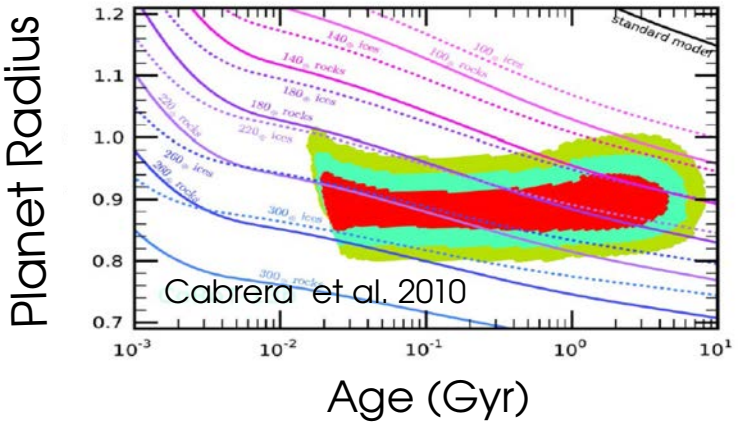
Diameters and Effective Temperatures of Benchmark Stars: Metal-poor stars and Seismic targets

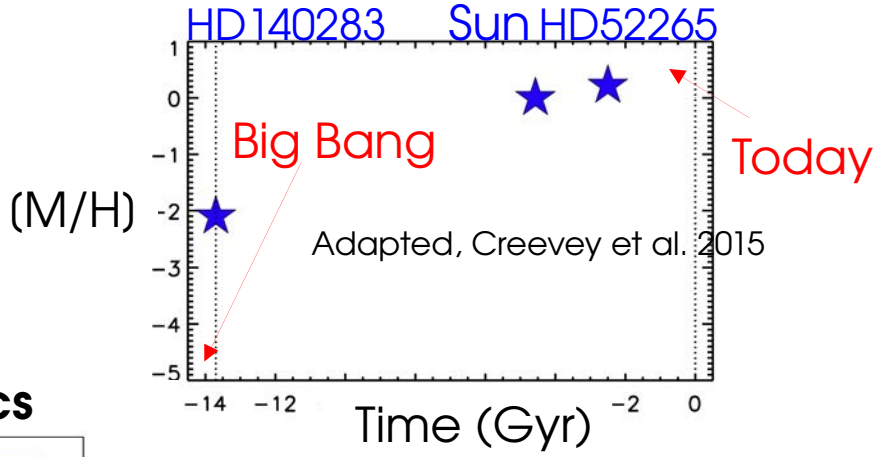
Orlagh Creevey
Frederic Thevenin, Philippe Berio, Ulrike Heiter,
Denis Mourard, Nicolas Nardetto, Tabetha Boyajian
et al.

