

PLAT



PLATO Science Preparation

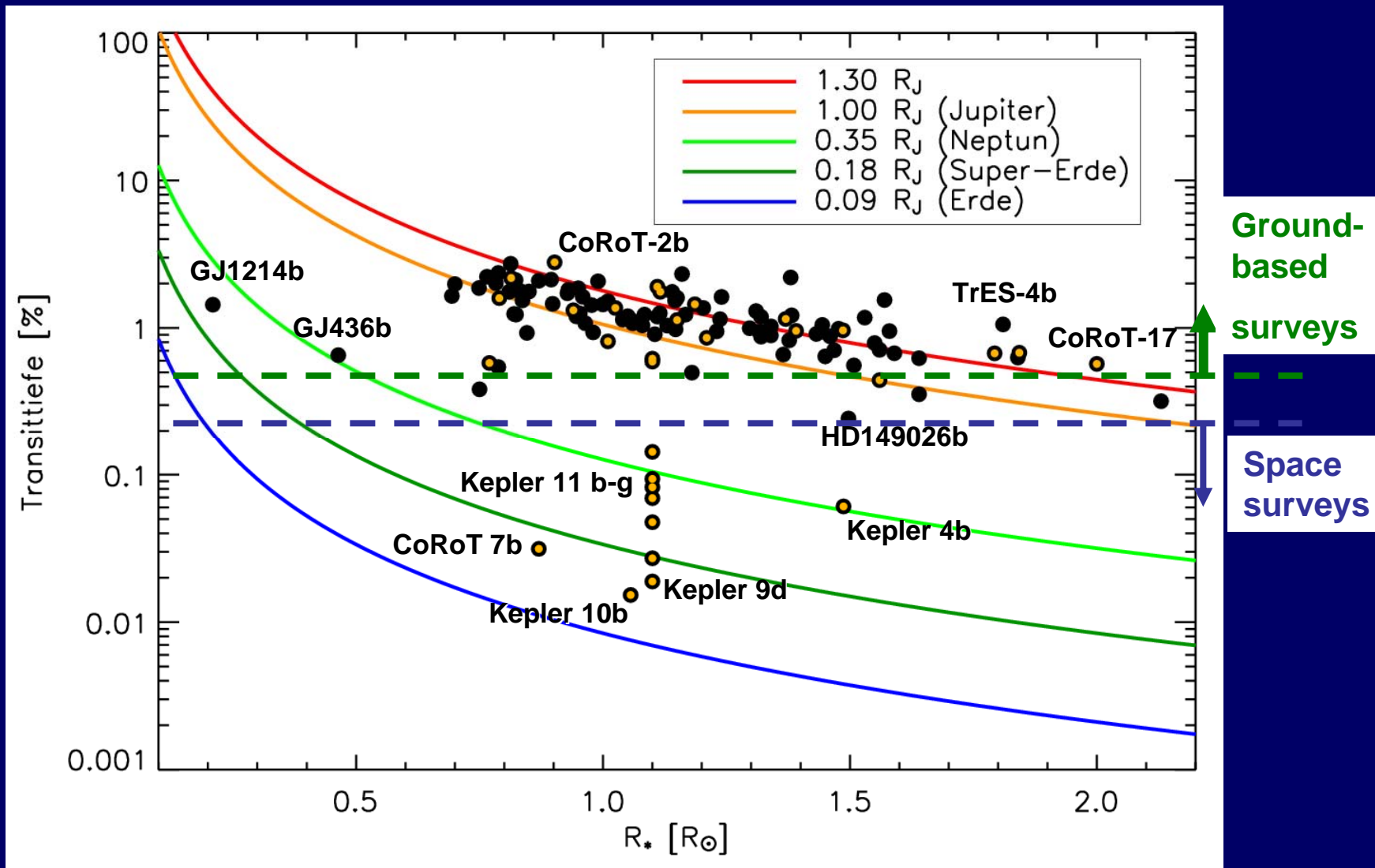
Heike Rauer and the PSPM team
(PLATO Science Preparation Management)

