

Plato Stellar Science Plan Management

WP 120000

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Objectives

- PSSPM organizes and carries out the scientific developments necessary to provide full characterisation of planet host stars mandatory to achieve Plato's goals

- During the definition phase, the PSSPM will demonstrate the feasibility to characterize the host star with the required precision level.

- During the implementation phase, the PSSPM will deliver tools and procedures specifically devised to characterize the host star with the required precision level.

Objectives

Star characteristics

radius R
mass M
age

chemical composition

Stellar activity and rotation

How stars formed and evolved

limb darkening

PDC

asteroseismic
parameters

Specifications of validated
procedures and tools

Ingredients identified
as useful by PDC

PSSPM

PSSPM focuses on F to M stars

Specifications of procedures and tools

PSPM must provide procedures and tools:

- to model stellar activity Examples: spot model, inversion procedures

- to measure star's radius, mass, age, chemical composition, rotation,..

Examples: grids of models, inversion procedures, etc...

- estimation of the impact of stellar physics uncertainties on these quantities

Tasks: to define the appropriate procedures and methods and develop for /adapt to Plato data

Specifications of Procedures:

Exemple: mass determination of the stellar mass

Radius R



$$M = 4\pi \int_0^1 \rho(r) r^2 dr = 4\pi R^3 \int_0^1 \zeta(x) x^2 dx$$

Scaled density

$$\zeta(x) = \rho(r) / R^3$$

$$x = r / R$$

Specifications of Procedures

Example: mass determination of the stellar mass, for instance as proposed by I. Roxburgh 2002-2010

Radius R

from Gaia

$$M = 4\pi \int_0^1 \rho(r) r^2 dr = 4\pi R^3 \int_0^1 \zeta(x) x^2 dx$$

Scaled density

$$\zeta(x) = \rho(r) / R^3$$

$$x = r / R$$

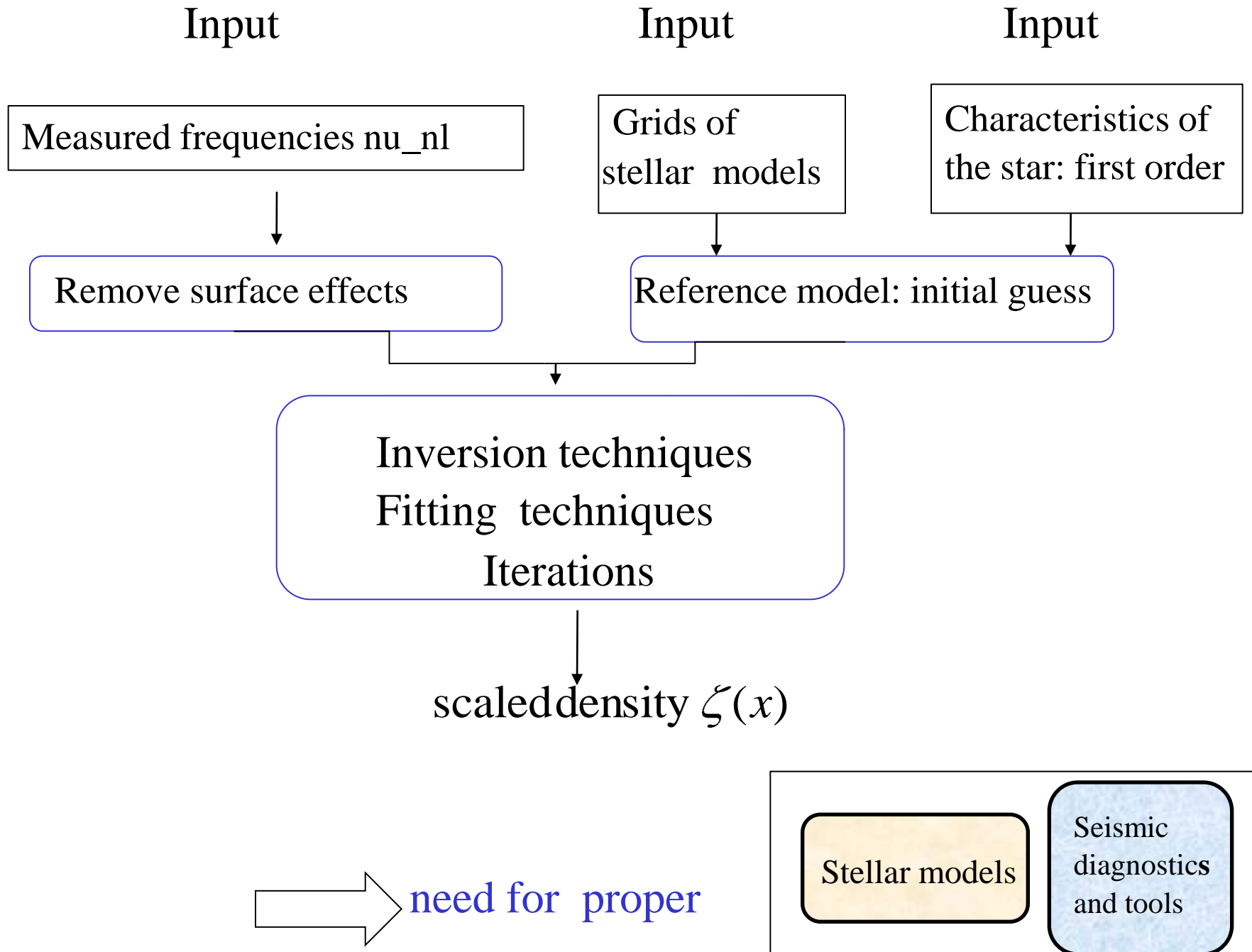
From seismic inversions
or model fitting

