

Towards a homogeneous sample of M-dwarf properties and abundances for the PLATO mission

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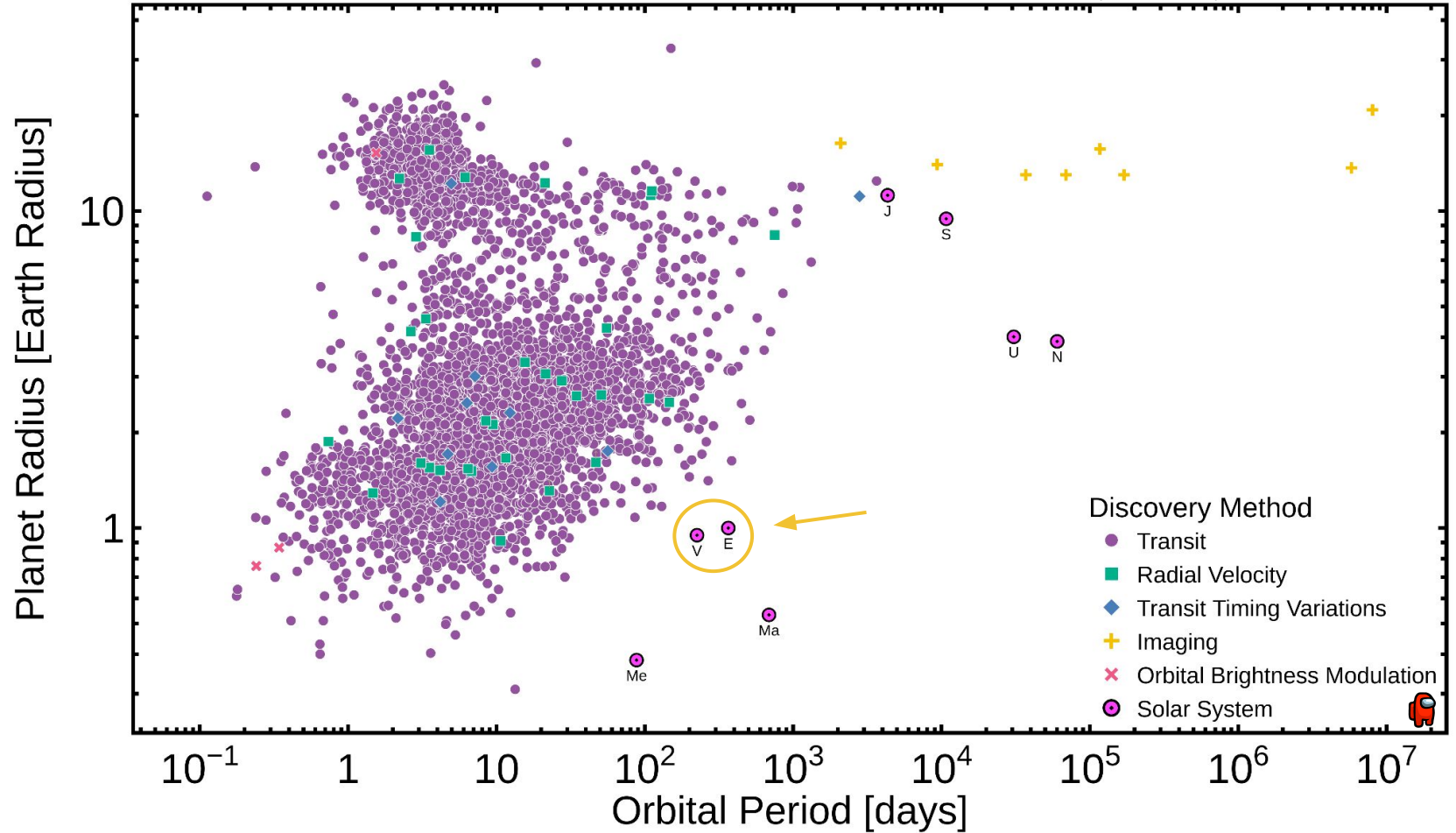
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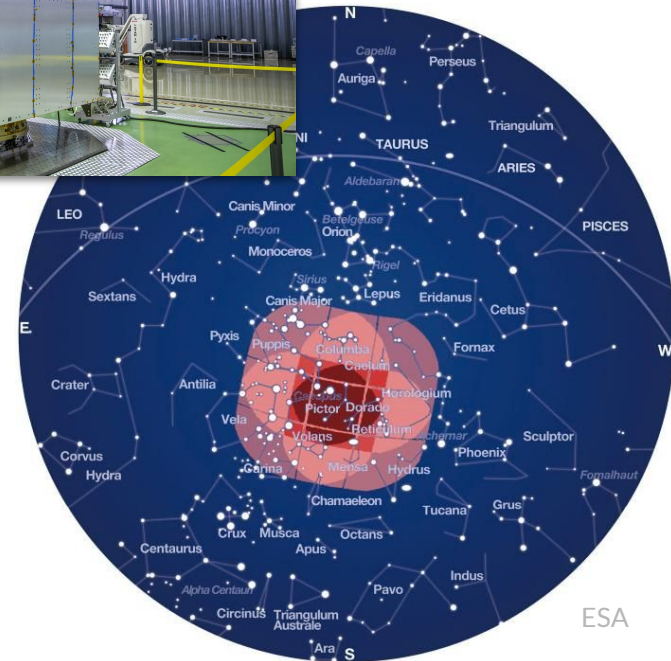
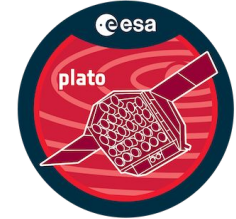
Planet Radius vs Orbital Period

