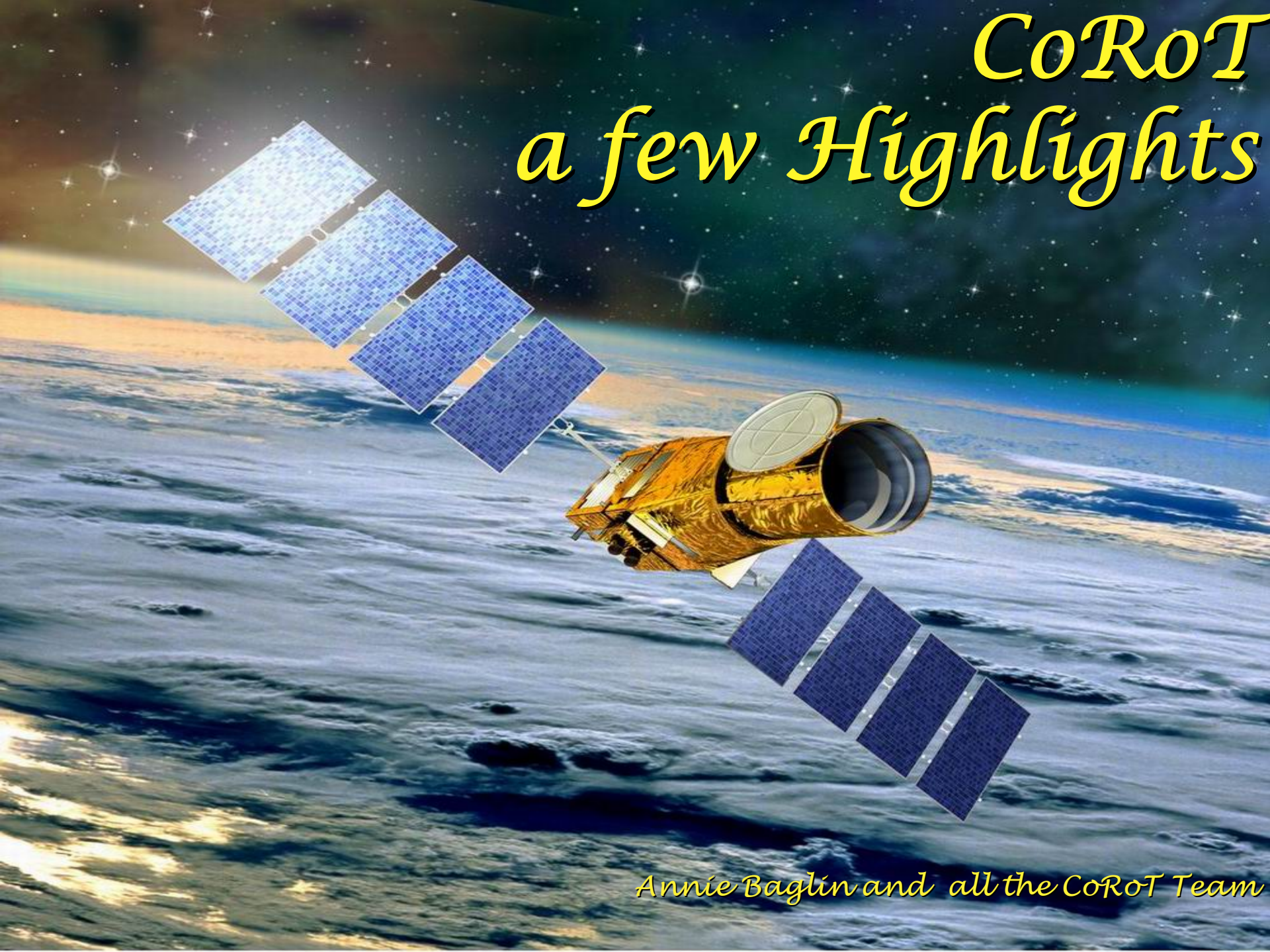
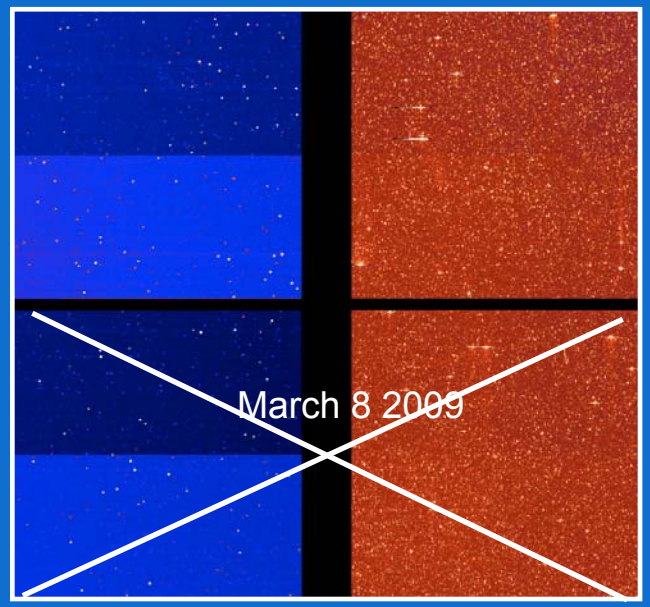

CoRoT
a few Highlights
Annie Baglin and all the CoRoT Team

CoRoT : A « SMALL » space mission

Built and operated by CNES (France)
with ESA, Austria, Belgium, Brazil, Germany and Spain

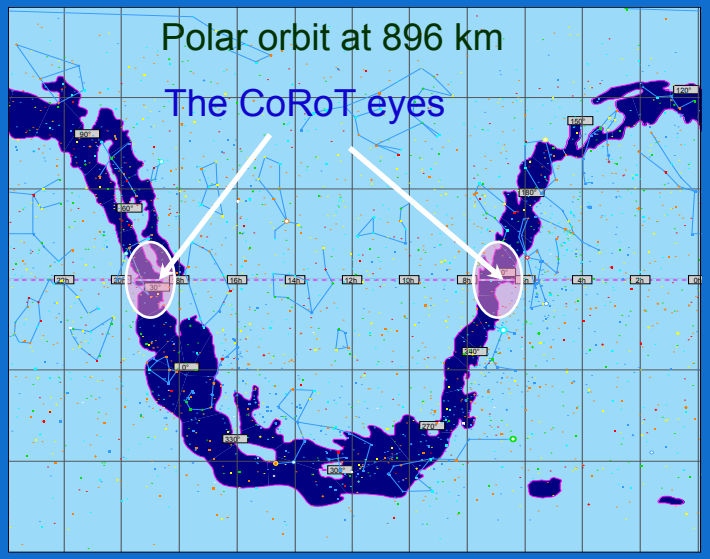
Telescope diameter 27cm
Camera with 4 detectors

Total cost at launch 160 M$ total mass 600 kg



10
bright stars
V : 5.5 to 9.5
at 32s

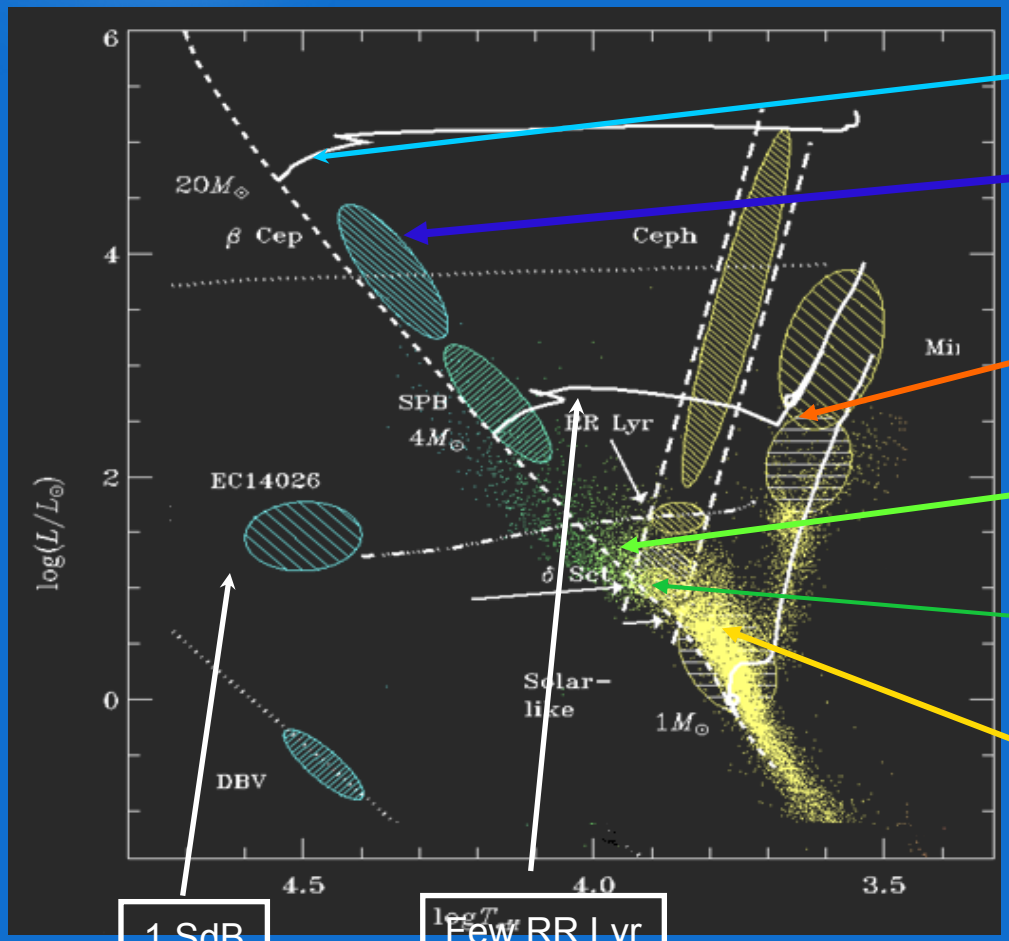
Up to12 000
Faint stars
R : 9 to 16
At 32 or 512 s



Funded till March 2013…..

