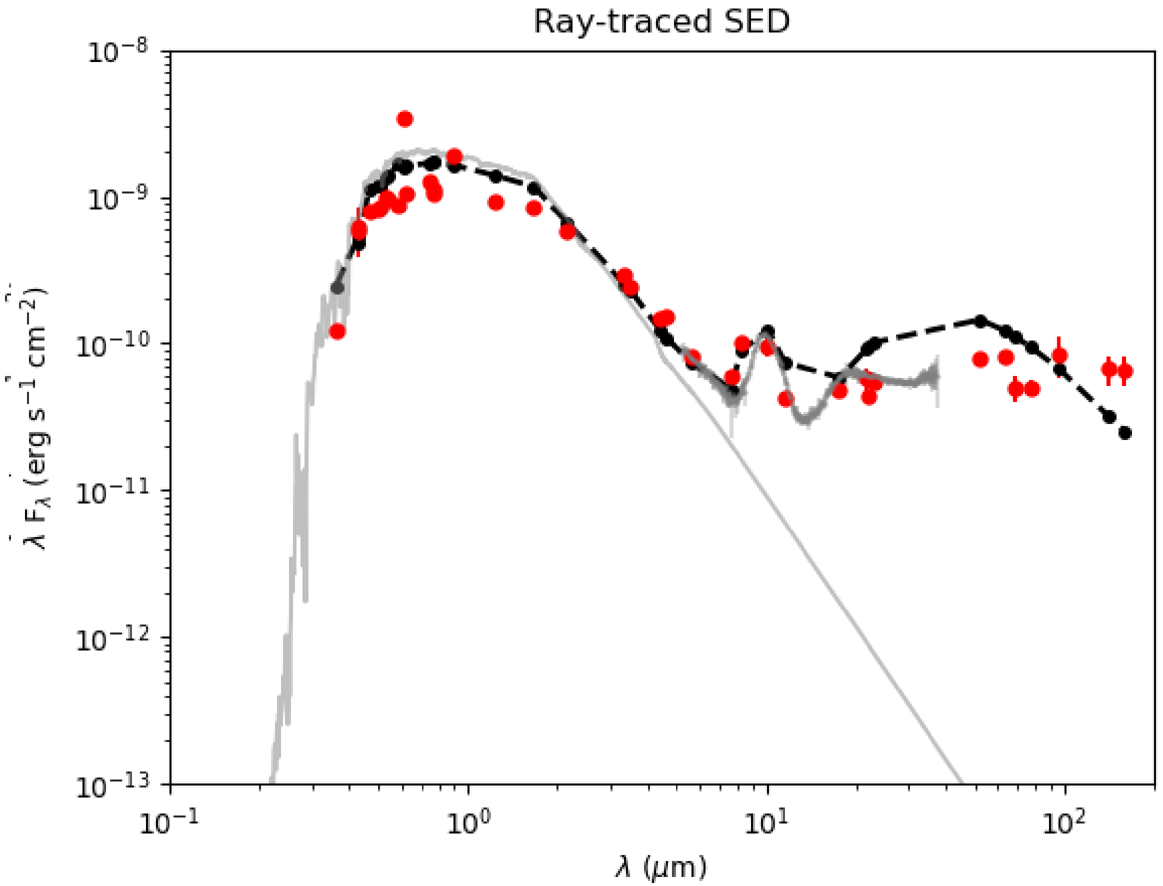
- Assumed solar metallicity
- Kurucz models + Kesseli templates (chi2 fit)
- Siess isochrones & evolutionary tracks (HR diagram)

	Literature	Best-fit
Teff [K]	4000 - 5400	4750 +- 125
Log(g)	2.44 - 4.28	3.0 +- 0.25
Radius [$R_\odot$]	1.51 - 1.61	1.96 +- 0.11
Mass [$M_\odot$]	1.15 - 1.35	1.52 (1.49 -1.55)
Age [Myr]	1 – 7	5.0 (3.6 - 6.8)
SpecType	K3 – K7 (K5)	K4

