Mass-radius relationship for low and very-low mass stars

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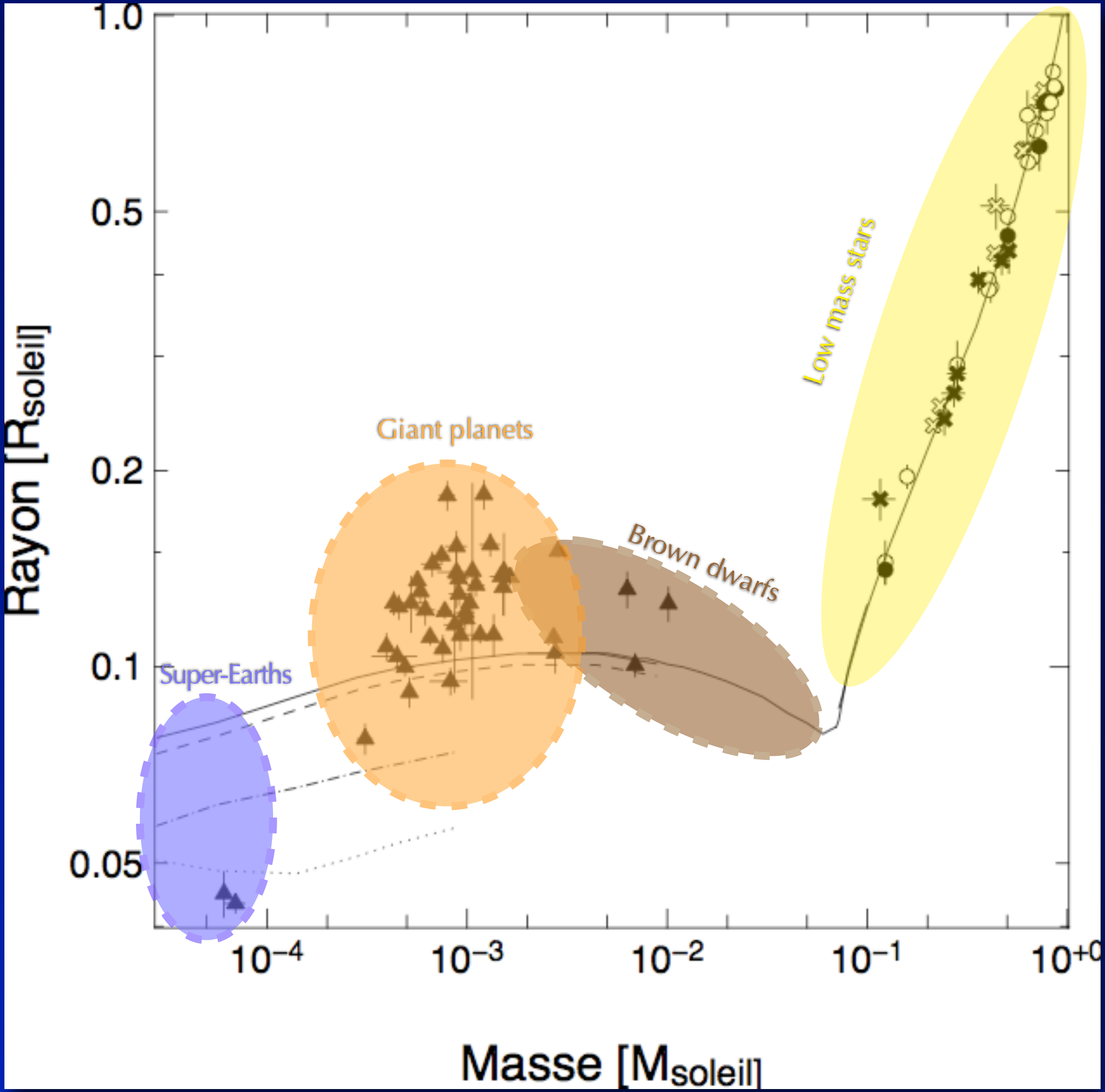
ESO
March 3rd, 2009

Outline

- From Earth-mass planets to solar mass stars
- Constraining stellar and planetary interiors with interferometry
- From visibilities to diameters
- Results, comparisons with current models