Fundamental parameters

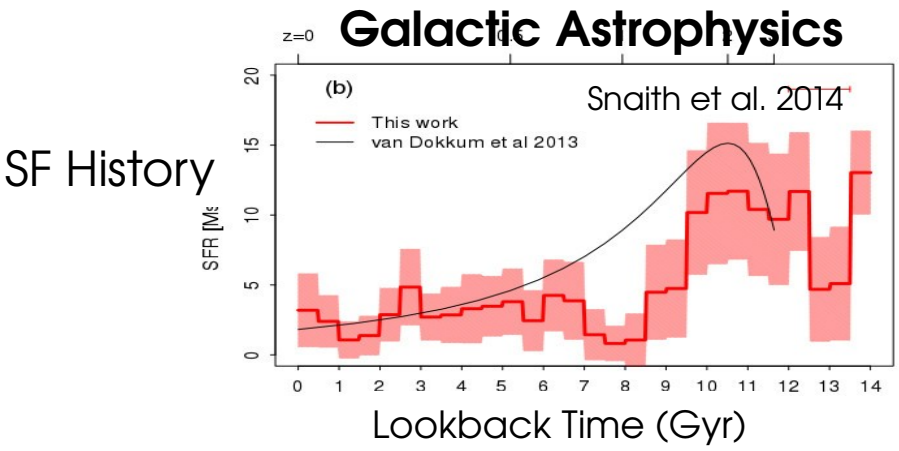
Planetary Science



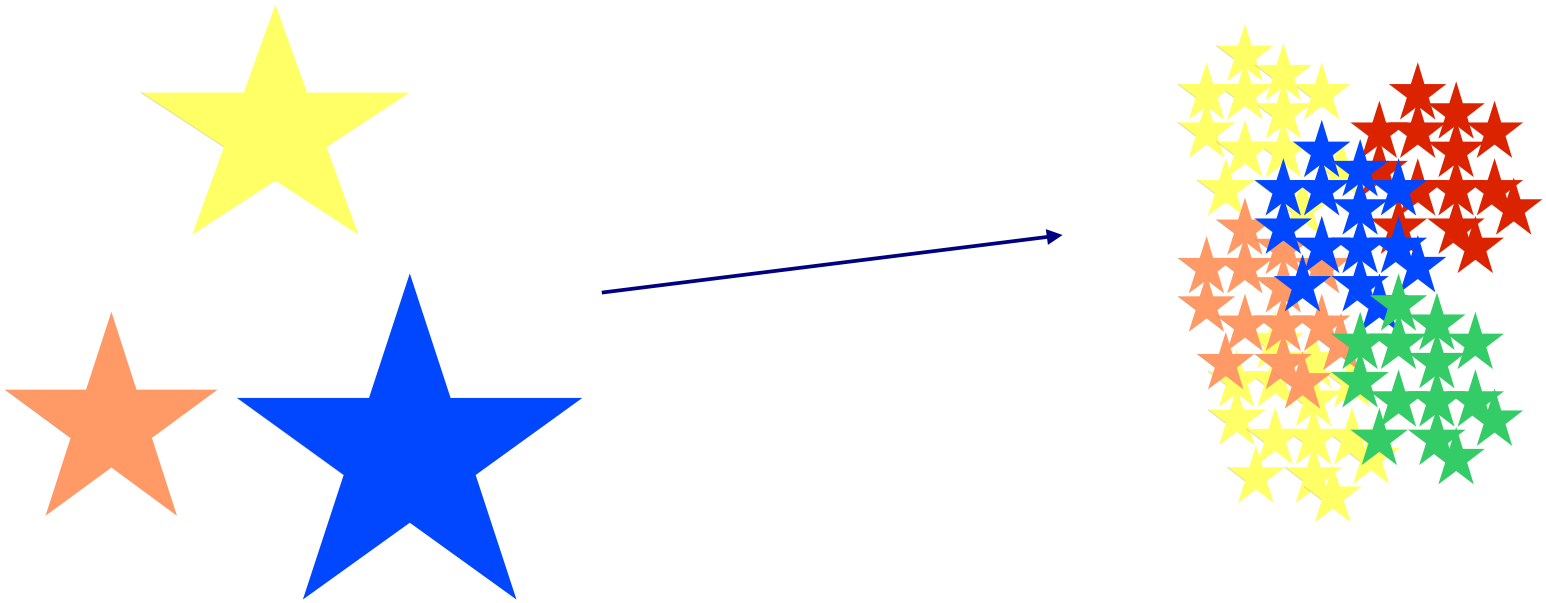
Stellar physics vs Cosmology



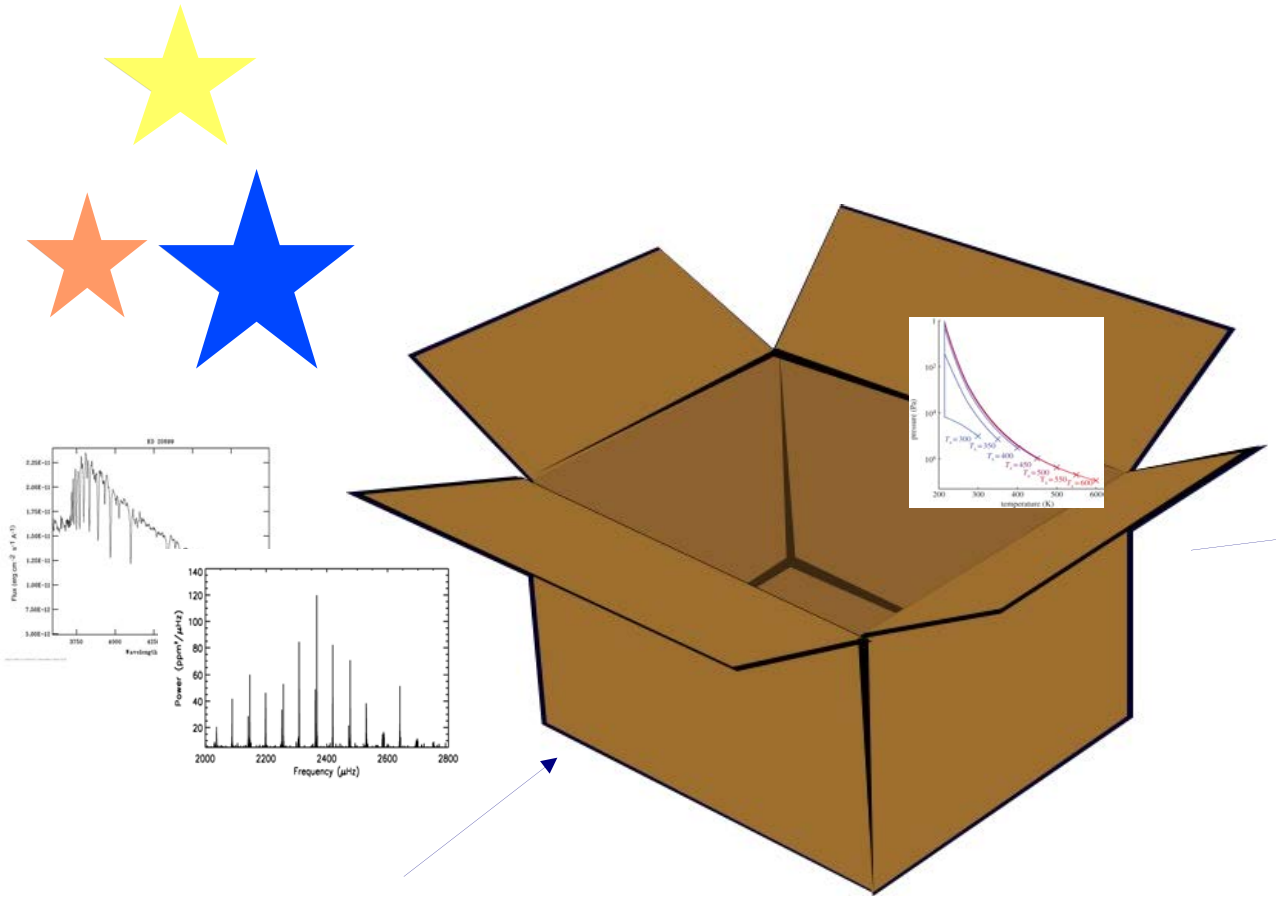
Galactic Astrophysics



Benchmark Stars

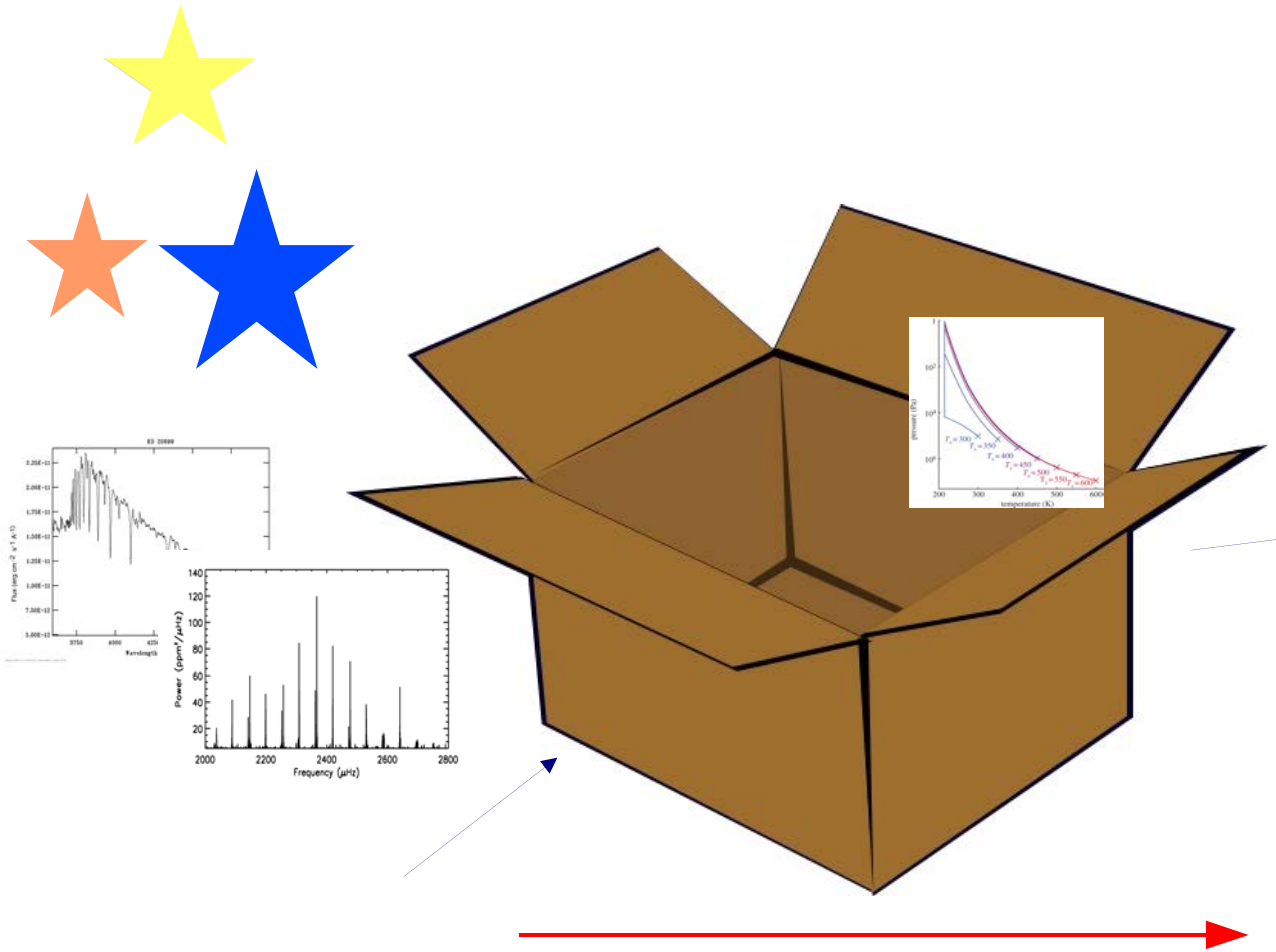


Diameters and Temperatures



Temperatures
Logg
Chemical
Composition
Mass
Radius
Age
Initial XYZ

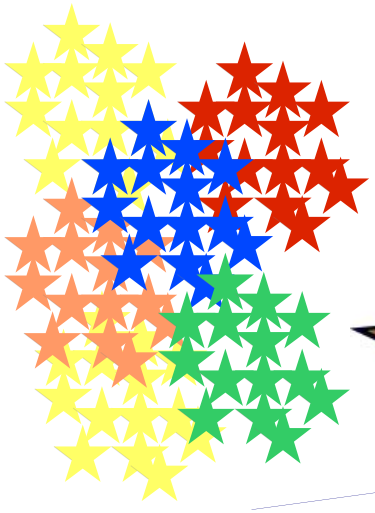
Diameters and Temperatures

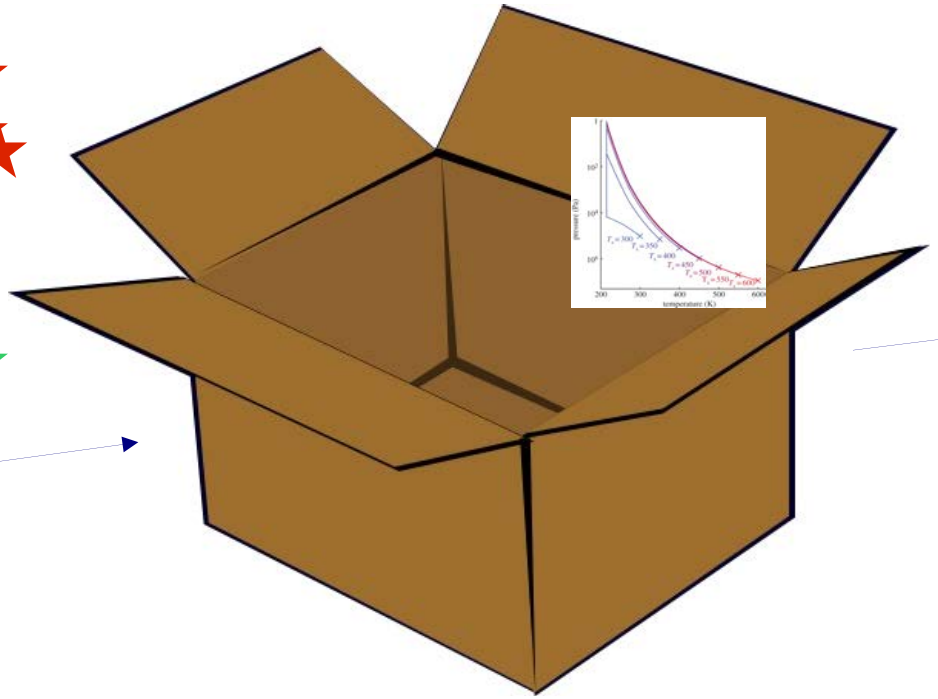


Chemical Composition
Mass
Age
Initial XYZ

Temperatures
Logg
Radius
Composition