need for proper

Stellar models

Seismic
diagnostics
and tools

Schematic example of procedure : to emphasize what is needed



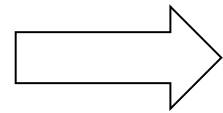
Several procedures can provide the stellar mass. A number of tests based on some of these procedures have been carried out and showed that one can expect $\Delta M \approx 5\% M$ assuming $\Delta R \approx 2\% R$ for the radius from Gaia

Tasks:

- to be generalized
- independent codes and comparative results
- Codes developed so that they can be used by someone who has not written the codes and develop the procedures

Several procedures can provide the stellar mass and radius

They must give coherent results



need for coherent

Determination of
stellar parameters

Task: identify the most efficient and complementary methods

Task: solve 'technical' problems:

- One must remove first *near surface effects* from frequencies

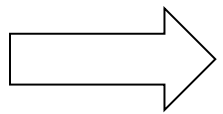
near surface effects: surface convection

interaction convection-pulsation

interaction radiation-pulsation

- Must remove contaminating oscillation from rapid variations of sound speed near the surface

- Must remove contaminating oscillation from rapid variations of density near the convective core : learning from CoRoT and KEPLER



need for proper

Seismic
diagnostics
and tools

Mode physics

Age determination :

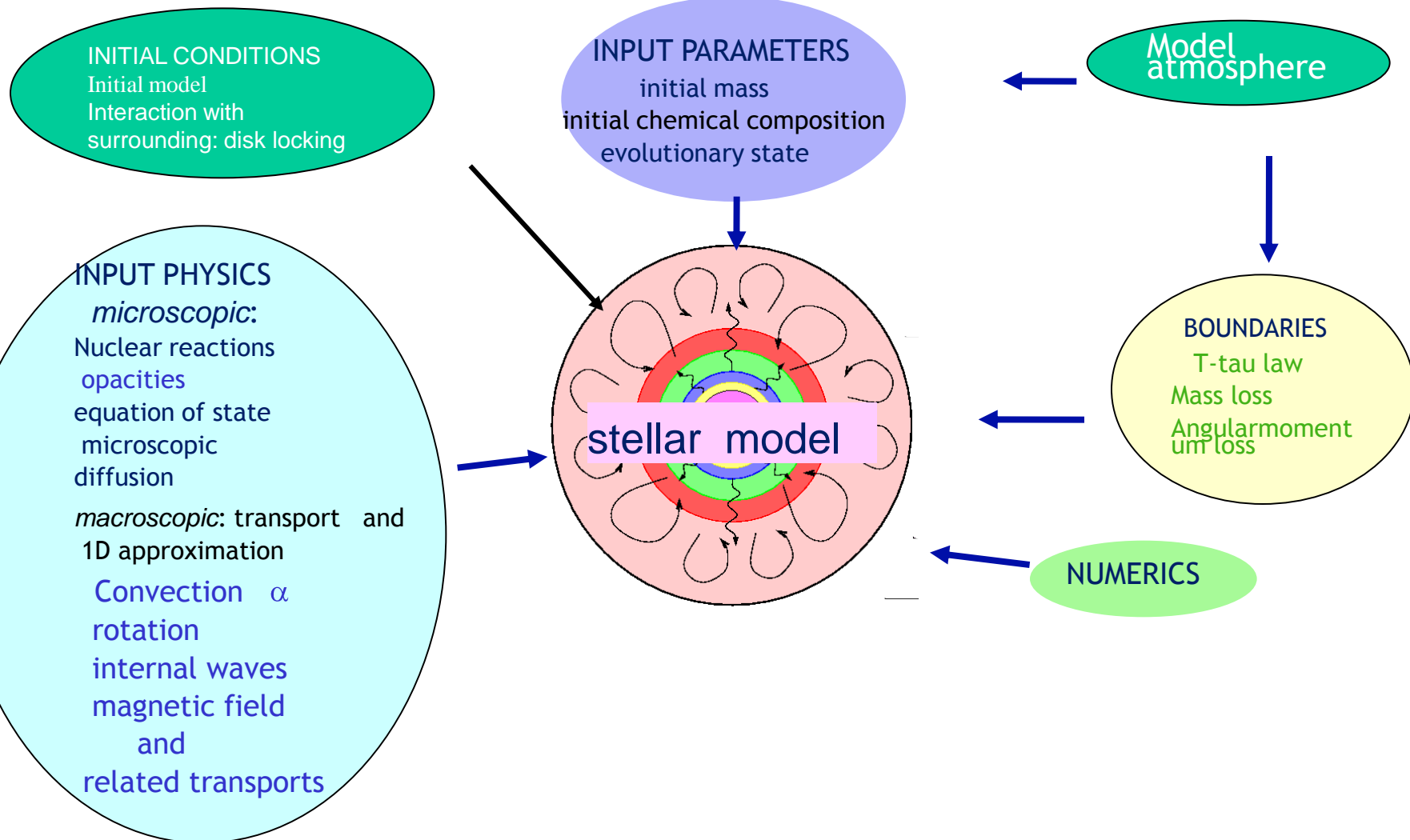
fit between observed and frequencies from models

by means of minimisation procedure

→ depends on the physical description of the stellar models.

Uncertainties on age determination:

Impact on age determination: a large number of processes
- some are under controlled
- some requires further work



Estimating uncertainties ΔM_{age} in all expected encountered cases

→ Requires a large number of expertise and will involve a large community

→ Requires to compute a large number of stellar models with various different assumptions on the physics of the models

Task

- estimate age uncertainties of actual models
- Identify the main necessary improvements and associated developments to carry out

