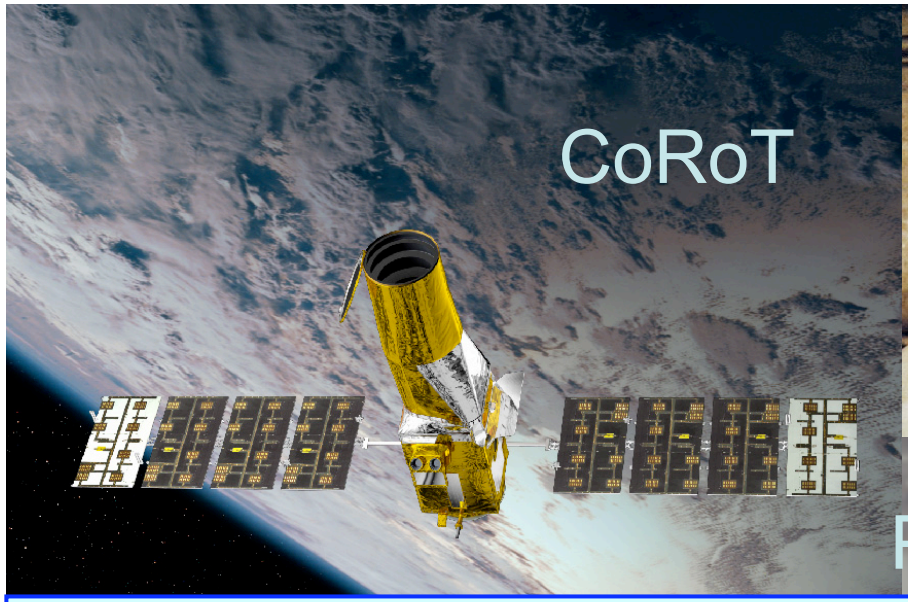
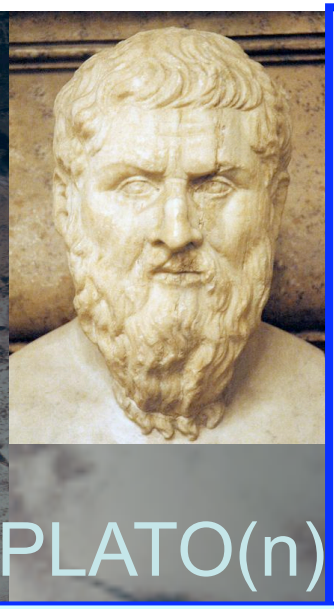
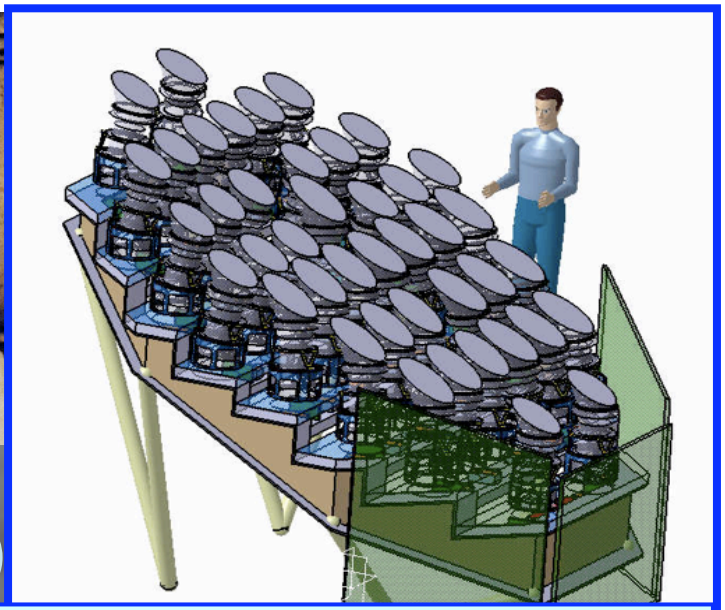
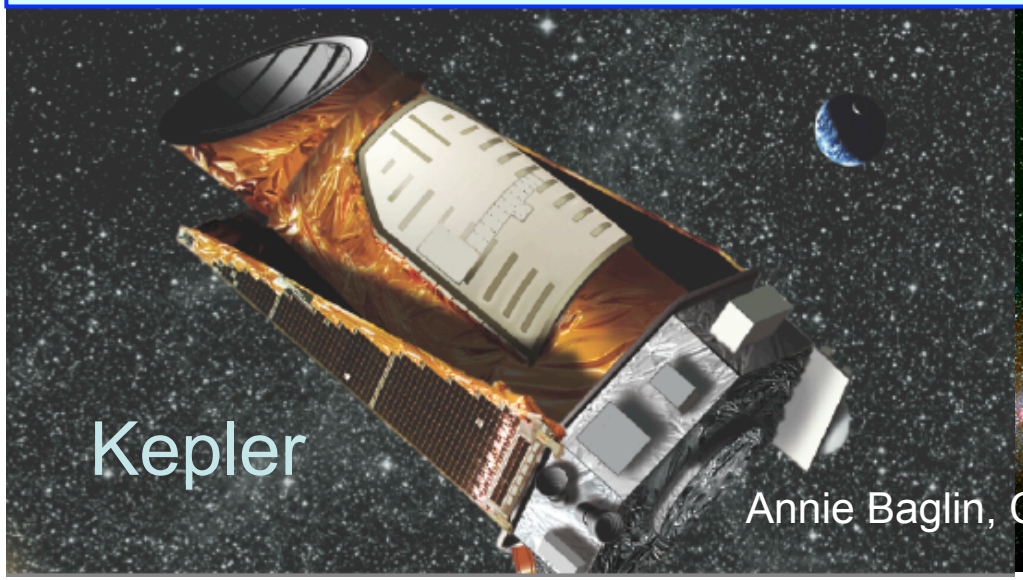