Diameters and Temperatures



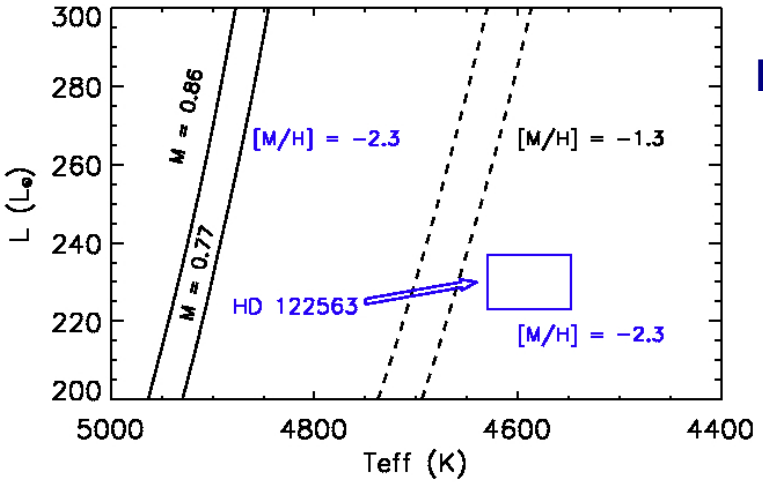


Fundamental Properties of 1000s of stars

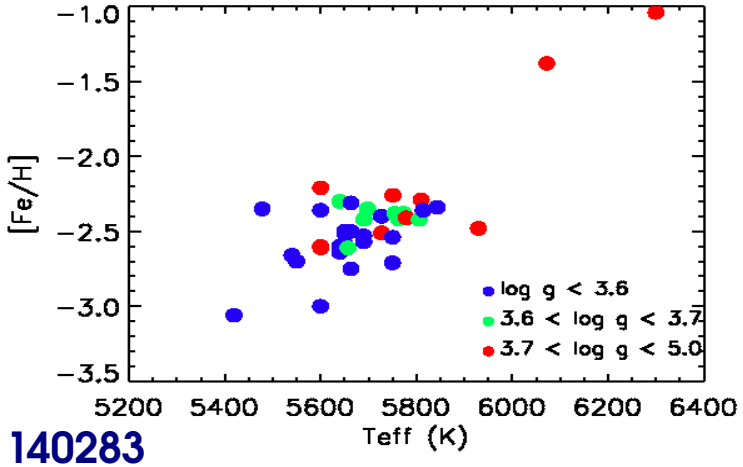
Interferometry Programs

- Metal-poor Population II stars
- Solar-like seismic stars
- K2 Giants (White/Huber/Boyajian/Creevey)

Metal-poor (Population II) stars



Position in HR diagram for HD122563



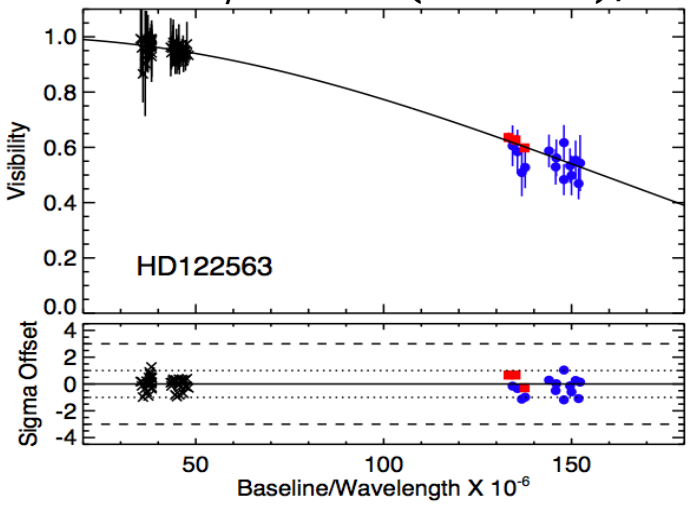
(Fe/H) versus Teff for HD 140283

Metal-poor Population II stars

- Sample of metal-poor stars
- HD122563, HD104328, HD103095
- HD107328 HD 220009 HD 221170 HD148897
- +3

