SELECTION AND VERIFICATION OF SEISMIC DATA
OR HOW TO COMPARE APPLES AND BANANAS

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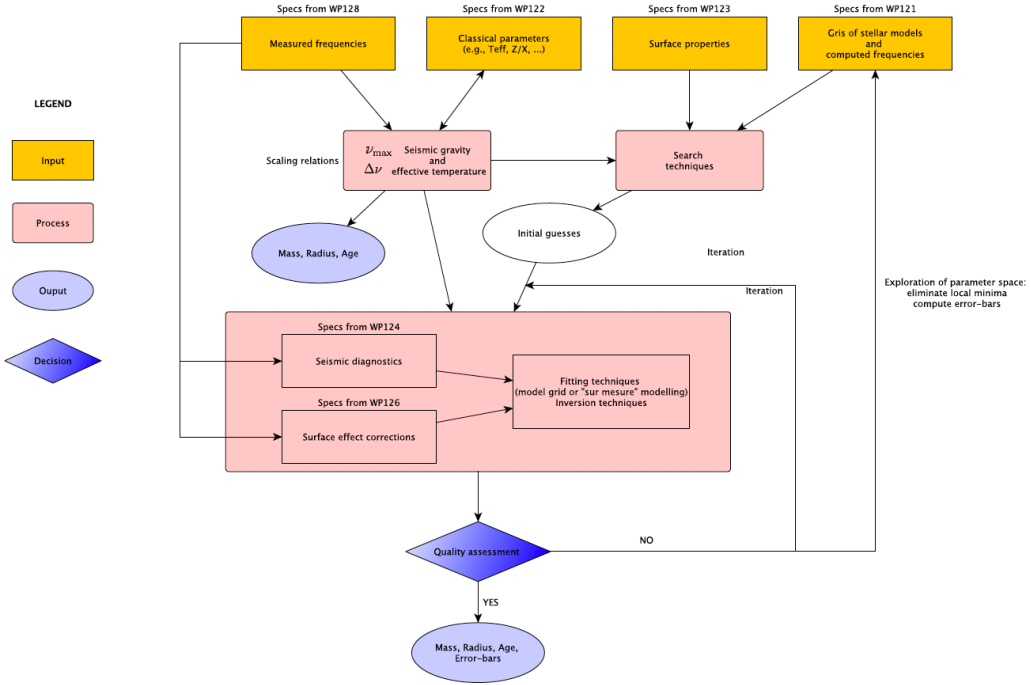
HOW DOES IT ALL WORK?



SO

We will receive R, M and ages with uncertainties (PDFs) from:

- WP 124 (Seismic diagnostics),
- WP 125 100 (Scaling Laws)
- WP 125 200 (Incorporation Classical Parameters)

From WP 122 we will also receive effective temperature, luminosity and composition, but these will first have to be consolidated by WP 125 200, as will R, M and ages. We will also receive input from WP 125 400 and WP 125 500.

Based on this we need

- To produce the final set of stellar properties (should we use parameters from individual frequencies, from scaling laws or classical parameters)
- Quality control (can the provided uncertainties be trusted)

Input

- R(seis), M(seis), Age(seis)
- R(scal), M(scal), Age(scal)
- R(clas), M(clas), Age(clas)
- T, L, [Fe/H]
- Benchmark stars

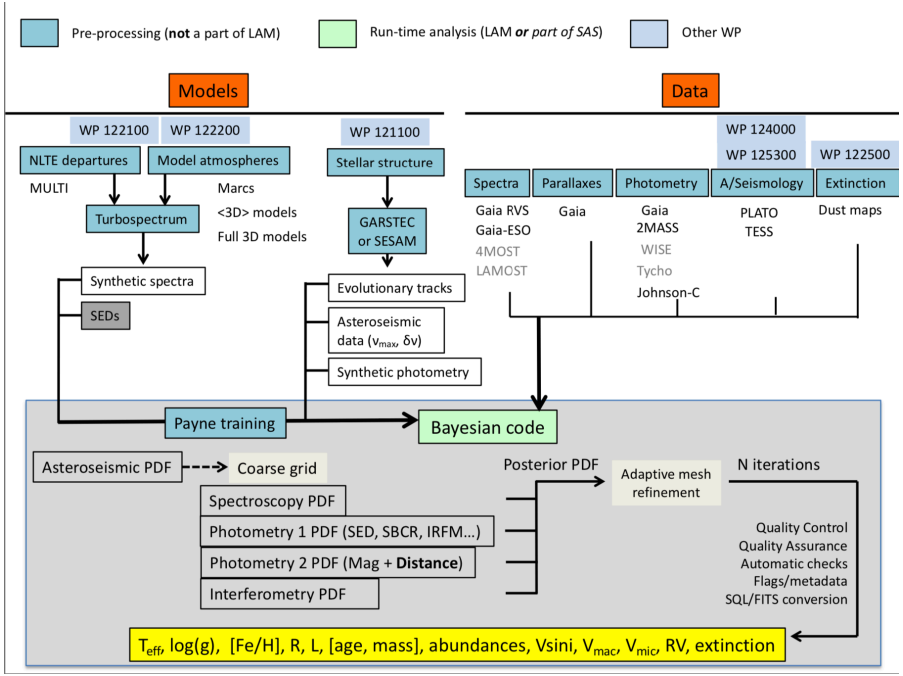
Output

- R(final)
- M(final)
- Age(final)
- T, L [Fe/H]