# *Ultra-high relative stellar photometry from space and GAIA*




Annie Baglin, Claude Catala LESIA, Observatoire de Paris

# Interpretation and preparation

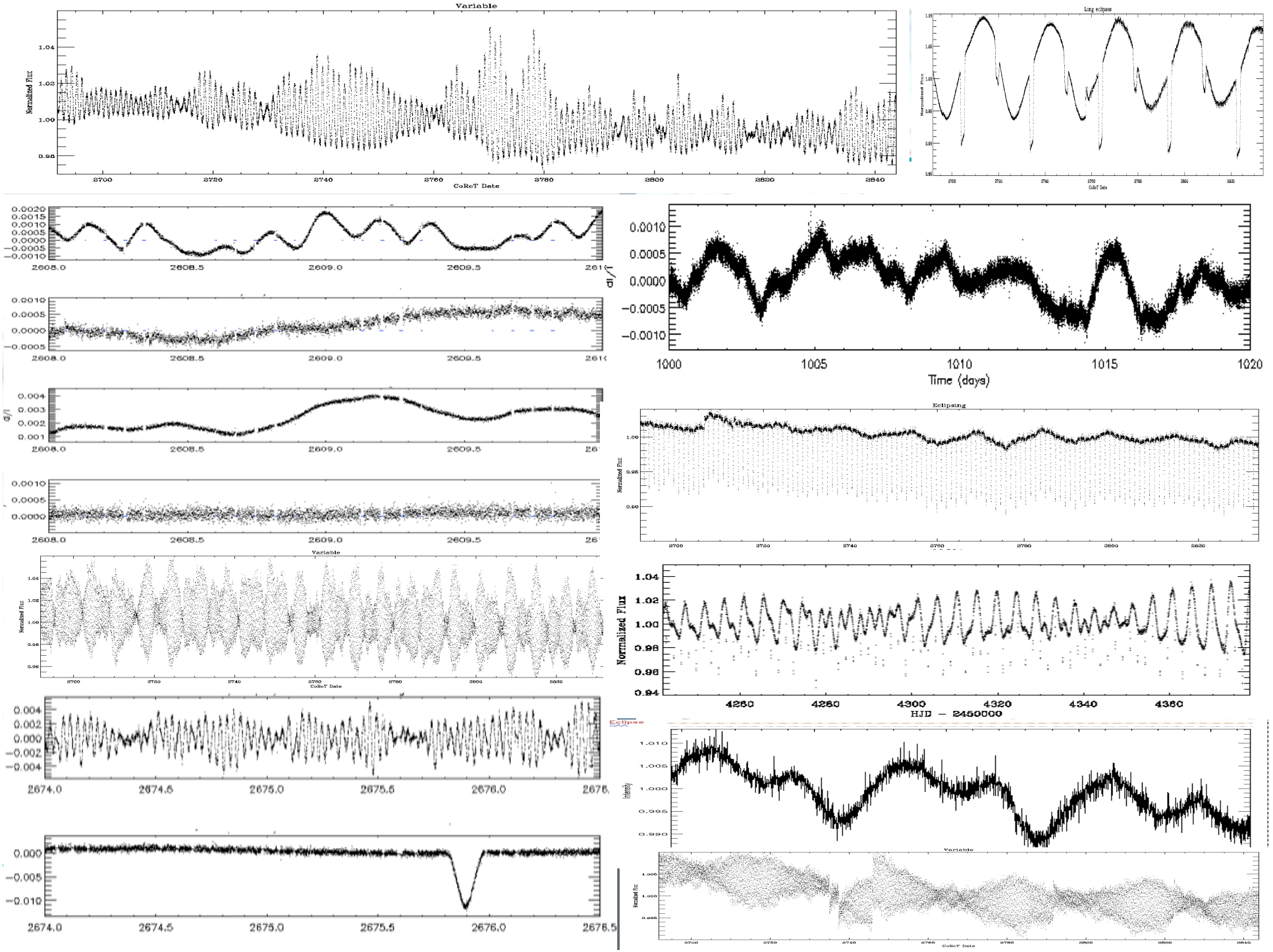
For CoRoT and Kepler: FU, for PLATO(n) : preparation + FU

The needs for interpretation:

Fundamental parameters of the targets highest accuracy
for stellar physics and exoplanet parameters

The needs for preparation

Selection of the targets
for planet detection cool dwarfs/subgiants
No contamination


Variable
Normalized Flux
CoRoT Date
Long eclipses
Eclipsing
Variable
Time (days)
Normalized Flux
HJD − 2450000
Eclipse
Intensity

# A huge potential in stellar physics

*« Il n'y a pas que les oscillations et les exo-planètes dans la vie de COROT*
*et il n'y aura pas que des exo-planètes dans la vie de Kepler et PLATO(n) »*

***from F. Baudin***

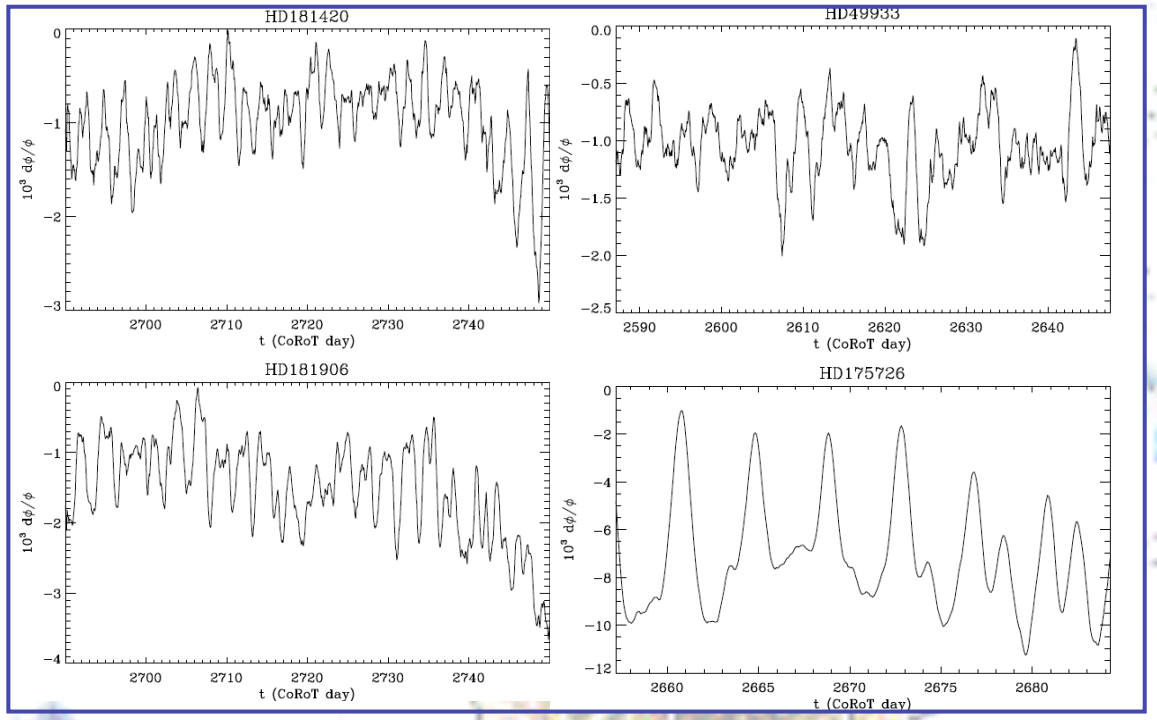
At the level of CoRoT photometric accuracy

