XO-Mass: Fundamental Astrophysical Parameters of Exoplanet Hosting Stars

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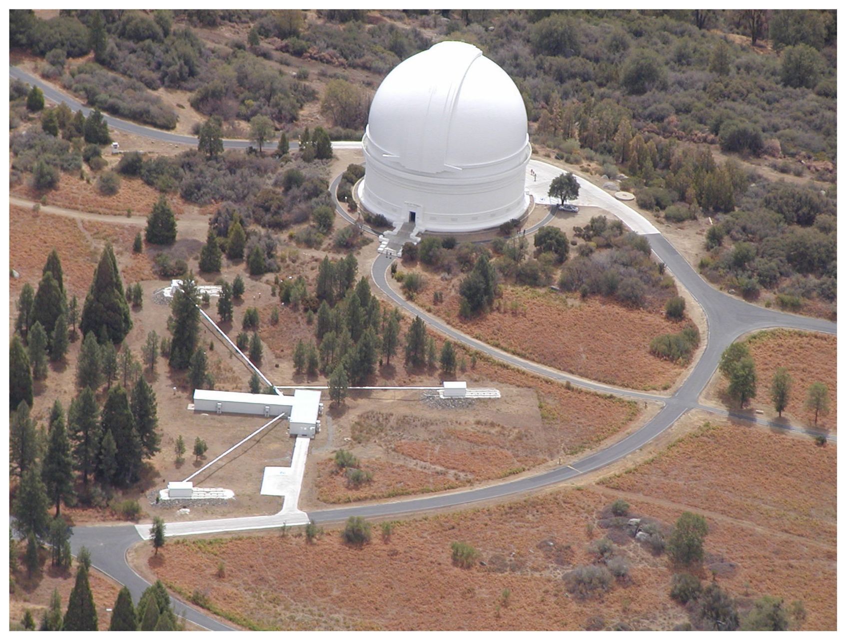
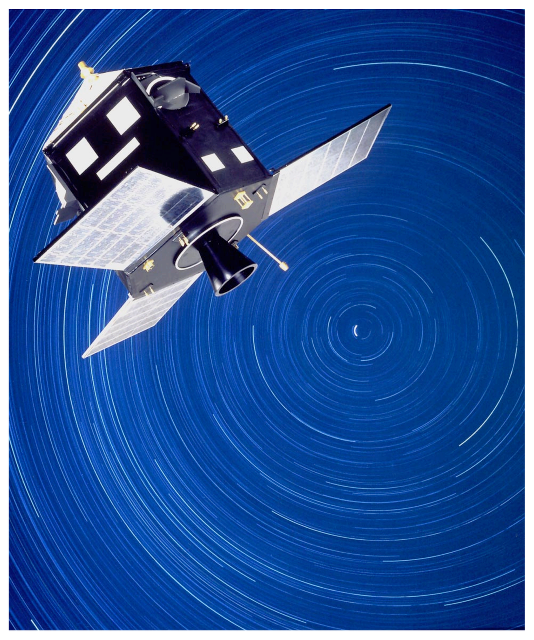
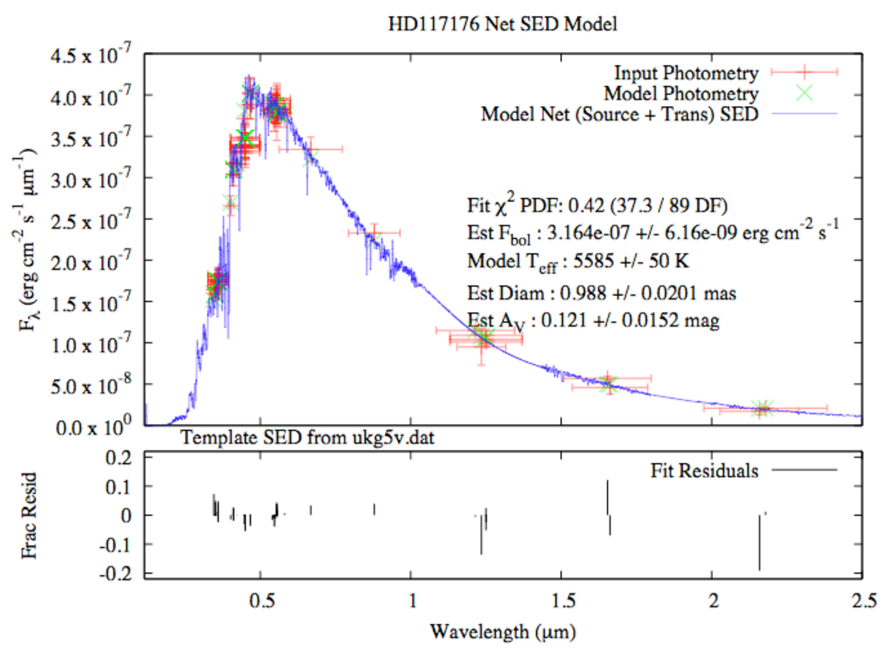
Abstract & Introduction: Formation, evolution, and radiation environment of extrasolar planets are sensitively dependent on the astrophysical properties of the respective parent star, including location and size of the habitable zone. The determination of these stellar astrophysical parameters is therefore critical to insights into exoplanet characterization. We use data obtained with the Palomar Testbed Interferometer (PTI) coupled with Hipparcos parallaxes to directly measure linear radii of about 15 nearby, bright exoplanet hosting stars. The knowledge of stellar radii allows for determination of effective temperatures by means of spectral energy distribution fitting. Finally, we use literature log g values, combined with our directly determined radii, to determine stellar masses.



