PLATO Science Preparation

Heike Rauer and the PSPM team

(PLATO Science Preparation Management)

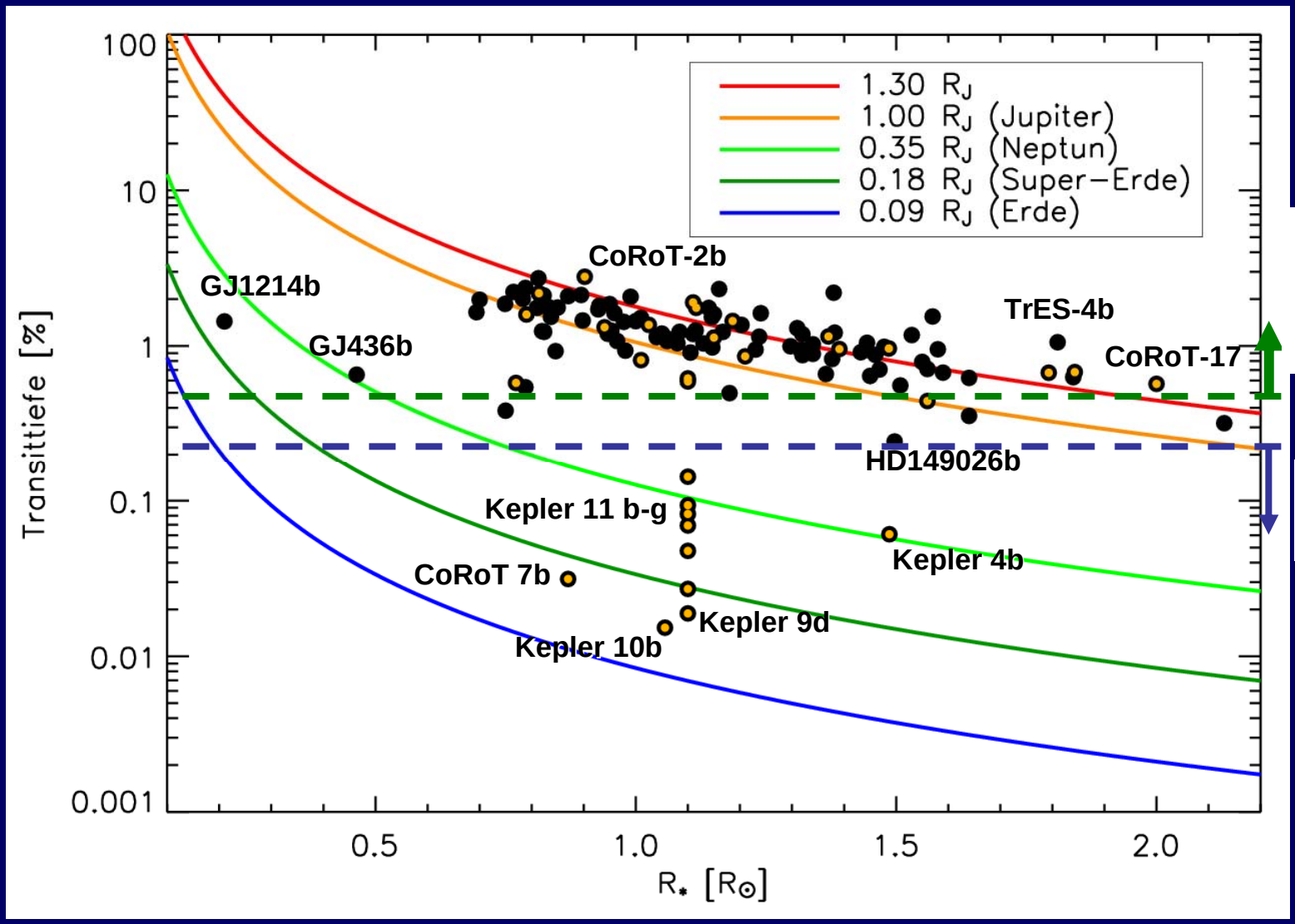
PLATO Science Objective

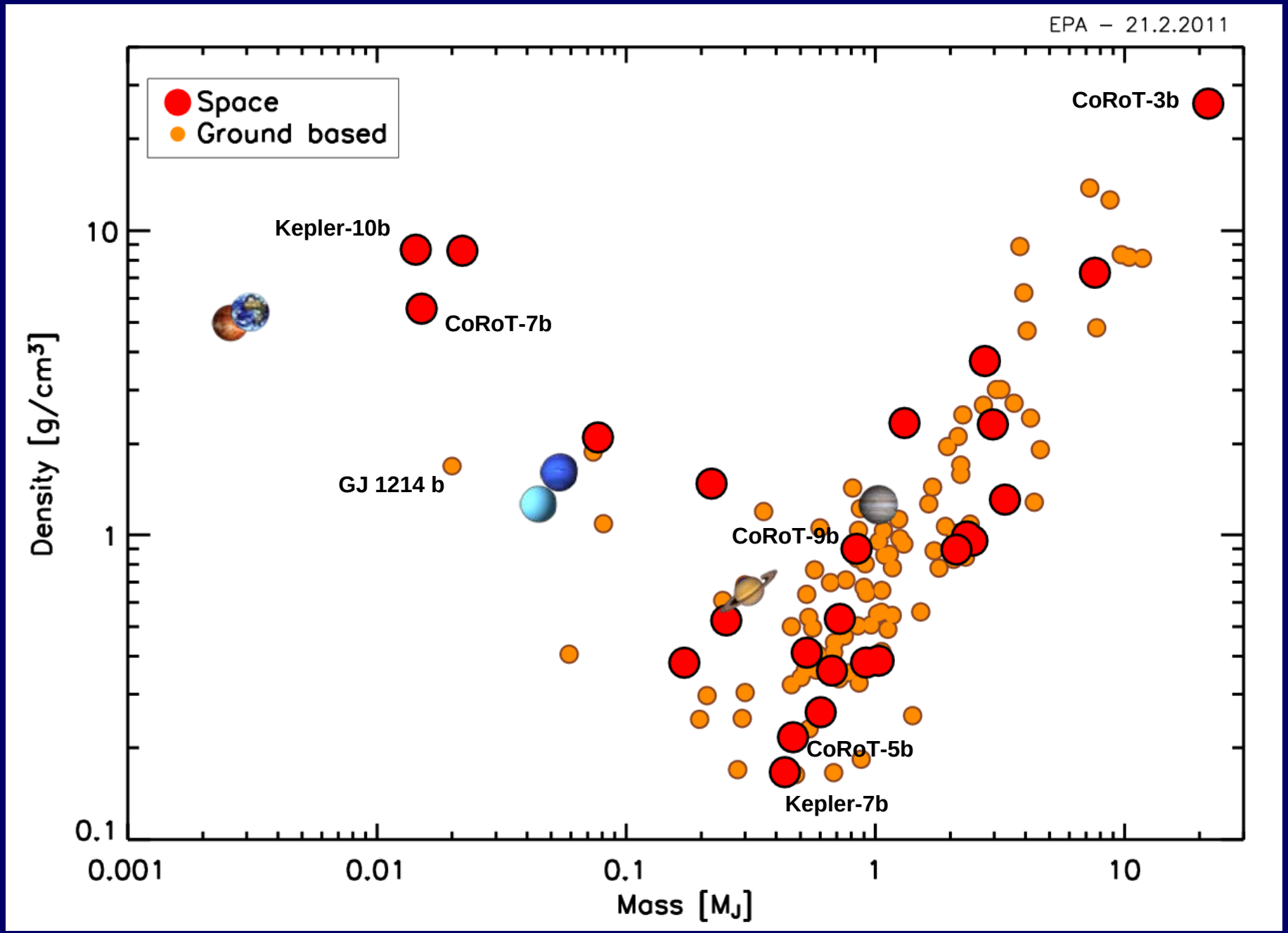
To detect and characterise exoplanetary systems and