

PRECISE MASS REFINEMENT OF THREE SUB-NEPTUNE SYSTEMS FROM RADIAL VELOCITY OBSERVATIONS



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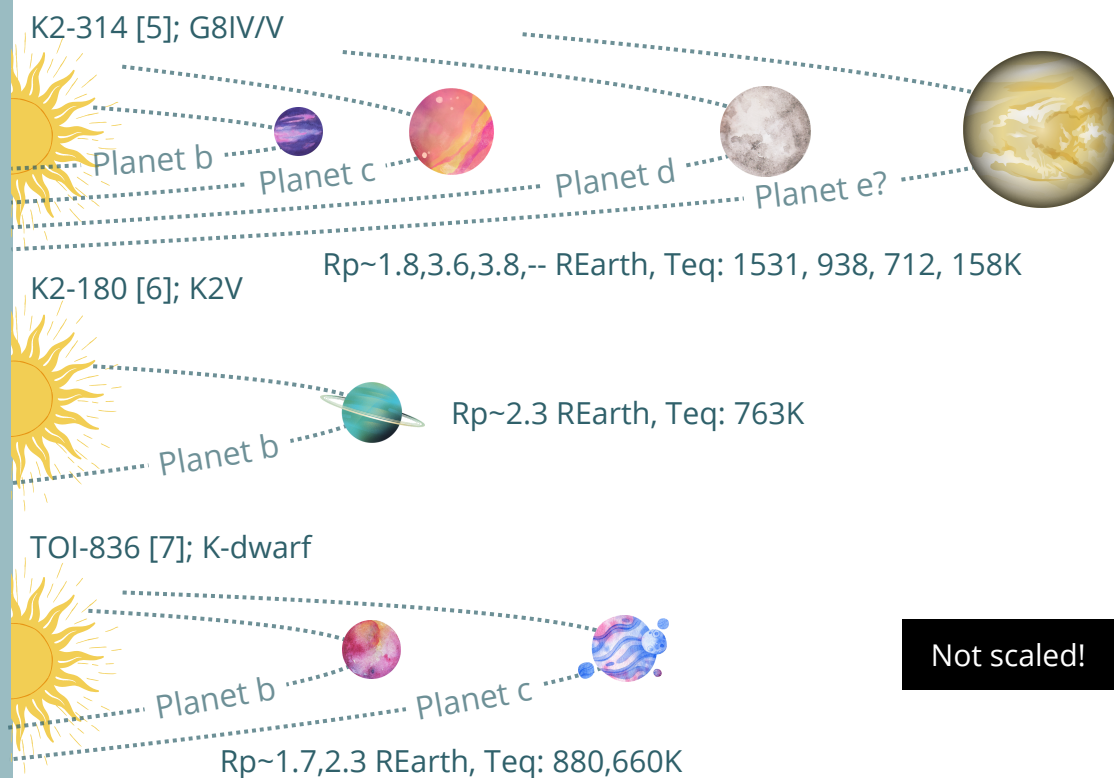
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THIRSTEE PROGRAMME

The nature of the most common planets in our Galaxy [1,2], the sub-Neptune planets, is still in discussion. This planet population presents two radius distribution, known as the “radius valley”. The radius valley could be explained with different atmospheric evolution scenarios [3]. However, other alternative explanation proposes that sub-Neptune planets could be formed by a rock-iron mixture, planets with a water-rock mixture (water worlds), or planets with a H/He envelope [4].

The Tracking Hydrates In Refined Small Transiting Exo-Earths (THIRSTEE) is a succesful programme which wants to answer if water worlds exists, and if they do, how do their properties depend on the host's spectral type.

EXPLORED SUB-NEPTUNE SYSTEMS



RESULTS

Table 1: Planetary Parameters for the three sub-Neptune systems.