The seismology targets

132 + many exofield targets



1 SdB

Few RR Lyr

7 O stars

16 B stars,
3Beta Ceph, 10 Be

10 giants (K,G,F)

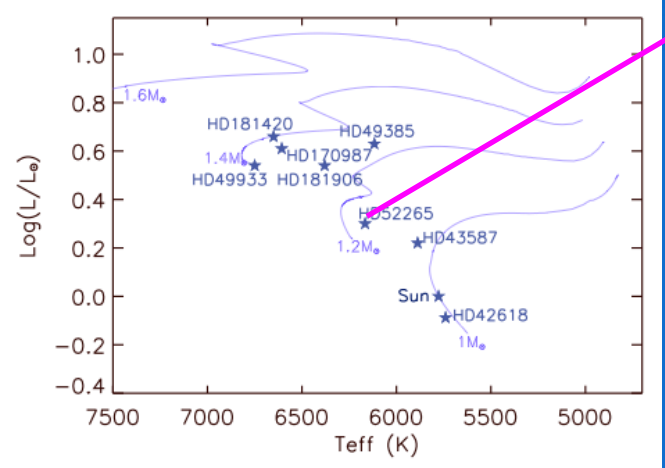
30 A/early F stars ?
2 Am, 7 Ap,

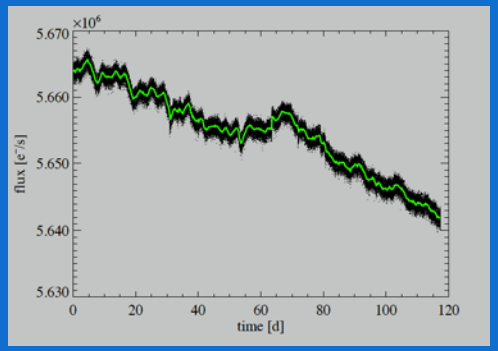
12 Delta Scuti,
4 delta Sct, gam Do
3 known gam Dor

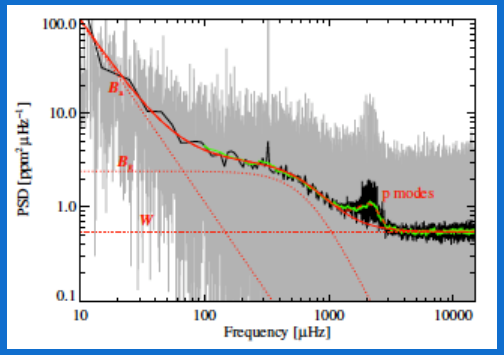
18 solar-like puls. cand.
(one observed twice)

Characterisation of solar like oscillations in Solar analogs

HD 52265 metal rich G0V (mv=6.3)
Hosting a planet (*Ballot et al. A&A submitted)*







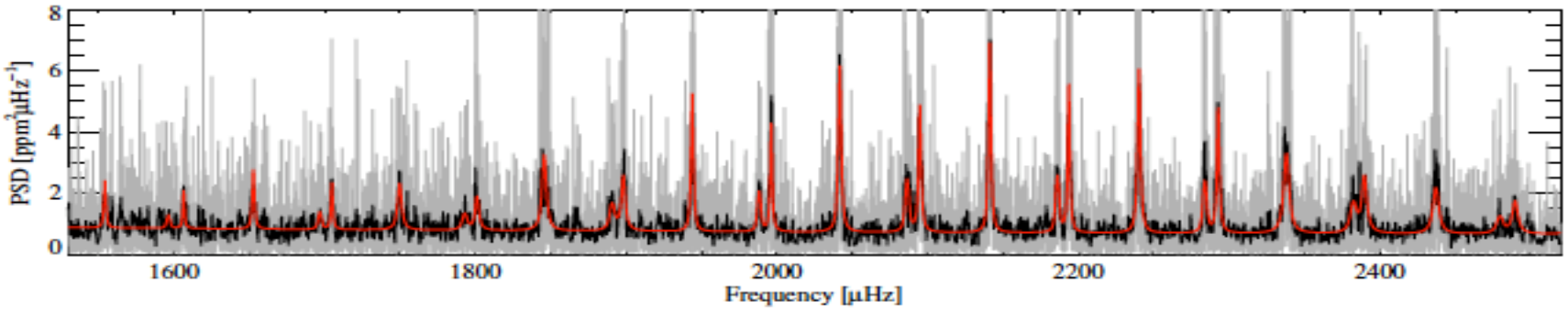


Fig. 8. Power spectral density of HD 52265 in the p-mode frequency range at full resolution (grey curve) and smoothed by a 11-bin wide boxcar (black curve). The red line corresponds to the fitted spectrum.

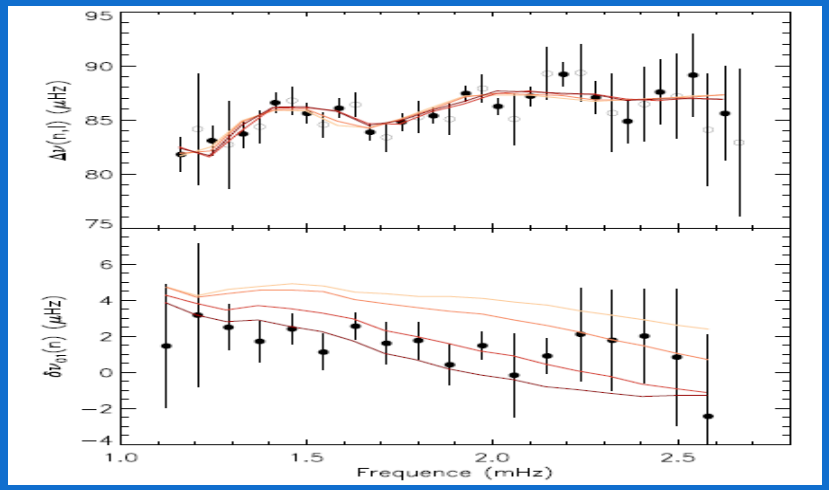
Oscillations in the frequency separations due to sharp features in the structure

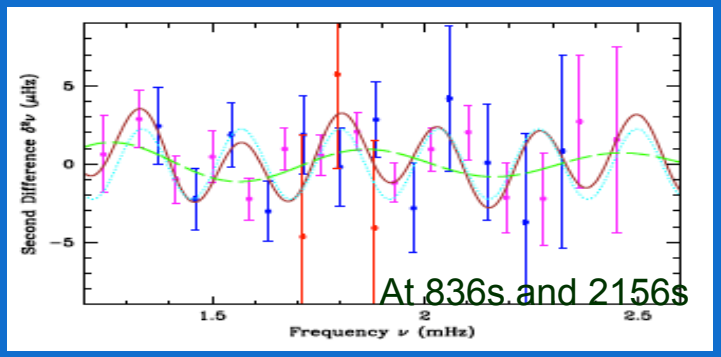
HD 49933 M= 1.13, Fe/H=-0.37, Prot=3.35 d
Core ~8%, ZC 88%, 3 Gyr

Basis of the outer ZC and Helium ionisation zone

$$\delta^2\nu = a_0 + b_0 \sin(4\pi\nu\tau_{\rm BCZ} + \phi_{\rm BCZ}) + (c_0 + c_1/\nu)\sin(4\pi\nu\tau_{\rm HIZ} + \phi_{\rm HIZ})$$

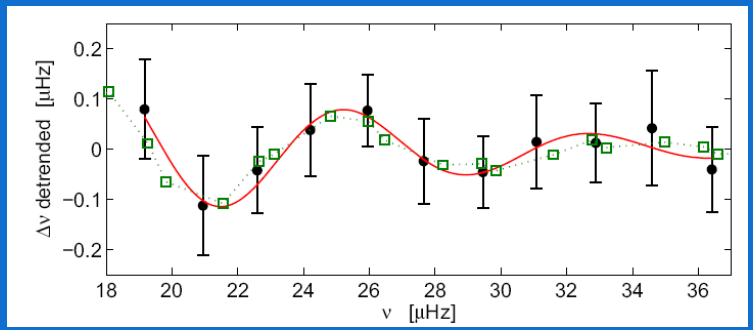
Extension of the core and mixing ?





(Mazumdar and Michel 2010, AN)

Also seen in a giant *(Miglio et al 2010)*

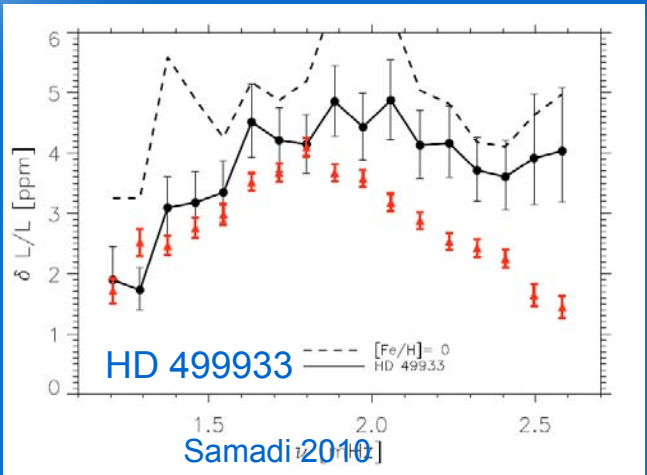


dark **α= 0.2, D_{turb} = 50cm²/s**
Medium α =0.2 D_{turb} =0
light α =0.1, D_{turb} =0
α =0.0, D_{turb} =0

(Goupil et al 2010 A&A in prep.)

Superadiabatic outerlayers

Amplitudes



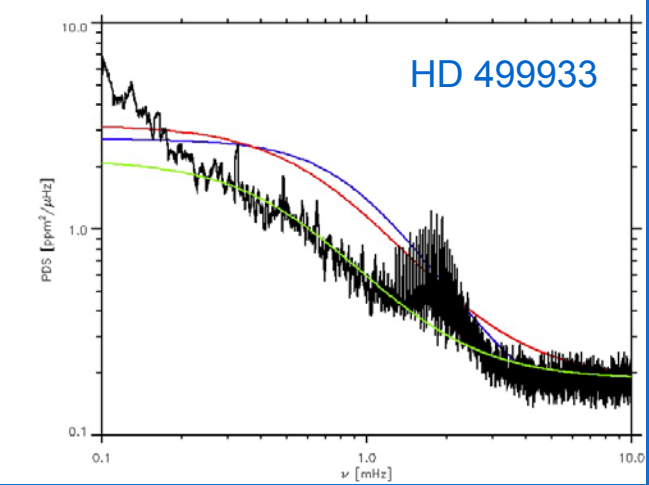
Surface metal abundance:

- Important effect on the mode amplitudes

Origins of the remaining discrepancy ?