The Palomar Testbed Interferometer in 2007. PTI operated mostly in *H* and *K* bands. Maximum baseline length = 110m. Interferometric observations provide **Angular Diameters (Θ)** of Exoplanet Host Stars. *Photo credit: G. T. van Belle.*



The Hipparcos Satellite. Trigonometric parallax measurements provide **Distances (D)** to Exoplanet Host Stars. *Image credit: ESA*



Spectral Energy Distribution Fitting. Literature photometry and Pickles (1998) spectral templates provide **Bolometric Flux (F_{BOL})** of Exoplanet Host Stars.

1. Linear Radii: Combination of **Distances** and **Angular Radii**.

$$R_{linear} \sim D * \theta$$

2. Effective Temperatures: Combination of **Bolometric Fluxes** and **Angular Radii**.

$$T_{eff} \sim \left(F_{bol} / \theta^2\right)^{1/4}$$

3. Stellar Masses: Combination of (literature) **Surface Gravities** & **Linear Radii**.

$$\log g \sim \log\left(\frac{GM_{star}}{R_{linear}^2}\right)$$

Results

HD	other name	number of known planets	PTI ang. diam.	PTI ang. diam. uncertainty	fract. err	parallax	parallax error	distance	linear radius	linear radius error	spectral type (NStED, ref. 1, ref. 2)	Fbol	Fbol uncertainty	Teff	Teff uncertainty	log g (ref. 3)	log g (ref. 4)	mass	mass error	CHARA ang diameter (ref. 2)	CHARA error (ref. 2)
			[mas]	[mas]		[mas]	[mas]	[pc]	[Rsun]	[Rsun]		[10e-8 erg cm^-2 s^-1]	[10e-8 erg cm^-2 s^-1]	[K]	[K]			[Msun]	[Msun]	[mas]	[mas]
3651	gj 27	1	0.697	0.077	11%	90.03	0.72	11.11	0.83	0.09	K0V	13.84	0.23	5408	300	4.45		0.71	0.18	0.79	0.027
9826	ups and	3	1.054	0.056	5%	74.25	0.72	13.47	1.52	0.08	G0	60.68	0.91	6364	171	4.25	4.26	1.51	0.24		
13189		1	0.673	0.130	19%	0.54	0.93	1852	134	233	K2	6.85	0.27	4617	448						
19994	gj 128 a	1	0.799	0.135	17%	44.69	0.75	22.38	1.91	0.32	G0V (F8V)	26.61	0.95	5948	505	4.24	4.07	1.91	0.75	0.788	0.026
22049	eps eri	1	1.958	0.043	2%	310.75	0.85	3.22	0.67	0.01	K2V	108.00	1.06	5393	61	4.57		0.47	0.06		
28305	eps tau	1	2.460	0.047	2%	21.04	0.82	47.53	12.52	0.25	K0III	127.10	2.03	5012	52		2.47	1.61	0.20		
38529		2	0.801	0.069	9%	23.57	0.92	42.43	3.64	0.31	G8III-IV	13.92	0.49	5052	222	4.05	3.68	3.54	1.62		
