ARIEL Space Mission

The ExoClock Project – Version 7.1

Originated 2021 March 3

Contents

1.0 Introduction

The Exoplanet Division is participating in a pro-am project supporting the ARIEL space mission with ground-based exoplanet observations. This is a great opportunity to get started in exoplanet transit observations and make a significant contribution to the mission.

The objective of this document is to encourage participation in this project and provide help in installing the Python/HOPS software, imaging and generating transit light-curves.

Data for an initial selection of target stars is shown in the appendices. More can be found on the ExoWorlds Spies Transit Scheduler.

Mark Salisbury is our contact point with Ariel for this project.

2.0 The ARIEL space mission

The mission website is at ARIEL Space Mission - https://arielmission.space/
ARIEL will use transit spectroscopy to characterise the atmospheres of ~1000 exoplanet.

Relevant documentation;
ESA Assessment Study Report - https://sci.esa.int/documents/34375/36249/1567260310680-ESA_SCI-2017-2_ARIEL.pdf
A chemical study of exoplanets with ARIEL - https://link.springer.com/article/10.1007/s10686-018-9598-x

2.1 The ExoClock project

Ground-based exoplanet observations in support of the ARIEL space mission - https://www.exoclock.space/project

There is a need to confirm the ephemerides, transit times, of the approximately 1000 ARIEL targets. Some of these targets will not have been observed for a several years, therefore their

predicted transit times could be in error and thus missed by ARIEL when imaging that particular event.

The project offers observers;
- ephemerides
- target prioritisation with alert system
- personalised observation schedule
- direct publications for participants
- continuous feedback to observers

To participate;
- register you telescope and sign up at https://www.exoclock.space/users/signup/
- Log in at https://www.exoclock.space/users/login/
- register you telescopes and check your schedule at https://www.exoclock.space/project
- observe a transit; beginners guide at https://exoworldsspies.com/en/observers/
  analyse your observation; software at https://exoworldsspies.com/en/software/
- upload your light curve; login required

A transit light-curve of WASP-52b obtained by Steve Futcher, Hampshire Astronomical Group, and Portsmouth University students is shown in Figure 2.1.1. It can also be viewed on the ExoClock Observations webpage at https://www.exoclock.space/database/observations

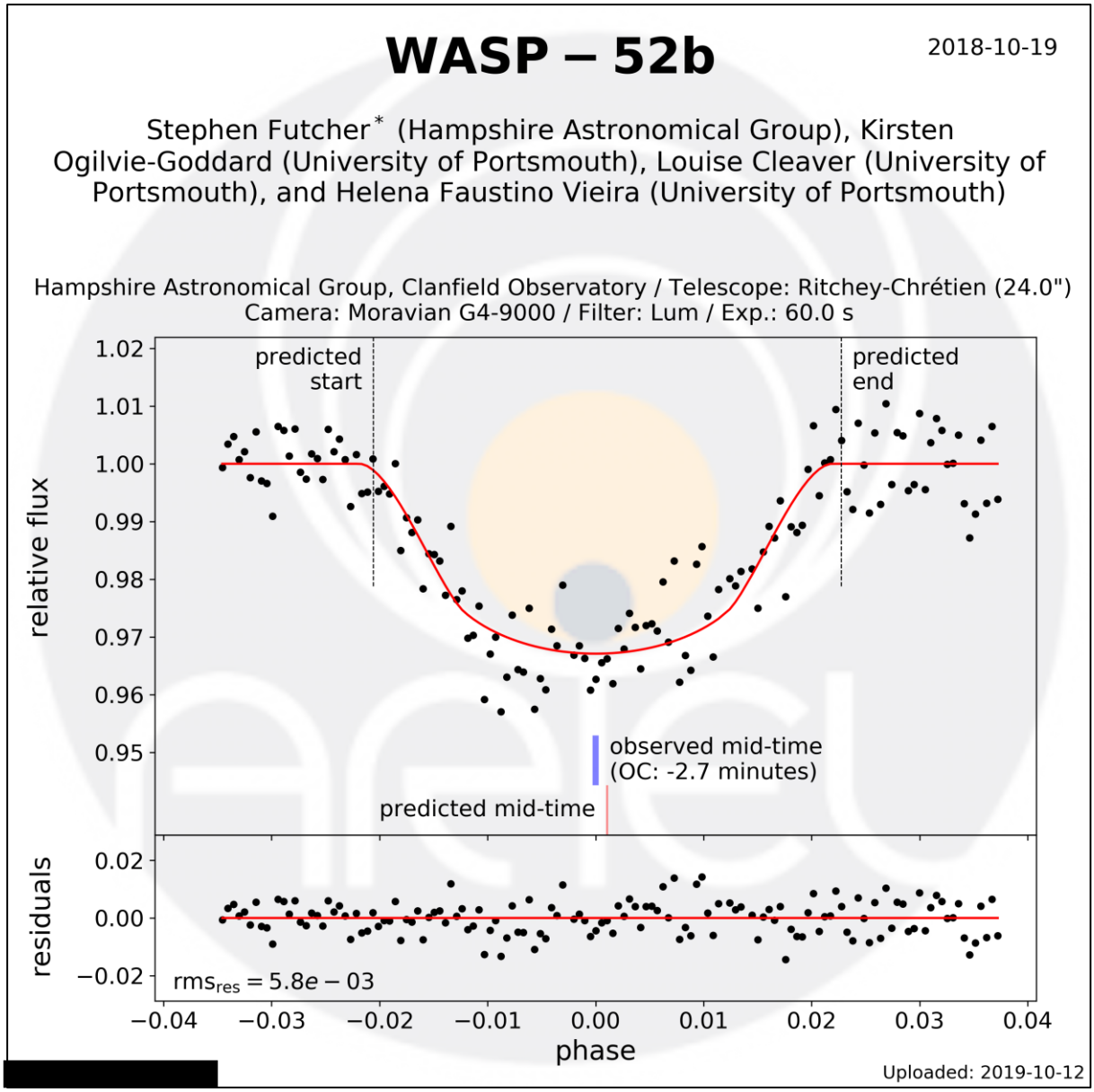


Figure 2.1.1. WASP-52b transit light-curve

You don't have to own your own telescope to participate. Martin Fowler and myself use the MicroObservatory robotic telescope to obtain a light-curve of HAT-P-32b – Figure 2.1.2. It can also be viewed on the ExoClock Observations webpage at https://www.exoclock.space/database/observations

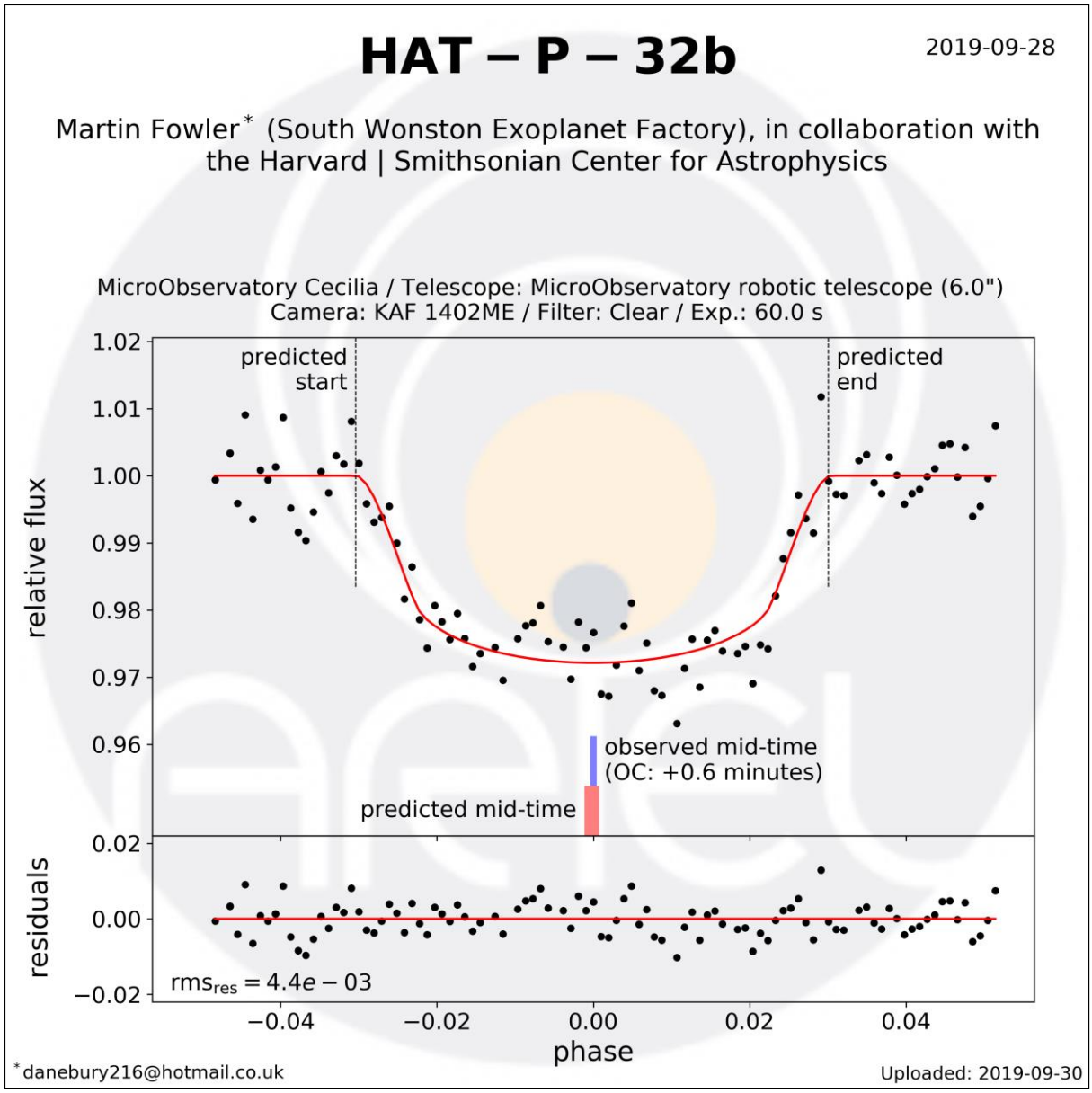


Figure 2.1.2. HAT-P-32b transit light-curve

Accessing the ExoClock Ephemerides page for a specific exoplanet, in this example HAT-P-32b, shows an O-C plot – Figure 2.1.3. The shaded area shows the uncertainty of the ephemeris as a function of time, the red dots indicate observations submitted to the ExoClock database and the blue circle shows the requirement for ARIEL.

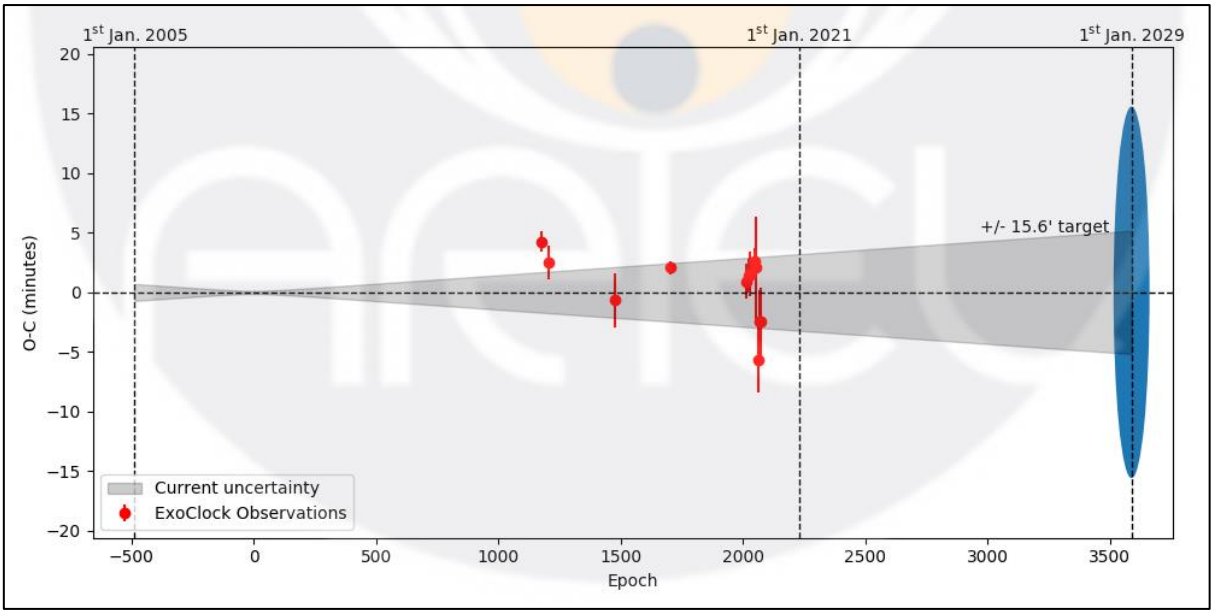


Figure 2.1.3 Observed vs Calculated plot for HAT-P-32b

2.2 ExoWorlds Spies

Website at www.exoworldsspies.com. Here observers can find information on;
- installation and use of HOPS software (Software and For observers) – see Appendix B
- practice targets (NAV/For observers) – see Appendix C

3.0 Imaging and analysis process

The ExoWorlds Spies website Observing an exoplanet transit webpage describes the ExoClock projects preferred imaging process. Note that a clear or no filter can be used – many of the observations on the ExoClock Observations database were so obtained. There is a link to the HOPS user manual – HOPS is the software to be used for image analysis.

It may help observers to obtain consistent results if comparison stars are defined for the ARIEL targets - https://www.exoclock.space/database/planets See appendix A for finder charts (Guide) and comparison stars plus a link to the relevant entry in the Exoplanet Transit Database. Transit times can be obtained from the ExoWorlds Spies Transit Scheduler, the Exoplanet Transit Database or Find Exoplanet Transits

4.0 ARIEL targets

4.1 Target selection

A number of targets suitable for Northern and Southern hemisphere observers have been selected and finder charts and comparison star data included in the appendices. The objectives of providing comparison stars are;
- identify stars of similar magnitude and colour (B-V) where possible
- provide a spread across the image
- ensure consistency of observations

While these objectives are an ideal case not all of them could be met for any specific target. Observers in other locations should access the websites mentioned below and input their specific location.

For transit times for a specific planet and location access;
- Exoworlds Spies Transit Scheduler

or
- Exoplanet Transit Database
or
- Find Exoplanet Transits

4.2 Exoplanet transit ephemerides

These tables list selected transiting exoplanets in the northern and southern celestial hemisphere with host stars brighter than magnitude 13.0V, transit depths of >=0.010 and altitude >20 degrees during transit (as of 2020 April 30). Prepared from ephemerides data on the *ARIEL* space mission *ExoClock* website.

Each exoplanet in the Northern and Southern celestial hemisphere tables is linked to data and charts for that planet.

Accessing the ExoClock Ephemerides database displays a finder chart and star and transit data.

Exoplanet data is obtained from the Exoplanet.eu database

STScI DSS charts are obtained from http://archive.stsci.edu/cgi-bin/dss_form using the HST Phase 2 (GSC1) or Phase 2 (GSC2) option.

Comparison stars were selected to be close to the target star in both magnitude and colour i.e.; V mag +/- 1.5 and (B-V) +/- 0.2 where possible. Stars may be selected outside these ranges to give a spread of comparison stars across the image and if there are few that meet these criteria. Data was extracted from Vizier/APASS catalogue at http://vizier.u-strasbg.fr/viz-bin/VizieR-3?-source=II/336/apass9&-out.max=50&-out.form=HTML%20Table&-out.add=_r&-out.add=_RAJ,_DEJ&-sort=_r&-oc.form=sexa

The AAVSO Variable Star Plotter at https://www.aavso.org/apps/vsp/ was accessed to check for variable and comparison stars near the target. The International Variable Star Index at https://www.aavso.org/vsx/index.php?view=search.top is also a useful resource in this respect.

Northern celestial hemisphere								
Exoplanet	Host star				Transit		Ephemeris	
	RA h m s	Dec. ° ' "	V mag	B-V mag	Depth (R) mmag	Duration h	T_0 (BJD_{TDB}) mid-time	Period d
HAT-P-19b	00 38 04.0	+34 42 42	12.90	+0.98	26.4	2.85	2455091.5350	4.008784
HAT-P-32b	02 04 10.3	+46 41 16	11.44	+0.55	29.6	3.12	2454420.4471	2.150008
WASP-11b	03 09 28.5	+30 40 25	11.57	+0.96	22.9	2.51	2454729.9072	3.722480
XO-6b	06 19 10.4	+73 49 40	10.25	+0.36	14.2	2.90	2456652.7132	3.765001
XO-4b	07 21 33.2	+58 16 05	10.81	+0.49	9.9	4.42	2454485.9332	4.125083
HAT-P-20b	07 27 40.0	+24 20 12	11.35	+1.20	19.9	1.85	2455080.9274	2.875317
XO-5b	07 46 52.0	+39 05 40	12.10	+0.76	13.2	3.14	2456864.3137	4.187756
XO-2Nb	07 48 06.5	+50 13 33	11.14	+0.86	14.2	2.68	2455565.5465	2.615859
WASP-13b	09 20 24.7	+33 52 57	10.42	+0.46	10.0	4.20	2455575.5144	4.353011
HD80606b	09 22 37.6	+50 36 13	9.00	+0.80	14.9	3.49	2455210.6430	111.436700
HAT-P-22b	10 22 43.6	+50 07 42	9.76	+0.84	14.4	2.88	2454930.2208	3.212220
WASP-85Ab	11 43 38.0	+06 33 49	10.72	+0.73	23.8	2.59	2456847.4736	2.655678
HAT-P-36b	12 33 03.9	+44 54 55	12.15	+0.93	18.2	2.34	2455565.1817	1.327347
HAT-P-3b	13 44 22.6	+48 01 43	11.86	+0.82	15.8	2.22	2454856.7020	2.899736
HAT-P-12b	13 57 33.5	+43 29 37	12.84	+1.09	27.6	2.34	2454419.1958	3.213059
WASP-14b	14 33 06.4	+21 53 41	9.75	+0.45	12.2	2.64	2455605.6535	2.243765
XO-1b	16 02 11.8	+28 10 10	11.25	+0.60	23.1	2.92	2453887.7477	3.941507
WASP-92b	16 26 46.1	+51 02 28	12.92	+0.49	14.8	2.80	2456381.2842	2.174674
HAT-P-18b	17 05 23.1	+33 00 45	12.76	+1.01	25.1	2.67	2454715.0225	5.508029
TrES-3b	17 52 07.0	+37 32 46	12.40	+0.62	27.0	1.38	2454185.9112	1.306186
Kepler-447b	19 01 04.5	+48 33 36	12.55	+0.74	26.0	2.72	2454954.6722	7.794302
TrES-1b	19 04 09.9	+36 37 57	11.42	+0.60	25.4	2.51	2453186.8070	3.030072
HAT-P-41b	19 49 17.4	+04 40 21	11.36	+0.63	13.5	4.12	2454983.8624	2.694047
HD189733b	20 00 43.7	+22 42 39	7.65	+0.93	28.1	1.83	2453988.8041	2.218573
HAT-P-23b	20 24 29.7	+16 45 44	11.94	+0.71	17.4	2.38	2454852.2655	1.212887
HAT-P-17b	21 38 08.7	+30 29 19	10.38	+0.80	20.5	3.52	2454801.1702	10.338523
HAT-P-8b	22 52 09.9	+35 26 50	10.36	+0.51	10.7	4.10	2454437.6742	3.076346
WASP-10b	23 15 58.3	+31 27 46	12.70	+1.11	34.4	2.28	2454664.0380	3.092730

Southern celestial hemisphere								
Exoplanet	Host star				Transit		Ephemeris	
	RA h m s	Dec. ° ' "	V mag	B-V mag	Depth (R) mmag	Duration h	T_0 (BJD_{TDB}) mid-time	Period d
WASP-77Ab	02 28 37.2	-07 03 38	10.12	+0.73	22.7	2.18	2455870.4505	1.360041
WASP-79b	04 25 29.0	-30 36 02	10.04	+0.42	13.8	3.81	2455545.2361	3.662387
WASP-35b	05 04 19.6	-06 13 47	10.94	+0.58	19.7	3.07	2455531.4798	3.161575
KELT-14b	07 13 12.4	-42 24 35	11.00	+0.69	13.4	2.24	2457091.0286	1.710059
KELT-15b	07 49 39.6	-52 07 14	11.39	+0.56	13.1	4.12	2457029.1663	3.329441
WASP-84b	08 44 25.7	+01 51 36	10.83	+0.83	19.9	2.76	2456286.1066	8.523487
WASP-43b	10 19 38.0	-09 48 23	12.40	+1.33	30.2	1.19	2455528.8686	0.813474
WASP-104b	10 42 24.6	+07 26 06	11.12	+0.83	16.6	1.77	2456406.1120	1.755414
WASP-31b	11 17 45.4	-19 03 17	11.66	+0.53	17.4	2.66	2455192.6895	3.405910
HATS-1b	11 42 06.1	-23 21 17	12.06	+0.65	18.9	2.55	2455241.2880	3.446459
WASP-41b	12 42 28.5	-30 38 24	11.63	+0.80	24.8	2.66	2455996.6793	3.052402
WASP-25b	13 01 26.4	-27 31 20	11.87	+0.71	24.1	2.77	2455888.6648	3.764833
WASP-15b	13 55 42.7	-32 09 35	10.91	+0.49	11.6	3.86	2454584.6986	3.752097
WASP-17b	15 59 50.9	-28 03 42	11.59	+0.45	20.0	3.20	2454592.8015	3.735485
WASP-16b	14 18 43.9	-20 16 32	11.29	+0.71	12.7	1.94	2454584.4290	3.118607
NGTS-2b	14 20 29.5	-31 12 07	10.96	+0.45	11.8	4.67	2457759.1269	4.511164
WASP-39b	14 29 18.4	-03 26 40	12.09	+0.78	27.2	2.83	2455342.9696	4.055280
K2-237b	16 55 04.5	-28 42 38	11.60	+0.59	18.3	3.05	2457684.8109	2.180560
KELT-10b	18 58 11.6	-47 00 12	10.62	+0.61	18.4	3.75	2457066.7205	4.166274
WASP-123b	19 17 55.0	-32 51 36	11.03	+0.71	13.7	3.10	2456845.1716	2.977641
HATS-33b	19 38 32.1	-55 19 48	11.91	+0.74	19.9	2.67	2456497.2326	2.549555
HAT-P-41b	19 49 17.4	+04 40 21	11.36	+0.63	13.5	4.12	2454983.8624	2.694047
WASP-7b	20 44 10.2	-39 13 31	9.50	+0.44	11.2	4.03	2455446.6349	4.954642
WASP-70Ab	21 01 54.5	-13 25 60	10.79	+0.62	12.2	3.36	2455736.5043	3.713020
HD209458b	22 03 10.8	+18 53 04	7.63	+0.51	17.7	3.08	2452826.6293	3.524749
WASP-6b	23 12 37.7	-22 40 26	11.91	+0.76	27.7	2.69	2454425.0218	3.361002
WASP-4b	23 34 15.1	-42 03 41	12.48	+0.75	31.1	2.19	2454966.7828	1.338232
WASP-29b	23 51 31.1	-39 54 24	11.33	+1.07	13.7	2.64	2455320.2350	3.922727
WASP-8b	23 59 36.1	-35 01 53	9.87	+0.70	16.2	3.35	2454679.3347	8.158715

Return to northern celestial hemisphere list

HAT-P19b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

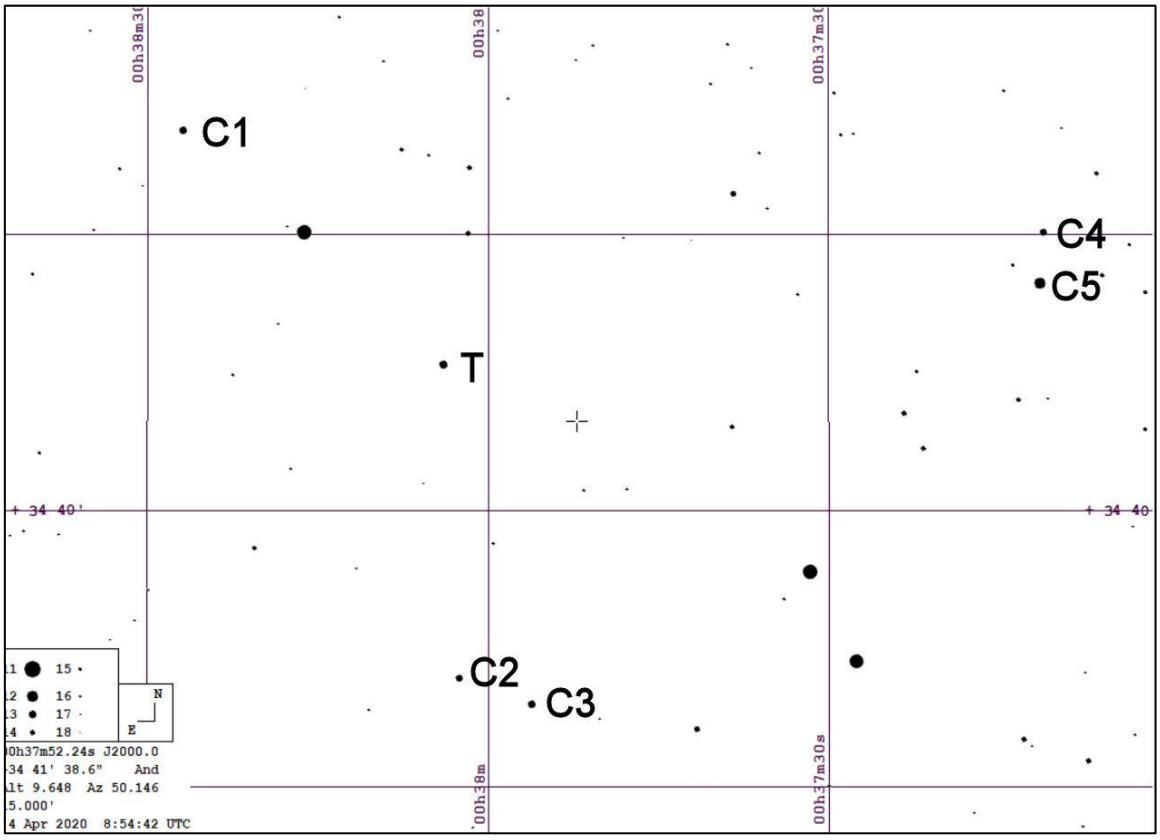


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	00 37 51.8	+34 41 30	-	-
Target	T	00 38 04.0	+34 42 41	12.85	+0.98
Comparison	C1	00 38 26.9	+34 46 55	12.85	+0.56
Comparison	C2	00 38 02.5	+34 37 01	12.99	+0.63
Comparison	C3	00 37 56.2	+34 36 32	13.04	+1.06
Comparison	C4	00 37 11.1	+34 45 05	13.27	+1.05
Comparison	C5	00 37 11.4	+34 44 07	12.05	+0.48

Table 2. Comparison and target star data

Return to northern celestial hemisphere list

HAT-P32b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

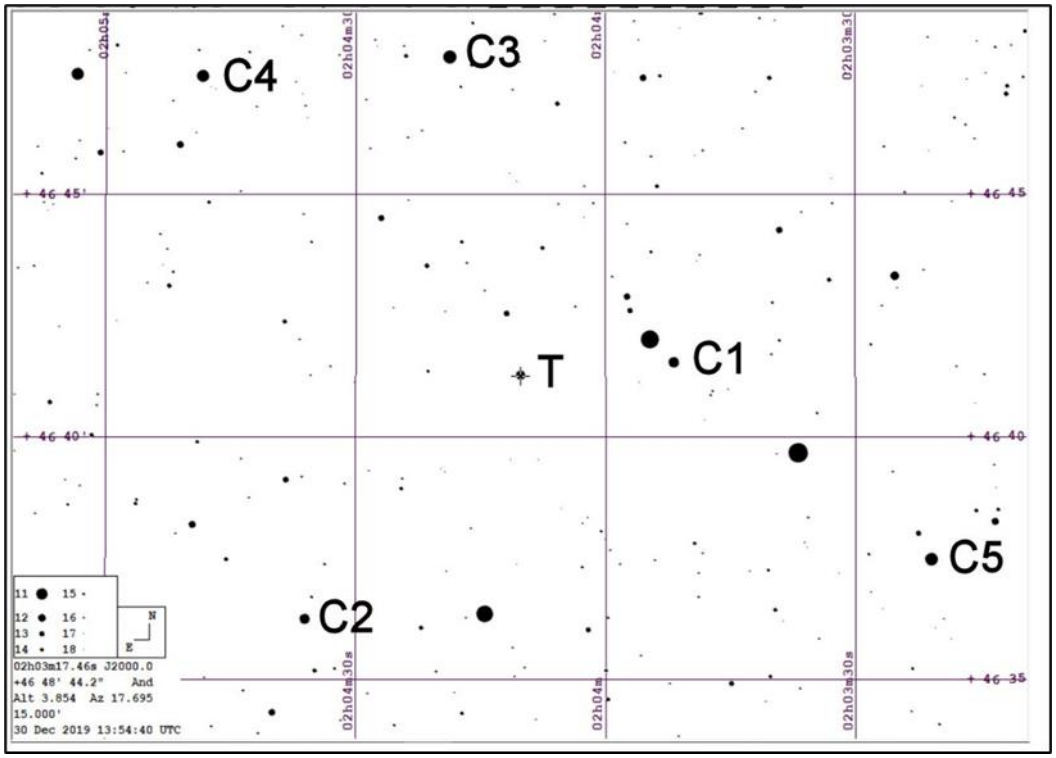


Figure 1. Guide finder chart, 15' x 15'

Star	ID	RA	Dec	V mag	B-V
Target	T	02 04 10.3	+46 41 16	11.44	+0.55
Comparison	C1	02 03 51.8	+46 41 32	11.24	+1.38
Comparison	C2	02 04 36.1	+46 36 14	11.48	+1.14
Comparison	C3	02 04 18.7	+46 47 50	10.44	+0.91
Comparison	C4	02 04 48.4	+46 47 27	10.60	+0.56
Comparison	C5	02 03 20.9	+46 37 29	10.70	+1.15

Table 2. Comparison star data

Return to northern celestial hemisphere list

WASP=11b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu (HAT-P-10Ab)
	Image	STSci DSS

Table 1. Target data. WASP-11b has alternative designations of WASP-11Ab, HAT-P-10b and HAT-P-10Ab

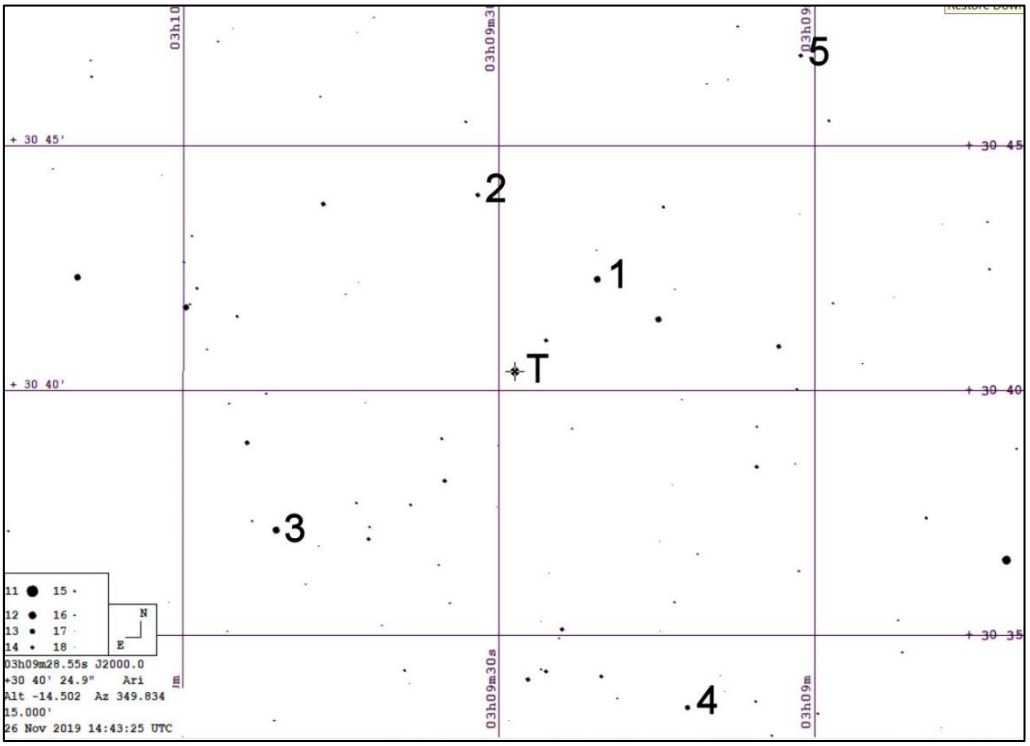


Figure 1. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V mag	B-V
Target	T	03 09 28.5	+30 40 25	11.57	+0.96
Comparison	C1	03 09 14.8	+30 41 29	12.63	+0.72
Comparison	C2	03 09 32.1	+30 44 02	13.57	+0.75
Comparison	C3	03 09 51.2	+30 37 11	12.48	+1.12
Comparison	C4	03 09 12.1	+30 33 33	13.46	+1.31
Comparison	C5	03 09 01.3	+30 46 52	13.85	+1.26

Table 2. Comparison star data

Return to northern celestial hemisphere list

X0-6b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

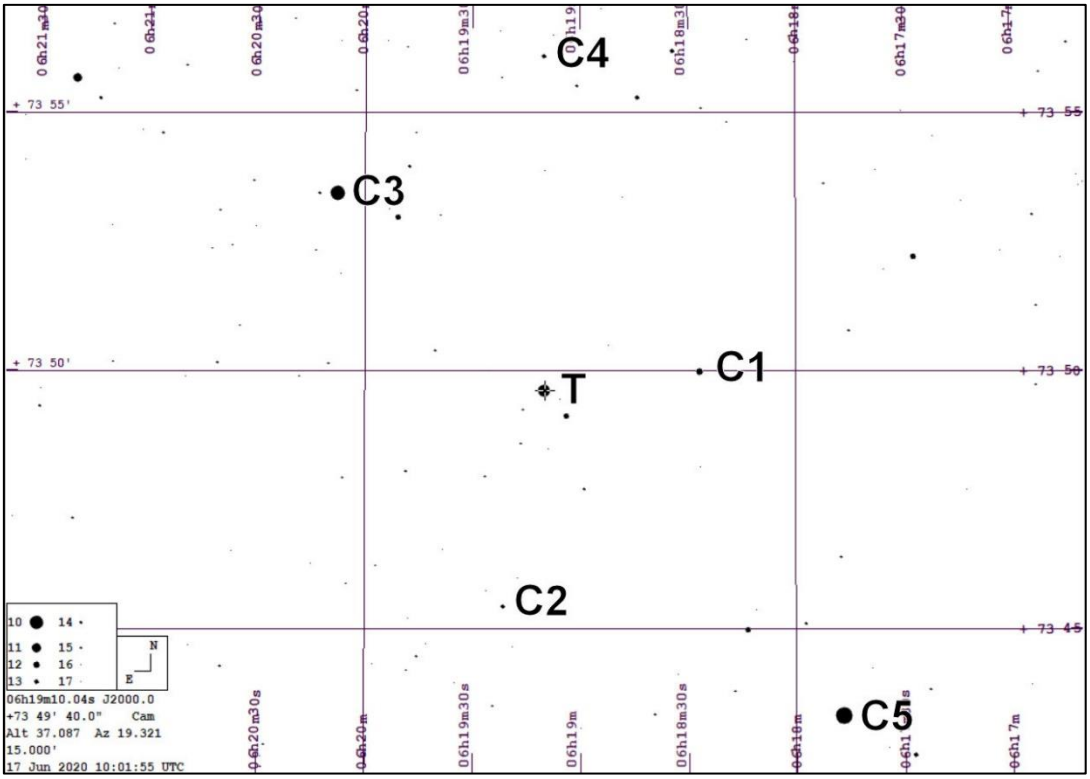


Figure 1. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V mag	B-V
Target	T	06 19 10.4	+73 49 40	10.25	+0.36
Comparison	C1	06 18 26.8	+73 50 02	12.01	+1.00
Comparison	C2	06 19 51.0	+73 53 02	12.51	+0.66
Comparison	C3	06 20 07.8	+73 53 30	9.84	+0.47
Comparison	C4	06 19 10.1	+73 56 10	13.30	+0.96
Comparison	C5	06 17 47.1	+73 43 21	9.45	+1.00

Table 2. Comparison star data

Return to northern celestial hemisphere list

XO-4b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

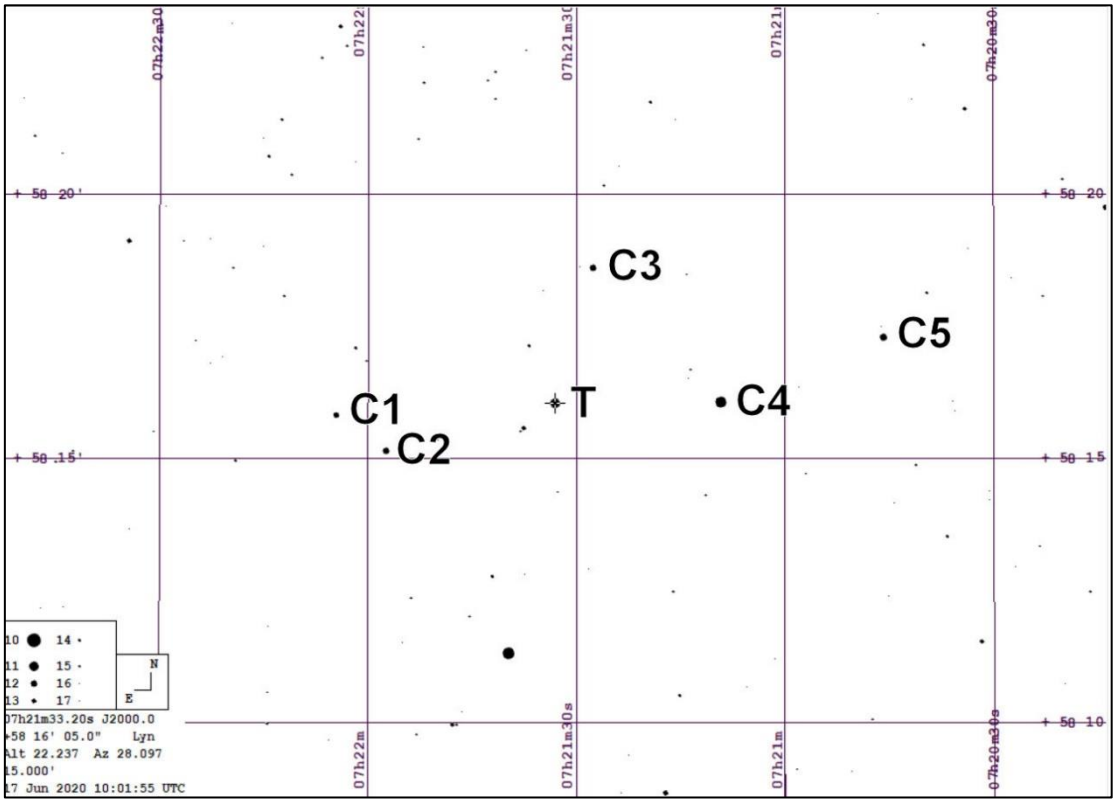


Figure 1. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V mag	B-V
Target	T	07 21 33.2	+58 16 05	10.81	+0.49
Comparison	C1	07 21 27.7	+58 18 38	12.32	+0.67
Comparison	C2	07 21 09.3	+58 16 05	10.51	+0.72
Comparison	C3	07 21 57.4	+58 15 10	11.62	+0.41
Comparison	C4	07 21 39.8	+58 11 20	10.32	+1.55
Comparison	C5	07 20 45.9	+58 17 18	11.51	+1.11

Table 2. Comparison star data

Return to northern celestial hemisphere list

HAT-P-20b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

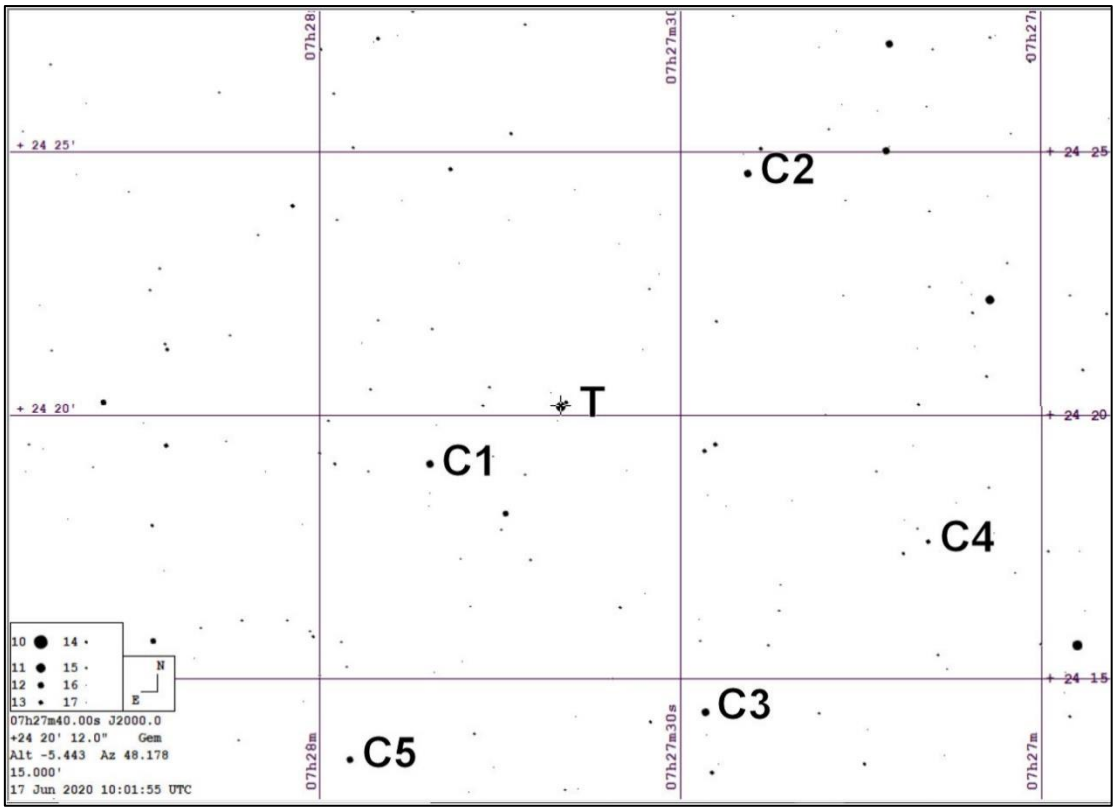


Figure 1. Guide finder chart, 15' x 15'

Star	ID	RA	Dec	V	B-V
Target	T	07 27 40.0	+24 20 12	11.35	1.20
Comparison	C1	07 27 50.8	+24 19 05	11.48	0.53
Comparison	C2	07 27 24.4	+24 24 37	11.89	1.29
Comparison	C3	07 27 27.9	+24 14 24	11.77	1.26
Comparison	C4	07 27 09.5	+24 17 38	13.13	0.77
Comparison	C5	07 27 57.4	+24 13 30	12.09	0.77

Table 2. Comparison star data

Return to northern celestial hemisphere list

XO-5b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

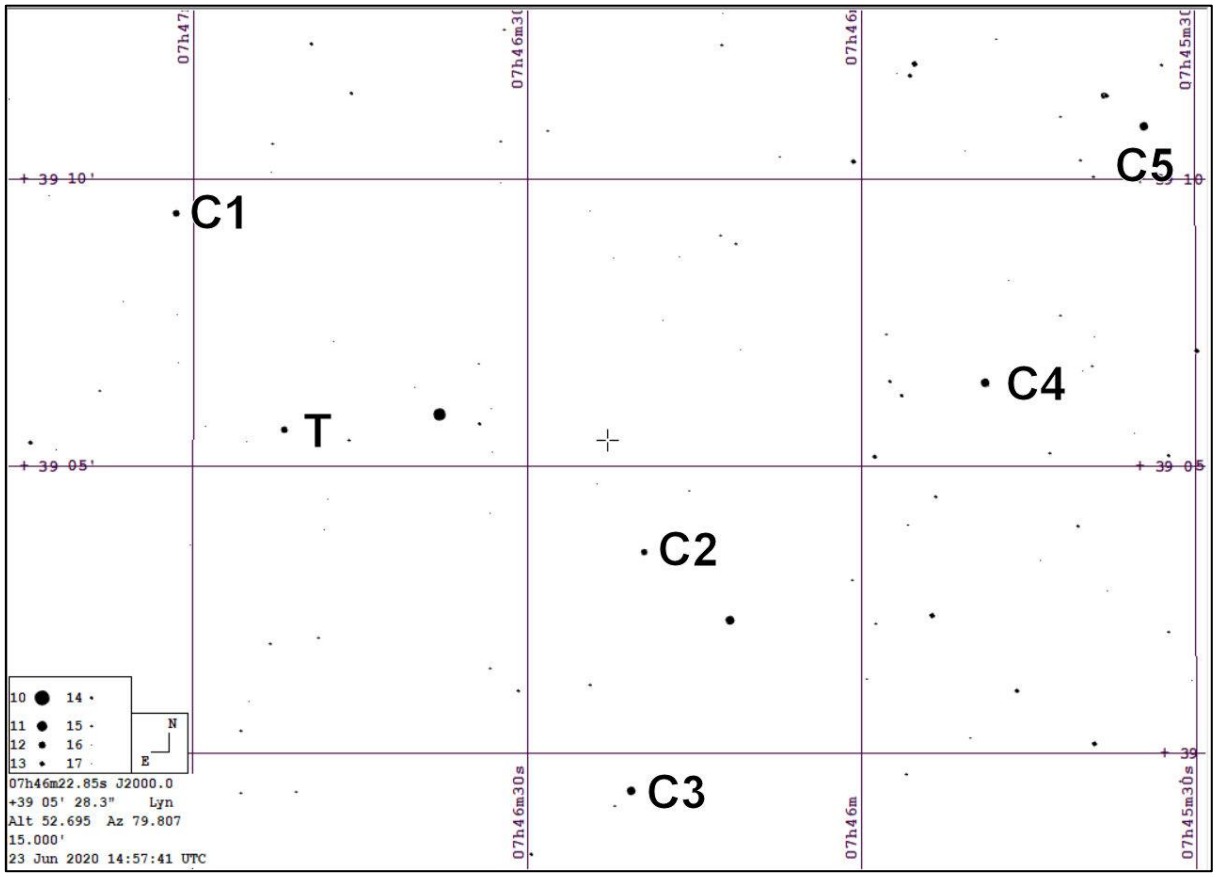


Figure 2. Guide finder chart, 15' x 15'.