in particular those with earth-like planets in the habitable zones of their host stars

> measurement of radius and mass, hence of planet mean density

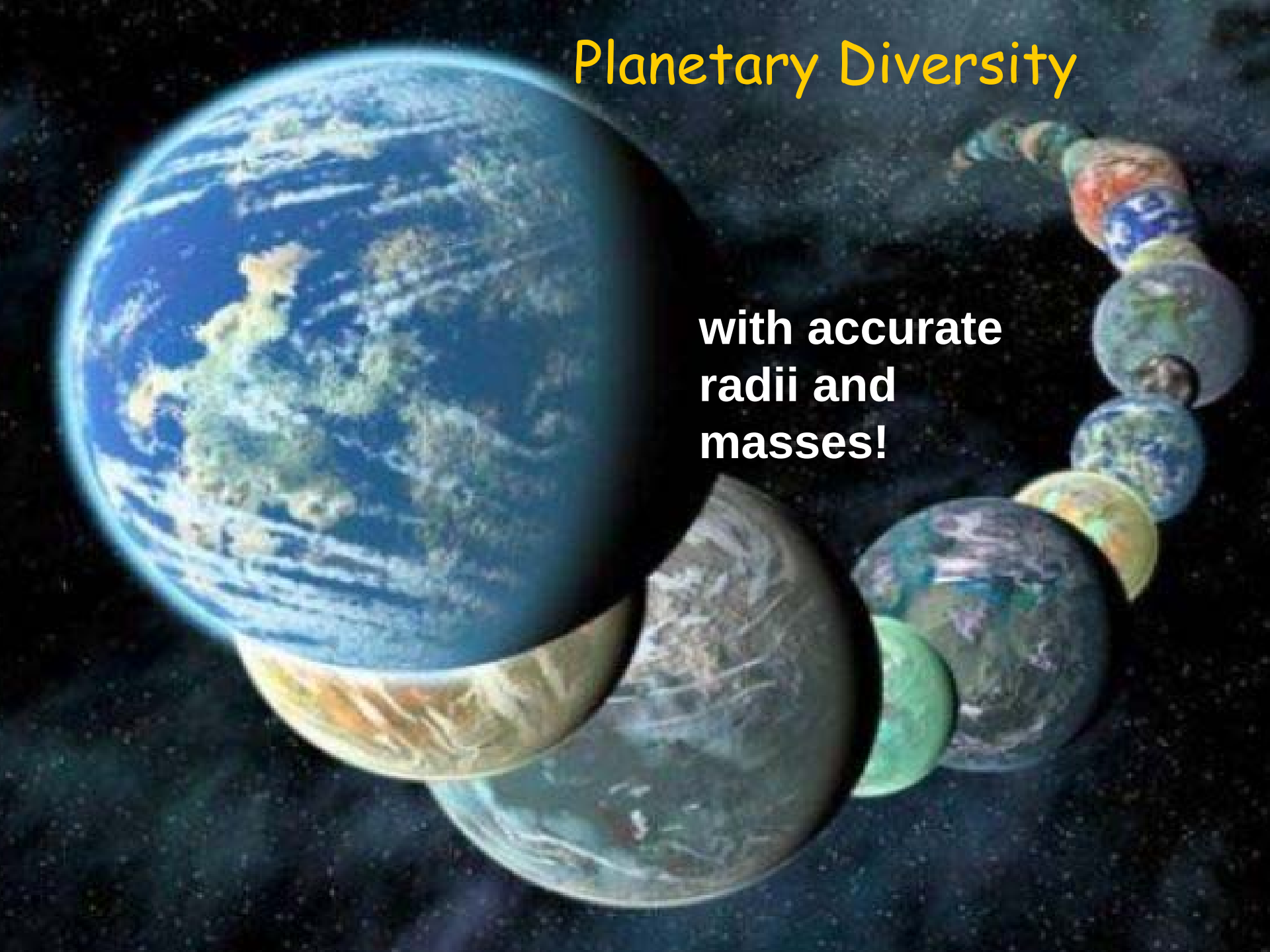
> measurement of age of host stars, hence of planetary systems

