Introduction to the 3rd WP12 meeting

SOC

MJ Goupil , K. Belkacem, R-M Ouazzani, A. Serenelli, T. Morel, N. Lanza, M. Cunha, J. Christensen-Dalsgaard, J. Ballot, B. Mosser,W. Chaplin

plato

Barcelona, Nov 19th-22th 2019

Main data products

From WP12 point of view, PLATO observations will provide photometric light curves by sectors of 3 months (L1)

Produced by the **stellar pipeline**

Product	*Designation*	*Level*
Calibrated lightcurves and centroid curves	DP1	L1
Planet candidate transits and parameters	DP2	L2
Asteroseismic mode parameters	**DP3**	**L2**
Stellar rotation and activity	**DP4**	**L2**
Stellar masses and ages	**DP5**	**L2**
Confirmed planet systems and their characteristics	DP6	L2

Organization :

- **PSM/WP12** must specify the **stellar pipeline (SAS)**, the methods and algorithms, the validation tests and benchmark stars
- PDC/WP37 must implement and run the SAS pipeline and carry out the tests, provide the outputs
- **PSM/WP12** in charge of evaluation of PLATO stellar performances, **validation of the tests and of the outputs** of the SAS pipeline after implementation by the PDC

Samples of target stars

With 24 telescopes and the current baseline observing strategy, the set of target stars in the core programme is divided into four samples:

- the P1 sample : about **15000 (~ 20000)** bright dwarfs and subgiants (V ≤ 11) ; spectral type F5-K7, a noise level ≤ 34 ppm/h, long observing run (LOP) ; 25s cadence. This sample will include the PLATO 'Rosetta stones';

- the P2 sample : more than **1 000** dwarfs and sub- giants (V ≤ 8.2) (300 stars with 2 colours) ; spectral type F5-K7, a noise level of ≤ 34 ppm/h, LOP; a 2.5s cadence.

- the P4 sample : more than **5000** M dwarfs V ≤ 16, sampling time 25s, noise level 800 ppm/h.

- the P5 sample : **≥ 245,000** dwarfs and subgiants (V ≤ 13) ; spectral type F5-K7 ; lower SNR than P1 ; 25s cadence. This sample is subdivided in two sub-samples:
  - P5-bright (V ≤ 11) stars for which mass measurements from ground will be possible;
  - P5-faint (11 < V ≤ 13) stars with a lower SNR

(see session 1)

Requirements

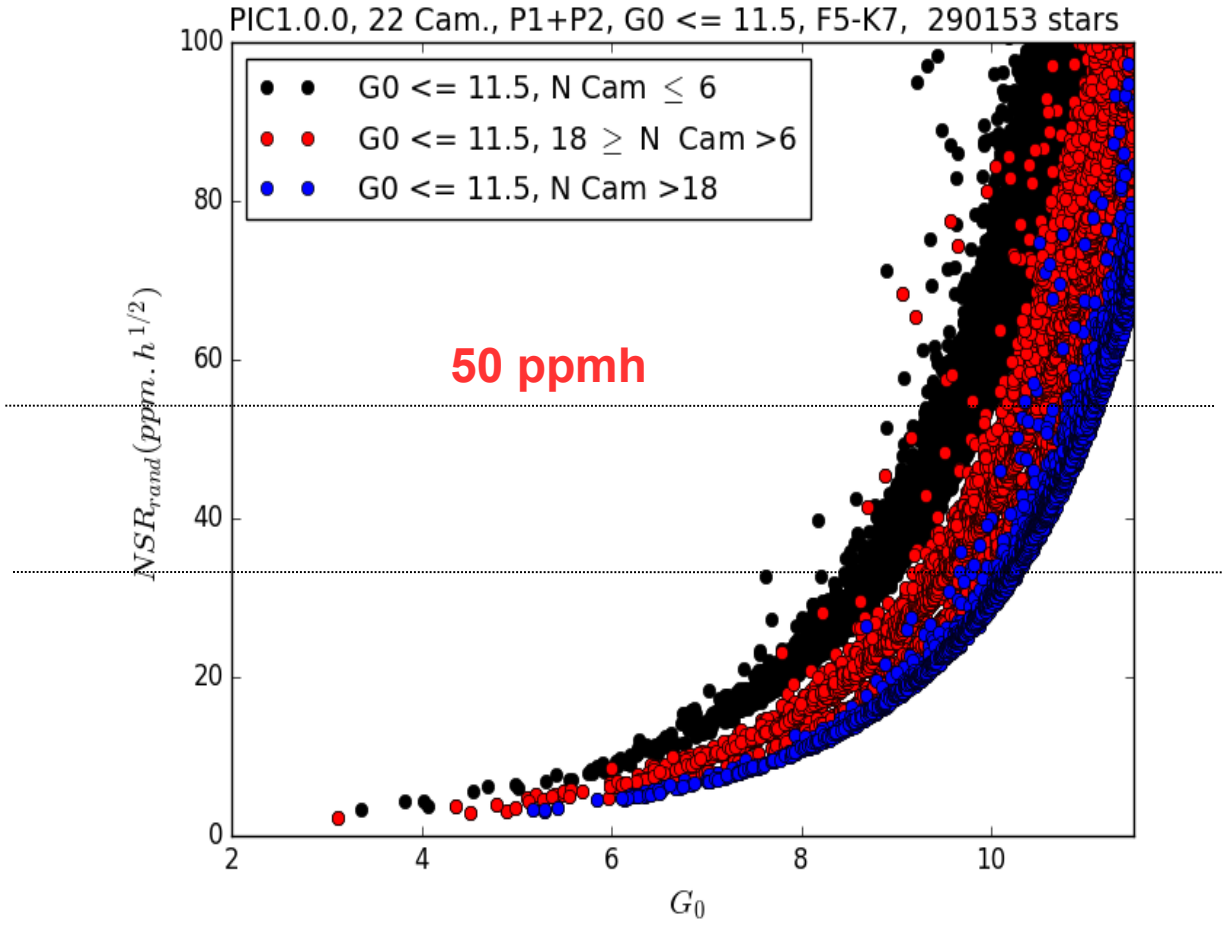
- **From SciRD** (PTO-EST-SCI-RS-0150, issue 7, July 7h 2019)

  For a G0V star
  - 2 % uncertainty on the stellar radius
  - 15 % on mass
  - 10% on age
  - 0.3-0.5 mHz for frequencies around numax
  - **NSR_rand <= 50 ppmh* at V=10 (goal 11)**

- NSR depends on the number of cameras and instrumental noise and magnitude of the star

