l'Observatoire de Paris | LESIA
Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique

plato

Wrap-up and actions

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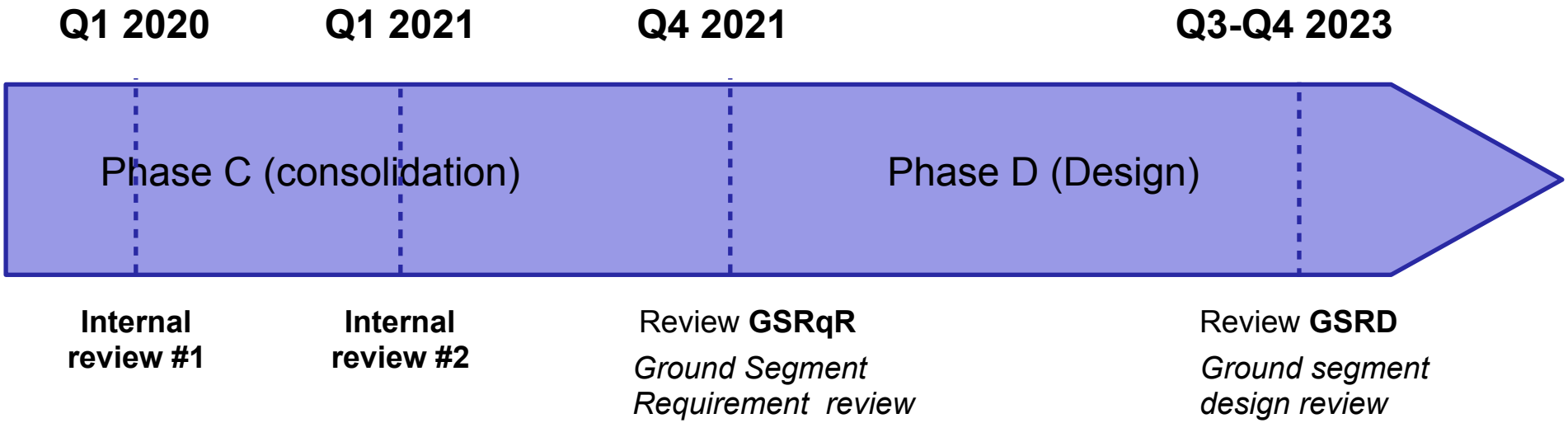
Schedule and deadlines



A first version of the pipeline must be implemented for 2023 (talk by L. Gizon)