exoplanetarchive.ipac.caltech.edu, 2026-03-19



PLATO: PLAnetary Transits and Oscillations

- ESA 'M-class' mission, selected 2014
- Planned **launch 2027**, on Ariane 6 to L2
- Payload of 26 cameras
- Lifetime of **4 years**, extension to 8.5
- Will continuously observe one part of the sky for at least 2 years
- Extensive ground-based follow-up program to confirm and characterise candidates
- Aims to find and characterise **Earth-like planets** around **Sun-like stars**



Finding Earth-like planets...

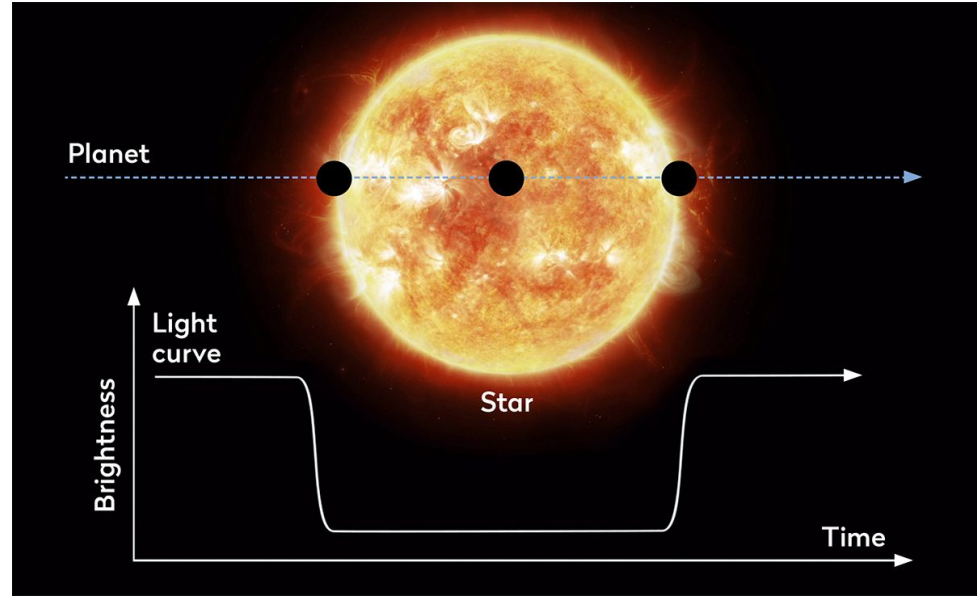
PLATO will use the *transit method*

Challenges:

- Earth = 1-year orbital period
- Very small transit signal
- Stellar variability

PLATO's approach:

- Observe longer!
- Precise and stable photometry
- Observe bright stars, so candidates can be confirmed with radial velocities



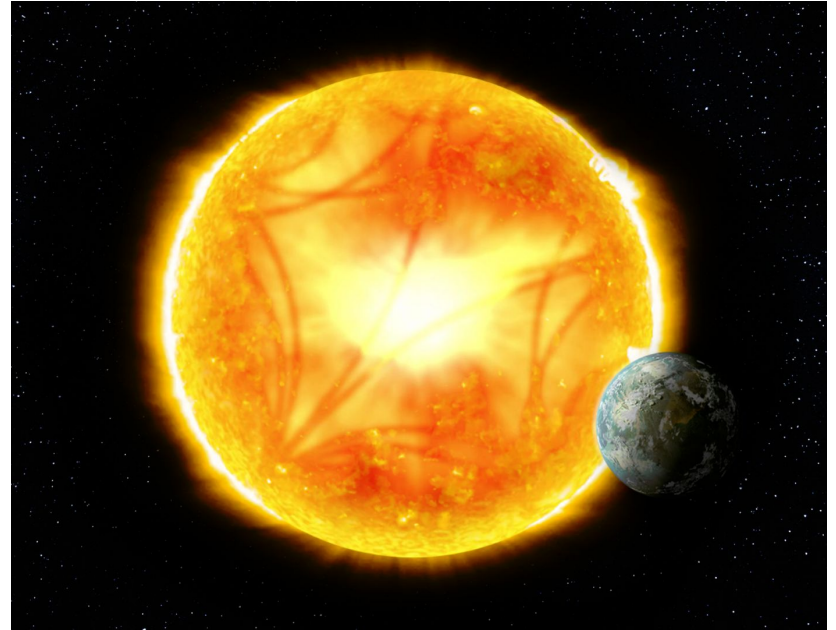
... around Sun-like stars ...

PLATO will characterise the host stars using *asteroseismology*

- Direct probe of the star's interior
- **Age**, size, mass

Measured *oscillation frequencies* are interpreted using empirical 'scaling' relations and models

- Extensive prep work ongoing
- Models and pipelines need *calibrating*



... and cool stars!

PLATO will also look for planets around **M dwarfs** – currently over 15,000 in first target field

Benefits:

- Small – easier to detect Earth-like planets
- Numerous – most stars are M-dwarfs
- Long lifetimes

Challenges:

- Small and faint!
- Complex spectra
- No asteroseismology
- Often magnetically active, with flares