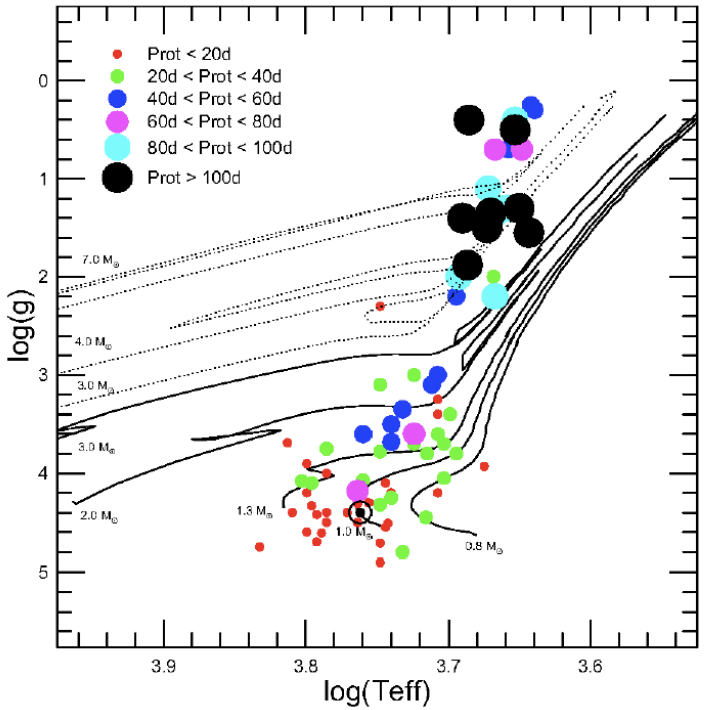
More than 45 % of periodic variables
And most of the rest erratic…..

What does this infomation tell us about stars?

# Rotation

## True period of rotation

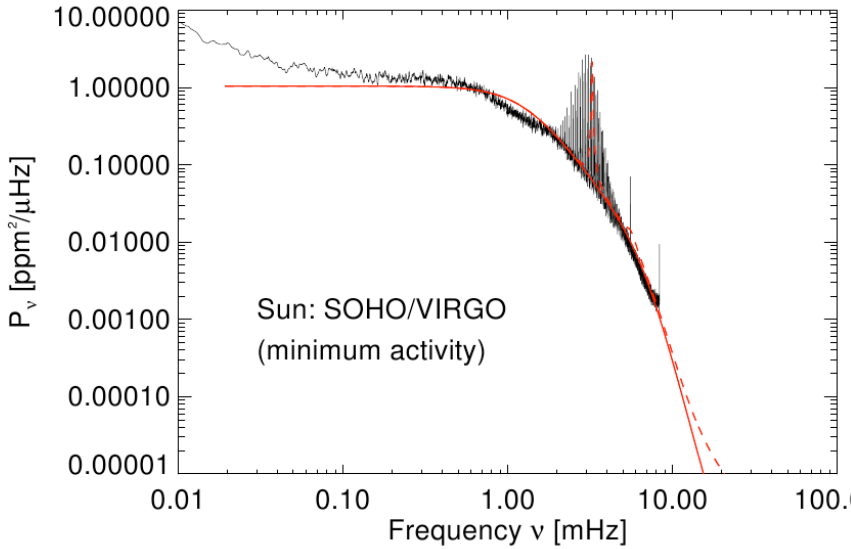


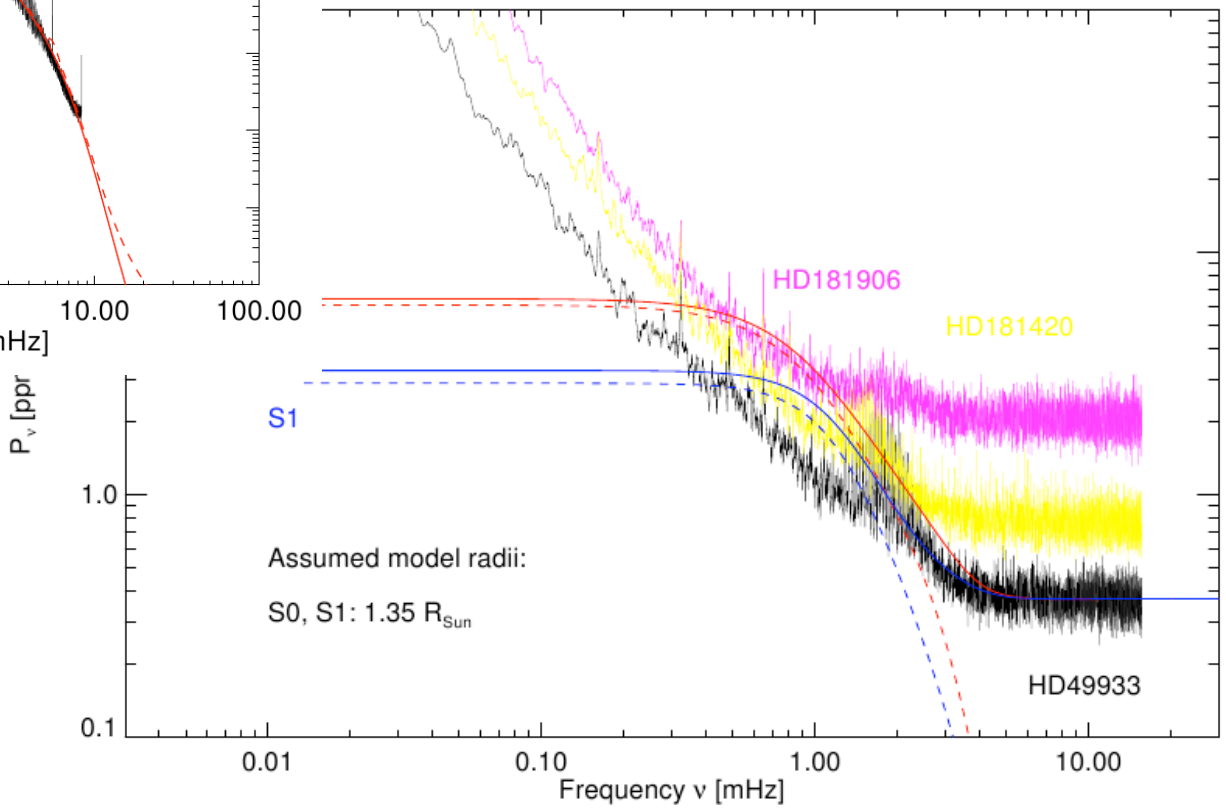




NEED from GAIA: Luminosity

FU gives good Teff

# Granulation




Modélisation basée
su
r
un code hydrodynamique 3D

Testé sur le Soleil

Ludwig et al (2009, A&A)