Detection range of transit surveys




EPA – 21.2.2011
Space
Ground based
CoRoT-3b
Kepler-10b
CoRoT-7b
GJ 1214 b
CoRoT-9b
CoRoT-5b
Kepler-7b
Density [g/cm³]
Mass [M_J]
10
1
0.1
0.001
0.01
0.1
1
10

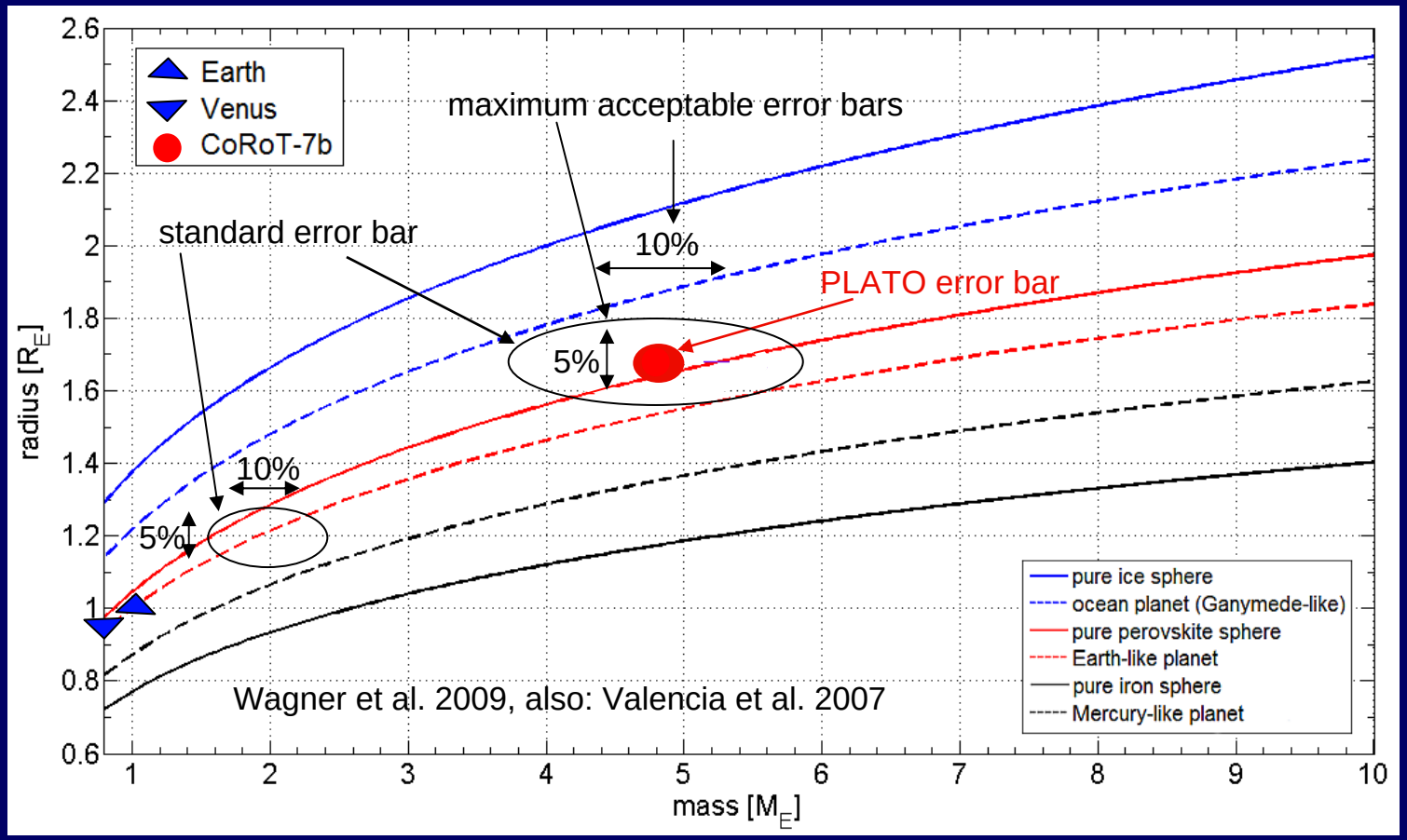
Planetary Diversity



with accurate radii and masses!