NASA Goddard Space Flight Center

MSteSci1-dM

Module Stellar Science 1 - M dwarfs

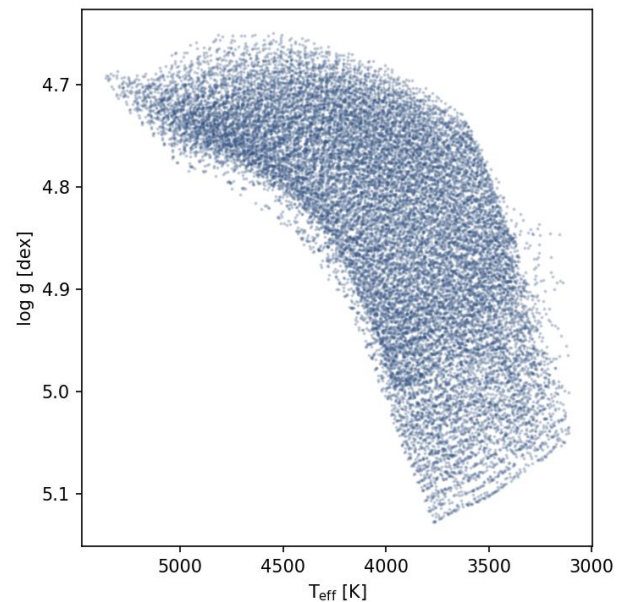
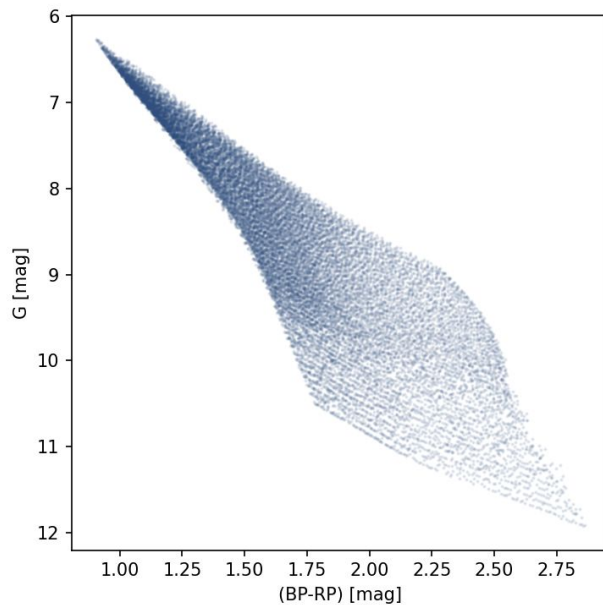
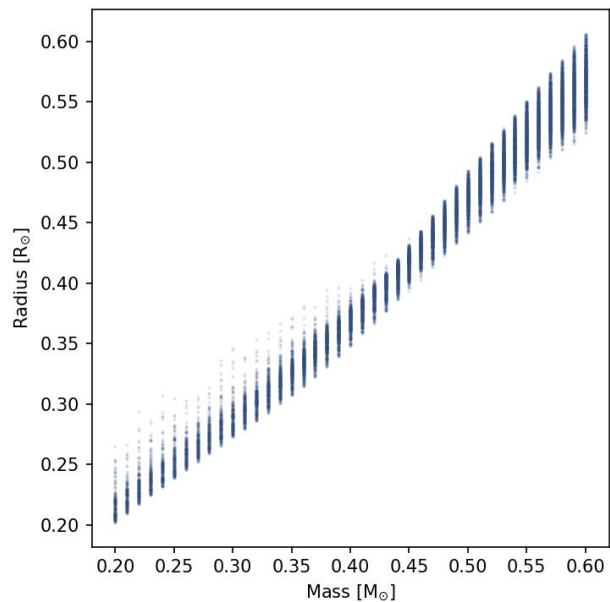
Photometry