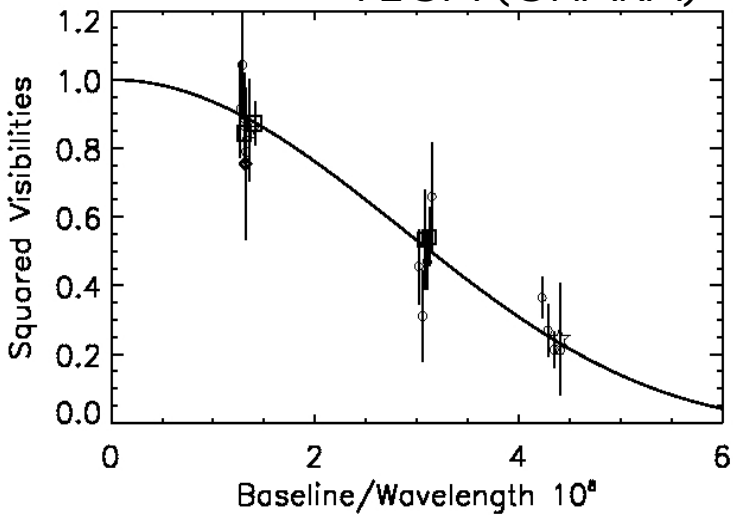
From V2 to Stellar properties

Classic/FLUOR (CHARA), PTI

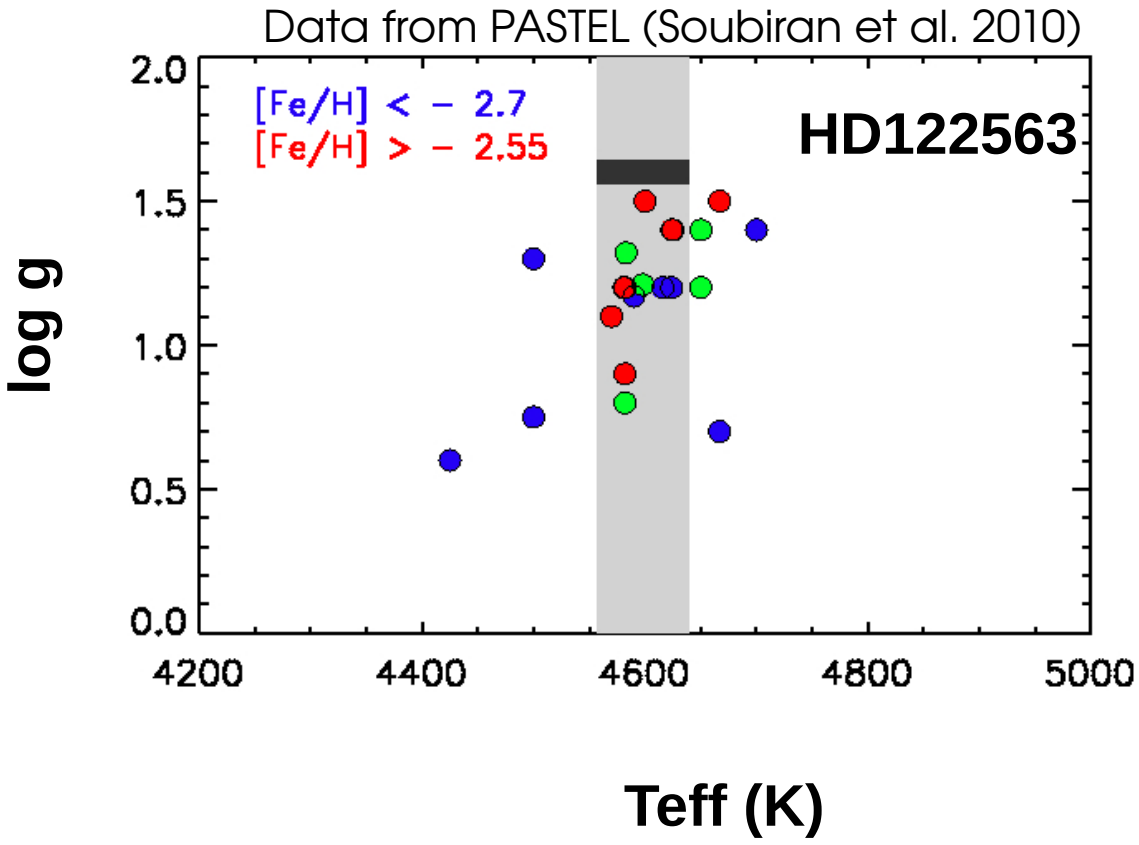


Creevey et al. 2012/2015

VEGA (CHARA)