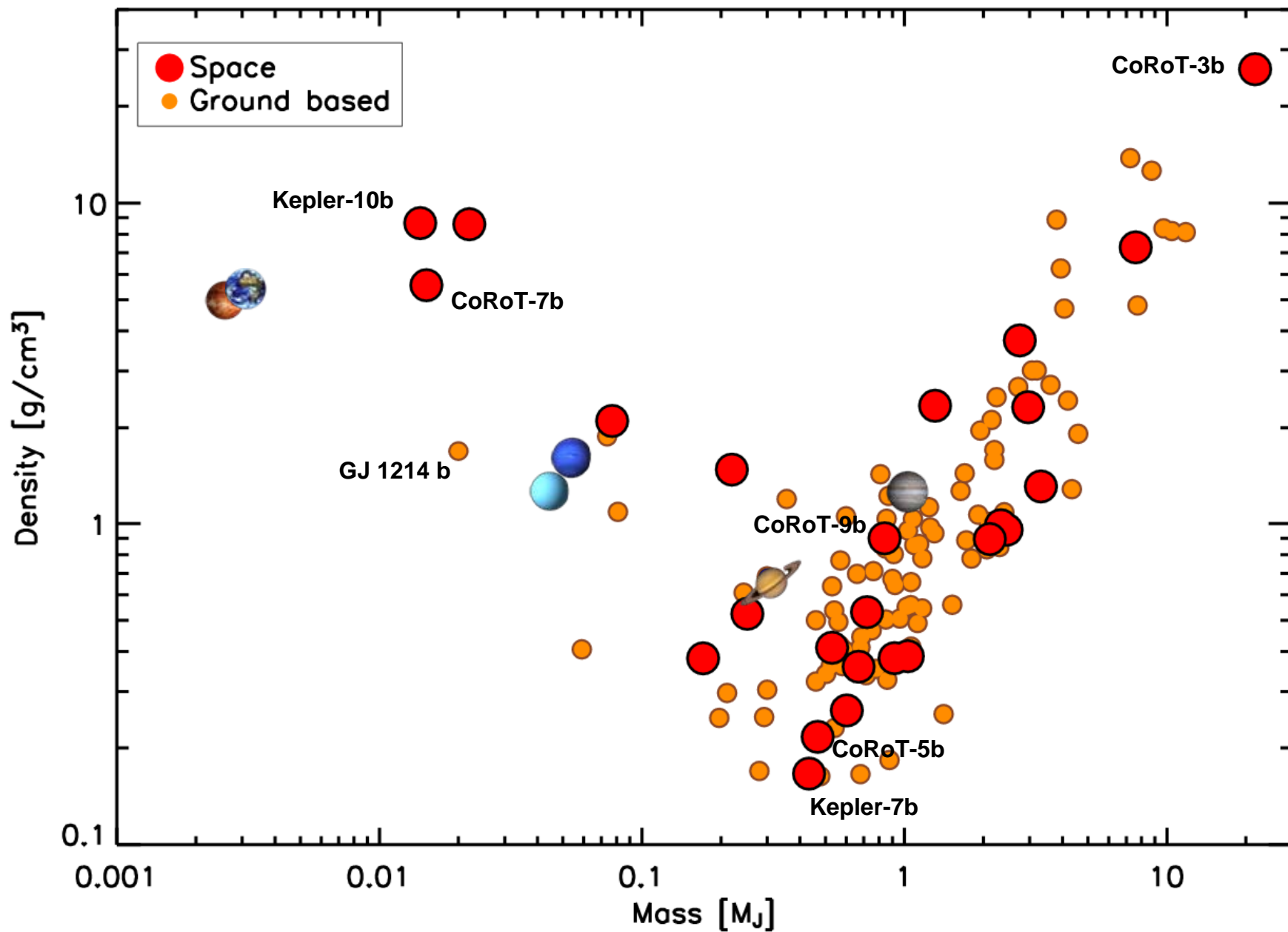
PLATO Science Objective

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

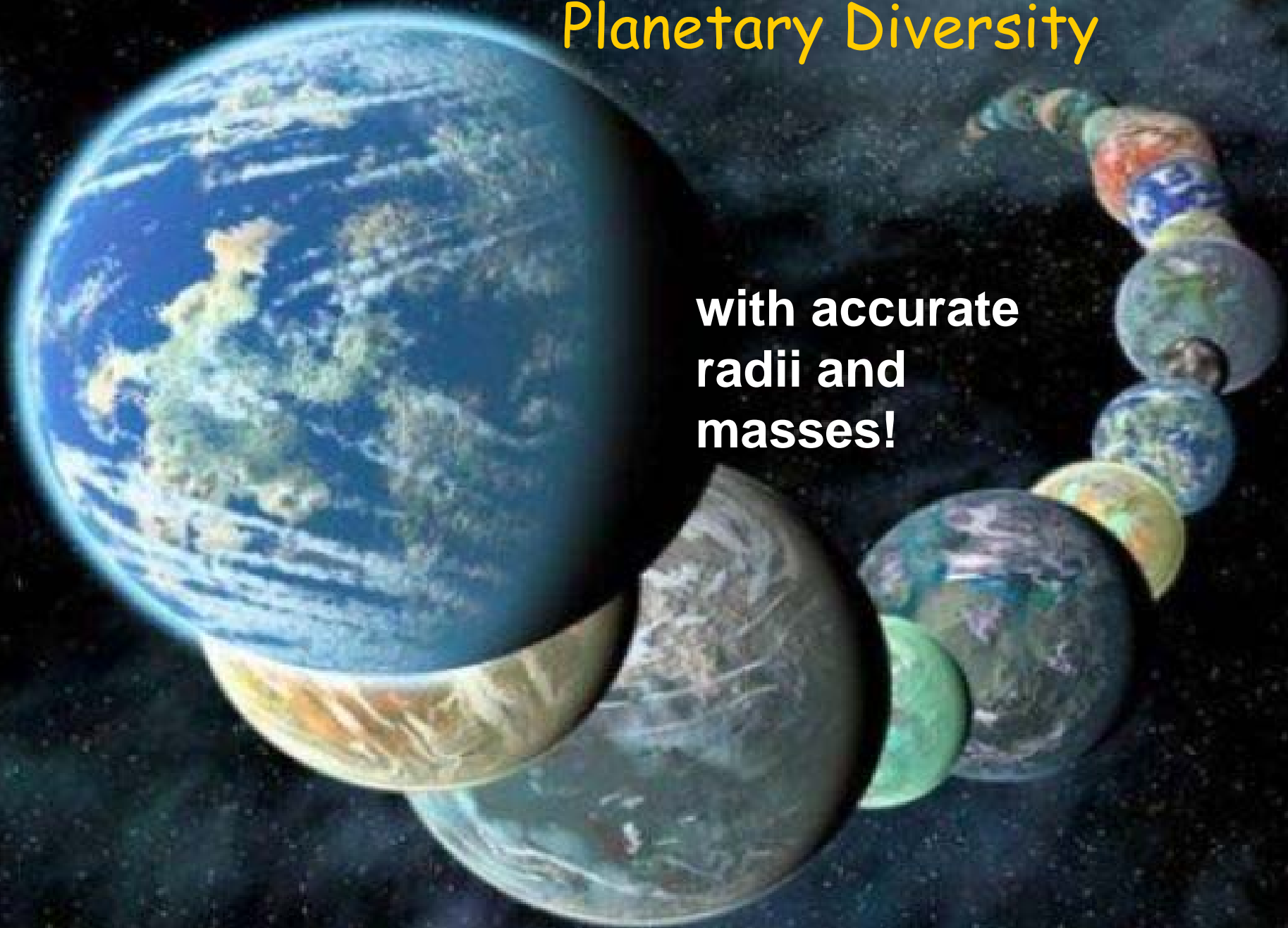
Detection range of transit surveys





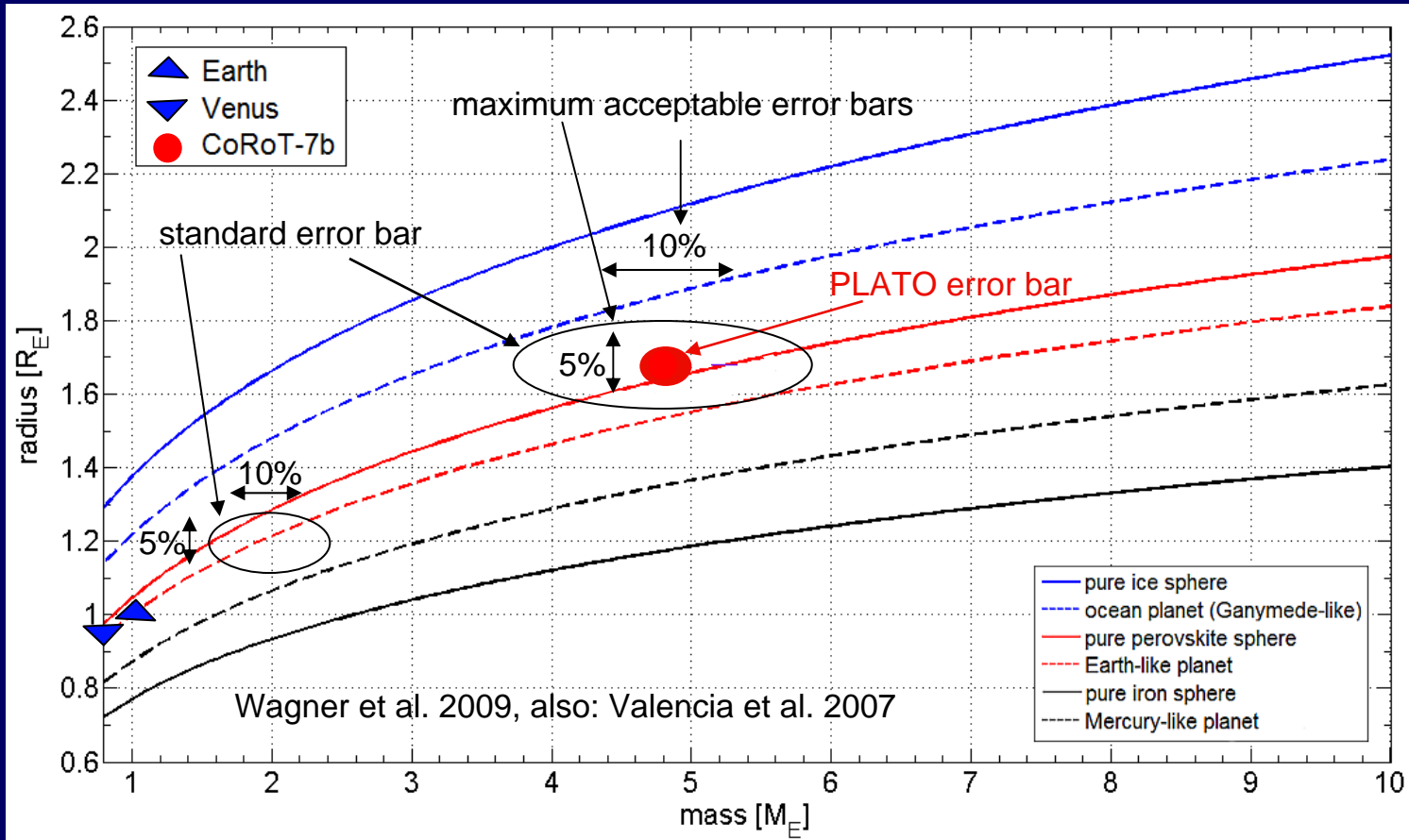