*ppmh = ppm. h^1/2

PIC1.0.0 (WP13) + NSR estimate by DLR

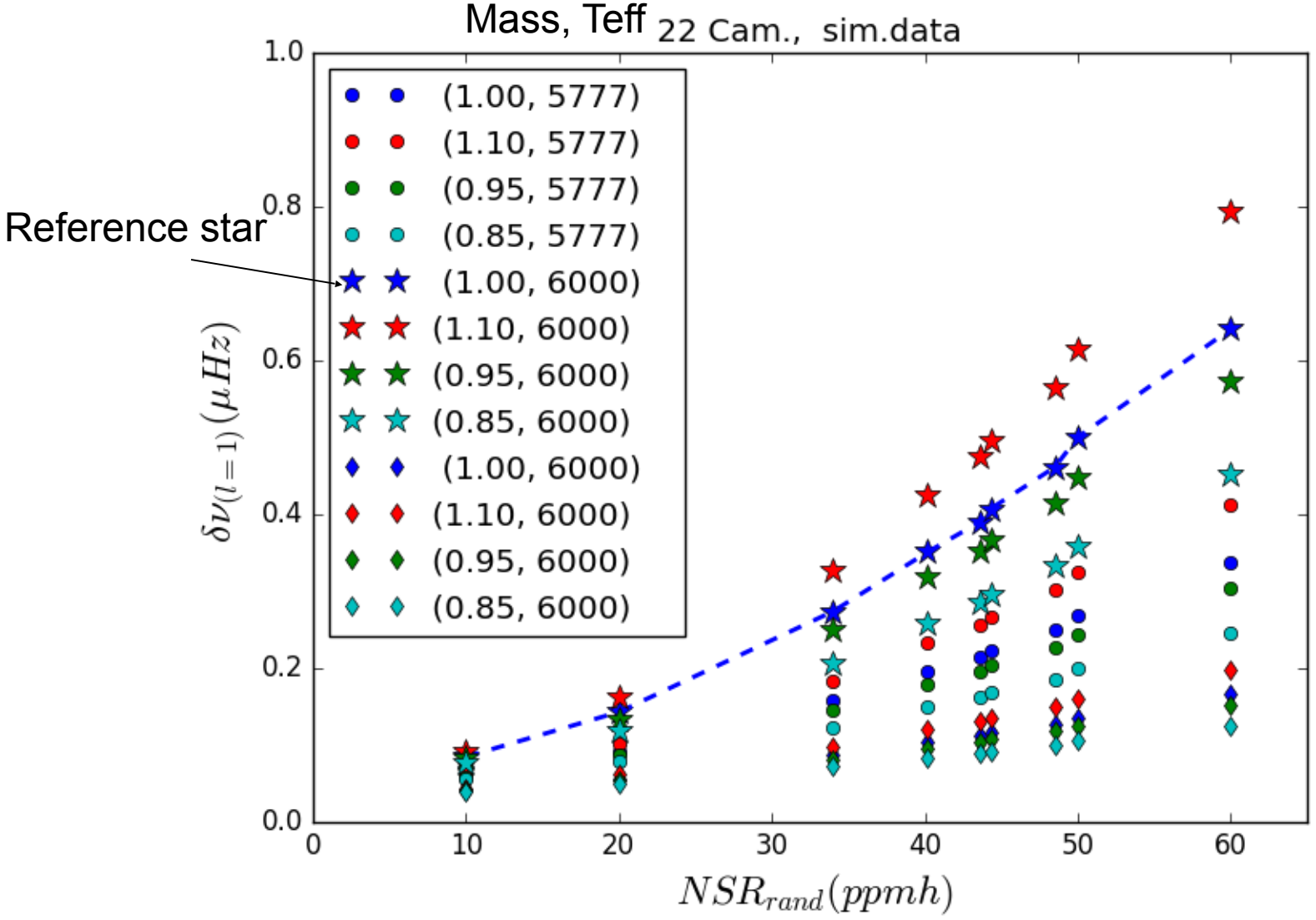


Deredenned Gaia magnitude

(PLATO-UPD-SCI-TN-015, issue1, Rev6, march 2019)

NSR to frequency uncertainty dn_1

Given NSR_rand+sys, NSR_tot depends on the star (log g, Teff, Y,Z/X)



- **NSR_rand+sys** from PLATO-DLR-PL-RP-0001, Issue 4, 21.09.2018

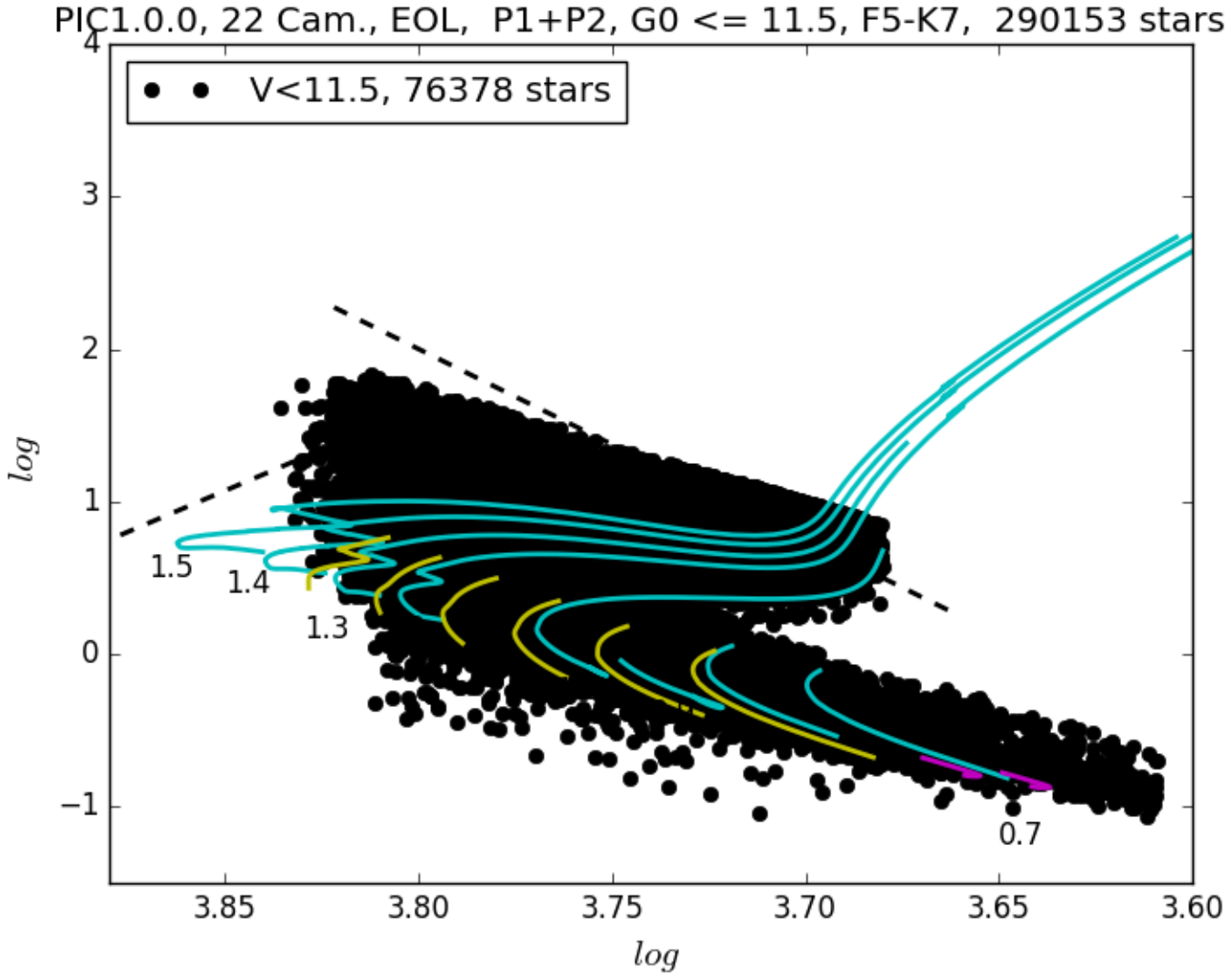
- **NSR_tot =** NSR_rand+sys+stellar noise