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	07 46 22.8	39 05 27	-	-
Target	T	07 46 51.9	+39 05 40	12.14	+0.76
Comparison	C1	07 47 01.6	+39 09 26	12.25	+1.04
Comparison	C2	07 46 19.5	+39 03 32	12.29	+0.92
Comparison	C3	07 46 20.7	+38 59 23	11.68	+1.12
Comparison	C4	07 45 48.8	+39 06 28	12.35	+0.64
Comparison	C5	07 45 34.6	+39 10 56	11.71	+0.86

Table 2. Comparison star data

Return to northern celestial hemisphere list

XO-2Nb		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

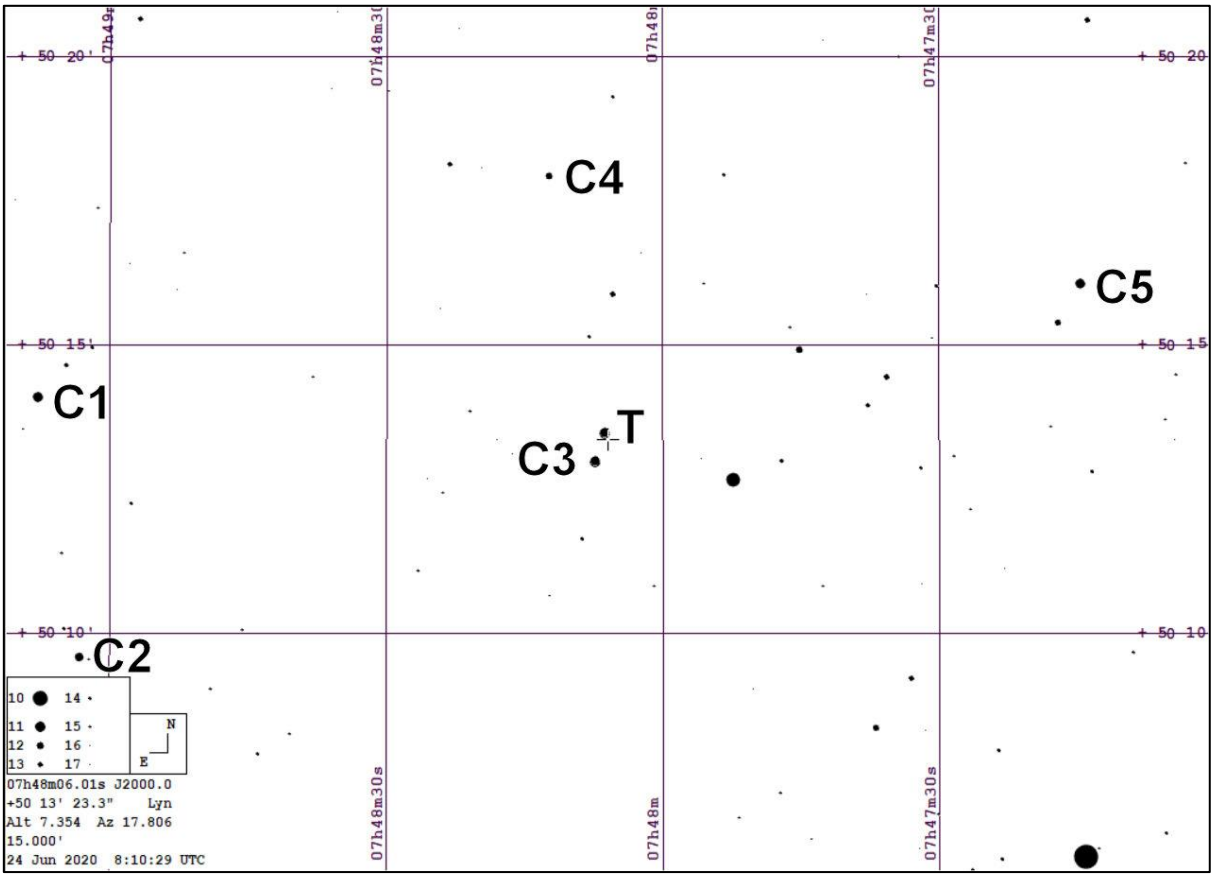


Figure 1. Guide finder chart, 15' x 15'

Star	ID	RA	Dec	V	B-V
Target	T	07 48 06.5	+50 13 33	11.14	+0.86
Comparison	C1	07 49 07.9	+50 14 05	11.02	+1.39
Comparison	C2	07 49 03.3	+50 09 36	11.29	+0.75
Comparison	C3	07 48 07.4	+50 13 01	11.09	+0.84
Comparison	C4	07 47 12.3	+50 17 55	11.67	+1.02
Comparison	C5	07 47 14.7	+50 16 05	11.19	+0.57

Table 2. Comparison star data

Return to northern celestial hemisphere list

WASP-13b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

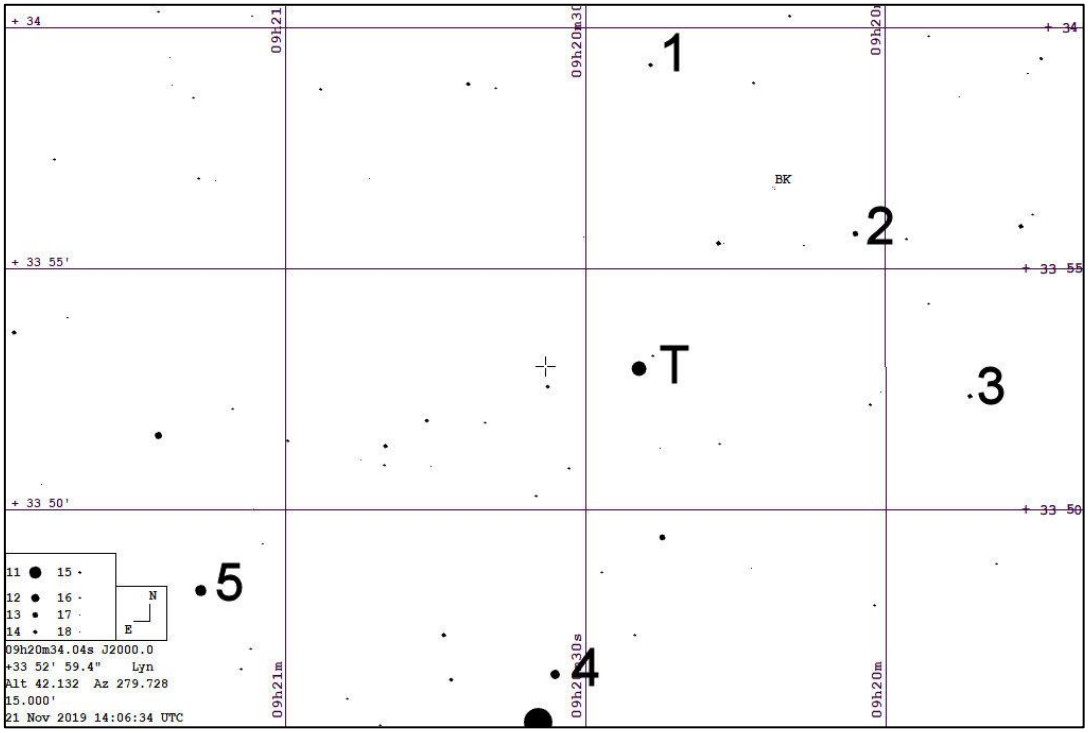


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	09 20 33.9	+33 52 47	-	-
Target	T	09 20 24.7	+33 52 57	10.42	0.46
Comparison	C1	09 20 23.5	+33 59 16.	13.87	0.57
Comparison	C2	09 20 03.0	+33 55 46	13.24	0.93
Comparison	C3	09 19 51.5	+33 52 24	13.87	0.39
Comparison	C4	09 20 33.1	+33 46 37	11.65	0.47
Comparison	C5	09 21 08.5	+33 48 21	11.09	0.94

Table 2. Comparison star data

Return to northern celestial hemisphere list

HD80606b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

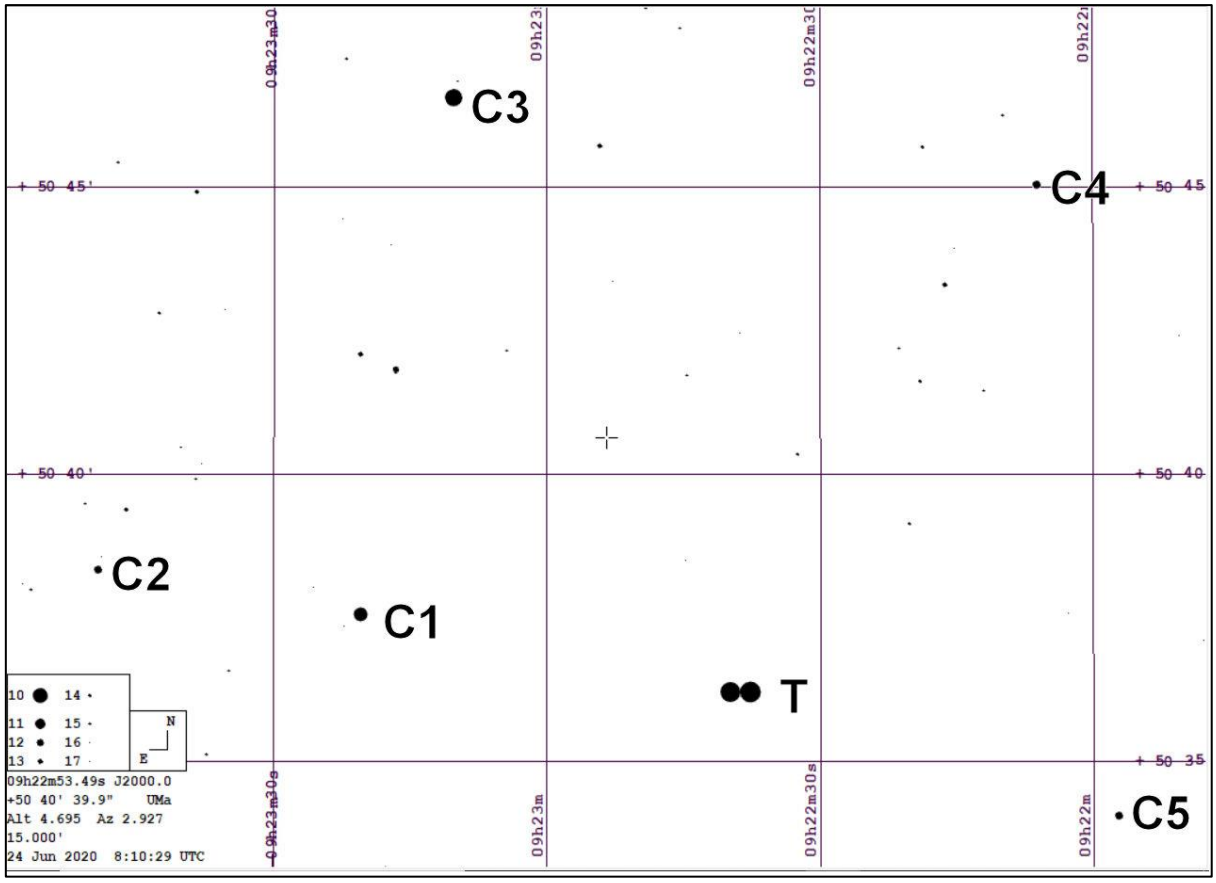


Figure 1. Guide finder chart, 15' x 15'

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	09 22 53.5	+50 40 40	-	-
Target	T	09 22 37.6	+50 36 13	9.06	+0.80
Comparison	C1	09 23 20.5	+50 37 35	10.16	+1.17
Comparison	C2	09 23 49.3	+50 38 21	11.78	+0.76
Comparison	C3	09 23 10.3	+50 46 35	9.59	+0.62
Comparison	C4	09 22 06.1	+50 45 03	12.64	+0.55
Comparison	C5	09 21 57.2	+50 34 04	11.78	0.68

Table 2. Comparison star data

Return to northern celestial hemisphere list

HAT-P-22b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

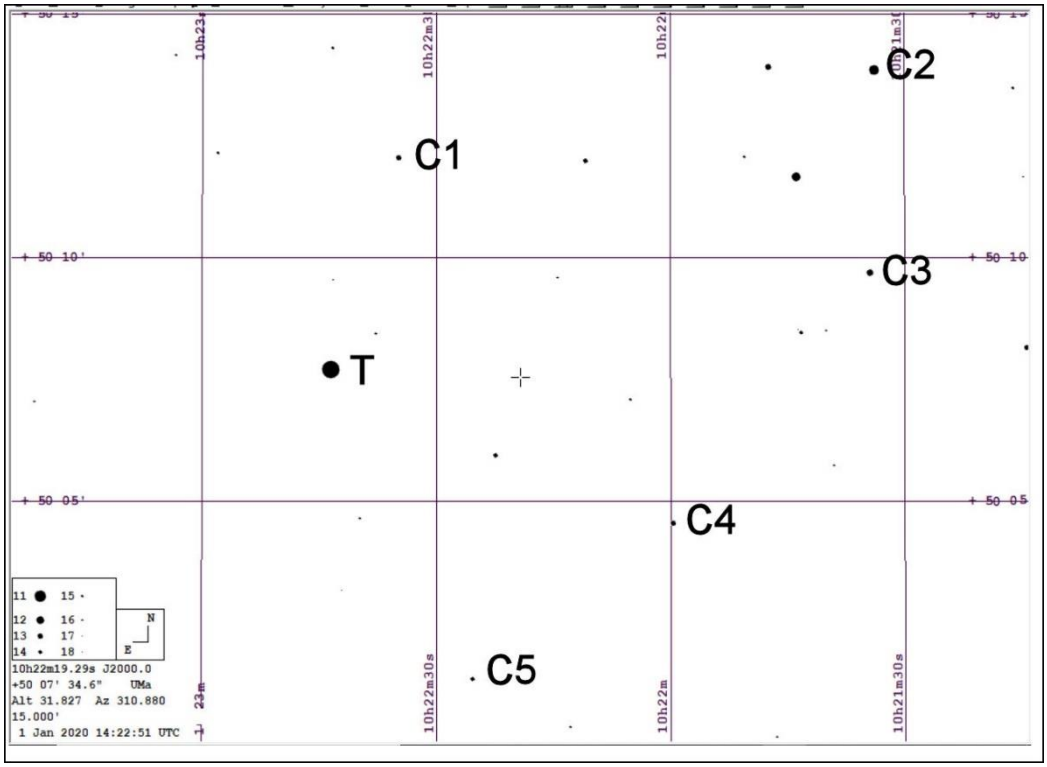


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	10 22 18.5	+50 07 31	-	-
Target	T	10 22 43.6	+50 07 42	9.76	0.84
Comparison	C1	10 22 34.9	+50 12 05	13.18	0.64
Comparison	C2	10 21 33.9	+50 13 53	11.29	1.01
Comparison	C3	10 21 34.4	+50 09 44	12.53	1.27
Comparison	C4	10 21 59.7	+50 04 36	13,10	0.55
Comparison	C5	10 22 25.3	+50 01 24	13.76	0.57

Table 2. Comparison star data

Return to northern celestial hemisphere list

WASP-85Ab		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

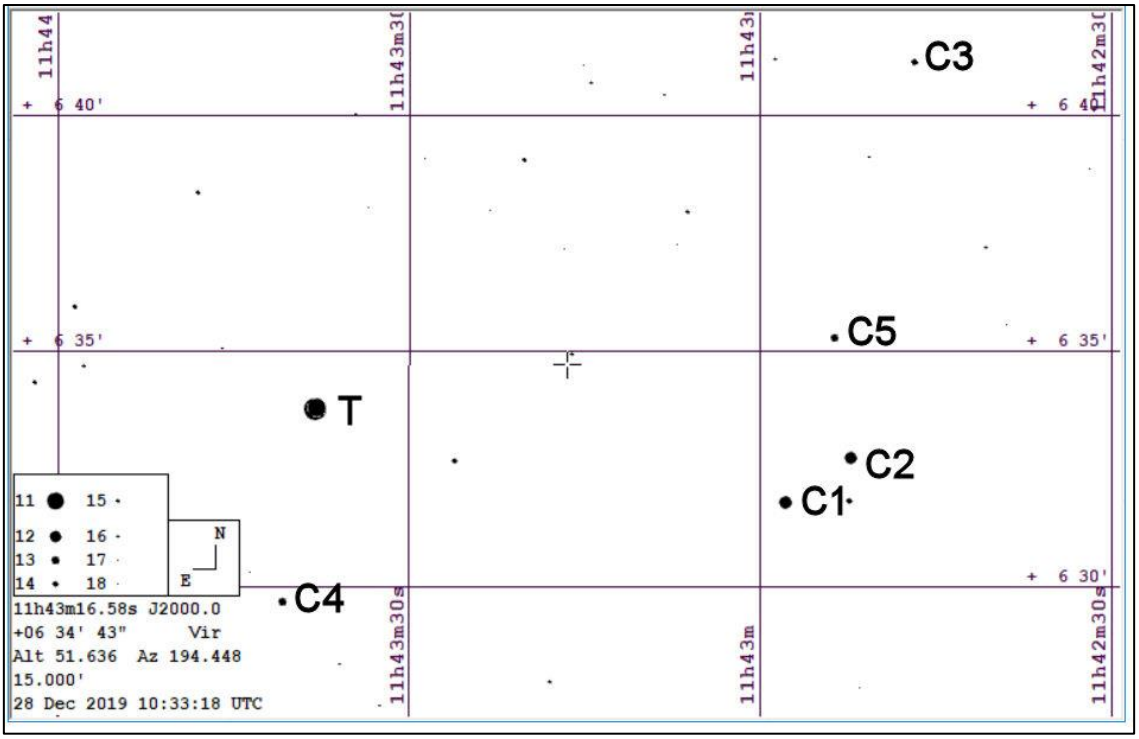


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	11 43 16.2	+06 34 42	-	-
Target	T	11 43 38.0	+06 33 49	10.72	+0.73
Comparison	C1	11 42 58.0	+06 31 49	11.93	+0.61
Comparison	C2	11 42 52.3	+06 32 47	11.91	+0.81
Comparison	C3	11 42 46.9	+06 07 00	13.66	-
Comparison	C4	11 43 40.8	+06 29 44	12.89	+0.59
Comparison	C5	11 42 53.7	+06 35 20	13.24	+0.91

Table 2. Comparison star data

Return to northern celestial hemisphere list

HAT-P-36b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

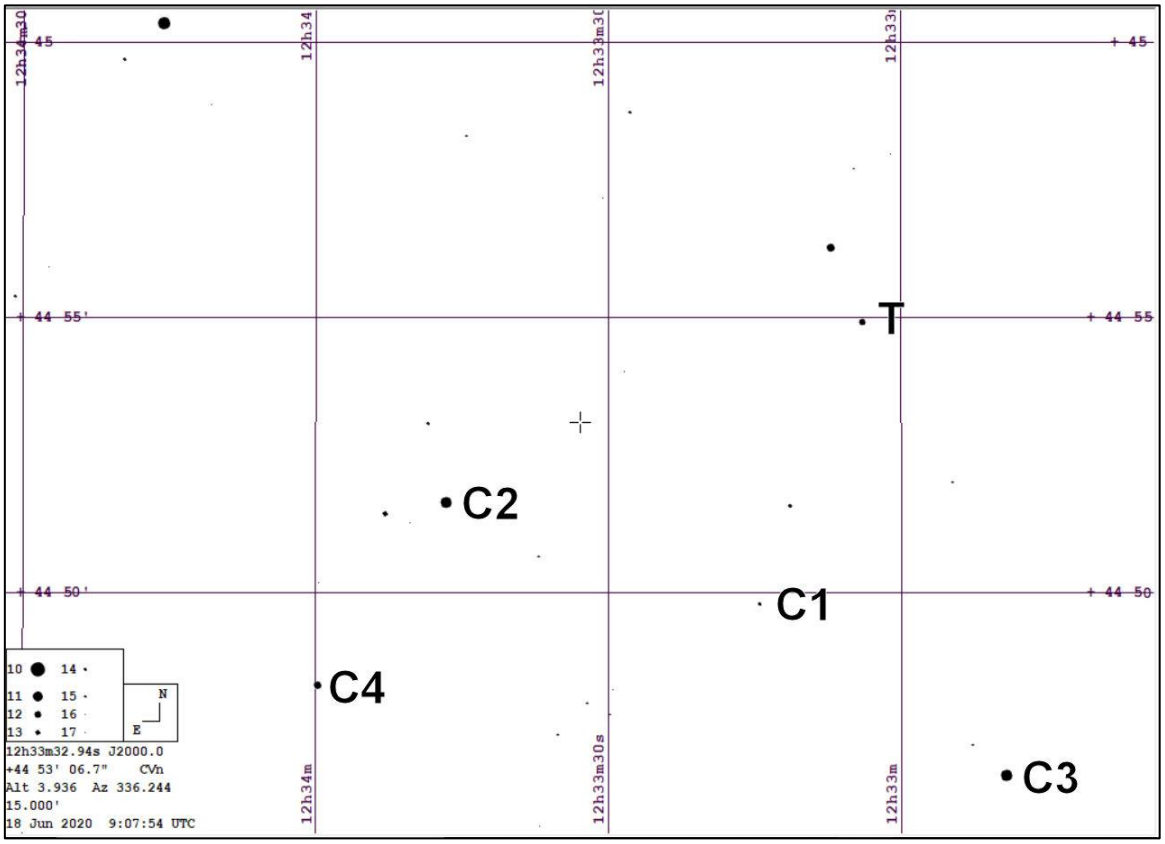


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	--	12 33 33.5	+44 53 26	-	-
Target	T	12 33 03.9	+44 54 55	12.20	+0.93
Comparison	C1	12 33 14.5	+44 49 49	13.69	+0.75
Comparison	C2	12 33 46.6	+44 51 39	10.72	+0.90
Comparison	C3	12 32 49.3	+44 46 41	10.50	+1.67
Comparison	C4	12 33 59.8	+44 48 19	11.43	+0.83

Table 2 Comparison star data

Return to northern celestial hemisphere list

HAT-P-3b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

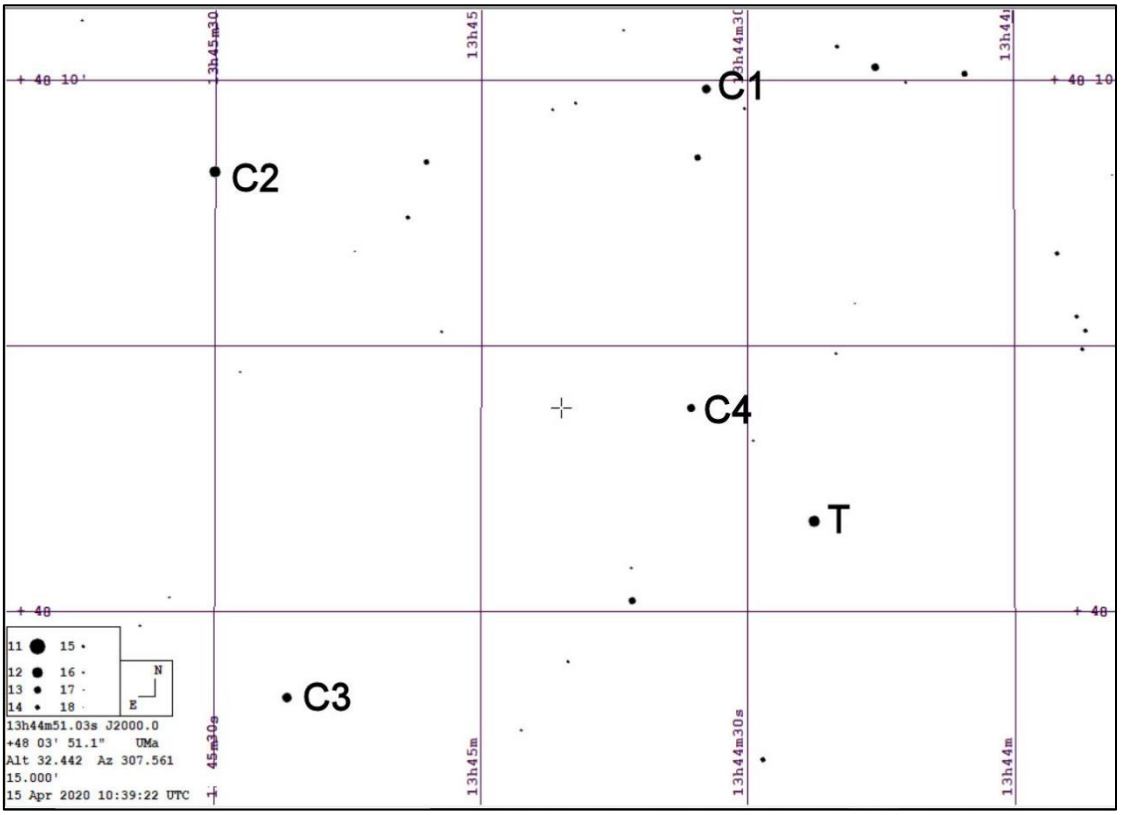


Figure 3 Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	13 44 54.3	+48 03 56	-	-
Target	T	13 44 22.6	+48 01 43	11.47	+0.82
Comparison	C1	13 44 34.6	+48 09 52	12.45	+0.55
Comparison	C2	13 45 30.0	+48 08 17	12.21	+0.60
Comparison	C3	13 45 21.8	+47 58 24	12.58	+1.15
Comparison	C4	13 44 36.4	+48 03 53	12.77	+0.81

Table 2. Comparison and target star data

Return to northern celestial hemisphere list

HAT-P-12b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

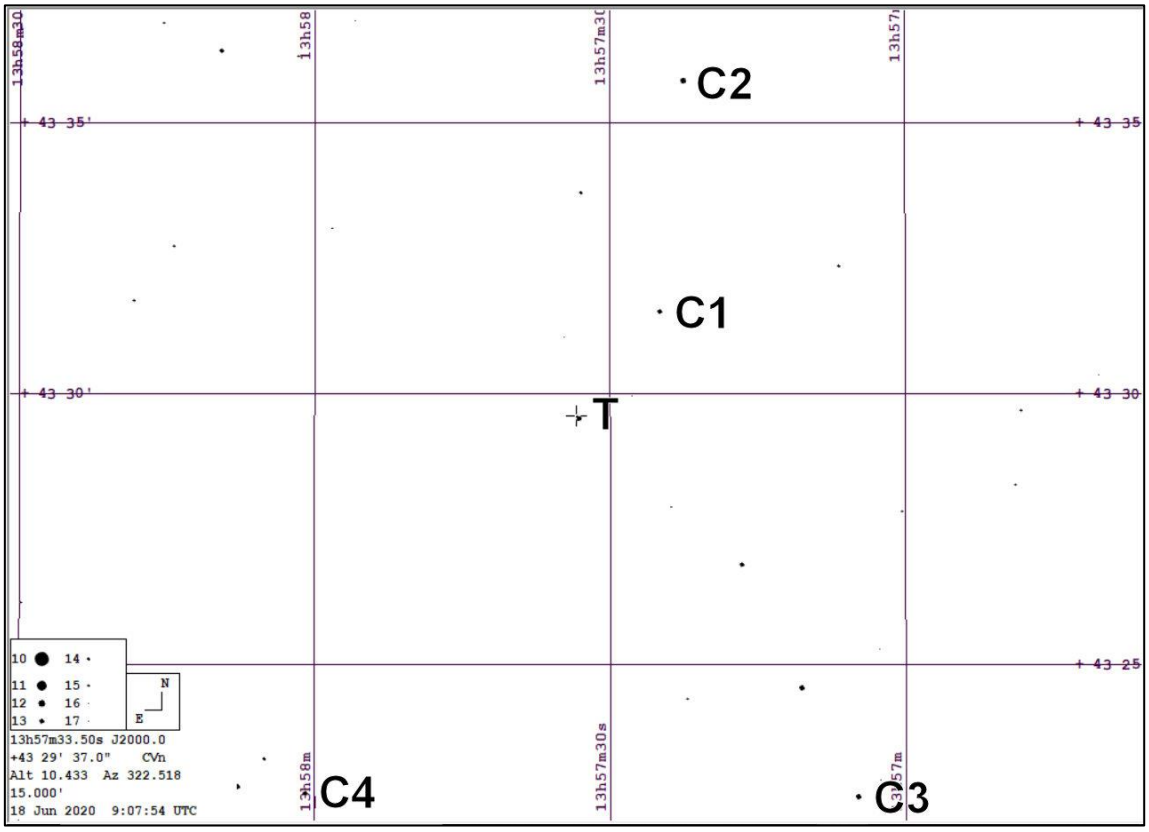


Figure 2. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V mag	B-V
Target	T	13 57 33.5	+43 29 37	12.84	+1.09
Comparison	C1	13 57 25.0	+43 31 34	13.13	+0.92
Comparison	C2	13 57 22.6	+43 35 48	12.63	+0.77
Comparison	C3	13 58 01.0	+43 22 40	13.20	+1.01
Comparison	C4	13 57 04.8	+43 22 36	12.81	+0.89
Comparison	C5	13 58 09.5	+43 36 21	13.31	+0.68

Table 2. Comparison star data

Return to northern celestial hemisphere list

WASP-14b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

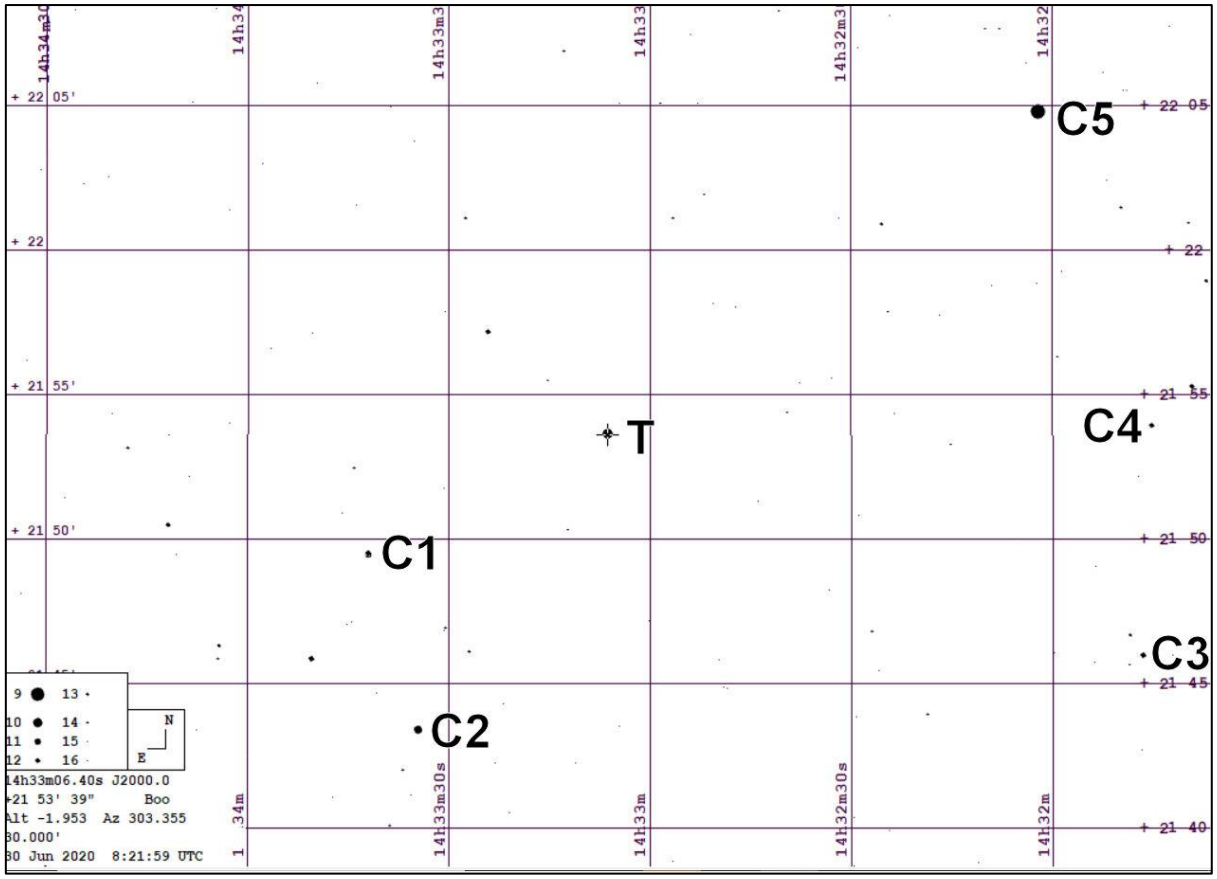


Figure 1. Guide finder chart, 30' x 30'

Star	ID	RA	Dec	V mag	B-V
Target	T	14 33 06.4	+21 53 41	9.75	+0.45
Comparison	C1	14 33 42.1	+21 49 34	11.45	+0.96
Comparison	C2	14 33 34.5	+21 43 26	10.26	+0.53
Comparison	C3	14 31 46.6	+21 45 58	11.51	+1.00
Comparison	C4	14 31 45.3	+21 54 00	12.04	+0.71
Comparison	C5	14 32 02.2	+22 04 47	8.76	+0.55

Table 2. Comparison star data

Return to northern celestial hemisphere list

XO-1b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

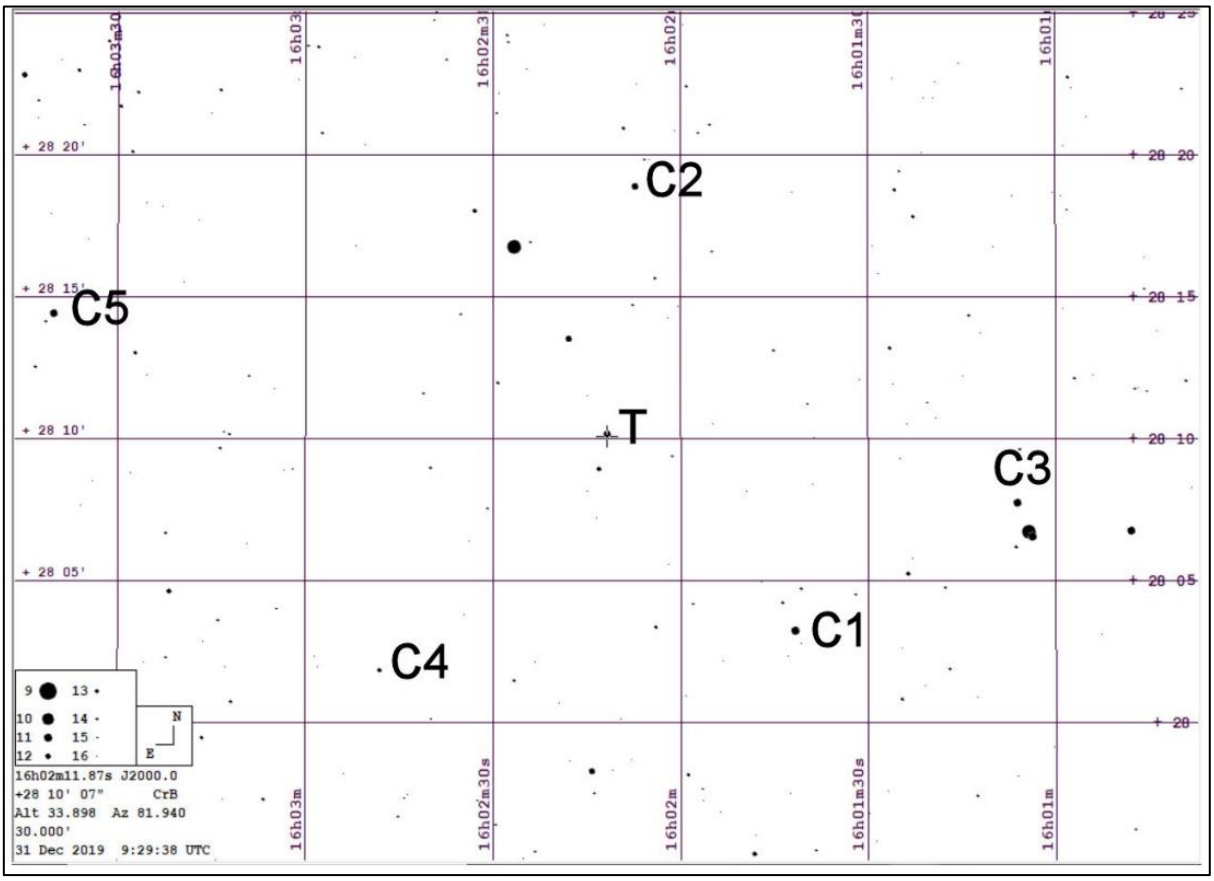


Figure 1. Guide finder chart, 30’ x 30’

Star	ID	RA	Dec	V mag	B-V
Target	T	16 02 11.9	+28 10 10	11.25	+0.60
Comparison	C1	16 01 41.7	+28 03 15	10.85	+0.94
Comparison	C2	16 02 07.3	+28 18 53	11.28	+1.10
Comparison	C3	16 01 06.2	+28 07 45	10.95	+0.97
Comparison	C4	16 02 48.1	+28 01 51	12.48	+0.67
Comparison	C5	16 03 40.3	+28 14 26	11.11	+0.52

Table 2. Comparison star data

Return to northern celestial hemisphere list

WASP-92b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

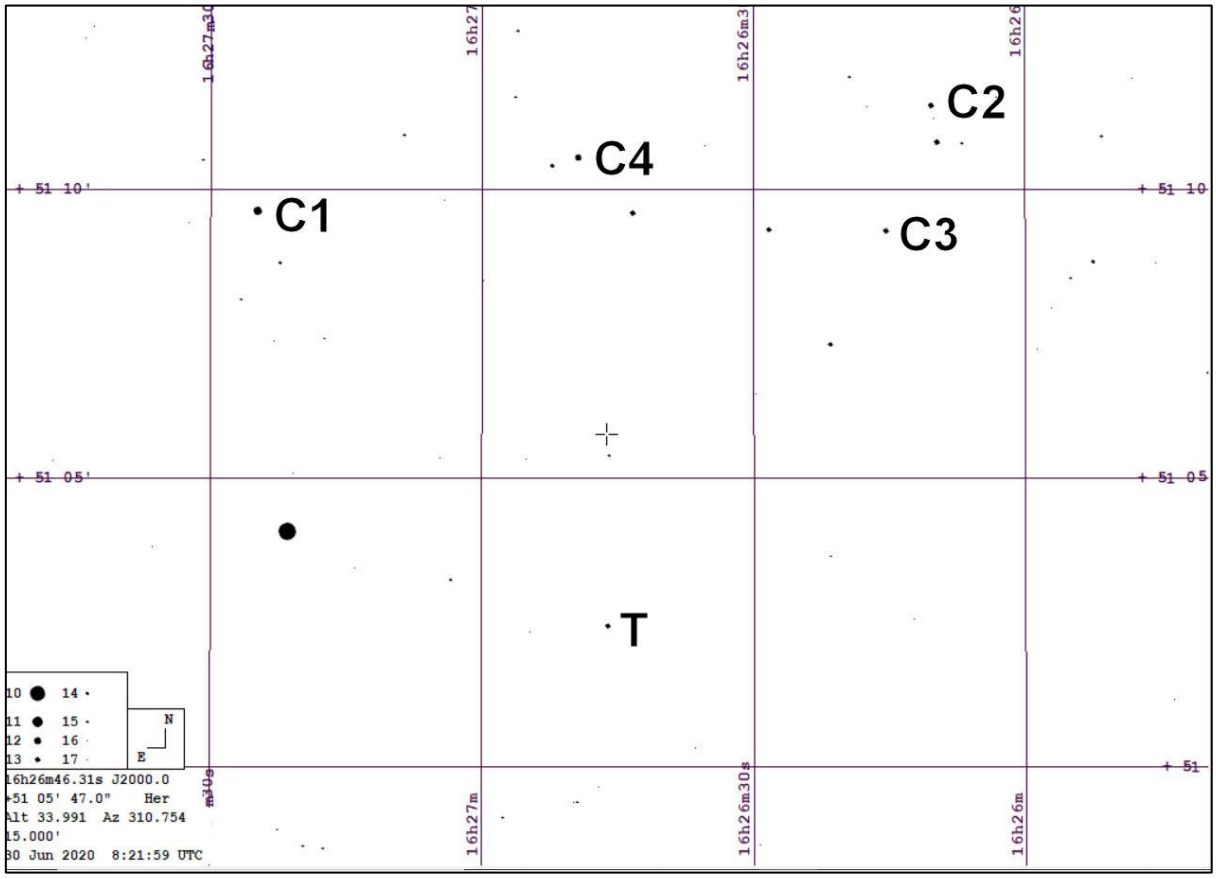


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	16 26 45.7	+51 05 50	-	-
Target	T	16 26 46.1	+51 02 28	12.92	+0.49
Comparison	C1	16 27 24.9	+51 09 43	11.96	+1.19
Comparison	C2	16 26 10.4	+51 11 28	12.61	+0.46
Comparison	C3	16 26 15.4	+51 09 19	12.85	+0.69
Comparison	C4	16 26 49.3	+51 10 36	12.36	+0.44

Table 2. Comparison star data

Return to northern celestial hemisphere list

HAT-P-18b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

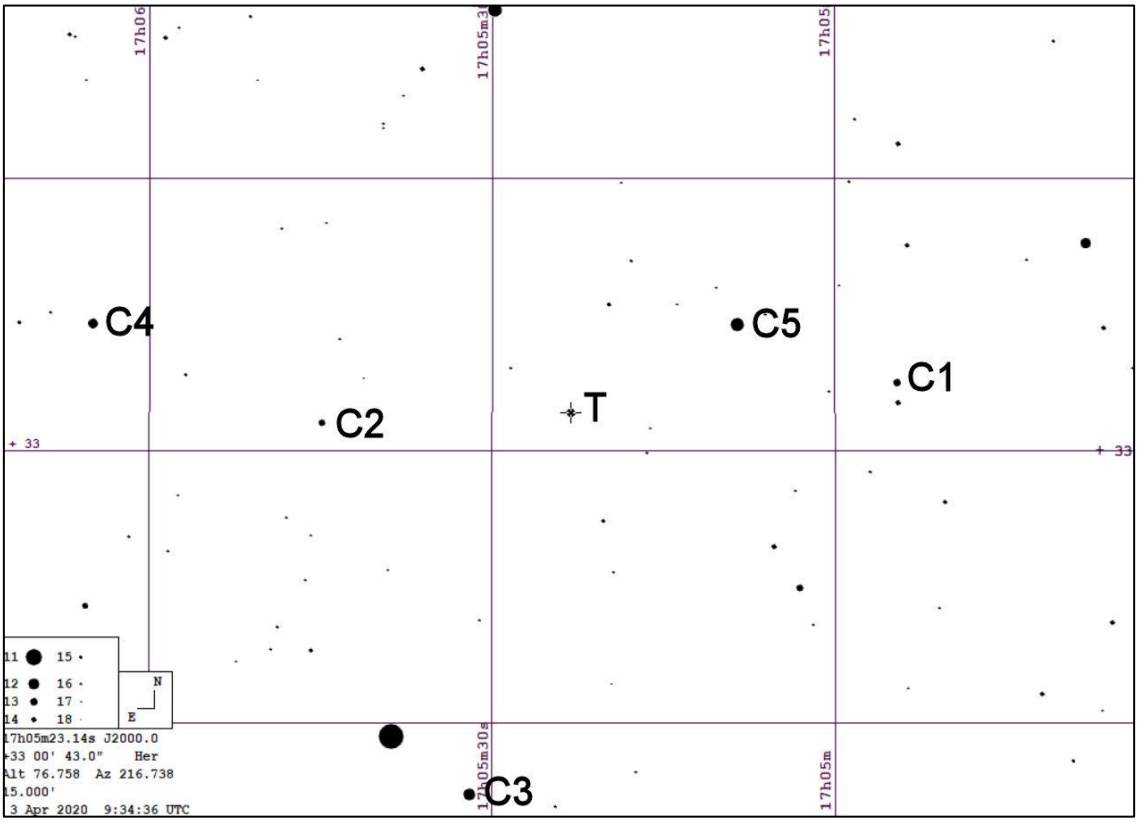


Figure 1. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V	B-V
Target	T	17 05 23.1	+33 00 45	12.66	+1.01
Comparison	C1	17 04 54.5	+33 01 18	13.11	+0.82
Comparison	C2	17 05 44.9	+33 00 32	13.15	+0.60
Comparison	C3	17 05 31.9	+32 53 42	11.65	+0.91
Comparison	C4	17 06 05.0	+33 02 21	12.51	+1.07
Comparison	C5	17 05 08.5	+33 02 19	11.25	+1.30

Table 2. Comparison and target star data

Return to northern celestial hemisphere list

TrES-3b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

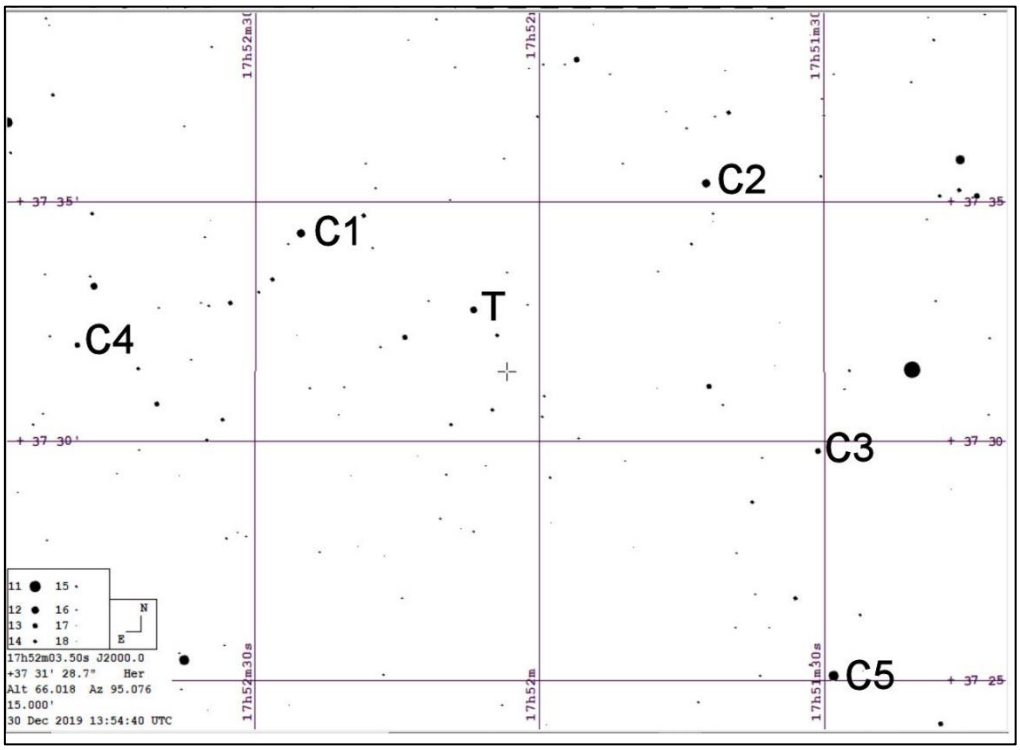


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	17 52 02.9	+37 31 25	-	-
Target	T	17 52 07.0	+37 32 46	12.40	+0.62
Comparison	C1	17 52 25.2	+37 34 22	11.78	+0.76
Comparison	C2	17 51 42.5	+37 35 24	12.26	+0.64
Comparison	C3	17 51 30.7	+37 29 48	12.59	+0.44
Comparison	C4	17 52 48.7	+37 32 02	12.90	+0.41
Comparison	C5	17 51 29.1	+37 25 07	11.43	+0.38

Table 2. Comparison star data

Return to northern celestial hemisphere list

Kepler-447b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

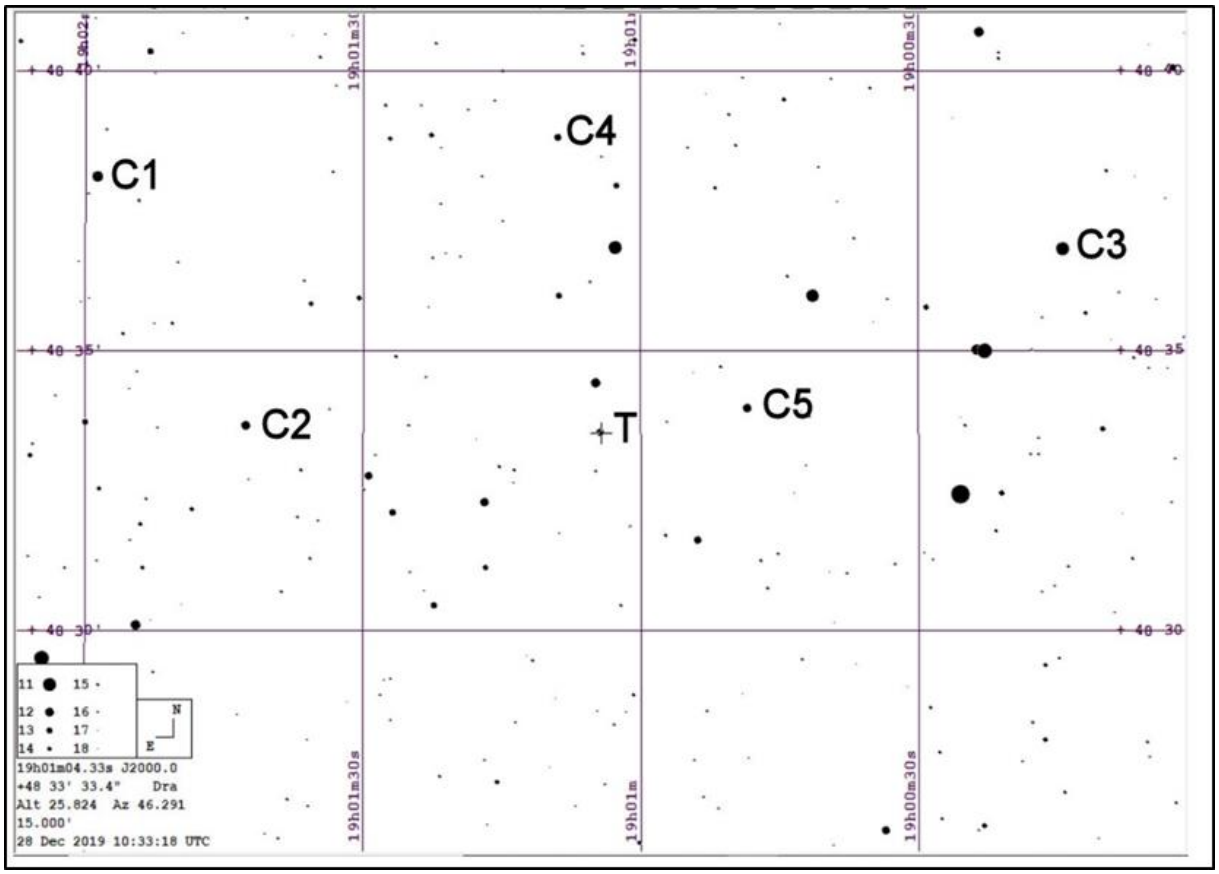


Figure 1. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V	B-V
Target	T	19 01 04.5	+48 33 36	12.55	+0.74
Comparison	C1	19 01 58.8	+48 38 08	11.45	-
Comparison	C2	19 01 42.6	+48 33 41	12.00	-
Comparison	C3	19 00 14.4	+48 36 50	11.01	+0.66
Comparison	C4	19 01 09.0	+48 38 51	12.61	-
Comparison	C5	19 00 48.6	+48 34 12	12.10	-

