A HOT MINI-NEPTUNE IN THE RADIUS VALLEY ORBITING SOLAR ANALOGUE HD 110113

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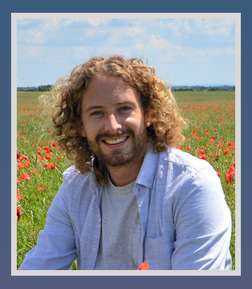
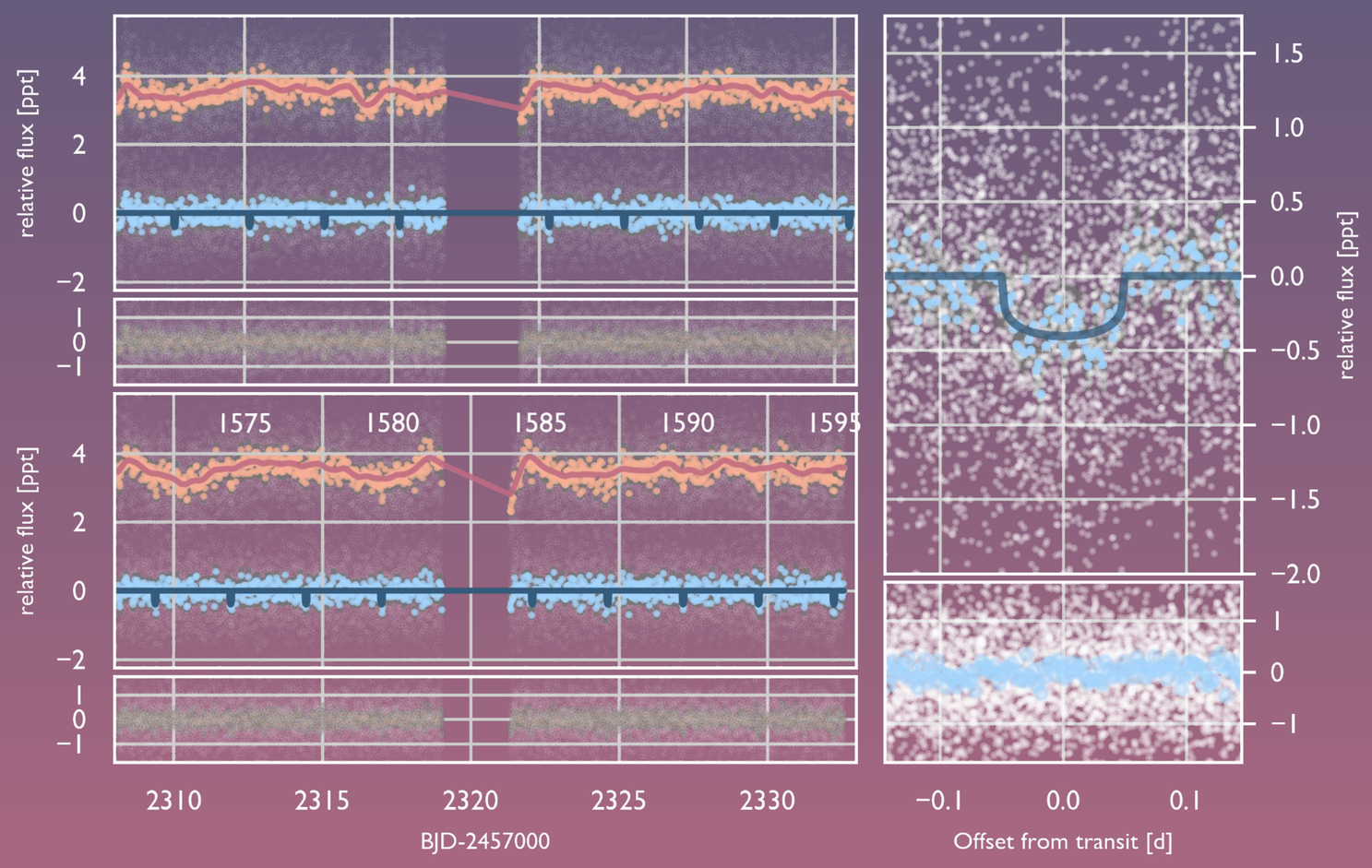