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graph TD; A[Photometry] --> B[Spectroscopy]; B --> C[Bayesian];
```

Spectroscopy

Bayesian

Grid of BASTI stellar evolution models



Mass: 0.2 – 0.6 M_{\odot}
[Fe/H]: -1.55 – 0.42 dex
Age: 0 – 20 Gyr

From observables to likelihoods

Observed magnitudes in each band



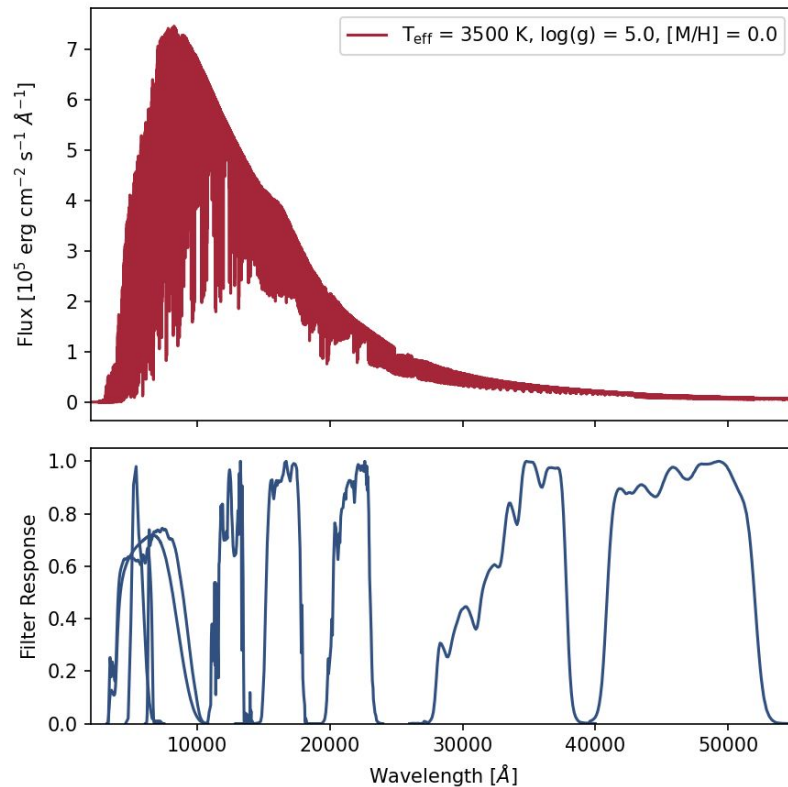
De-reddened **absolute magnitudes**, accounting for uncertainties in distance and extinction



Calculate **likelihood** of each point in model grid



Best estimates for T_{eff} , $\log g$, radius, mass, etc.



MSteSci1-dM

Module Stellar Science 1 - M dwarfs

Photometry

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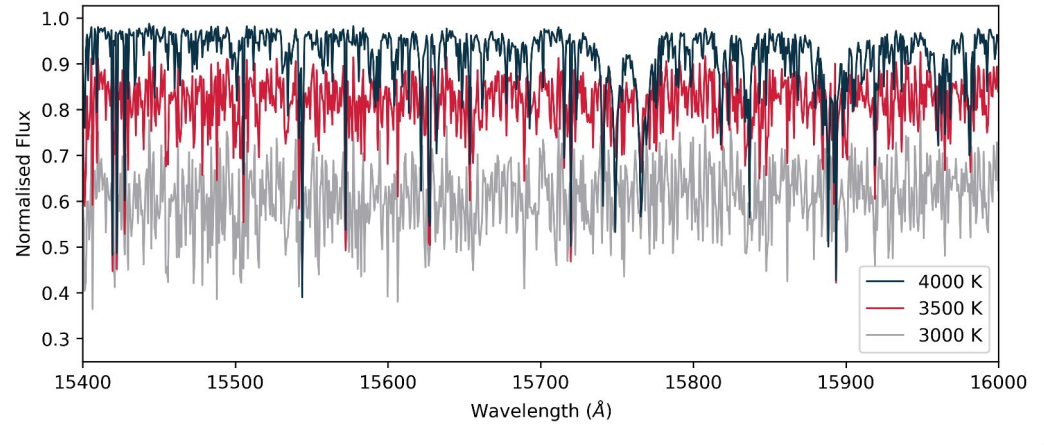
Spectroscopy