Table 2. Comparison star data

Return to northern celestial hemisphere list

TrES-1b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

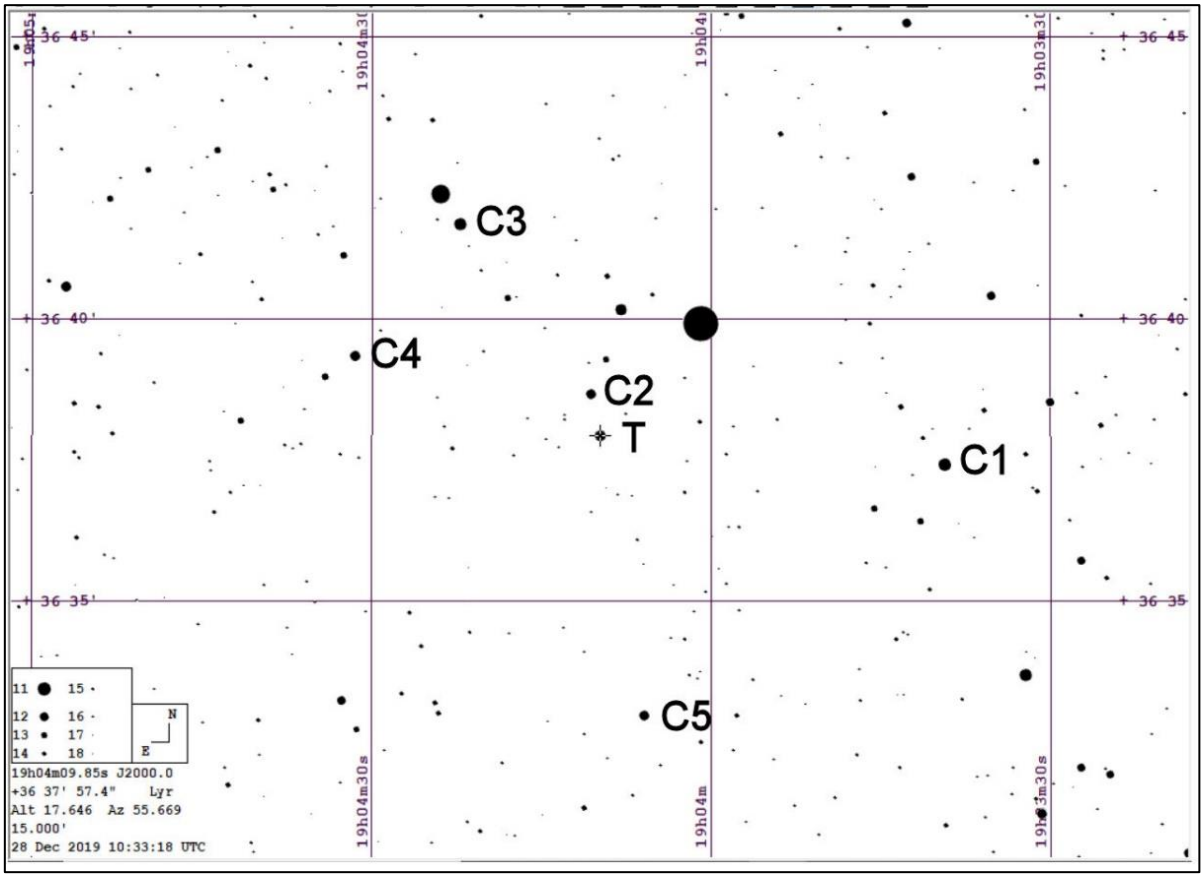


Figure 1. Guide finder chart, 15' x 15'

Star	ID	RA	Dec	V mag	B-V
Target	T	19 04 09.9	+36 37 57	11.42	+0.60
Comparison	C1	19 03 39.3	+36 37 26	10.95	+0.69
Comparison	C2	19 04 10.6	+36 38 41	11.51	+0.96
Comparison	C3	19 04 22.2	+36 41 42	11.27	+1.12
Comparison	C4	19 04 31.5	+36 39 21	11.41	+1.27
Comparison	C5	19 04 06.0	+36 33 00	12.02	+1.08

Table 2. Comparison star data

Return to northern celestial hemisphere list

HAT-P-41b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

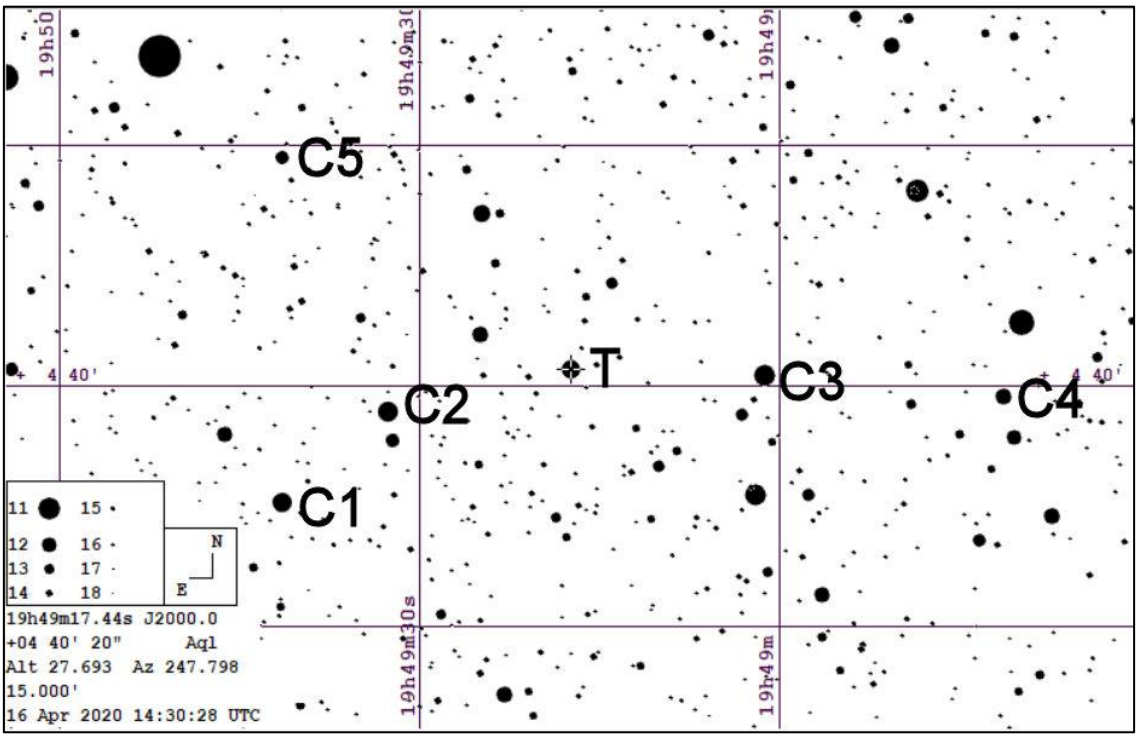


Figure 3. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V	B-V
Target	T	19 49 17.4	+04 40 21	11.36	+0.63
Comparison	C1	19 49 41.5	+04 37 35	11.20	+0.61
Comparison	C2	19 49 32.7	+04 39 27	11.04	+1.39
Comparison	C3	19 49 01.2	+04 40 15	11.59	+1.64
Comparison	C4	19 48 41.3	+04 39 48	12.00	+1.20
Comparison	C5	19 49 41.4	+04 44 47	12.32	+0.65

Table 2. Comparison and target star data

Return to northern celestial hemisphere list

HD189733b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

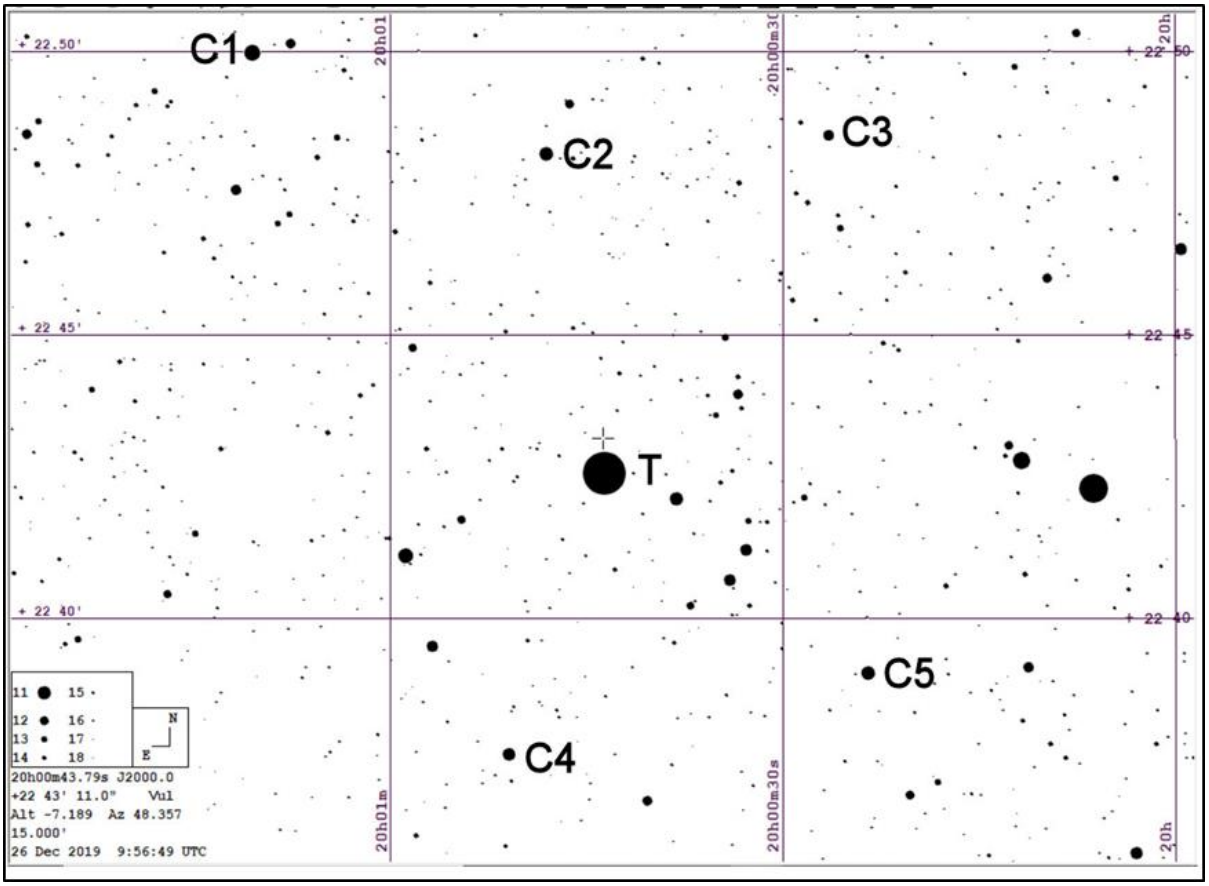


Figure 1. Guide finder chart, 15' x 15'

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	20 00 43.9	+22 43 01	-	-
Target	T	20 00 43.7	+22 42 39	7.65	+0.93
Comparison	C1	20 01 10.7	+22 49 58	10.42	+0.44
Comparison	C2	20 00 48.2	+22 48 12	10.75	+0.57
Comparison	C3	20 00 26.5	+22 48 31	11.57	+0.60
Comparison	C4	20 00 50.9	+22 37 36	11.16	+0.44
Comparison	C5	20 00 23.5	+22 39 03	10.80	+0.57

Table 2. Comparison star data

Return to northern celestial hemisphere list

HAT-P-23b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

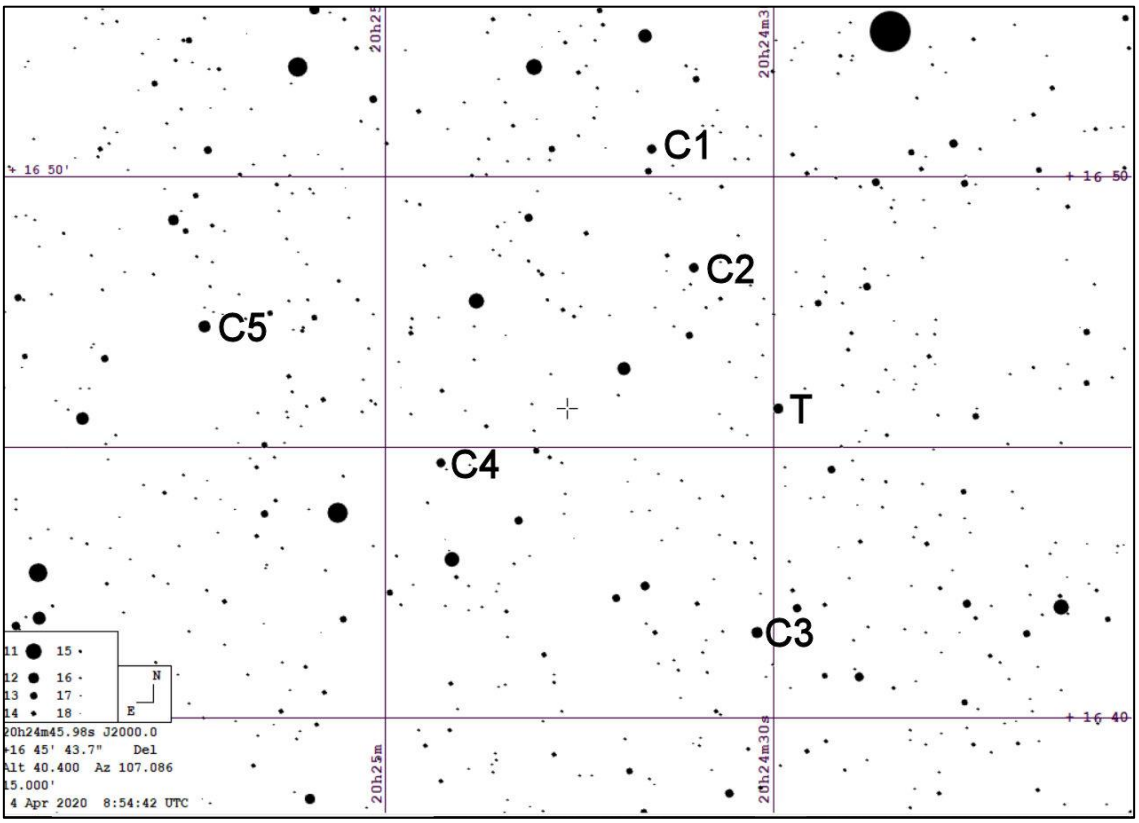


Figure 3. Guide chart finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	20 24 46.1	+16 45 43	-	-
Target	T	20 24 29.7	+16 45 44	12.32	+0.71
Comparison	C1	20 24 39.5	+16 50 32	12.39	+0.58
Comparison	C2	20 24 36.2	+16 48 18	12.30	+0.58
Comparison	C3	20 24 31.3	+16 41 35	11.96	+1.19
Comparison	C4	20 24 55.6	+16 44 43	12.62	+0.80
Comparison	C5	20 25 14.0	+16 47 14	11.53	+1.07

Table 2. Comparison and target star data

Return to northern celestial hemisphere list

HAT-P-17b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

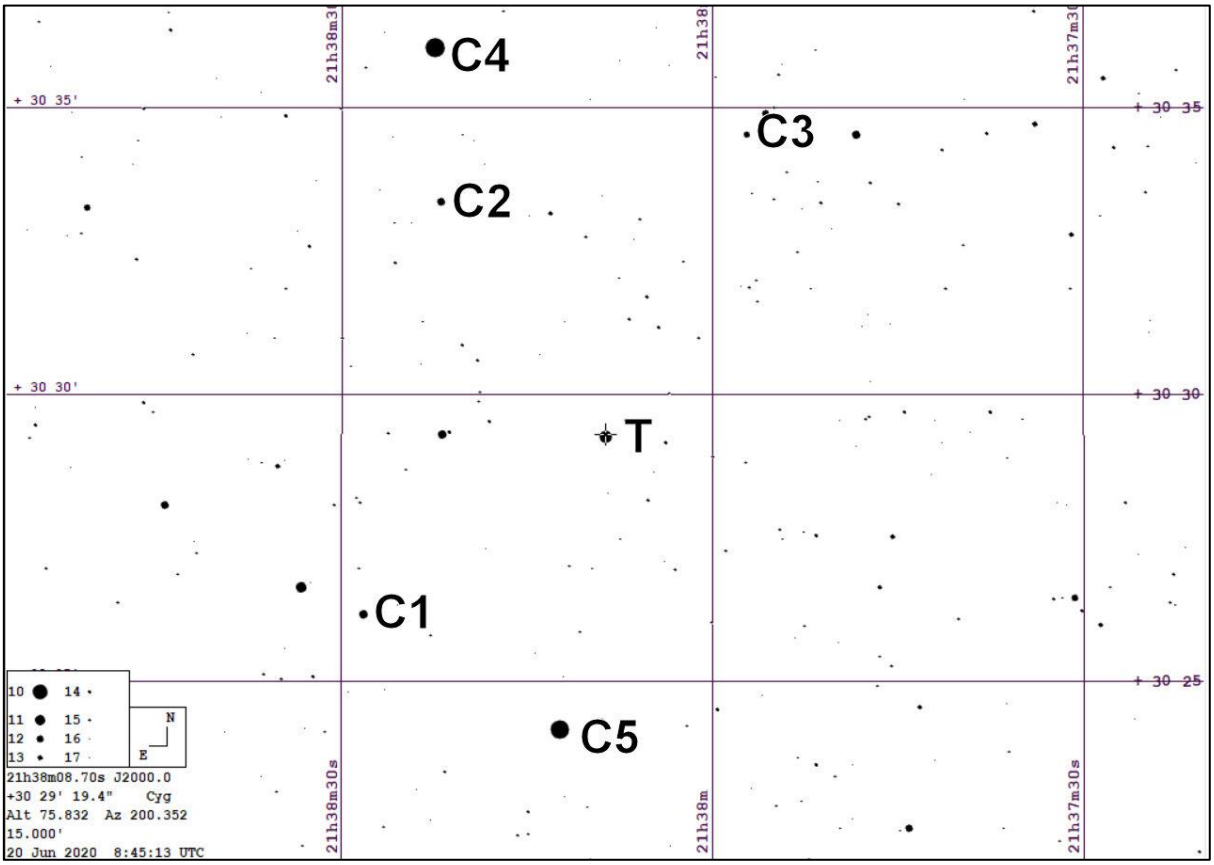


Figure 3. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V mag	B-V
Target	T	21 38 08.7	+30 29 19	10.38	+0.80
Comparison	C1	21 38 22.0	+30 33 22	11.92	+0.27
Comparison	C2	21 38 28.3	+30 26 11	11.32	+0.40
Comparison	C3	21 37 57.2	+30 34 33	12.49	+0.60
Comparison	C4	21 38 22.4	+30 36 03	9.05	+0.50
Comparison	C5	21 38 12.3	+30 24 10	9.40	+0.30

Table 2. Comparison star data

Return to northern celestial hemisphere list

HAT-P-8b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

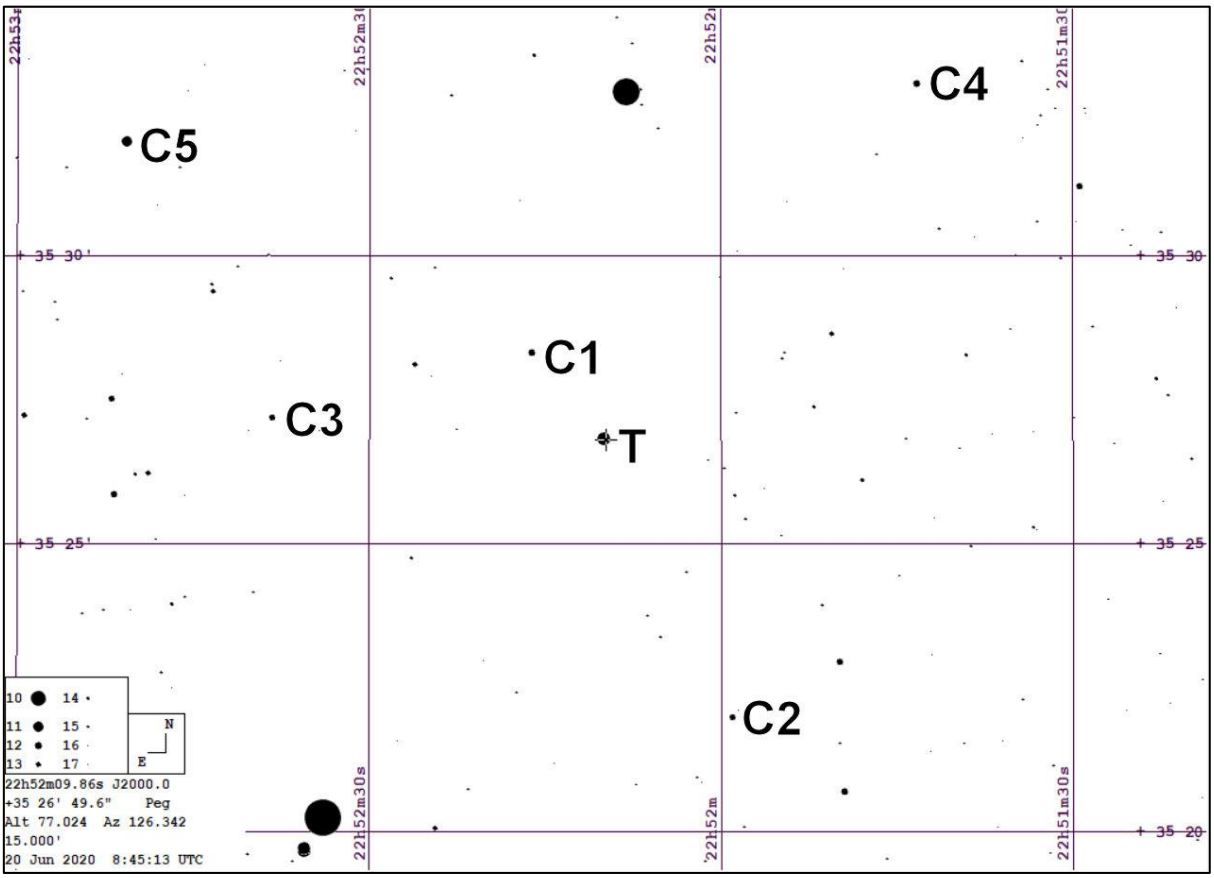


Figure 3. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V mag	B-V
Target	T	22 52 09.9	+35 26 50	10.36	+0.51
Comparison	C1	22 52 16.2	+35 28 20	12.43	+0.46
Comparison	C2	22 51 59.0	+35 22 01	12.61	+0.56
Comparison	C3	22 52 38.3	+35 27 14	12.70	+0.75
Comparison	C4	22 51 43.3	+35 33 00	12.39	+0.54
Comparison	C5	22 52 50.7	+35 31 59	10.90	+0.45

Table 2. Comparison star data

Return to northern celestial hemisphere list

WASP-10b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

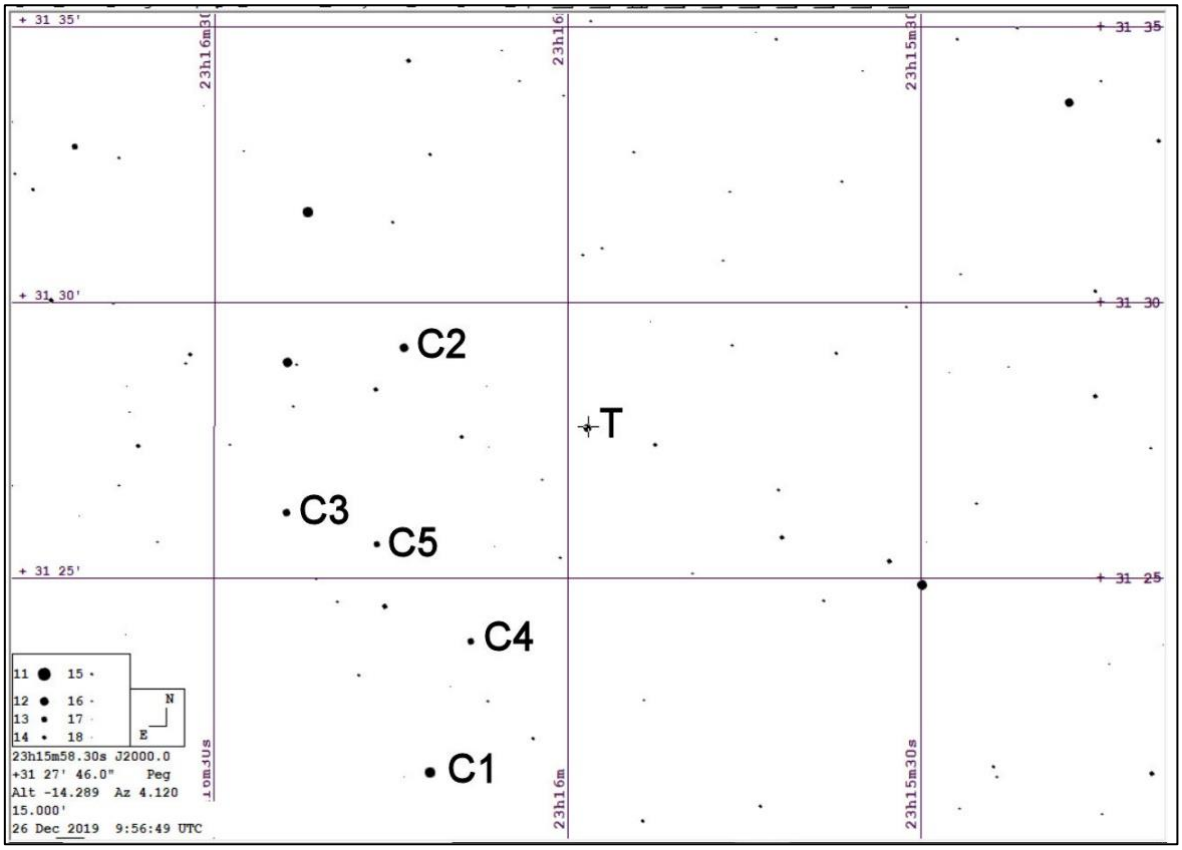


Figure A11.2. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V mag	B-V
Target	T	23 15 58.3	+31 27 46	12.70	+1.11
Comparison	C1	23 16 11.7	+31 21 30	11.31	+0.71
Comparison	C2	23 16 13.9	+31 29 13	11.97	+0.54
Comparison	C3	23 16 23.9	+31 26 14	12.35	+0.65
Comparison	C4	23 16 08.2	+31 23 53	12.60	+0.56
Comparison	C5	23 16 18.2	+31 25 39	12.84	+0.65

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-77Ab		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

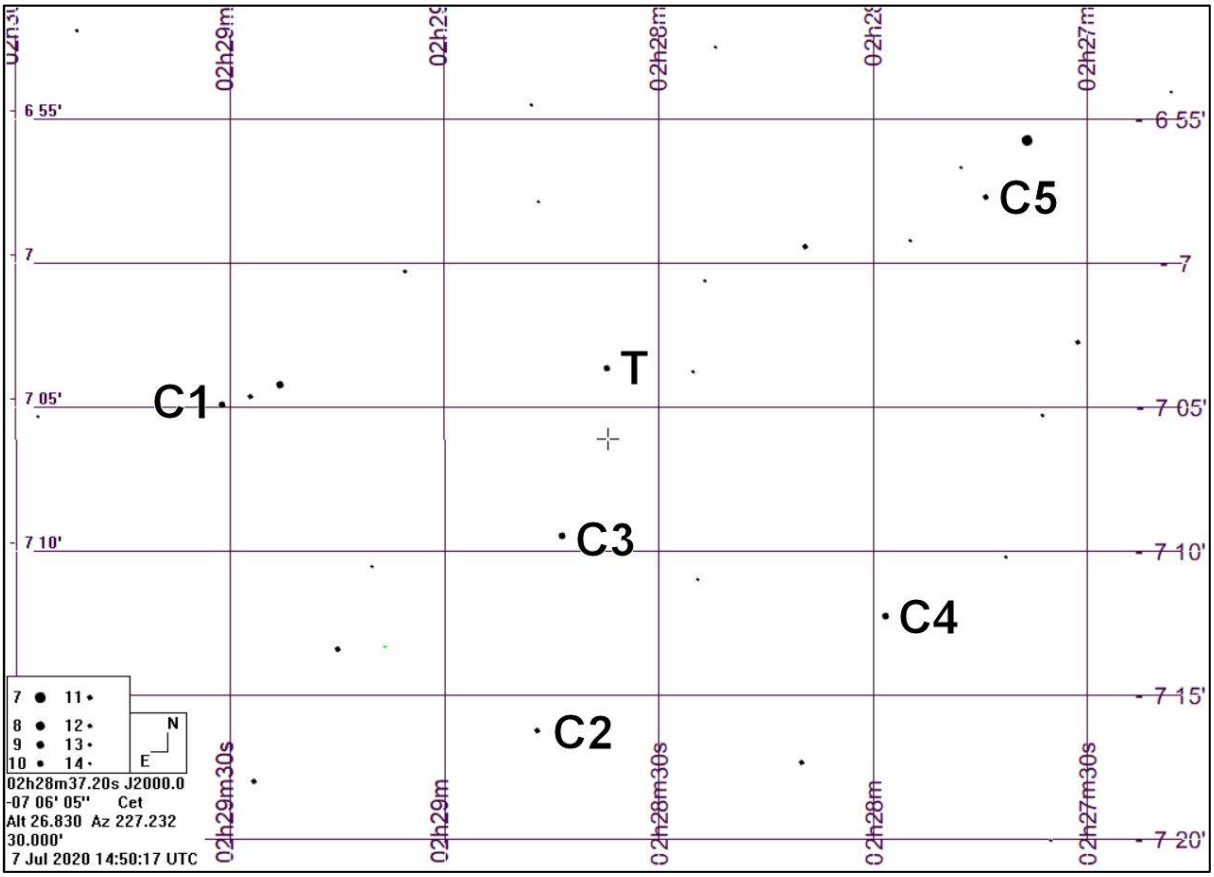


Figure 1. Guide finder chart, 30’ x 30’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	02 28 37.2	-07 06 05	-	-
Target	T	02 28 37.2	-07 03 38	10.12	+0.73
Comparison	C1	02 29 31.1	-07 04 54	9.92	+1.21
Comparison	C2	02 28 47.1	-07 16 13	11.12	+0.91
Comparison	C3	02 28 43.6	-07 09 27	9.73	+0.87
Comparison	C4	02 27 58.4	-07 12 13	9.69	+0.63
Comparison	C5	02 27 44.2	-06 57 41	10.81	+0.43

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-79b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

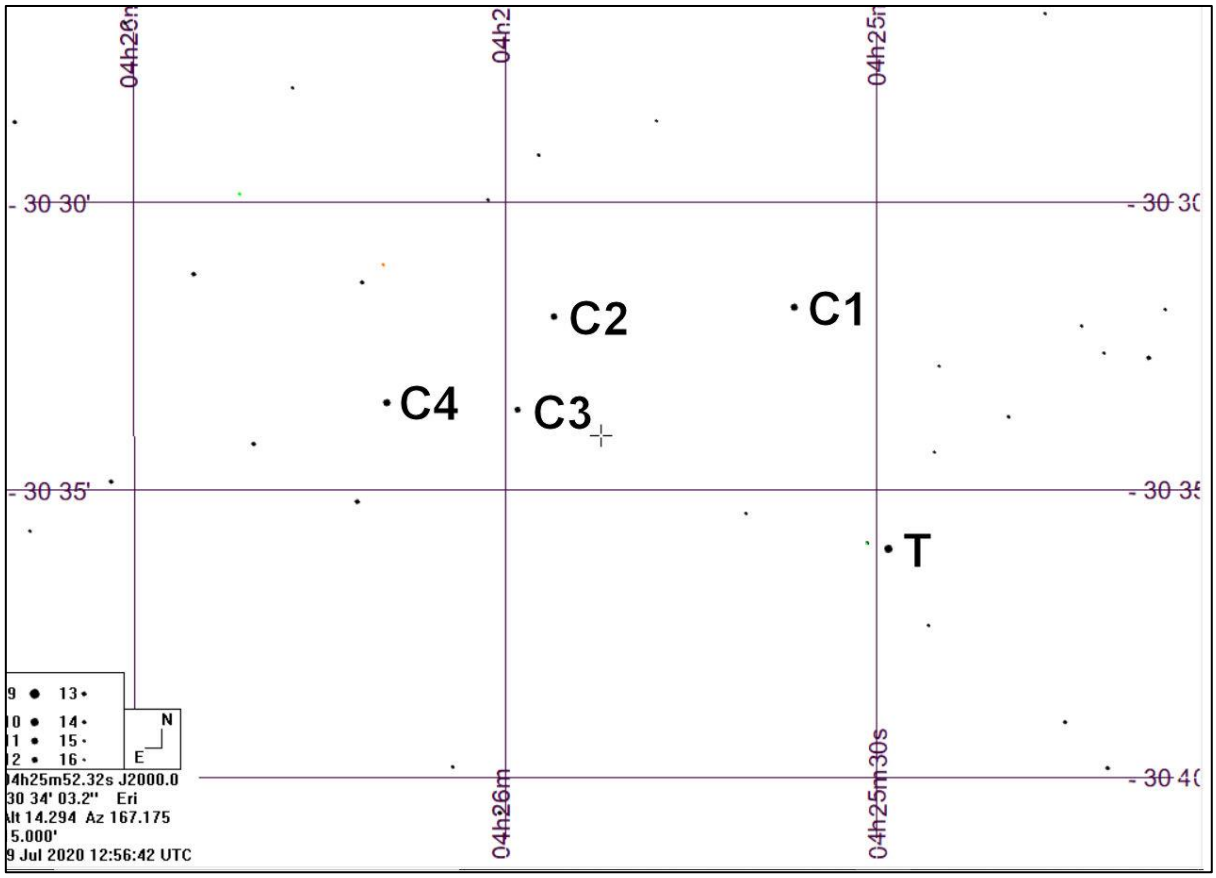


Figure 1. Guide finder chart, 15’ x15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	04 25 52.4	-30 34 03	-	-
Target	T	04 25 29.0	-30 36 02	10.04	+0.42
Comparison	C1	04 25 36.6	-30 31 50	10.81	+0.57
Comparison	C2	04 25 56.0	-30 31 59	11.36	+0.82
Comparison	C3	04 25 59.1	-30 33 36	11.62	+0.41
Comparison	C4	04 26 09.5	-30 33 30	10.64	+0.45

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-35b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

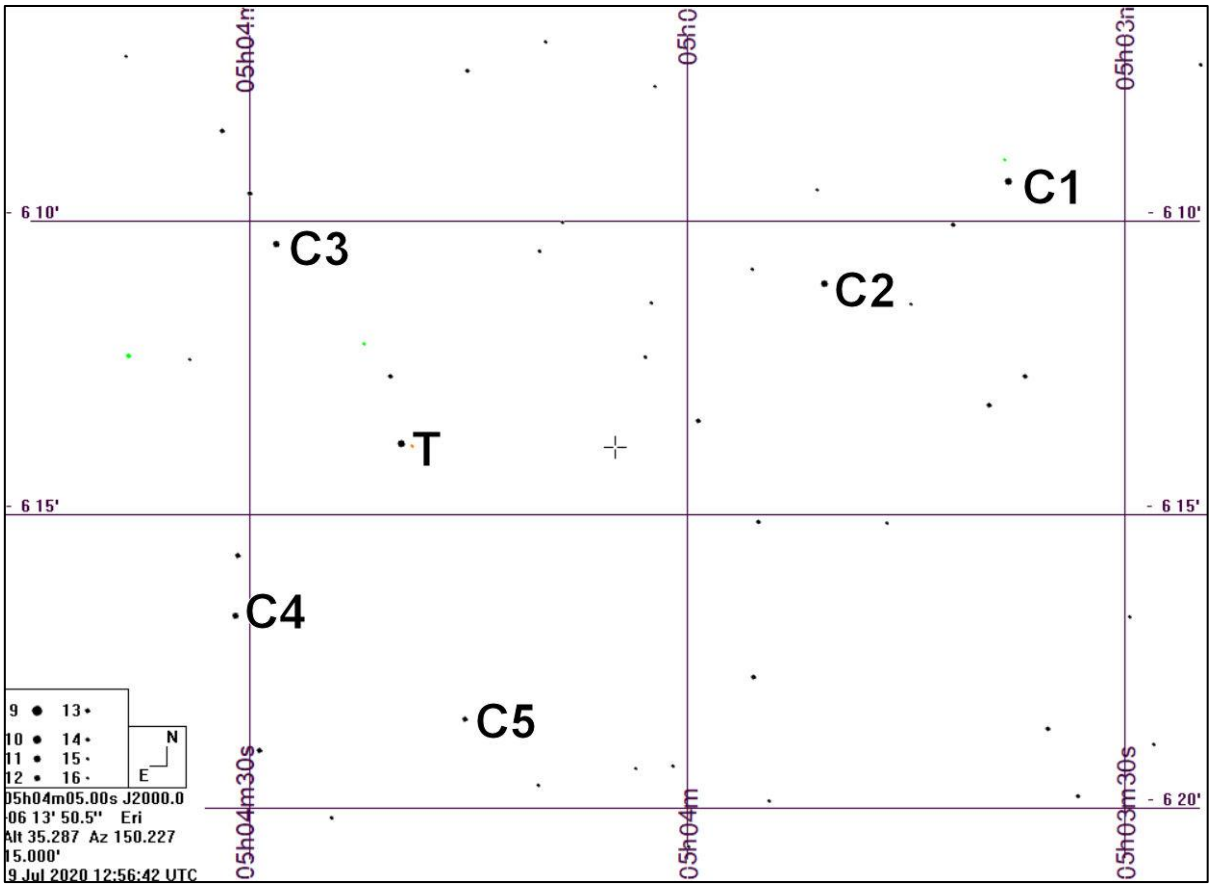


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	05 04 05.1	-06 13 52	-	-
Target	T	05 04 19.6	-06 13 47	10.94	+0.58
Comparison	C1	05 03 38.0	-06 09 19	11.03	+0.52
Comparison	C2	05 03 50.7	-06 11 04	10.95	+0.75
Comparison	C3	05 04 28.2	-06 10 23	11.33	+0.53
Comparison	C4	05 04 31.1	-06 16 43	12.05	+0.51
Comparison	C5	05 04 15.4	-06 18 28	12.56	+0.50

Table 2. Comparison star data

Return to southern celestial hemisphere list

KELT-14b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu (no entry)
	Image	STSci DSS

Table 1. Target data

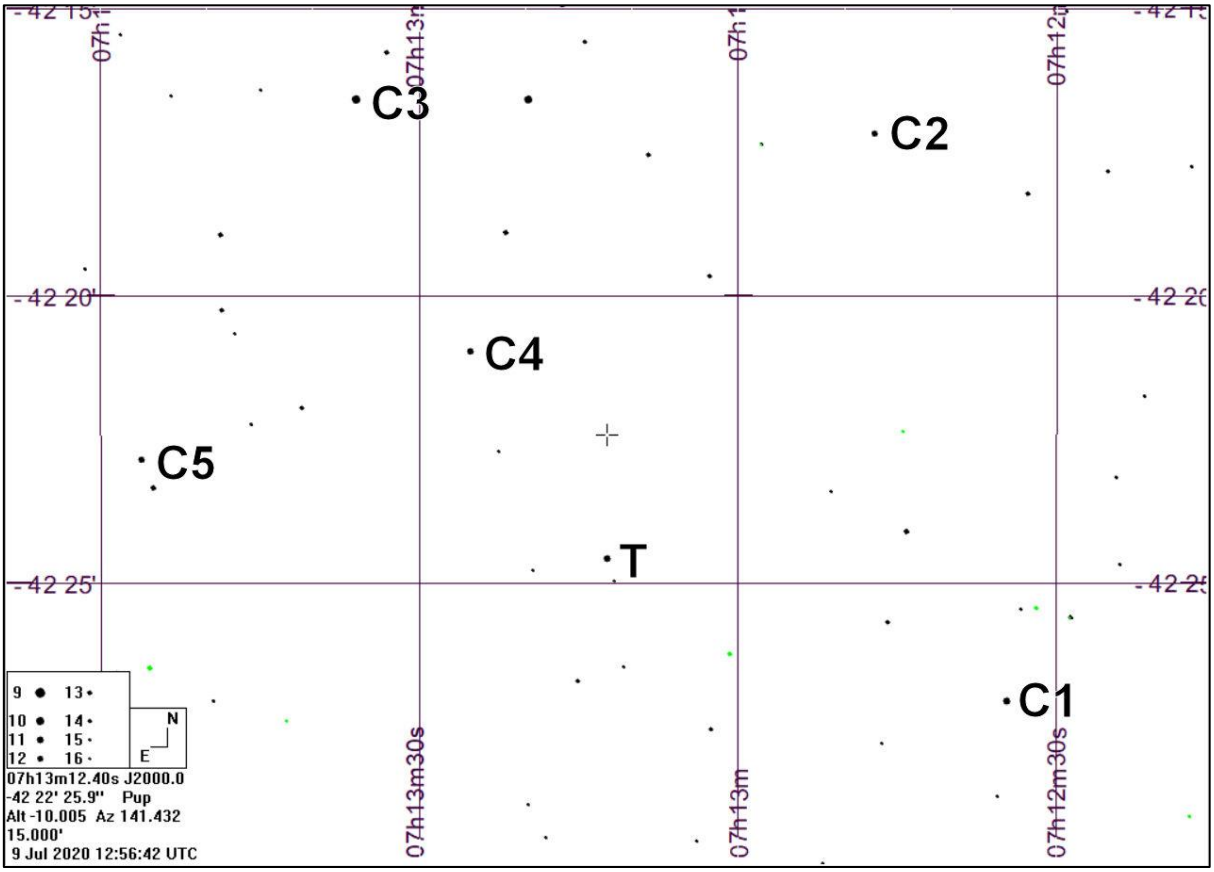


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	07 13 12.4	-42 22 25	-	-
Target	T	07 13 12.4	-42 24 35	11.00	+0.69
Comparison	C1	07 12 34.7	-42 27 04	10.70	+1.00
Comparison	C2	07 12 47.2	-42 17 11	12.06	+0.48
Comparison	C3	07 13 36.0	-42 16 35	9.76	+0.67
Comparison	C4	07 13 25.3	-42 20 60	11.39	+0.04
Comparison	C5	07 13 56.2	-42 22 52	11.90	+0.75

Table 2. Comparison star data

Return to southern celestial hemisphere list

KELT-15b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

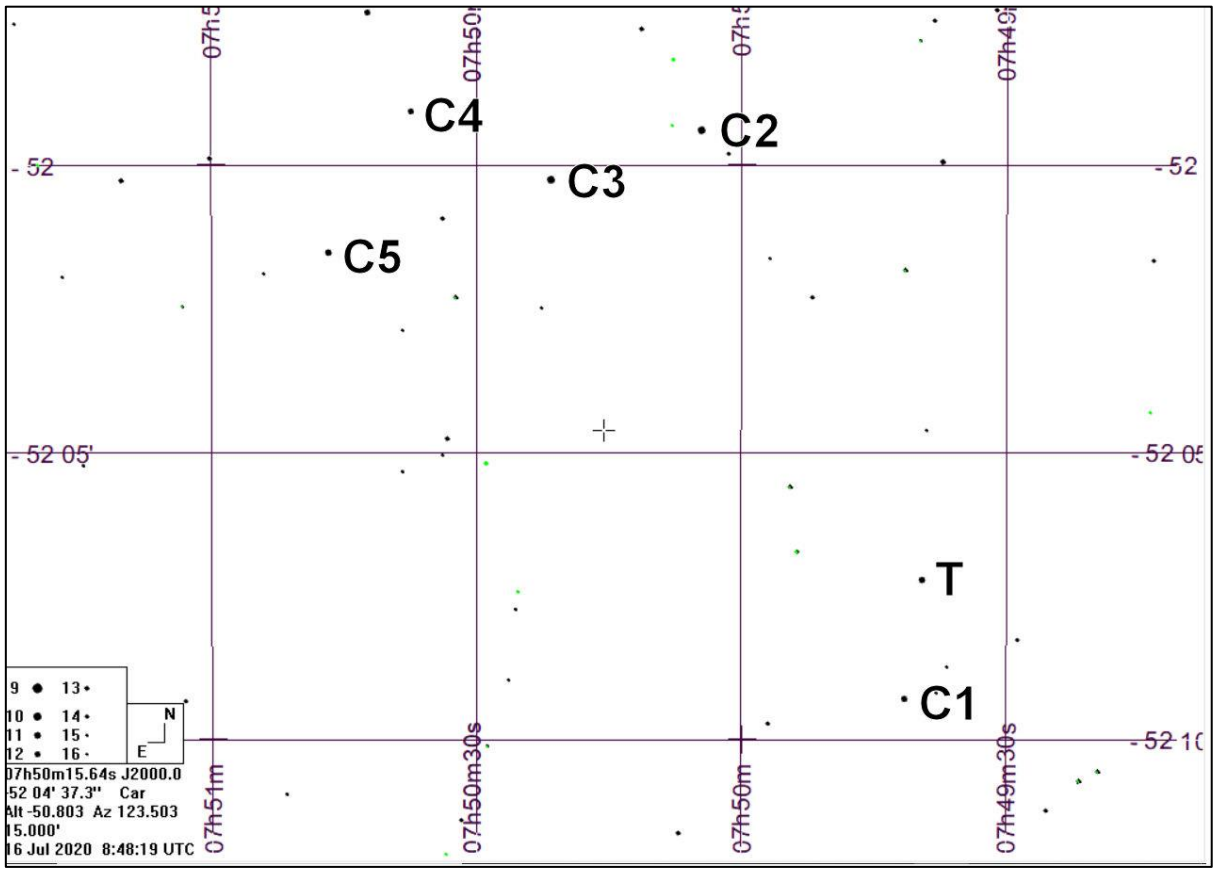


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	07 50 15.8	-52 04 41	-	-
Target	T	07 49 39.6	-52 07 14	11.39	+0.56
Comparison	C1	07 49 41.5	-52 09 19	11.38	+0.66
Comparison	C2	07 50 04.6	-51 59 24	10.46	+0.44
Comparison	C3	07 50 21.5	-52 00 16	10.46	+1.06
Comparison	C4	07 50 37.4	-51 59 05	11.68	+0.40

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-84b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data

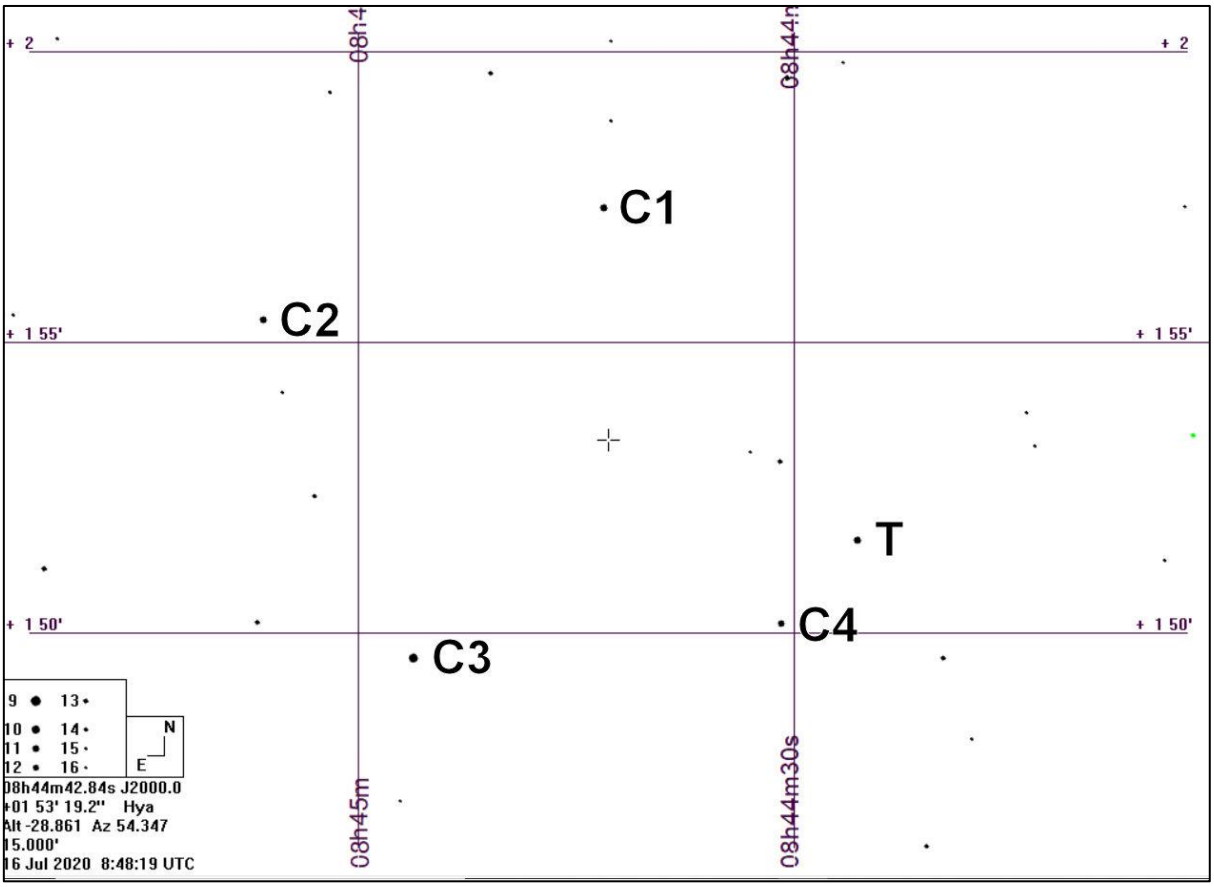


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	08 44 42.8	+01 53 19	-	-
Target	T	08 44 25.7	+01 51 36	10.83	+0.83
Comparison	C1	08 44 43.2	+01 57 18	10.79	+0.60
Comparison	C2	08 45 06.6	+01 55 23	11.04	+0.49
Comparison	C3	08 44 56.2	+01 49 33	9.61	+0.58
Comparison	C4	08 44 30.9	+01 50 09	11.19	+0.67