- Entropy contribution ?
- Scale-length separation ?
- Magnetic field ?

Granulation



3D hydro model (Ludwig et al 2009, A&A)

1D theoretical model (Samadi et al, 2011, in prep.)

To be improved…..

A stellar cycle from seismology

HD 49933, F5V,

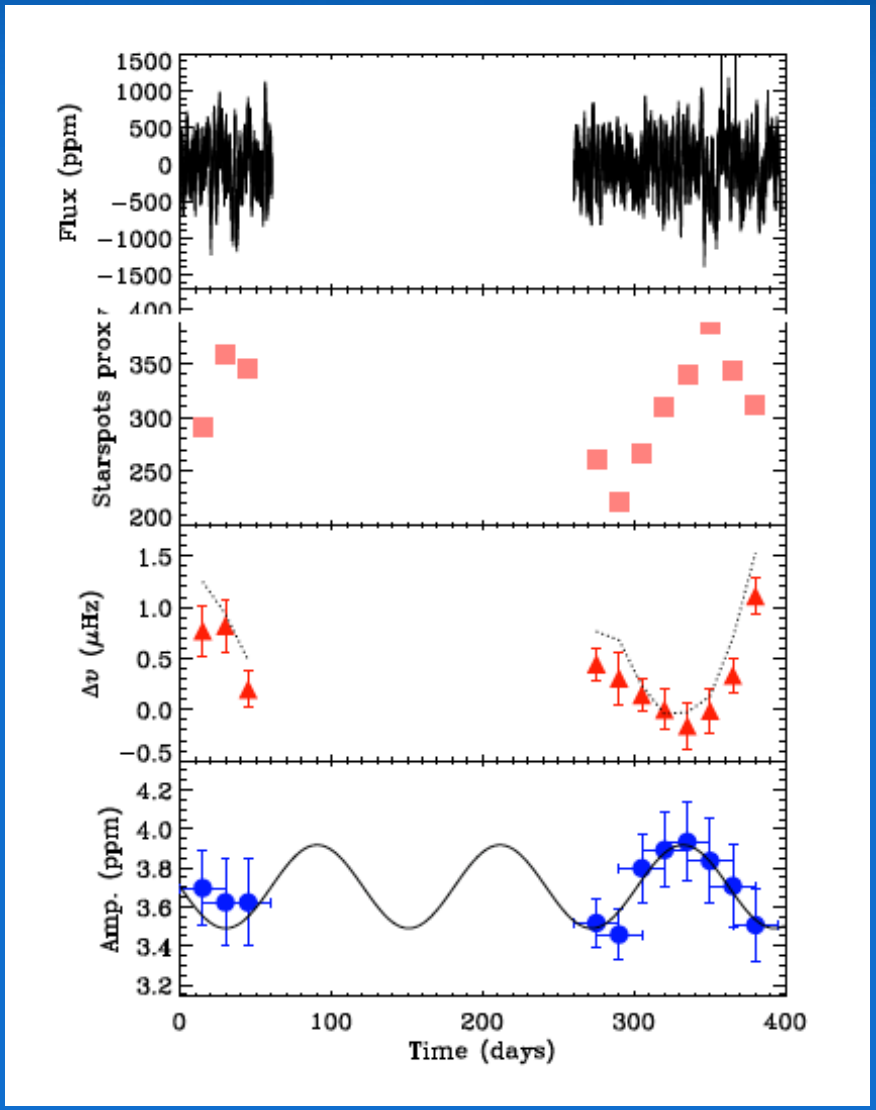
1.2 Mo, Rotation period 3.4 days

Observed twice for 400 days,

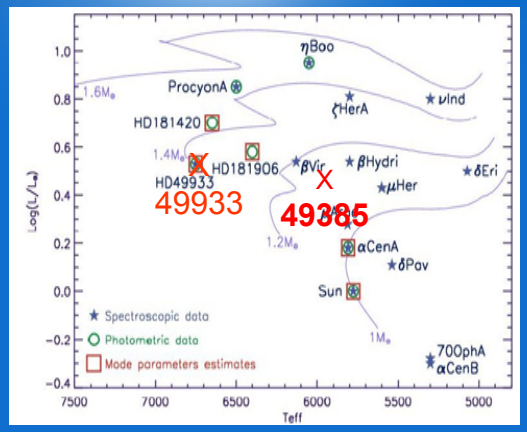
Modulation of seismic + activity indicators as in the Sun

around 120 days

Garcia et al., Science, Mathur

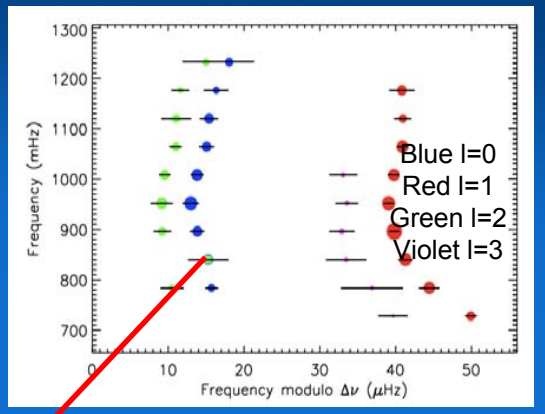


Off the MS



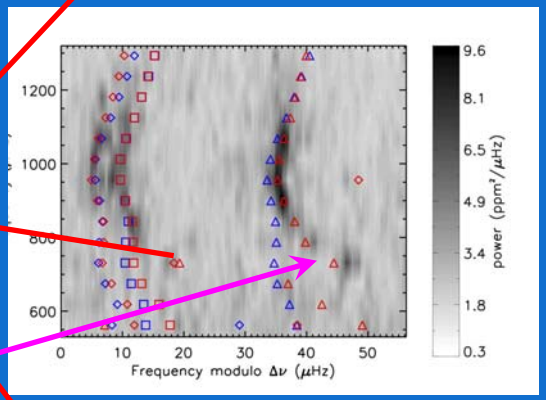
Large amplitudes
Brighter than the Sun
Vconv higher
Same T

Life time of the modes longer



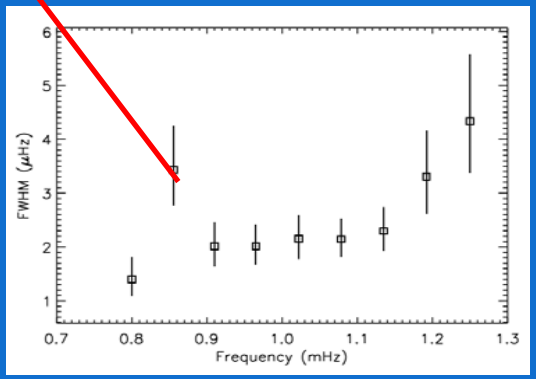
a mixed mode

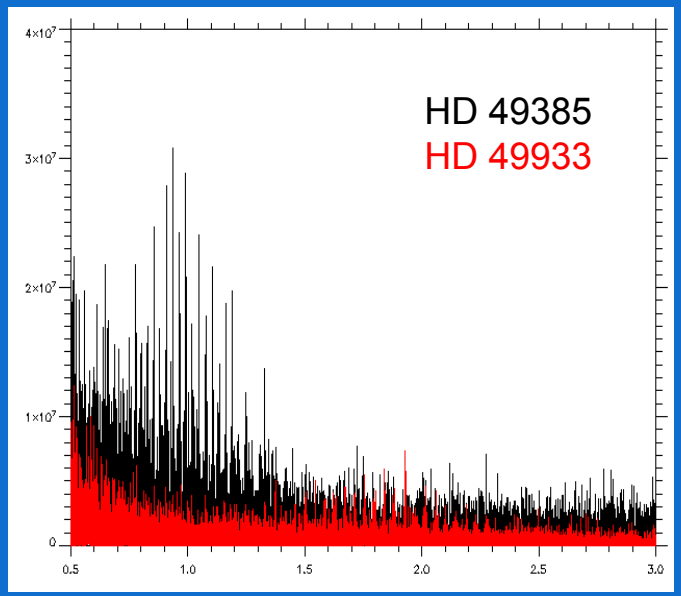
In Post MS only



curvature

Of the l=1 ridge





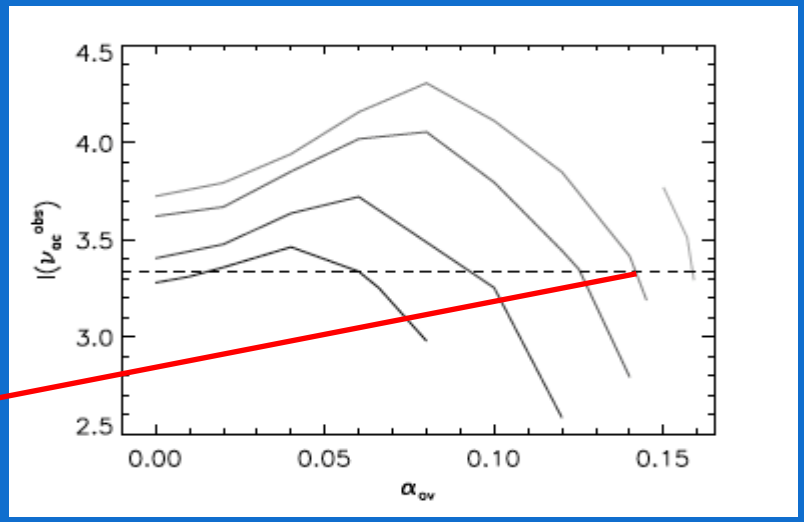
Deheuvels et al.
A&A accepted

What a mixed mode can tell

* The frequency of the mixed mode (g type)

$\Delta\nu = 56.3\ \mu Hz$

$\nu_{ac}^{obs} = 748.6 \pm 0.23\ \mu Hz$



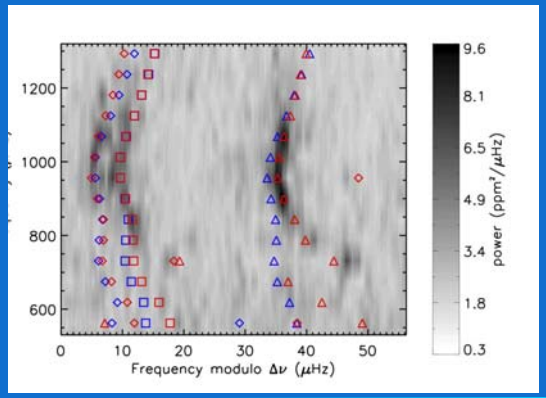
Models fitted to Teff, L/L_o, Z/X, And $\Delta\nu$