- Frequency uncertainty **dn_1** computed from Amp/noise using NSR_tot with Libbrecht's formulation for Tobs = 2 years

The PLATO expected seismic sample in the HR diagram

Nb of stars

initial PIC catalogue	290153
stars with V<11.5	76378



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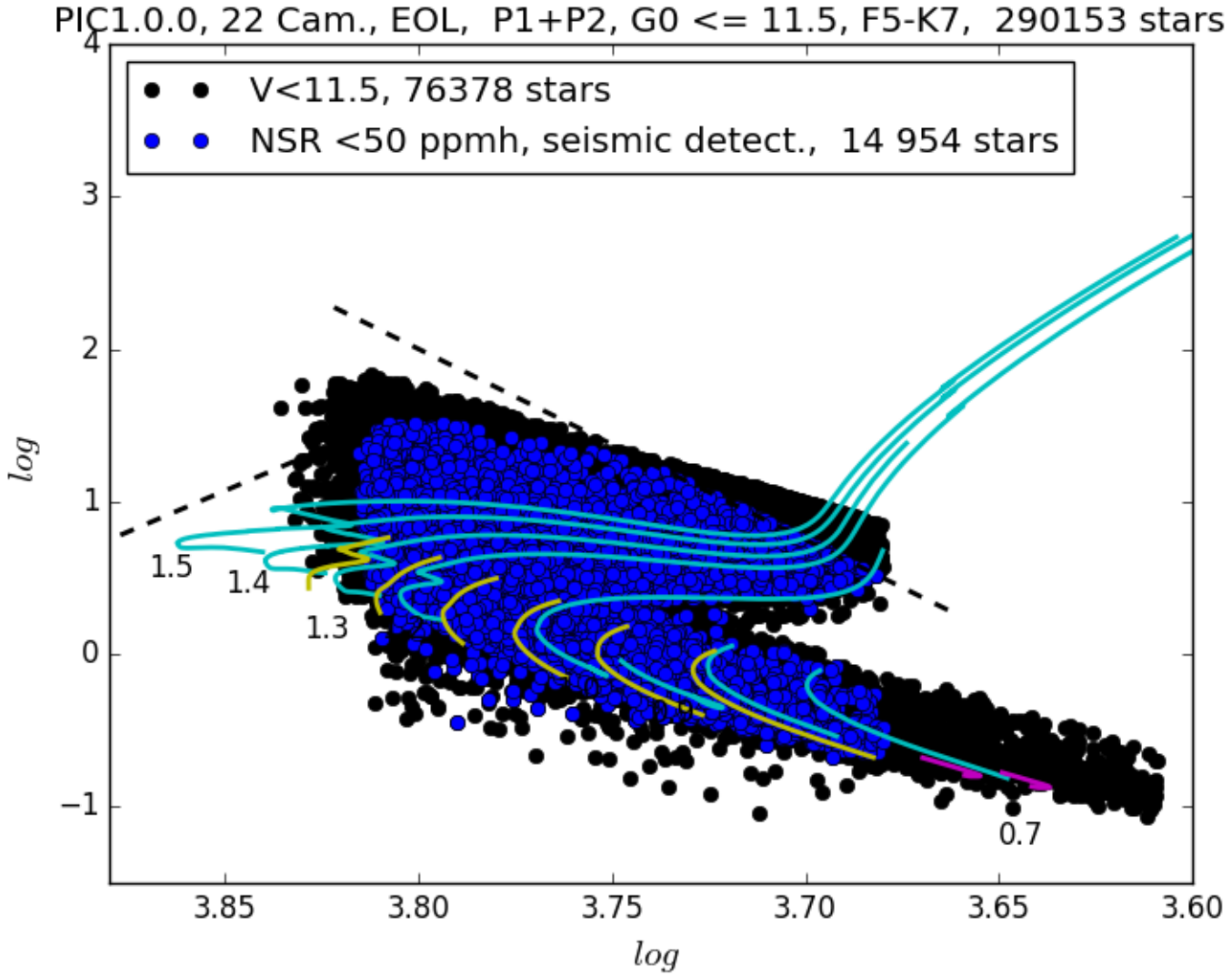
stars with NSR< 50 ppmh	14954



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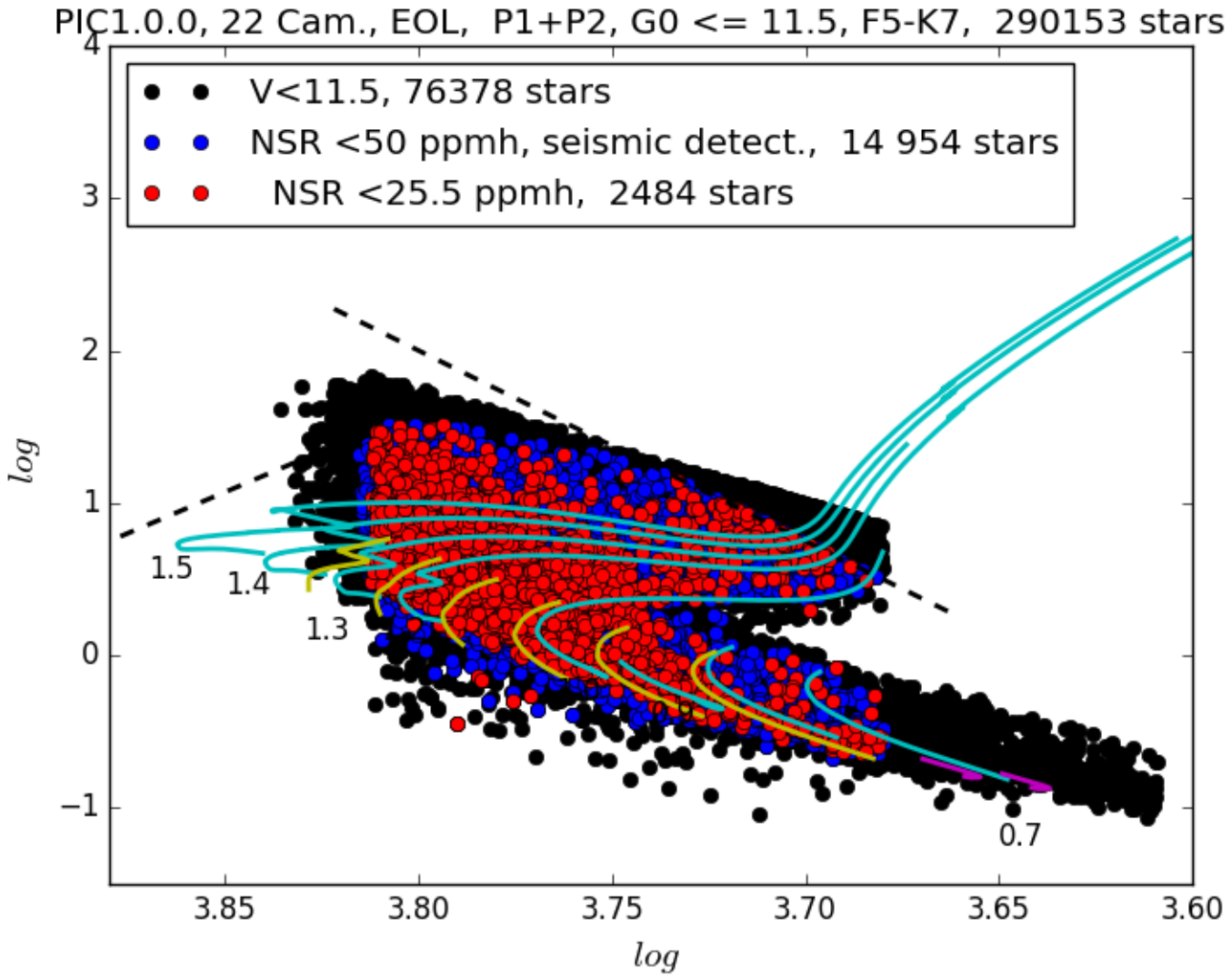
Criteria for 10% dage/age

