A radiative-convective equilibrium model for young giant exoplanets: Applications to β pictoris b data

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# I.Model II.β pictoris b III.Uncertainties

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### Model description : core and inputs

<u>Atmospheric</u> <u>model :</u>

- Radiative, convective equilibrium
- Thermochemical equilibrium

Free parameters :

log(g), Teff, R,

 $\tau_{clouds}$ , radius particles,

abundances<sub>elementary</sub>

#### 2.1<log(g)<5.5

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700K<Teff<2100K



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 Radiative, convective equilibrium

 Thermochemical equilibrium

Free parameters :

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abundances<sub>elementary</sub>

Gaseous molecular absorptions :

 TiO, VO, H<sub>2</sub>O, NH<sub>3</sub>, CO, Na, K,

CH<sub>4(Exomol)</sub> New !!!

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• K-correlated coefficients

Continuum H<sub>2</sub>-He

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### Model description : clouds



•  $Mg_2SiO_4$ 

Continuum H<sub>2</sub>-He Atmospheric model :

- Radiative, convective equilibrium
- Thermochemical equilibrium

Free parameters :

log(g), Teff, R,

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Gaseous molecular absorptions :

TiO, VO, CH<sub>4</sub>,
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#### **B** pictoris b



Observations NaCo, NiCi, MaGAO et GPI : Ys, J, CH<sub>4S1 %</sub>, H, Ks, L', NB<sub>405</sub>, M' and J spectrum from GPI

Using in parallel Lyon's model **BT-Cond,Dusty,Settl** from Allard et al. and **Drift-phenix model** of Helling et al. to constrain parameters

Teff 1600 ± 150 K, log g <4.7 dex

See Bonnefoy et al. 2014 for more

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With the SED only 1.27<R<2.1

With the spectrum only

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Similar results but with more precise constraints coming from the normalized spectrum Teff~1600K, log(g)>3 (SED) or 4 (spectrum)

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Uncertainties on retrieved parameters

 $\bullet 2 \sigma$  error bars on parameters taking into account observational uncertainties

• GPI J-band spectrum : Normalized spectrum: fit of the shape

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## Uncertainties on retrieved parameters

We observed degeneracy between Teff and radius and low sensitivity to g for high Teff.



Input spectrum: log(g)=3.5, Teff = 1100 With Y,J,H,Ks magnitudes with an error bar of 0.1

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#### **Conclusions**

- A very simple model, well understood
- Using observations and constraints (radius and mass) of  $\beta$  pic b
- Good agreement for derived parameters between all models

- We begin to have a lot of different observations
- To go further we need:
  - radius(transit?)
  - mass(radial velocity?)

Bonnefoy et al. A&A 2014, Baudino et al. In prep

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