75732	55 Cnc	5	0.756	0.072	9%	79.8	0.84	12.53	1.01	0.10	K0IV-V (G8V)	13.32	0.26	5144	246	4.45	4.48	1.09	0.21	0.854	0.024
95128	47 Uma	3	0.842	0.066	8%	71.04	0.66	14.08	1.27	0.10	G0	28.33	0.92	5886	236	4.38		1.41	0.27		
117176	70 Vir	1	0.993	0.058	6%	55.22	0.73	18.11	1.93	0.20	G0	31.64	0.62	5572	165	4.07	4.04	1.53	0.32		
120136	tau Boo	1	0.865	0.065	7%	64.12	0.7	15.60	1.44	0.11	F5	49.49	1.33	6676	255	4.26	4.25	1.37	0.21		
142091	kap CrB	1	1.469	0.046	3%	32.13	0.61	31.12	4.89	0.17	K0III-IV	43.68	1.01	4965	83		3.02	0.91	0.12		
143761	rho CrB	1	0.684	0.078	11%	57.38	0.71	17.43	1.28	0.15	G0V	20.05	0.41	5990	343	4.36	4.2	1.13	0.33	0.686	0.044
167042		1	0.748	0.083	11%	20	0.51	50.00	4.00	0.45	K0	14.00	0.60	5236	296		3.17	0.86	0.22		
188310	Xi Aql	1	1.616	0.045	3%	15.96	1.01	62.66	10.84	0.30	K0	48.63	1.44	4863	77		2.49	1.32	0.17		
190360	GJ 777a	2	0.723	0.074	10%	62.92	0.62	15.89	1.23	0.13	G7 IV-V	16.38	0.37	5539	285	4.38	4.35	1.28	0.27		
199665	18 Del	1	0.959	0.060	6%	13.68	0.7	73.10	7.50	0.47	K0 (G6III)	20.51	1.04	5087	172		2.88	1.56	0.26	1.111	0.028
210702		1	0.773	0.071	9%	17.88	0.74	55.93	4.63	0.43	K0 (K1III)	14.27	0.43	5175	241		3.12	1.03	0.23	0.875	0.018
217014	51 Peg	1	0.689	0.078	11%	65.1	0.76	15.36	1.13	0.13	G3V	17.94	0.18	5804	329	4.45	4.32	1.14	0.31	0.748	0.027
221345	14 And	1	1.406	0.047	3%	13.09	0.71	76.39	11.50	0.39	K0 (G8III)	33.68	1.33	4756	92		2.59	1.88	0.25	1.336	0.009

Table Notes:

1. Principal Results are in Blue Font.
2. References in Table: (1) van Belle & von Braun 2009, (2) Baines et al. 2008, (3) Valenti & Fischer (2005), (4) Allende-Prieto & Lambert (1999).
3. Parallax values from Hipparcos.
4. Spectral types from NStED (http://nsted.ipac.caltech.edu) or van Belle & von Braun (2009); spectral types in parentheses from Baines et al (2008).
5. log g values are averaged wherever available; uncertainty = half the difference (or = 0 if only one value present).
6. Last two columns are for comparison purposes; taken from Baines et al. (2008).

References:

Allende-Prieto, C. & Lambert, D. L. 1999, A&A, 352, 555
Baines, E. K., et al. 2008, ApJ, 680, 728
Pickles, A. J. 1998, PASP, 110, 863
Valenti, J. A. & Fischer, D. A. 2005, ApJS, 159, 141
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