HARPS-N fills the mass-radius diagram for small planets

Ultra-short period planets get characterised...

K2-141b - 0.2803244 d - 1.51 R⊕ - 5.08 M⊕ (Malavolta et al. 2018)

Kepler-78b - 0.3550 d - 1.173 R⊕ - 1.86 M⊕ (Pepe et al. 2013)

TOI-561b - 0.446578 d - 1.423 R⊕ - 1.59 M⊕ (Lacedelli et al. 2021)
as well as the longest period planets.

K2-263b - 50.8 d - 2.41 R_⊕ - 14.8 M_⊕ (Mortier et al. 2018)

TOI-561e - 77.2 d - 2.67 R_⊕ - 16.0 M_⊕ (Lacedelli et al. 2021)

Kepler-538b - 81.73778 d - 2.215 R_⊕ - 10.6 M_⊕ (Mayo et al. 2019)
Large planets prefer high metallicity (not clear what happens at lower end). Small planets seem to have no metallicity preference.
Metallicity is complicated

"Iron"-poor stars are enhanced in alpha-elements (Mg, Si, C, ...). How does this influence their orbiting planets?

See also Adibekyan et al. 2012, 2021; Dorn et al. 2015, 2017; and Bonsor et al. 2021.

(reproduced from Buder et al. 2021 - GALAH+ survey results)
TOI-561 - system with many secrets

Are there 3 or 4 transiting planets? (Lacedelli et al. 2021)
TOI-561 b has an unusually low density

Small ultra-sort period planets should not retain a large atmosphere. Does TOI-561 b have a large water envelope or a much smaller iron core? (Lacedelli et al. 2021)
Independent RV extraction (Rajpaul et al. 2020) and in-depth stellar activity modeling (Rajpaul et al. 2015) using Polychord (Handley, Hobson & Lasenby 2015) led to the extraction of the smallest significant RV semi-amplitude ($1.22 \pm 0.31$ m/s) with HARPS(-N) data.
**K2-111b - iron-poor planet around iron-poor star**

\[ R_{p,b} = 1.82 \pm 0.1 \, R_\oplus \quad \text{and} \quad M_{p,b} = 5.29 \pm 0.77 \, M_\oplus \]

Iron core with a mass fraction of around 10% in a two-layer model;

Consistent with its iron-poor, alpha-enhanced host star.

Non-transiting planet in near-resonance: \[ M_{p,c} = 11.3 \pm 1.1 \, M_\oplus \]

(Mortier et al. 2020)
Conclusions - small planets are fun! (but hard)