Planet	Period [d]	t_0 [BTJD] ^[a]	K [m/s]	R_p [R_\oplus]	M_p [M_\oplus]
<i>K2-314</i>					
Planet b	$3.5954^{+0.0002}_{-0.0001}$	3161.396 ± 0.001	$3.35^{+0.32}_{-0.33}$	1.81 ± 0.08	$8.33^{+0.81}_{-0.84}$
Planet c	15.624 ± 0.001	3165.8417 ± 0.0002	3.75 ± 0.37	3.56 ± 0.13	$15.14^{+1.59}_{-1.55}$
Planet d	$35.743^{+0.006}_{-0.008}$	3175.6523 ± 0.0004	2.13 ± 0.32	3.88 ± 0.13	$11.32^{+1.76}_{-1.70}$
Planet e?	2854^{+177}_{-285}	4328^{+44}_{-65}	$23.13^{+4.16}_{-6.24}$	-	536^{+24}_{-23}
<i>K2-180</i>					
Planet b	8.86563 ± 0.00002	7143.400 ± 0.002 ^[b]	$3.63^{+0.65}_{-0.66}$	2.34 ± 0.14	$11.13^{+2.31}_{-2.18}$
<i>TOI-836</i>					
Planet b	3.81673 ± 0.00002	1599.9944 ± 0.0003	$2.66^{+0.42}_{-0.44}$	$1.72^{+0.21}_{-0.19}$	$4.92^{+0.89}_{-0.86}$
Planet c	$8.59532^{+0.00008}_{-0.00007}$	1599.7622 ± 0.0003	$3.79^{+0.75}_{-0.74}$	2.30 ± 0.21	$9.17^{+1.98}_{-1.85}$

^[a] BJD-2457000, ^[b] BJD-2450000.

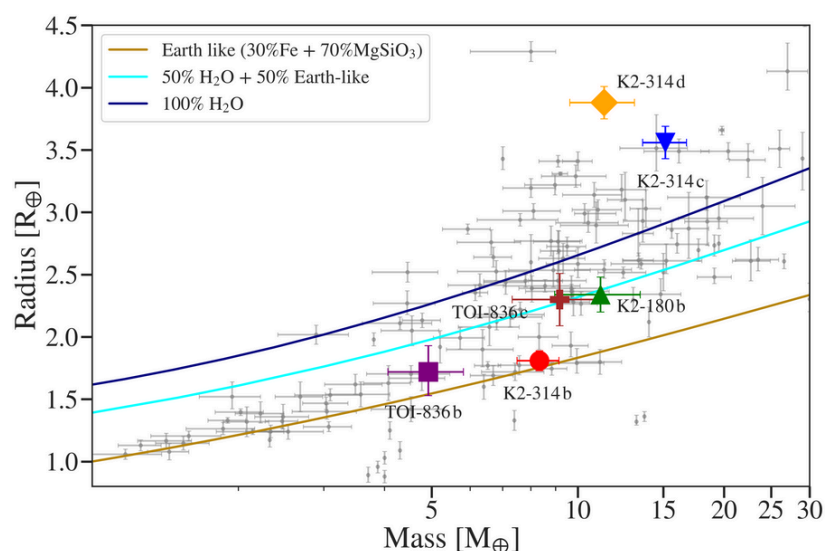


Figure 1: Mass and Radius diagram for the three sub-neptunes planetary systems. The gray dots are confirmed exoplanets from NEA.

DISCUSSION AND CONCLUSIONS

In this work, we combined new RV dataset and public dataset from the archive. For K2-314 the instruments used were: CARMENES, HARPS, HARPN, and ESPRESSO; for K2-180 were used HARPS, FIES, and ESPRESSO; for TOI-836 were used HARPS, HARPN and PFS.

The masses calculated for the planets orbiting K2-314 have high precision for all the planets (>2%). Moreover, with the new dataset we propose a new planet candidate. In K2-180b the mass uncertainty arises, probably because the new analysis includes a more realistic model (e.g. including eccentricity). TOI-836 b, and c present a challenge to produce a joint fit model. The preliminary suggest the presence of a trend, and TTVs that complicate the analysis.

REFERENCES AND ADITIONAL FIGURES

- [1] Bathala et al. 2013; [2] Marcy et al. 2014; [3] Dai et al. 2019; [4] Luque & Pallé 2022; [5] Hidalgo et al. 2020; [6] Korth et al. 2018; [7] Hawthorn et al 2023.

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