Mass-radius relationship



Constraining stellar and planetary interiors

Direct radii determination
obtained by interferometry

- Probing EOS
  e.g. *Chabrier et al., 2000*

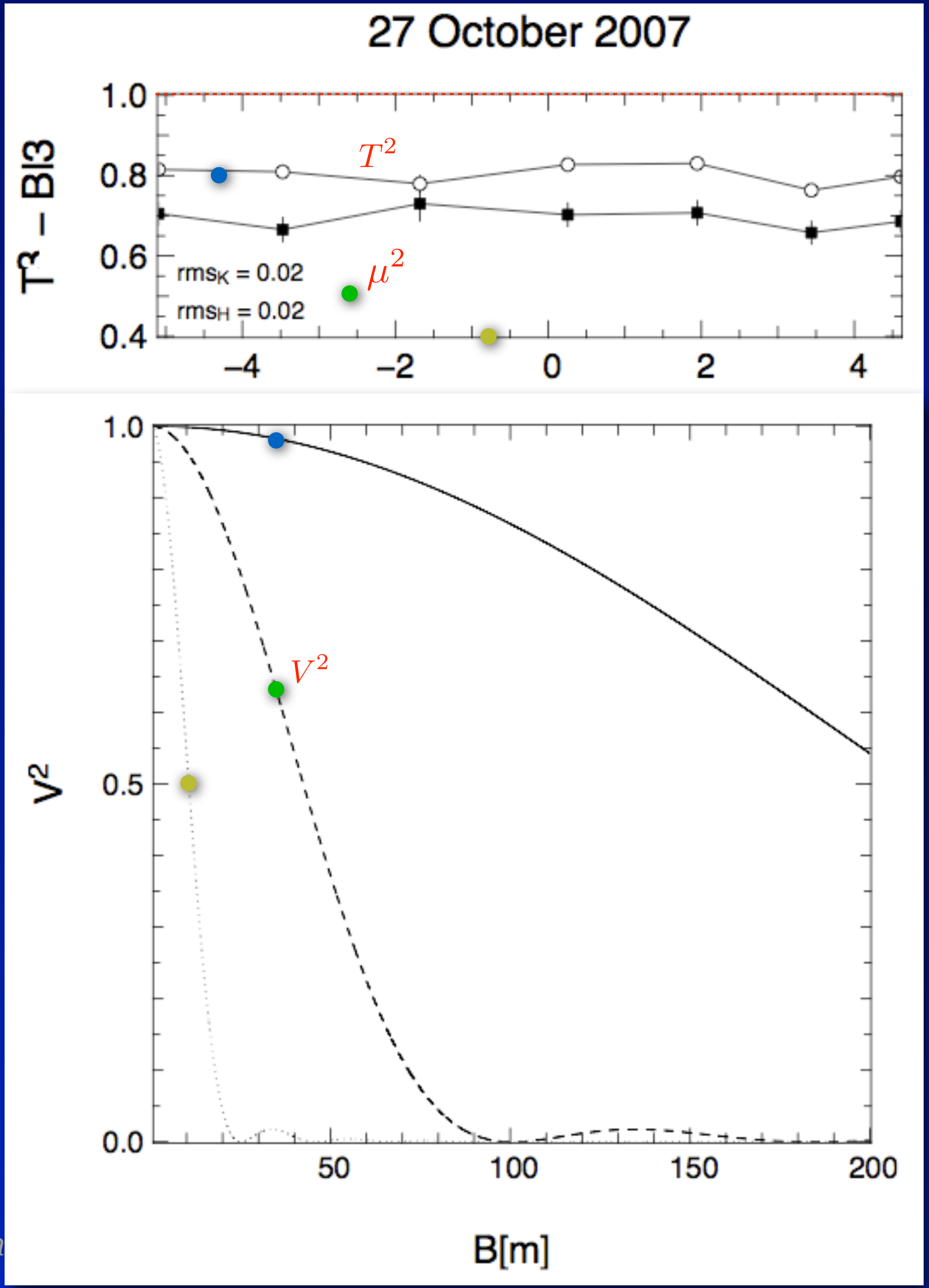
- Incidence of activity
  e.g. *Lopez-Morales, 2005*