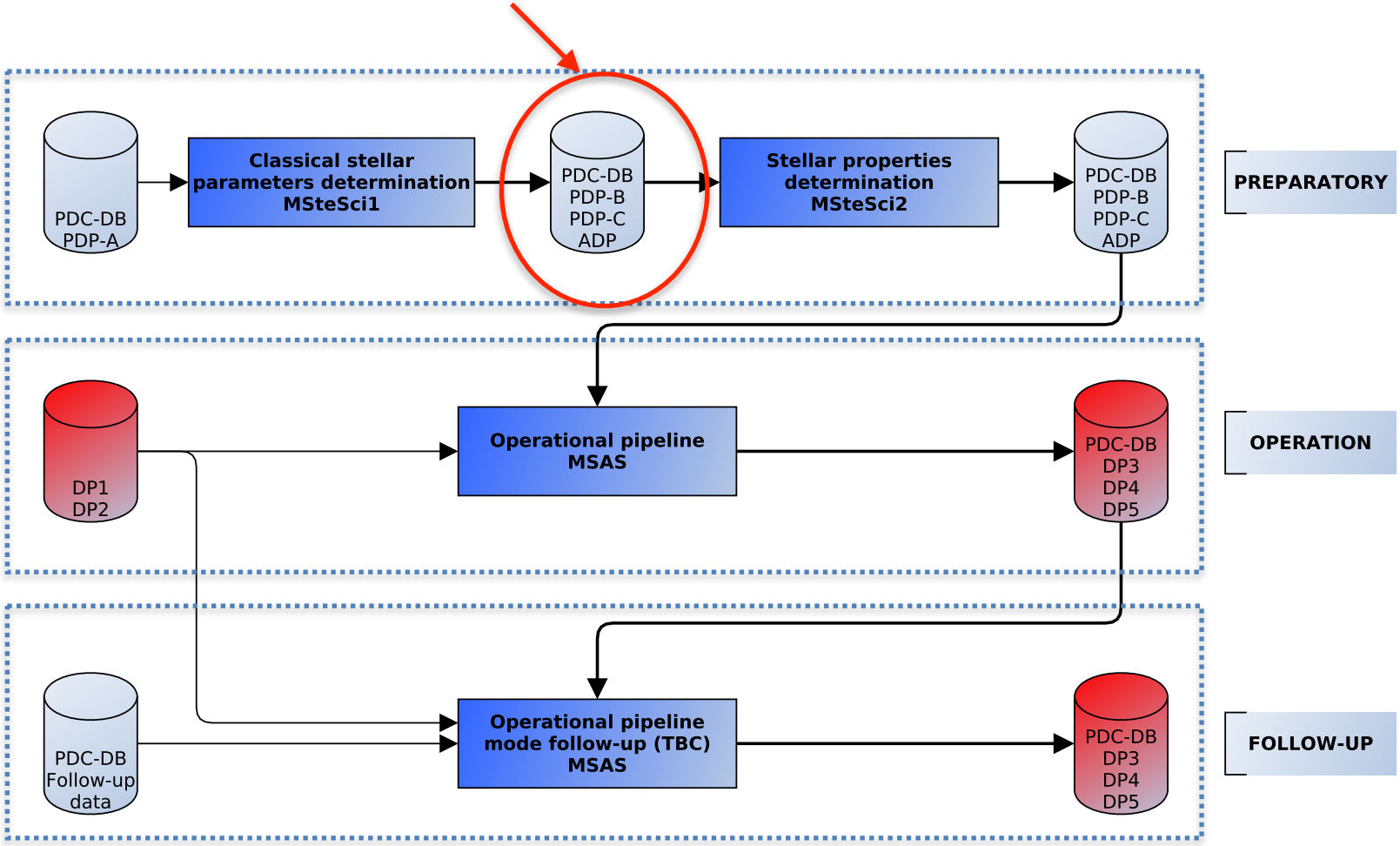
- Architecture of the pipeline (data-flow, inputs/outputs), data products must be fixed very soon (Level-0 end 2019, Level-1 beginning 2020)
- 2020 beginning of algorithms selection and specification

→ For this first version of the pipeline: we need to be pragmatic

Further improvements and update of the pipeline will be possible after 2023

Level 0 data-flow

Grid(s) of stellar models and oscillation frequencies must be computed and delivered upstream



Preparatory phase

Grid of stellar models and frequencies

- A first grid of stellar models and frequencies is now available (v1.0)
- « Not intended for 'professional' PLATO use » because further improvements are expected: physics, dimension of the grids, mixed modes, etc…
- For the physics of the models, still some issues to address, e.g. interfaces between radiative and convective regions

	Range	Step
Mass	[0.6, 2.0] $M_\odot$	0.01 $M_\odot$
[Fe/H]	[-1.0, +0.60] ext. down to -2.5	0.05
Age	70 Gyr (priors later on) logg = 3.1	max step scales as 10Myr/M^3
N. steps & frequencies	2000-2500	ΔT_{eff} < 10-15K in SG
Structures	1/3 cadence	
Storage	190 Gb / 380 Gb 2.4 Tb / 4 Tb (w/structures)	

List of actions	***Resp.***
Define and document the requirements for the first grid to be delivered to the PDC	A. Serenelli
Use the v1.0 grids for dimensioning (storage, exact content of the grid, file format, etc…) the grid to be delivered to the PDC	A. Serenelli
From HH exercises, define the procedure for selecting the evolutionary and oscillation codes to produce the grids to be delivered to the PDC	A. Serenelli