Planetary Diversity

**with accurate
radii and
masses!**



Impact of radius and mass measurement

Compare exoplanets with predictions of models with various compositions and structures

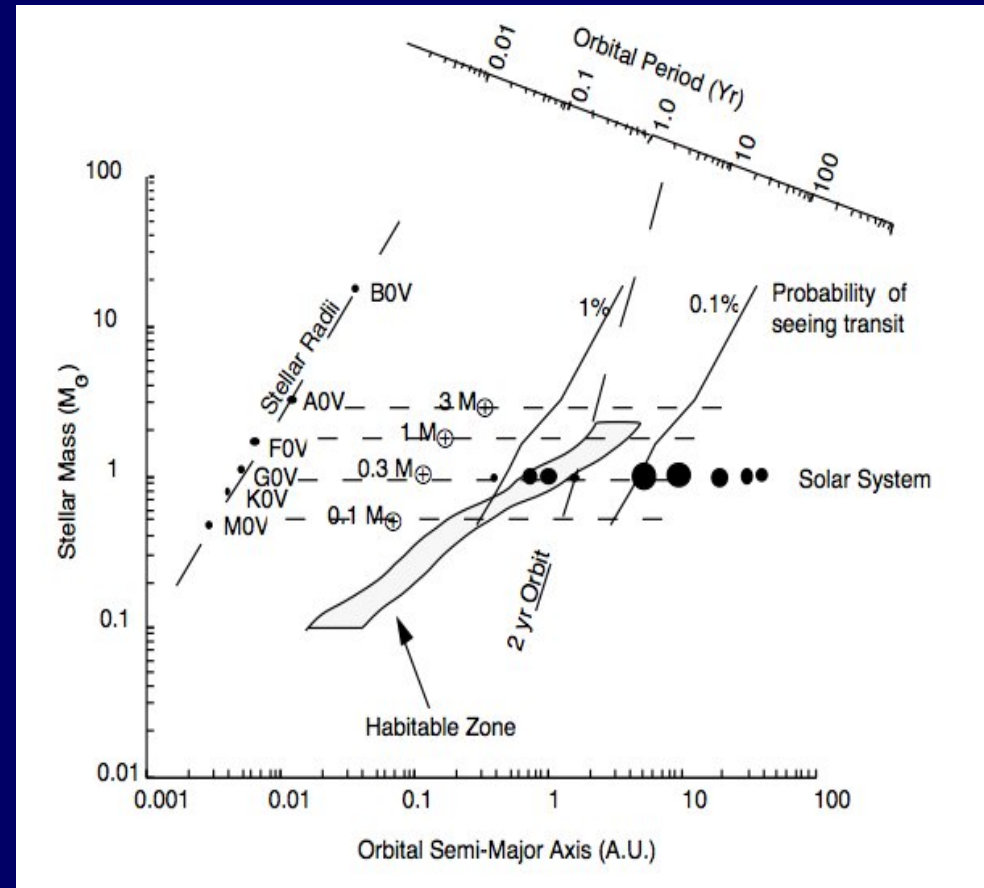


- constraints on planet interiors
- radii and masses \rightarrow atmospheres
- diversity

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 $I \sim 15-16$ 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...)