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-43b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data

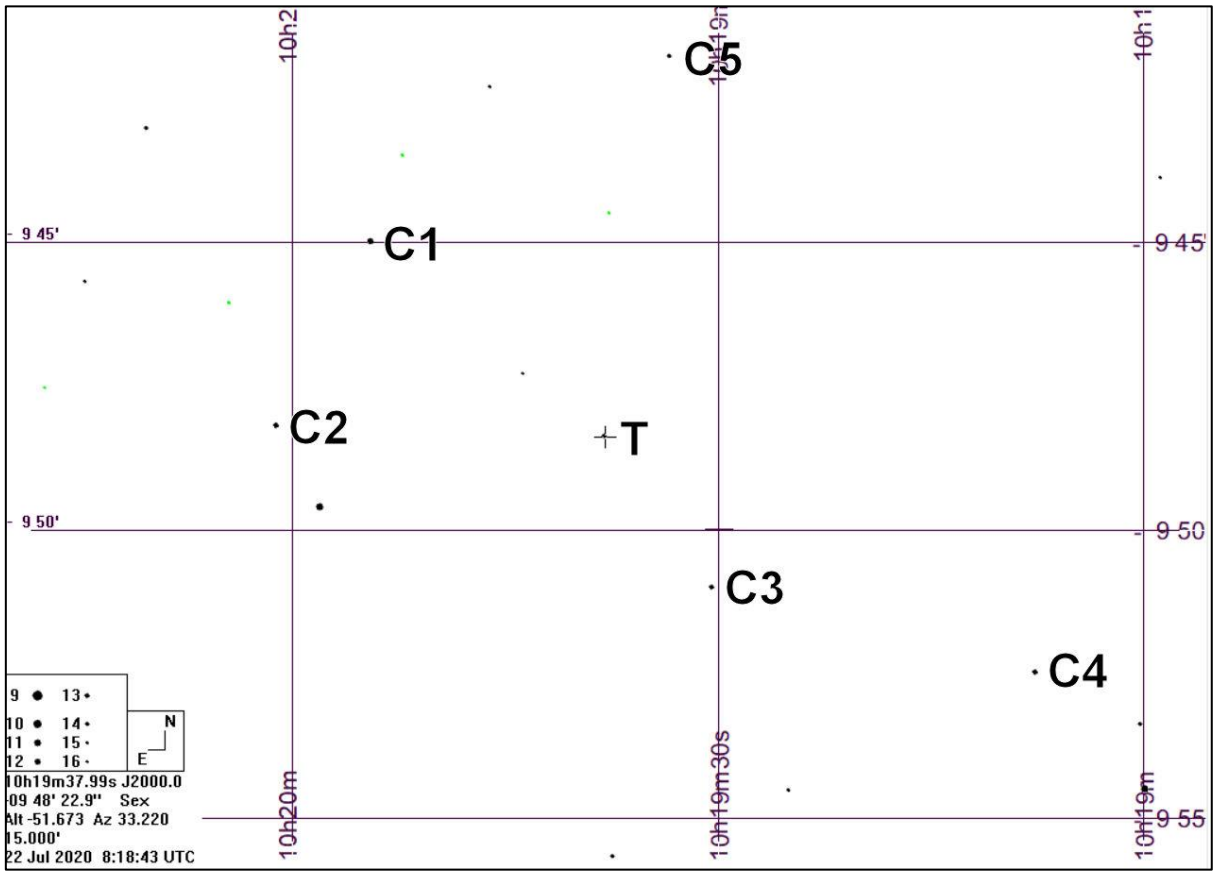


Figure 1. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V mag	B-V
Target	T	10 19 38.0	-09 48 23	12.40	+1.33
Comparison	C1	10 19 54.6	-09 44 59	11.13	+0.63
Comparison	C2	10 20 01.3	-09 48 10	11.66	+0.87
Comparison	C3	10 19 30.4	-09 50 58	12.69	+0.58
Comparison	C4	10 19 07.7	-09 52 27	11.99	+0.69
Comparison	C5	10 19 33.5	-09 41 46	13.23	+1.31

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-104b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data

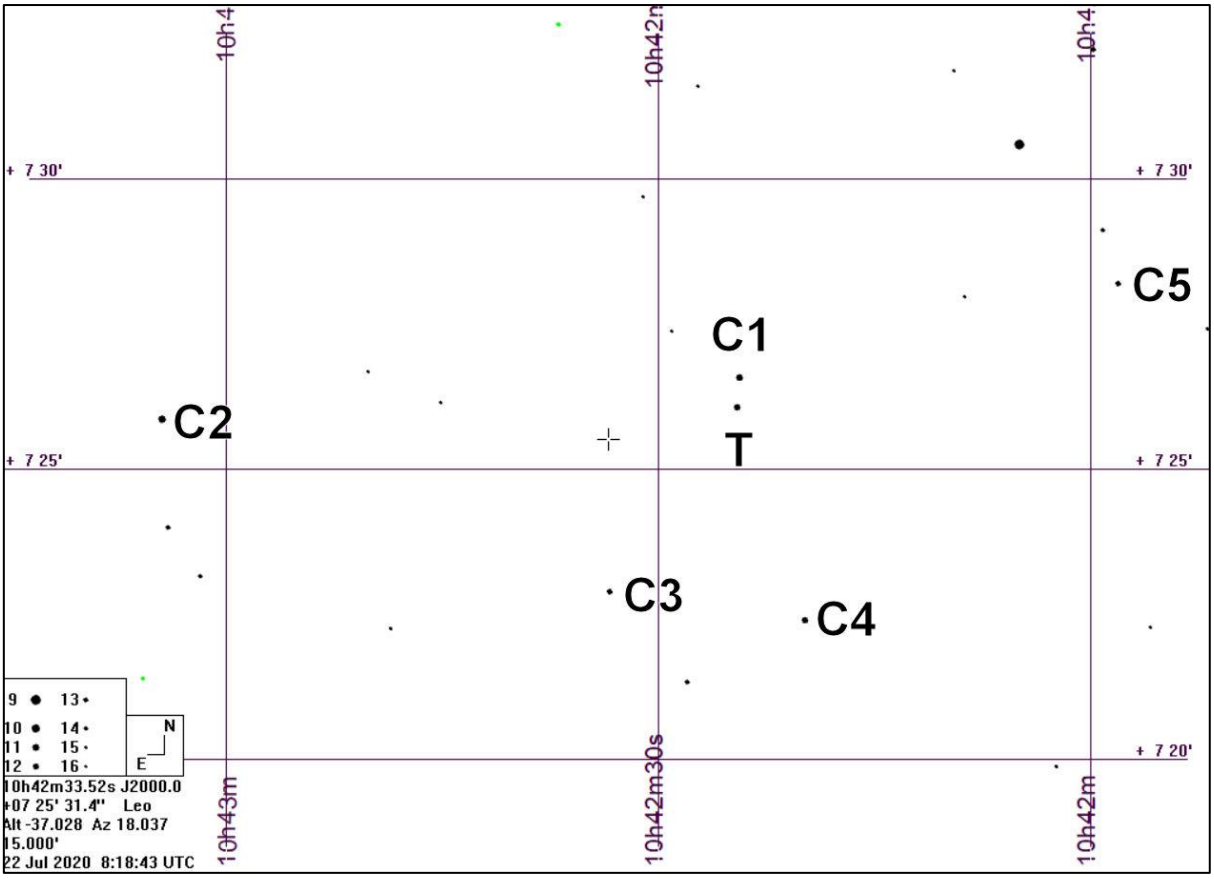


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	10 42 33.5	+07 25 30	-	-
Target	T	10 42 24.6	+07 26 06	11.12	+0.83
Comparison	C1	10 42 24.4	+07 26 35	11.16	+0.46
Comparison	C2	10 43 04.5	+07 25 51	10.45	+0.55
Comparison	C3	10 42 33.5	+07 22 55	12.59	+0.82
Comparison	C4	10 42 19.9	+07 22 24	12.31	+0.95
Comparison	C5	10 41 58.1	+07 28 14	12.71	+0.82

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-31b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data

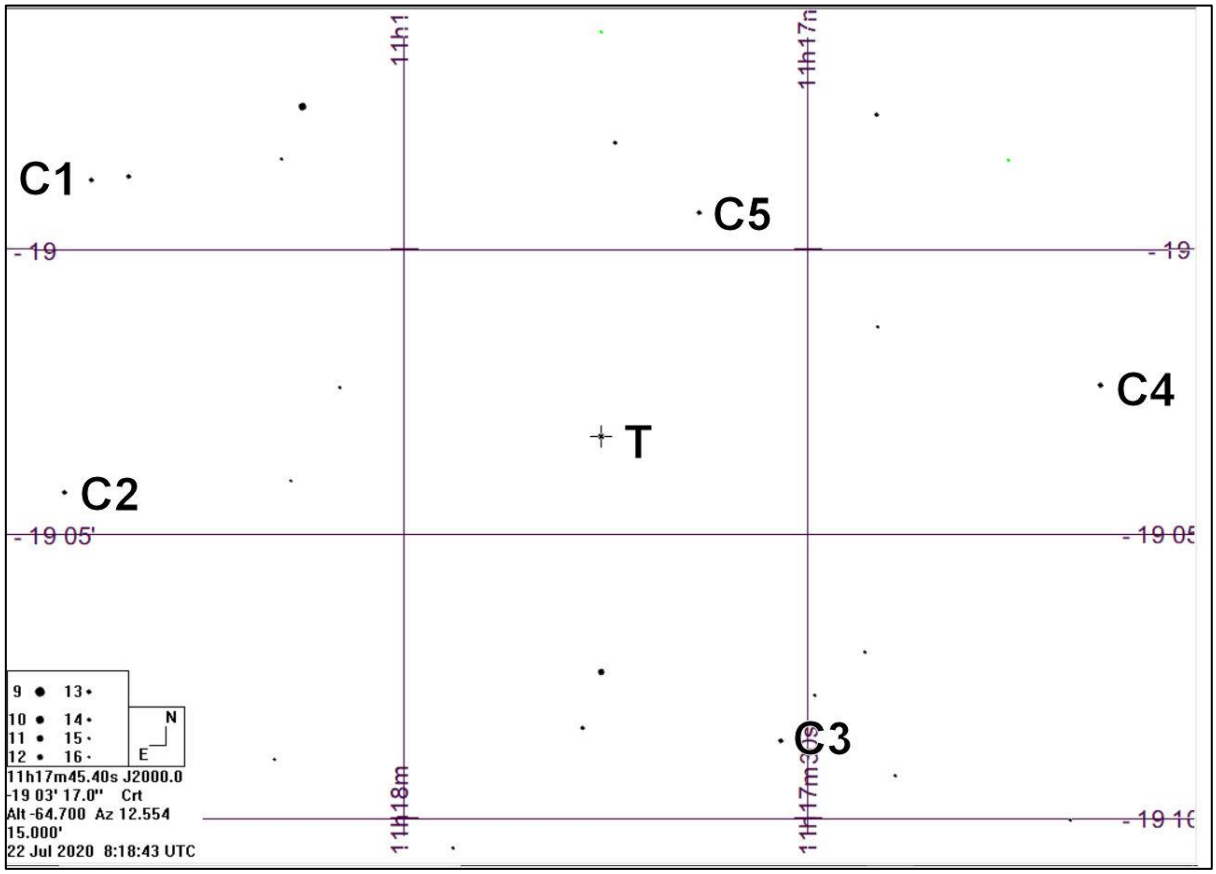


Figure 1. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V mag	B-V
Target	T	11 17 45.4	-19 03 17	11.66	+0.53
Comparison	C1	11 18 23.2	-18 58 46	12.82	+0.50
Comparison	C2	11 18 25.3	-19 04 14	12.97	+0.49
Comparison	C3	11 17 32.0	-19 08 37	12.61	+0.50
Comparison	C4	11 17 08.3	-19 02 22	12.06	+0.67
Comparison	C5	11 17 38.1	-18 59 20	13.03	+0.67

Table 2. Comparison star data

Return to southern celestial hemisphere list

HATS-1b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data

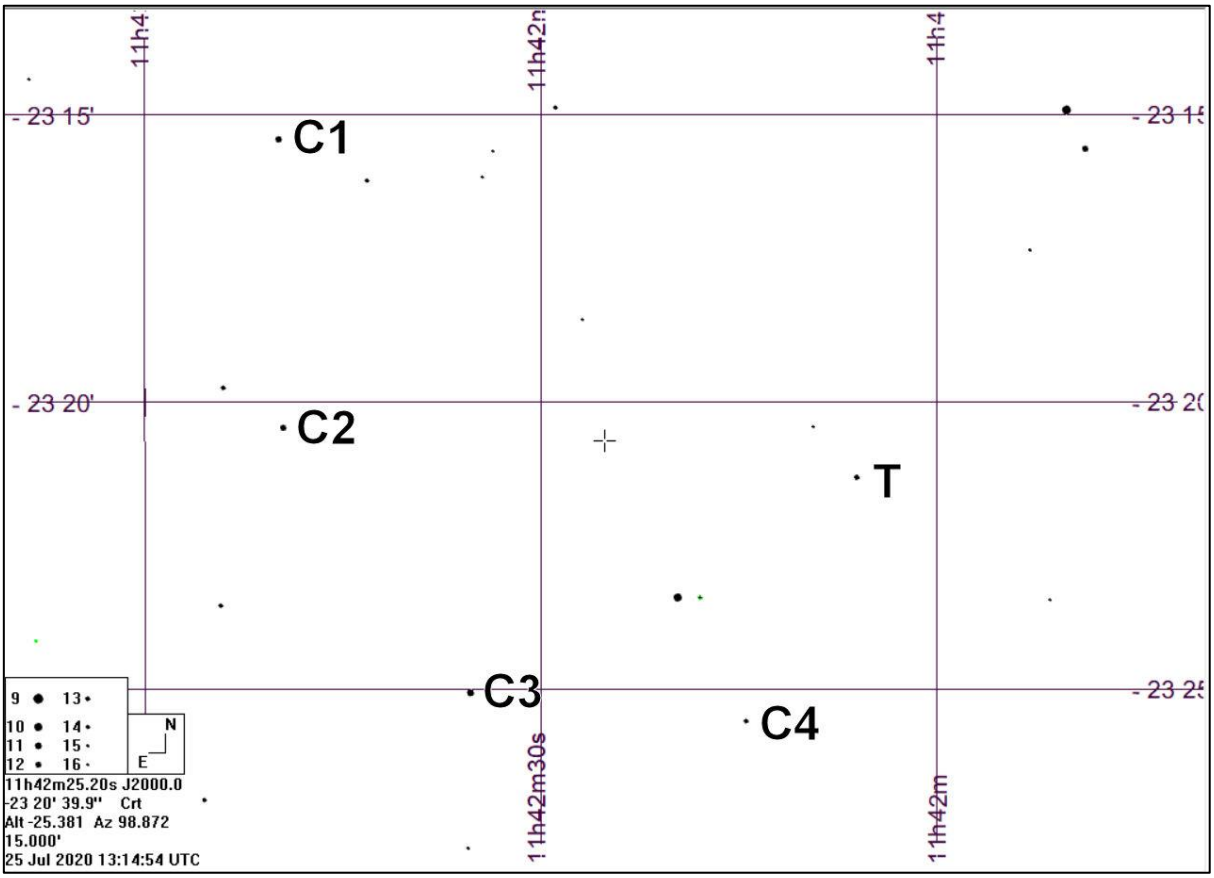


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	11 42 25.3	-23 20 40	-	-
Target	T	11 42 06.1	-23 21 17	12.06	+0.65
Comparison	C1	11 42 49.6	-23 15 25	11.54	+0.43
Comparison	C2	11 42 49.5	-23 20 26	12.23	+0.49
Comparison	C3	11 42 35.4	-23 25 04	10.84	+0.70
Comparison	C4	11 42 14.5	-23 25 32	13.12	+0.68

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-41b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data

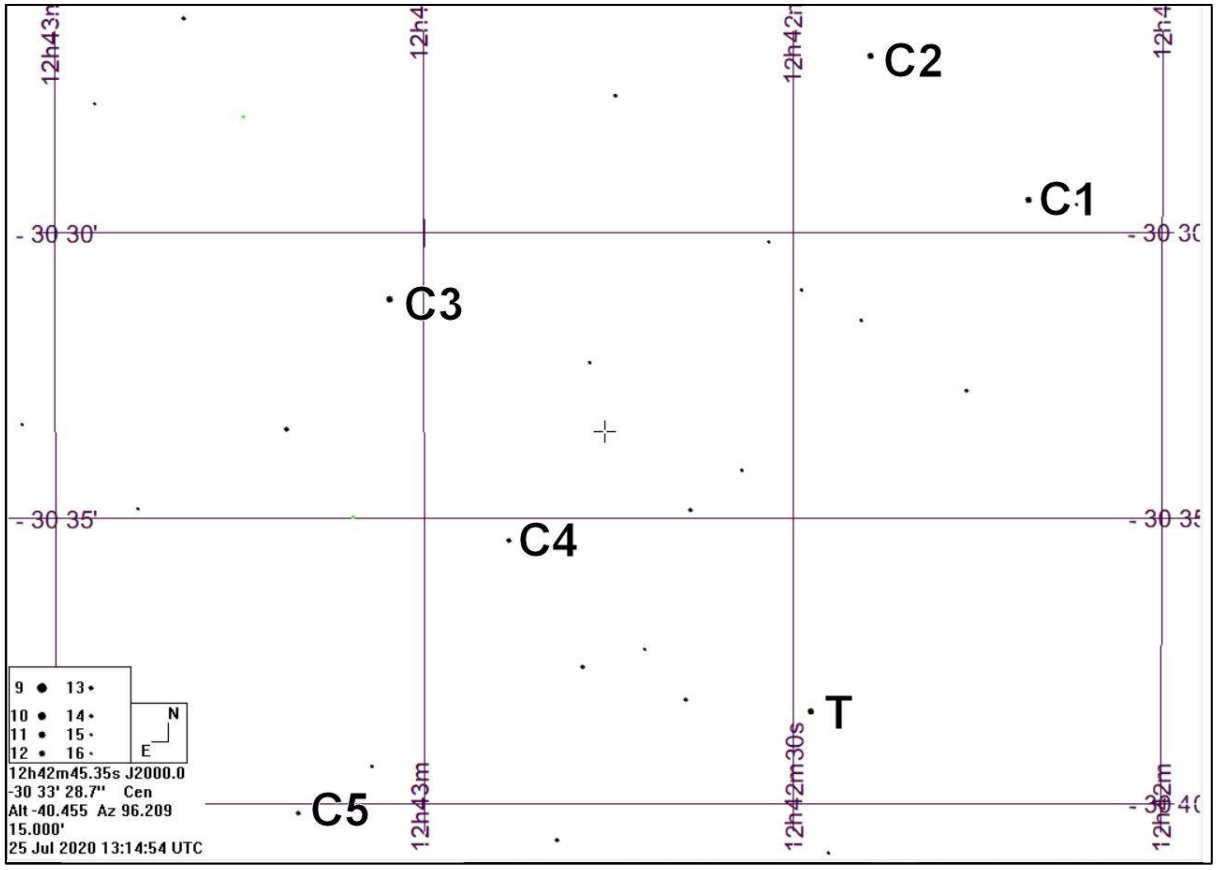


Figure 1. Guide finder chart, 15' x 15'

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	12 42 45.3	-30 33 30	-	-
Target	T	12 42 28.5	-30 38 24	11.63	+0.80
Comparison	C1	12 42 10.9	-30 29 26	11.42	+0.58
Comparison	C2	12 42 23.7	-30 26 54	11.66	+0.53
Comparison	C3	12 43 02.8	-30 31 11	11.27	+0.77
Comparison	C4	12 42 53.2	-30 35 23	12.38	+0.97
Comparison	C5	12 43 10.2	-30 40 10	12.90	+0.51

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-25b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data

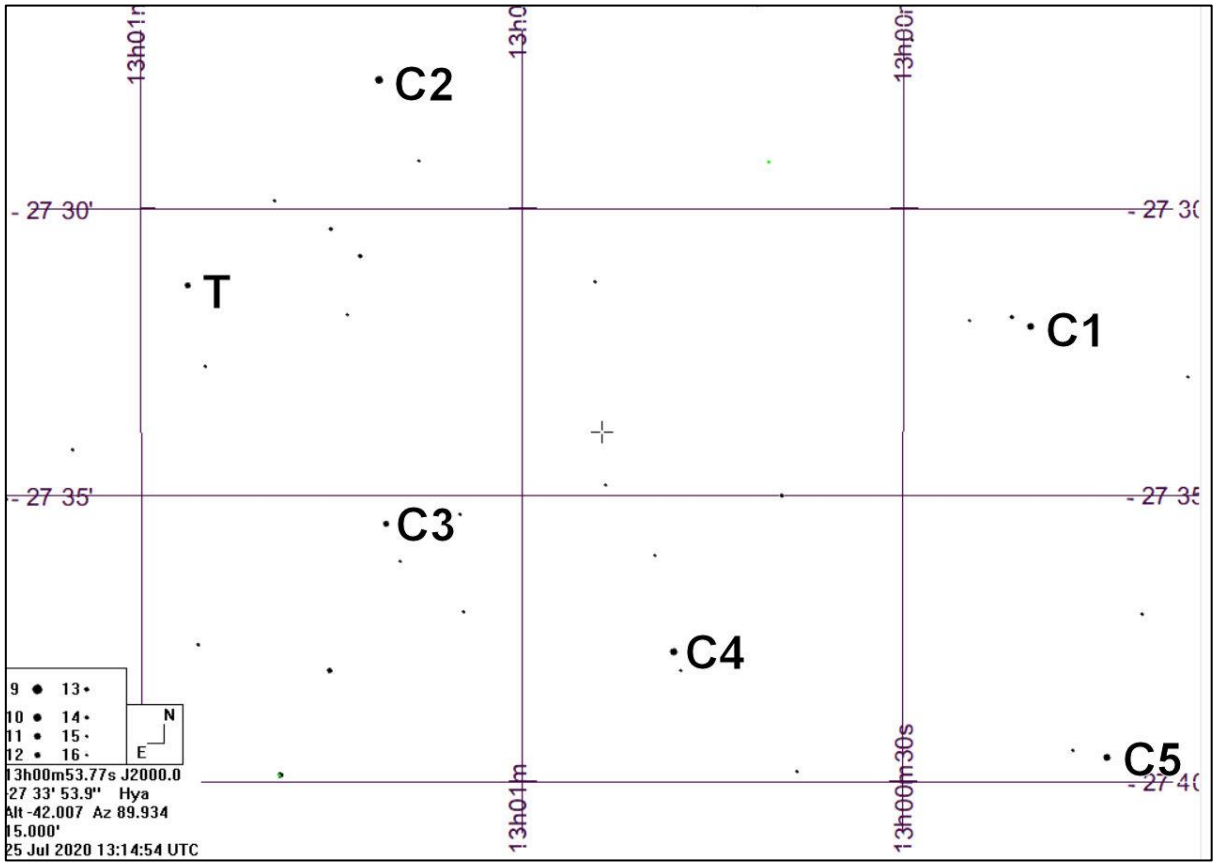


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	13 00 53.7	-27 33 54	-	-
Target	T	13 01 26.4	-27 31 20	11.87	+0.71
Comparison	C1	13 00 20.0	-27 32 04	11.10	+0.36
Comparison	C2	13 01 11.3	-27 27 45	10.33	+0.65
Comparison	C3	13 01 10.6	-27 35 30	11.66	+0.46
Comparison	C4	13 00 48.1	-27 37 44	10.70	+0.53
Comparison	C5	13 00 13.9	-27 39 34	10.87	+0.64

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-15b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data

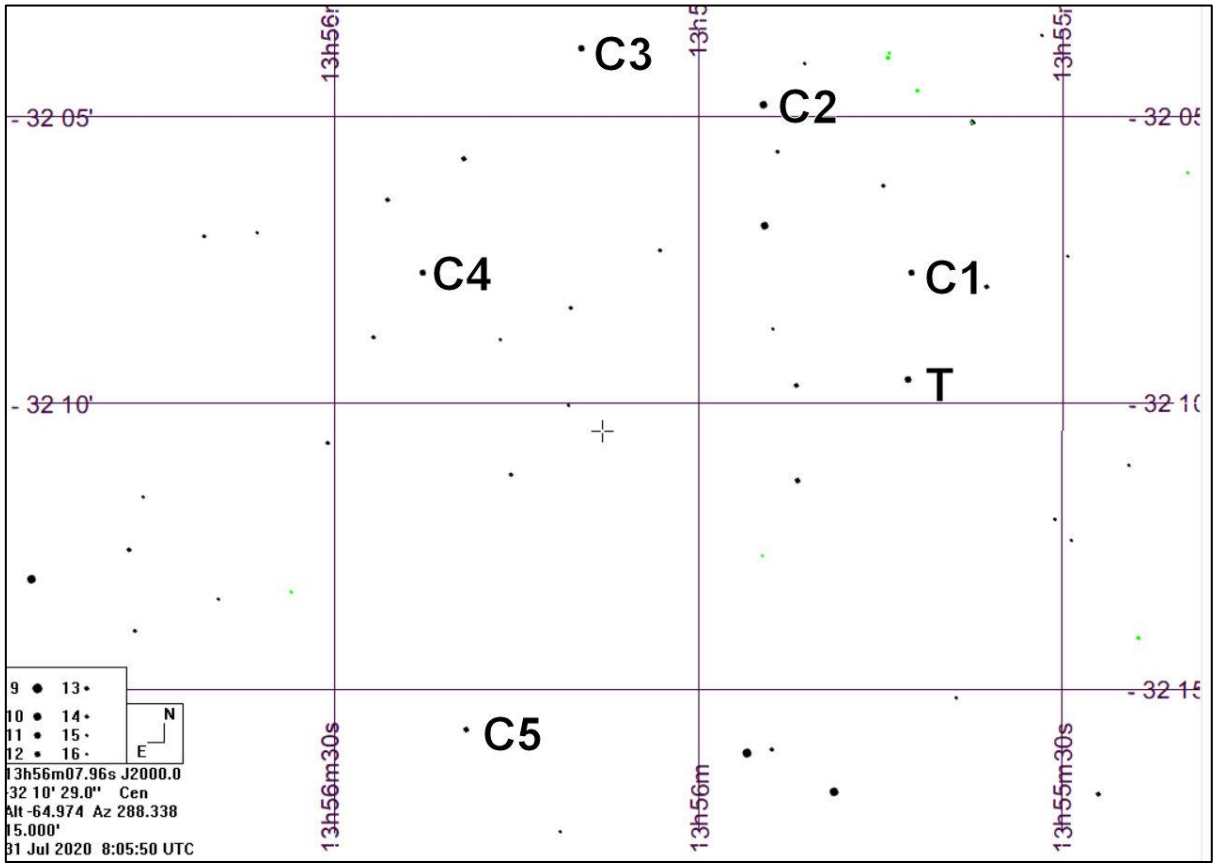


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	13 56 07.9	-32 10 31	-	-
Target	T	13 55 42.7	-32 09 35	10.91	+0.49
Comparison	C1	13 55 42.4	-32 07 43	11.46	+0.61
Comparison	C2	13 55 54.7	-32 04 48	10.41	+0.43
Comparison	C3	13 56 09.7	-32 03 48	11.28	+0.38
Comparison	C4	13 56 22.7	-32 07 43	11.71	+0.66
Comparison	C5	13 56 19.2	-32 15 42	12.50	+0.52

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-17b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data

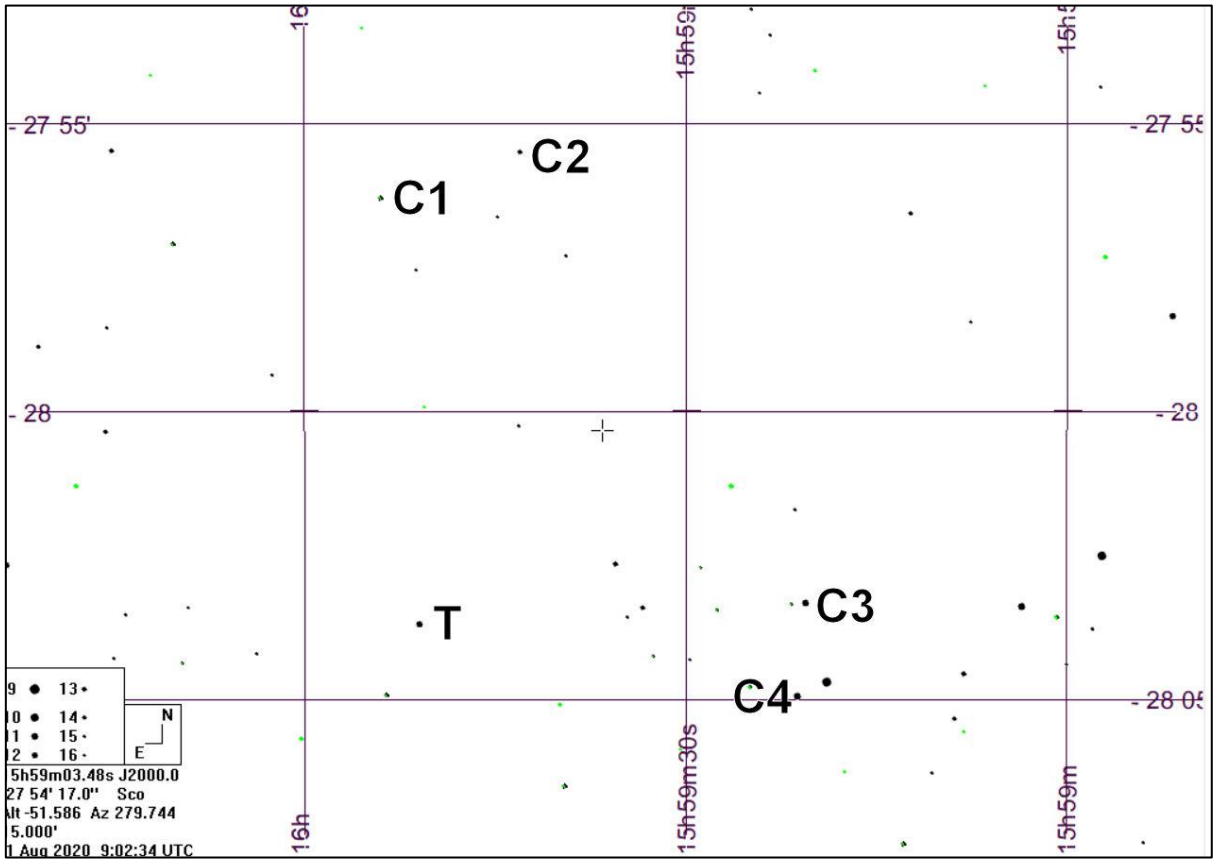


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	15 59 36.5	-28 00 21	-	-
Target	T	15 59 50.9	-28 03 42	11.59	+0.45
Comparison	C1	15 59 54.0	-27 56 18	12.63	+0.61
Comparison	C2	15 59 43.0	-27 55 30	12.82	+0.49
Comparison	C3	15 59 20.6	-28 03 19	11.23	+0.39
Comparison	C4	15 59 21.2	-28 04 57	10.95	+0.51

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-16b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data

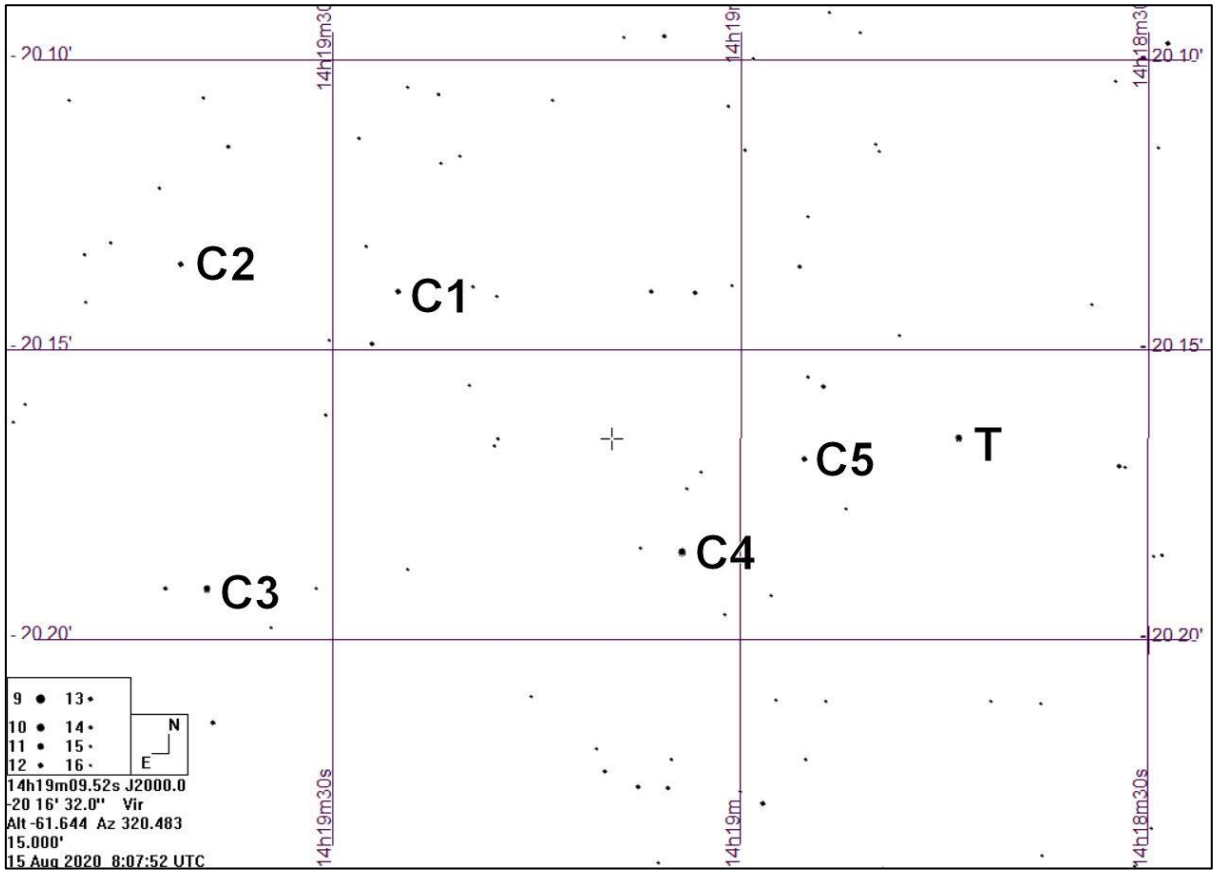


Figure 1. Guide finder chart, 15' x 15'

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	14 19 09.5	-20 16 32	-	-
Target	T	14 18 43.9	-20 16 32	11.29	+0.71
Comparison	C1	14 19 25.2	-20 13 59	12.10	+0.85
Comparison	C2	14 19 41.2	-20 13 30	11.95	+1.32
Comparison	C3	14 19 39.3	-20 19 07	11.14	+1.13
Comparison	C4	14 19 04.3	-20 18 30	10.34	+0.54
Comparison	*C5*	14 18 55.4	-20 16 52	12.00	+0.55

Table 2. Comparison star data

Return to southern celestial hemisphere list

NGTS-2b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data.

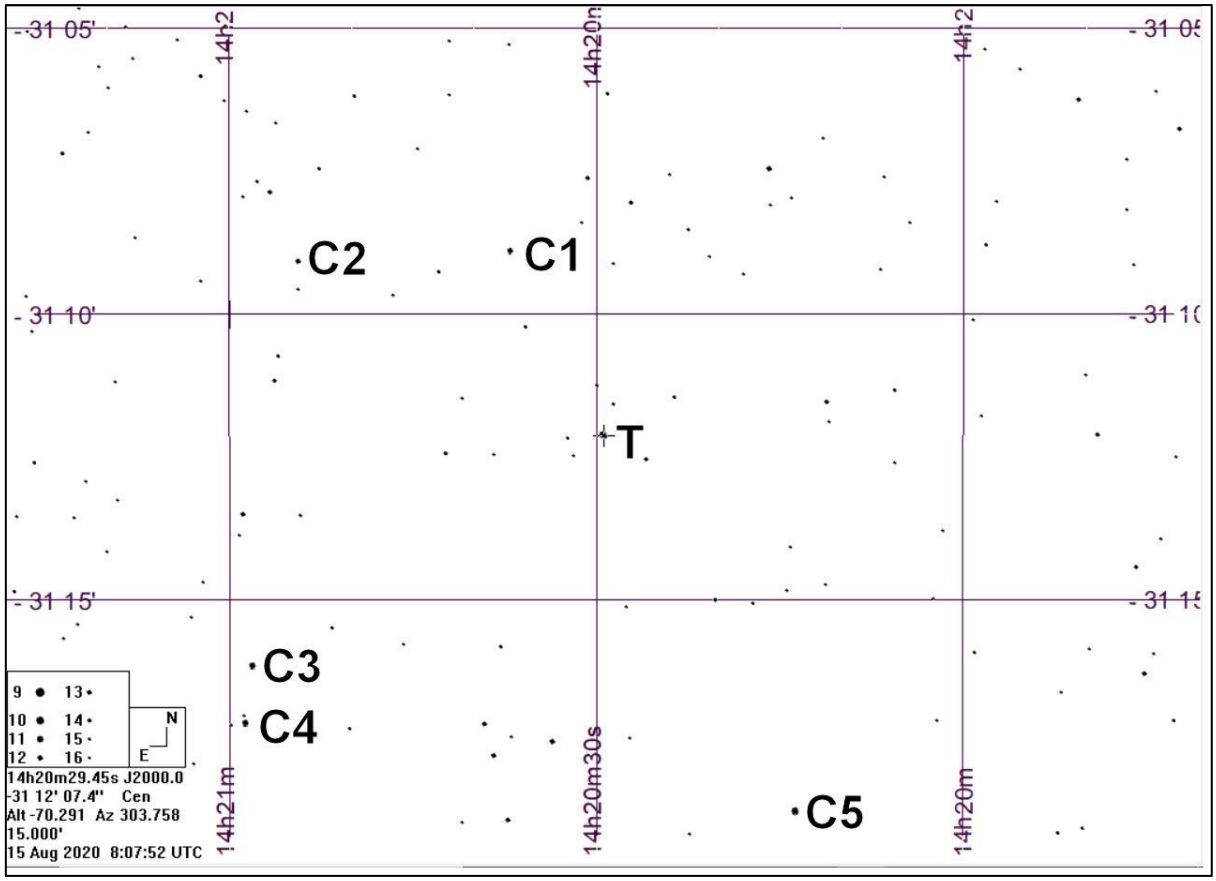


Figure 1. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V mag	B-V
Target	T	14 20 29.5	-31 12 07	10.96	+0.45
Comparison	C1	14 20 37.1	-31 08 54	12.04	+0.90
Comparison	C2	14 20 54.4	-31 09 04	12.69	+0.60
Comparison	C3	14 20 58.2	-31 16 09	11.62	+0.61
Comparison	C4	14 20 58.8	-31 17 09	11.46	+0.68
Comparison	*C5*	14 20 13.7	-31 18 42	10.62	+1.56

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-39b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data.

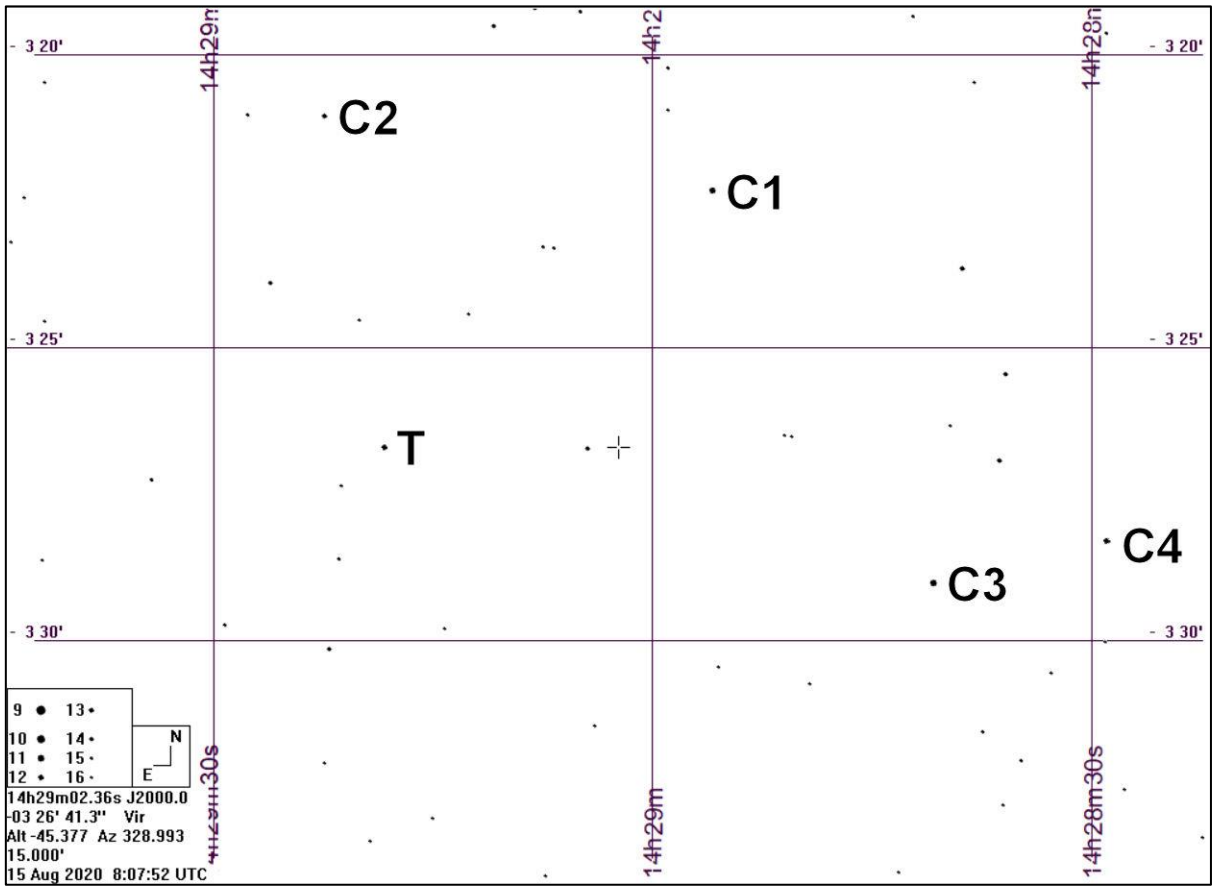


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	14 29 02.4	-03 26 40	-	-
Target	T	14 29 18.4	-03 26 40	12.09	+0.78
Comparison	C1	14 28 55.9	-03 22 18	11.56	+1.15
Comparison	C2	14 29 22.4	-03 21 02	13.21	+0.60
Comparison	C3	14 28 40.8	-03 28 59	11.11	+0.78
Comparison	C4	14 28 28.9	-03 28 17	12.26	+0.90

Table 2. Comparison star data

Return to southern celestial hemisphere list

K2-237b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data.

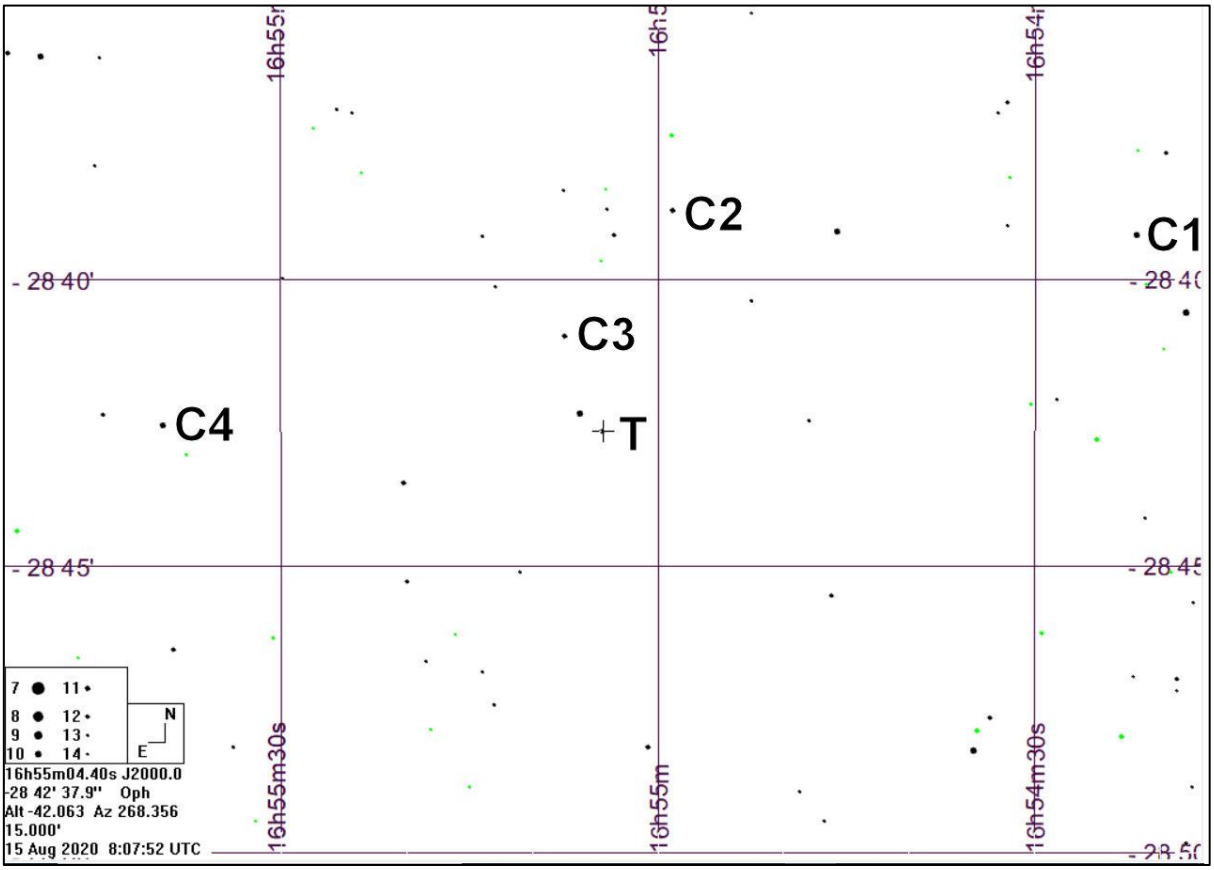


Figure 1. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V mag	B-V
Target	T	16 55 04.5	-28 42 38	11.60	+0.59
Comparison	C1	16 54 21.9	-28 39 11	10.35	+0.59
Comparison	C2	16 54 58.8	-28 38 46	11.65	+0.58
Comparison	*C3*	16 55 07.5	-28 40 58	11.14	+0.58
Comparison	C4	16 55 39.4	-28 42 32	10.92	+0.36

Table 2. Comparison star data

Return to southern celestial hemisphere list

KELT-10b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data.