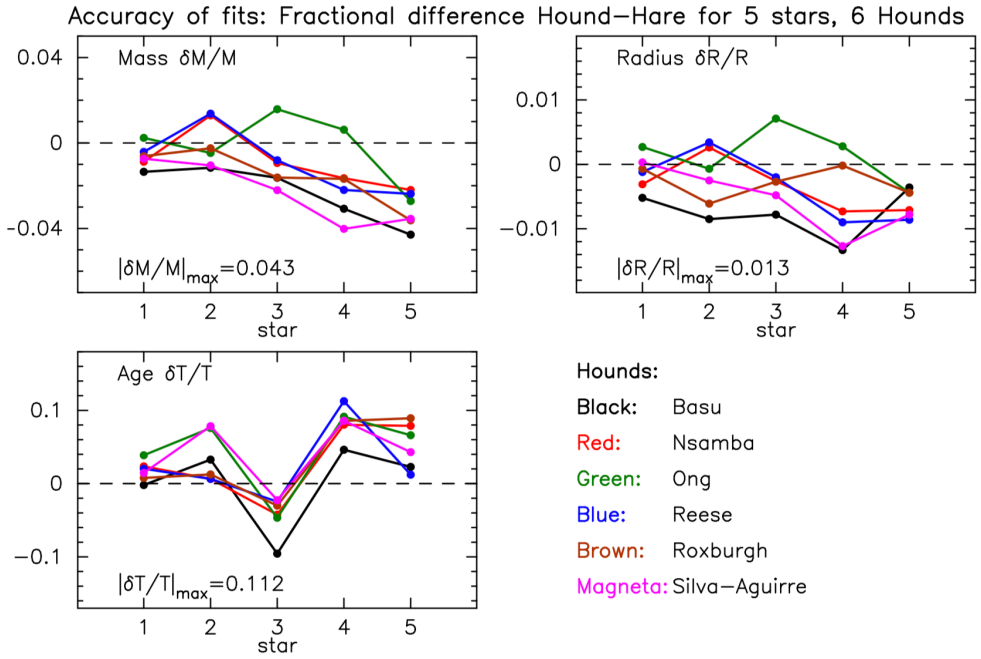
And a flag

How to do this? Should we be exclusive or inclusive?

SUMMARY OF SESSION 4

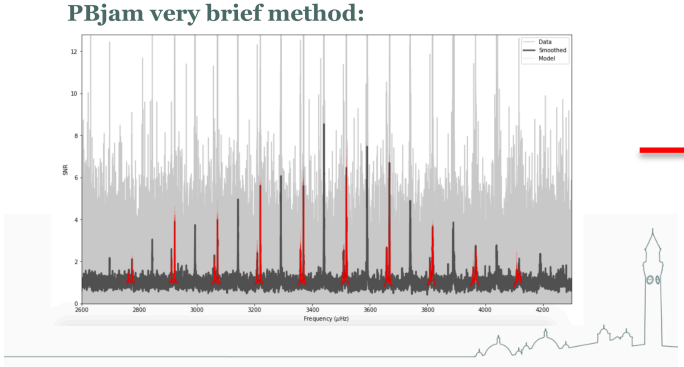


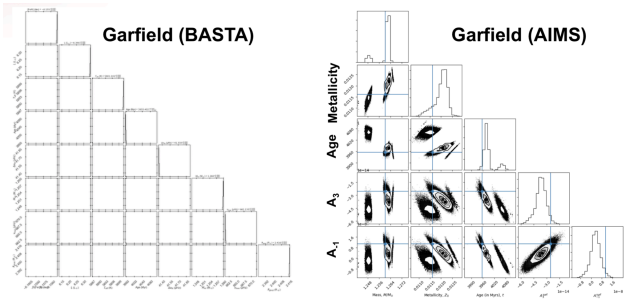
SUMMARY OF SESSION 5



DIFFERENCE BETWEEN SCALLING LAWS AND MODELLING OF INDIVIDUAL FREQUENCIES

$$\frac{Y}{Y_\odot} \simeq \left(\frac{\nu_{\max}}{\nu_{\max,\odot}}\right)^{\alpha} \left(\frac{\Delta\nu}{\Delta\nu_\odot}\right)^{\beta} \left(\frac{\delta\nu}{\delta\nu_\odot}\right)^{\gamma} \left(\frac{T_{\rm eff}}{T_{\rm eff,\odot}}\right)^{\delta} \exp\left([\mathrm{Fe/H}]\right)^{\epsilon}$$