**Un désaccord énigmatique**

**Luminosité? Teff?**

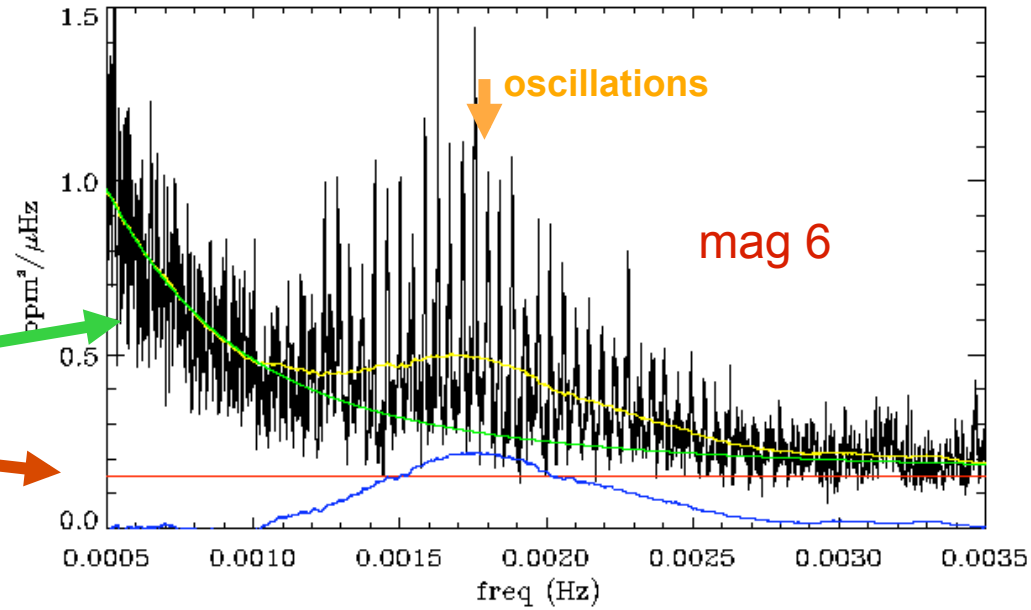
# Seismology and fundamental parameters

In principle, seismology could be autonomous as for the Sun,
But……..

The best signal presently reachable in photometry:
CoRoT (sismo), Kepler, PLATO(n)
is **unsufficient**

granulation

White noise

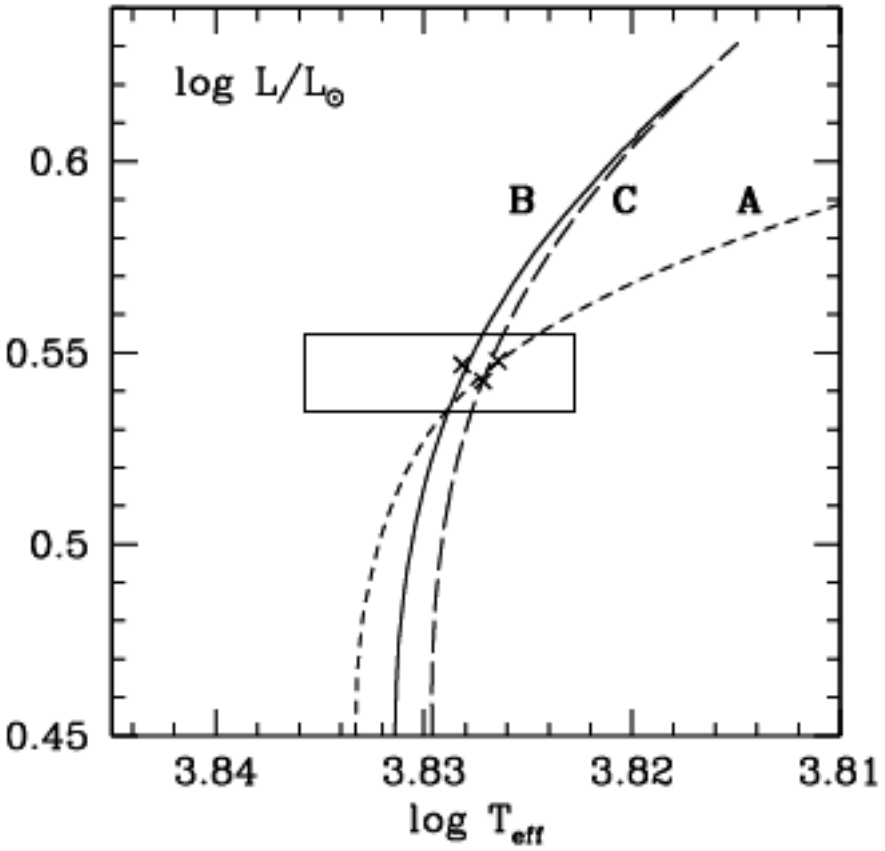



In solar analogs, detection of ~80 modes

rotation, activity, width of the modes

# Modeling the seismology targets

## Ex: HD 49933, mv= 5.6




$\varpi$ = 33.45 ± 0.84 at 30 pc (Hipparcos)

$T_{eff}$ = 6735*K* ±130*K*;
(*Z*=*X*)0 = [0.008 ; 0.0124];
log *L*/*Lo*
= 0.54 ± 0:02