@exohugh

TESS PHOTOMETRY

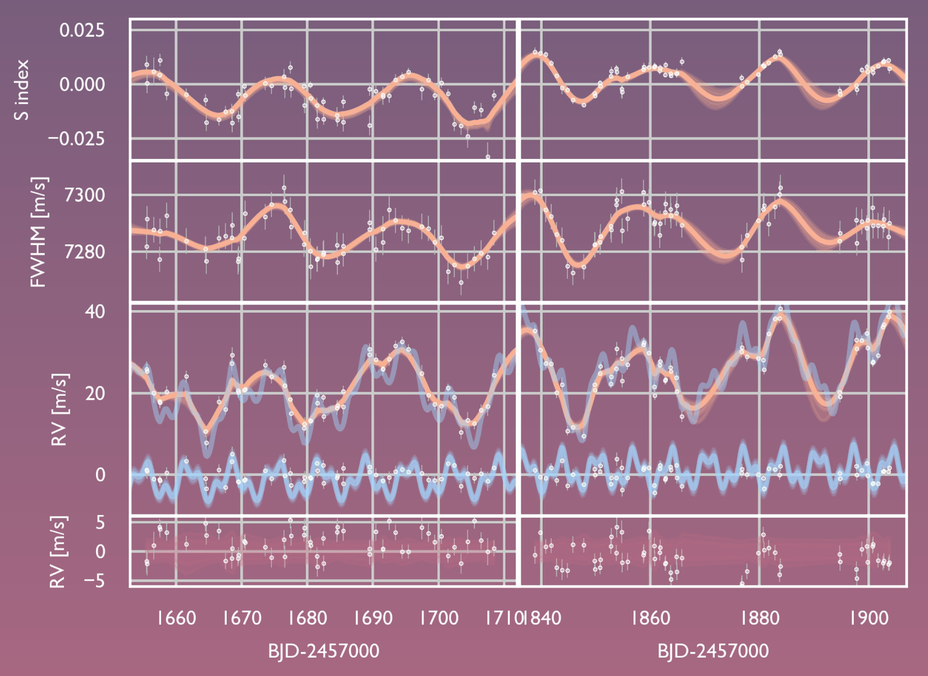
SPOC detected a 400ppm-deep candidate signal around HD 110113 in sector 11, becoming **TOI-755**. It was re-observed in S37, and we have re-analysed the photometry here.



HARPS RVs & GP MODEL

Our 114 HARPS RVs showed activity with a rotation period of 21d. Linear decorrelation with activity indices revealed two clear RV periodogram peaks - at 2.54 & 6.7d.

We co-fitted a GP rotation kernel on RVs, S-index and FWHM. The activity time-series constrain the stellar rotation signal & prevent the GP from overfitting planetary signals.



DERIVED STELLAR & PLANETARY PROPERTIES

	HD 110113	
Rs ($R_\odot$)	0.968	±0.018
Ms ($M_\odot$)	0.997	±0.06
Teff (K)	5732	±50
log g (cgs)	4.46	±0.05
Age (Gyr)	4.09	±0.75

	HD 110113 b		HD 110113 c	
Period (d)	2.540476	±0.000014	6.732	±0.005
Epoch (TJD)	1570.1023	±0.0027	1798.01	±0.25
Radius ($R_\oplus$)	2.06	±0.09	-	-
Mass ($M_\oplus$)	4.5	±0.68	10.5	±1.1
Density (gcm^{-3})	2.9	±0.6	-	-

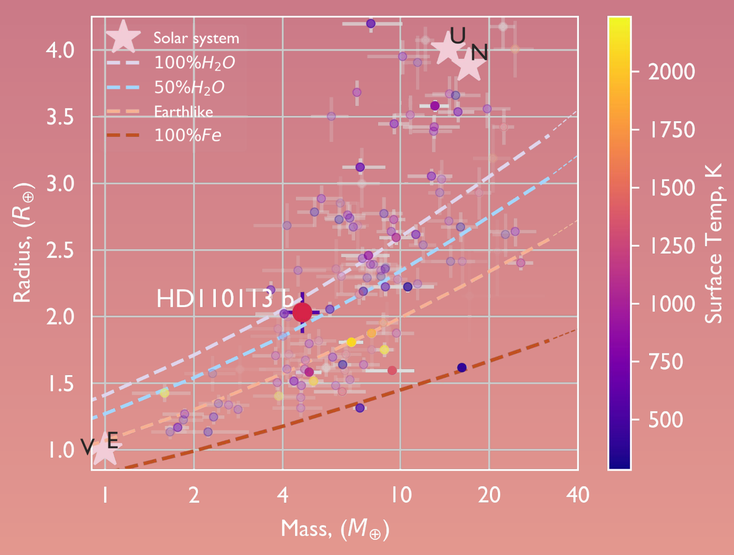
ADDITIONAL TFOP DATA

Ground-based photometry with LCO helped rule out nearby stars as the source of the transit.

High-resolution imaging from SOAR and Gemini/Zorro ruled out nearby close stellar companions.