Bellinger 2019, MNRAS, 486, 4212

THE EXCLUSIVE WAY (DECISION TREE)

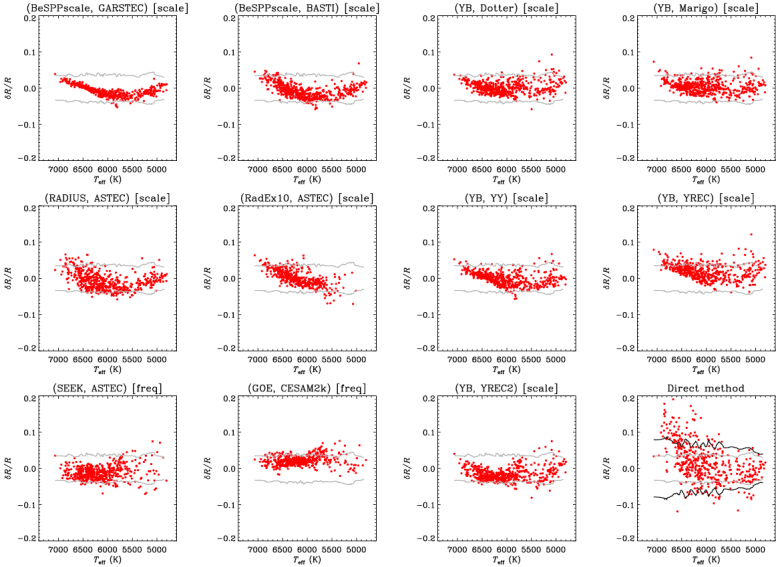


Figure 13. Fractional differences in estimated radii, R, for analyses performed on the entire ensemble, with $\Delta\nu$ and $\nu_{\rm max}$, the photometric (IRFM) $T_{\rm eff}$ and field [Fe/H] values used as inputs. The plots show differences with respect to the BeSPP pipeline run with the GARSTEC grid run using model-calculated eigenfrequencies to estimate the $\Delta\nu$ of each model in its grid. Gray lines mark the median 1σ envelope of the grid-pipeline returned, formal uncertainties. These lines are included to help judge the *typical* precision only. The bottom right-hand panel shows results from direct application of the scaling relations, the black lines showing the median 1σ envelope on the resulting uncertainties.

Chaplin et al. 2014, ApJS, 210, 1

THE INCLUSIVE WAY (ENSEMBLE LEARNING)

Linear opinion pool:

$$p(\theta) = \sum_{i=1}^{n} \omega_i p_i(\theta),$$

where n is the number of methods (seis, scal, clas) of the PDF, $p_i(\theta)$ is the PDF of method i. ω_i is a weight we assign to each method. E.i. we might want to say that we trust the seismic results from individual frequencies mores than the scaling relations or ...

THE INCLUSIVE WAY (ENSEMBLE LEARNING)

Logarithmic opinion pool:

$$p(\theta) = k \prod_{i=1}^{n} p_i(\theta)^{w_i},$$

where k is a normalizing constant, n is the number of method (seis, scal, clas) of the PDF, $p_i(\theta)$ is the PDF of method i. ω_i is a weight we assign to each method. E.i. we might want to say that we trust the seismic results from individual frequencies mores than the scaling relations or ...

THE INCLUSIVE WAY (ENSEMBLE LEARNING)

Bayesian approach

$$p^* = p(\theta|g_1, \dots, g_n) \propto p(\theta)L(g_1, \dots, g_n|\theta),$$

where p^* is the updated a prior distribution $p(\theta)$. $g_1, \dots, g_n$ is the PDF of θ provided by model n and L represents the likelihood function associated with the PDF of model n.

The problem is however, that L should account for the precision and bias of the individual PDFs and should also be able to model the dependences among the different PDFs.

THE INCLUSIVE WAY (ENSEMBLE LEARNING)

The copula approach

$$P(\theta|f_1,\dots,f_n) \propto c[1-F_1(\theta),\dots,1-F_n(\theta)]\prod_{i=1}^{n} f_i(\theta),$$

where c represents the copula density function and $F_i(\theta)$ is the cumulative distribution function and $f_i(\theta)$ is the continuous density of model i.

Here the evaluation of the individual models is separated from the evaluation of the dependences between the different models.

QUALITY CONTROL

- That is simple...
- Flag all results were seis, scal and clas differ by more than one sigma defined by the PDF
- This could also include results from e.g. binary stars, gyrochronology, filcker etc.

- Maybe we should define a decision tree on what to do if a star is flaged?