Comparison of effective temperatures



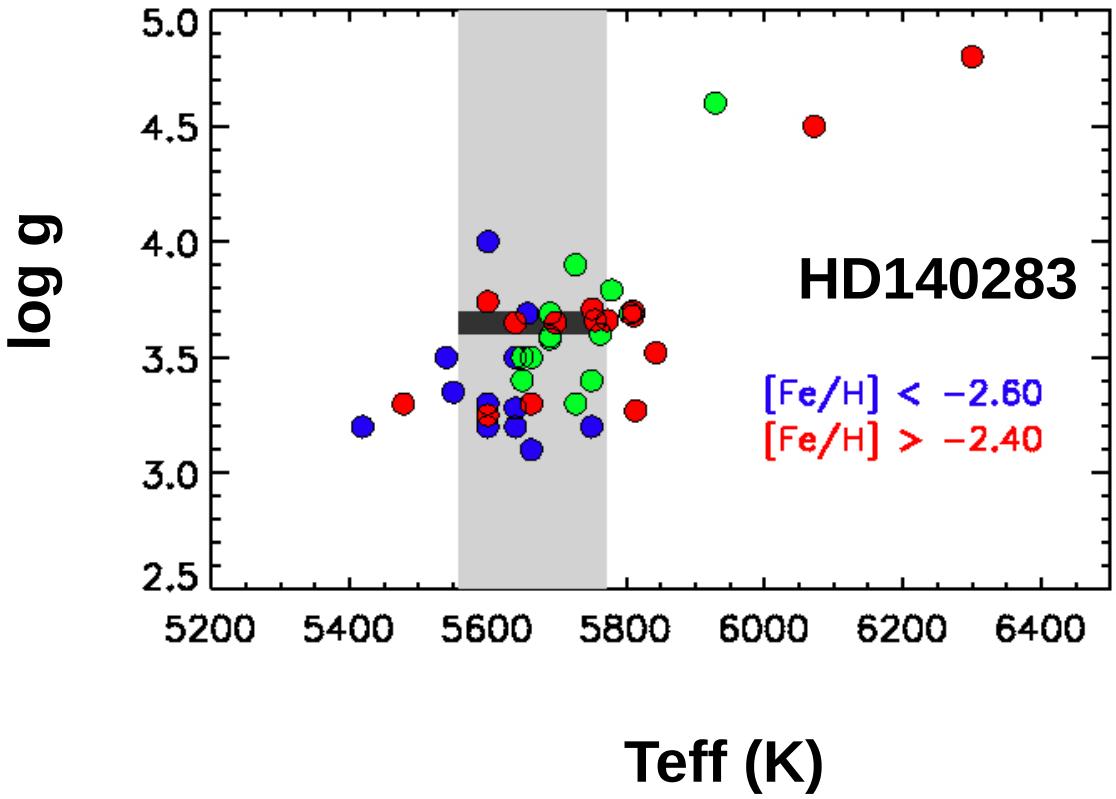
Ø: 0.948±0.012 mas

T_{eff}: 4598 ± 41 K

R: 24.1±1.1R

log g: 1.60±0.04

Comparison of effective temperatures



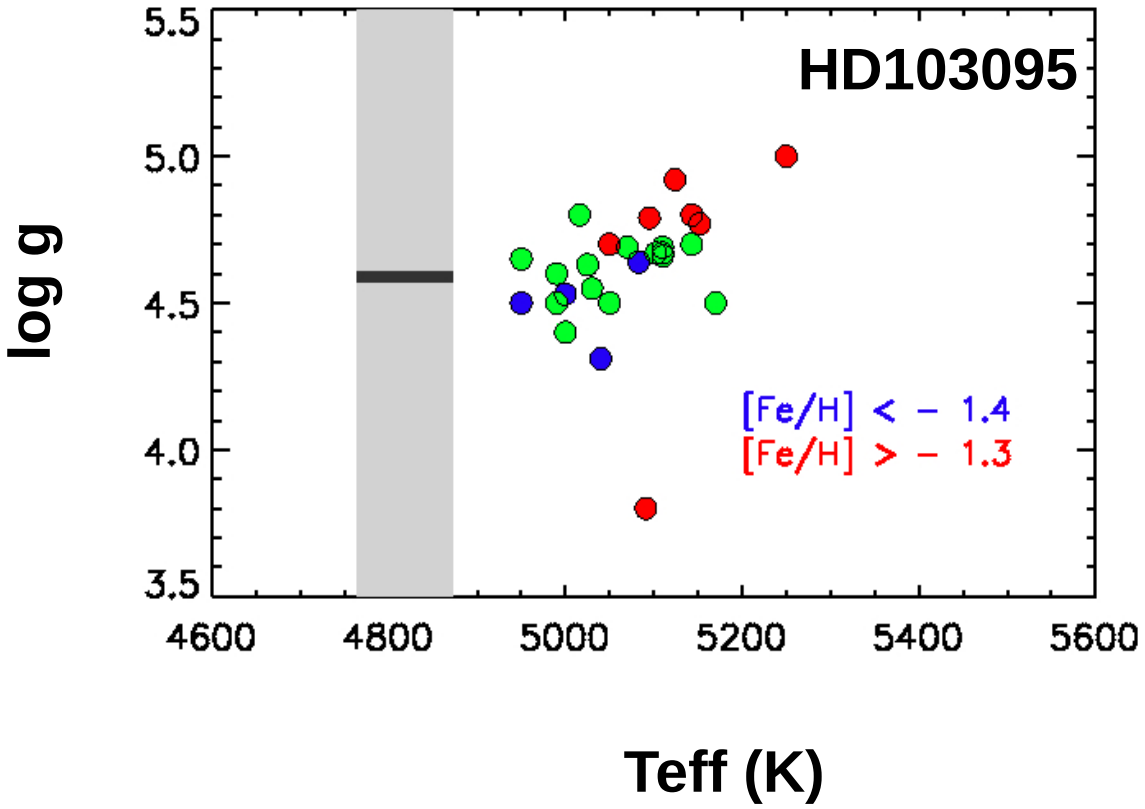
Ø: 0.353±0.013 mas

T_{eff}: 5665 ± 106K

R: 2.21 ± 0.08 R

log g: 3.65±0.05

Comparison of effective temperatures



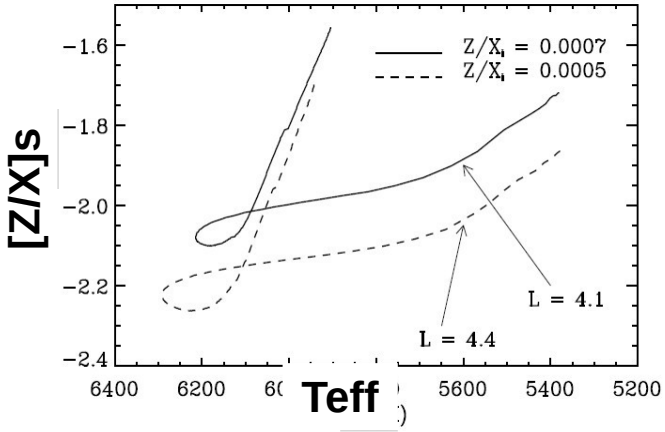
Ø: 0.679±0.007 mas

T_{eff}: 4818 ± 54 K

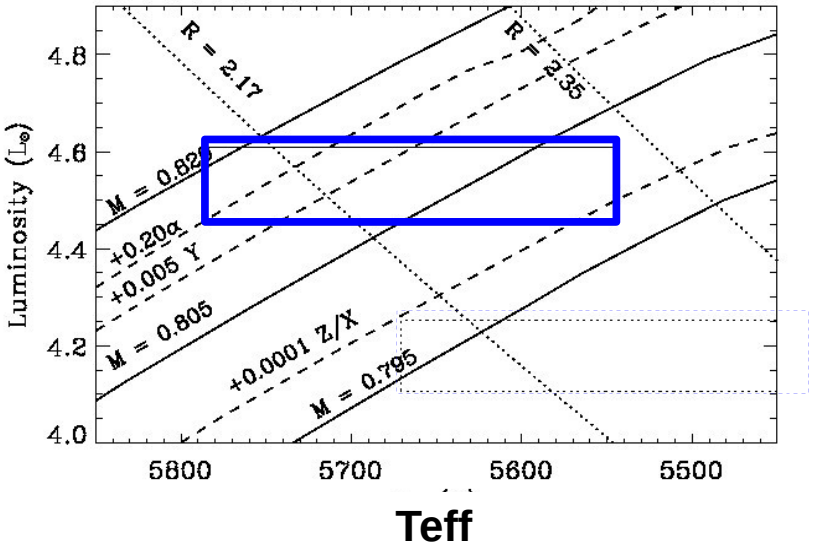
R: 0.665± 0.014R

log g: 4.59±0.02

Model Stellar properties



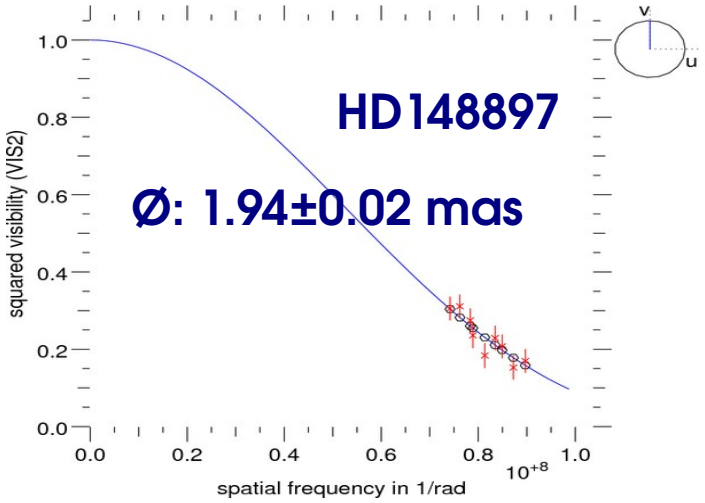
Calibrated extra-mixing with NGC6397 using CESAM2K