Impact of radius and mass measurement

Compare exoplanets with predictions of models with various compositions and structures

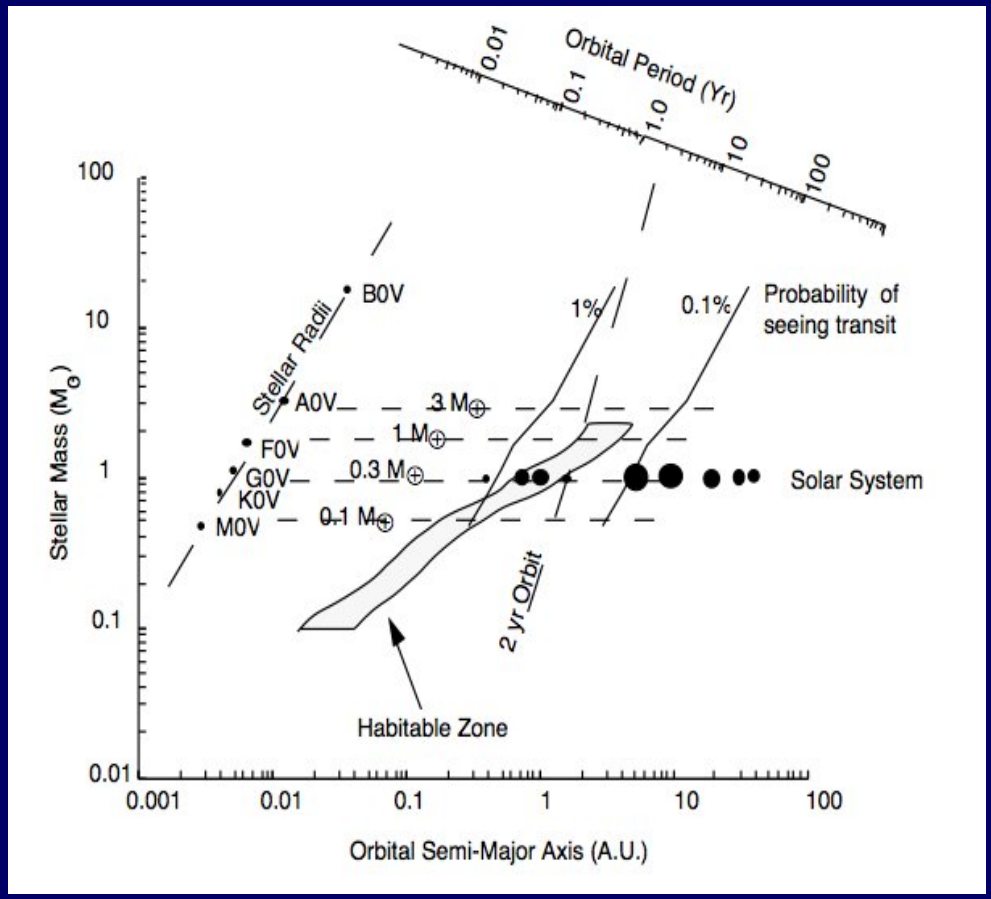


- constraints on planet interiors
- radii and masses → atmospheres
- diversity

PLATO Survey of $1R_E$ rocky planets in habitable zones of all late type stars

News:

- Now includes M dwarfs
- M stars lower intrinsic brightness (local) and very red
- PLATO can work as faint as I~15-16 mag with little blending in most cases
- 6000 M stars per pointing
- RV signal larger



Proto Earth

Magnetosphere
Carbon-silicate cycle

Oxygen rise
Ozone layer

Impact of age measurement

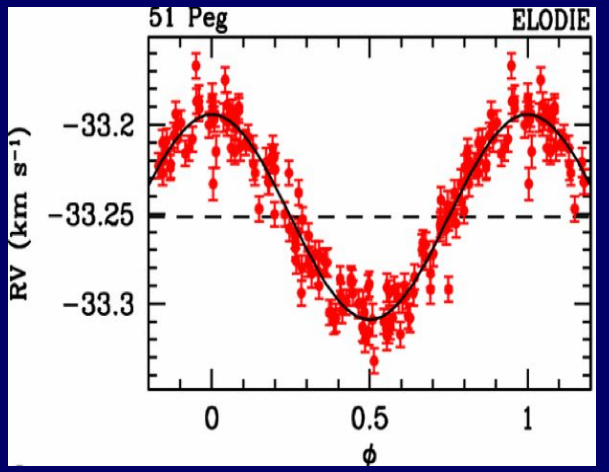
PLATO: compare Earth-like exoplanets with age scale of Earth