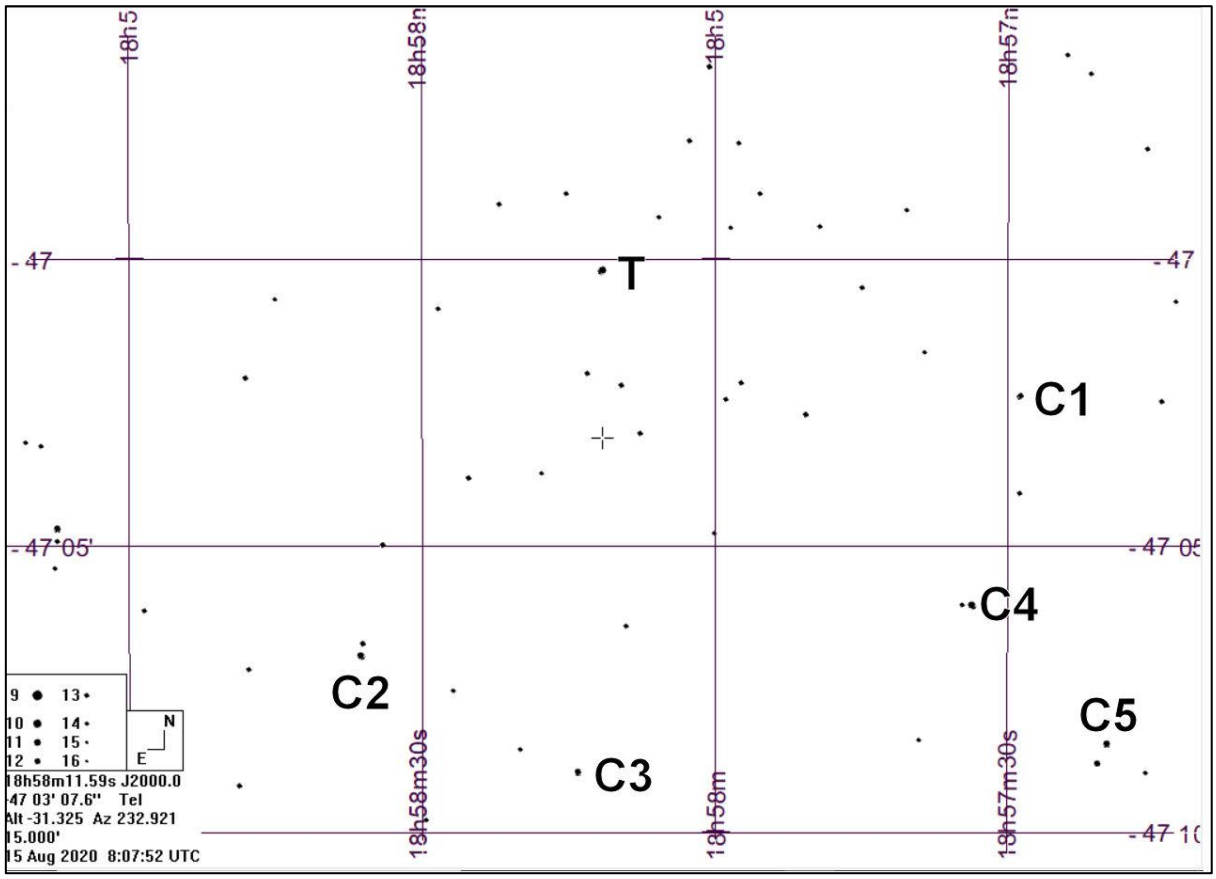


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	18 58 11.6	-47 03 25	-	-
Target	T	18 58 11.6	-47 00 12	10.62	+0.61
Comparison	C1	18 57 28.8	-47 02 24	12.65	+0.58
Comparison	C2	18 58 36.2	-47 06 36	12.94	+0.70
Comparison	*C3*	18 58 14.0	-47 08 58	12.11	+0.40
Comparison	C4	18 57 33.8	-47 06 03	11.27	+0.47
Comparison	C5	18 57 19.9	-47 08 27	11.52	+0.48

Table 2. Comparison star data

Return to southern celestial hemisphere list

WASP-123b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data.

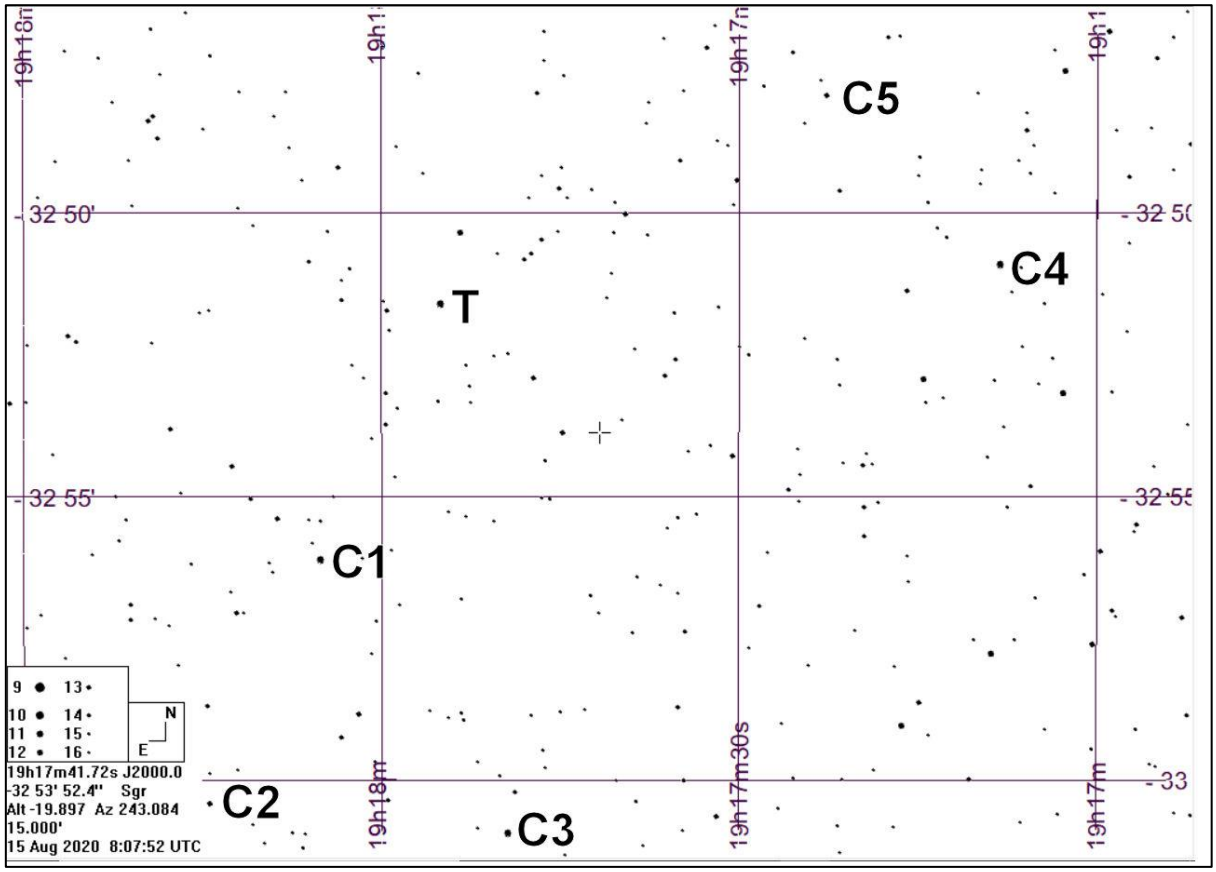


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	19 17 41.7	-32 53 54	-	-
Target	T	19 17 55.0	-32 51 36	11.03	+0.71
Comparison	C1	19 18 05.1	-32 56 07	11.01	+1.00
Comparison	C2	19 18 14.4	-33 00 24	12.4	+0.80
Comparison	C3	19 17 49.4	-33 00 56	11.4	+0.47
Comparison	C4	19 17 08.1	-32 50 54	10.9	+0.52
Comparison	C5	19 17 22.7	-32 47 54	12.6	+0.79

Table 2. Comparison star data

Return to southern celestial hemisphere list

HATS-33b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table1. Target data.

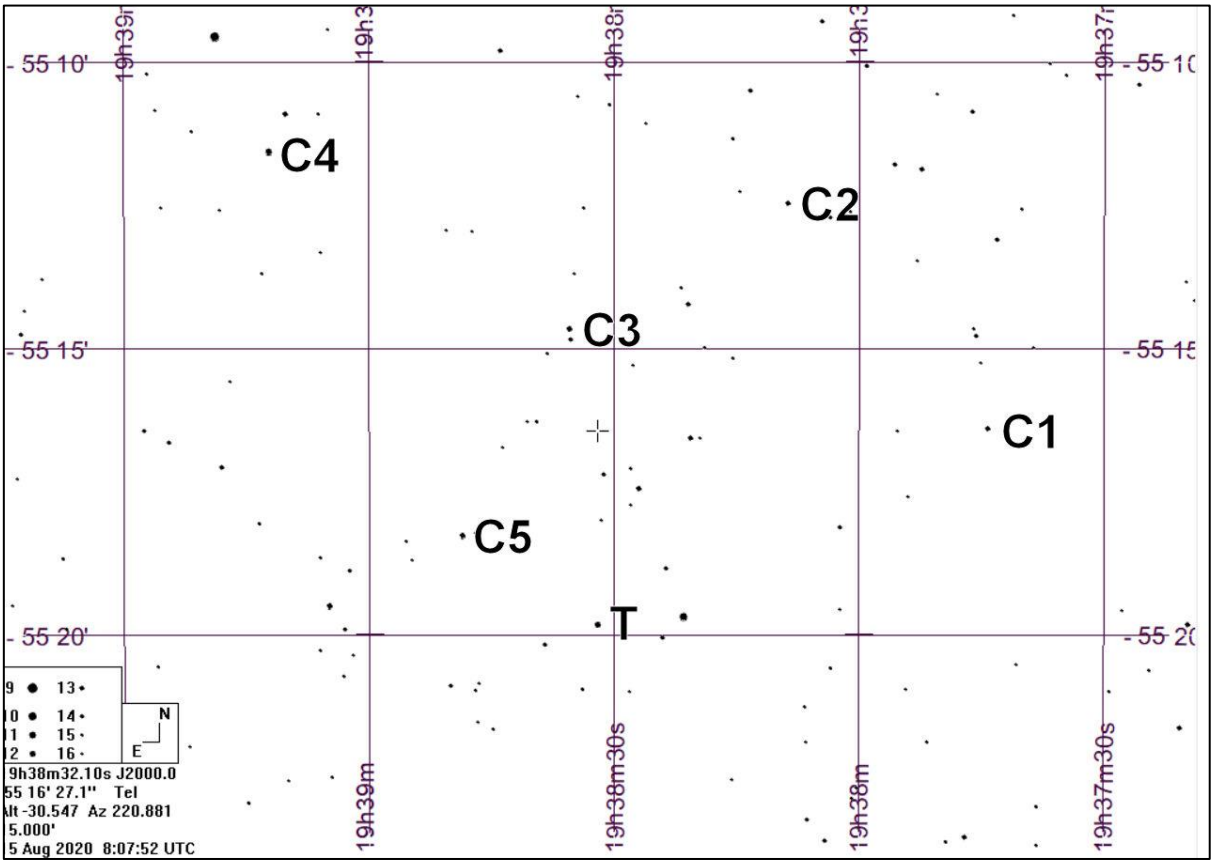


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V mag	B-V
Chart centre	-	19 38 32.1	-55 16 28	-	-
Target	T	19 38 32.1	-55 19 48	11.91	+0.74
Comparison	C1	19 37 44.3	-55 16 24	12.65	+0.53
Comparison	C2	19 38 08.7	-55 12 28	12.74	+0.63
Comparison	C3	19 38 35.5	-55 14 44	12.22	+0.62
Comparison	C4	19 39 12.3	-55 11 35	11.51	+0.58
Comparison	C5	19 38 48.6	-55 18 17	12.39	+0.64

Table 2. Comparison star data

Return to southern celestial hemisphere list

HAT-P-41b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

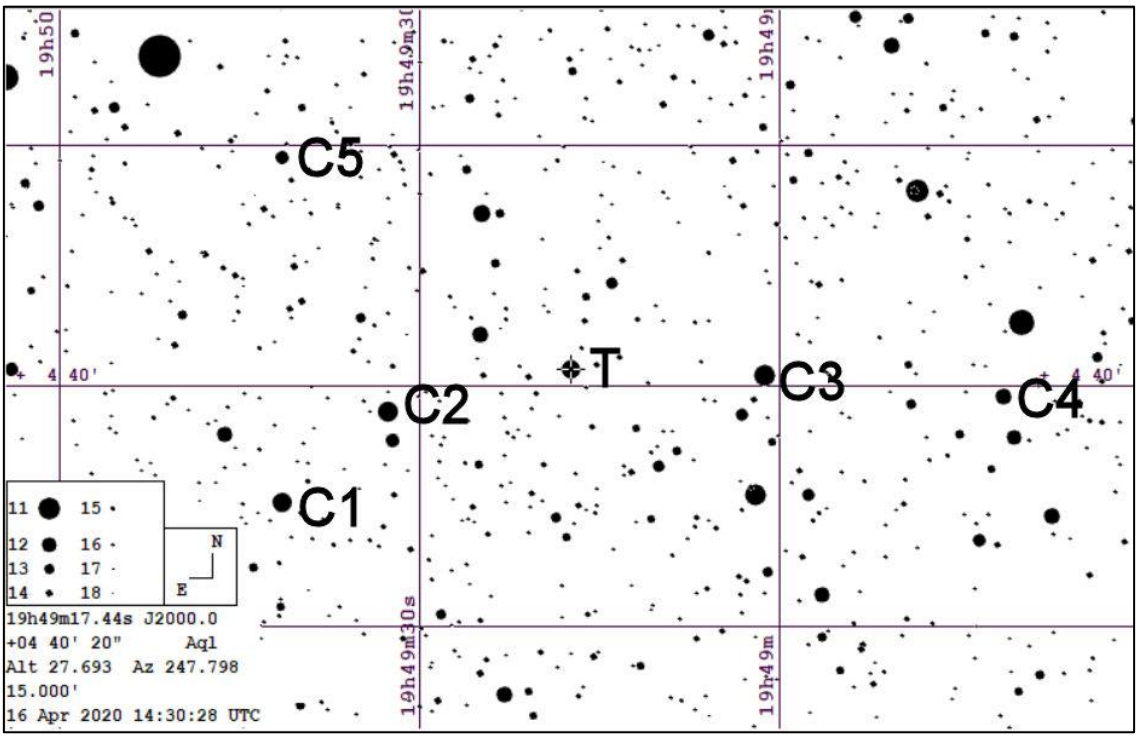


Figure 3. Guide finder chart, 15’ x 15’

Star	ID	RA	Dec	V	B-V
Target	T	19 49 17.4	+04 40 21	11.36	+0.63
Comparison	C1	19 49 41.5	+04 37 35	11.20	+0.61
Comparison	C2	19 49 32.7	+04 39 27	11.04	+1.39
Comparison	C3	19 49 01.2	+04 40 15	11.59	+1.64
Comparison	C4	19 48 41.3	+04 39 48	12.00	+1.20
Comparison	C5	19 49 41.4	+04 44 47	12.32	+0.65

Table 2. Comparison and target star data

Return to southern celestial hemisphere list

WASP-7b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

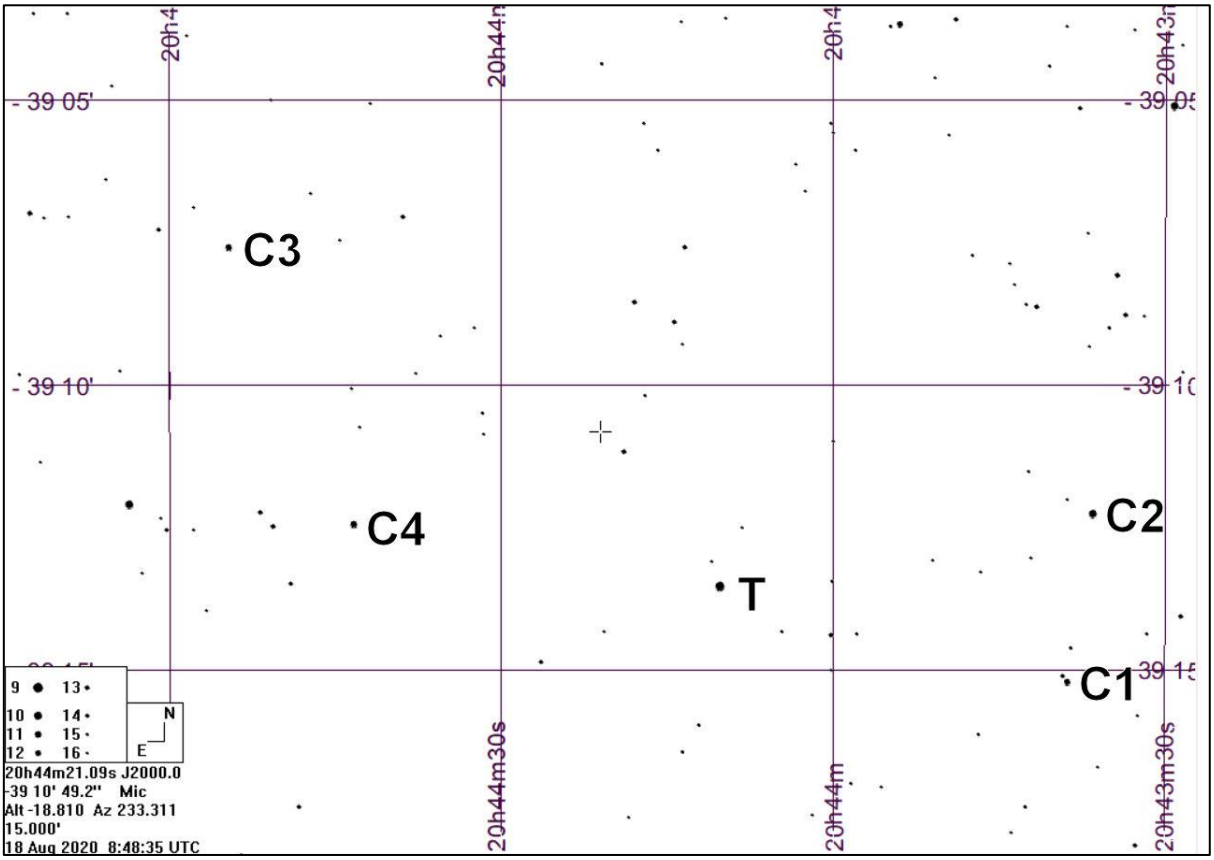


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	20 44 21.2	-39 10 52	-	-
Target	T	20 44 10.2	-39 13 31	9.50	+0.44
Comparison	C1	20 43 38.8	-39 15 12	11.75	+0.60
Comparison	C2	20 43 36.5	-39 12 15	10.37	+1.00
Comparison	C3	20 44 54.6	-39 07 35	11.57	+0.48
Comparison	C4	20 44 43.3	-39 12 27	11.12	+0.55

Table 2. Comparison and target star data

Return to southern celestial hemisphere list

WASP-70Ab		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

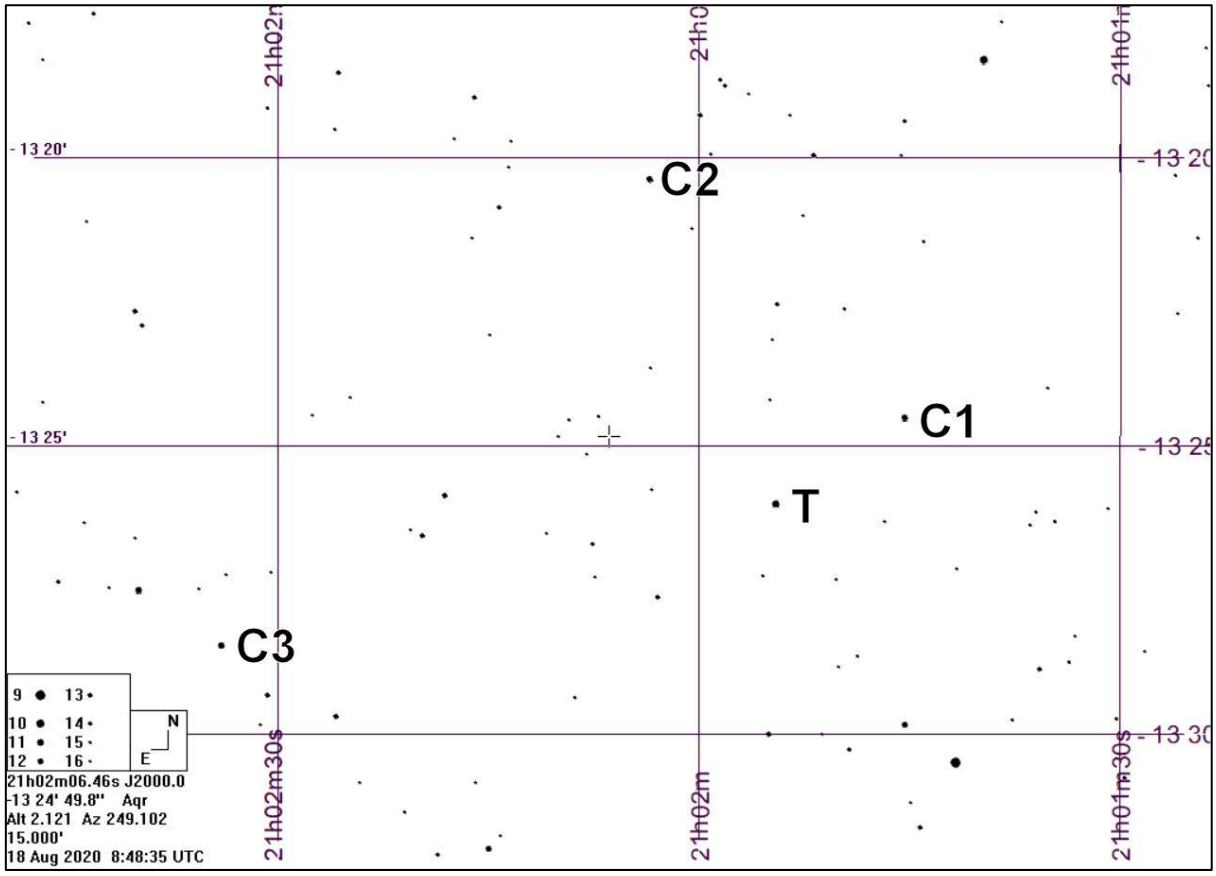


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	21 02 06.5	-13 24 52	-	-
Target	T	21 01 54.5	-13 25 60	10.79	+0.62
Comparison	C1	21 01 45.4	-13 24 31	11.71	+0.51
Comparison	C2	21 02 03.5	-13 20 22	12.35	+0.64
Comparison	C3	21 02 34.0	-13 28 27	11.20	+0.69

Table 2. Comparison and target star data

Return to southern celestial hemisphere list

HD209458b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

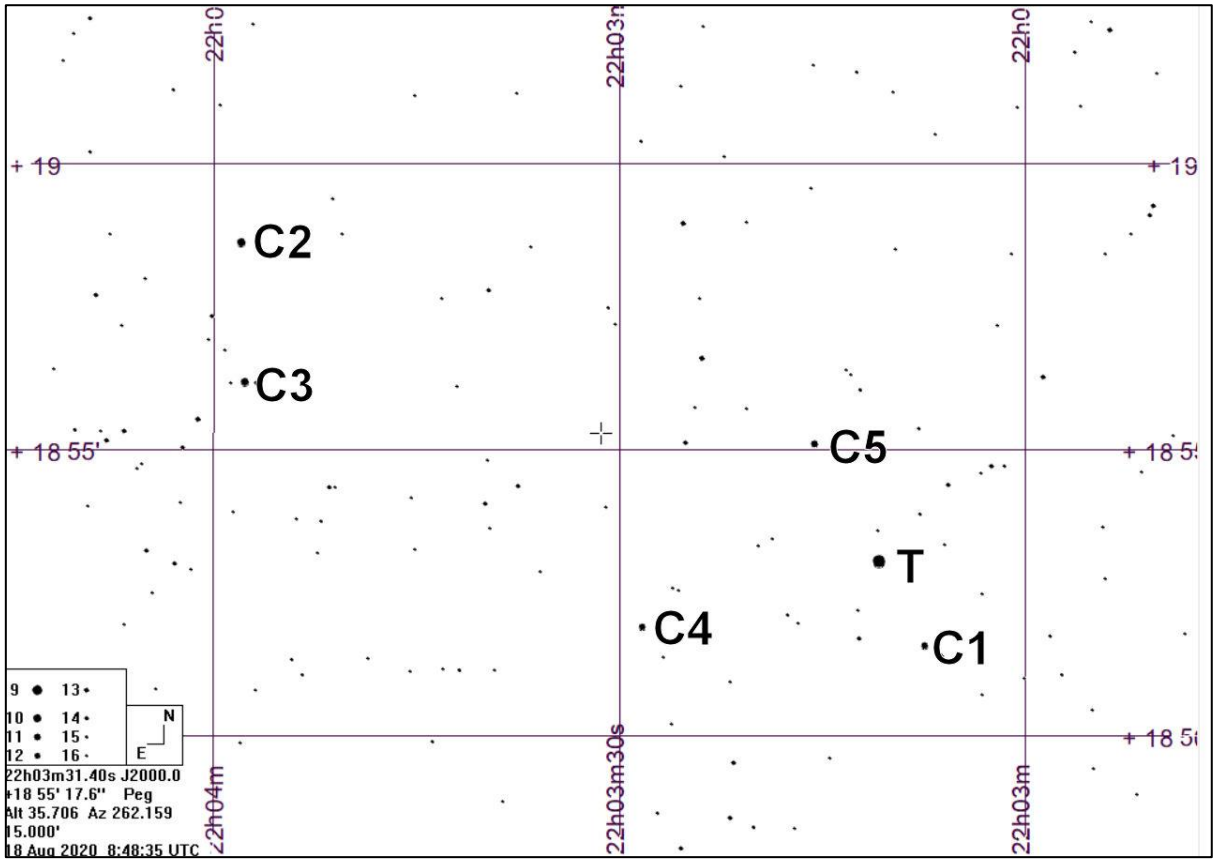


Figure 1. Guide finder chart, 15’ x 15’

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	22 03 31.8	+18 55 22	-	-
Target	T	22 03 10.8	+18 53 04	7.63	+0.51
Comparison	C1	22 03 07.4	+18 51 34	11.23	+0.46
Comparison	C2	22 03 58.0	+18 58 37	9.97	+0.39
Comparison	C3	22 03 57.7	+18 56 11	10.32	+1.00
Comparison	C4	22 03 28.3	+18 51 54	11.54	+1.19
Comparison	*C5*	22 03 15.6	+18 55 06	11.84	+1.26

Table 2. Comparison and target star data

Return to southern celestial hemisphere list

WASP-6b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

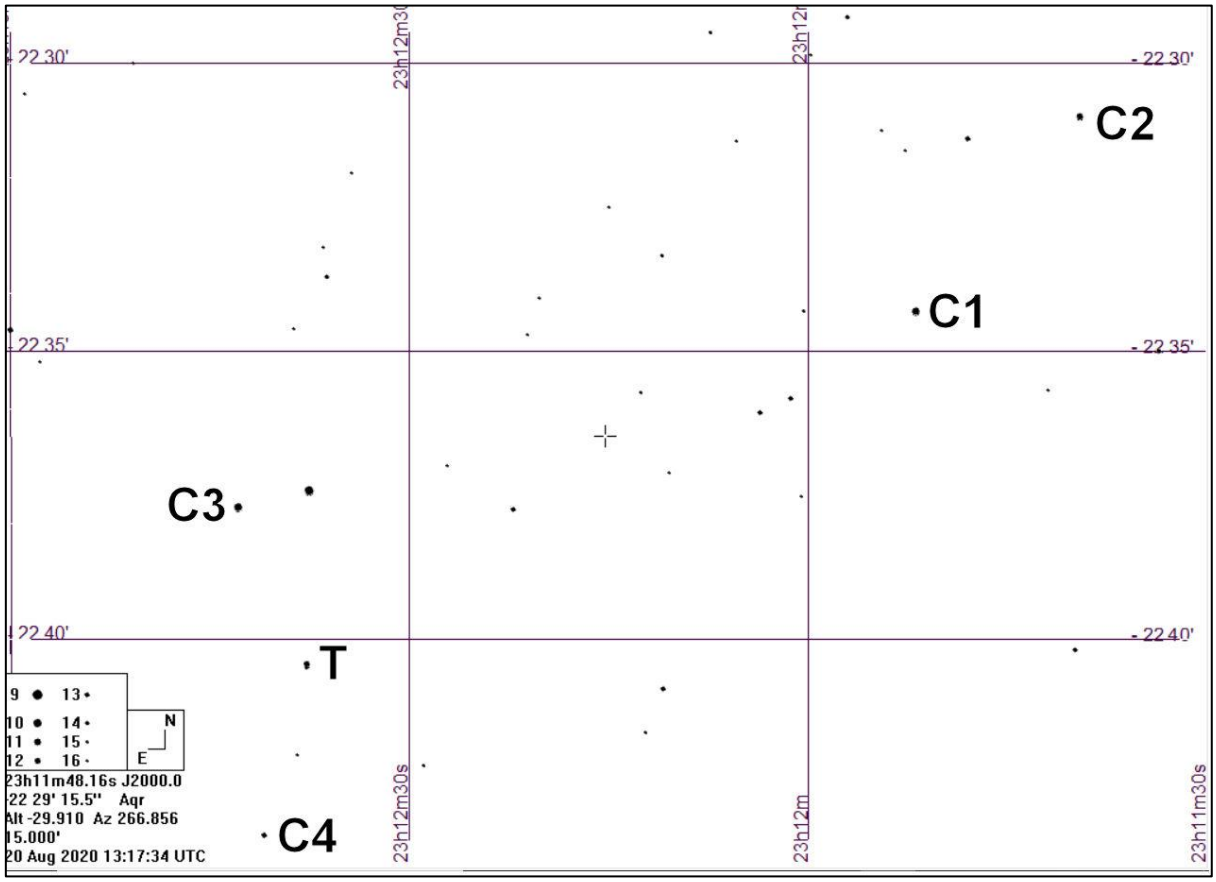


Figure 1. Guide finder chart 15' x 15'

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	23 12 15.3	-22 36 30	-	-
Target	T	23 12 37.7	-22 40 26	11.91	+0.76
Comparison	C1	23 11 51.9	-22 34 18	10.58	+0.45
Comparison	C2	23 11 39.6	-22 30 56	11.62	+0.56
Comparison	C3	23 12 42.9	-22 37 43	10.39	+1.10
Comparison	C4	23 12 41.0	-22 43 23	12.50	+0.96

Table 2. Comparison and target star data

Return to southern celestial hemisphere list

WASP-4b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

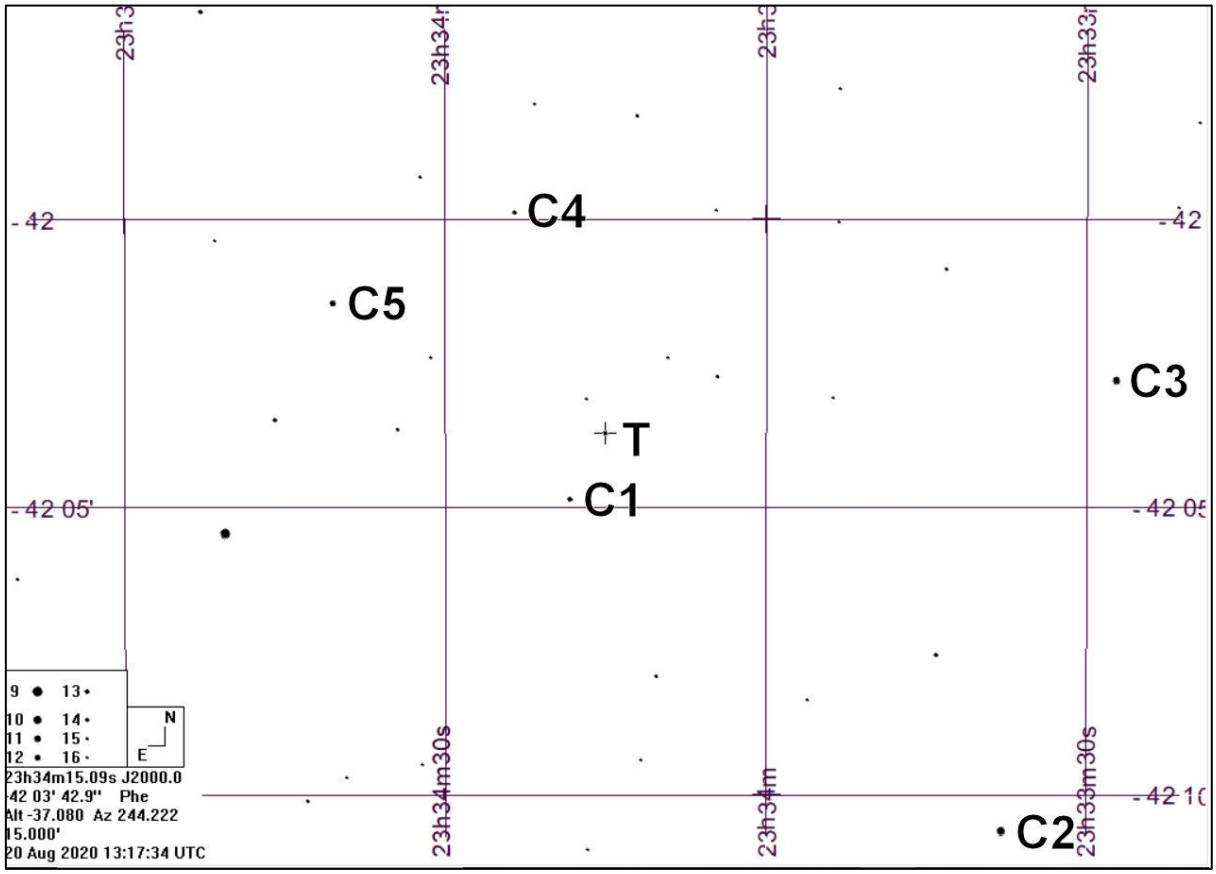


Figure 1. Guide finder chart 15' x 15'

Star	ID	RA	Dec	V	B-V
Target	T	23 34 15.1	-42 03 41	12.48	+0.75
Comparison	C1	23 34 18.4	-42 04 51	12.92	+0.66
Comparison	C2	23 33 38.0	-42 10 37	10.15	+0.55
Comparison	C3	23 33 27.3	-42 02 48	10.90	+0.88
Comparison	C4	23 34 23.6	-41 59 52	13.97	+0.68
Comparison	C5	23 34 40.5	-42 01 27	11.99	+1.00

Table 2. Comparison and target star data

Return to southern celestial hemisphere list

WASP-29b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

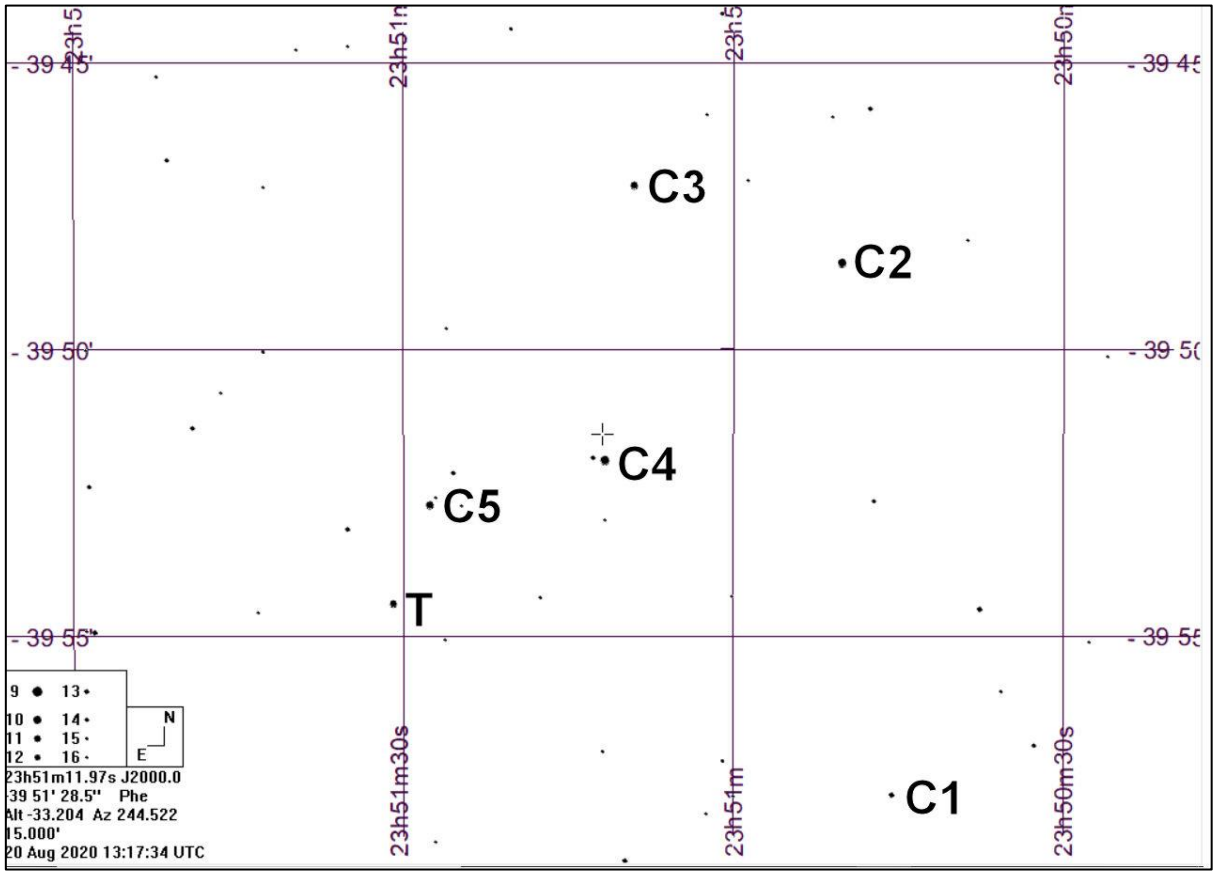


Figure 1. Guide finder chart 15' x 15'

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	23 51 12.0	-39 51 29	-	-
Target	T	23 51 31.1	-39 54 24	11.33	+1.07
Comparison	C1	23 50 45.6	-39 57 45	12.64	+0.64
Comparison	C2	23 50 50.1	-39 48 30	10.05	+1.14
Comparison	C3	23 51 09.0	-39 47 08	10.84	+1.23
Comparison	C4	23 51 11.7	-39 51 56	9.91	+0.40
Comparison	C5	23 51 27.6	-39 52 43	10.50	+0.59

Table 2. Comparison and target star data

Return to southern celestial hemisphere list

WASP-8b		
Links	Ephemerides	ExoClock Ephemerides
	Planet and host star data	Exoplanet.eu
	Image	STSci DSS

Table 1. Target data.

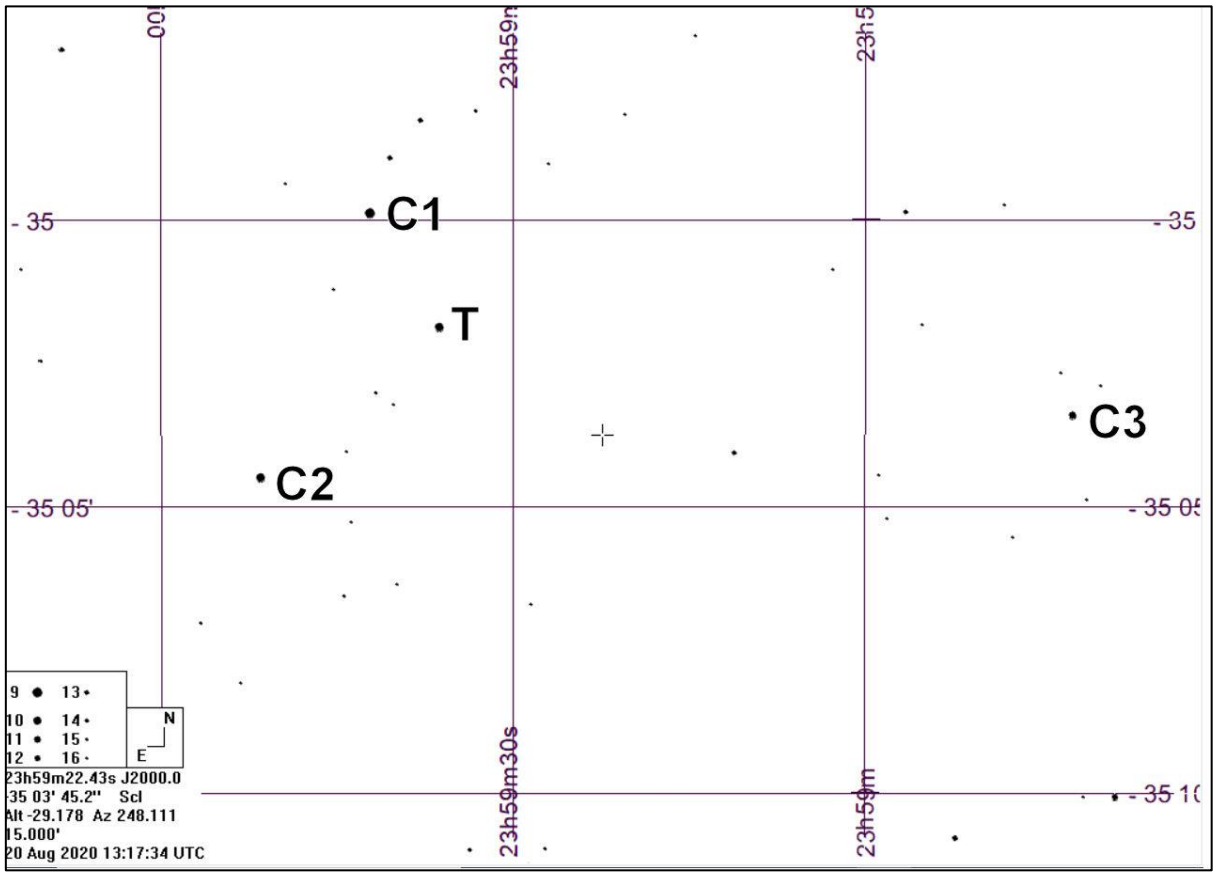


Figure 1. Guide finder chart 15' x 15'

Note; target is offset from centre to allow for better choice of comparison stars

Star	ID	RA	Dec	V	B-V
Chart centre	-	23 59 22.3	-35 03 30	-	-
Target	T	23 59 36.1	-35 01 53	9.87	+0.70
Comparison	C1	23 59 42.2	-34 59 54	9.08	+0.94
Comparison	C2	23 59 51.6	-35 04 30	9.64	+1.00
Comparison	C3	23 58 42.3	-35 03 24	10.48	+0.95

Table 2. Comparison and target star data

Return to beginning of document

Appendix A

Python/HOPS installation notes

My thanks to William Bristow for these installation notes.

1.0 Python Installation

See https://exoworldsspies.com/en/software/

A User Manual is available at hops3_manual_en.pdf (exoworldsspies.com)

Please follow the installation instructions exactly as described on the above website.

Installation has been problematic for some, including myself, so the following notes and screenshots will help you through the process with the Windows 10 operating system.

Note:
Anaconda is a required science package that provides the libraries necessary for HOPS to function. A compatible version of Python is included with the Anaconda installer. Anaconda is free for personal use. If you already have Python installed, or have had Python installed in the past, or are not sure, observe the following figures and instructions A1.1 to A1.4 on pages 70 – 73 before proceeding further.

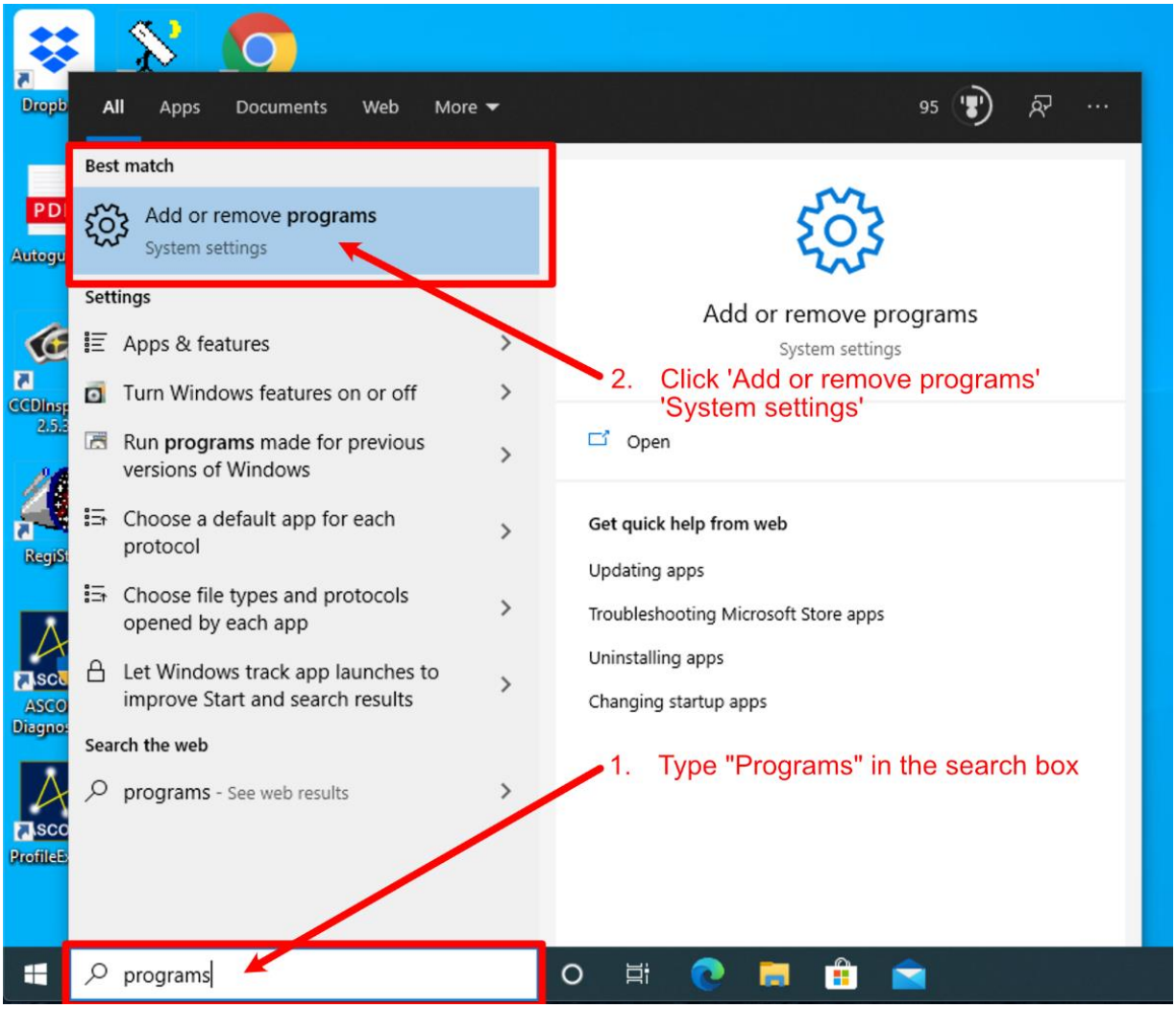


Figure A1.1 Add or remove programs.

Type **"Programs"** in Windows desktop lower search bar and in the pop-up '**Best match**' listing click:

'Add or remove programs'
'System settings'

The '**Apps and features**' page will open.

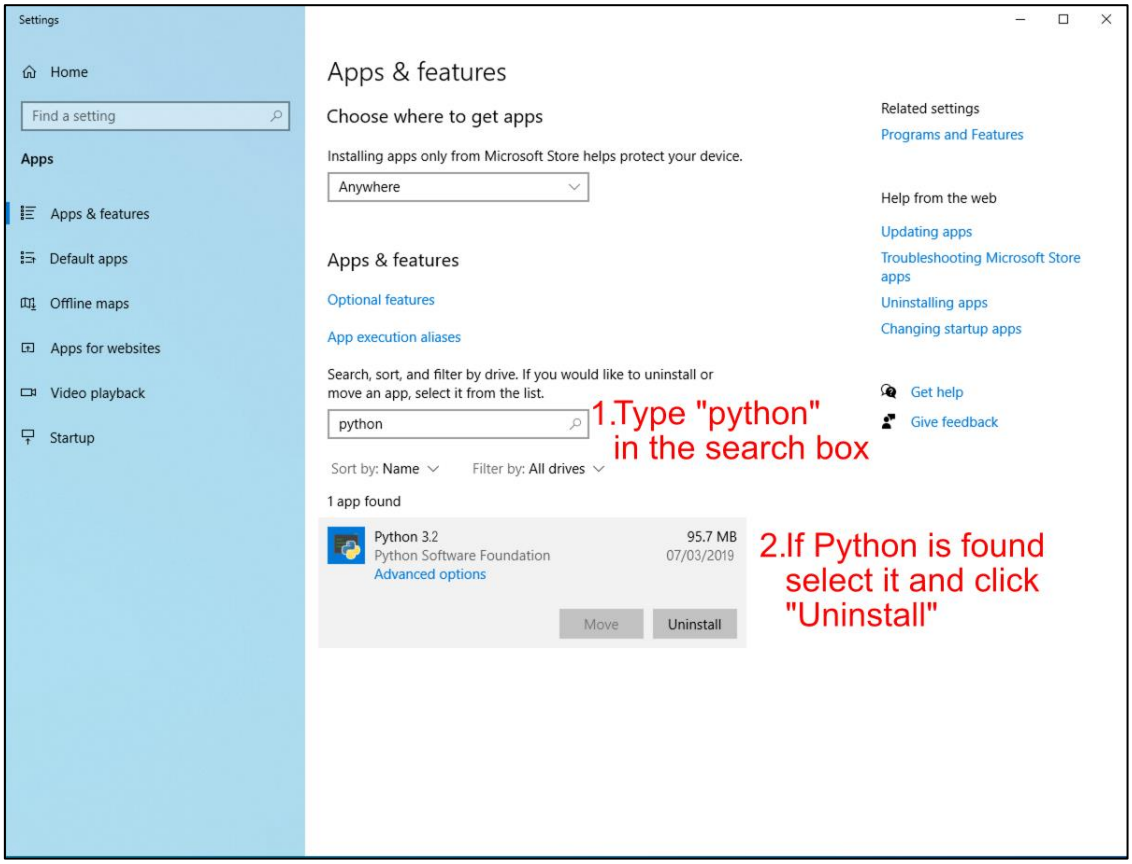


Figure A1.2 Apps & features page.

In the middle of the page, select search box, (**1.**) Type "**python**" (without quotes).