$1.3 < M < 1.36\ M_o$

overshooting
$\alpha_{ov} < 0.16$

•The curvature of the ridge
modified by the avoided crossing

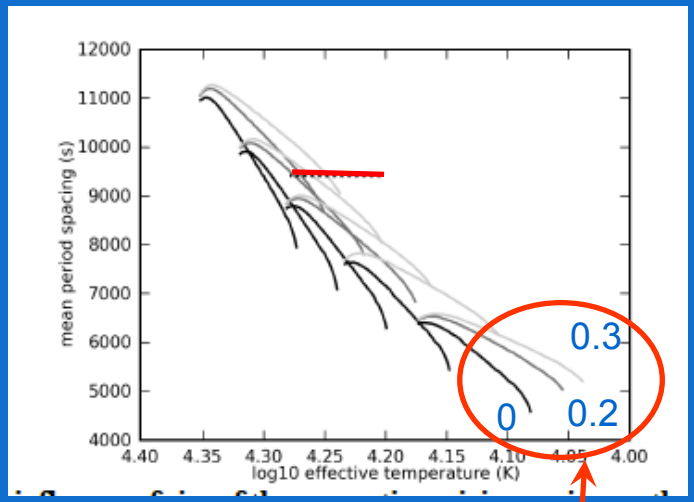
But..presently unsuccessful
several modes involved
Some physics missing ?



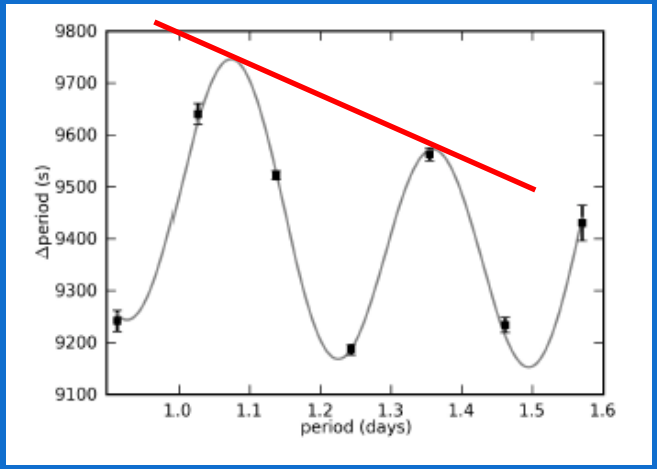
G mode period spacing in hot stars

G modes of High order and of the same degree
Have almost regular period spacing

HD 50230
Log g = 3.8
M ~7Mo
Teff= 17500
Vsini= 5km/s



Mean spacing= 9418s
60 % H burnt and some Ov

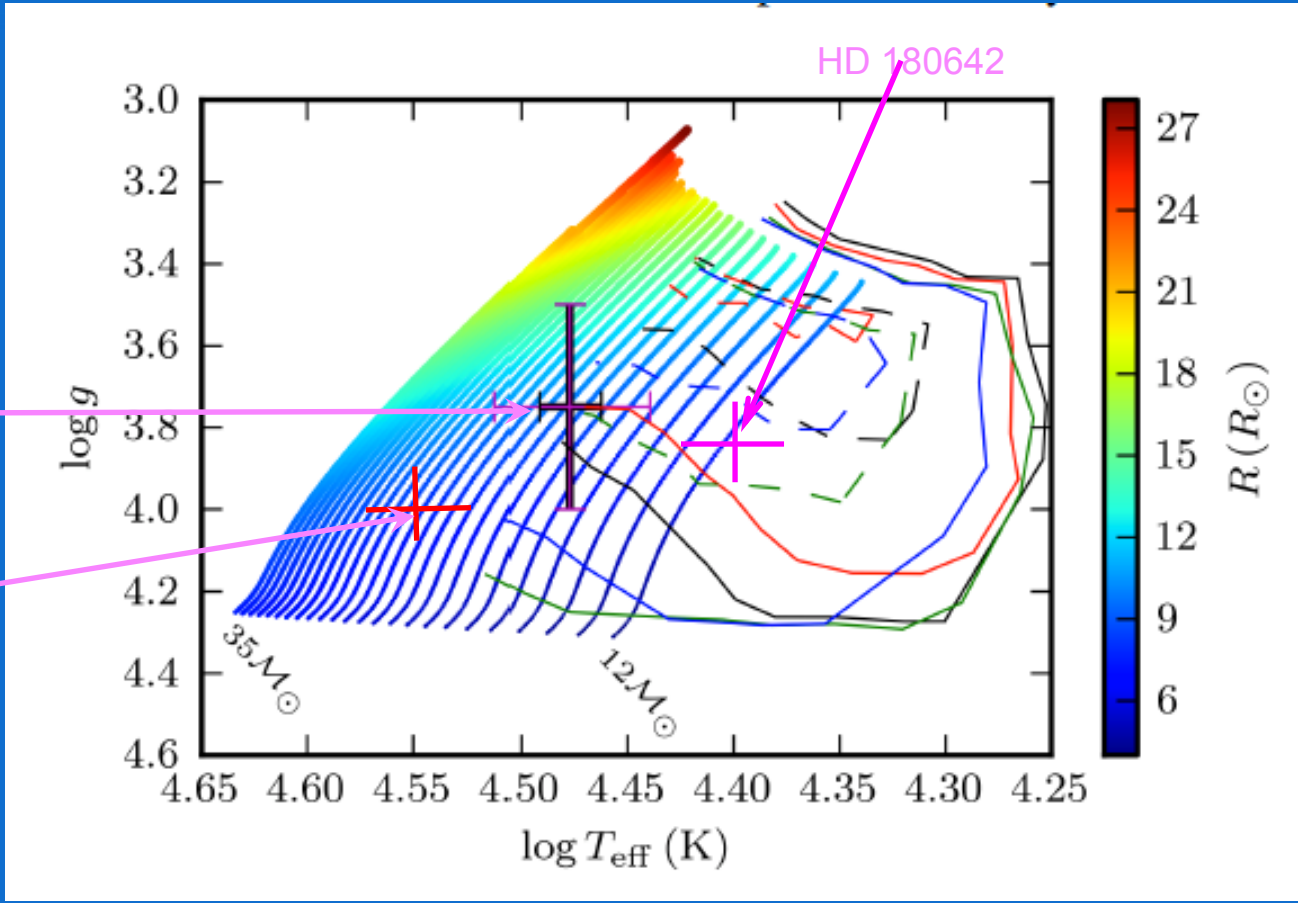


Periodic deviation of the spacing
2450s
Decreasing amplitude
smooth gradient of chemical composition
Mixing process ?

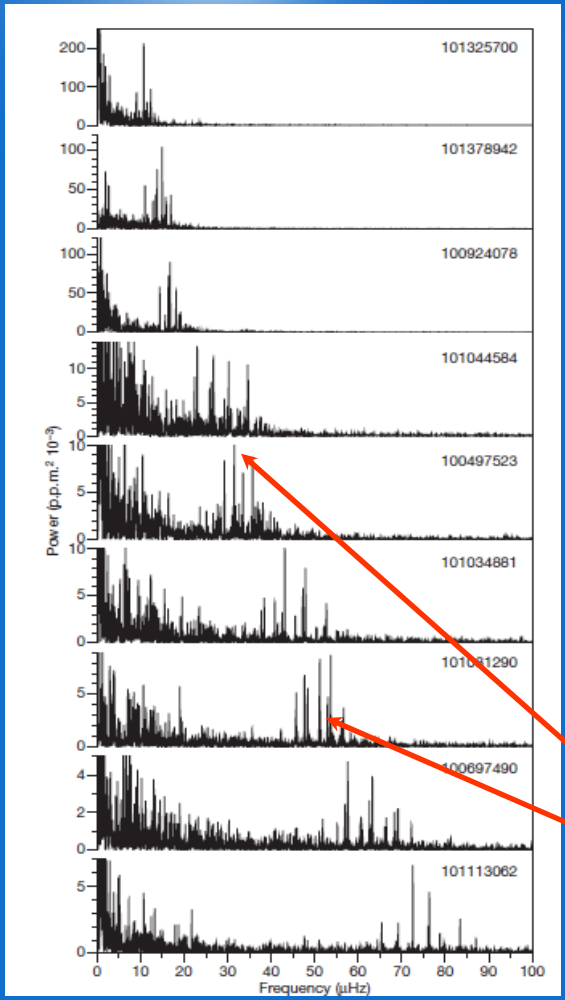
Difficulty : the beta cephei instability strip

HD 51756
NO

67 ν

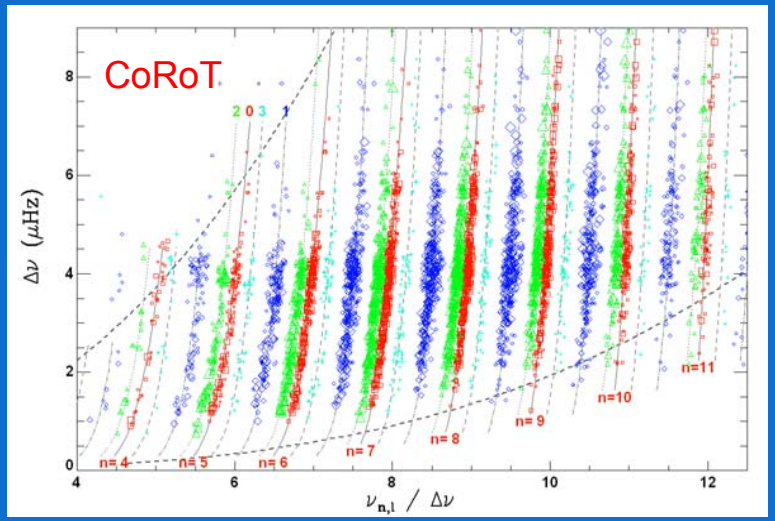


The « universal » spectrum in red giants



De Ridder et al. Nature 2009

$$\nu_{n,l} / \Delta\nu = n + l/2 + \varepsilon(\Delta\nu) - d_{0,l}(\Delta\nu)$$



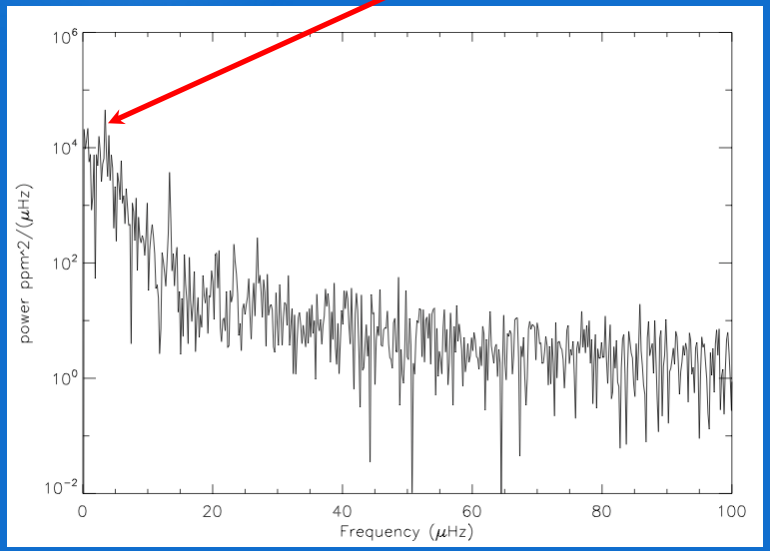
Mosser et al. A&A 2011

Scaling law for ε ?