→ need for proper

Stellar models

Models of Stellar
Atmosphere

Stellar activity
and rotation

Validation of Procedures

Before delivering procedures to the PDC, SPM must make sure of their efficiency

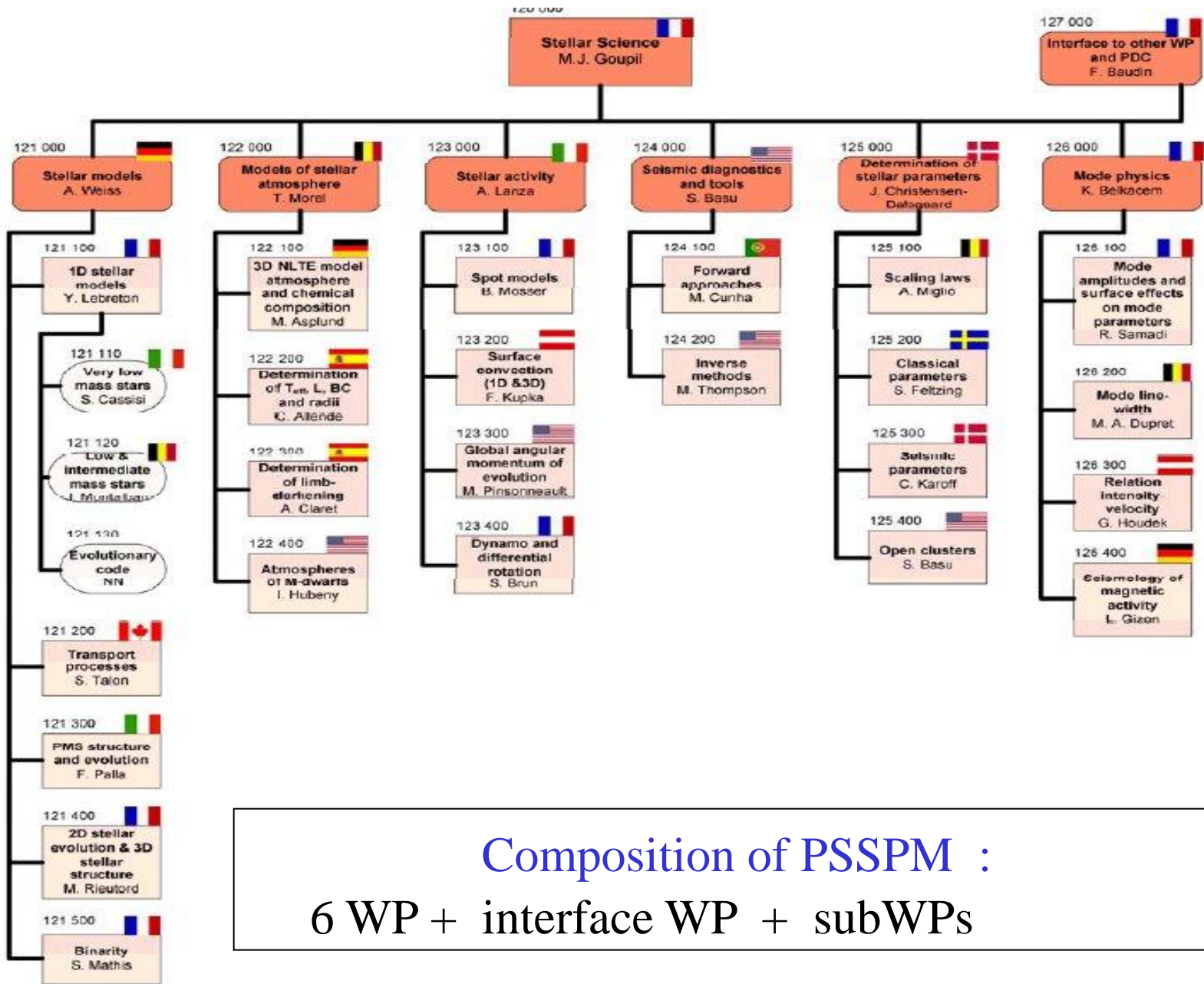
Task: to build prototypes and test them with hare and hound exercises (simulated data) and available data (CoRoT and KEPLER legacy)

Tasks : summary

Production of

- * grids of validated stellar evolution models including the most recently modelled physical ingredients (rotation, internal waves, magnetic fields).
- * grids of validated model atmospheres including the most recently modelled physical ingredients in order to determine stellar parameters such as the chemical composition of the star, produce detailed and accurate boundaries to stellar models, to carry out specific studies of surface effects on the oscillations.
- * validated seismic forward and inversion techniques specifically adapted to PLATO data in order to reach the requested level of accuracy
- * validated models describing all aspects of stellar activity and interaction with the surrounding

First generation followed by second generation models and procedures



Composition of PSSPM :
6 WP + interface WP + subWPs

PSSPM web site in construction, on line next week

Aim: for the community to download and upload documents,
and to circulate information between WP12xxxx

*(Responsibles: F. Baudin leader of WP interface WP127000
and K. Belkacem deputy responsible of WP120000)*

In particular a **letter of intent** will be sent next week to the
community and answer from interested persons/groups to
this letter will be upload on this site

End