Computation of classical and stellar parameters

- Pipeline v0 exists and first results with Gaia benchmark stars are encouraging

ID	reference			WP122300 pipeline		
	$T_{\rm eff}$	log(g)	[Fe/H]	$T_{\rm eff}$	log(g)	[Fe/H]
α Cen A	5792 ±16	4.31 ±0.01	0.26 ±0.08	5760^{+7}_{-11}	$4.30^{+0.01}_{-0.01}$	0.21
bet Hyi	5873 ±45	3.98 ±0.02	-0.04 ±0.06	5871^{+2}_{-15}	$4.01^{+0.01}_{-0.05}$	-0.05
bet Vir	6083 ±41	4.10 ±0.02	0.24 ±0.07	6132^{+6}_{-9}	$4.09^{+0.02}_{-0.01}$	0.23
eta Boo	6099 ±28	3.79 ±0.02	0.32 ±0.08	6139^{+10}_{-18}	$3.84^{+0.02}_{-0.01}$	0.31

- Further improvements soon (IRFM, SBCR, interferometry) and other test on benchmark stars
- Determination of masses, radii, and ages before the operations → still an issue

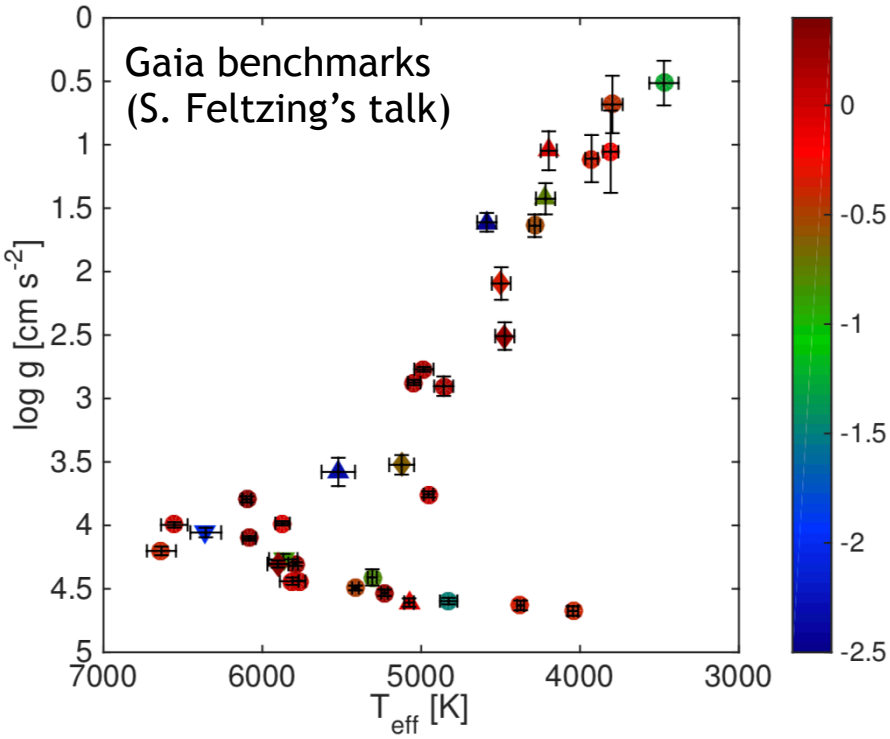
List of actions	***Resp.***
To define the needs for the inputs and define the interface with the PDC-DB: which input data do we need (spectroscopic data, etc…)	T. Morel
To define a development plan for the pipeline for classical parameters	M. Bergemann
To define the strategy for computing the stellar masses, radii, and ages prior to the operations	J. Christensen-Dalsgaard

Benchmarks

- A lot of benchmarks have been discussed: eclipsing binaries, interferometric stars, Gaia benchmarks, etc…

Still a lot of issues: what type of benchmarks do we need before launch (test of the pipeline), during observations (validation)?

