Stellar fundamental parameters with VEGA

1- Combining interferometry, asteroseismology, and 3D hydro-simulations

Bigot, Creevey, Perraut, Berio, Mourard, Thévenin, Schmider, Chiavassa, Provost, Nardetto

«Asteroseismic» program of VEGA@CHARA

Combined interferometric + asteroseismic data
+3D model atmospheres for **accurate stellar masses and ages**

Advantages :

- **Best angular resolution** λ/2B ~ 0.2 mas (visible +long 330m base line)
- Spectral dispersed fringes (0.45-0.85 µm) medium (6000) & high (30000) resolutions
- Precise angular diameters ~1% (Teff ~ 50-100K)
- Current limitation V < 7-8 (too faint for Kepler stars)

→ successor **FRIEND** (PI Berio, 2017) higher sensitivity (V<10-11), closure phases

Recent examples :

- **CoRoT subgiant** : HD49933 (Bigot et al. 2011)
- **MOST magnetic roAp** : HR1217, 10Aql (Perraut et al. 2011, 2013)
- **CoRoT G-dwarf** : HD52265 (Creevey et al. in prep)
- **CoRoT, Red Giant** : HR7349 (Bigot, Creevey et al. in prep.)

Preparation of PLATO

- Improving surface brightness relations
- Testing asteroseismic scaling relations
- Clues toward improving models for difficult targets (CP, active or giant stars)

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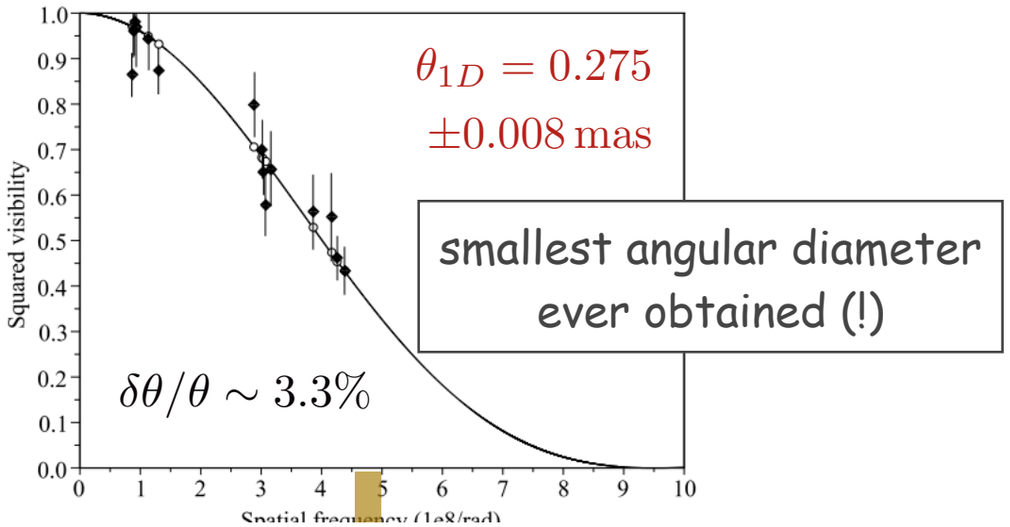
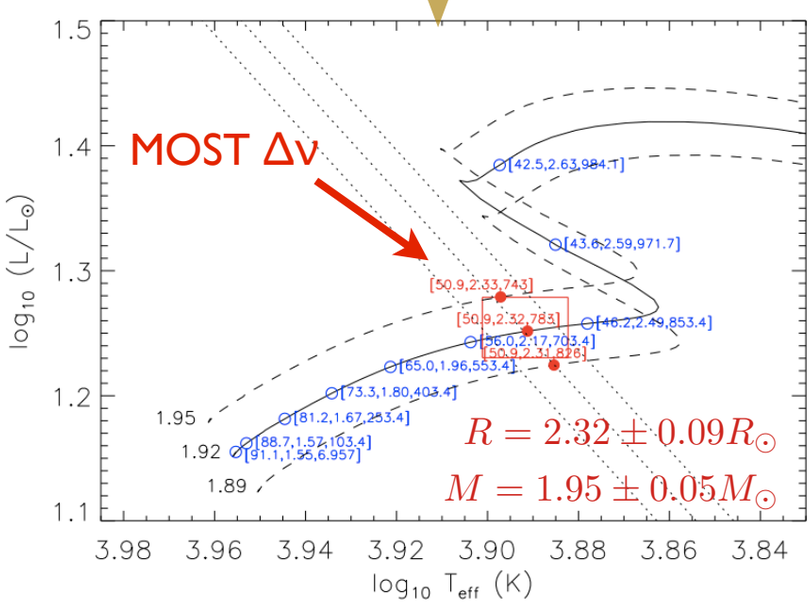
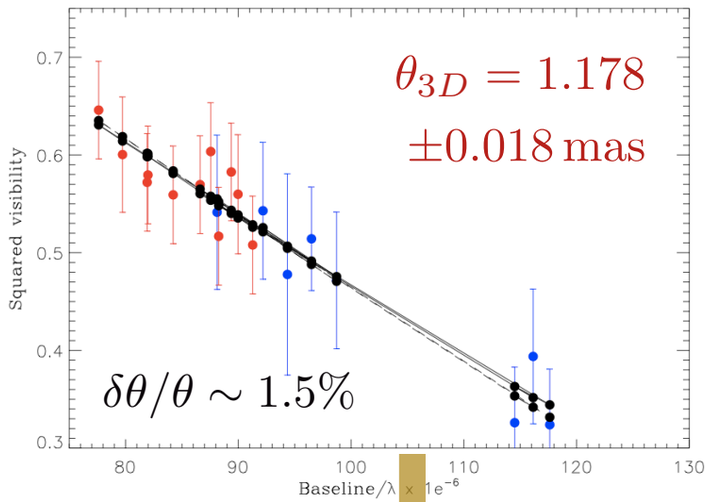
10 Aql (magnetic roAp)