- precision better than timescale planet evolution
- targets of future characterization dated by PLATO (Earth-like, but also Neptunes, hot Jupiters…)

place exoplanetary systems in evolutionary context

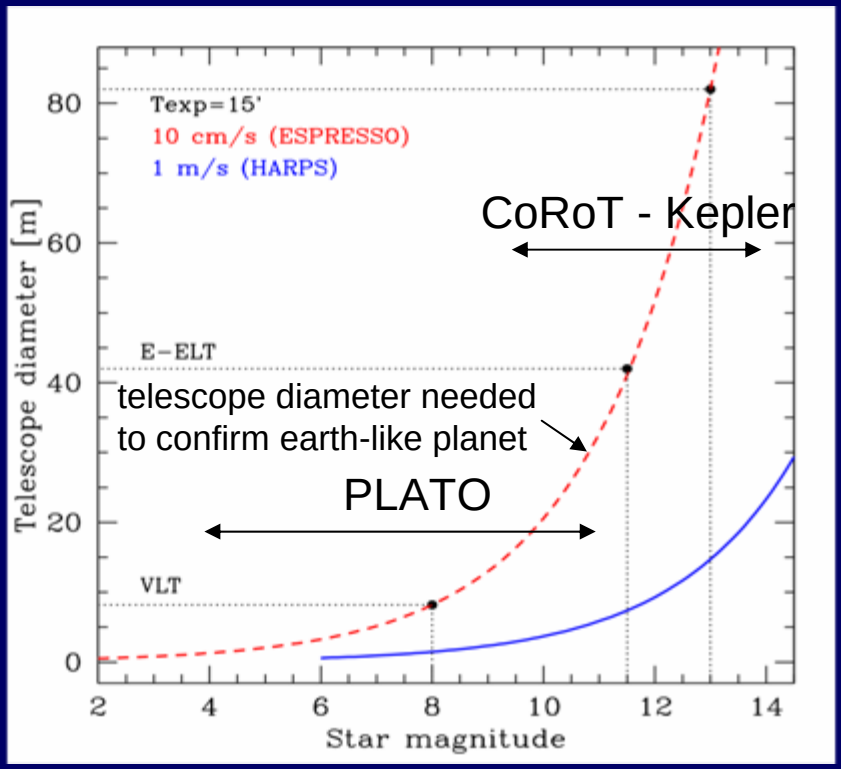
Groundbased follow-up

- Vigorous follow-up needed
- Most important aspect = radial velocity monitoring
  ⇒ planet confirmation and mass measurement



Planet	Distance (AU)	RV Amp. (m/s)
Jupiter	1	28.4
Neptune	0.1	4.8
Neptune	1	1.5
SuperEarth	0.1	1.4
SuperEarth	1	0.5
Earth	1	0.1

- Stellar intrinsic « noise »:
  oscillations, granulation, activity
- need to apply proper averaging technique
- time consuming
- in practice limited to bright stars

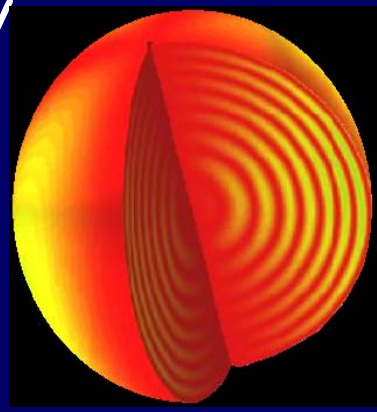


Asteroseismology

- Key Tool

Planet parameters ← stellar parameters (asteroseismology)

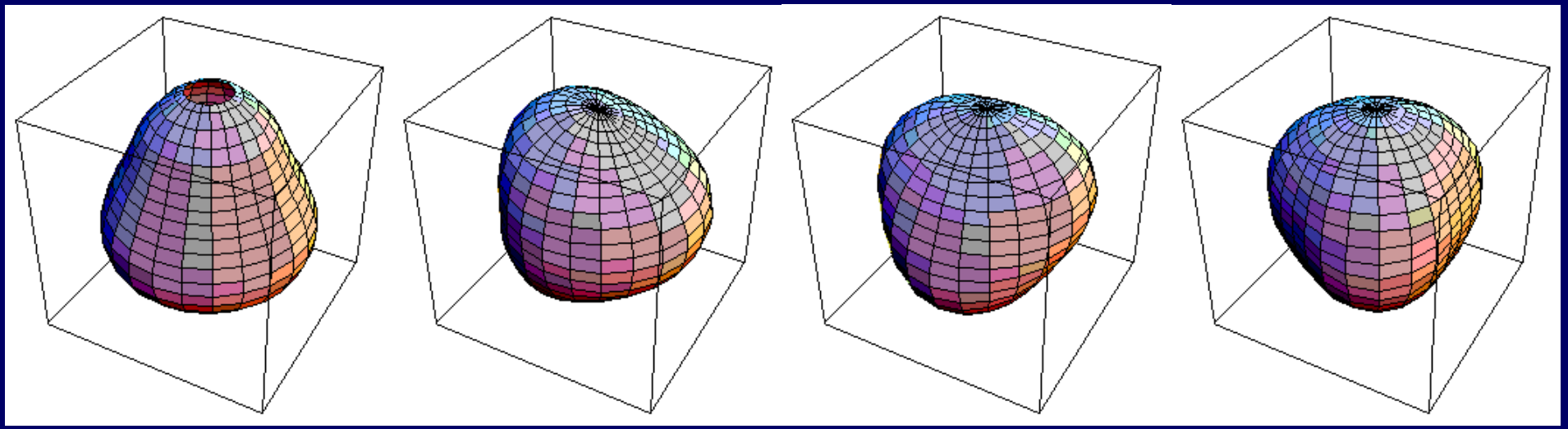
Solar-like stars oscillate in many modes, excited by convection. Sound waves trapped in interior



Resonant frequencies determined by structure:

→ frequencies probe structure

→ gives mass, angular momentum, age



Asteroseismology

Power spectrum of light curve gives frequencies ν

Large separations $\Delta \propto \sqrt{M/R^3}$
→ mean density

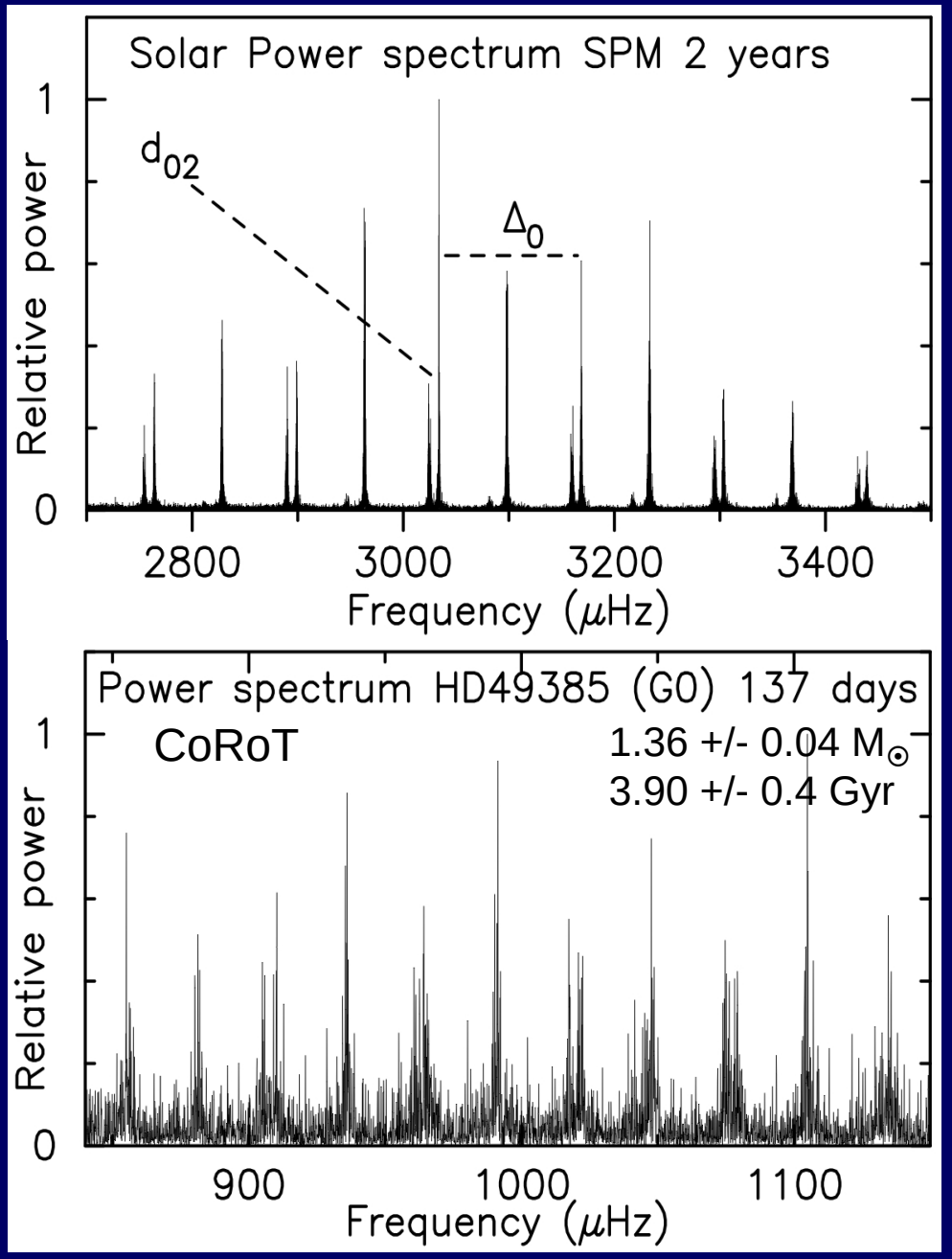
Small separations d_{02}
→ probe the core → age

Inversions + model fitting + ν → consistent ρ, M, Ω, J, age

PLATO will provide:

Uncertainty in Mass ~ 2%

Uncertainty in Age ~ 10%



The PLATO Science Preparation Management

→ We need the best possible tools, algorithms, models, catalogues, observational support, … available for PLATO!

→ this requires support from the science community for PLATO preparation, and analysis after launch

Tasks of PLATO Science Preparation Activities

- the development of methods and algorithms for exoplanet science

- the development of methods and algorithms related to the stellar physics programme

- provide resulting specifications to the PDC

- the provision of all necessary data and information for the construction of the PLATO input catalogue