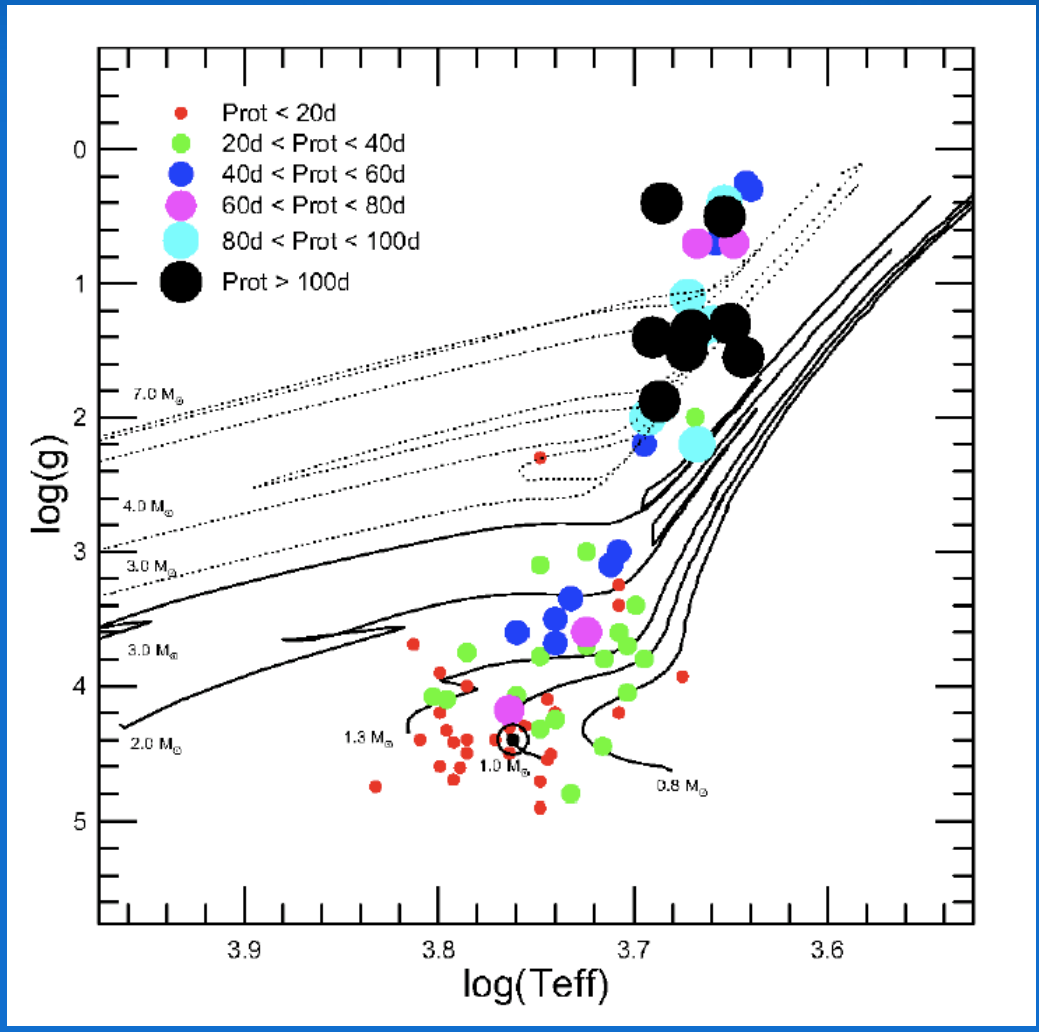
$$\varepsilon = A + B \log \Delta\nu$$

The Rotation of the Sun in time

True Prot
No vsini effect

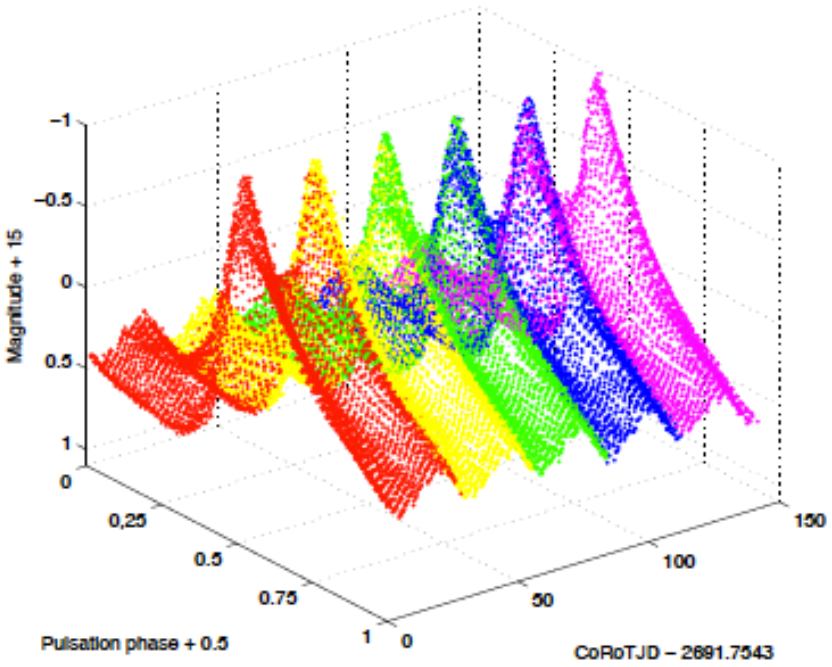


+ Extended program
of spectroscopic observations
To obtain the
Fundamental parameters



Dias de Nascimento eta., submitted

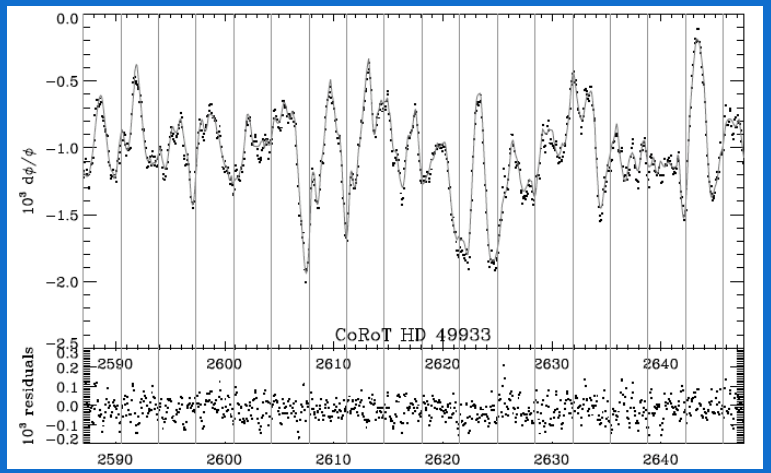
RR Lyrae from the exofield

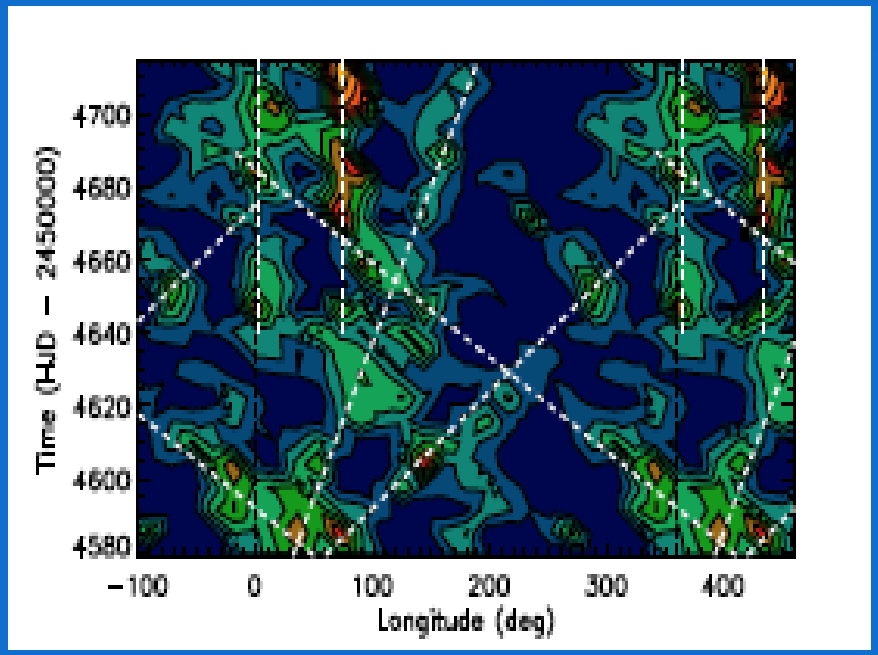


Detailed analysis of the Blazho effect….in progress

Spot modeling

HD 49933
P rot: 3.35 days
Spot life time: 2.5 to 3.5 days
Surface of the spots 3%
Inclination 55°
in agreement with seismology

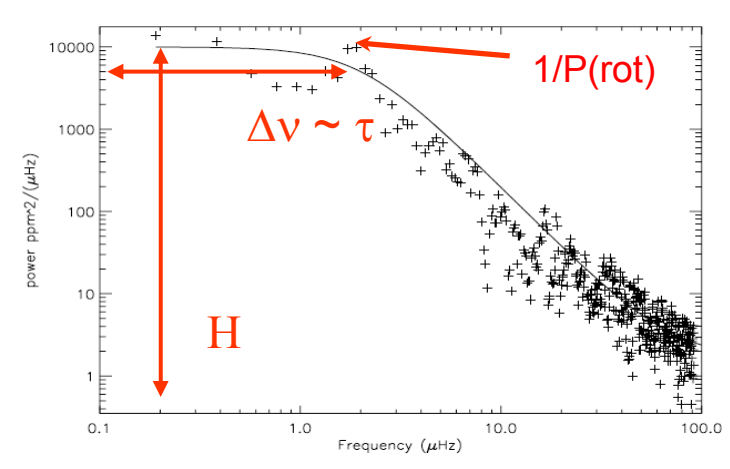




CoRoT 6: differential rotation ?