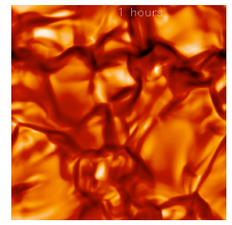
Perraut, Borgniet, Cunha, Bigot et al. (2013)
(Cunha, Perraut et al. 2013: Constraints mode excitation)



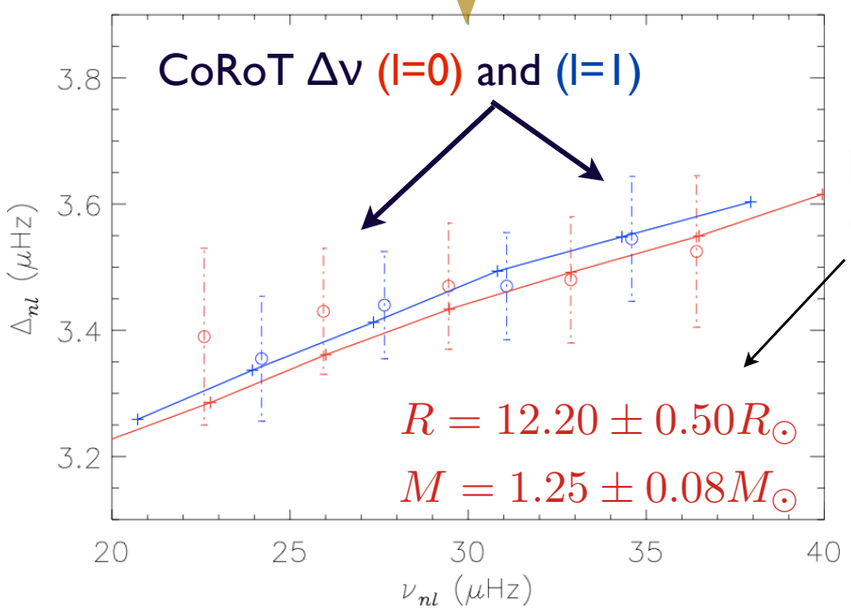
HR7349 (Red Giant)



Bigot, Creevey, Berio, Provost et al. (in prep)



3D sim. for
Limb darkening



limitation : parallaxes
(waiting for **Gaia !**)

Stellar fundamental parameters with VEGA

2- Calibration of Teff of Halo stars by interferometry and 3D hydro-simulations

Creevey,Thévenin, Bigot, Berio, Mourard, Chiavassa, Nardetto

«Metal-poor» program of VEGA@CHARA

Combined interferometric +3D model atmospheres for **accurate Teff**

Galaxy physics :

Halo stars are the oldest stars in our Galaxy: clues towards its formation conditions, scenarios and age.