- Metallicity effects
  e.g. *Berger, 2006*

From coherence factors to visibilities

- Necessity for calibration CAL-SCI-CAL at least for Vabs
- Choosing calibrators
- Atmospheric and instrumental transfer function monitoring

$$V^2 = \frac{\mu^2}{T^2}$$



AMBER : data analysis

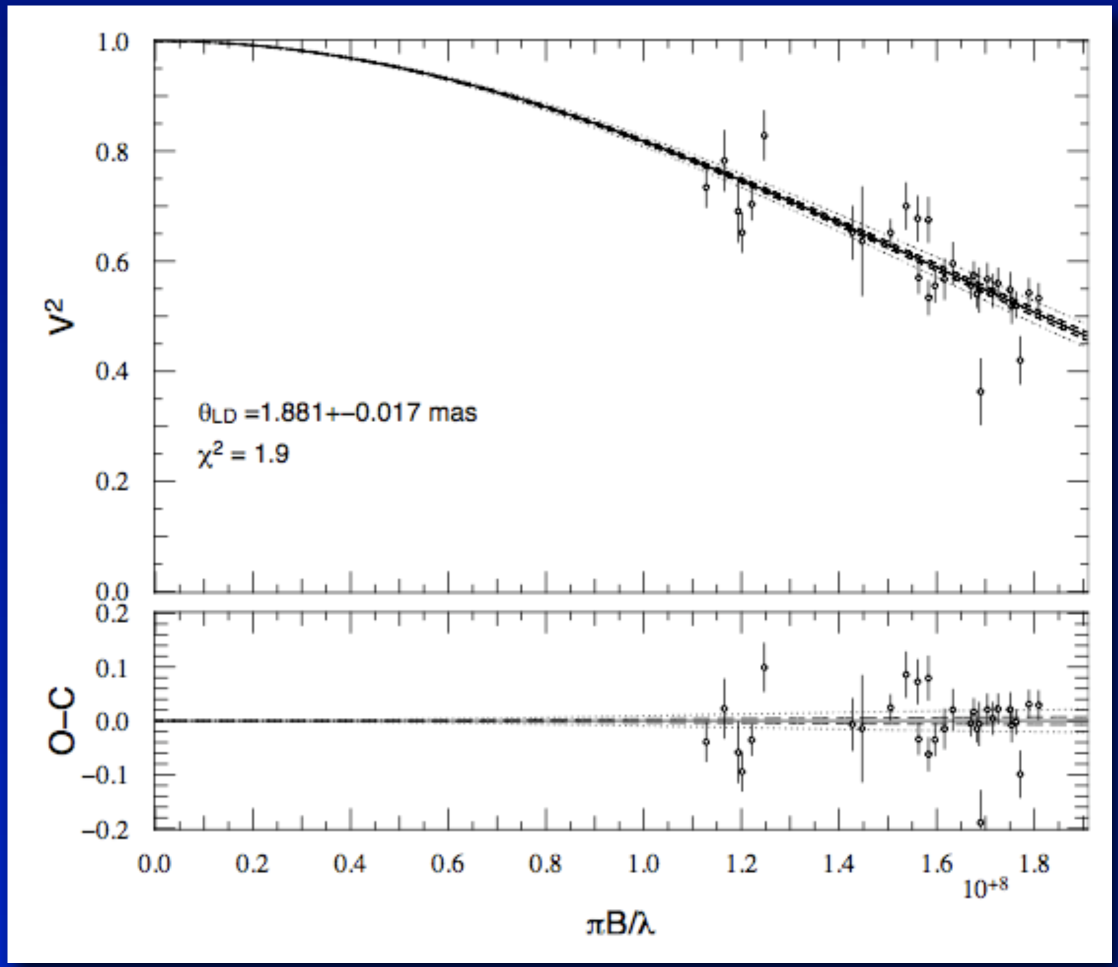
- Non-independant measurements
  - Calibrator diameter
  - Correlated noise (atmosphere)
- Correlation factors :

$$\rho_{\lambda_r,\lambda_k} = \frac{\langle (V^2_{\lambda_r} - \overline{V^2_{\lambda_r}})(V^2_{\lambda_k} - \overline{V^2_{\lambda_k}}) \rangle}{\sqrt{(V^2_{\lambda_r} - \overline{V^2_{\lambda_r}})^2 (V^2_{\lambda_k} - \overline{V^2_{\lambda_k}})^2}}$$