Bayesian

Spectroscopy of M dwarfs

M dwarfs are cool → molecules → complex!

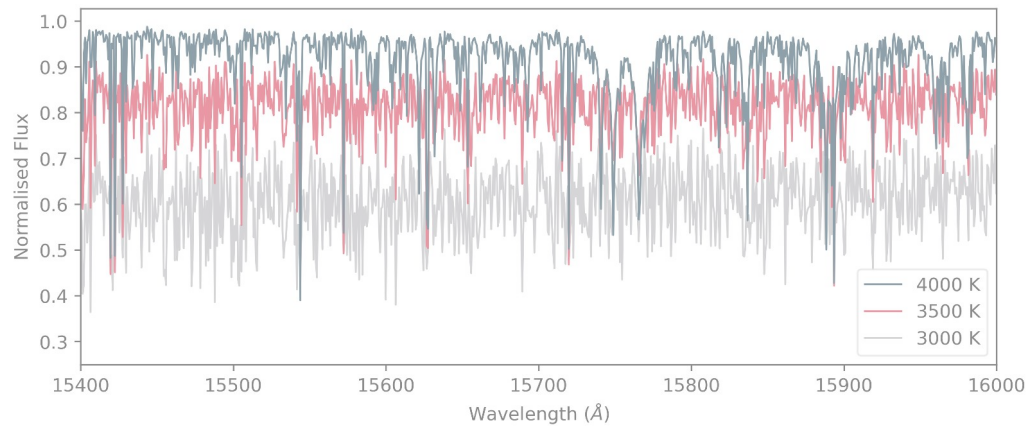
- Use near-infrared spectra (APOGEE)
- But where is the continuum?



Spectroscopy of M dwarfs

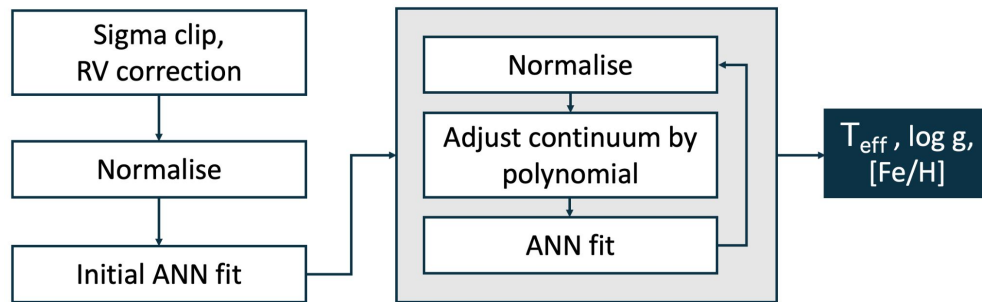
M dwarfs are cool → molecules → complex!

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Our procedure:

- Use an **Artificial Neural Network** (ANN) trained on model spectra
- Find the continuum **iteratively**, with a lookup grid of polynomials



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Module Stellar Science 1 - M dwarfs

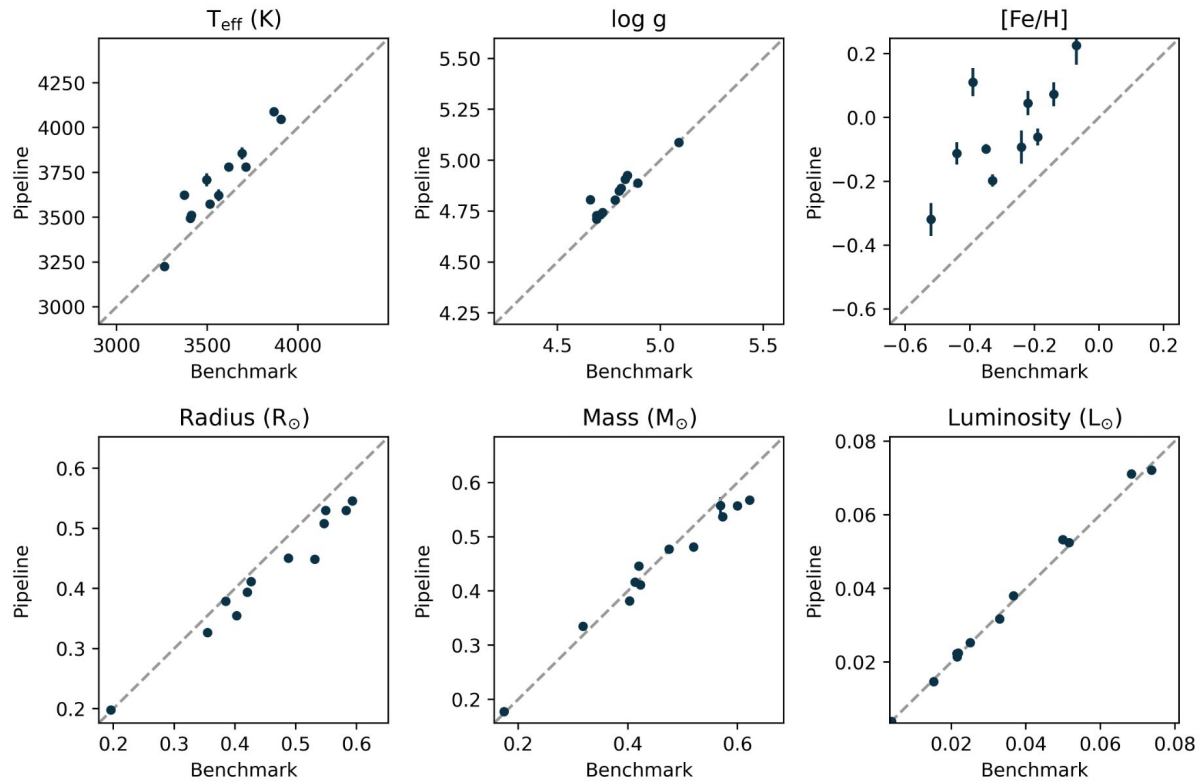
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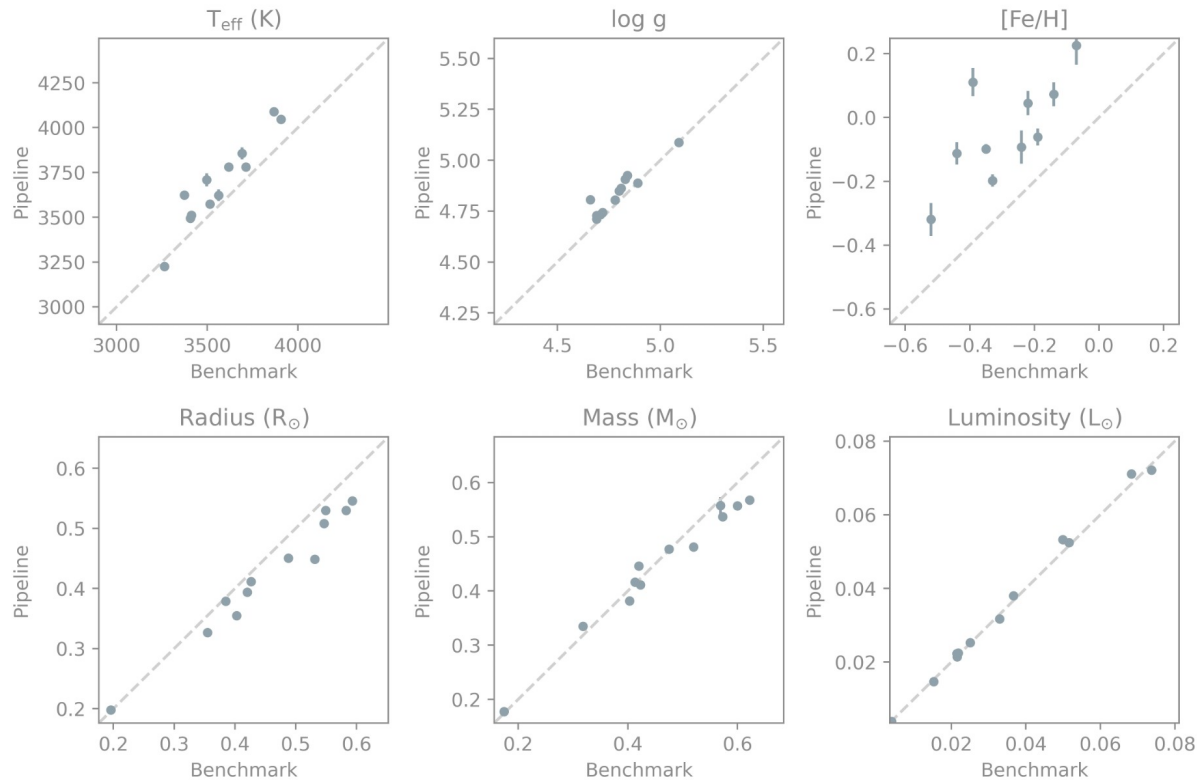
Spectroscopy

Bayesian

Pipeline performance



Pipeline performance ... and next steps



Current status:

- ✓ First version fully implemented
- ✓ Basic tests complete
- ✓ Photometry models upgraded

Next steps:

- Train and validate new ANN model
- Test, test, test!

Summary

- PLATO will search for Earth twins around Sun-like stars *and M dwarfs*
- We need a solid stellar science foundation to constrain the exoplanet science:
 - “*Know thy star, know thy planet*”
- Pipeline for characterising M dwarfs observed by PLATO is being developed at Uppsala
- We’re assembling a sample of benchmark stars for testing models, pipelines and more
- ***PLATO is launching very soon!***

**Thank you!
Questions?**

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