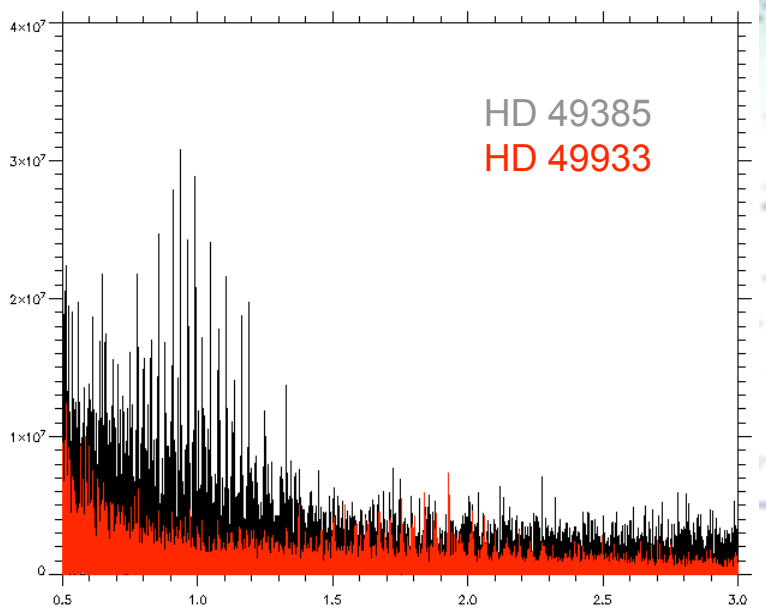
$\varpi$ $T_{eff}$ *too large, can it be improved?*
*Z*/*X* *much too large, can it be improved?*

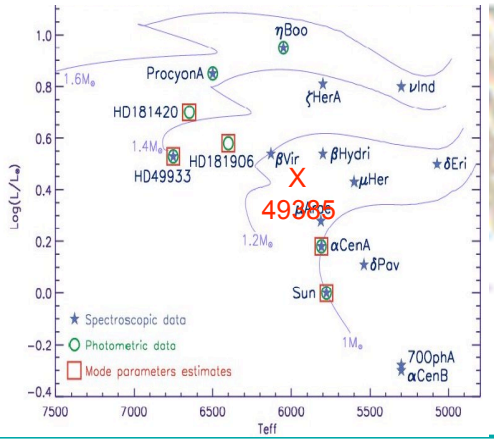
$\varpi$ *L*/*L* *slightly too large*

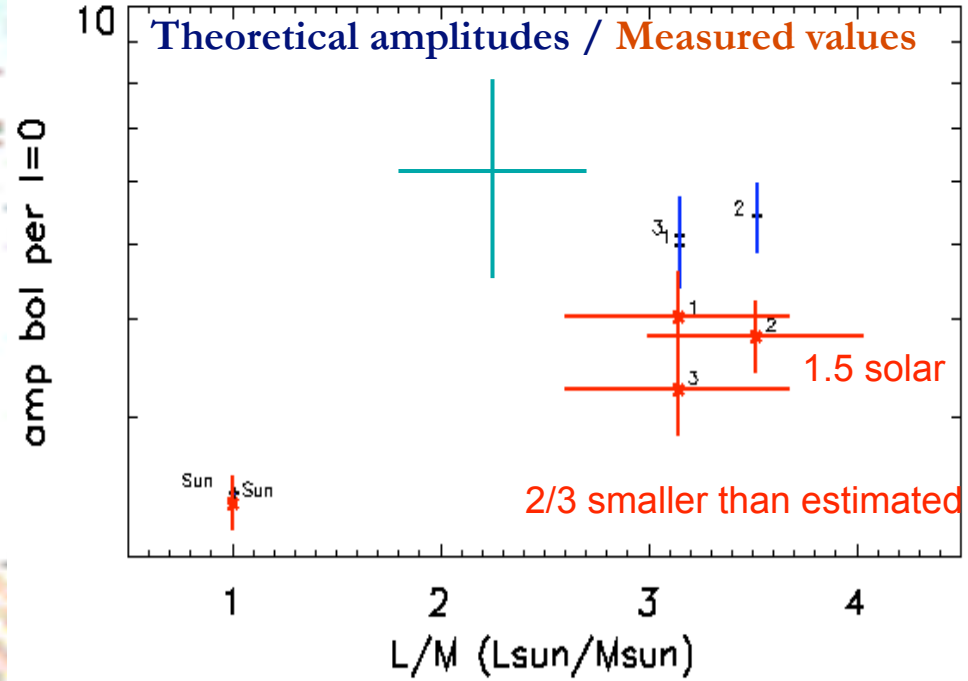
**Need at least this accuracy on all the targets**