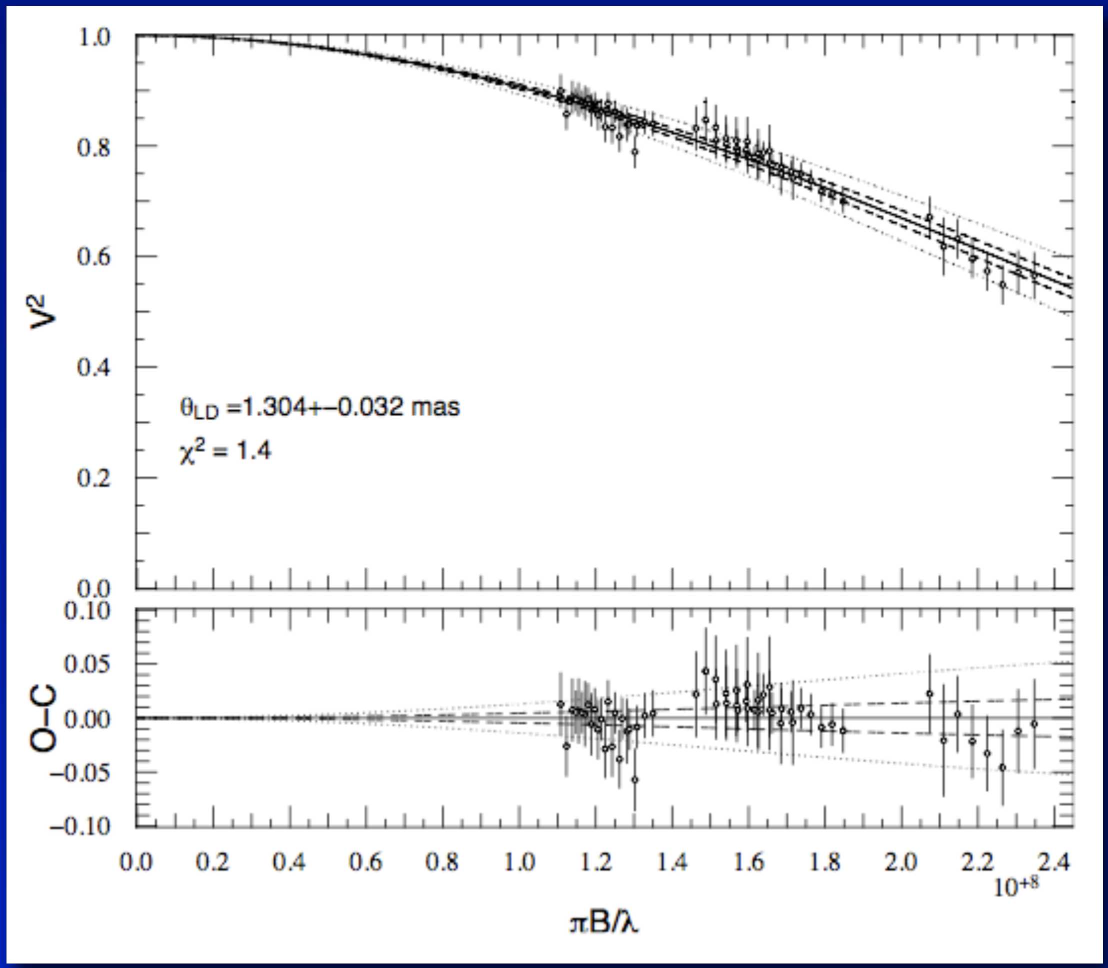
- Allows to estimate the independent amplitude of error bars

AMBER & VINCI : results for GJ845A & GJ887

- GJ845A (VINCI)