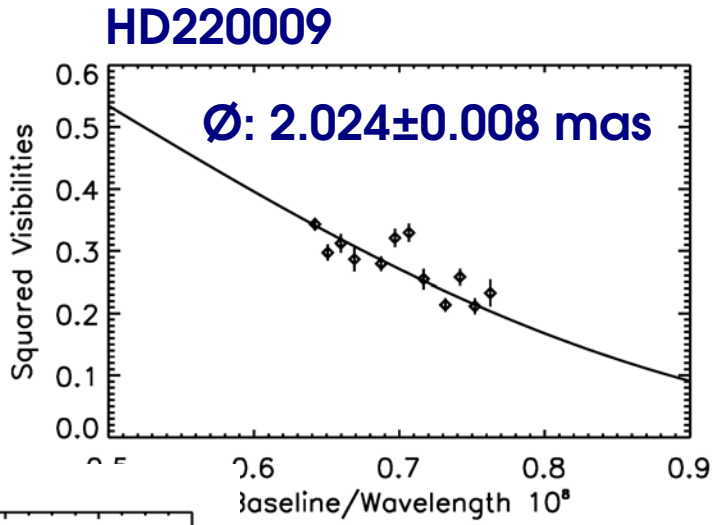


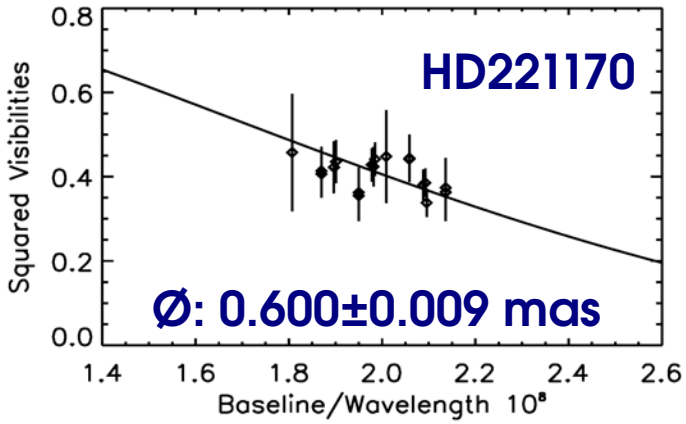
Model Stellar properties

- Mass (3%) Ages (10%)
- Interstellar Reddening: errors in age > 1Gyr
- Mixing-length parameter variable
  - Results standard tracks 'overestimate age'
- Other variable parameters-> more constraints, e.g. More stars....

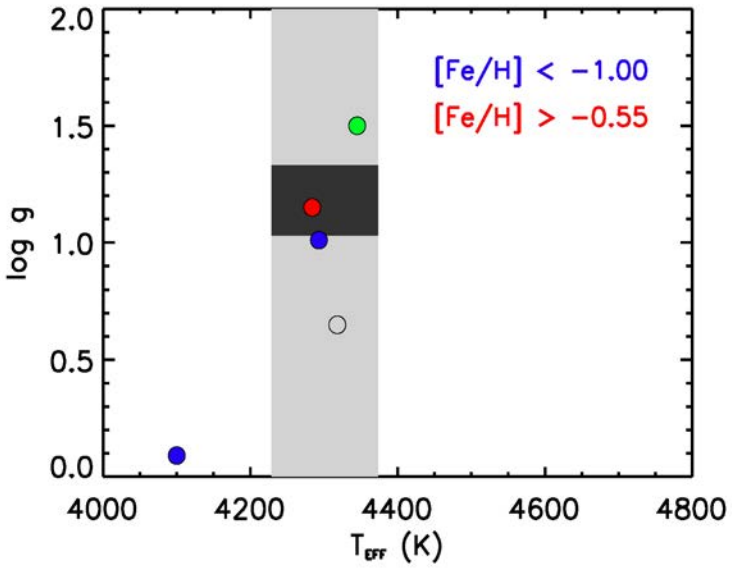
Newest data


HD148897
Ø: 1.94±0.02 mas
squared visibility (VIS2)
spatial frequency in 1/rad
10+8
v
u


HD220009
Ø: 2.024±0.008 mas
Squared Visibilities
Baseline/Wavelength 10⁸


HD221170
Ø: 0.600±0.009 mas
Squared Visibilities
Baseline/Wavelength 10⁸

HD148897



Ø: 1.94 ± 0.02 mas
T_{eff}: 4302 ± 72 K
R: 40.2 ± 3.3R
log g: 1.18 ± 0.15
L: 497 ± 88 L**
Fbol: 43.0 ± 2.8
(Av=0.2mag)

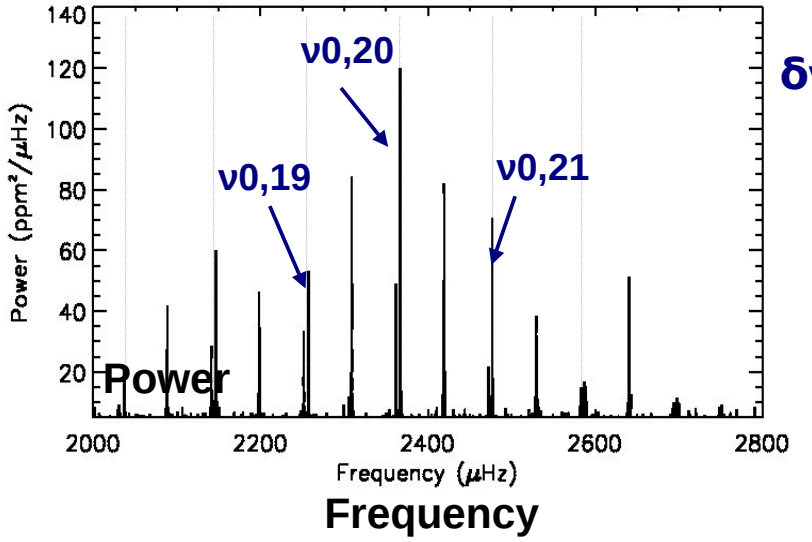
Why more sensitive

- ~0.3 mas, but fainter +7 stars
- >0.2 mas +13 stars
- >0.1 mas + 27 stars

Interferometry Programs

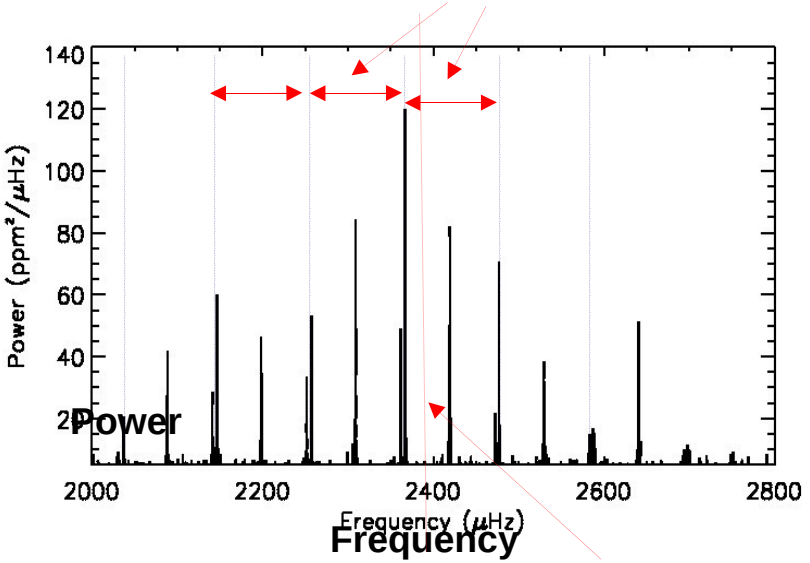
- Metal-poor Population II stars
- Solar-like seismic stars
- K2 Giants (White/Huber/Boyajian/Creevey)