It becomes urgent that each leader of the main WP properly define the needs!



List of actions	*Resp.*
To define what are the needs for WP12: which type of stars for which purpose?	O. Creevey

Operational phase

- Module 1: « *Preparation of analysis-ready light-curves* »

Lead: W.J. Chaplin & N. Lanza

- Module 2: « *Stellar oscillation modes detection and measurement* »

Lead: W.J. Chaplin

- Module3: « *Stellar rotation and activity measurement* »

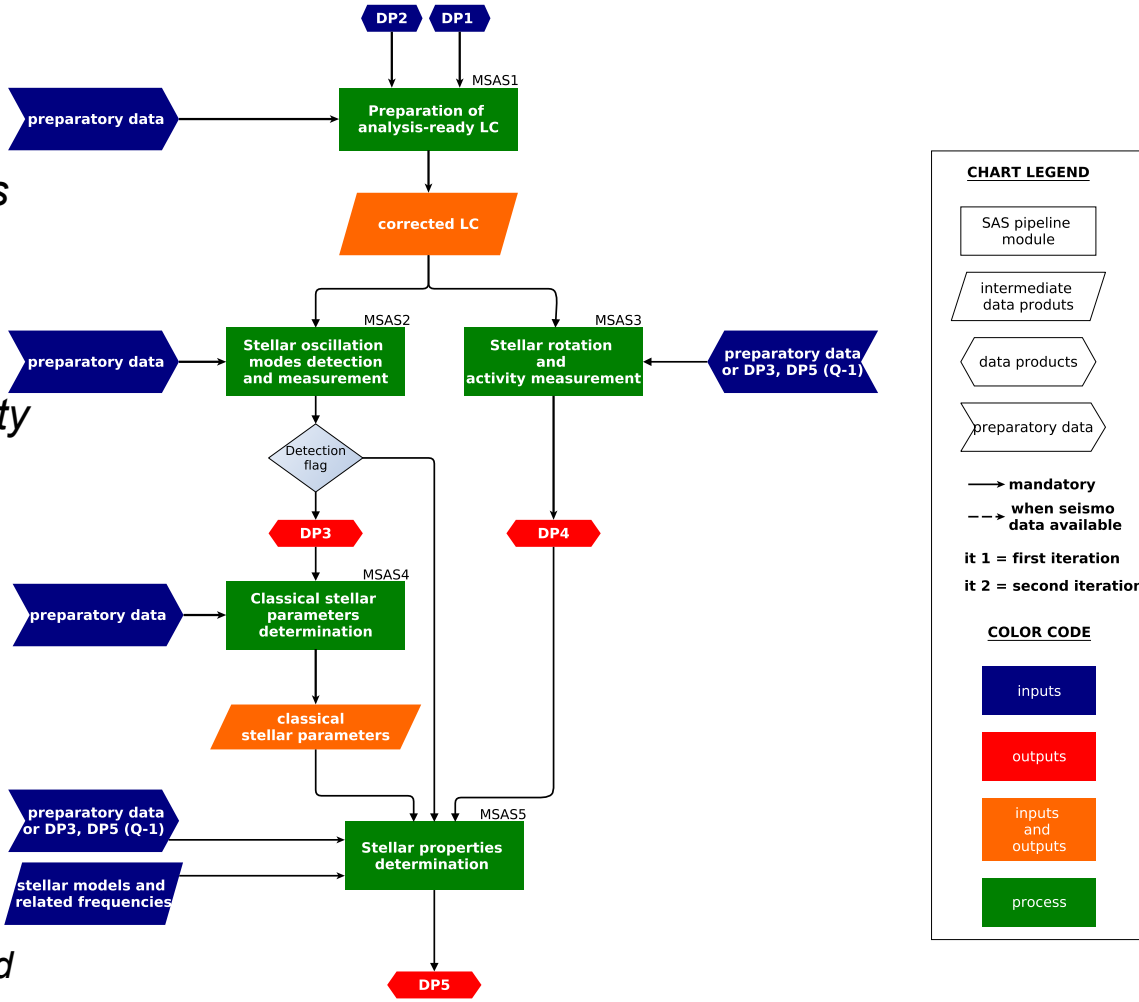
Lead: N. Lanza

- Module 4: « *Classical stellar parameters determination* »