Activity Indexes

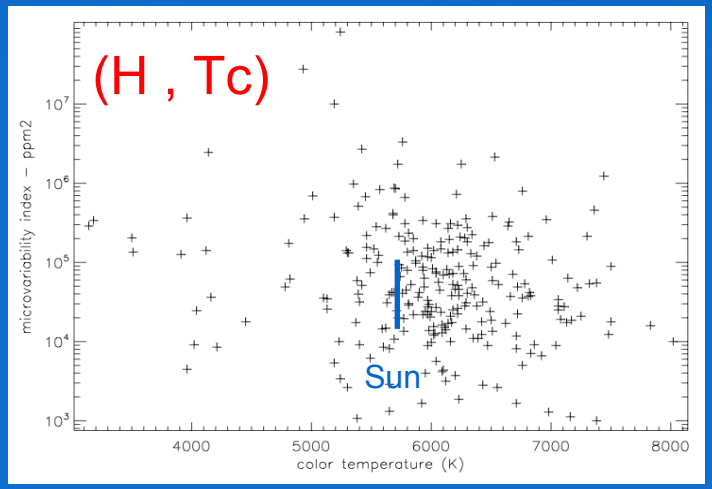
400 stars of the exofield + 30 from the sismofield

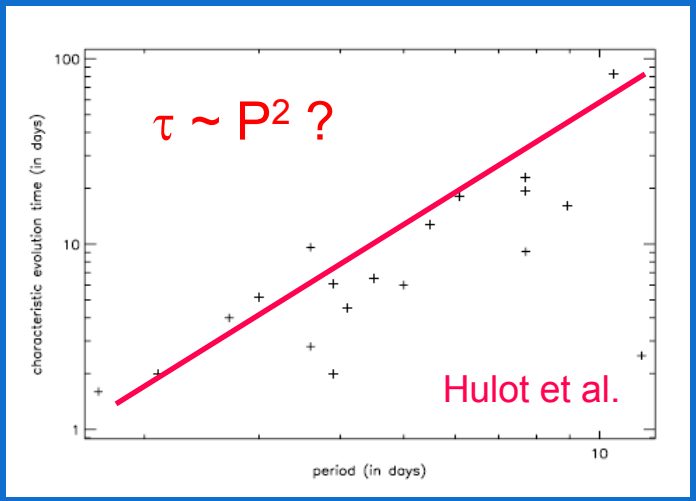


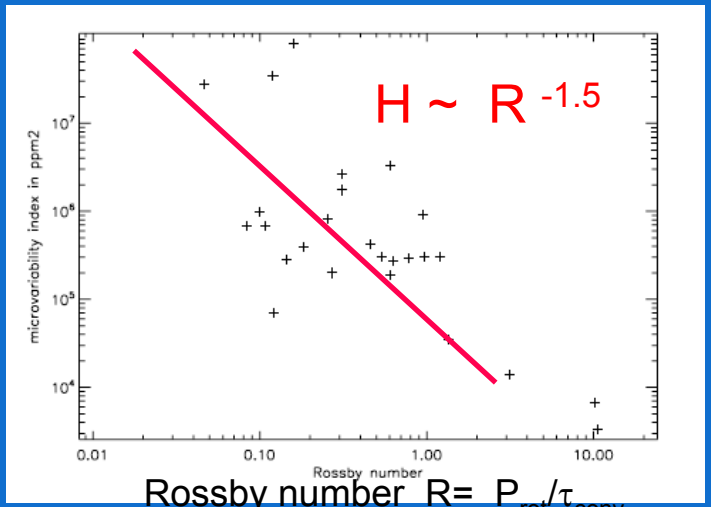
τ = evolution time

HΔν = activity index

(< 100 ❍Hz)







Rossby number $R = P_{rot}/\tau_{conv}$

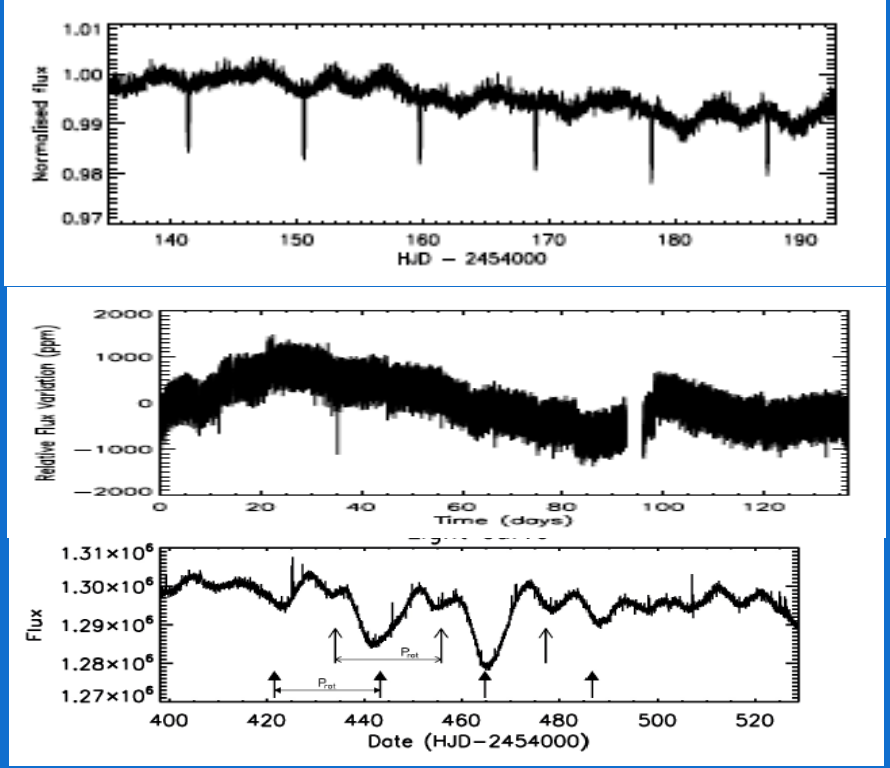
The CoRoT exoplanet programme

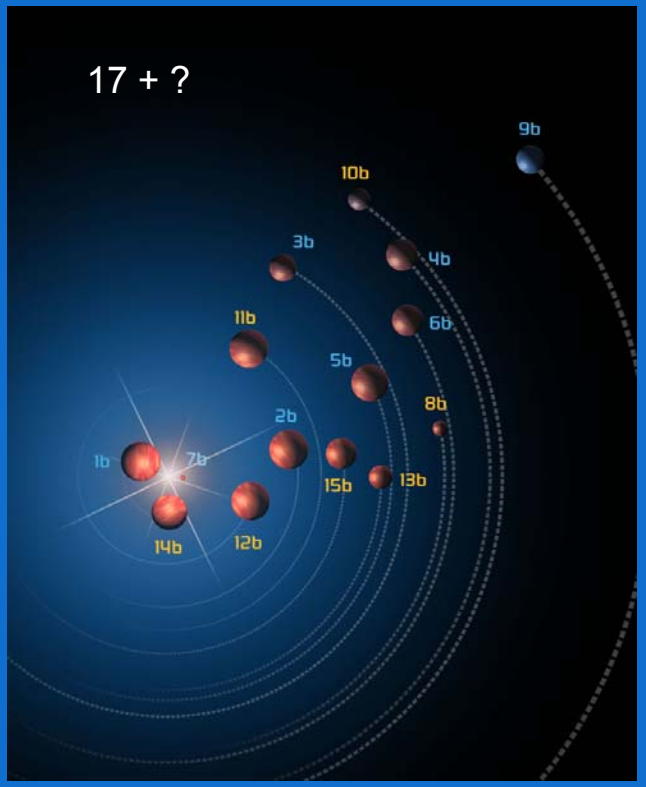
From light curves to complete planet characterisation……

Per run

10 000 targets 300 candidates

50 selected for FU obs 2 to 4 planets !