Archival WASP photometry also revealed variability at 21d

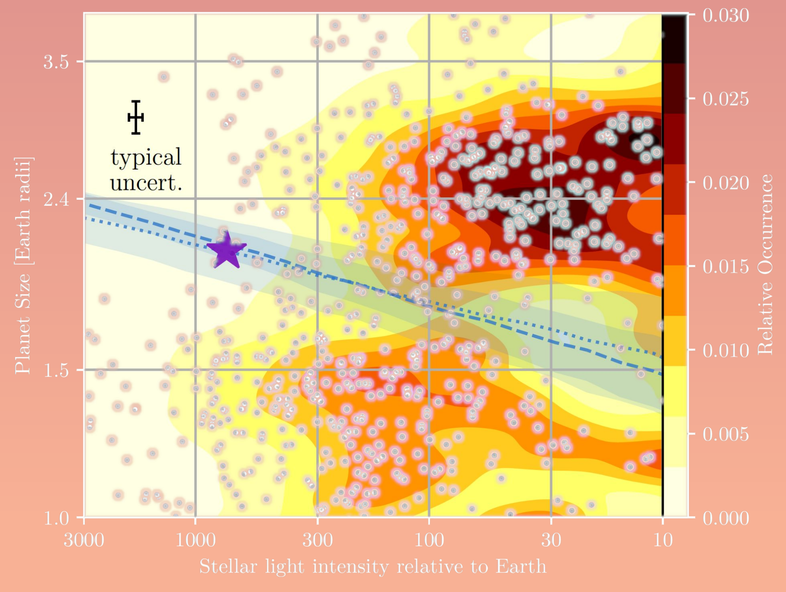
DISCUSSION



The precise radius & mass from photometry (10% error) & RVs (15% error) produce a well constrained planetary density of 2.9±0.6gcm^{-3}. This makes it one of the lowest density worlds known with M_p<5$M_\oplus$ (figure left)

Compositional models show that HD 1110113 b has retained a gaseous envelope of ~1% by Mass.

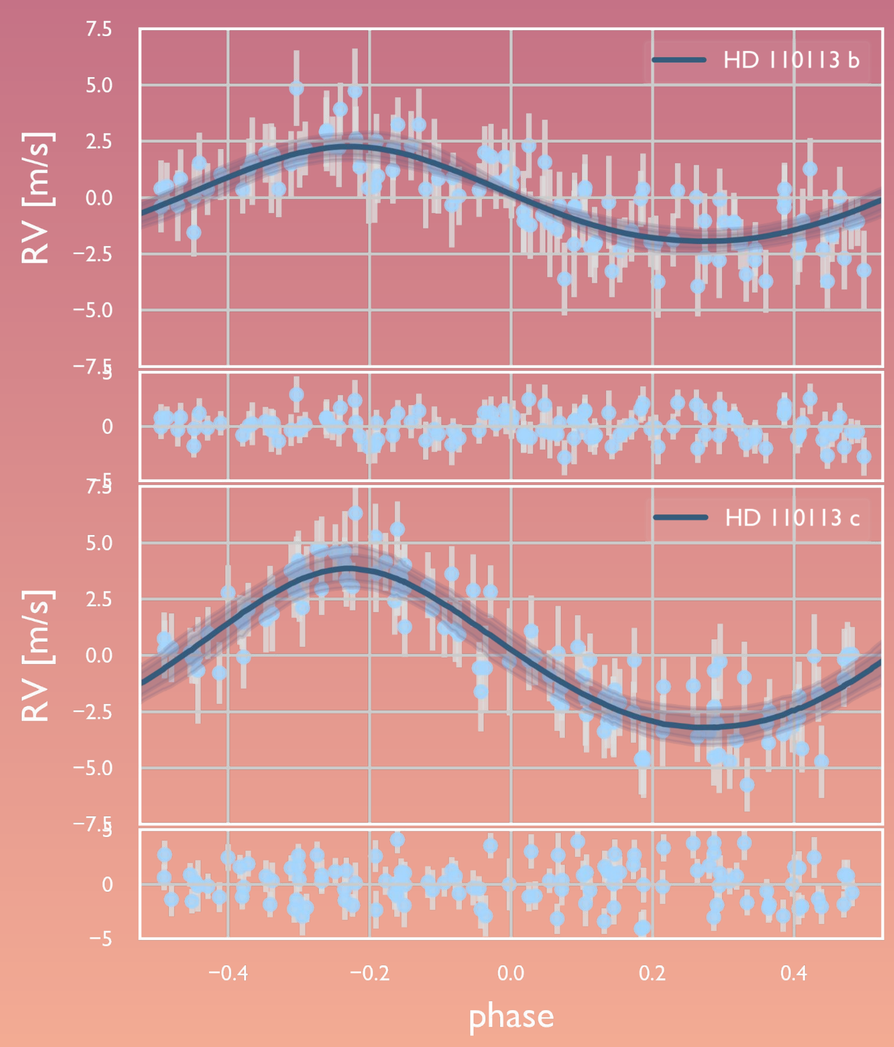
HD 110113 b's low-density is unusual as the planet receives extremely high-insolation (~1MWm^{-2}), putting it inside the "Radius Valley" between gaseous mini-Neptunes & rocky super-Earths (figure below).



Either HD 110113 b degassed a substantial secondary atmosphere after being stripped, or it began with a thick H-He envelope and managed to retain a small fraction of it despite significant heating.

HD 110113 b is among the top 5% small planets (Rp<4$R_\oplus$) for transmission & emission spectroscopy with JWST, therefore its formation pathway may be answerable in the near future.

HD 110113 c



RVs revealed a strong periodogram peak at 6.732±0.005d, corresponding to Mp sin i=10.5±1.1Me. Bayesian model comparison favours a 2-planet model (ΔBIC=16.3). TESS shows no transit so HD 110113 c must be non-transiting & potentially mis-aligned.

REFERENCE: **A hot mini-Neptune in the radius valley orbiting solar analogue HD 110113** (2021) , Osborn et al, MNRAS

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