**Seismic data improve the modeling if identification is easy…..**

# Amplitudes and luminosity



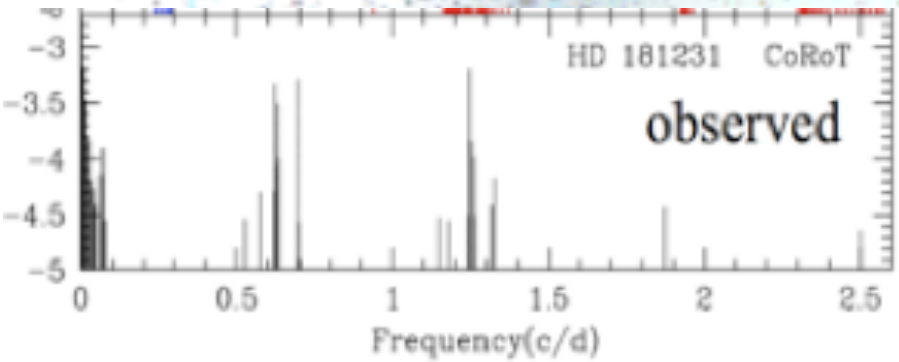




Both luminosity and metallicity

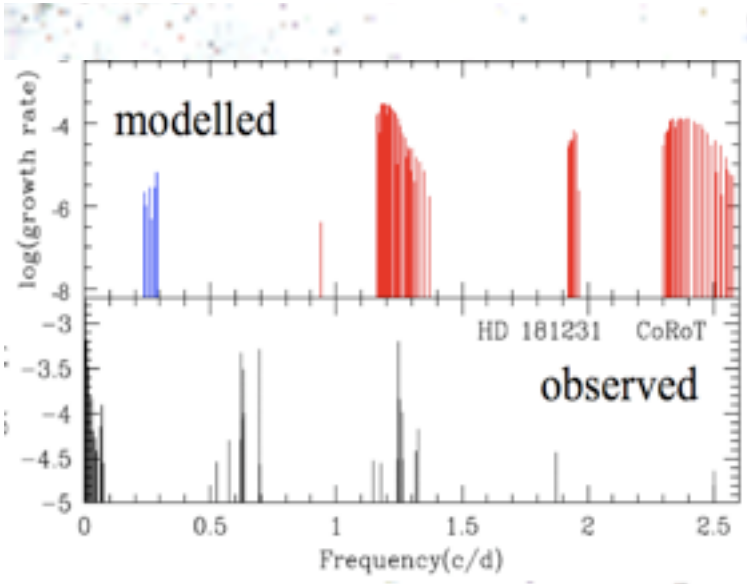
# B and Be stars

For the first time very low frequency modes detected



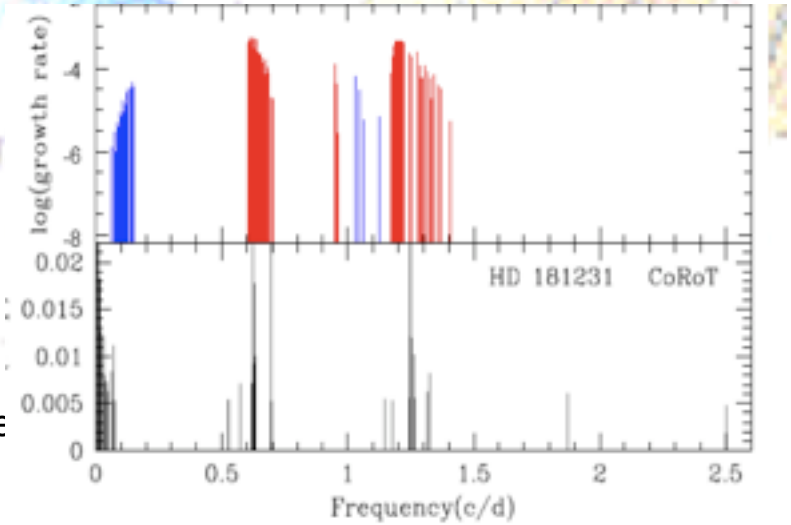

Their frequency domain depends on the internal structure

BUT…. also on L (M).