Stellar Physics :

Test stellar models with characteristics different to the Sun → improve isochrones/atmospheres.

Teff scale is poorly calibrated at the low metallicity (error>±200K): (problems with calibrated colors, Balmer lines)

→ **An independent measurement like the angular diameter is crucial.**

→ VEGA well adapted for metal-poor Halo stars - **unique angular resolution** (≠ K-band interferometers)

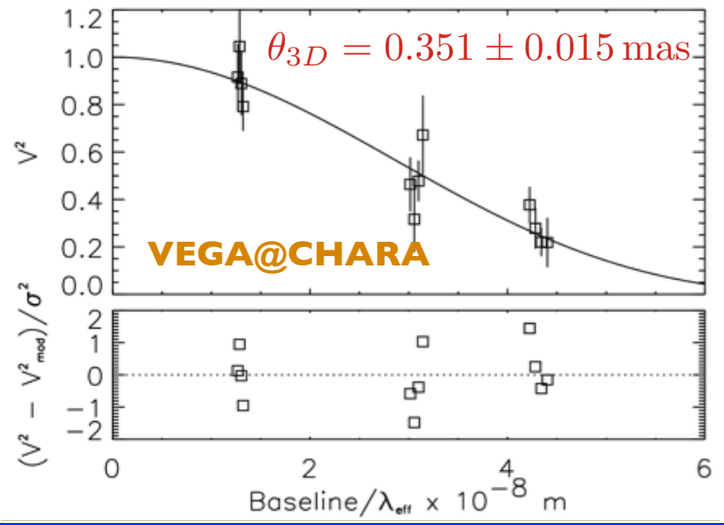
Objectives:
- **Precise fundamental parameters (masses, ages)**
- **Calibration of surface brightness relations at low metallicities**
  (esp. in era of large-scale multi-band photometry for faint/distant stars)
- **Teff-Li relations** for diffusion processes in stars

Stellar fundamental parameters with VEGA

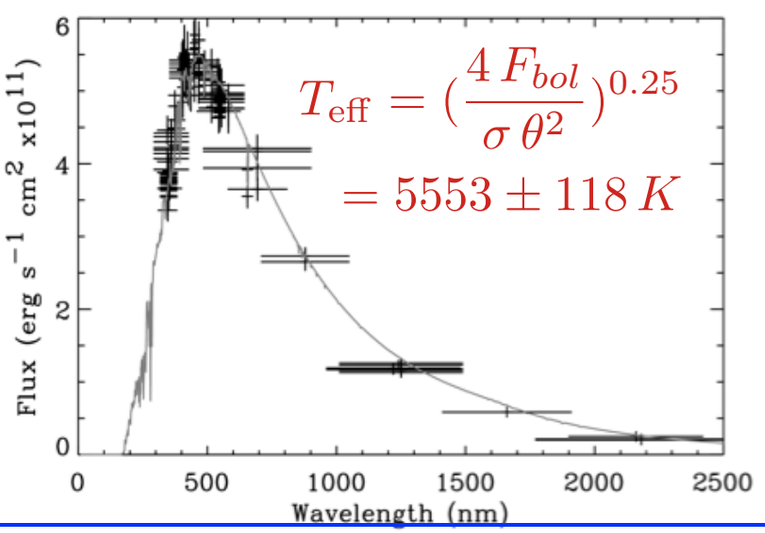
2- Calibration of Teff of Halo stars by interferometry and 3D hydro-simulations