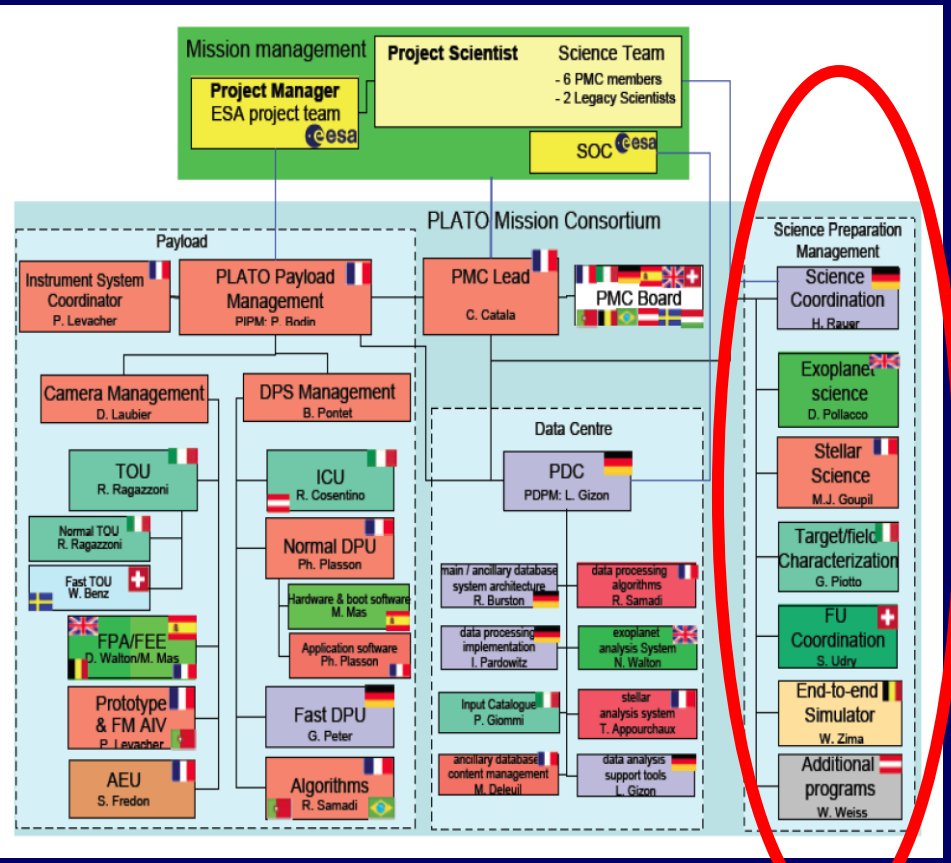
- the identification of the required follow-up facilities, including a world-wide effort obtaining in particular radial velocity observations to determine planet masses;

- the development of the end-to-end PLATO data simulator

- the coordination of additional science activities within PMC and the general community.