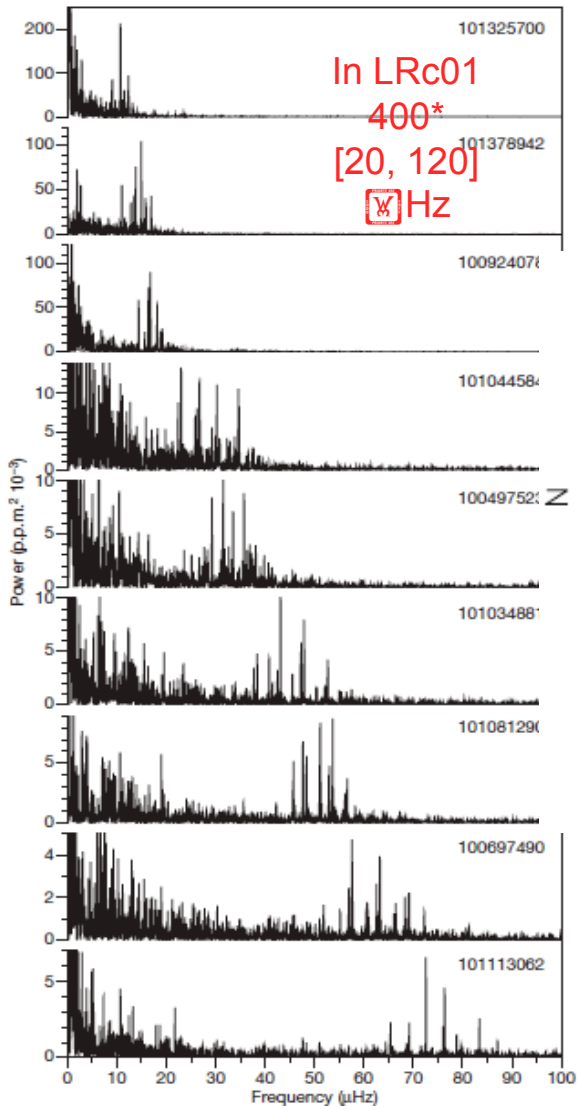



Small core

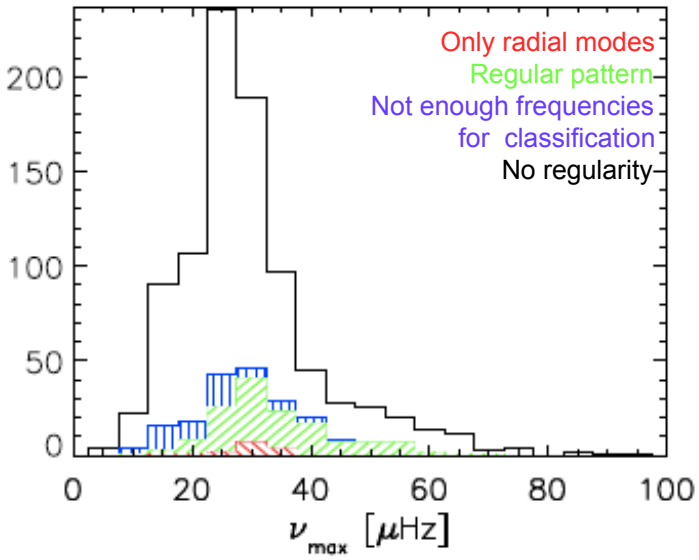
Extented core

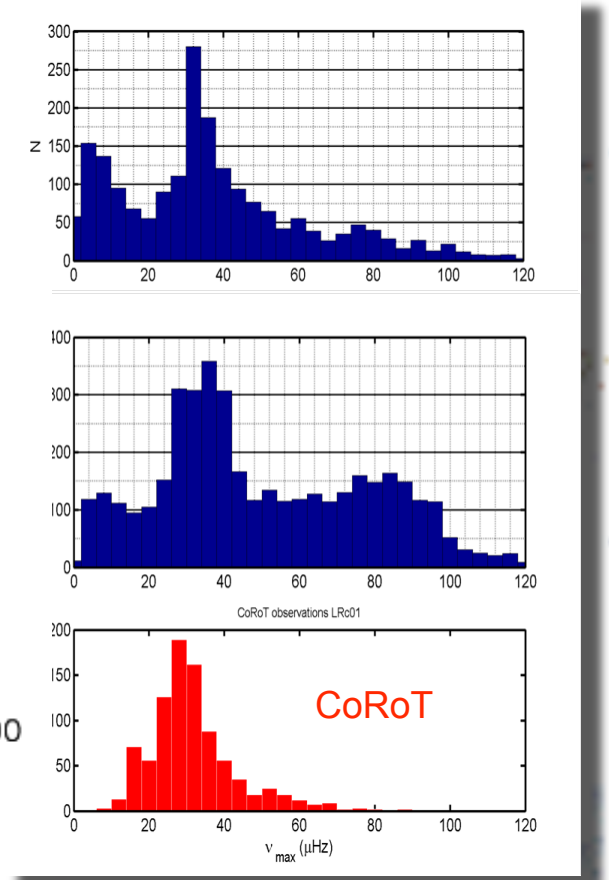


# Seismology and galactic structure?




Faint Red giants
400 stars



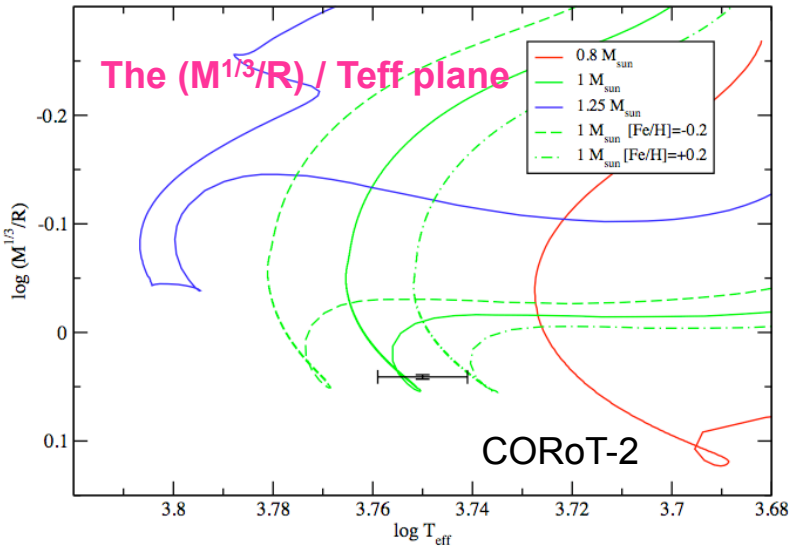

Non uniform, unimodal distribution
Compared to models of synthetic populations

# Planets and Stellar parameters

Transits: **R/R*** and **M*$^{1/3}$/R***

**very high precision ( 10-3)**

Radial velocities: **M/M***




At constant chemical composition

logTeff = 0.01 --> M ~ 0.06

At constant effective temperature

Fe/H = 0.2 --> M ~ 0.1

Variable mixing length

= 0.2 --> M ~ 0.05

M*~0.13 R* ~ 0.04

Ages: 30 Myr to 4 Gyr

# Stellar radii

## 1- Rp/R*

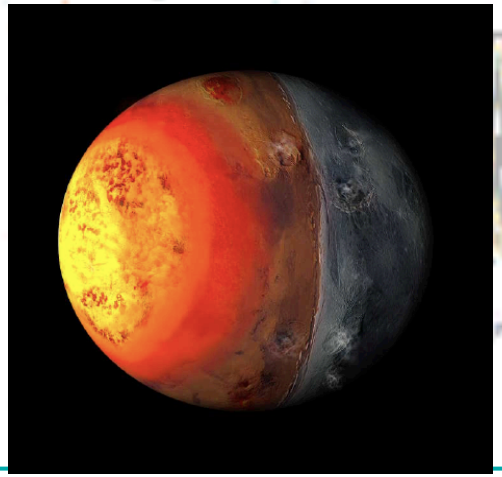
R*/R*=2 T/T+ d/d +

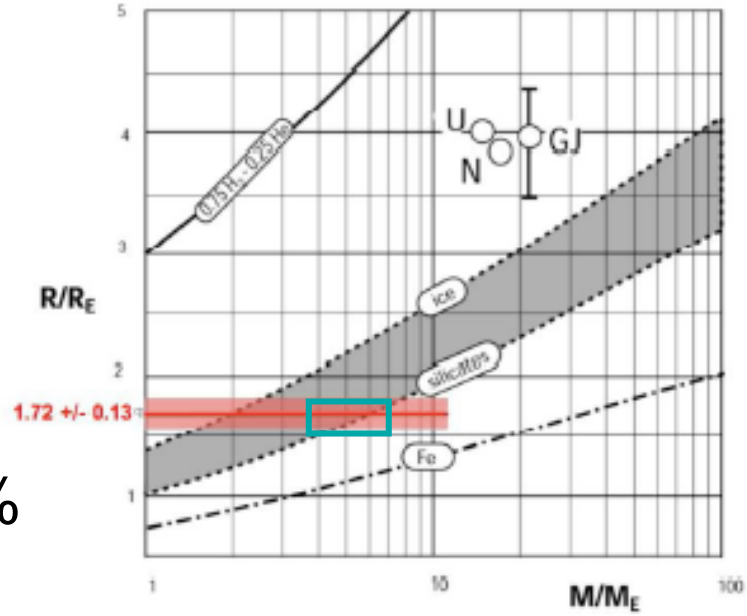
T/T ~1% with HRSon large tel.

d/d~1 % GAIA

## 2- $M^{*1/3}/R^*$

M*/M* 1% ! Mp/Mp: qq%






R/M pour différentes compositions (Grasset 2009)

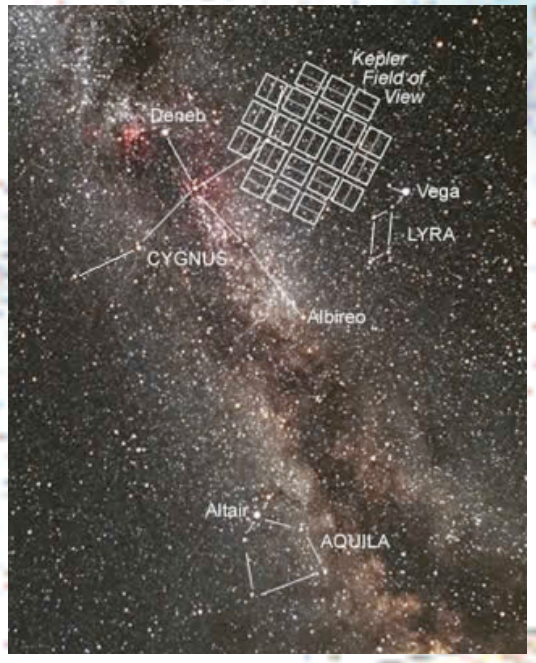
Determinations for CoRoT-7b (red transit only, green RV)