NSR <34 ppmh	5684
NSR <25.5 ppmh	2484
NSR <50 ppmh, dn_2 < 0.1 mHz	1890



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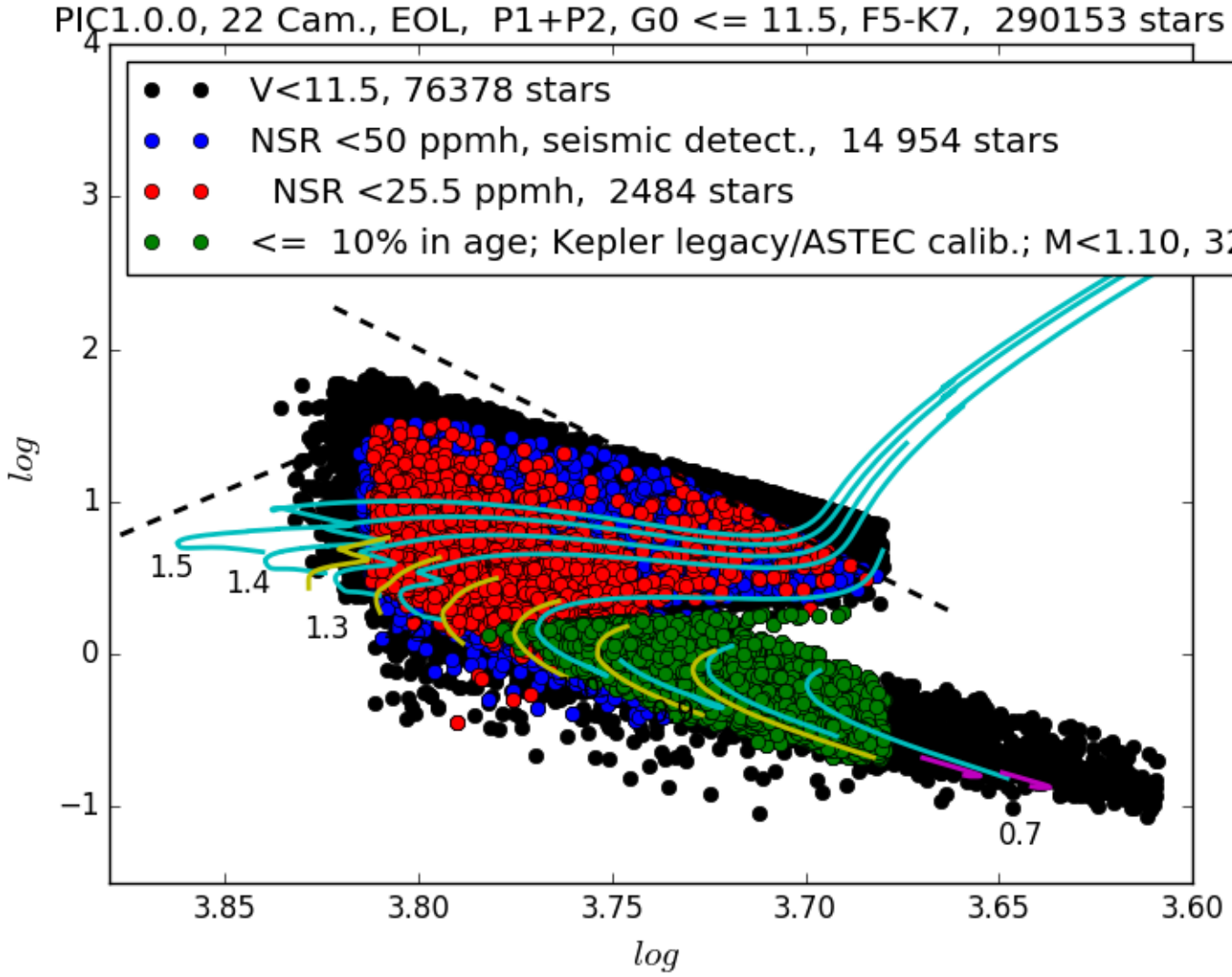
NSR <50 ppmh, calibration Kepler legacy stars/ASTEC M<=1.10; dage<=10%	3204