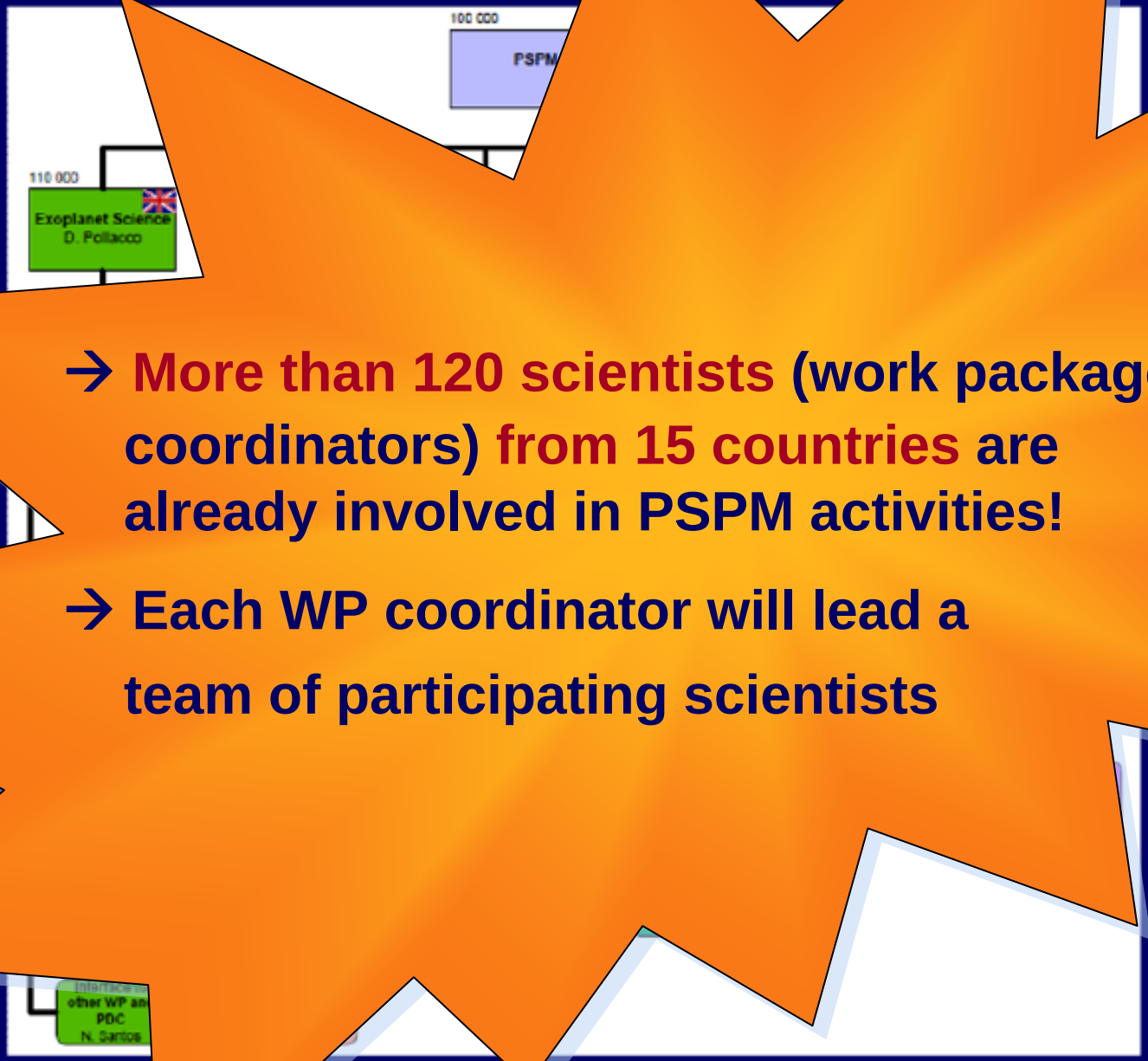
- coordinate an active outreach program

PLATO Science Preparation



- **Science coordination**: overall PSP coordination, coordinate community, PR
- **Exoplanet Science**: transit detection, planet parameters
- **Follow-Up Coordination**: organization of follow-up observations
- **Stellar Science**: stellar physics, oscillation modes, stellar evolution models
- **Target/Field Characterization**: PLATO input catalogue, prepare field selection
- **End-to-End Simulator**: PLATO data simulator
- **Additional Science**: **prepare for** additional science program

PLATO Science Prepa tion Ma nent



→ **More than 120 scientists (work package coordinators) from 15 countries are already involved in PSPM activities!**

→ **Each WP coordinator will lead a team of participating scientists**

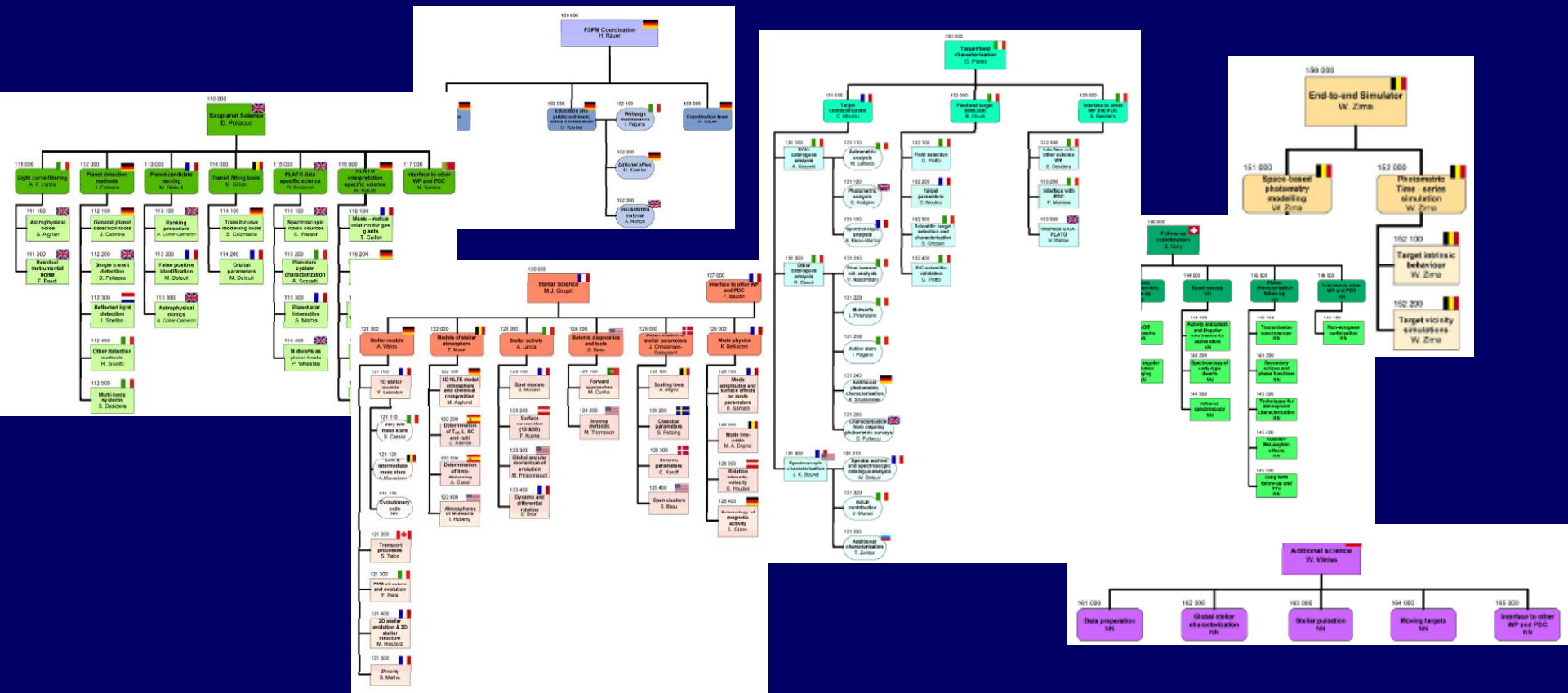
Find more information about the PSPM at:

http://www.oact.inaf.it/plato/PPLC/Home.html

- information about the PLATO mission
- up-to-date work breakdown structure
- short description of every work package
- name of work package coordinators and contact information
- further information at PSPM share point (password protected)

How to join the PSPM activities:

- identify the work package(s) you are intested in
- contact the work package coordinator
- fill the letter of intent (see web page)



PLATO will:

*** provide a large number of planetary systems around bright stars**

*** allow us to study planet diversity in mass – radius with unprecendented accuracy**

*** provide knowledge of an accurate age for a large number of planetary systems**

*** study stellar evolution**

*** provide a huge data base for additional science objectives**

→ needs a joint community approach!