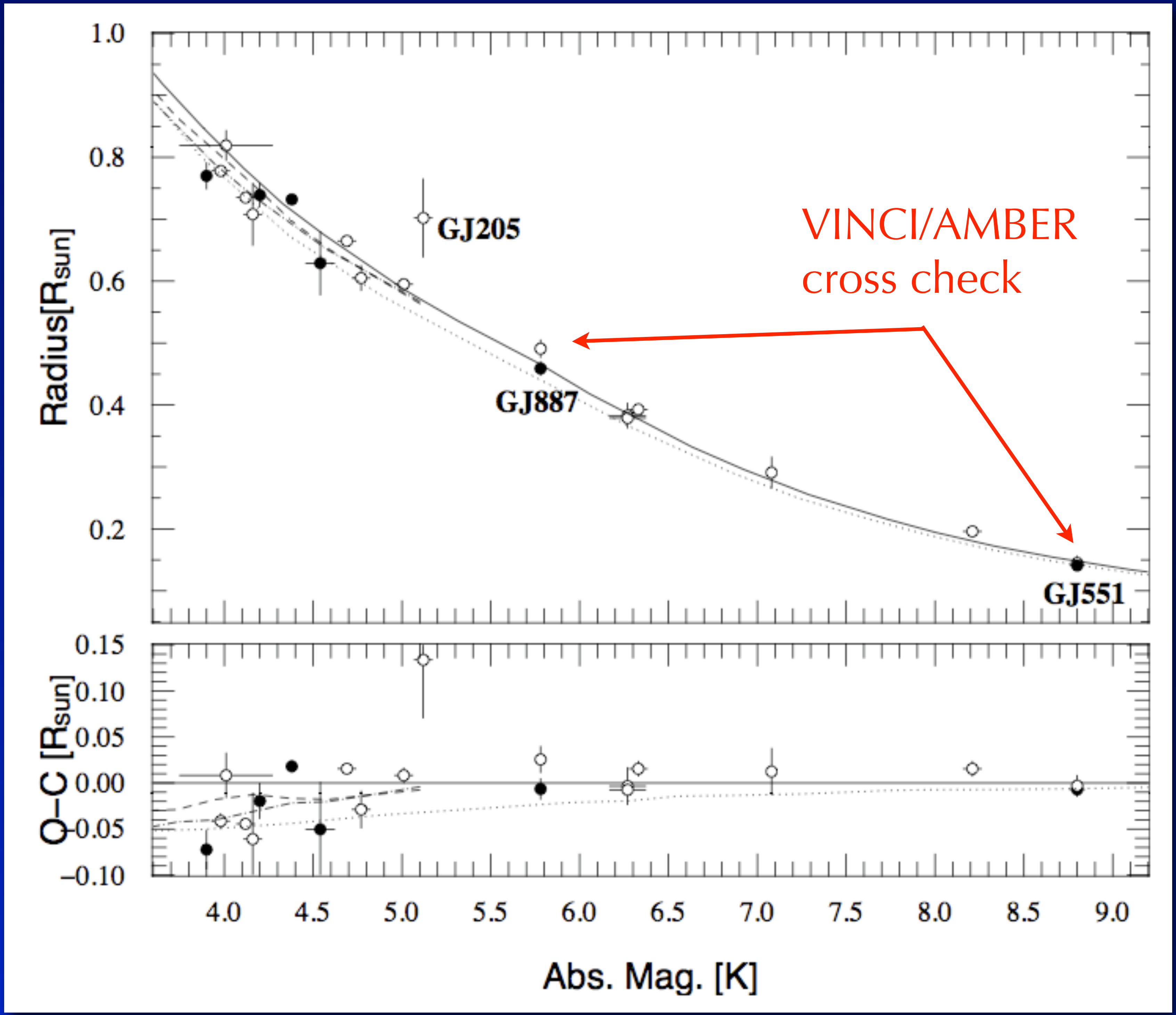


- GJ887 (AMBER)