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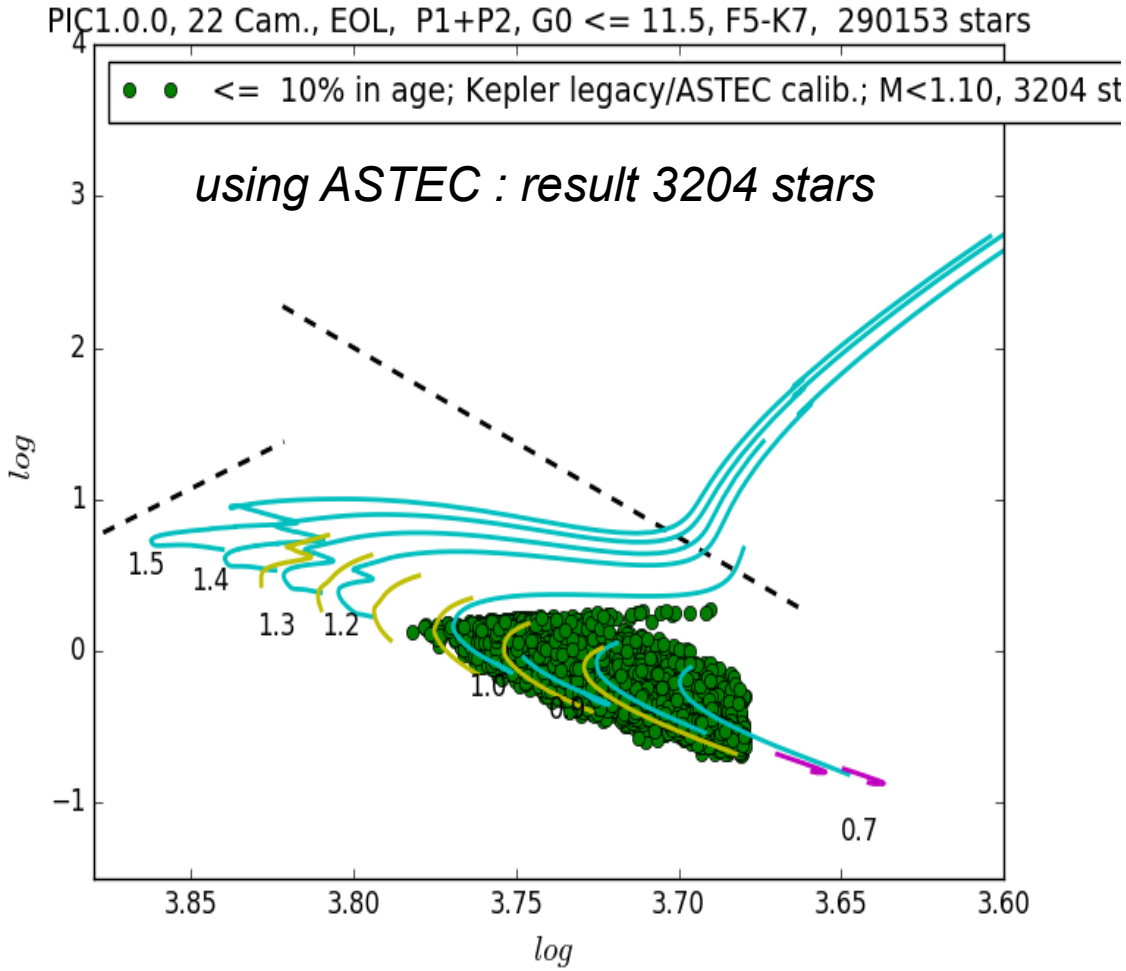
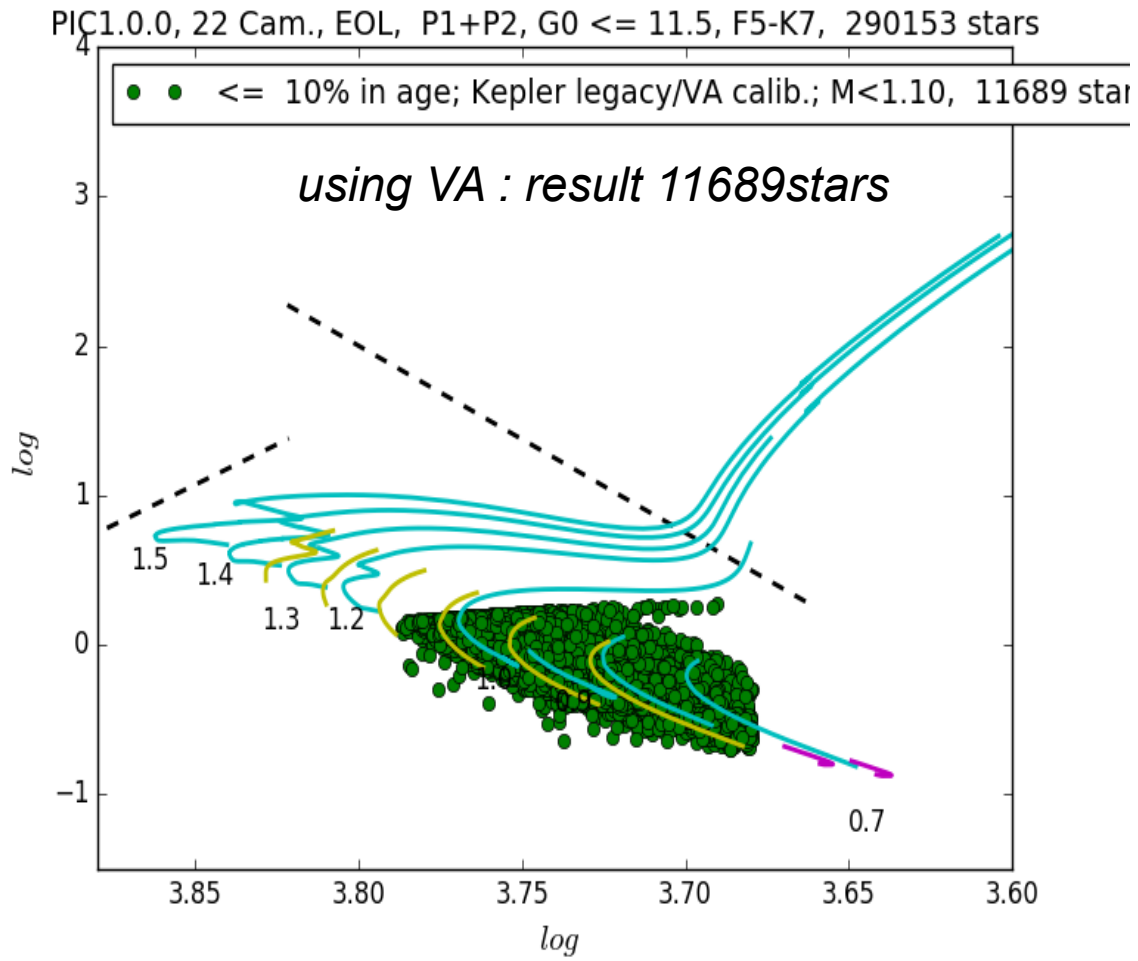
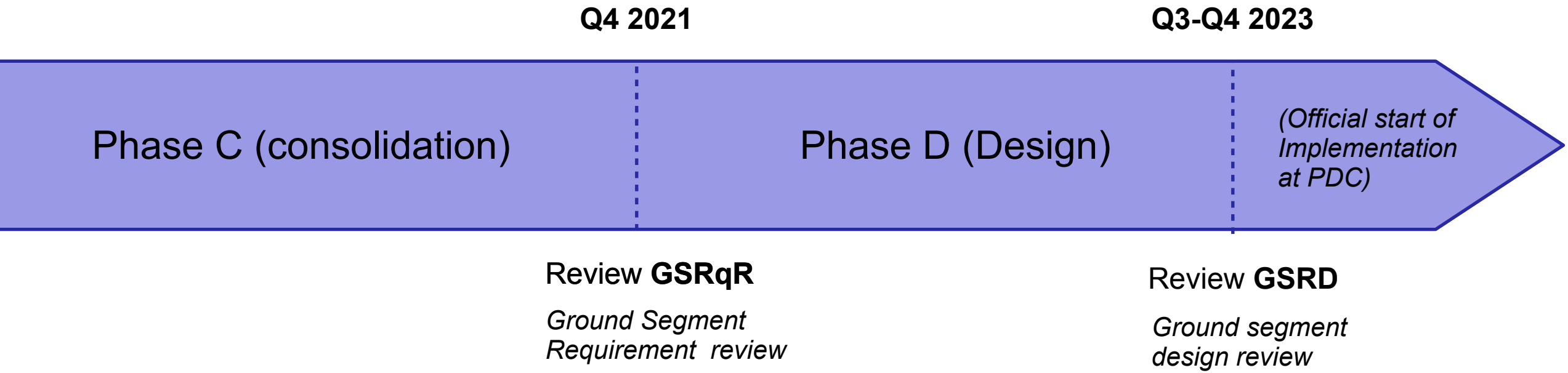