If any previous versions of Python are already installed (**2.**) click on them to reveal the uninstall option, then click '**Uninstall'.**

After uninstall is complete, and/or if no instances of Python are found, click the link '**App execution aliases'** found in the middle of the '**Apps & features'** page.

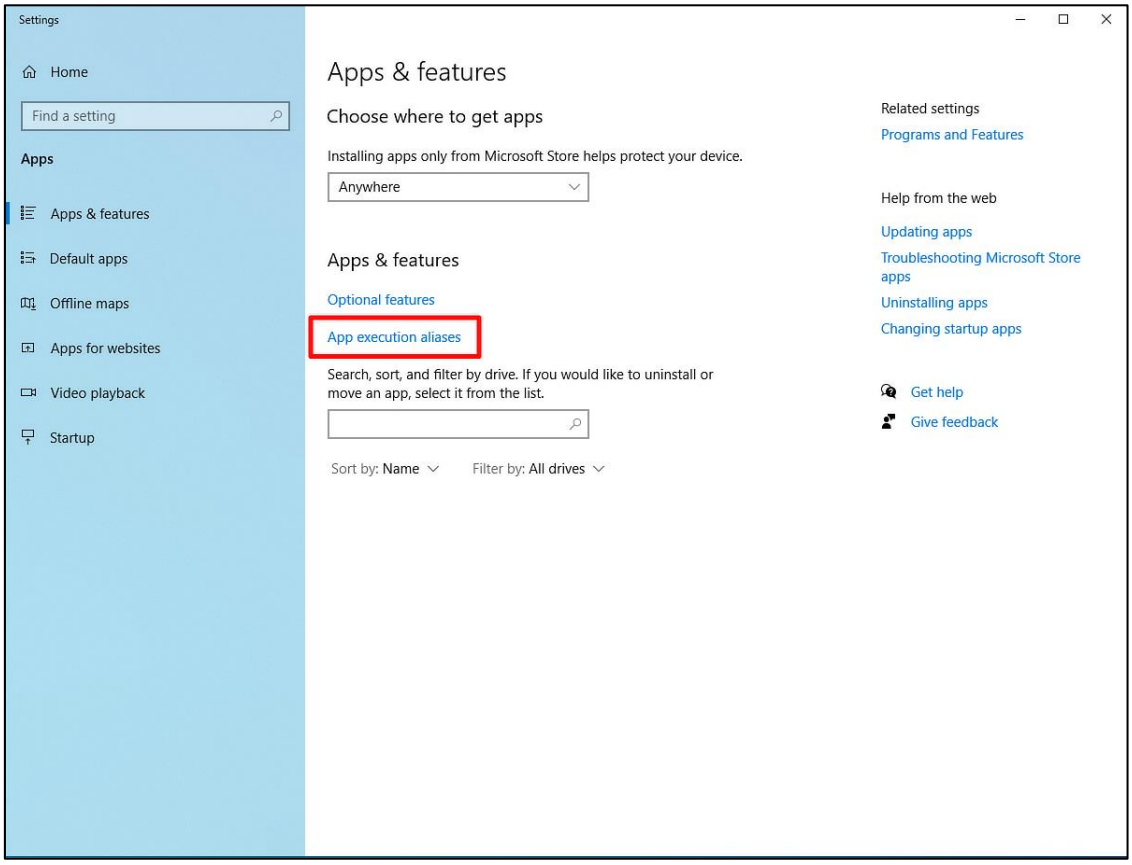


Figure A1.3 Click link - App execution aliases.

If Python was previously installed via the Microsoft App Store there will be Python application aliases enabled on this page, deselect any Python aliases present.

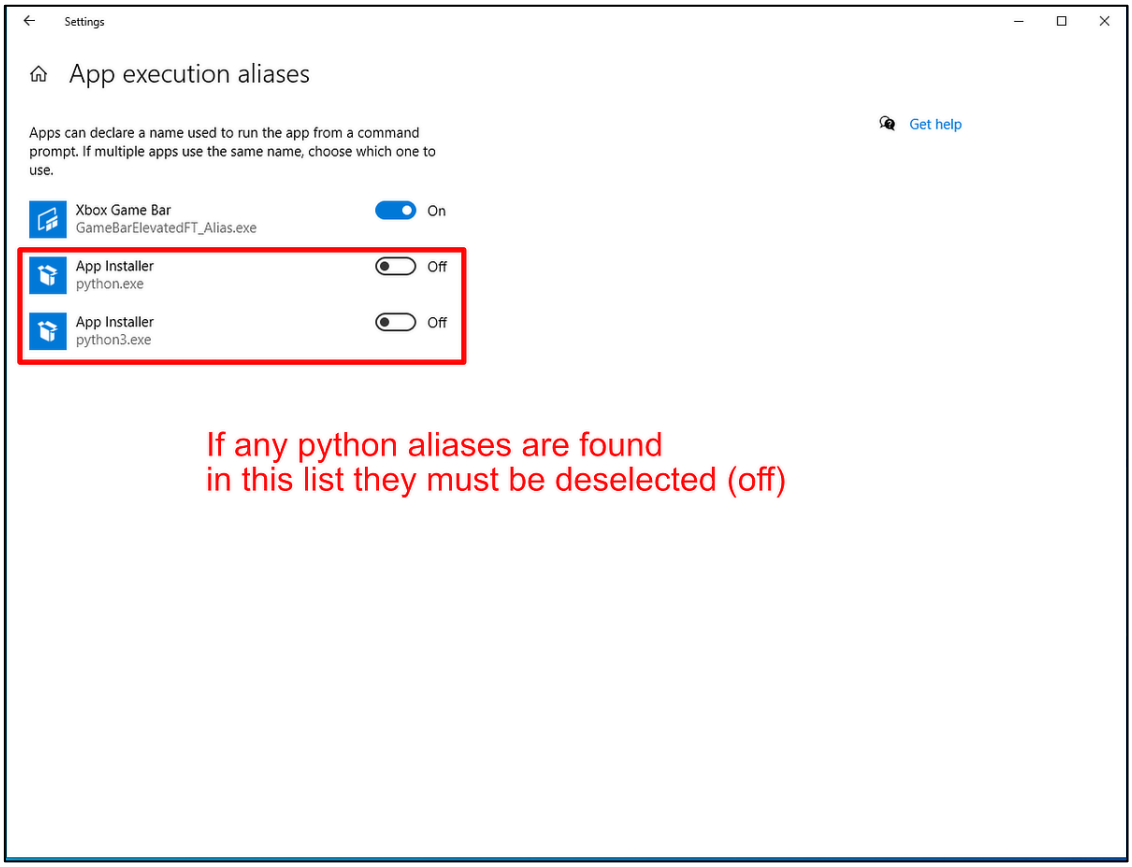


Figure A1.4 App execution aliases - deselect python

If you obtained a previous version of Python direct from Python.org there should be no aliases present and the page can be closed with no changes.

Visit the Anaconda website

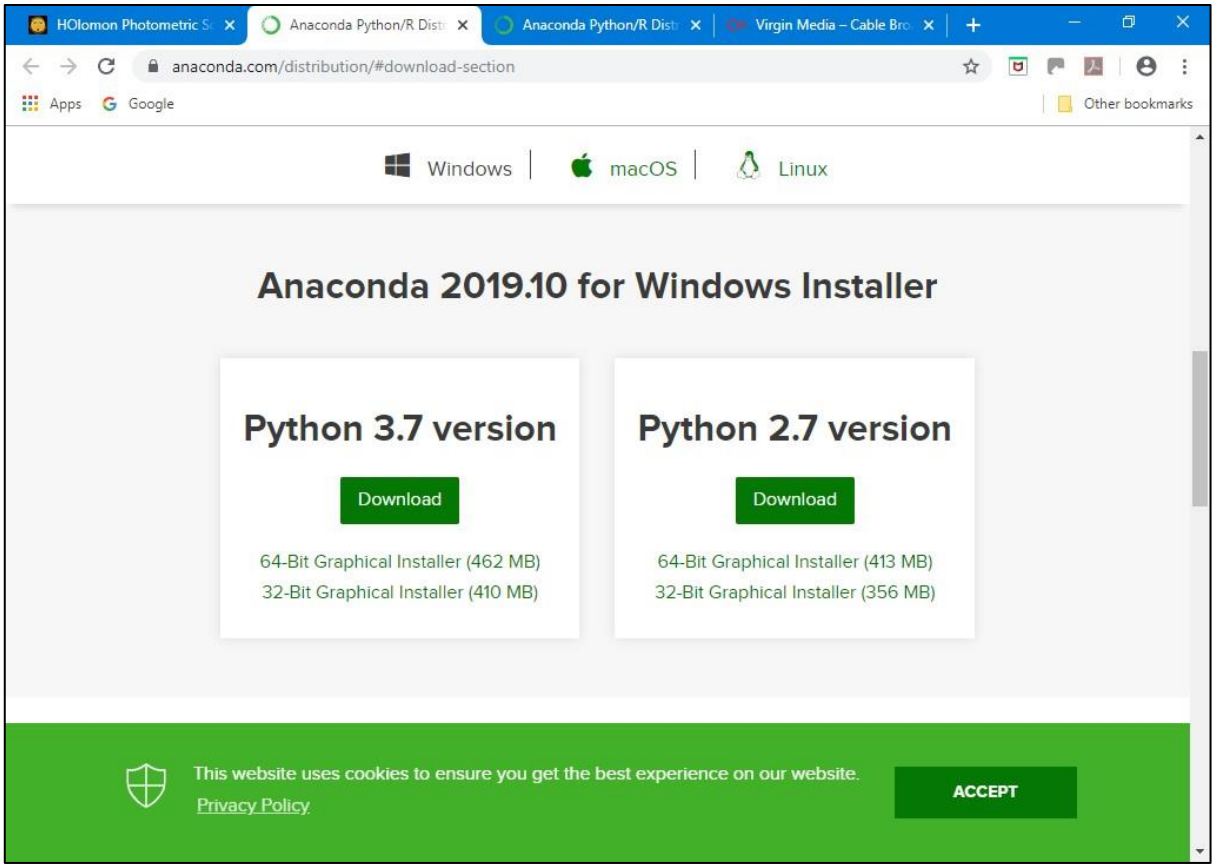


Figure A1.5

Click on '**Download**' under Python 3.7 version and choose 64 or 32 bits to suit your system and save (in Downloads for example).

Open the file:

Figure A1.6

Select '**Next**'

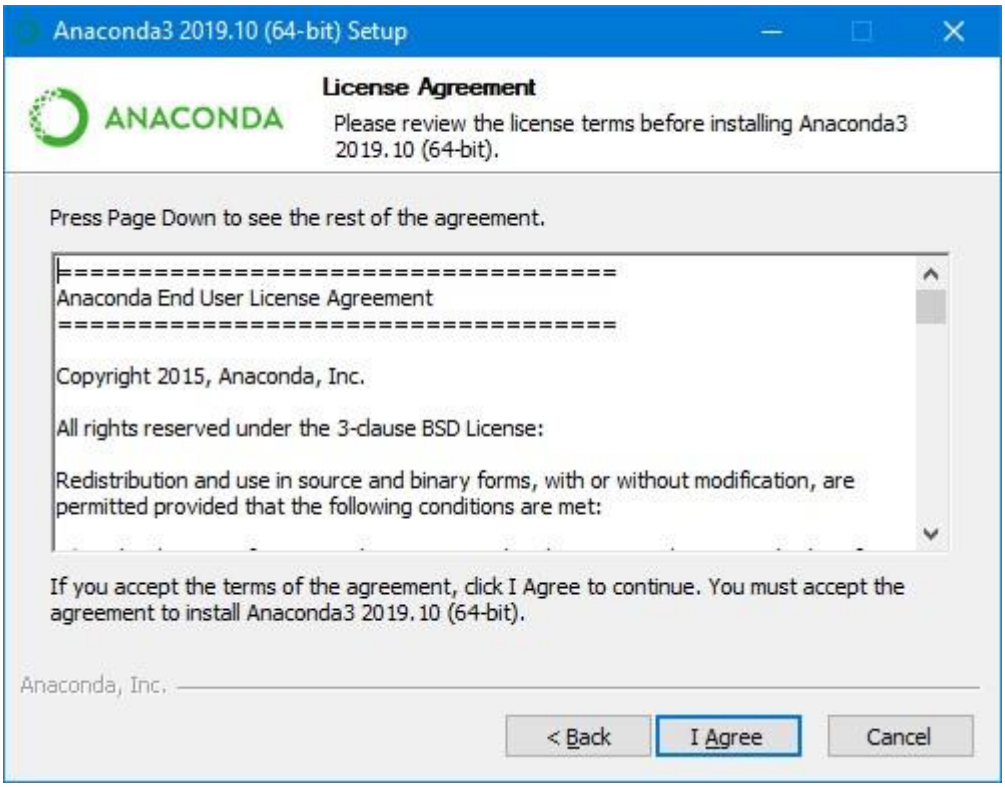


Figure A1.7

Select **'I Agree'**

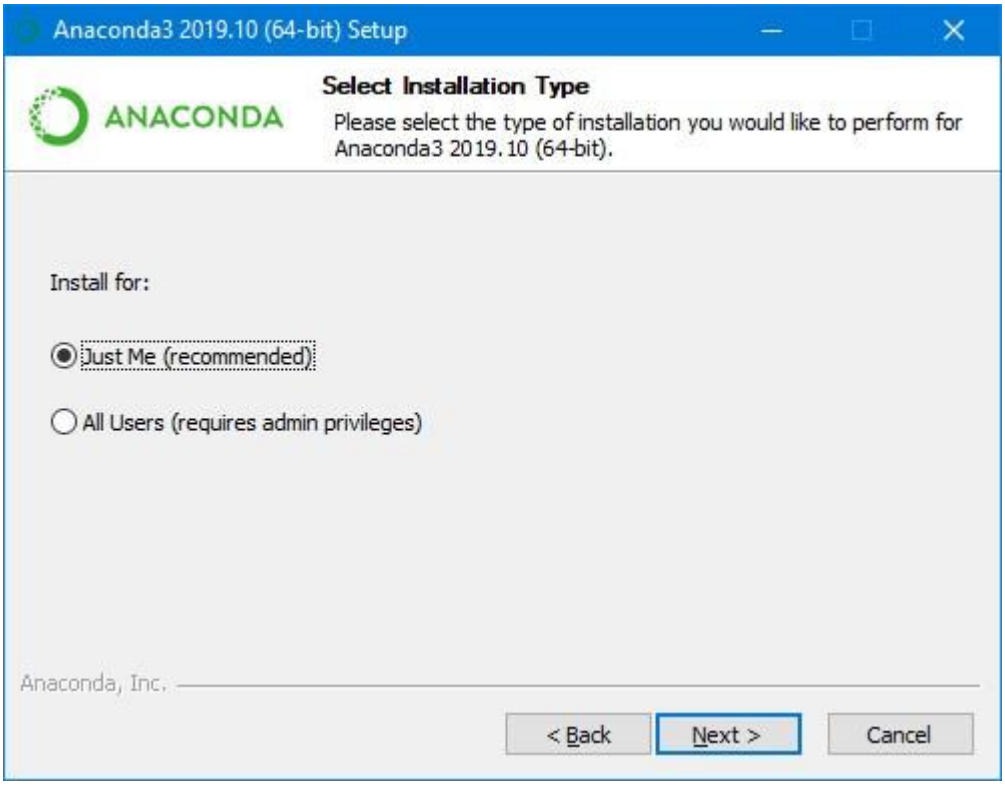


Figure A1.8

Select '**Just Me**' (recommended) and then '**Next**'

Important:
The choice of destination folder is critical to the operation of Python scripts. Python scripts will fail to run correctly if the root folder for Python has a name that includes spaces.

In the next two figures, A1.9 and A1.10 the default installation destination folder for Anaconda and Python show folder names that are both allowed by Windows, however only the user directory without spaces is a valid destination for Python.

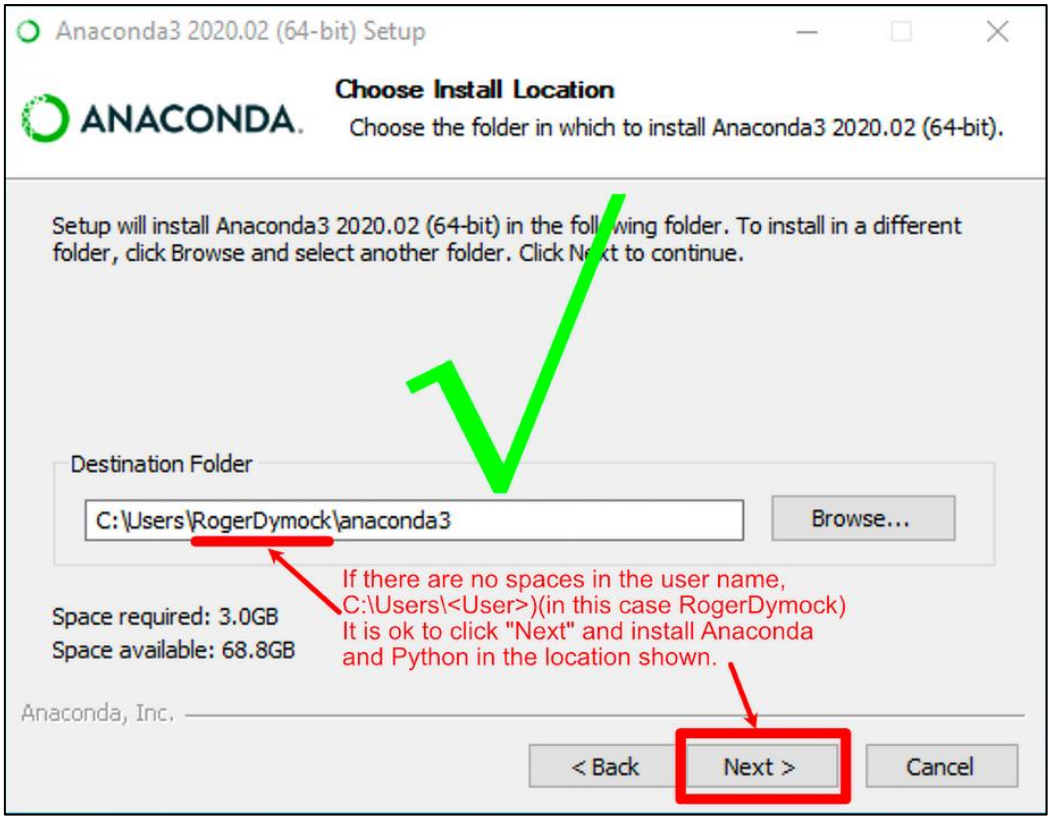


Figure A1.9

In this example, figure A1.9, it is OK to install Anaconda and Python in the default user directory whose name has no spaces.

If your user name contains no spaces then you may continue with the default installation destination and click '**Next**' then jump to figure A1.15.

If your user directory name contains a space follow figures A1.10 to A1.15 below and create a destination directory at the root of the C:\ drive.

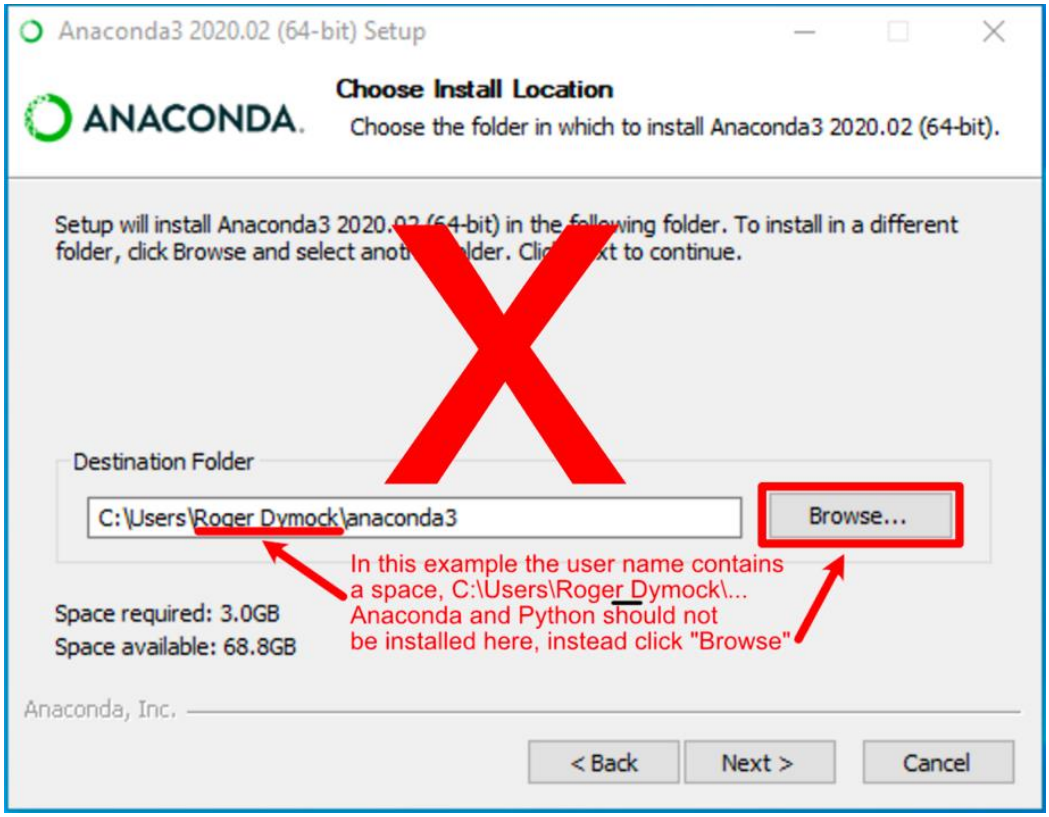


Figure A1.10

Do not install Anaconda and Python here, the user directory contains a space in the name.

Click the '**Browse**' button and continue with the next figures A1.11 to A1.15.

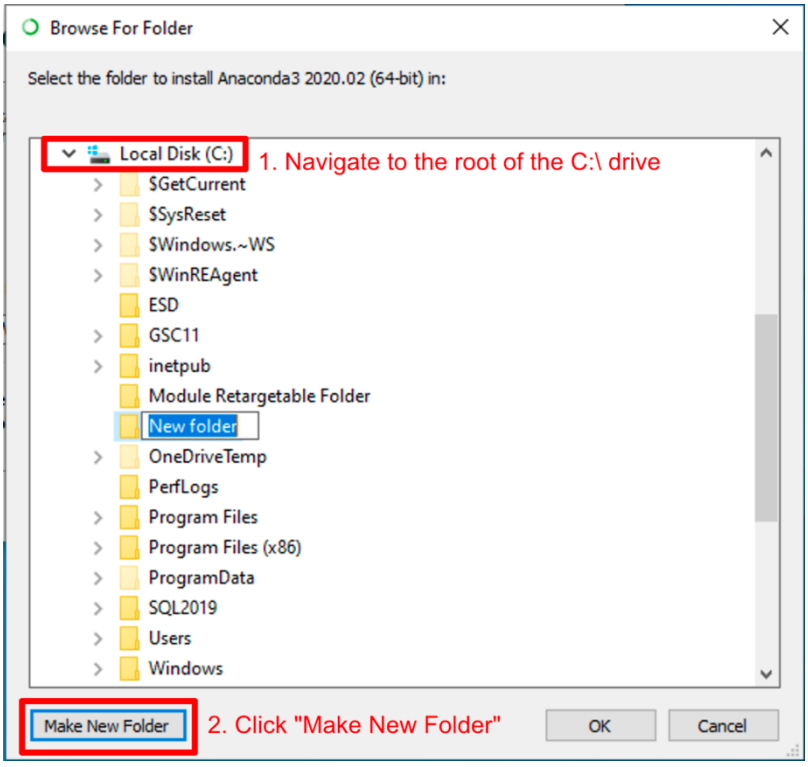


Figure A1.11

Navigate to the root of the C:\ drive and click '**Make New Folder**'

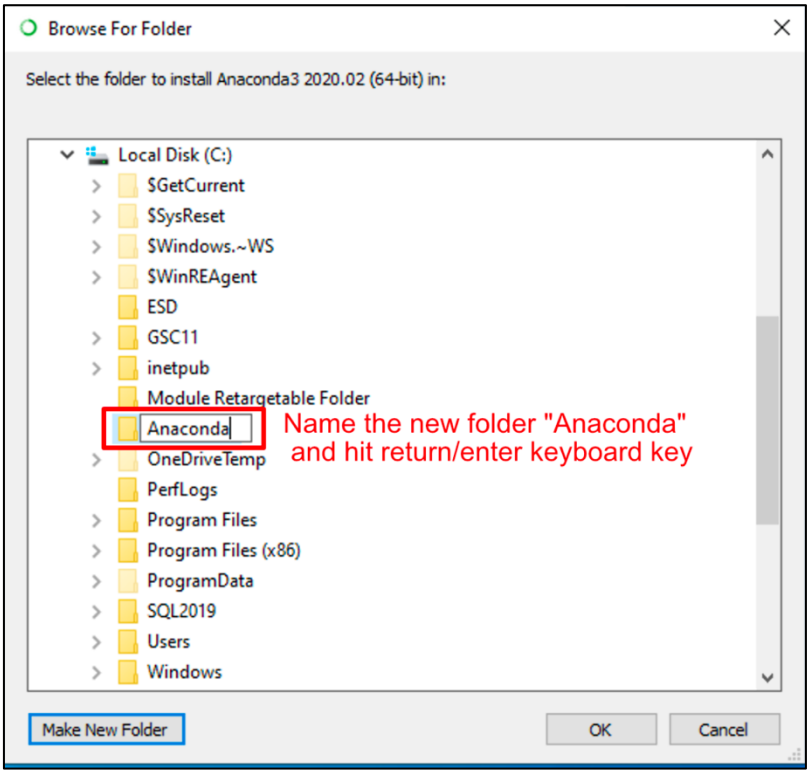


Figure A1.12

Name the new folder "**Anaconda**" (without the quotes) and hit the keyboard Return/Enter key.

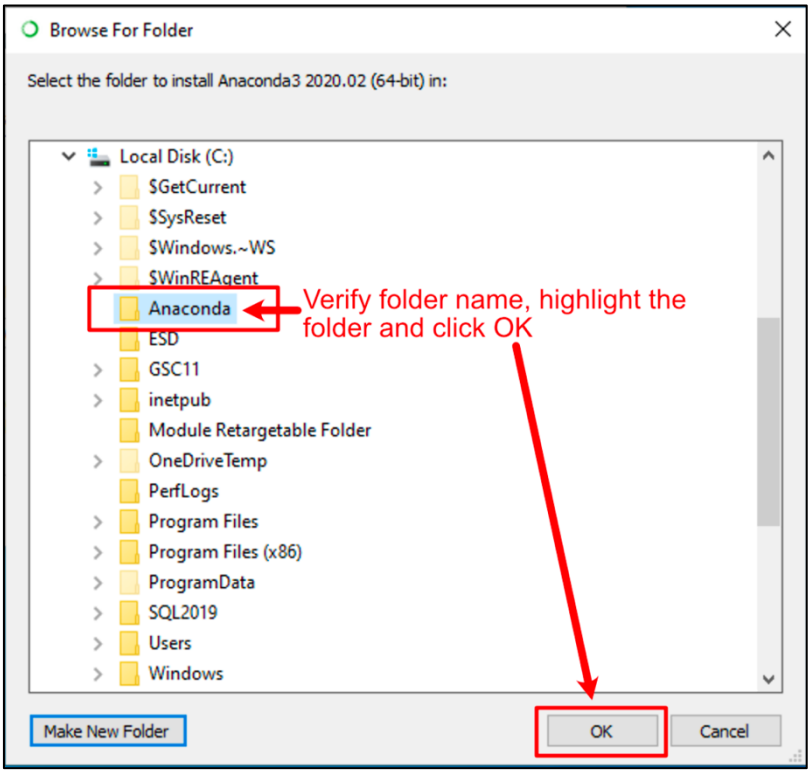


Figure A1.13

Verify the new folder name, select it and click '**OK**'

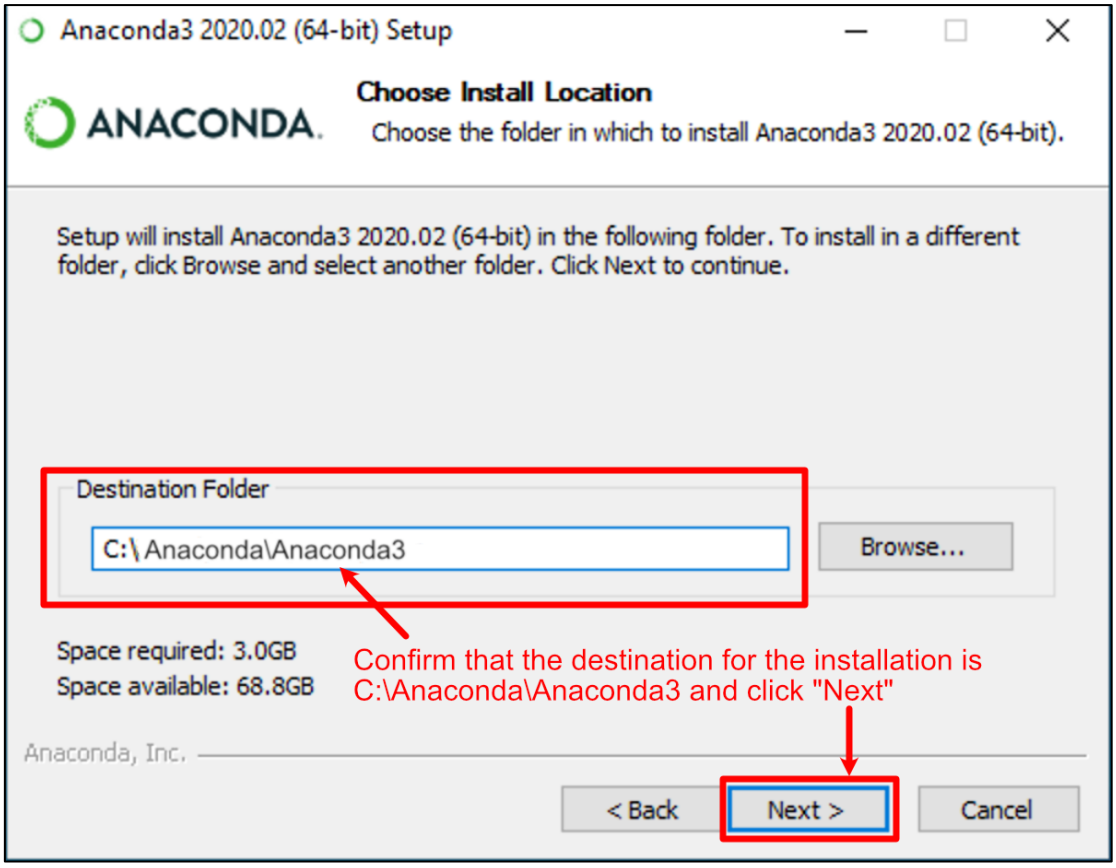


Figure A1.14

The default destination for Anaconda and Python will now be:
C:\Anaconda\Anaconda3

Click **'Next'** and continue from figure A1.15

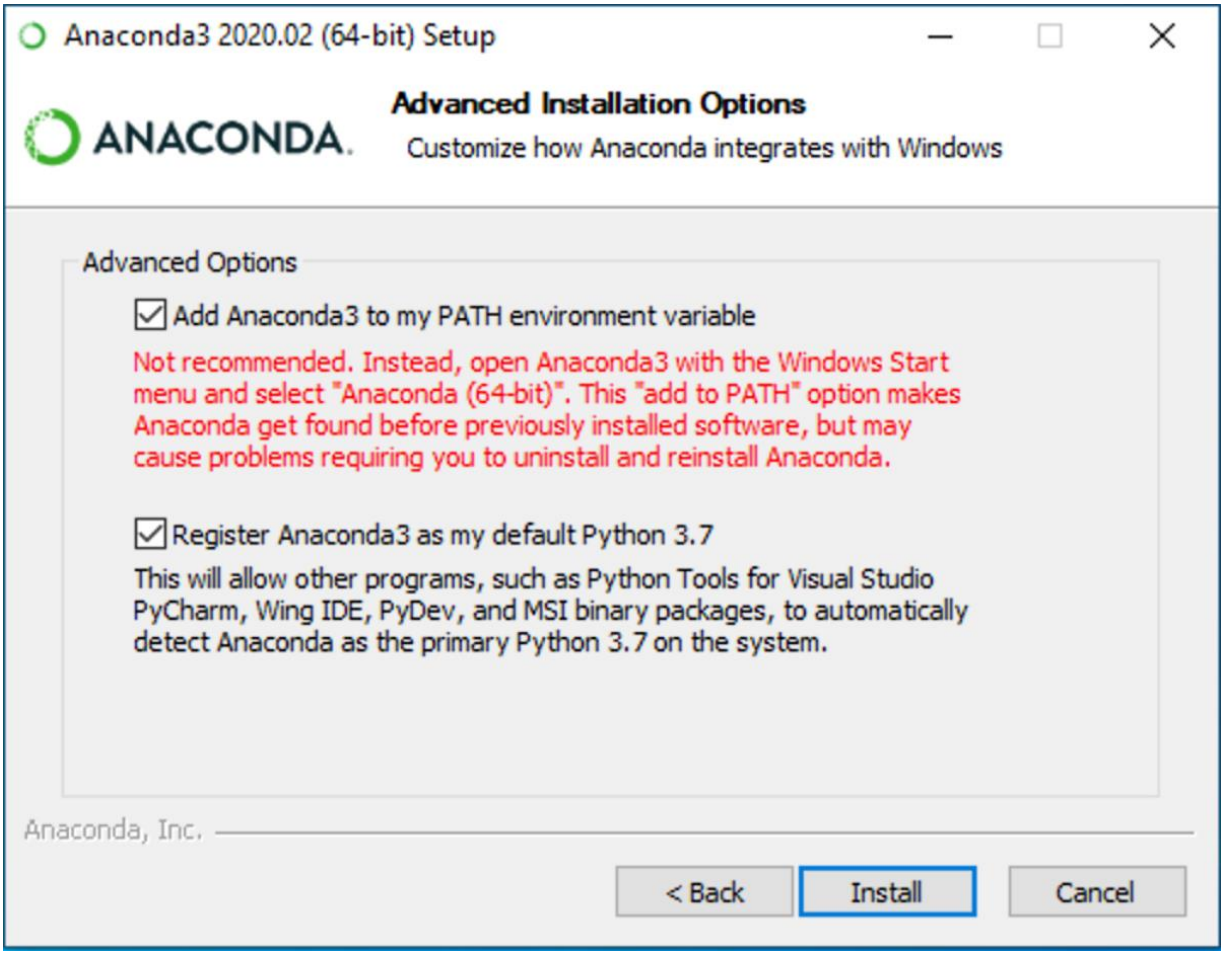


Figure A1.15

Very important - check both boxes - and then select '**Install**'

Ignore the message "Not Recommended. Instead, Open Anaconda3…."

Both Advanced Options **must** be selected for HOPS to install correctly.

Installation of Anaconda and Python takes several minutes to complete.

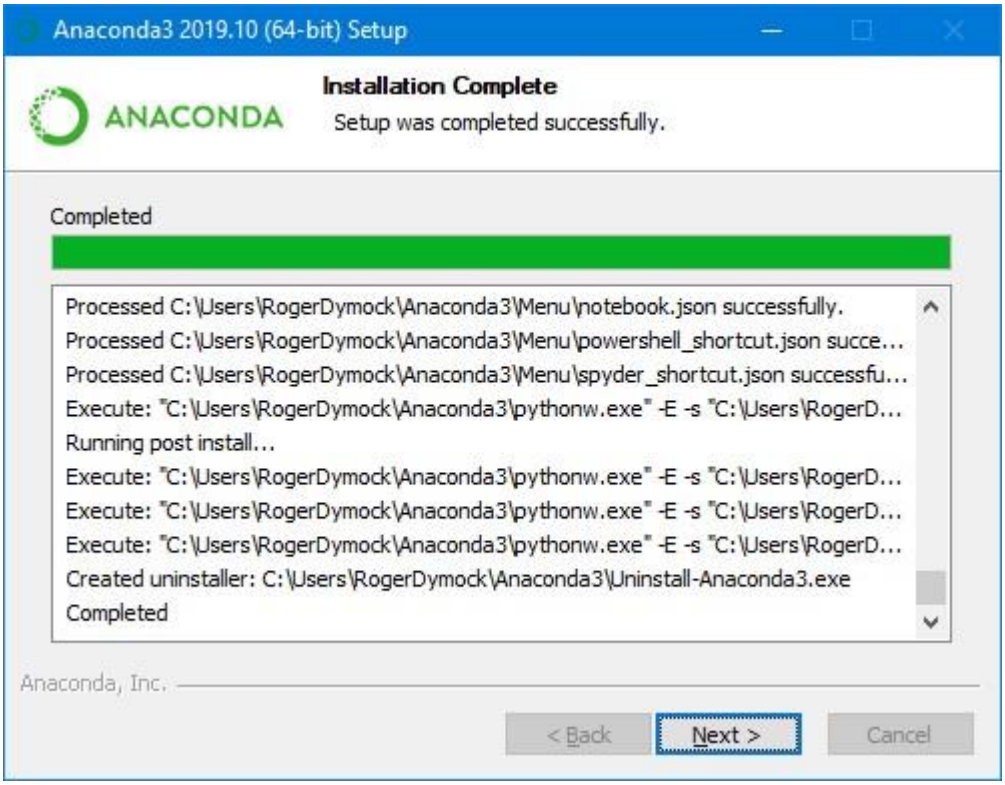


Figure A1.16

Select '**Next**'

Figure A1.17

Select '**Next**'

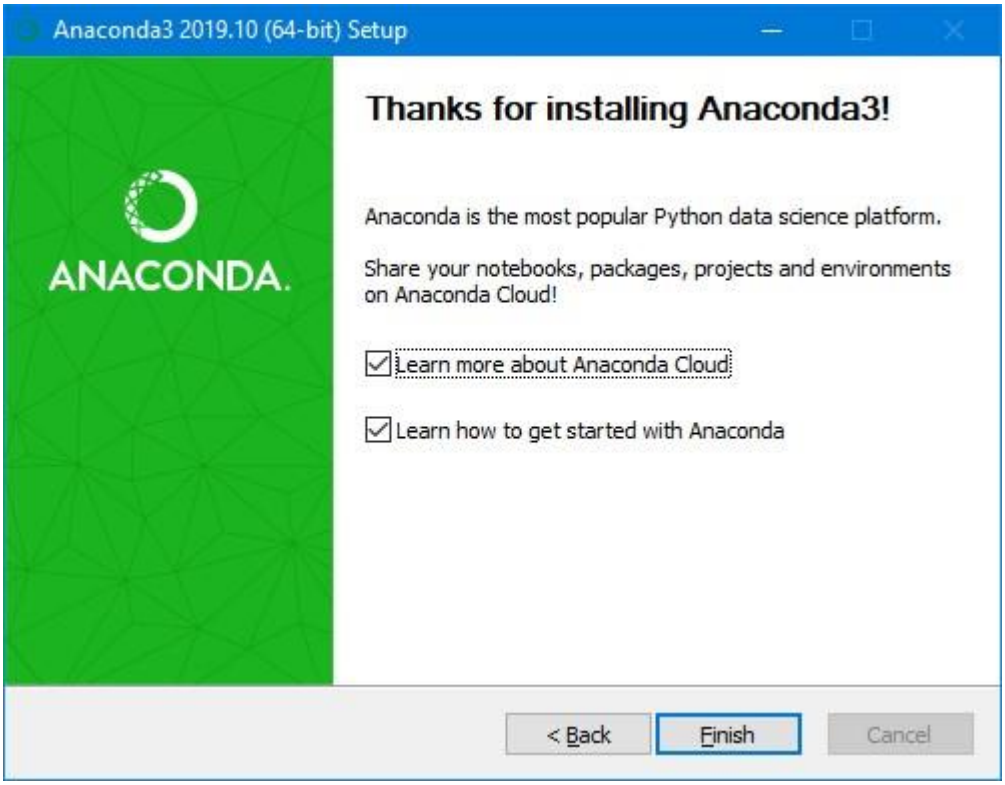


Figure A1.18

Tick or untick two boxes as required and then select '**Finish**'

Before continuing with HOPS installation, it is necessary to launch Anaconda so that its libraries and interfaces are registered with Windows and to verify that Python is installed and accessible.

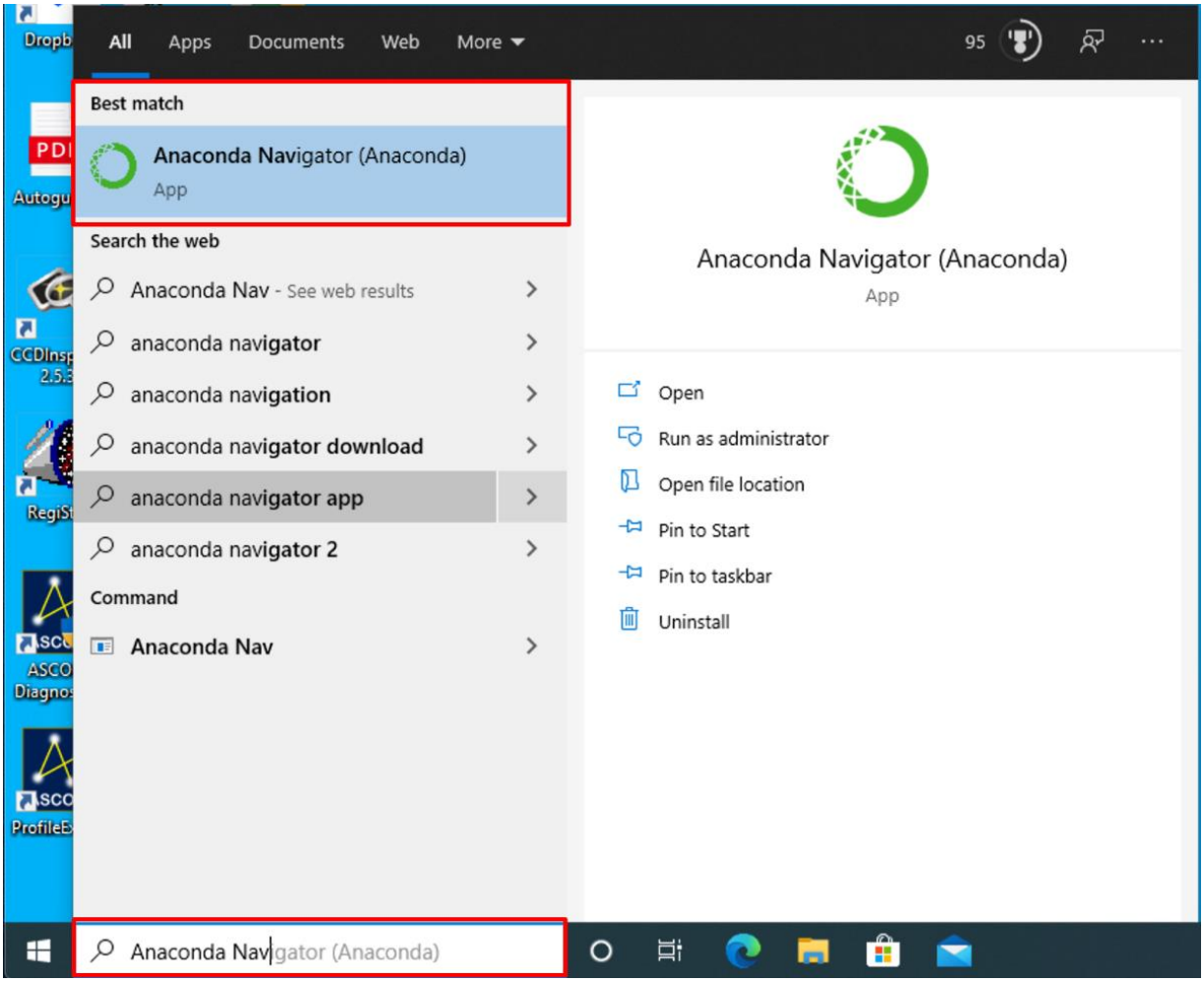


Figure A1.19

Begin typing "**Anaconda Navigator**" in the Windows desktop lower search box, when -

'Anaconda Navigator (Anaconda)'
'App'

- appears under the '**Best match**' banner, click on the item to launch the program.

During Anaconda start-up it is normal to see various blank windows appear and disappear on the Windows desktop, after a few moments the Anaconda Navigator desktop will appear.

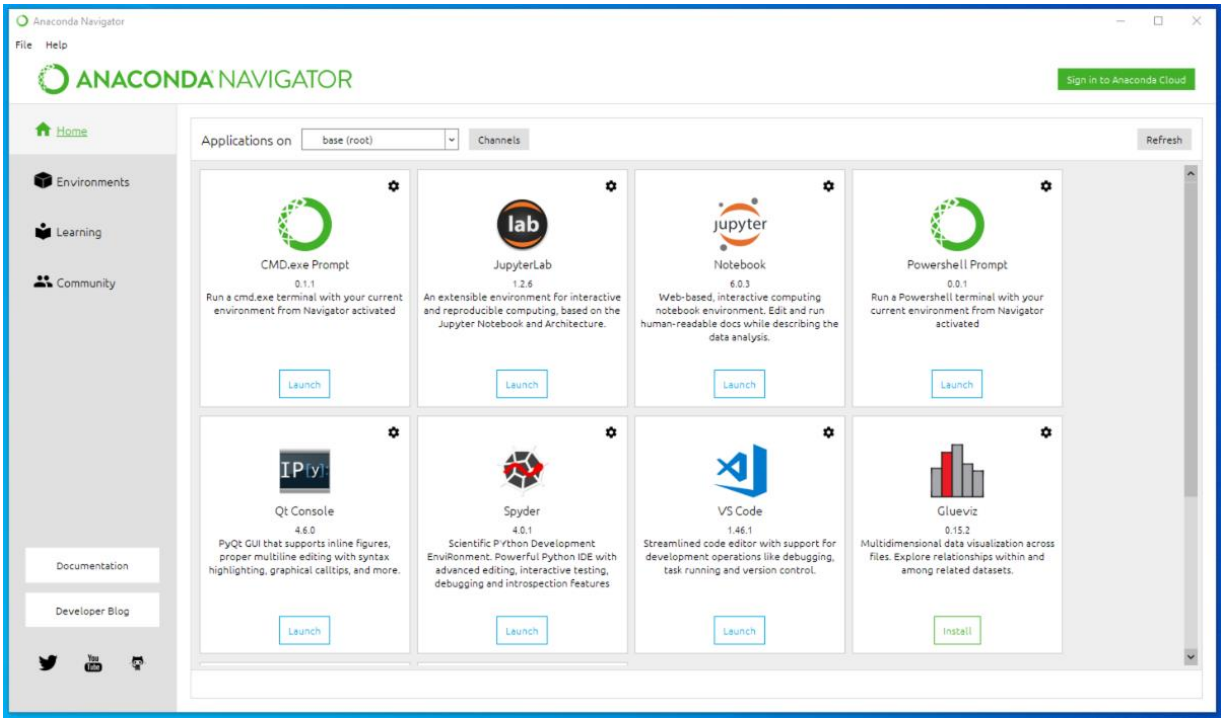


Figure A1.20 Anaconda Desktop

After Anaconda Navigator desktop (above), has appeared, wait a few moments and close the program.

Next, check that Python is installed correctly:

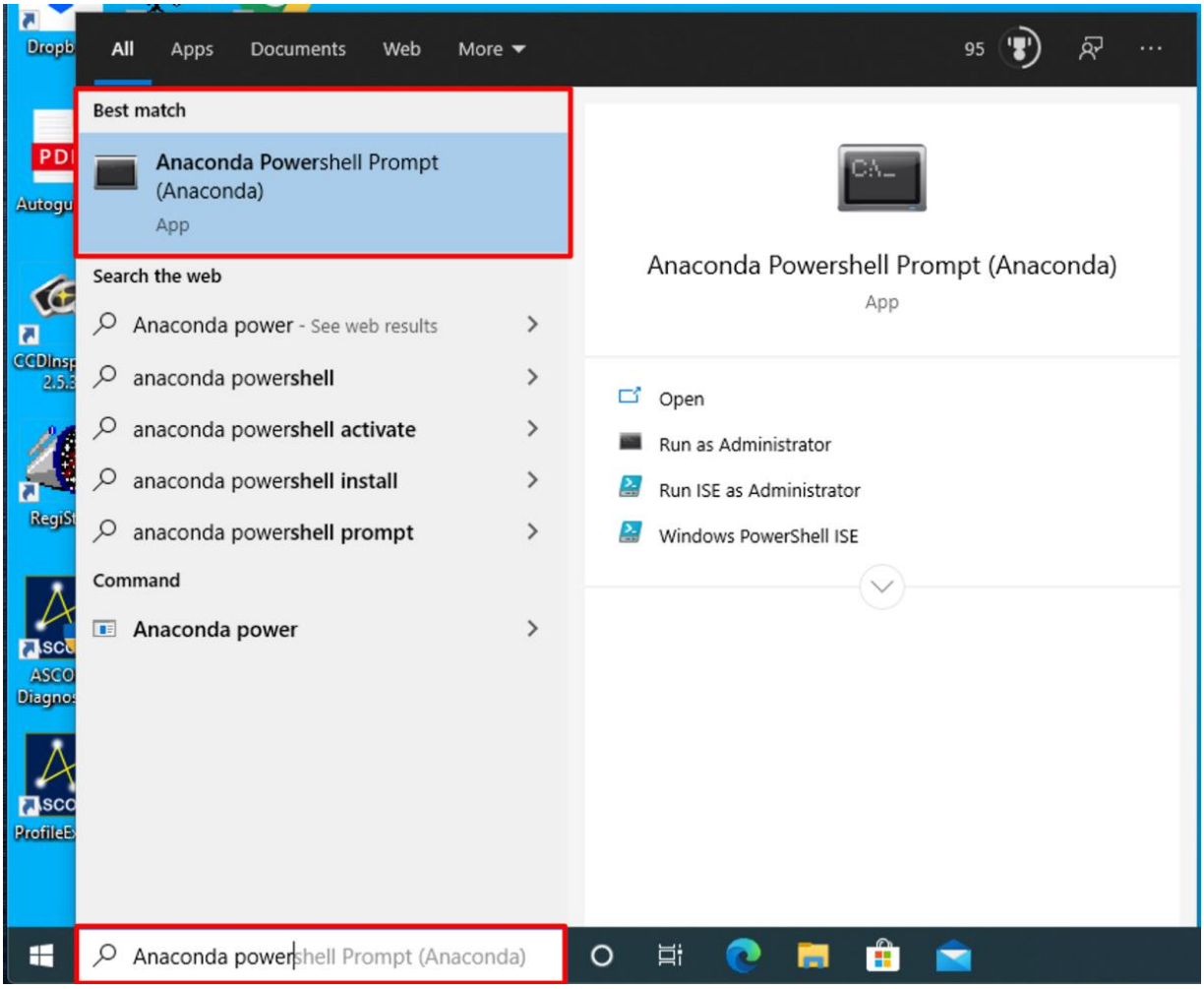


Figure A1.21

Begin typing "**Anaconda Powershell**" in the Windows desktop lower search box, when –

'Anaconda Powershell Prompt'
'(Anaconda)'
'App'

- appears under the '**Best match'** banner, click on the item to launch the Powershell.