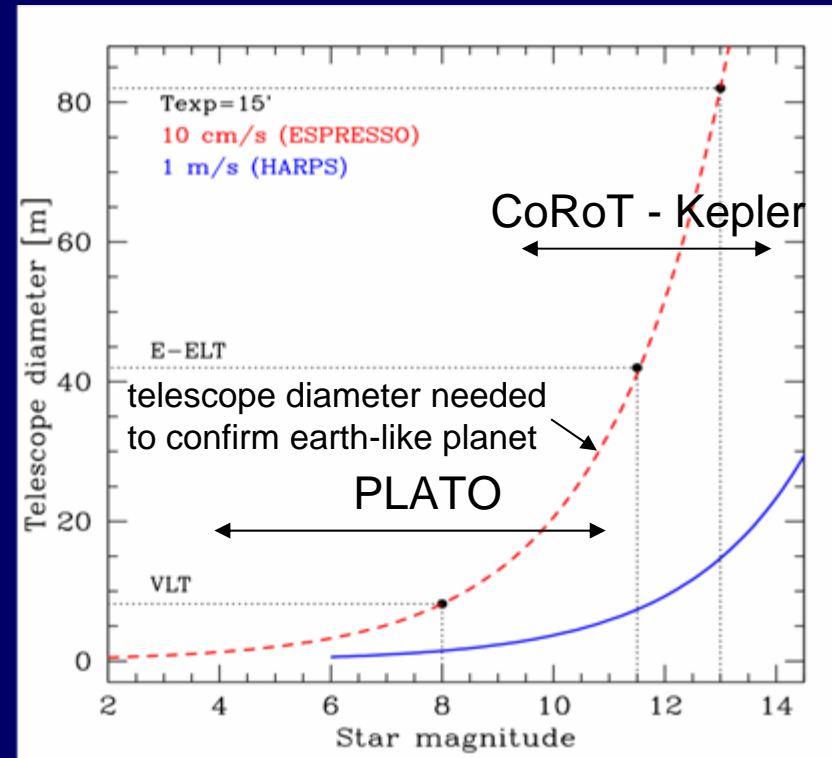
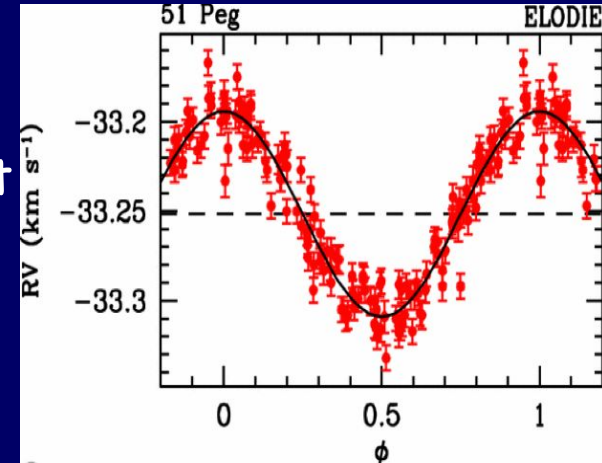
place exoplanetary systems in
evolutionary context

Groundbased follow-up

- Vigorous follow-up needed
- Most important aspect = radial velocity monitoring
 \Rightarrow 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

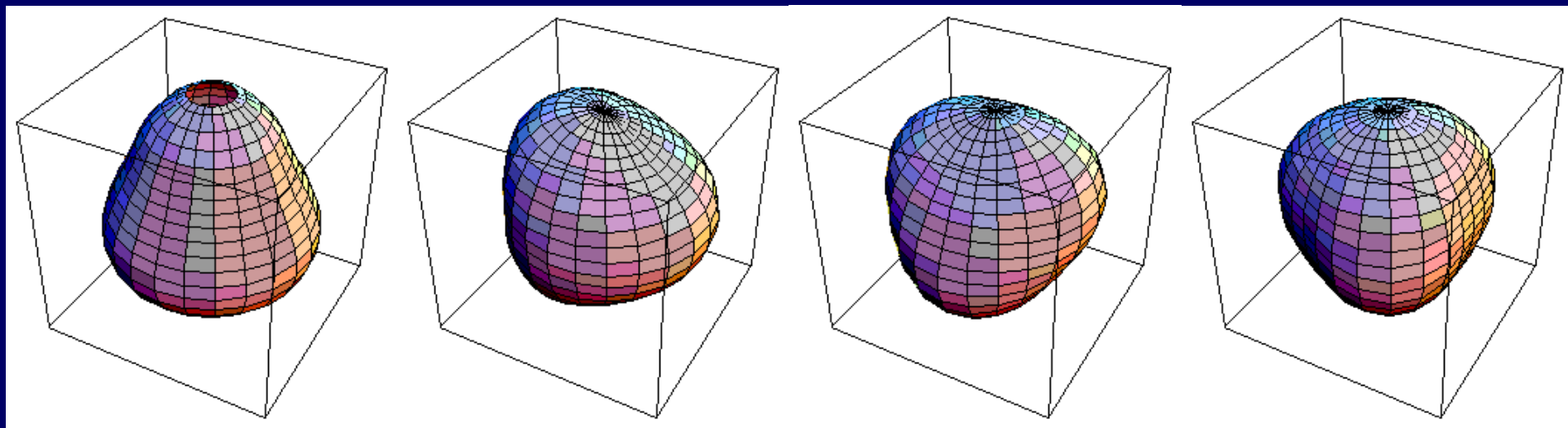
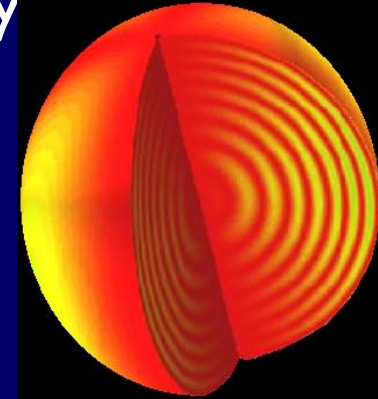
Planet parameters \leftarrow stellar parameters (asteroseismology)