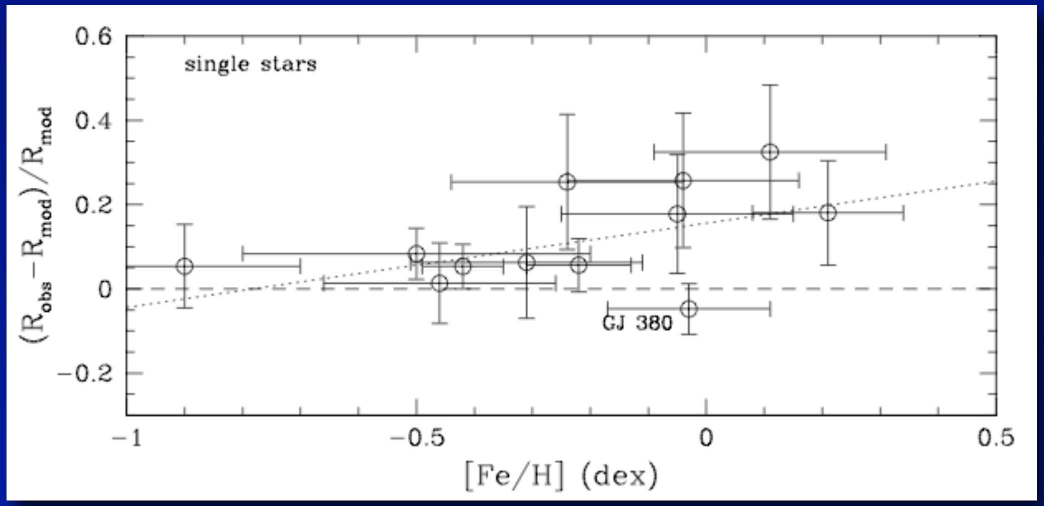
Radius-Luminosity relationship

- EOS tests : GJ551 et GJ887

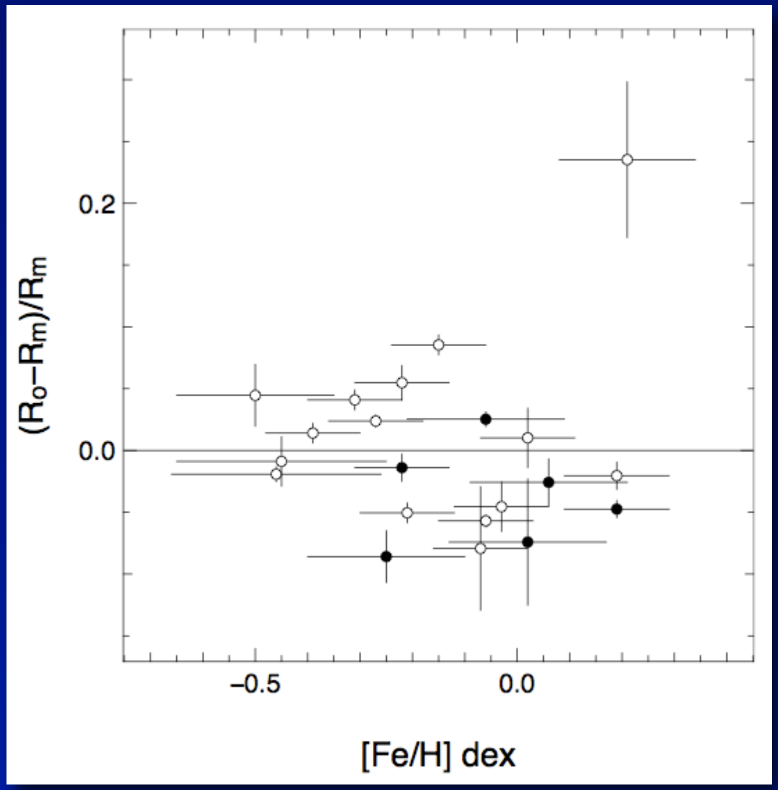


Demory et al 2009

Metallicity-radius connection ?