The Anaconda base Powershell window will appear:

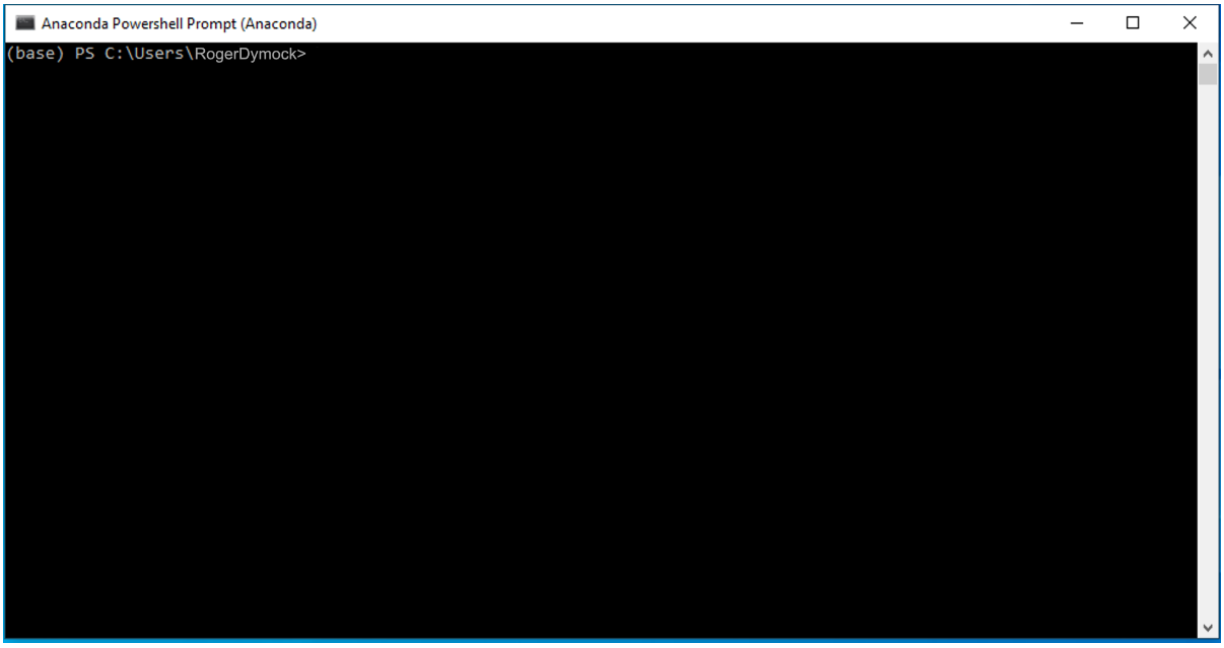


Figure A1.22 Anaconda Powershell.

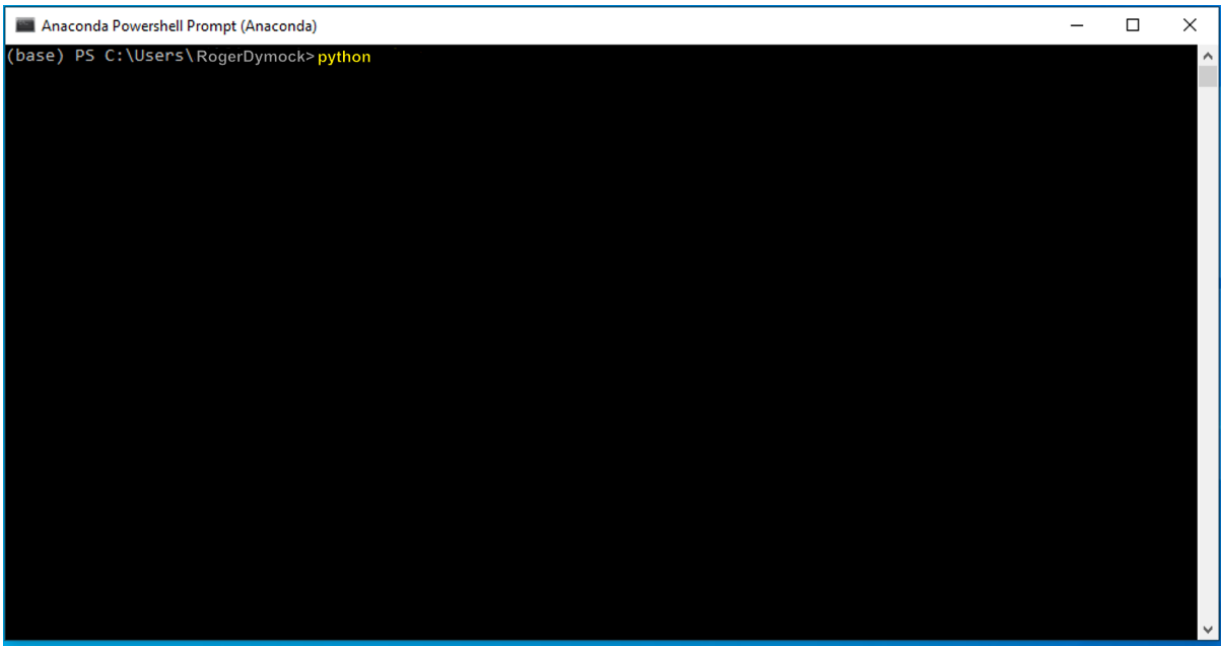


Figure A1.23

In the Powershell window type at the prompt symbol (>) "**python**" (without quotes) and hit the keyboard Return/Enter key. The window changes to Python editor mode.

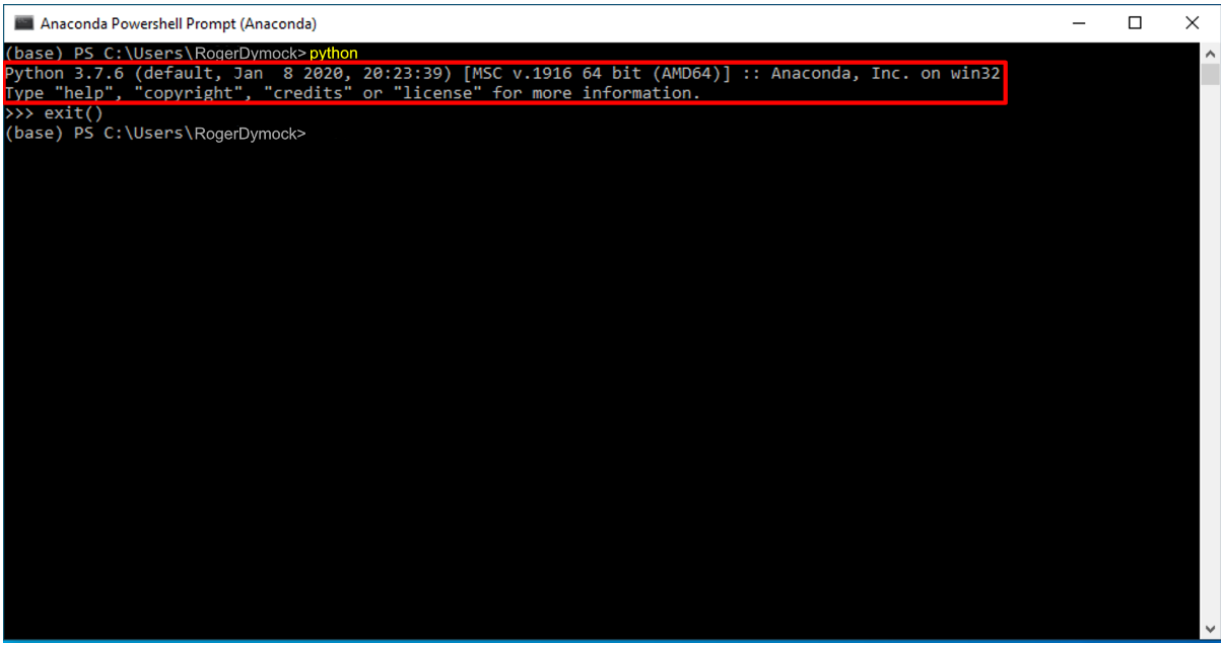


Figure A1.24 Python version.

If Python has installed correctly the current version deployed with Anaconda is displayed.

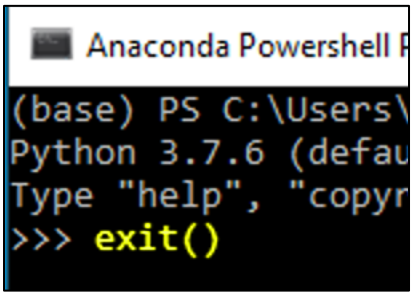


Figure A1.25 Exit Python editor.

Exit the Python editor by first typing at the command prompt (>) "**exit()**" (without the quotes but with the trailing brackets) and hit keyboard Return/Enter.

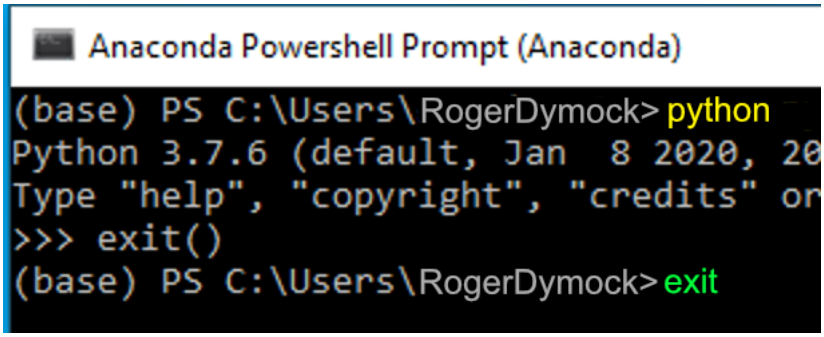


Figure A1.26 Exit Anaconda Powershell.

Then type "**exit**" again, (without the quotes and this time without the trailing brackets) and hit keyboard Return/Enter to close Anaconda Powershell.

2.0 HOPS Installation

Download the code from GITHUB

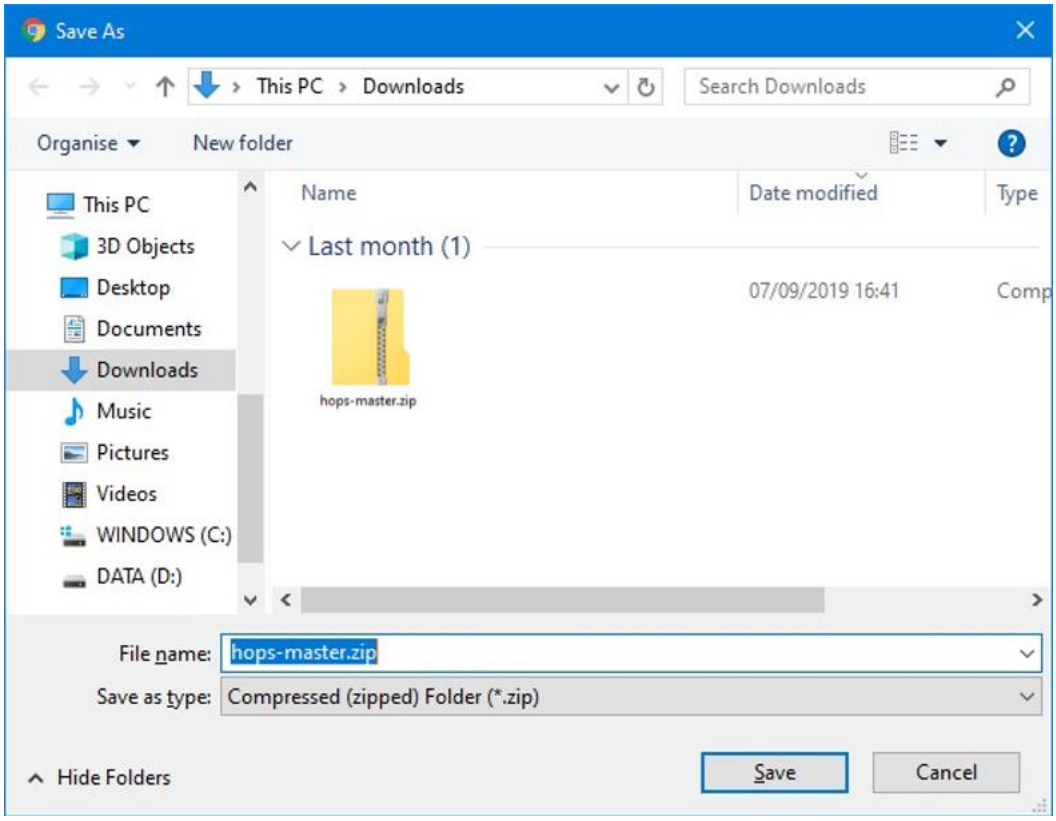


Figure A2.1

Select '**Save**'

Unzip by ***mouse-right-clicking*** on the '**hops-master.zip**' folder and selecting '**Extract all**'.

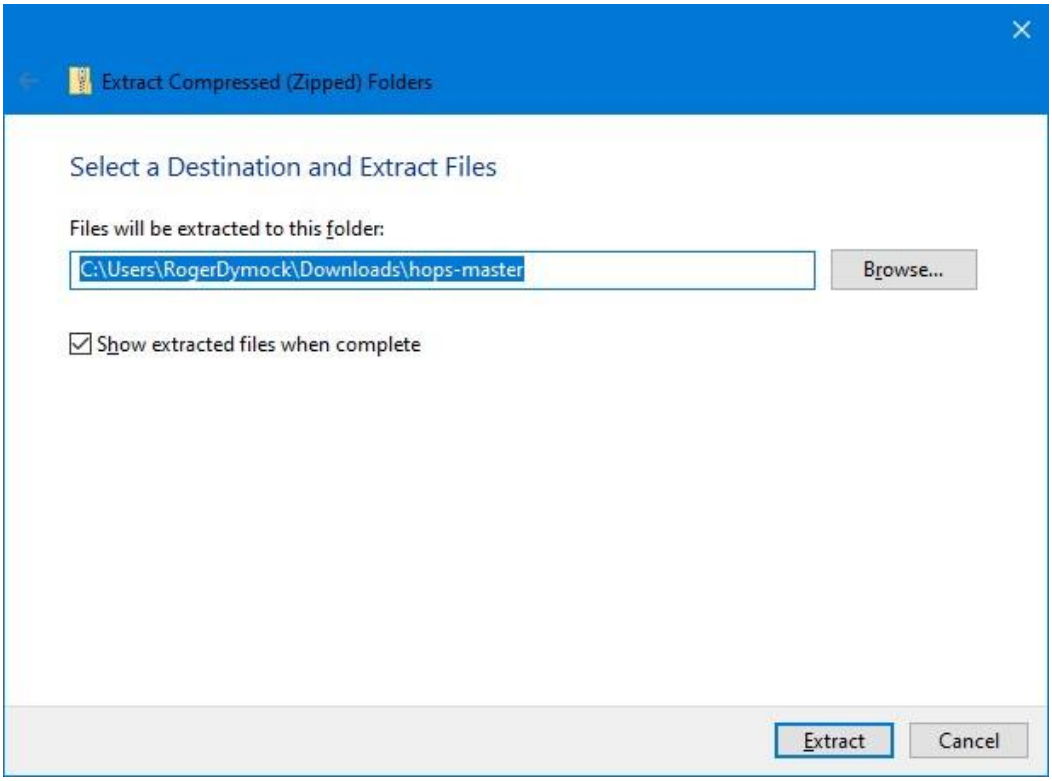


Figure A2.2

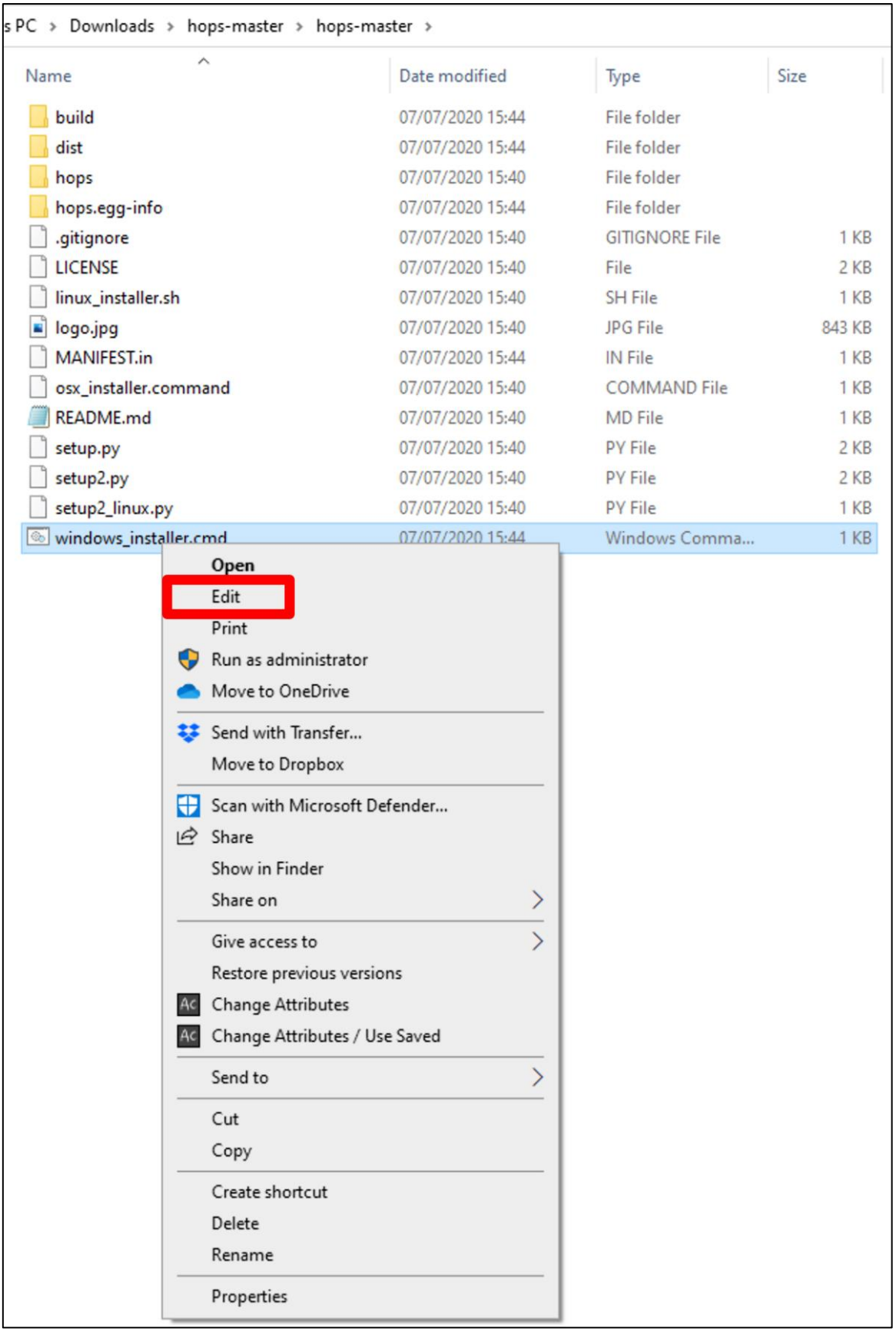
Select '**Extract**'

The next step is optional but recommended to allow monitoring of HOPS installation. Any errors that might occur can then be noted and remedied.

If you wish to continue with a 'Blind' install of HOPS then jump to figure A2.8 below otherwise continue here:

In the extracted folder '**hops-master'** we will modify the file 'windows_installer.cmd' so that the install progress can be monitored in a CMD window.

In the extracted folder '**hops-master'** ***mouse-right-click*** on the file '**windows_installer_cmd**' and select '**edit**' from the context menu:


s PC › Downloads › hops-master › hops-master ›
Name
Date modified
Type
Size
build 07/07/2020 15:44 File folder
dist 07/07/2020 15:44 File folder
hops 07/07/2020 15:40 File folder
hops.egg-info 07/07/2020 15:44 File folder
.gitignore 07/07/2020 15:40 GITIGNORE File 1 KB
LICENSE 07/07/2020 15:40 File 2 KB
linux_installer.sh 07/07/2020 15:40 SH File 1 KB
logo.jpg 07/07/2020 15:40 JPG File 843 KB
MANIFEST.in 07/07/2020 15:44 IN File 1 KB
osx_installer.command 07/07/2020 15:40 COMMAND File 1 KB
README.md 07/07/2020 15:40 MD File 1 KB
setup.py 07/07/2020 15:40 PY File 2 KB
setup2.py 07/07/2020 15:40 PY File 2 KB
setup2_linux.py 07/07/2020 15:40 PY File 1 KB
windows_installer.cmd 07/07/2020 15:44 Windows Comma... 1 KB
Open
Edit
Print
Run as administrator
Move to OneDrive
Send with Transfer...
Move to Dropbox
Scan with Microsoft Defender...
Share
Show in Finder
Share on
Give access to
Restore previous versions
Change Attributes
Change Attributes / Use Saved
Send to
Cut
Copy
Create shortcut
Delete
Rename
Properties
Figure A2.3

A Windows protection screen will appear:

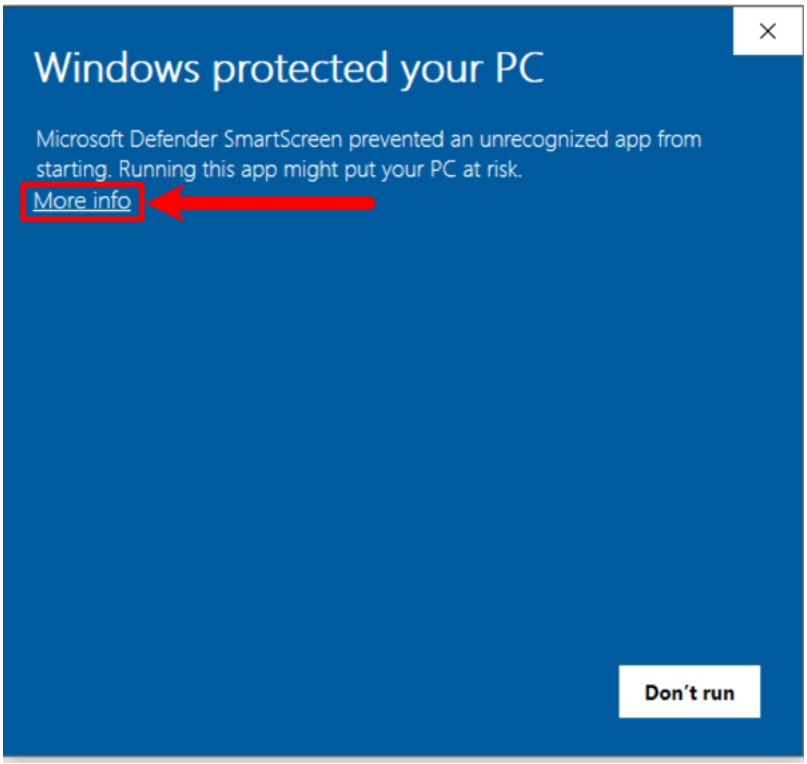


Figure A2.4 Windows protection enabled.

Click on the '**More info'** link

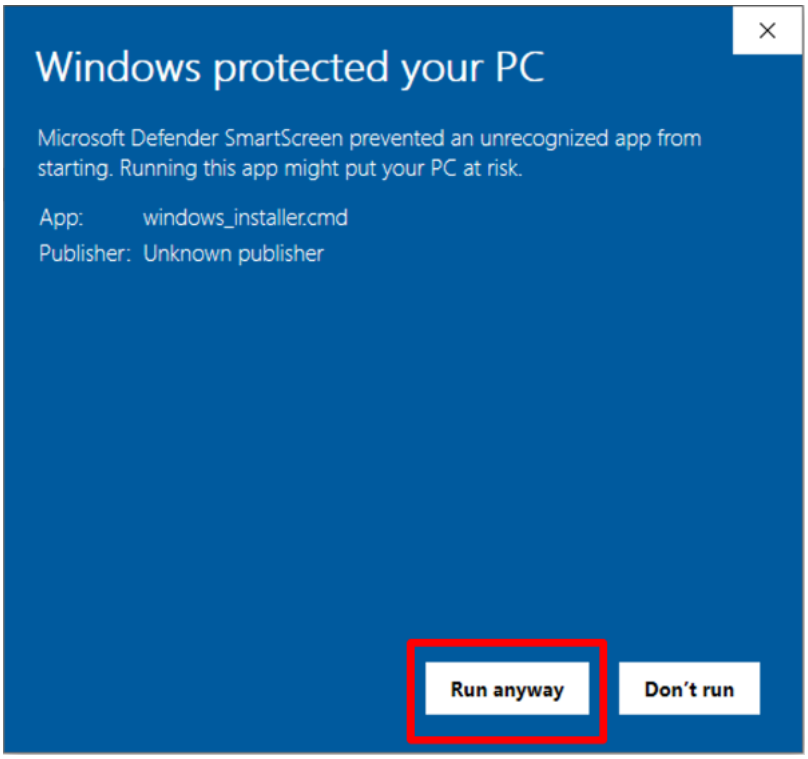


Figure A2.5 Windows protection confirmed

Click the '**Run anyway'** button.

Notepad will open and display the following text:

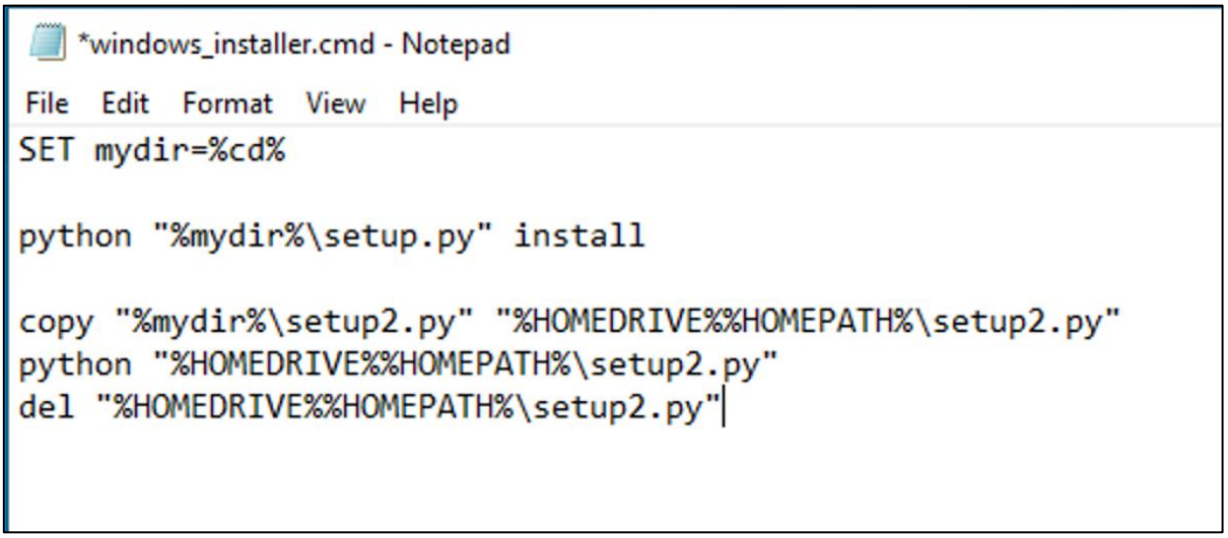


Figure A2.6

Place the cursor at the end of the last line of text and hit the keyboard 'Return/Enter' key twice to generate two empty lines below the text.
Place the cursor at the beginning of the last empty line and type the following (without quotes)
cmd /k (note the single space after 'cmd' and before '/' then click '**File**' and '**Save**' in the top toolbar. The saved file will look like this:

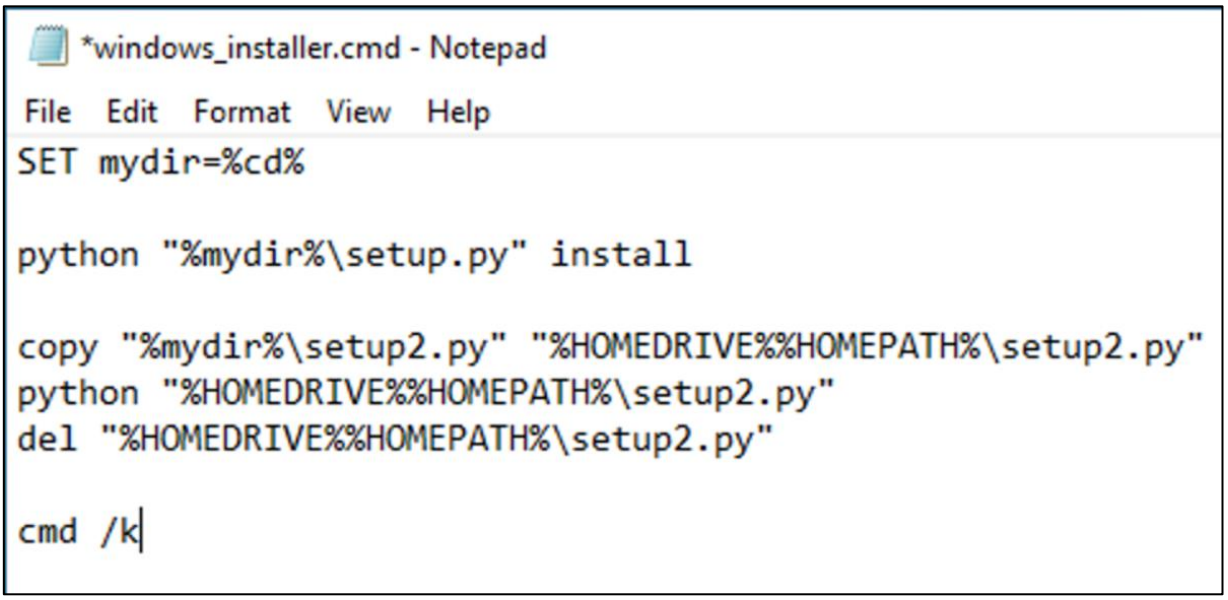


Figure A2.7

Close Notepad and continue with HOPS installation:

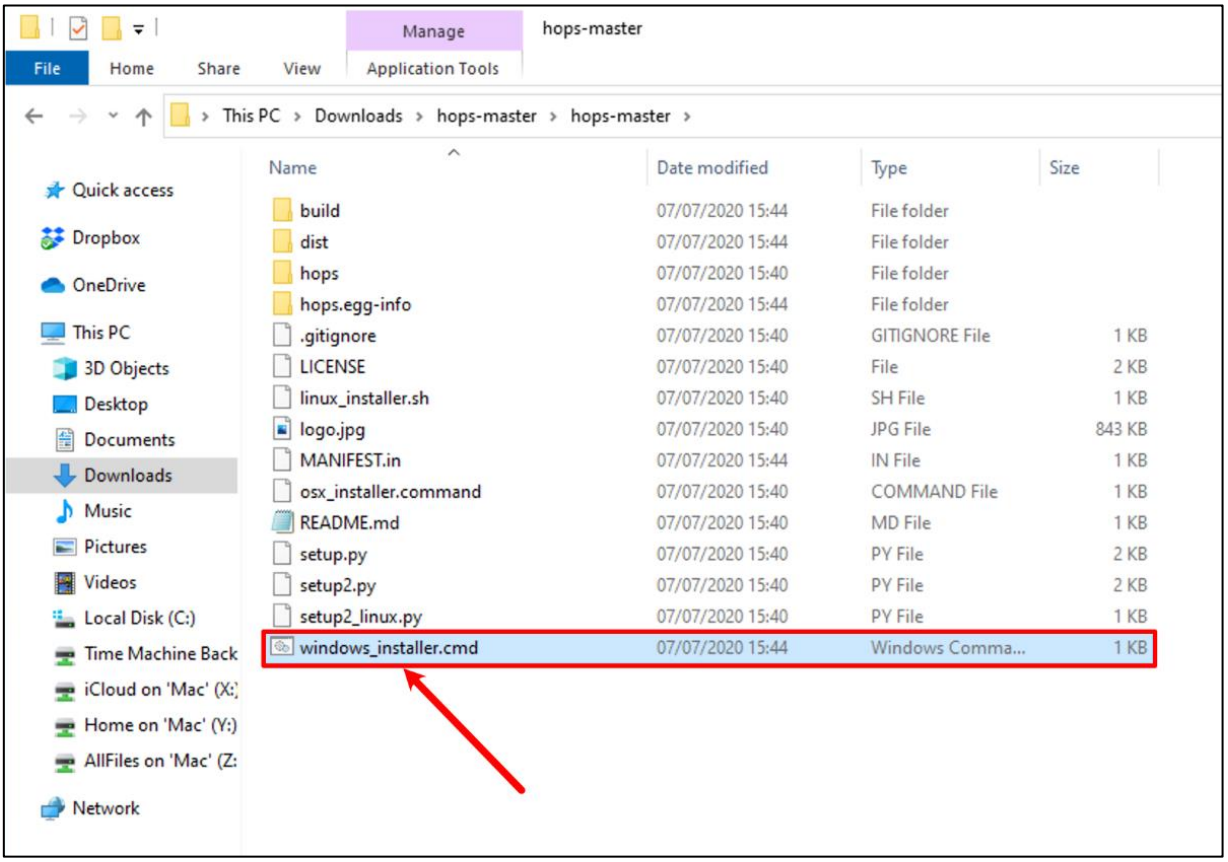


Figure A2.8

In the extracted folder '**hops-master**' *double-click* '**windows_installer.cmd**'.

Note: *If you edited the file '**windows_installer_cmd**' previously, as described above in figures A2.6 and A2.7 then you will not see the Windows protection screen below, jump to figure A2.11*

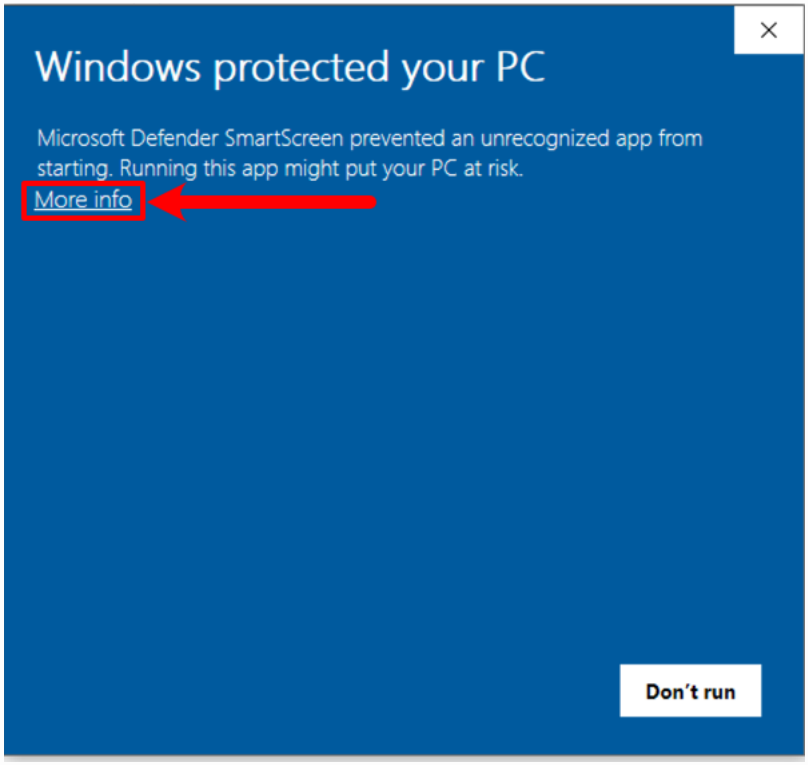


Figure A2.9 Windows protection enabled

The first time you click on '**windows_installer_cmd'** Windows protection is invoked as shown in figure A2.9 above.

Click on the '**More info**' link.

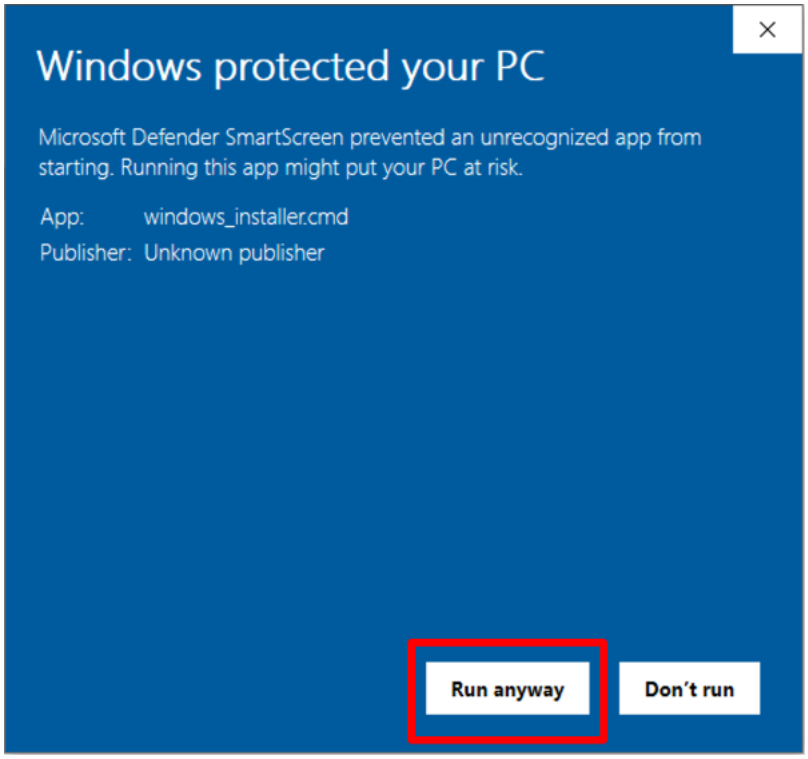


Figure A2.10 Windows protection confirmed.

Click on '**Run anyway**'.

During HOPS installation, and if you edited the file windows_installer_cmd as described above, you will be able to monitor the progress of the installation and watch for any fatal errors. Many error messages displayed are of no consequence for the end user but may be helpful in diagnosing installation problems or for forwarding to the developer.
If the installation is successful you will see a screen similar to this:

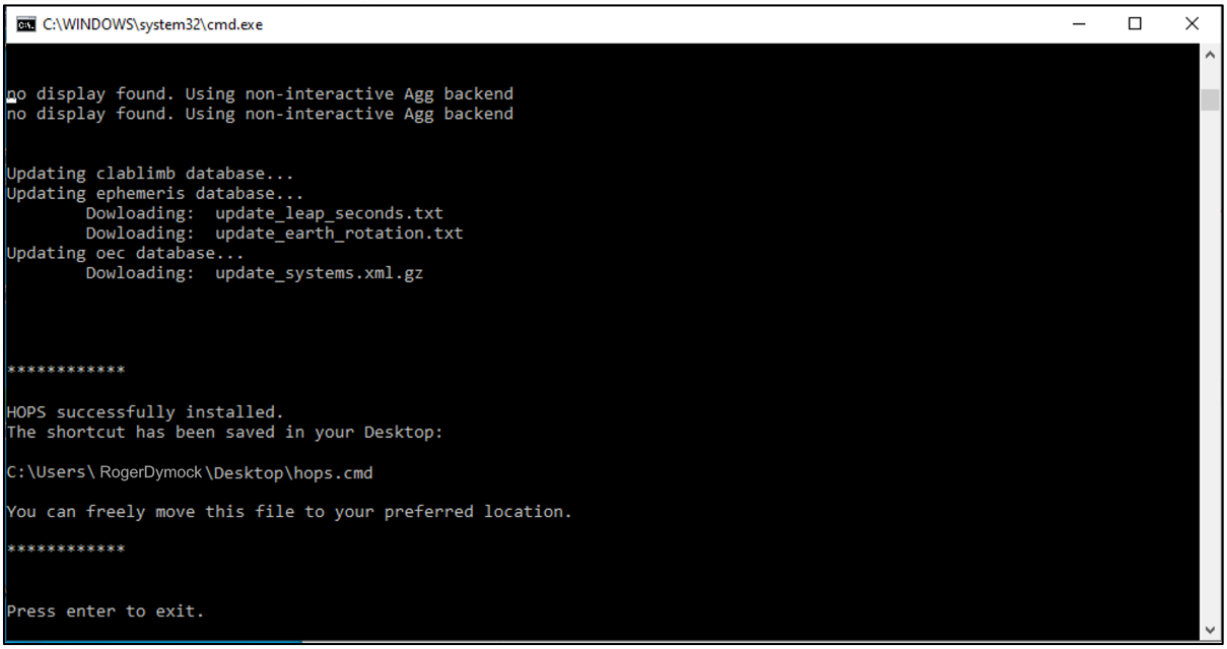


Figure A2.11

Hit the keyboard Return/Enter key.

If you **did not edit** the file '**windows_installer_cmd**' then the window will close.

If **you edited** the file '**windows_installer_cmd**' then the screen will remain open, if so:

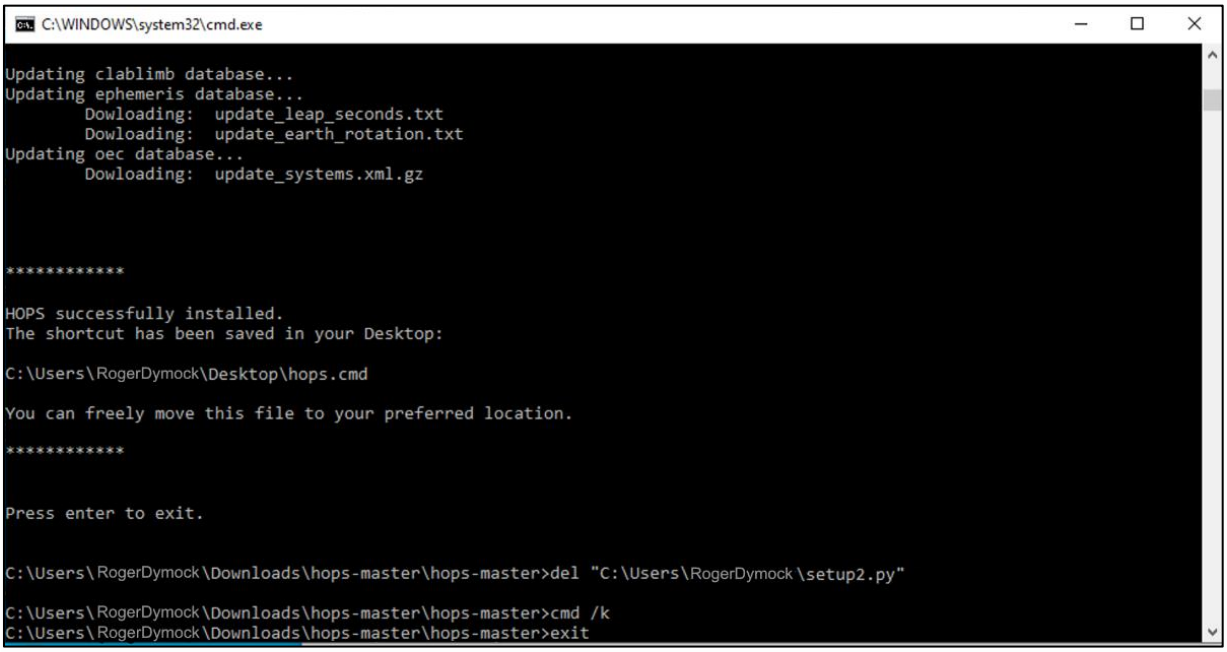


Figure A2.12

At the command prompt (>) type '**exit**' (without the quotes) and hit the keyboard Return/Enter key to close the window.

HOPS installation is complete.

The hops.cmd icon,  , is placed on your desktop.

hops.cmd

Double clicking on that opens two windows, Figures A2.12 and A2.13.

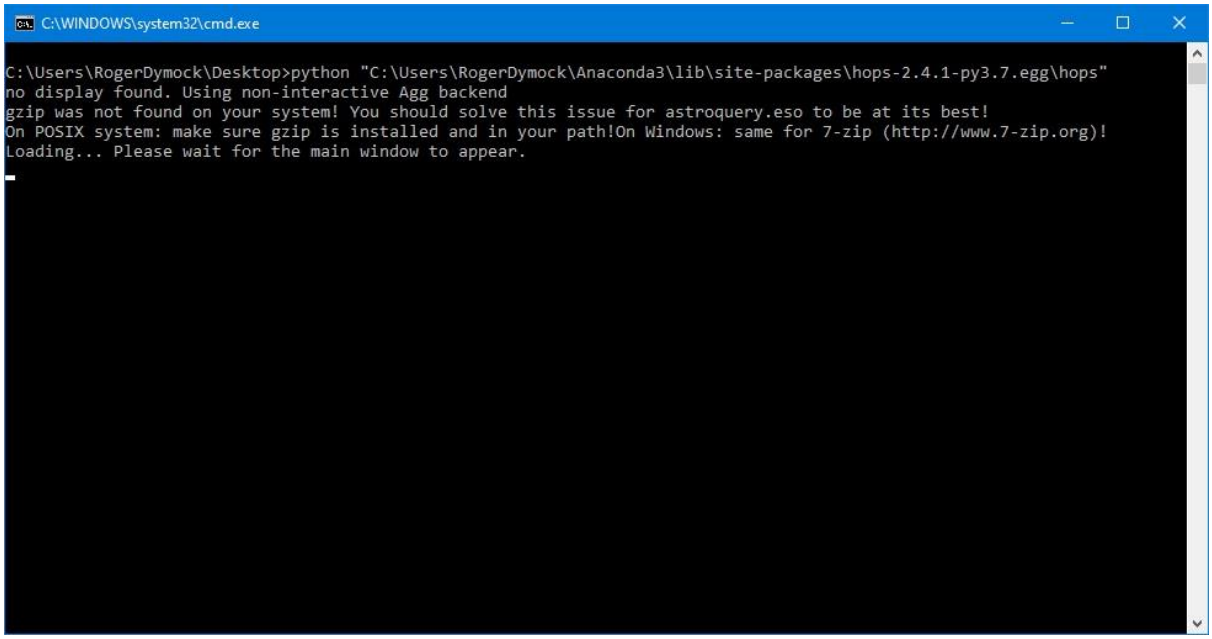


Figure A2.12

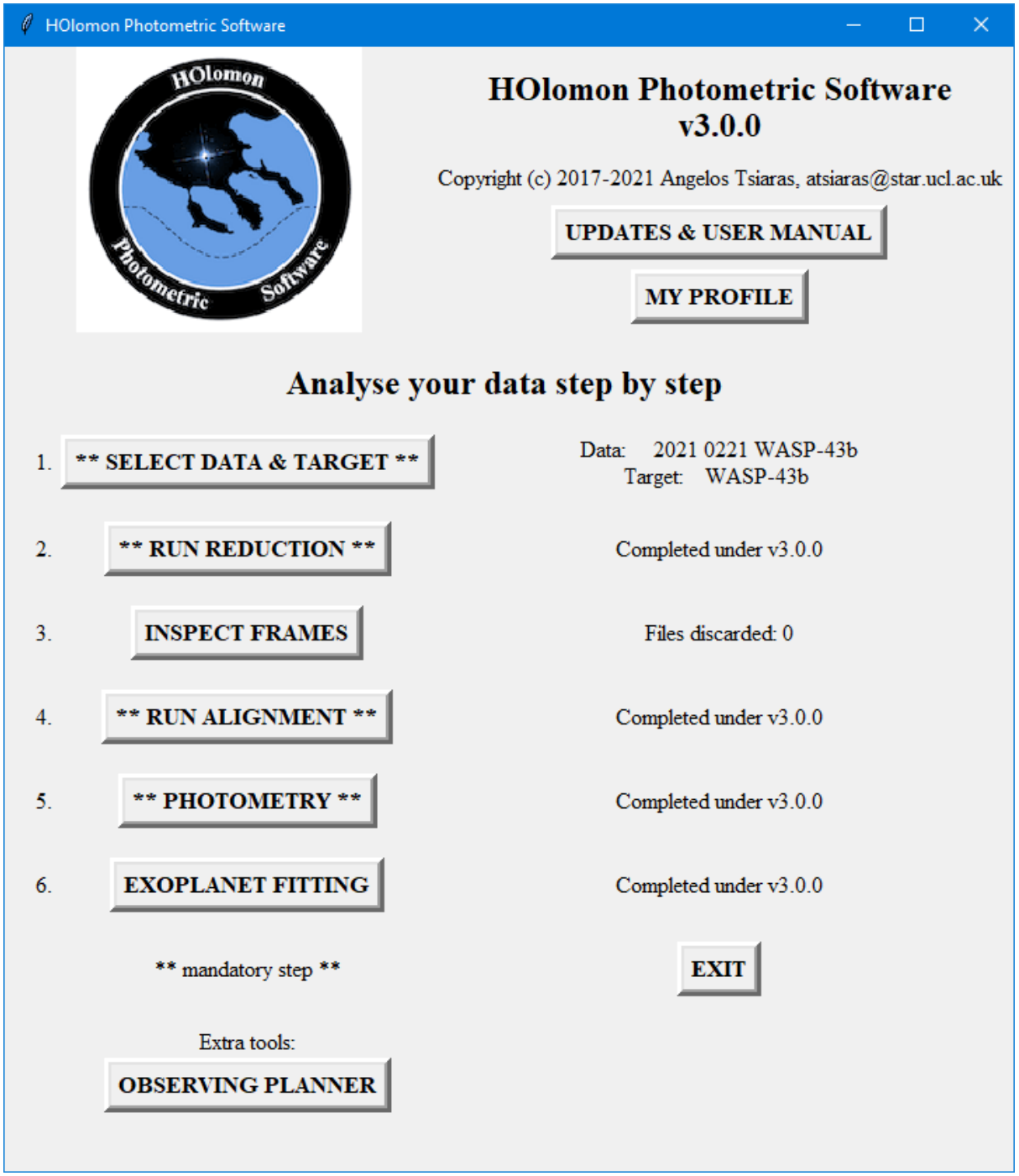


Figure A2.13

That's about it for installation.