Creevey,Thévenin, Bigot, Berio, Mourard, Chiavassa, Nardetto

Angular diameter fit



Bolometric flux fit

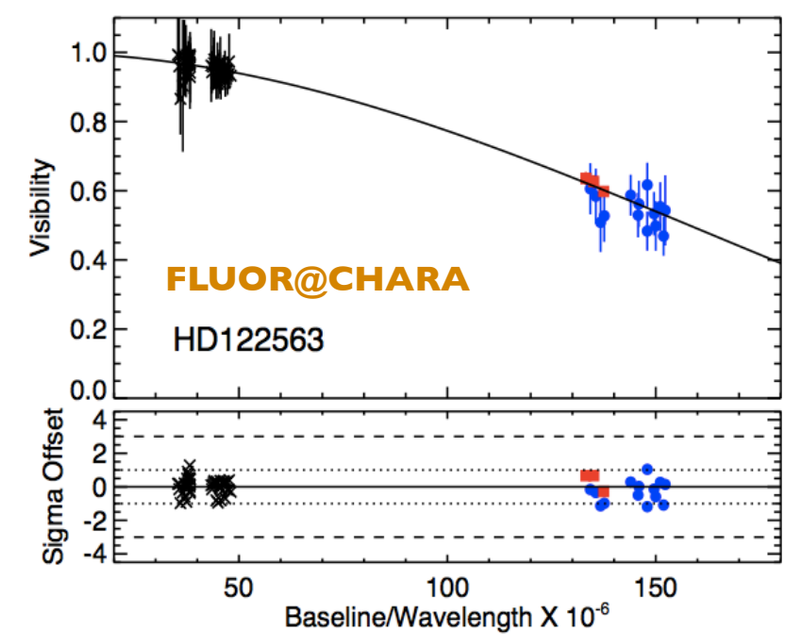


HD 140283

3D hydro atmosphere modeling + CESAM2k

M = 0.800 ± 0.015 M⊙,
Age = 12.1 ± 0.9 Gyr
Logg=3.65 ± 0.05,
α = 1.0 (α_⊙ = 2.0)

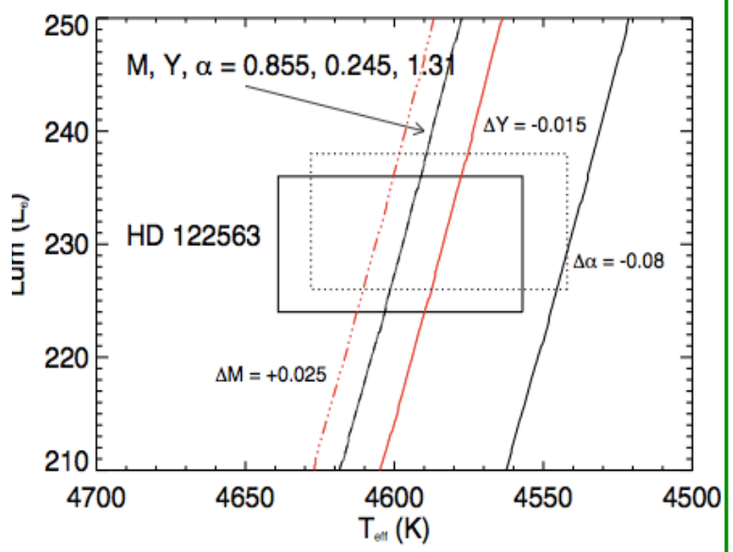
Creevey et al. (2014, in prep)



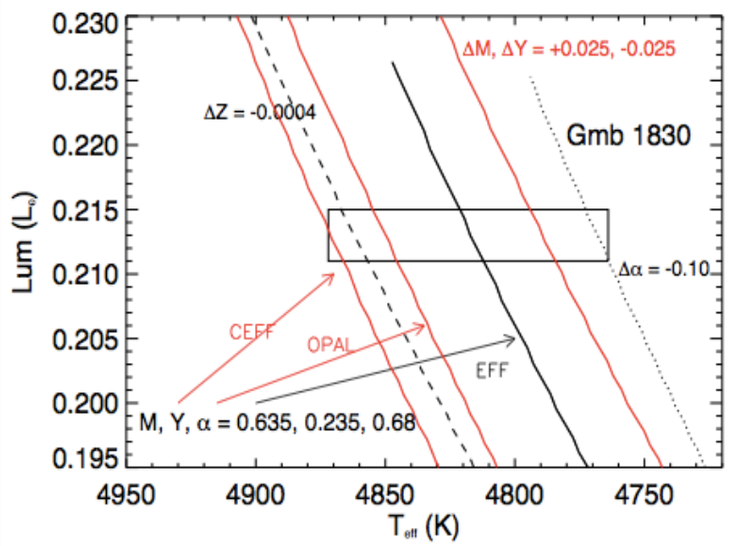
T(3D) = 4598 ± **41 K**
L = 230±**6 L⊙**

Creevey et al. (2012)

HD 122563



Gmb 1830



T = 4818 ± **54 K**
L = 0.213±**0.002 L⊙**
... models test EOS...

Creevey et al. (2012)