Lead: T. Morel

- Module 5: *Stellar parameters determination*

Lead: M. Cunha & J. Christensen-Dalsgaard



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➡ The exact pipeline depends on the conclusions of the Lightcurve Stitching Working Group (LSWG)

Preparation of LCs for seismic inference:

- Transit removal and gap filling: small impact on frequencies
- Transit removal and gap filling: issue with the mode heights and widths (due to the background)

Preparation of LCs for rotation and activity:

- Keeping all the astrophysical variability in L1 from minutes to year months
- Need for a coordination with L0—>L1 on-ground correction

List of actions	***Resp***
Ensure with WP32 (R. Samadi) and WP 325 400 (R. West) that L0—>L1 algorithms do not affect astrophysical signal	N. Lanza

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➡ A prototype of the pipeline already exists (PBjam)

➡ Results of the exercices are satisfying and encouraging!

➡ Still, need for improvements and developments

- Effect of glitches for the priors
- Including rotation

Main issue = mixed modes

- Measuring mixed mode frequencies for sub-giants is not trivial and even less automatic (for now at least!)

Actions	Resp
Define a strategy for inferring mixed mode frequencies in evolved stars	W.J. Chaplin

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Within the F. Baudin's classification:
the main tasks are considered as NMW (No Much Worries) except spot modeling

But quite a lot of work to achieve :

→ e.g.: exercices for rotation period measurement to be extended to L1 LC and completed with other methods

→ Gyrochronology: type of stars? performances?

Issue: Spot modeling

→ There are many challenges to address

→ Need for a strategy for the first delivery of the pipeline

Actions	Resp
To define the type and number of stars to which spot modeling can be applied	N. Meunier

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This module will run during operation **if and only if** the seismic data (from the LC) improves the performances

Issue: do seismic data as inputs improve the performances on Teff and Z?

➡ help to break degeneracies in spectroscopy and greatly confine the photometric parameter space

➡ Teff and metallicities accurate to < 1%

List of actions	***Resp***
Quantification of the performances with and without seismic data as inputs	T. Morel & M. Bergemann
Determine which algorithms will need to be run during operations	M. Bergemann

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For seismic inferences:

- ➡ Even if new exercices are needed, the results are promising
- ➡ Issue: for subgiants still some efforts needed ! Back-up solution: use radial modes
- ➡ Issue: for surface effect correction the situation is still very unclear. What is the best strategy to adopt?

For non-seismic inferences:

- ➡ Issue: rotation/activity/abundances vs age: we need to go ahead (a specific meeting next year on this?)
- ➡ Issue: decision tree, combination of methods, validation for DP5: very good questions and proposals have been made but we will need first answers very soon

List of actions	***Resp***
To define the strategy for computing the ages from rotation/activity/abundances and to assess the performances	J. Christensen-Dalsgaard
Define a first proposal for the selection and validation of final DP5	J. Christensen-Dalsgaard

Conclusions

- ✓ Quite a lot of issues and problems to address but a leap forward has been done!

- ✓ We have now a rather well idea of the pipeline and algorithms to develop and we already have prototypes for most of them

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Conclusions

✓ Quite a lot of issues and problems to address but a leap forward has been done!

✓ We have now a rather well idea of the pipeline and algorithms to develop and we already have prototypes for most of them

✓ The forthcoming months and years will be demanding for all of us. Be ready !

✓ Next PLATO Stellar Science Workshop:

- When? → Beginning of 2021 (TBC)
- Where? → S. Deheuvels and J. Ballot agreed to organize it in Toulouse (TBC)