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

Resonant frequencies determined by structure:

\rightarrow frequencies probe structure

\rightarrow gives mass, angular momentum, age



Asteroseismology

Power spectrum of light curve gives frequencies ν

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

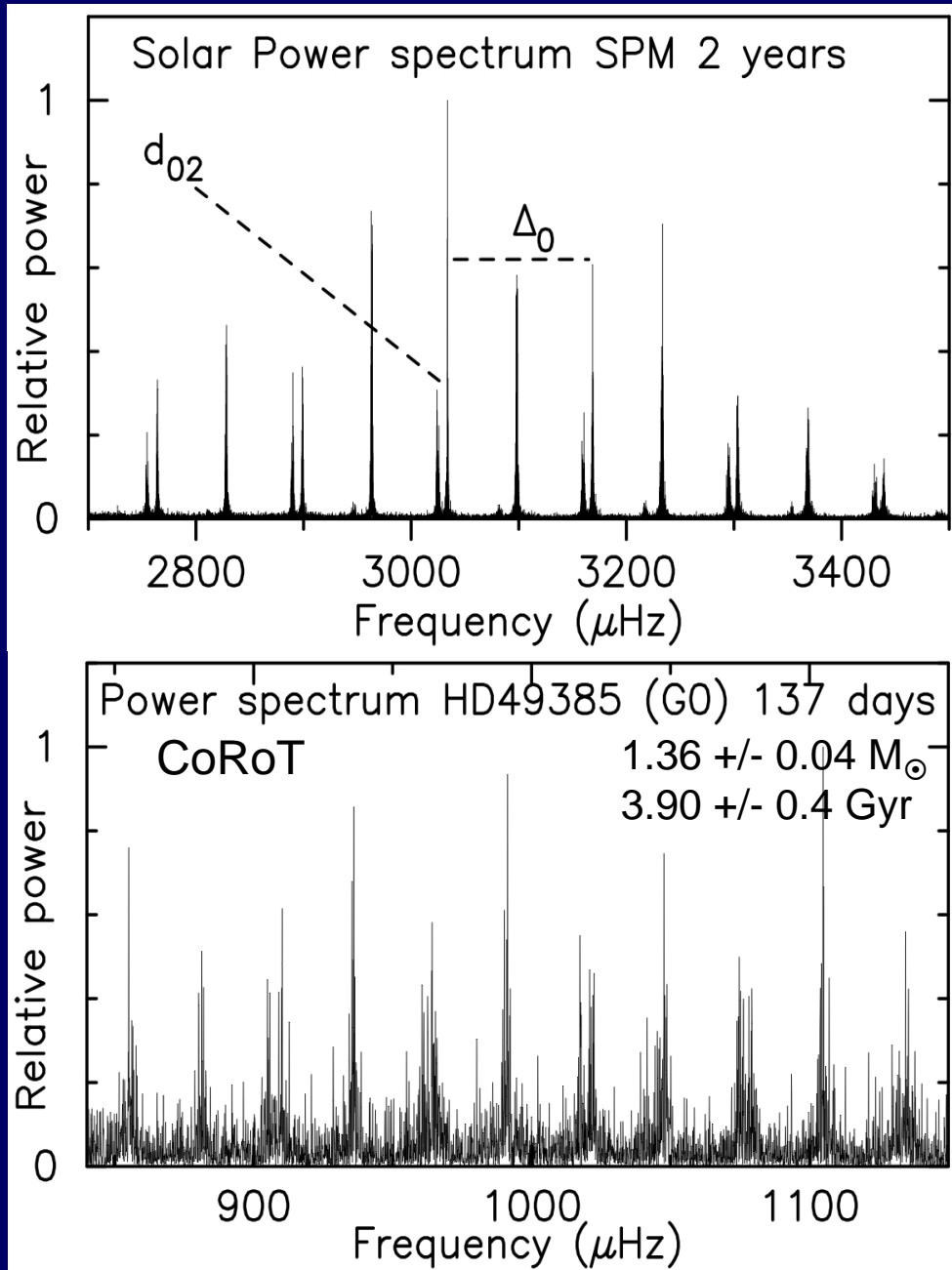
Small separations d_{02}
→ probe the core → age