Calibration using legacy stars with mass <1.10 Msun and dage/age <10% based on results from Silva Aguirre et al (2017)

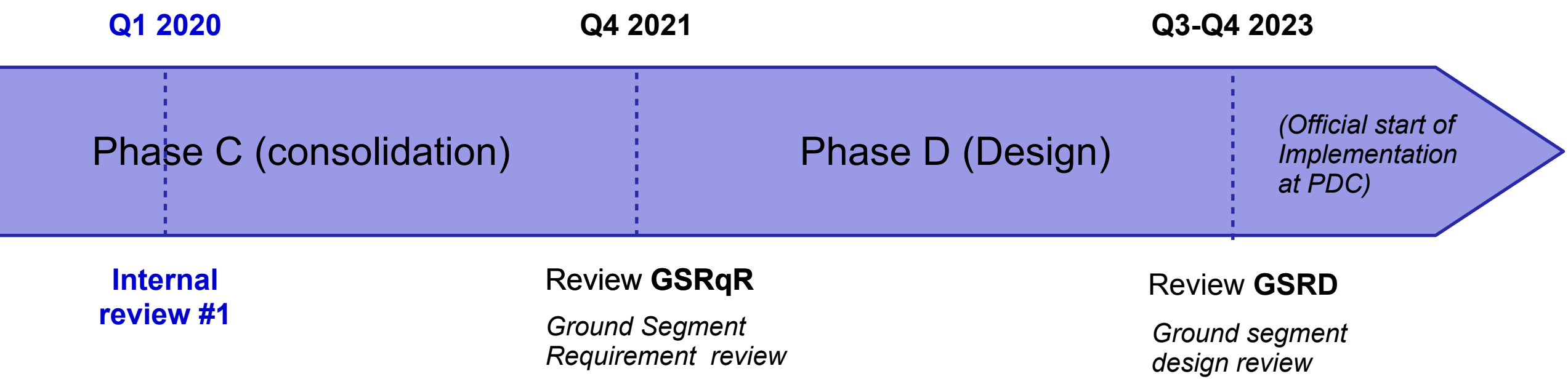
Deadlines/schedule



GSRqR

- L2/L3 URDs : Top level description of requirements for the EAS/SAS pipelines
- Validation tests
- Input/output Data
- Work package description
- Science Implementation Plan (SIP)
- Interface description

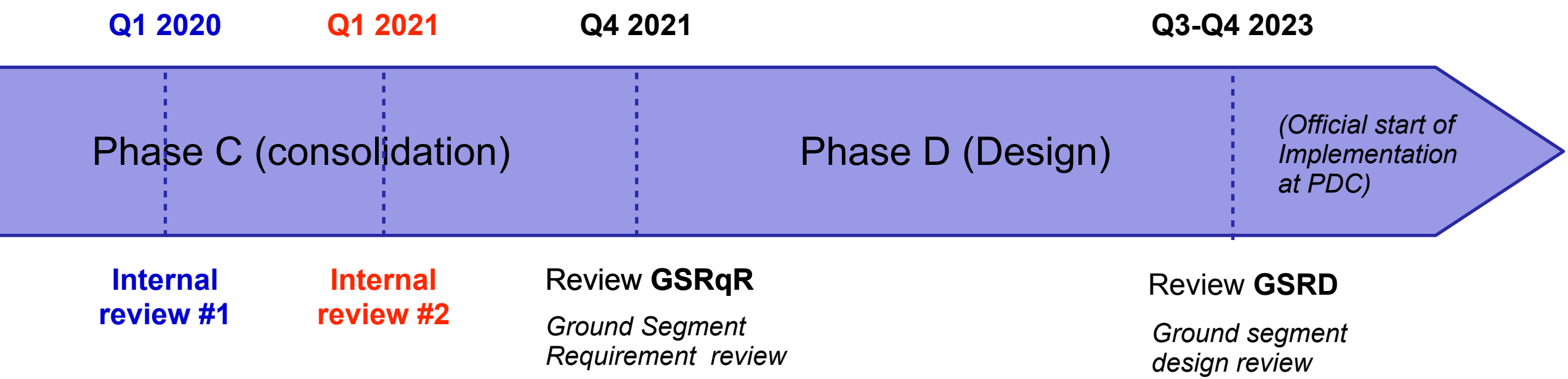
Deadlines/schedule



Internal reviews :

- L2/L3 URDs : Top level description of requirements for the EAS/SAS pipelines
- Work package description
- Science Implementation Plan (SIP)

Deadlines/schedule



Internal reviews :

- L2/L3 URDs : Top level description of requirements for the EAS/SAS pipelines
- Work package description
- Science Implementation Plan (SIP)
- Design of the pipeline + Input/output data
- Data products description
- Validation tests
- Interface description

WP12 : where are we ?

General request from David (at PW8, April 2019)

Start thinking about how to achieve your WP objectives:
o What algorithms and tools exist?
o What are the inputs and outputs?
o Which other WPs does this interact with?

WP12 pipeline and tools: current status

All procedures are known, the algorithms exist, the global architecture of the pipeline is defined

Architecture definition tasks	Status
Pipeline architecture - Level 0: 5 Main Modules defined (described in the URDs)	Done
Input/output for each module (WP120 data-product document)	To be consolidated
Pipeline architecture - Level 1: detailed architecture (data-flow + sub-module description)	In progress
Validation tests	To be defined
Interfaces (with EAS, etc…)	To be defined

Tools	Status
Grid of stellar models associated numerical frequencies	In progress
Grid of initial stellar parameters (Teff, Z/X, M,R,A) → another pipeline	In progress
Benchmark stars	In progress
Simulations for validation tests	To be defined