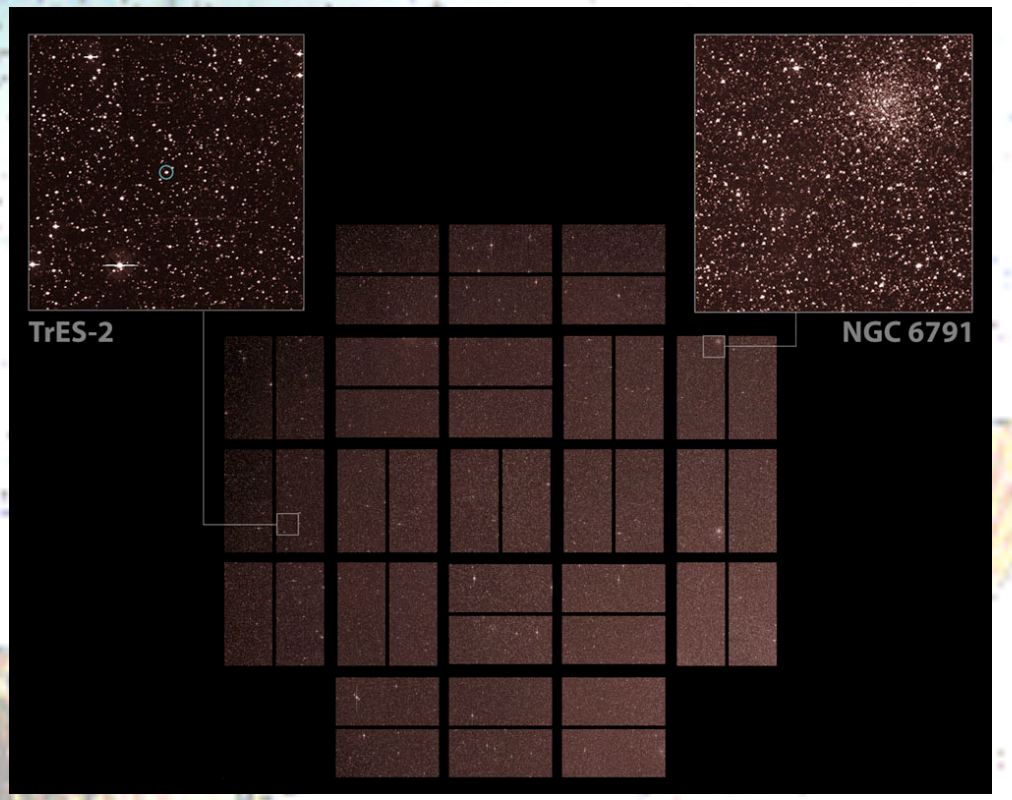
*Pas d' Hydrogene*
*(evaporé en quelques millions d'années)*
*Pas des métaux purs:*
*mélange d'eau de silicates et de métaux?*

# The major characteristics of the missions

| Mission | | CoRoT | Kepler | PLATO(n) |
|---|---|---|---|---|
| Period of operation | | 2007-2012 | 2009-2014+ | 2017-…. |
| Duration: 1 obs | | 150 d | 5 y | 3y x2 |
| Sampling | | 32s | 15 to 1min | 1 min |
| Continuity | | 97% | ? | 95% |
| Diameter (cm) | | 27 | 90 | 76 |
| Targets | Nb | 150 000 | 100 000 | 200 000 (500000) |
| | Mag | 10-16 | 9-14 | 6-15 |
| | distance | 500-1000 | 400-800 | 200-500 |

# Kepler FU ?




Analogous situation as CoRoT
Brighter stars….same number..
1 Region of the sky 105 square °

# PLATO(n) preparation

**≤ 2017**

## Selection of small radii targets with GAIA data

L: 30 to 40 %  Teff 10% (500 K)  Radii 15-20% sufficient

needed 1,5 y before launch (2y after the partial release of GAIA data)

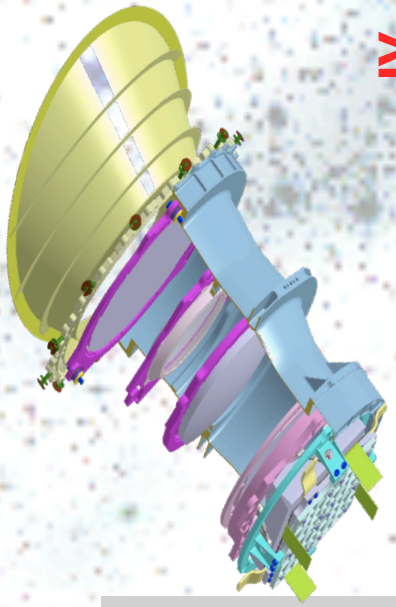
## Characterisation of the stellar surrounding of the targets

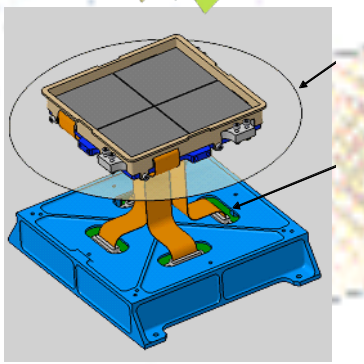
position, magnitude, colour,  m<19 r< 1 arcmin

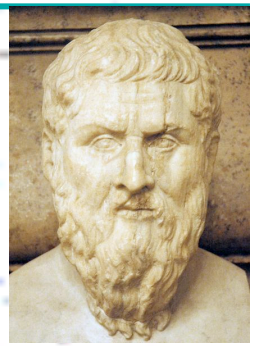
needed 1,5 y before launch

The fields of PLATO(n): 42°x42°  (□=11h □=-63)  (□= 19h30 □= +40)

# PLATO(n) Scientific Exploitation







**≥ 2019**

- Seismology
  - L/L: 1%
- Planet Radii : 2 to 3 %
  - * Cool dwarfs 11 < m < 13
    d< 200pc
  - d/d 1 % ? GAIA
  - T~50K high resolution spectrocopy
- Planet mass Mp/M*
  - High precision spectro VR EXPRESSO ?


SHHHT.
J'AI BIEN LE SENTIMENT QUE QUELQUES TRANSITS NOUS ÉCHAPPENT!
SCRATCH! SCRATCH!
Tome 2008