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

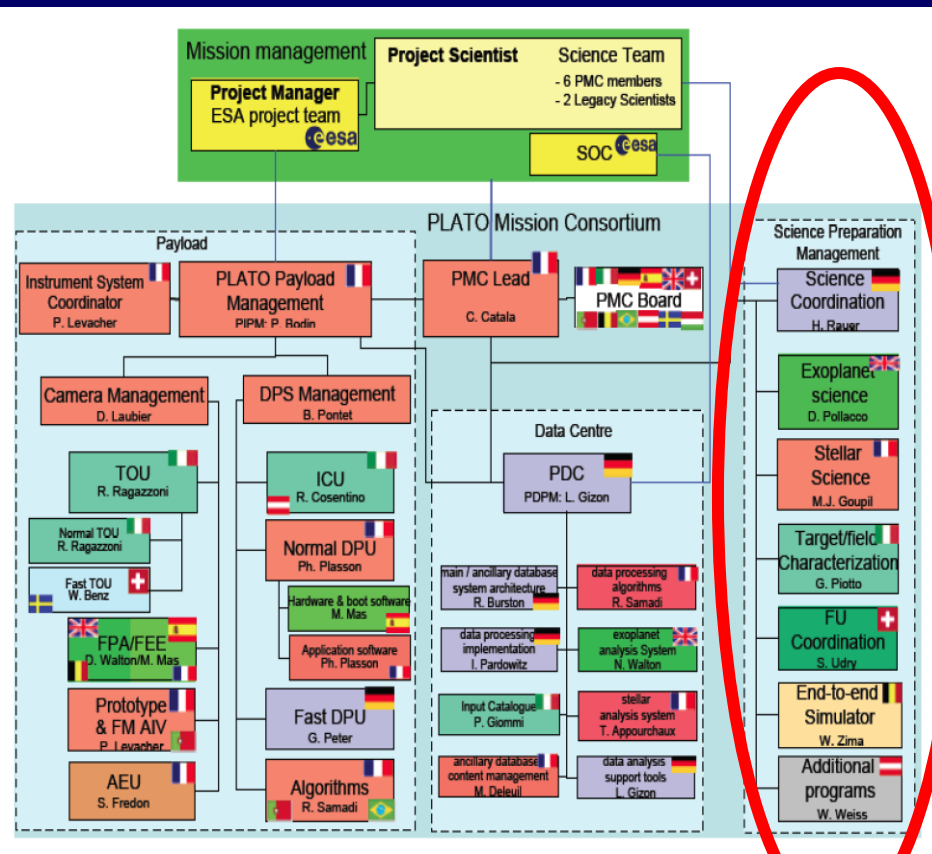
- We need the best possible tools, algorithms, models, catalogues, observational support, ... available for PLATO!
- this requires support from the science community for PLATO preparation, and analysis after launch