Iterations between modules to be consolidated

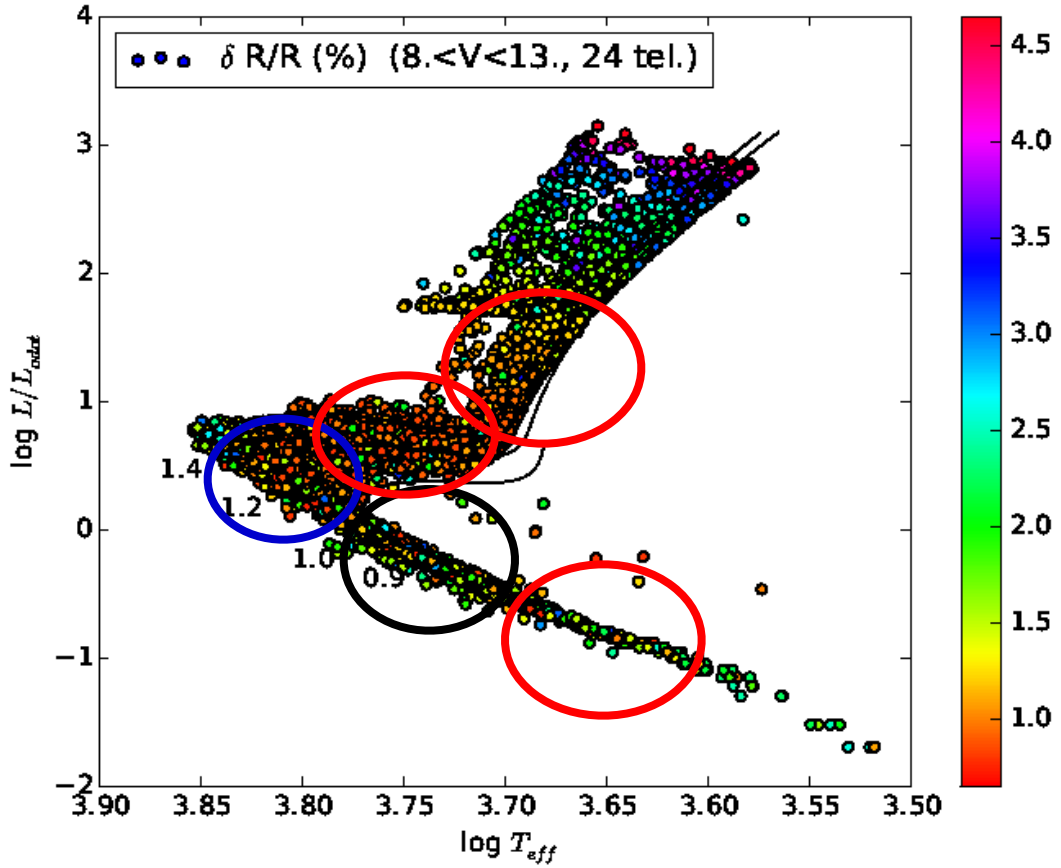
WP12 pipeline and tools: current status

Pipeline must take into account v**arious cases to consider**

Various cases :

- various types of stars
- various NSR

- 'Bloody' F
- Solar like
- Late K to M
- Subgiants
- Calibration stars

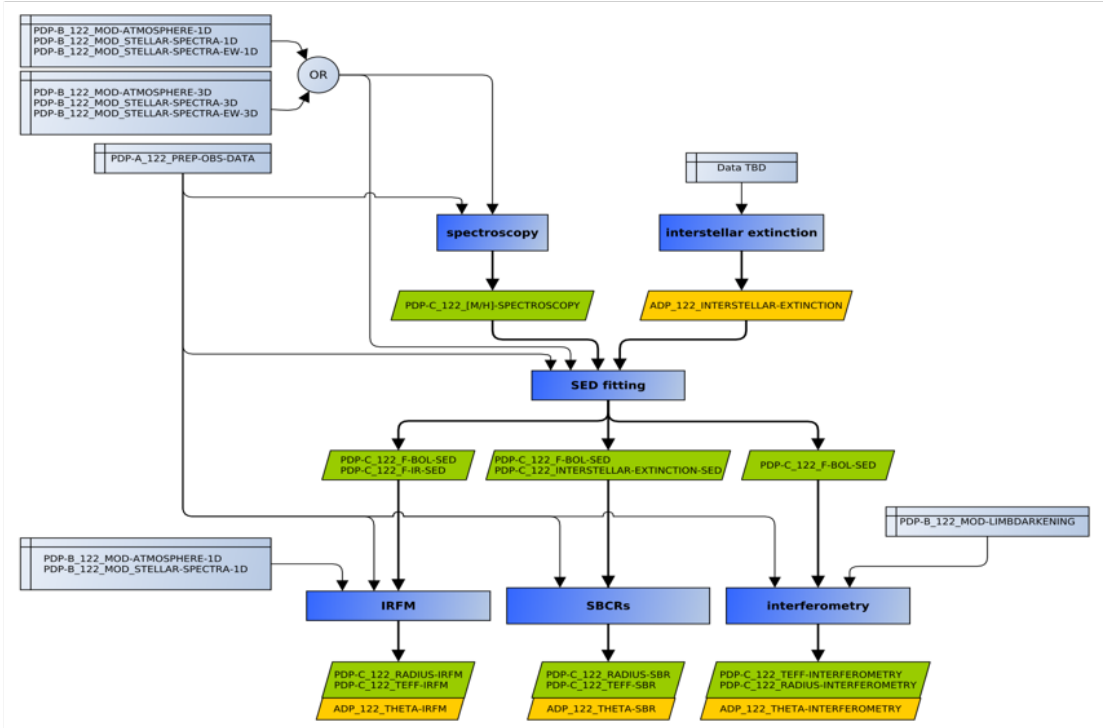


- low NSR (faint stars or/and only a few cameras)
- High NSR (bright stars or/and many cameras)

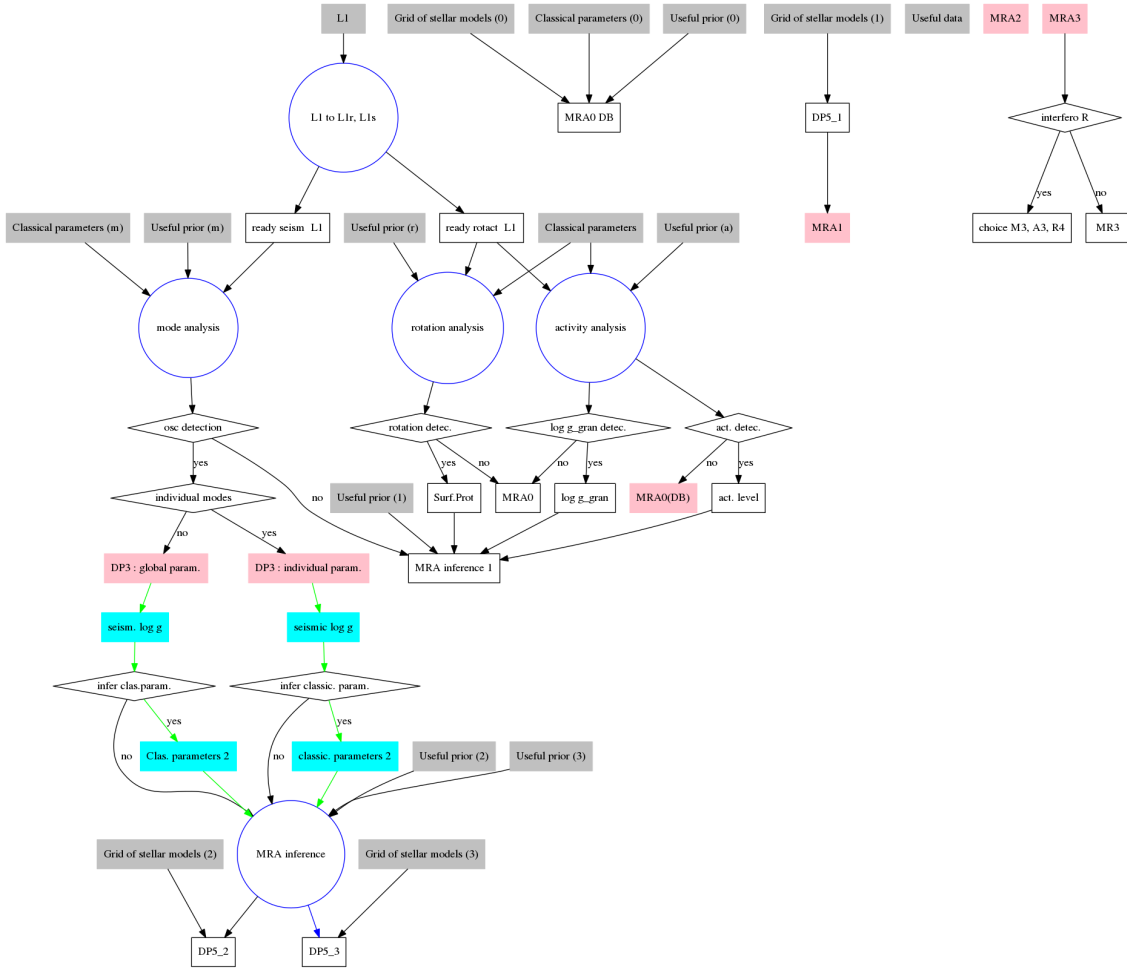
WP12 preparatory developments: current status