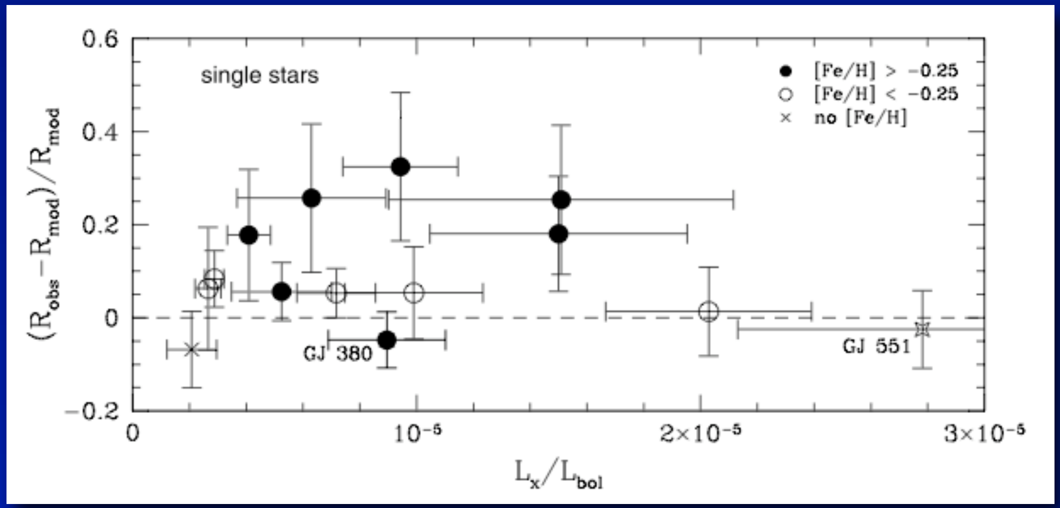
Lopez-Morales 2007
Berger et al 2006



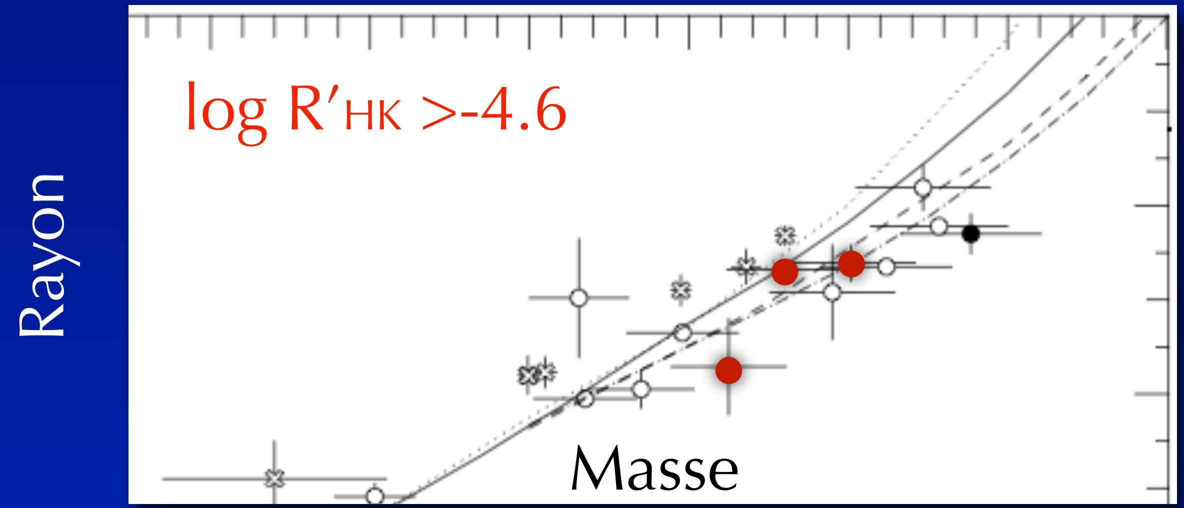
Demory et al 2009

Δ[Fe/H] = 1dex implies a 3% effect on radius only
Chabrier et al. 2007

Incidence of activity on radii ?