Tasks of PLATO Science Preparation Activities

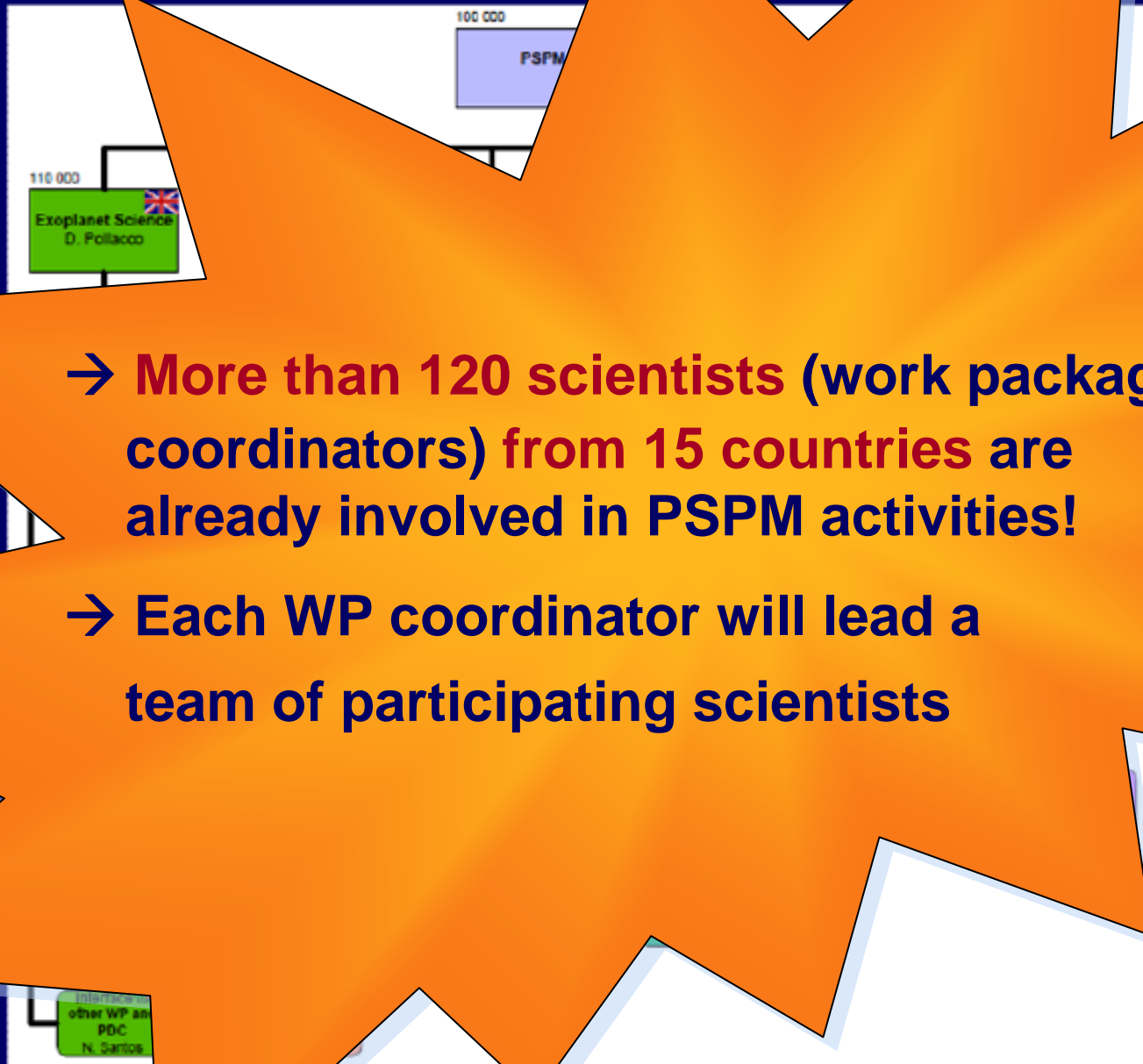
- the development of methods and algorithms for exoplanet science
- the development of methods and algorithms related to the stellar physics programme
- provide resulting specifications to the PDC
- the provision of all necessary data and information for the construction of the PLATO input catalogue
- 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 Preparation Management



- **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>



The screenshot shows the homepage of the PLATO mission website. At the top, there is a navigation menu with links for HOME, NEWS, PROJECT, SCIENCE OVERVIEW, CALENDAR, PLATO MISSION CONSORTIUM, MEETINGS, PHOTO GALLERY, IN DEPTH, DOCUMENTS, ON THE PRESS, and LINKS. The main heading is "PLATO" in large orange letters, followed by "An European Space Agency (ESA) Cosmic Vision 2015-2025 Project". Below this is a large image of the PLATO satellite in space, with the ESA logo in the bottom right corner. To the right of the satellite image is a "NEWS ON THE PRESS" section with a yellow background and a red "NEWS" header. Below the main heading is a blue link that says "Welcome on the PLATO Mission Consortium web site". The main content area is divided into two columns. The left column contains a paragraph about PLATO being one of the three medium-class (M-class) missions selected for definition in the framework of the ESA Cosmic Vision 2015-2025 program. It then states the scientific goal of PLATO is the discovery and study of extrasolar planetary systems by means of planetary transits detection. Below this is a paragraph about PLATO observing a large sample of bright stars to characterize discovered planets and their hosting stars, including seismic analysis to determine mass, radius, and age. The right column features a small image of the philosopher Plato and a text box explaining that PLATO is an acronym for Planetary Transits and Oscillations of stars, but also the name of a famous Greek philosopher. It quotes Simplicius (VI century A.D.) saying Plato posed the question: "What about those uniform and regular motions, assuming which the errant stars orbits are caused?"

- 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)

PLATO will:

- * provide a large number of planetary systems around bright stars**
 - * allow us to study planet diversity in mass – radius with unprecedented 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!**