Before launch

- To build a grid of stellar models
  (specification in progress)
- To compute the associated frequency sets
  (specification in progress)
- To determine precise/accurate classical stellar parameters



During operation



Note : fields will be defined 2 years before launch

Goal of the meeting

- to discuss results of several HH exercises and other works and draw conclusions and make decisions
- to consolidate decisions which have been taken by mail or over coffee → TN
- to discuss and solve some pending issues or to define action in order to solve them

Exemples of issues:

- interaction between the procedures providing DP3 and DP4 (inclination angle, surface rotation period/seismic one, DP5 as input for DP4?)

- specification of the grid of stellar models (uniform density ? number of free parameters , space allocation ? timescale for building/updating the grid ….)
  * Version 1 for the prototype
  * Version 2 to deliver to PDC in 2023

- pending issue of the log g_seis
  Two issues : - does the log g_seism provide a real improvment for the Teff and Z determination ?
  - Is the Teff, Z improvments significant enough to improve the DP5 output ?
  Likely this depends on the target case (low SNR) ?

- what do we do about surface effects ?

- do we choose one or several methods/algorithms to measure the rotation period, to infer DP5
- automatization of mass, radius and age inferences for subgiants ?
- definition of the uncertainties
- format of input/output data and their uncertainties (pdf, quartiles, correlations …. ?)
- **decision about validation tests (which simulated cases, real cases to test what)**
- **to establish the decision criteria and procedure in case of multiple choices**

Issue to establich the decision criteria and procedure in case of multiple choices

Multiple-choice for DP5: criteria for choosing ?

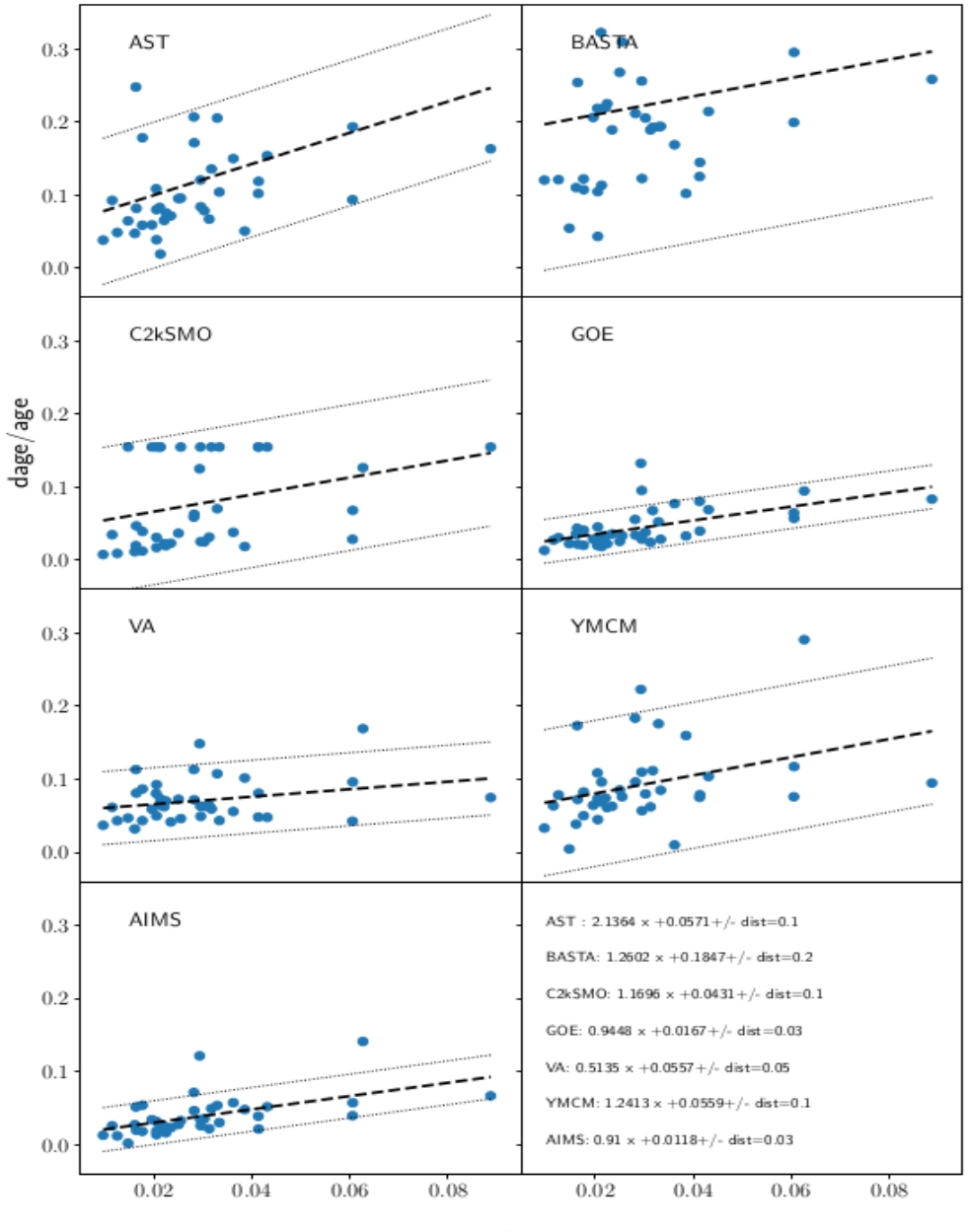
Kepler legacy : uncertainties on the age
(Silva Aguirre + 2017)

Different pipelines :
- various optimisation methods,
- various stellar codes and grids
- various way of
assessing the age uncertainties

Lead to various results !!!

Urgent to define decision criteria

Credit M. Deal



Lundt+2017, Christophe2018 ← Relative uncertainties of the seismic observable r02

- No proceeding
- The SOC will write a synthetized report about the outcome of the meeting
- Send comments, minutes, notes taken during the meeting (if relevant ;-) !!)

to PLATO **plato.wp120-office@obspm.fr**

END

Criteria for the requirements

- Based on CoRoT and Kepler, NSR <= 34 ppmh give 10% on age (?)
- <=34ppmh equivalent to 0.1-0.2 mHz at $\mathbf{n}_{\mathbf{max}}$ (?) give 10% on age (?)
- **dn** at $\mathbf{n}_{\mathbf{max}}$ gives $\mathbf{d}r_{02}$ and with r_{02}(age) give **d**age