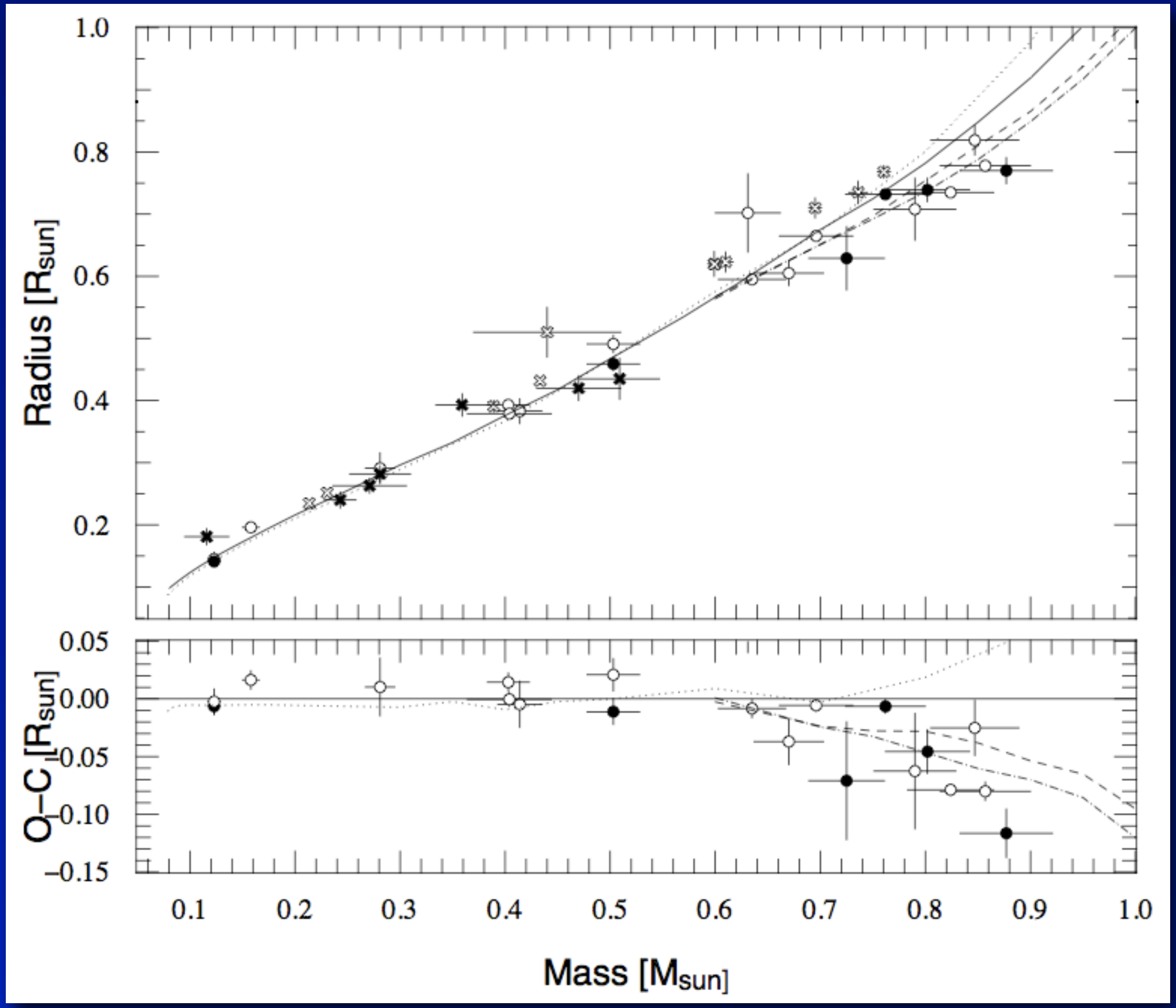


Lopez-Morales 2007



Demory et al 2009

Radii dependence with mixing length parameter α



Demory et al 2009

Same trend for 70 OphA : $\alpha \sim 0.85\text{-}1.05\ \alpha_{sol}$

Eggenberger et al 2008

Conclusions

Single stars - models are in good agreement with the observations, confirming a correct understanding of the underlying physics of low and very low mass stars :

*- The **very low-mass regime** is almost adiabatic and thus constraints the equation of state.*

- A mixing length parameter α *of 1.0 leads to a progressive underestimation of radii for **early K dwarfs**, that are better represented by a solar mixing length parameter (*α *= 1.9), as expected.*