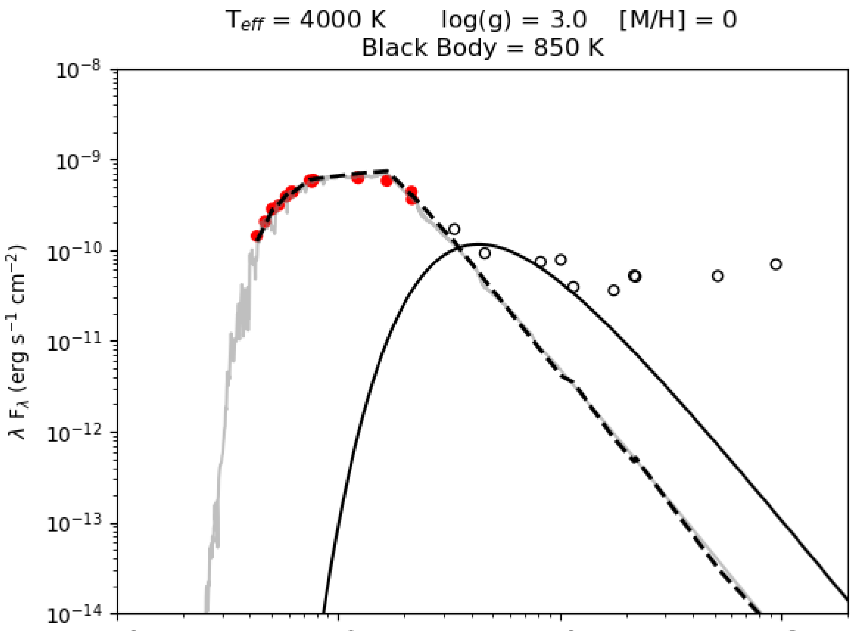


Radiative transfer model of LkCa 15

- **VOSA best-fit used as input:**
  - Stellar spectrum: Kurucz model (logg = 3, solar metallicity)
  - **Teff**: 4750 K
  - **Mass**: 1.51 Msun
  - **Radius**: 1.96 Rsun
- **Work in progress!**
  - Photosphere
  - NIR excess
  - Silicate feature
  - Excess at > 20 µm

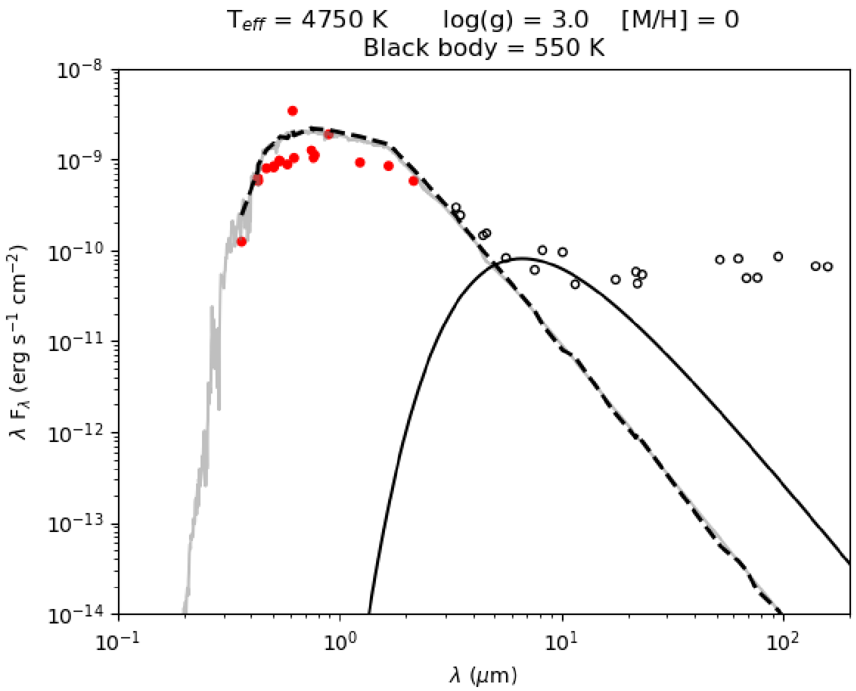


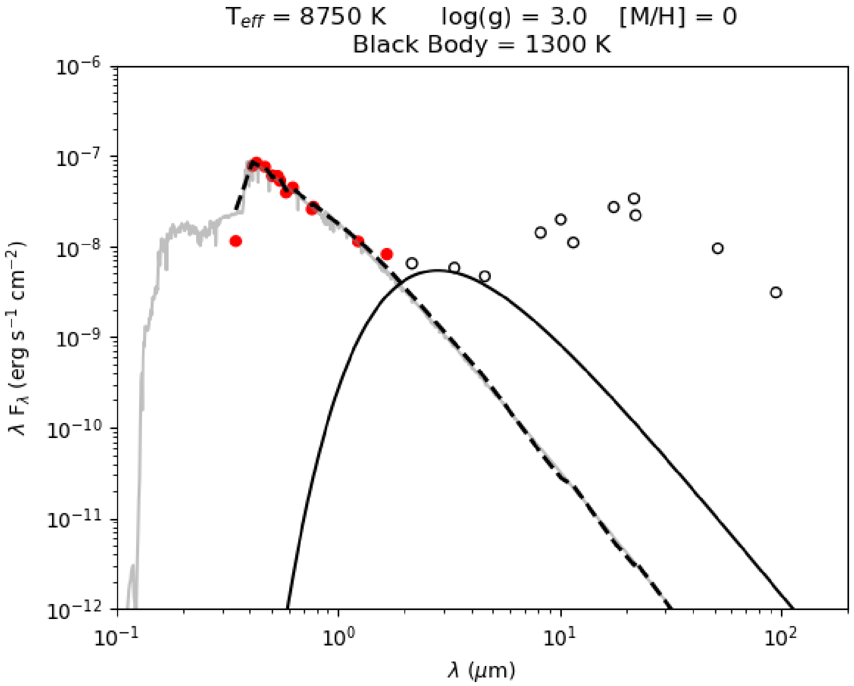
Binary fits



PDS 70

LkCa 15





HD 100546

- Best-fit **photosphere + black body**
- **NIR excess**: ~1 - 5 μm
- Values from literature: 500 – 1500 K

Summary

- **VOSA**:
  - Useful to derive properties of stellar photospheres.
  - Results strongly depend on data points considered/ignored in the fitting.