Solar-like Oscillations



δν/ν<0.01%

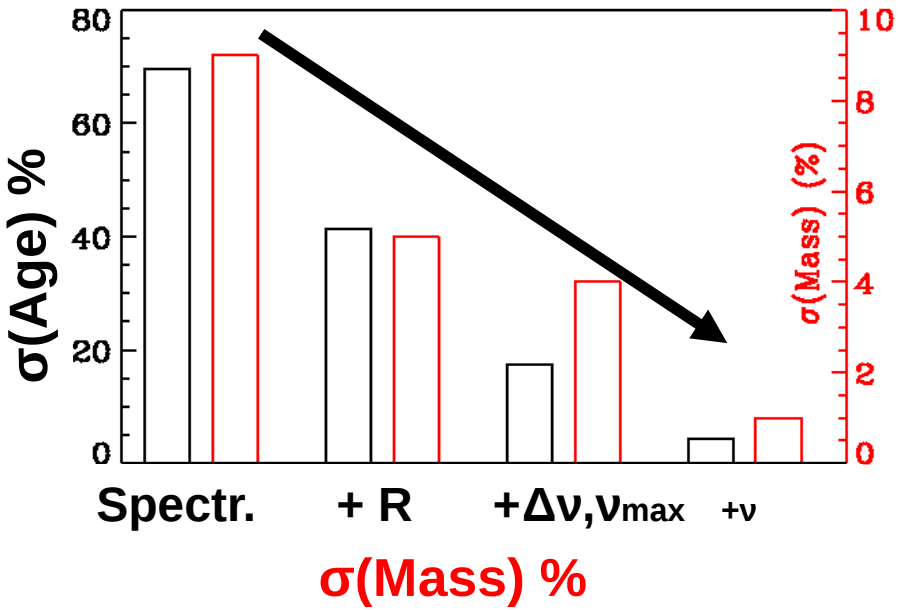
<Δν> = (M/R3) 0.5 =
<Large frequency separations>