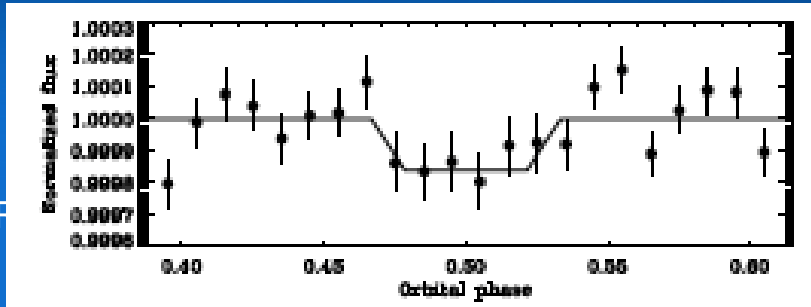


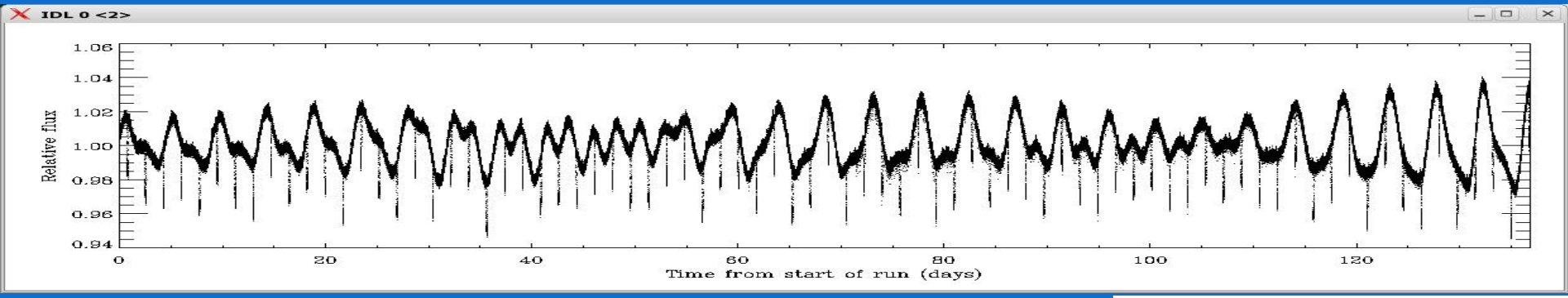
Hot jupiters around very active stars

CoRoT - 2

81 successive transits; Period: 1.742996 d; Radius: 1.465 R

Mass: 3.31 M_J; Rotation of the star 4.5 d

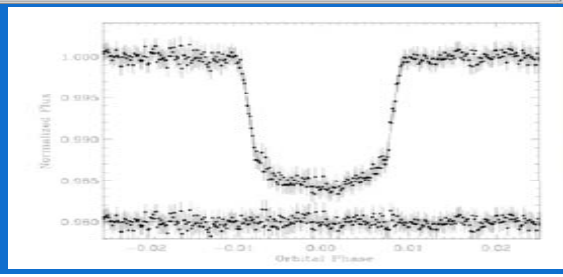


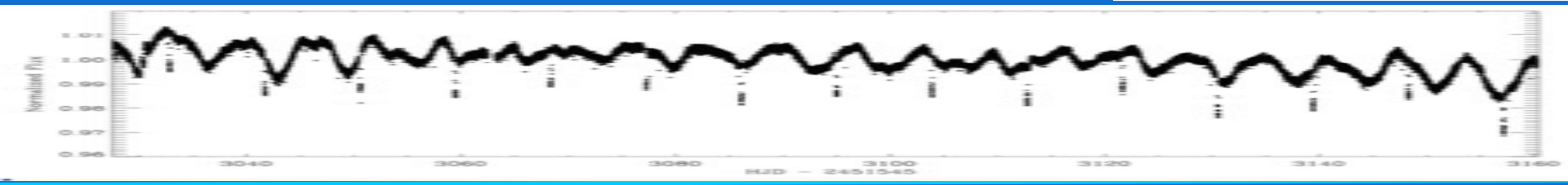


CoRoT - 6

15 successive transits; Period: 8.88 d; Rayon: 1.5 R_J

Mass: 3.3 M_J; Rotation of the star 6 d

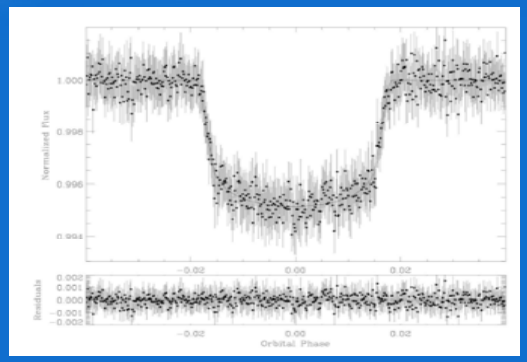




Between stars and planets

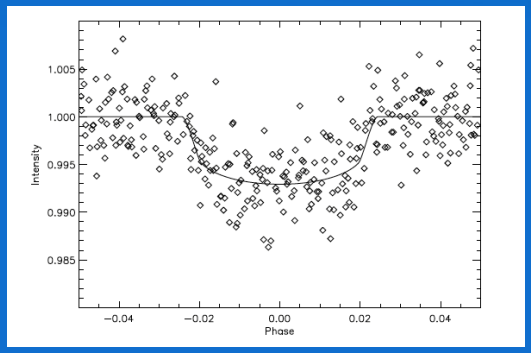
CoRoT- 3b

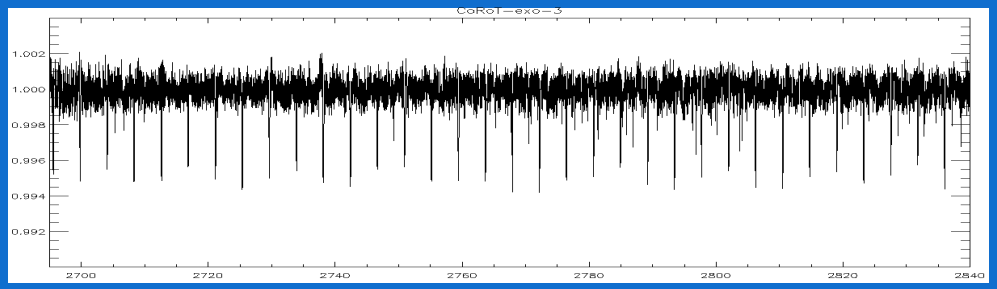
34 transits
Period 4.26 d
Radius: 1.01
Mass: 21.66
Rotation of the star ~ 4 d

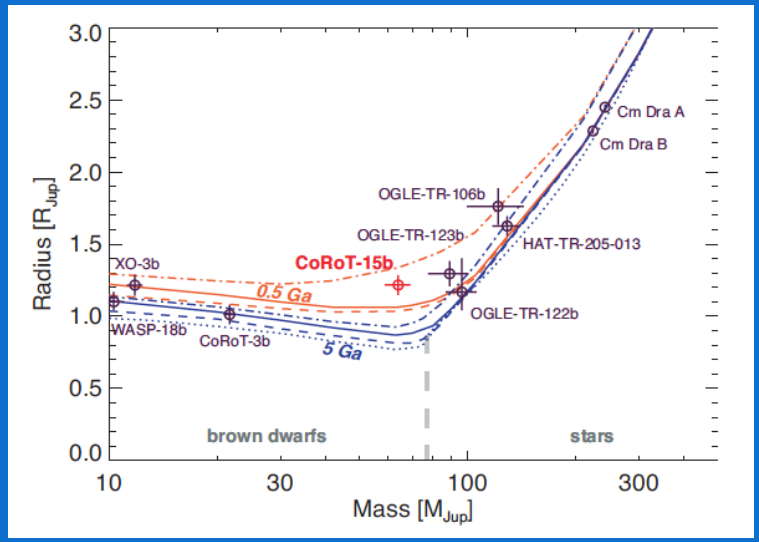


CoRoT- 15b

11 transits
Period 3 d
Radius: 1.22
Mass: 64







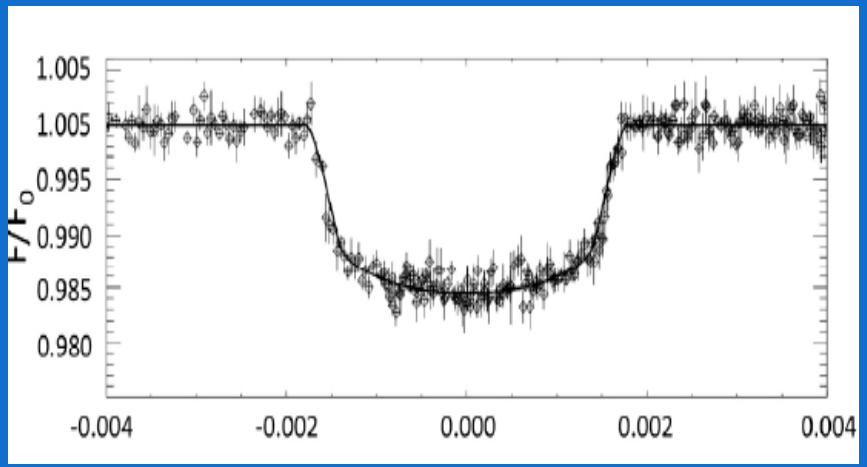
Deleuil et al. A&A 2008, 491, Bouchy et al. A&A accepted

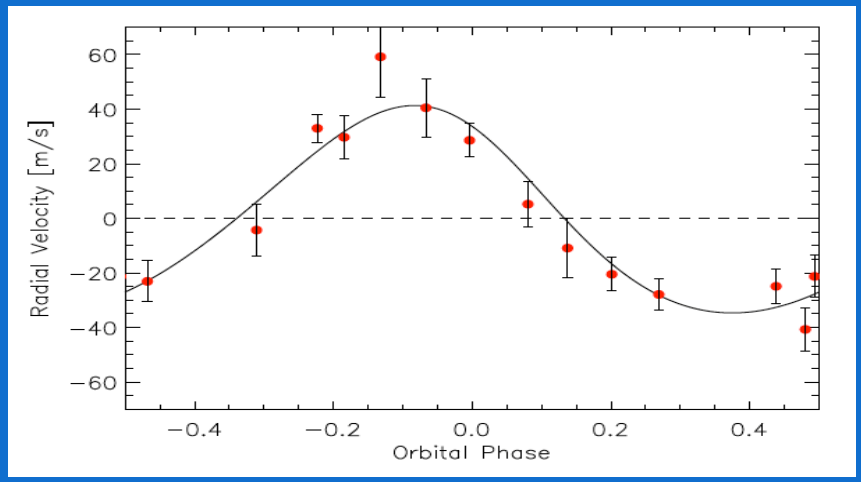
A temperate gaseous planet

CoRoT- 9

1.5 transit + WISE Photometry+ Harps Coralie spectroscopy..