- **Science case**:
  - Results agree with literature for both T Tauri stars.
  - Dust temperature can be constrained with black bodies.

- **Future work**:
  - Fine-tune the RT model of LkCa 15.
  - Create RT models for PDS 70 and HD 100546.

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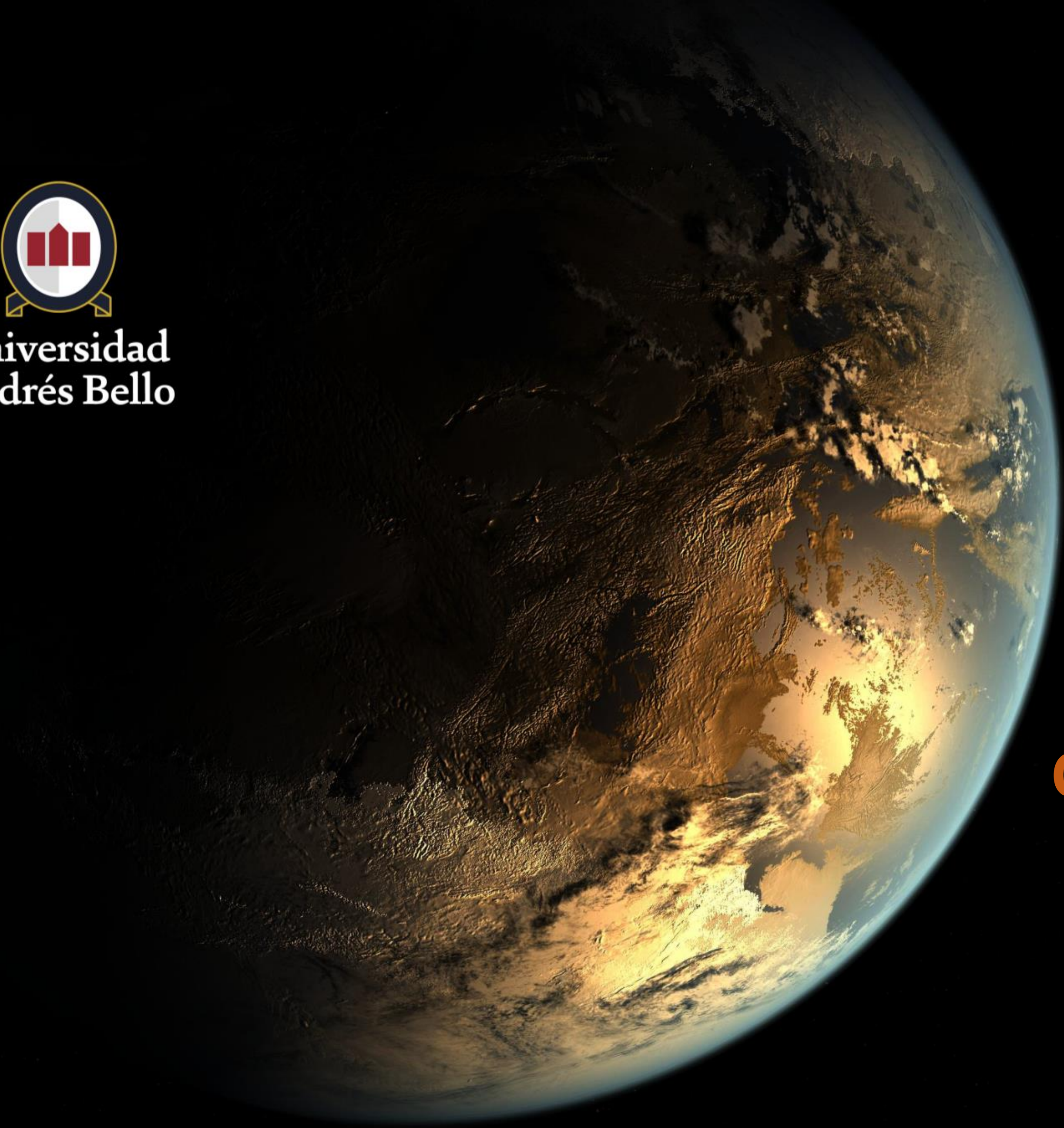

Thank you!

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