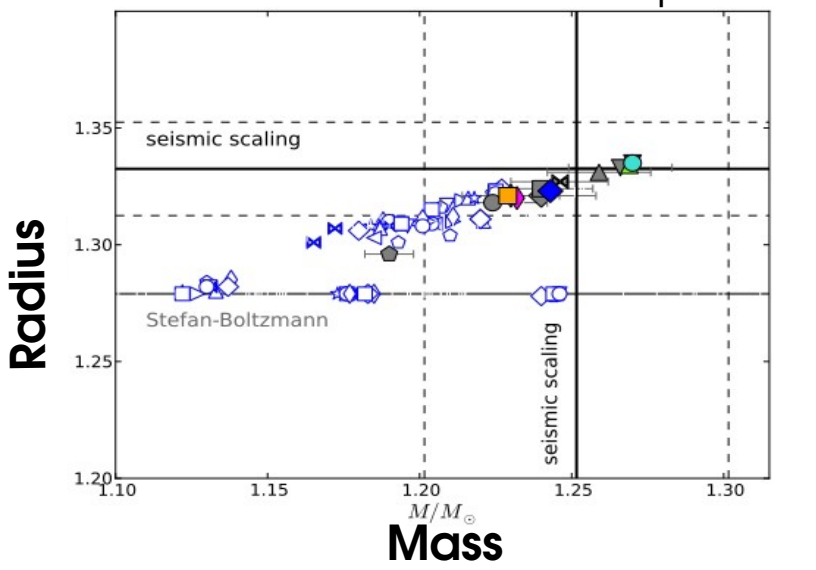
Frequency of maximum power

νmax ~ M / R2 Teff0.5

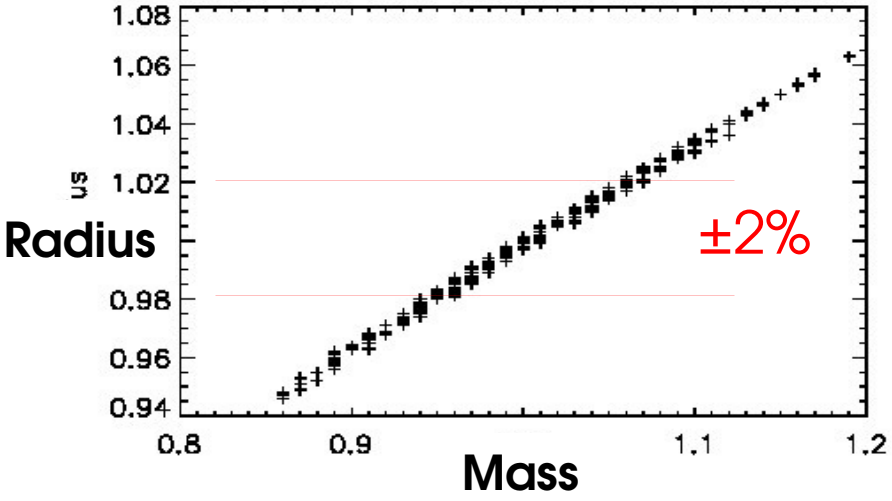
Why the radius



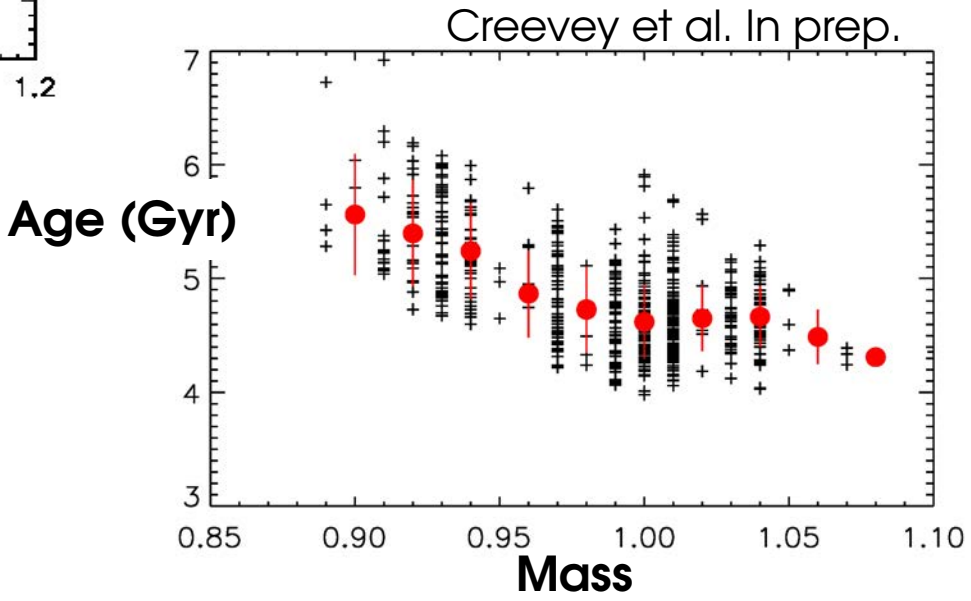
Lebreton & Goupil 2014



Refining model parameters



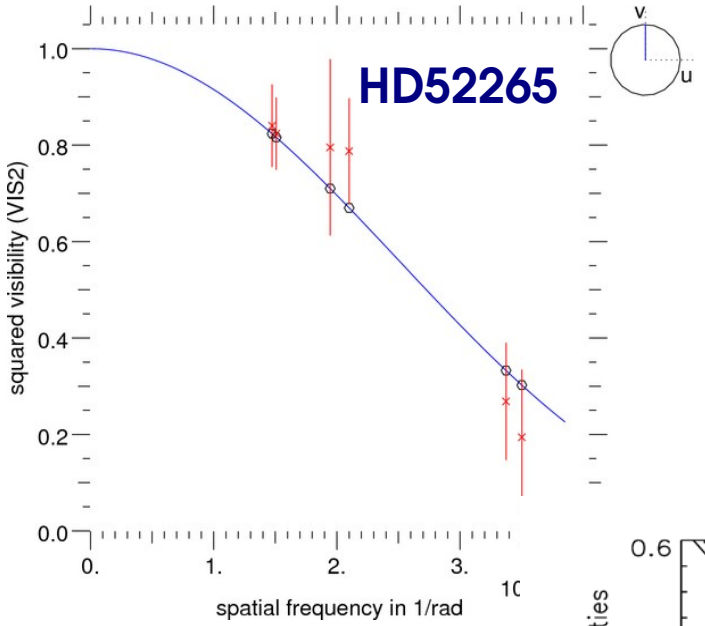
Creevey et al. In prep.

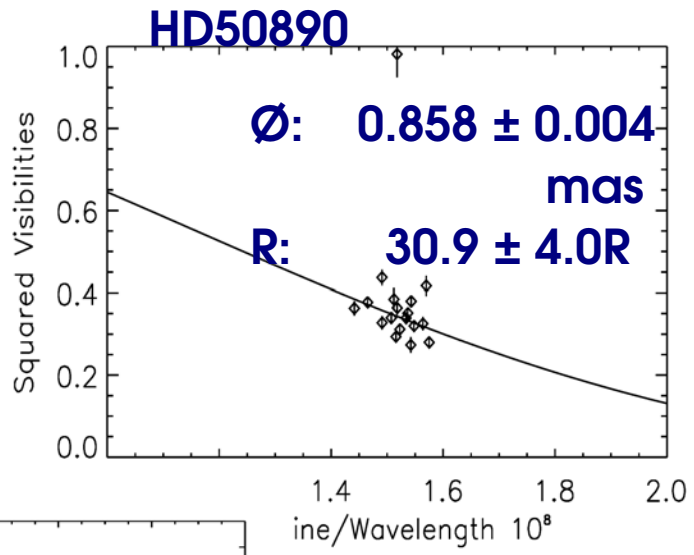


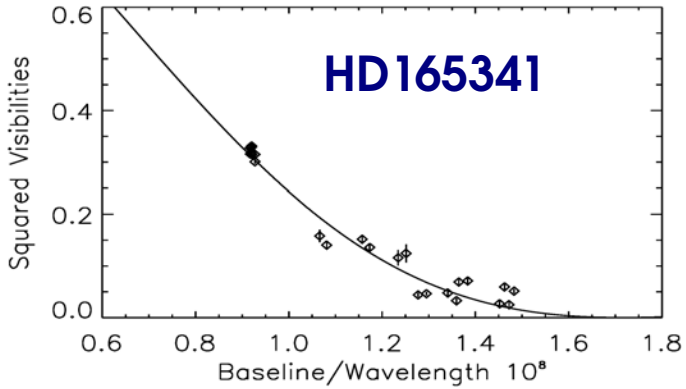
VEGA/CHARA Program

- CoRoT stars (many Winter targets)
- HD 165341 A&B
- Measure diameters, model frequencies

V2 curves


HD52265
squared visibility (VIS2)
spatial frequency in 1/rad
v
u


HD50890
Ø: 0.858 ± 0.004 mas
R: 30.9 ± 4.0R
Squared Visibilities
ine/Wavelength 10⁸

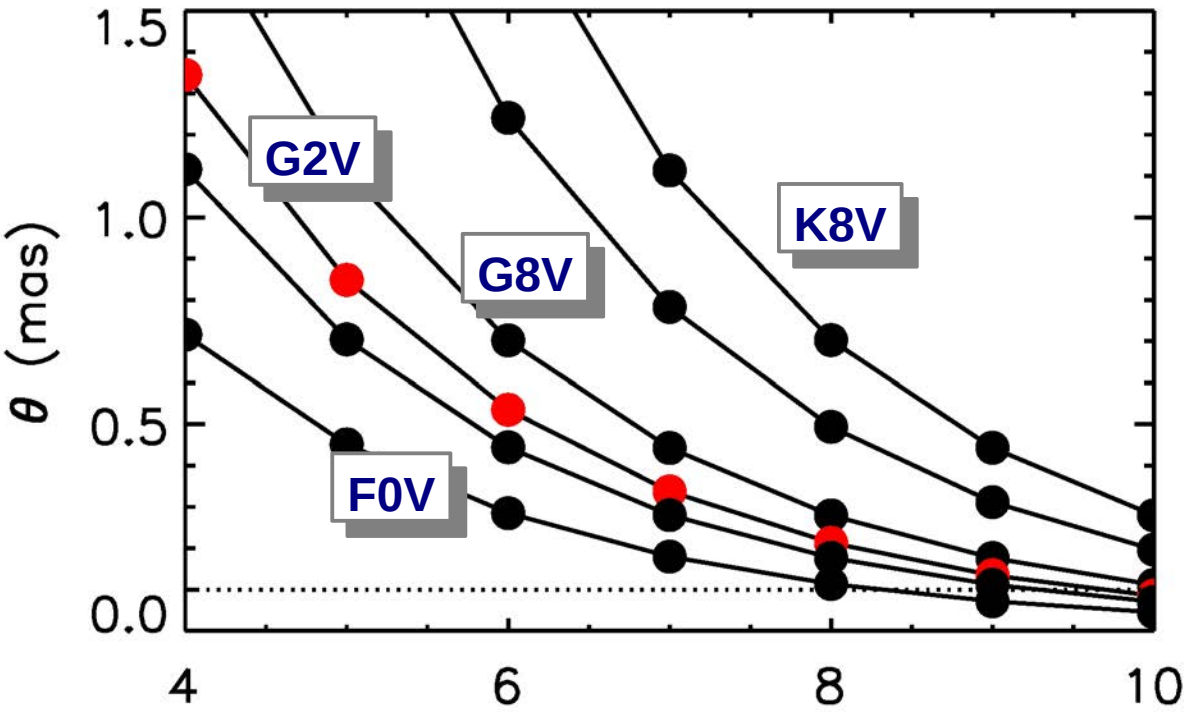

HD165341
Squared Visibilities
Baseline/Wavelength 10⁸

Conclusions

- Metal-poor stars:
  - teff, logg, (M/H)
  - Missing physics atmospheres, Gaia, surveys
  - Diffusion, convection, Ages
- Seismic stars
  - Better precision mass, age, Yi (Kepler,Tess,Plato)
  - convection, diffusion
- Need for more sensitivity

Conclusions

- Metal-poor stars:
  - t
  - N
  - D
- Seis
  - B
  - A
- Ne



Estimated angular diameter for ZAMS stars (not evolved)

Fin / end

Go raibh mile maith agat