Period 95 .27 days (145 days of observations)
Transit duration 8.8 hours
Eccentricity 0.11
G3V, not active, 0.9 Ms,
Rp= 1.1 Rjup, Mp= 0.84 Mj, Tsurf= 350K, H+ He+ 20mE rocks

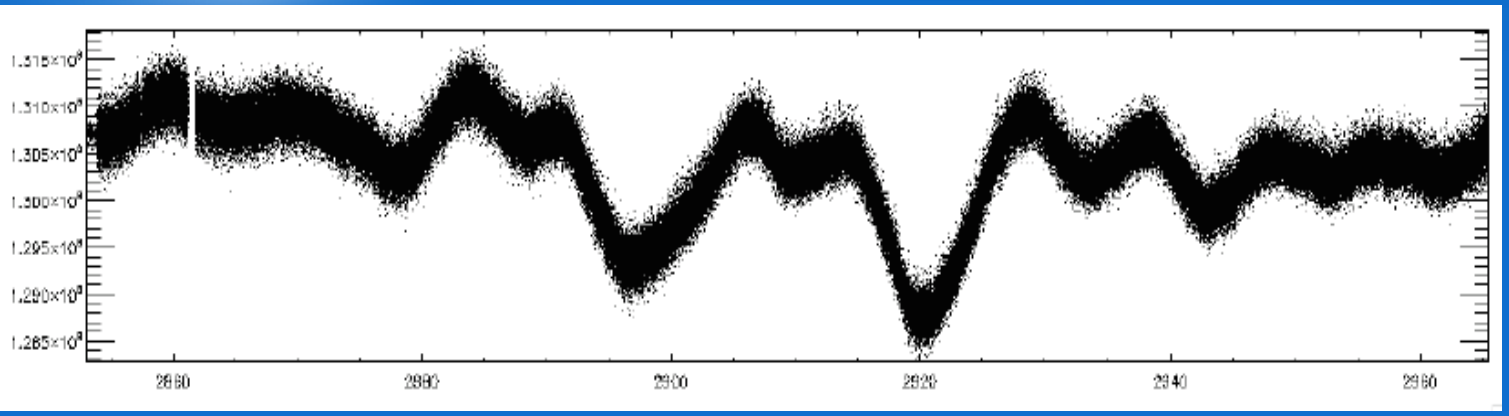




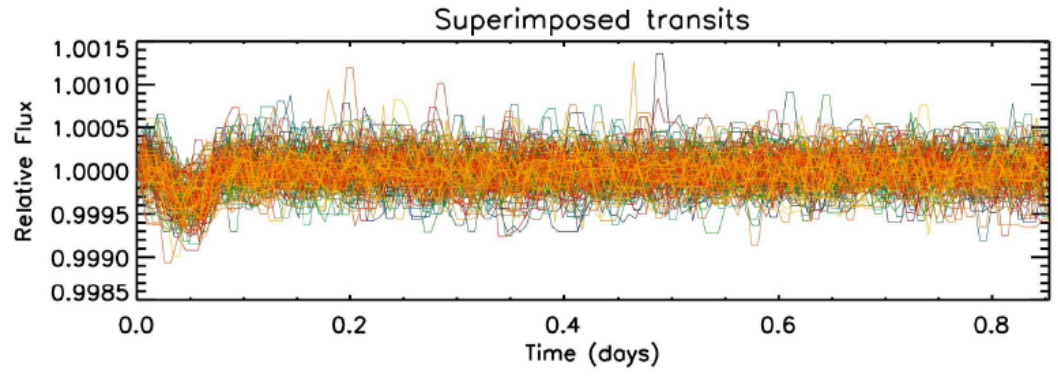
Beng reobserved this summer

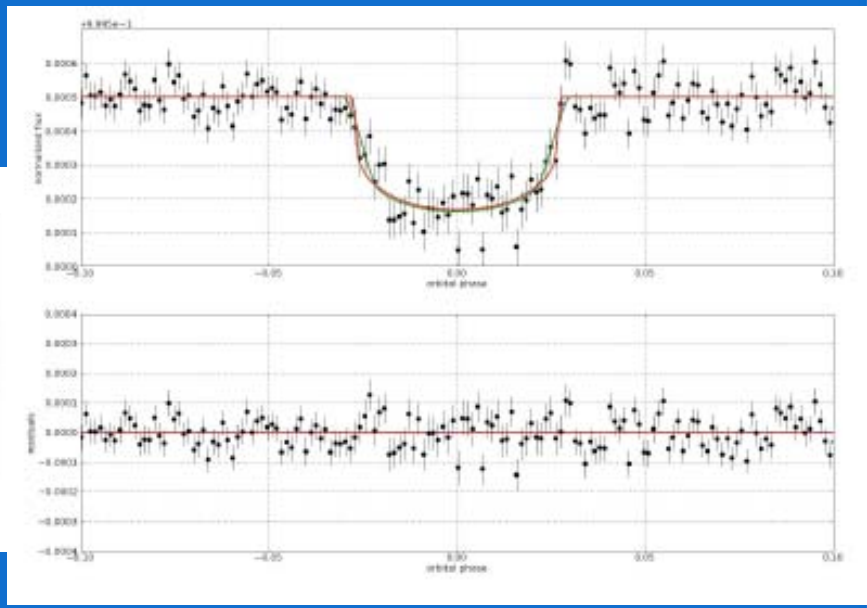
The smallest one

CoRoT-7b



~ 170 transits
Period: 0.85 j
P rot: 23 j
R= 1.7 Rearth

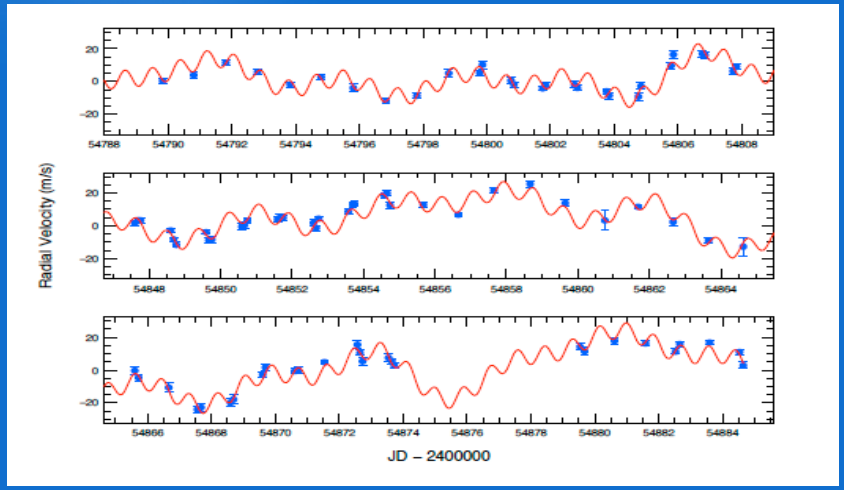




Stellar activity and planet confirmation

CoRoT-7b

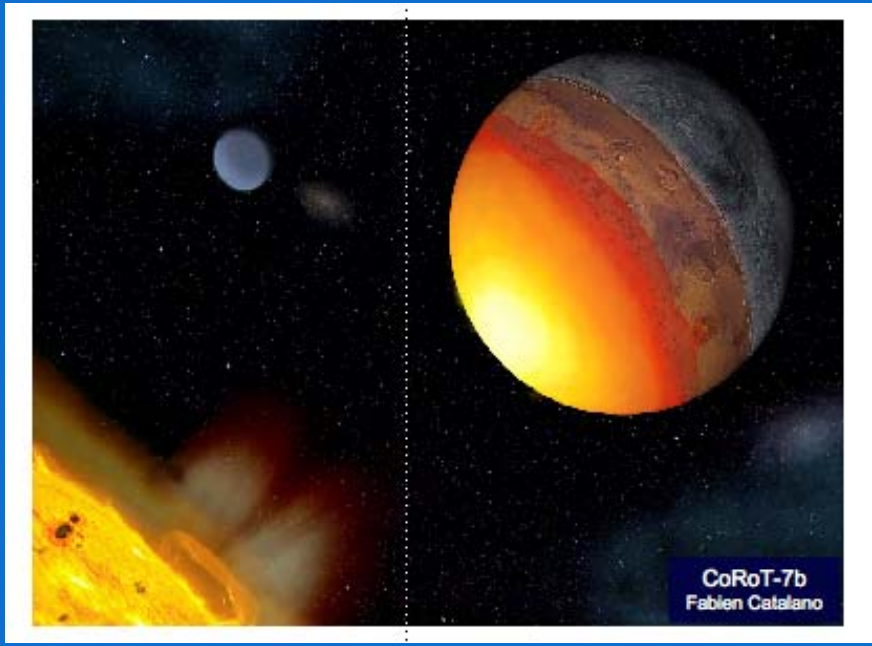
110 nights with HARPS:



Strong noise due to stellar activity……
Spot modeling confirms

0.85 days period exists, amplitude: ~ 5m/s
M between 2.8 and 6 $M_\oplus$
Density ~ 5
Silicates + water ?

second periodicity: 3.7 days, hot Neptune M= 9$M_\oplus$
And a third one…..



The photometric Road Map ……

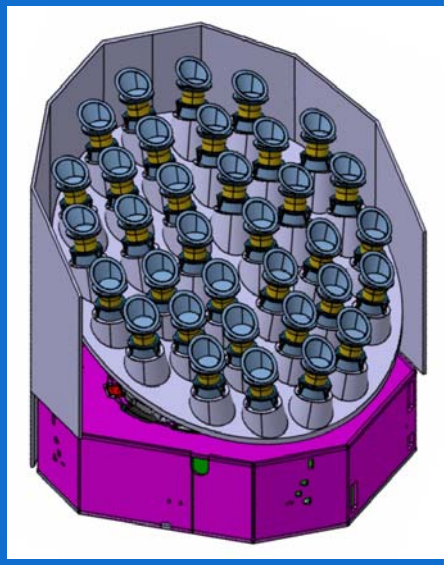
MOST : Space born photometry fruitful technique for stellar variability studies (duration continuity)

CoRoT : High S/N, Detailed seismology on selected stars, various transiting planet detection
Start to understand the difficulties with real data!

Kepler : Opening of extended high S/N statistical studies in both domains

BRITE : a few bright stars

Stars and planetary systems have to be studied together
…… PLATO…….



Second CoRoT Symposium: Exploring Planet Diversity & Stellar Musics

13 to 17 June 2011 in Marseille at the Palais des Congrès.

http://symposiumcorot2011.oamp.fr/

Scientific Organisation committee :

- A. Baglin (chair)
- M. Deleuil
- E. Michel
- P. Bordé
- T. Guillot
- C. Moutou
- the CoRoT science council

CoRoT data are public since december 2008
Continuously pouring into the mission archive…

http://idoc-corot.ias.u-psud.fr

As soon as they are public at NStED

http://nsted.ipac.caltech.edu/NStED/docs/datasethelp/ETSS_CoRoT.html

Enjoy it !

Thank you !