Return to beginning of document

Appendix B

Running HOPS

1.0 Introduction

The HOPS User Manual at https://exoworldsspies.com/en/software/ provide detailed instructions on running HOPS but this example may be of help. HOPS may have been updated since this was written so please refer to the latest User Manual at hops3_manual_en.pdf (exoworldsspies.com)

Tis example uses images of WASP-43b obtained on 2021 February 21 using the MicroObservatory robotic telescope

It is convenient to organise your data as per the instructions in the HOPS manual; i.e.
- Keep all scientific and reduction frames in one folder without subfolders
- Use a specific identifier for the scientific frames e.g.WASP
- Use a specific identifier for the bias frames, not containing the same identifier as the scientific frames e.g. bias (none available in this example)
- Use a specific identifier for the dark frames, not containing the same identifier as the scientific frames e.g. dark
- Use a specific identifier for the flat frames, not containing the same identifier as the scientific frames e.g. flat (none available in this example)

2.0 Analysis

Double click on the hops.cmd icon and wait until the Main window in Figure B2.1 is displayed.

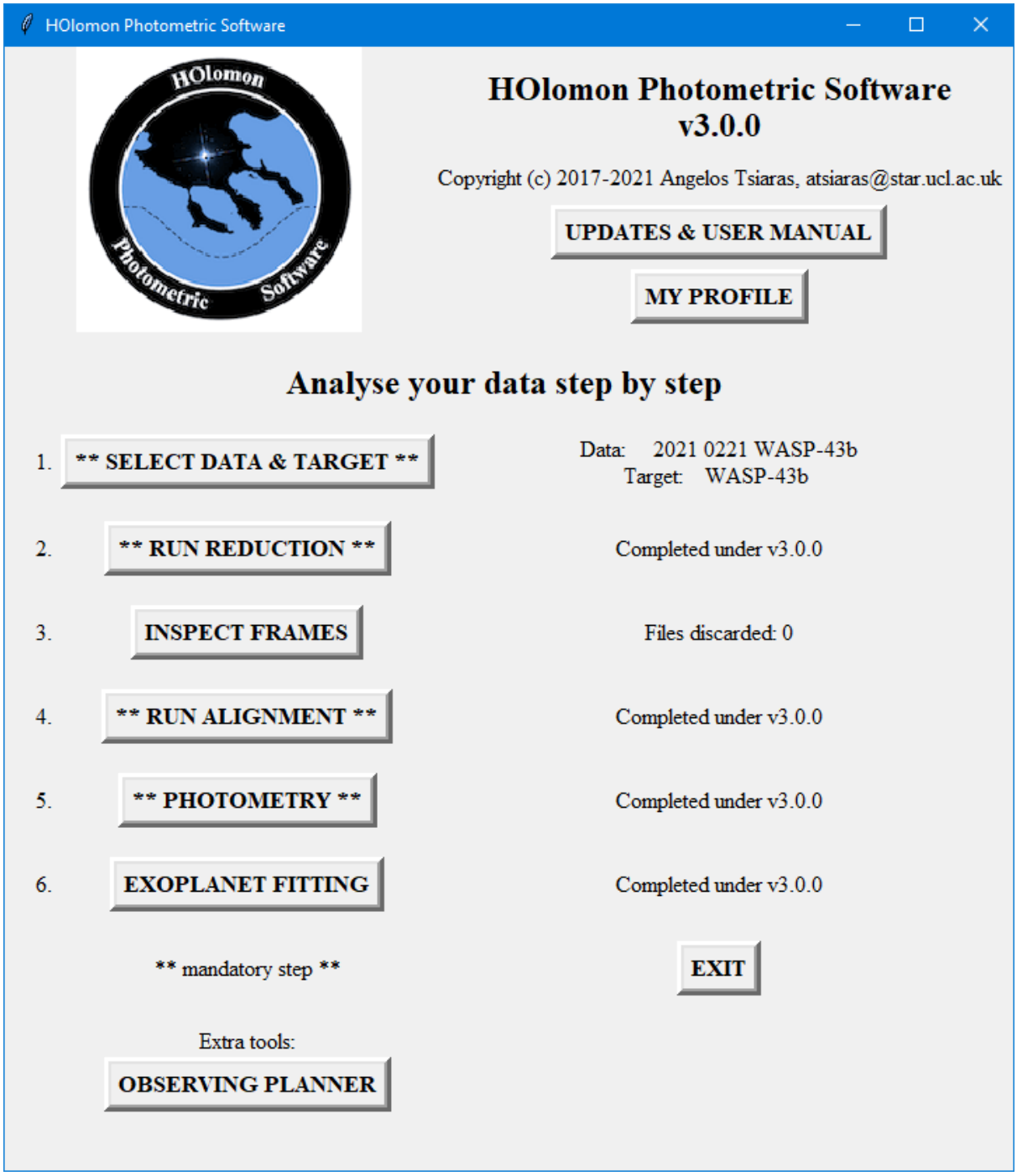


Figure B2.1. HOPS Main window

Click on the MY PROFILE button, fill in the observatory data and click on Update – Figure B2.2 shows data for the MicroObservatory robotic telescope. Do not leave 'None' in any of the boxes as this will cause an error later. Select SAVE CHANGES & CLOSE WINDOW TO RETURN TO THE Main window.

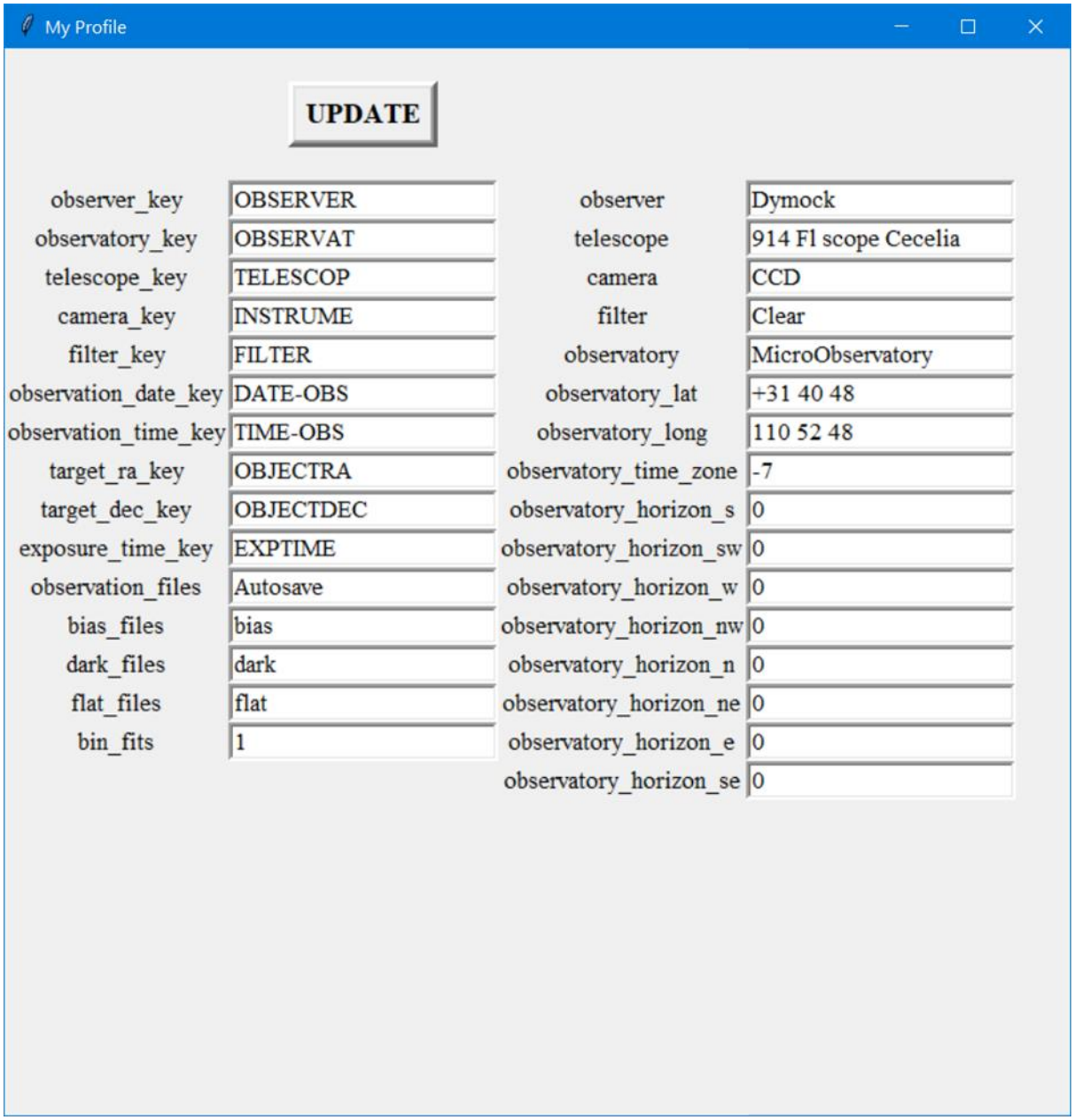


Figure B2.2. Profile for MicroObservatory robotic telescope

Click on the SELECT DATA & TARGET box to open the Data & Target window – Figure B2.3

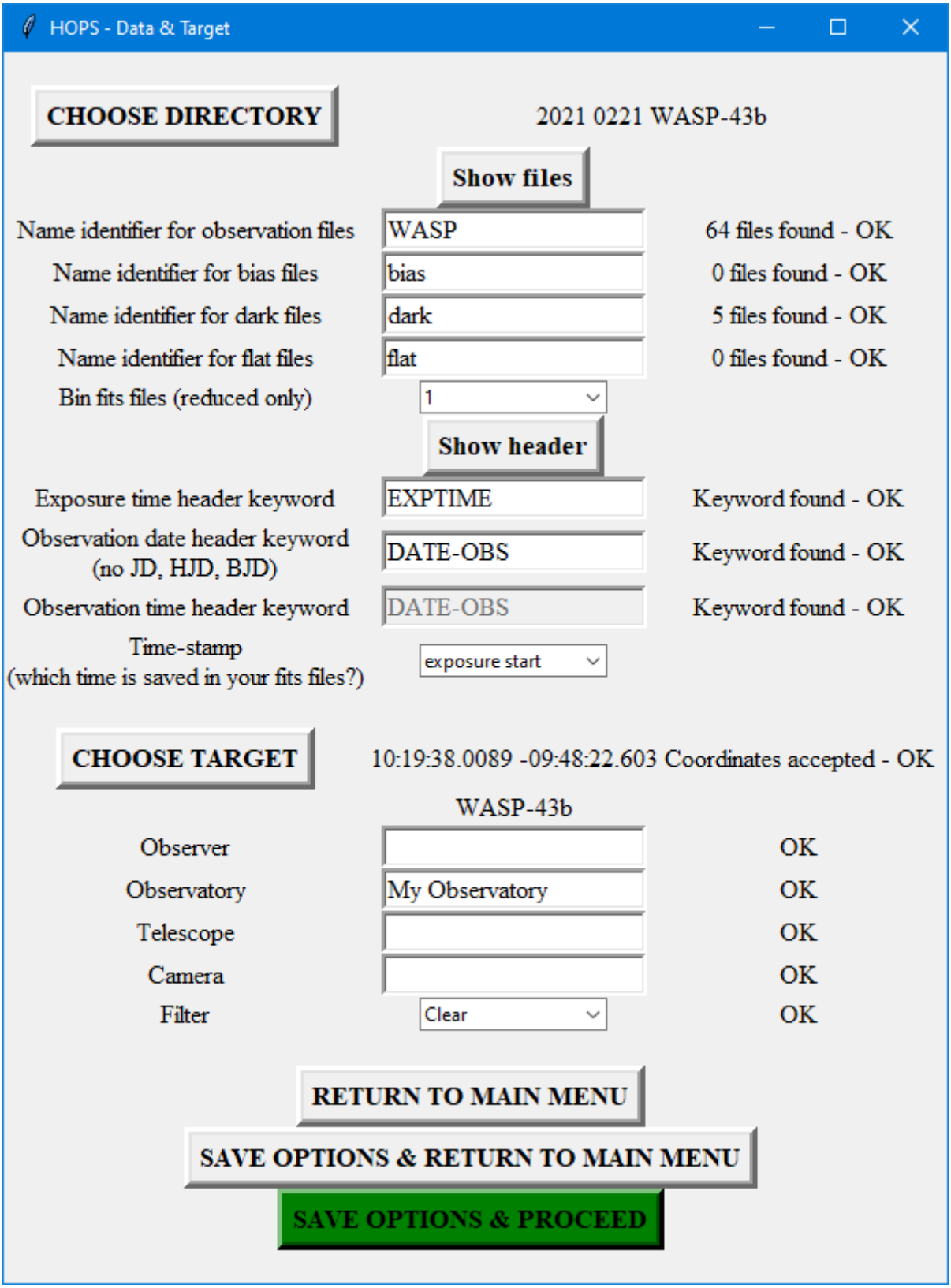


Figure B2.3. Data and Target window

Enter the Name identifier for observation files, WASP and dark files and the quantities of images and calibration frames will now be listed. Click on SAVE OPTIONS & PROCEED. On completion of reduction the Inspection window is displayed - Figure B2.4

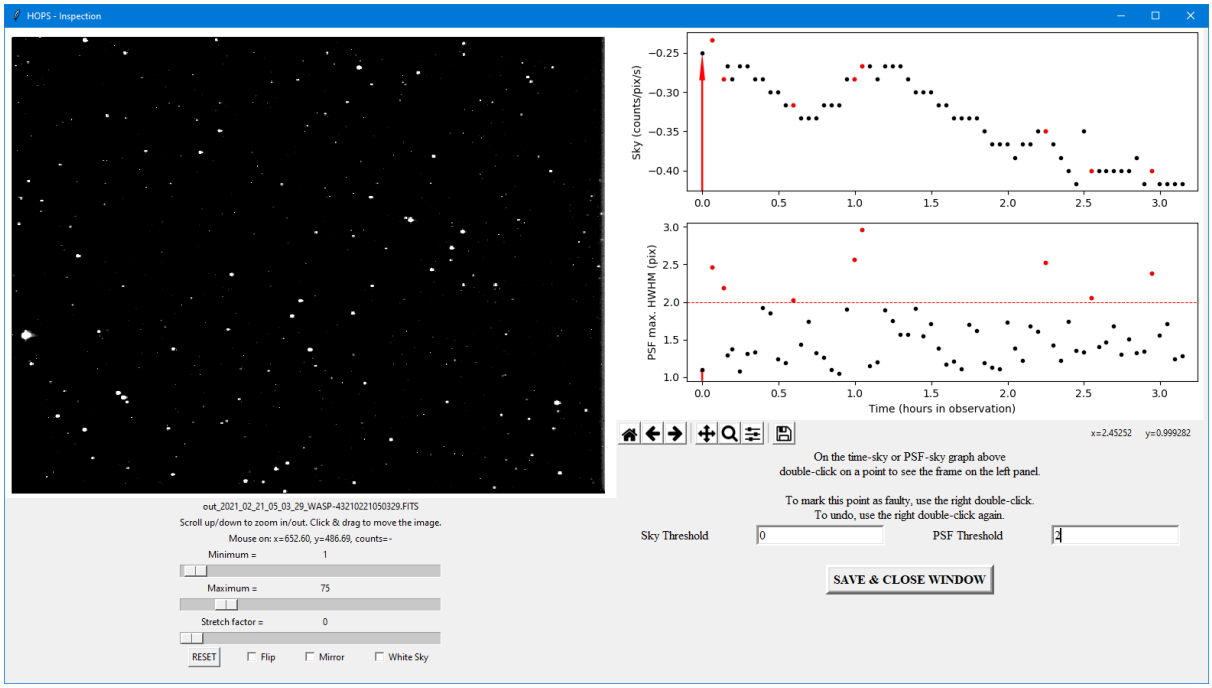


Figure B2.4 Inspection window

The Sky Threshold and/or PSF Threshold can be set – in this case the latter was set to 2.0.

Important note from HOPS manual
The alignment process relies heavily on your first image. This is a good moment to check your first image again and verify that it is not overexposed and that the tracking is representative of your observation in total. If your first image is not of good quality, select it as faulty here it will save you a lot of time!

Click on SAVE OPTIONS AND PROCEED TO OPEN the Alignment window. On completion of alignment the Photometry window is opened – Figure B2.5. You may need to press RESET to properly display the image.

Alignment omits saturated sources. It will not use stars with peak higher than the 2/3s of the saturation limit (65000 for a 16-bit camera). You can change this by modifying the second line of the log.yaml file.

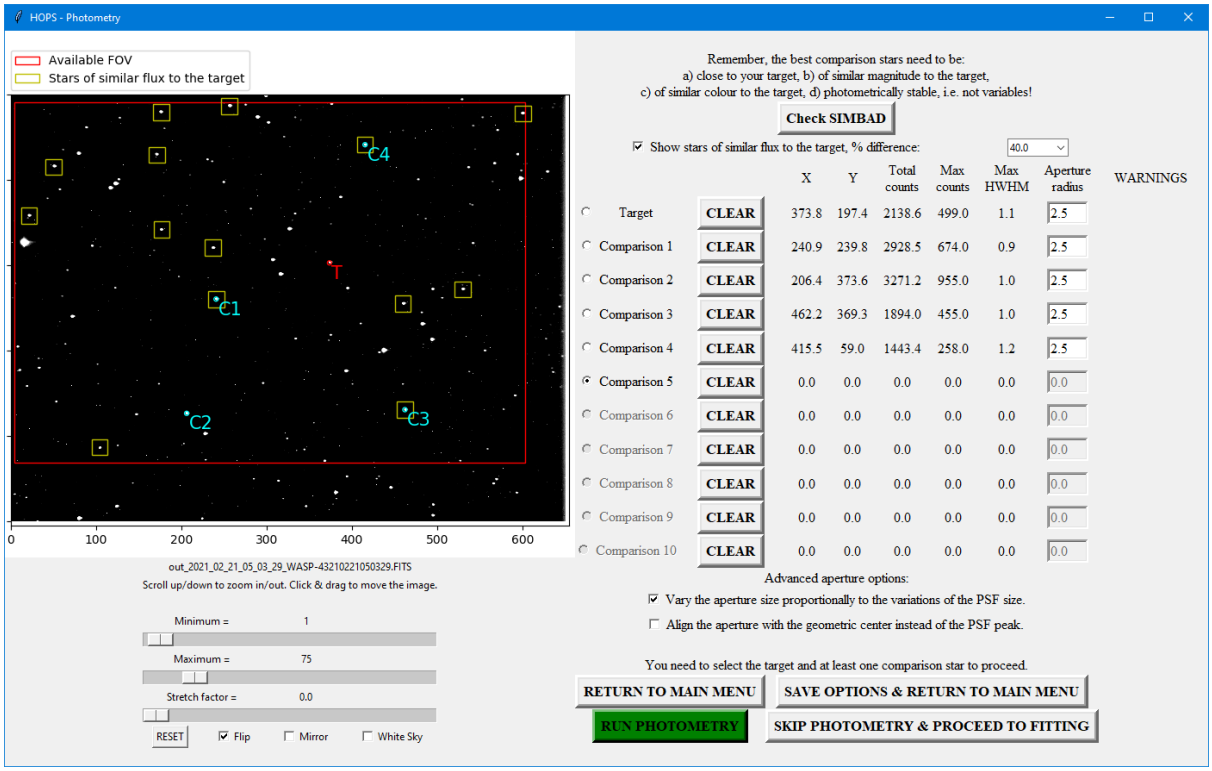


Figure B2.5. Photometry window (Target and comparison stars previously selected)

Refer to the relevant ExoClock page to identify the target – Figure B2.6

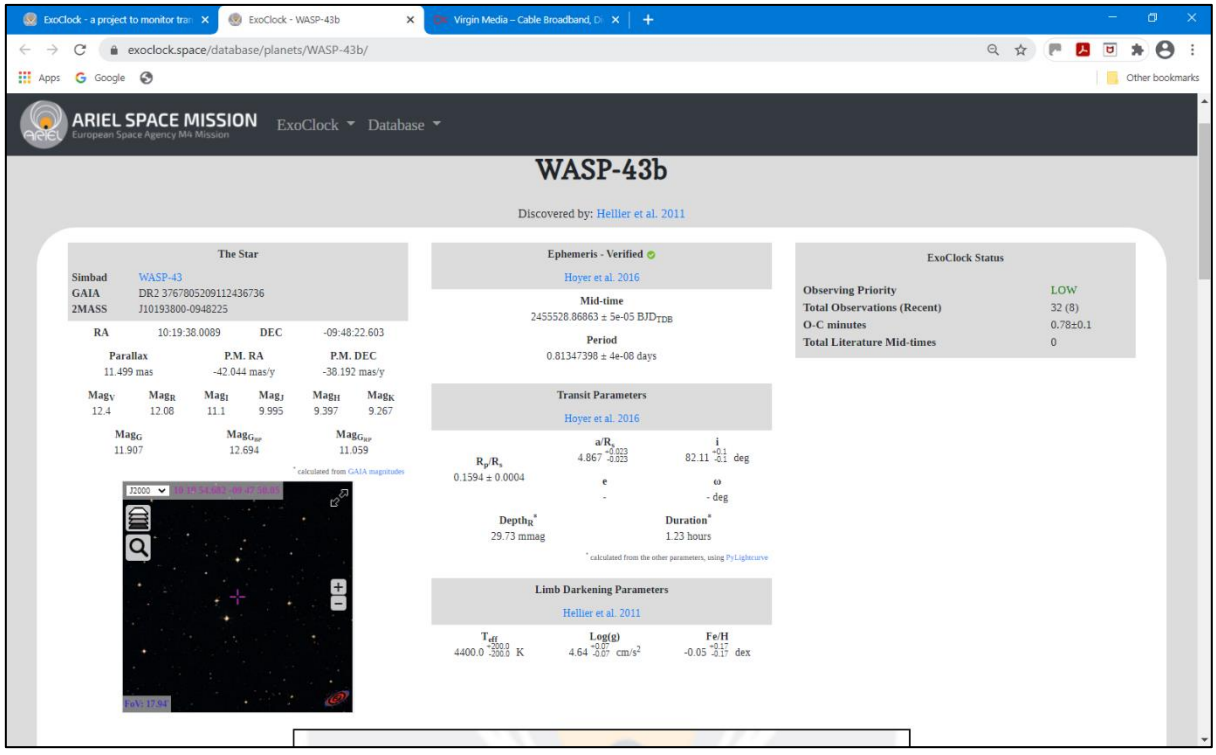


Figure B2.6. ExoClock database entry for WASP-43b

Double click on the target which identifies that as T and highlights similar comparison stars. Select five from different areas of the image by first selecting Comparison 1, 2, 3, etc and then double clicking on the selected comparison star – Figure B2.5

You can vary the aperture size if WARNING shows as Apert too small. Suggest you run with various Advanced aperture option selected (or none) to see which gives the best light-curve.

Select RUN PHOTOMETRY, save your results and then select PROCEED TO FITTING MENU resulting in the transit light curve being displayed – Figure B2.7

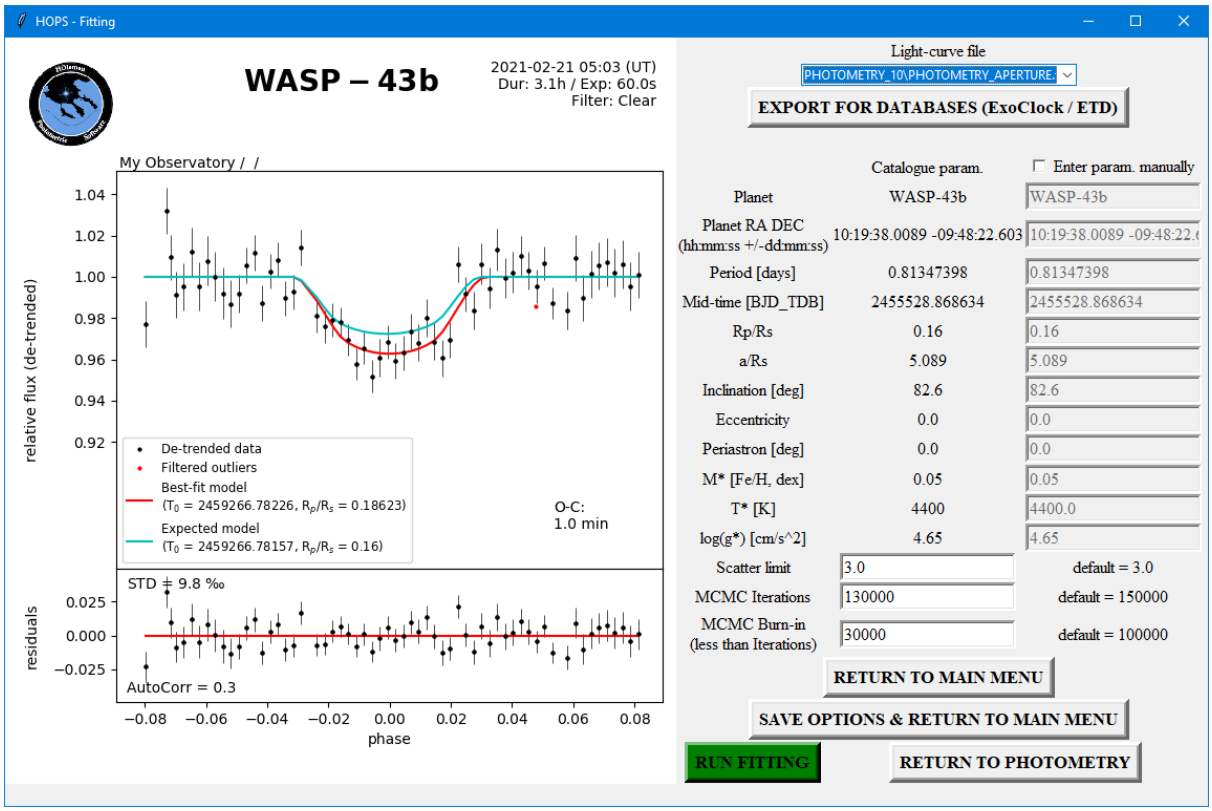


Figure B2.7. Transit light-curve and associated data

Select RUN FITTING, may take a couple of minutes, to produce the final light-curve which is stored in the FITTING folder – Figure B2.8.

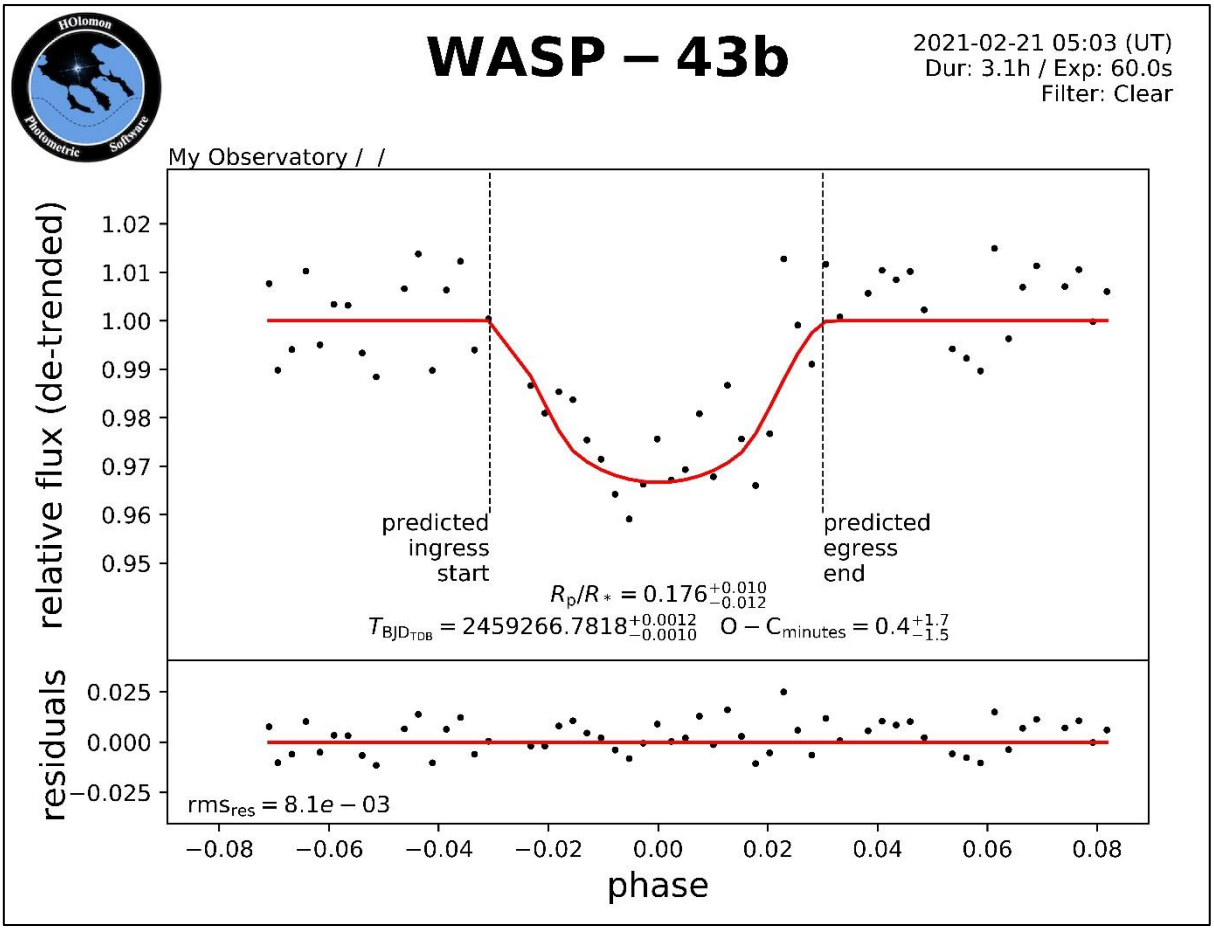


Figure B2.8. Final version of transit light-curve

In the Results saved successfully window click OK. In the Fitting progress window select RETURN TO FITTING – Figure B2.7

In the Fitting window select EXPORT FOR DATABASES (ExoClock/ETD) which displays the Export Results window. – Figure B2.9.

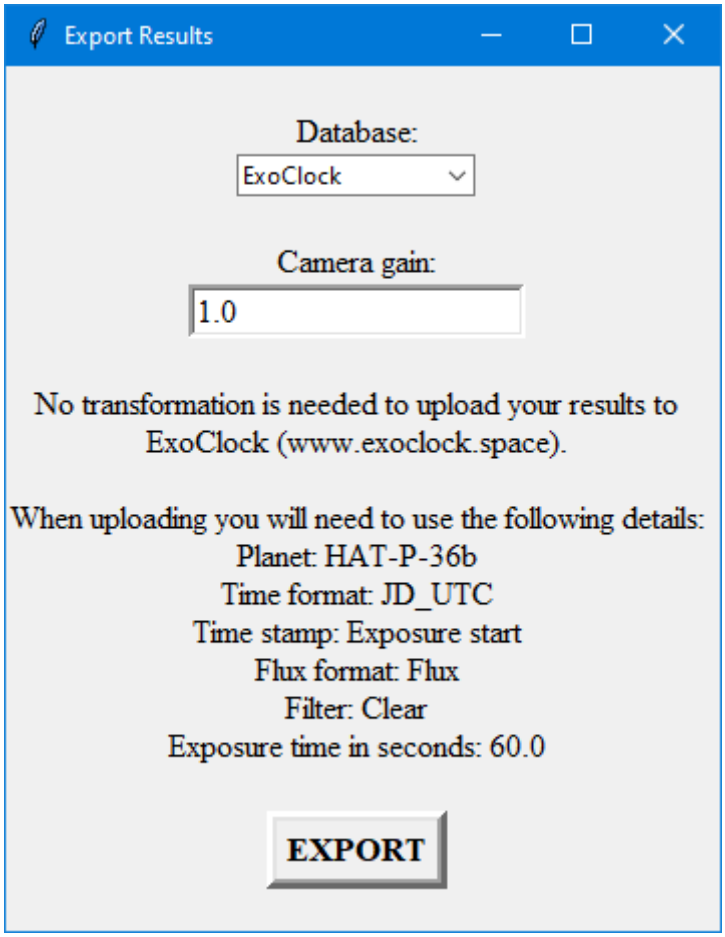


Figure 2.9. Export to ExoClock

To save results in ExoClock format, select ExoClock in the Database window and then EXPORT.

To save results in ETD format, select ETD in the Database window and then EXPORT – Figure 2.10. Note details required for ETD upload.

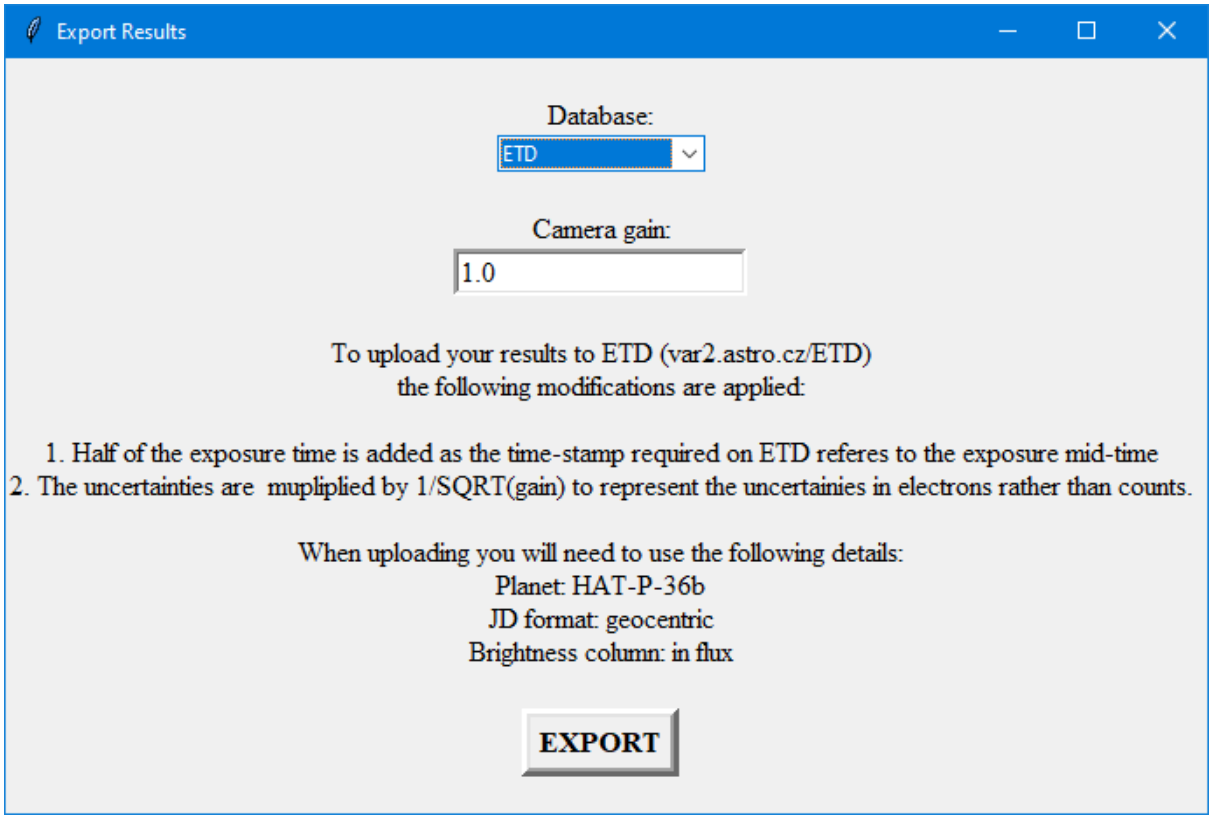


Figure B2.10 Export Results window for creating ETD file

Return to beginning of document

Appendix C

Submitting results to the ExoClock and the Exoplanet Transit Database

The file ‘ ExoClock_info.txt’,below, is located in the Photometry folder and indicates which file should be uploaded – PHOTOMETRY_APERTURE.txt in this case.

```
-----------------------------------------------------------------
The ExoClock Project is an effort to keep the ephemerides of
exoplanets as precise as
possible for planning future observations. If you have observed an
exoplanet you can
contribute your observation at:

https://www.exoclock.space

File to upload: PHOTOMETRY_APERTURE.txt
(this is a suggestion based on the scatter
of your light curves, you can also try
uploading PHOTOMETRY_GAUSS.txt)

Planet: WASP-43b
(this is the closest known exoplanet found
in the catalogue, if this is not the target
you observed, please ignore)

Time format: JD_UTC
(UTC-based Julian date)

Time stamp: Exposure start
(the time produced refers to the beginning of each exposure)

Flux format: Flux
(flux of target over summed flux of comparisons)

Filter: Clear

Exposure time in seconds: 60.0
-----------------------------------------------------------------------------------------------------
```

To upload your results;
- go to the ExoClock homepage at https://www.exoclock.space/project
- Log-in (assuming you are registered)
- select My lab/Upload Observation and complete the observation data, Figure C3.1.1, and click on ‘Upload Observation’

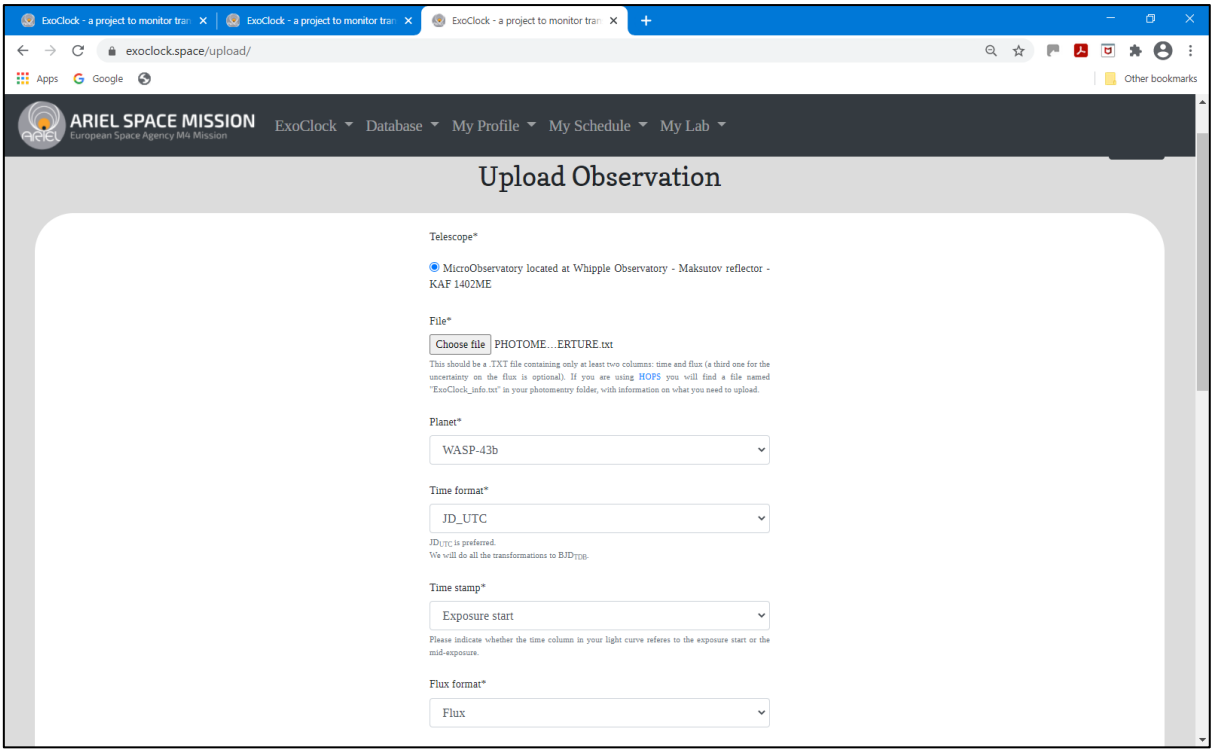


Figure C3.1.1 Observation data for WASP-43b

Complete the upload by selecting ‘Submit’ and clicking on ‘Update Observation’. Figure C3.1.2 resulting.

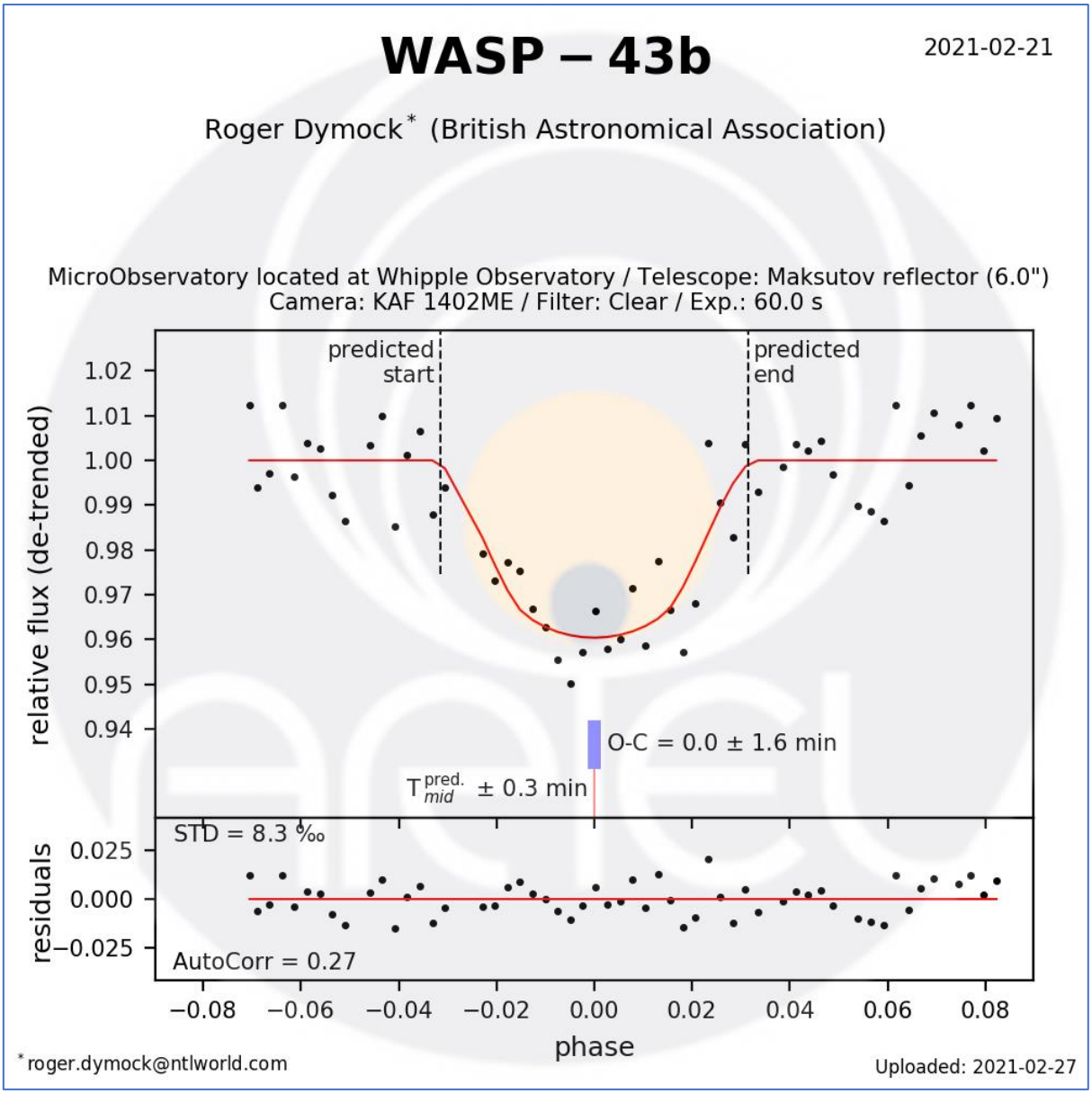


Figure C3.1.2. Uploaded transit light-curve.

Selecting My Profile/My Observations shows the status of your submissions – Figure C3.1.3.

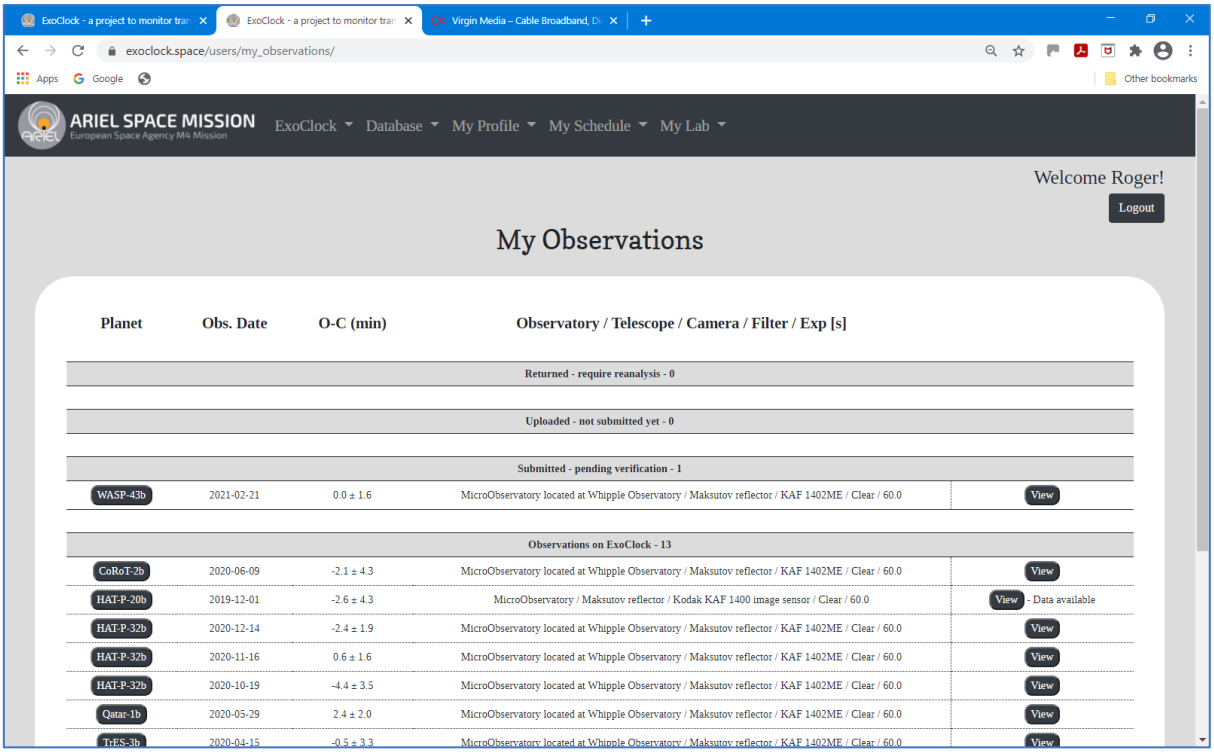


Figure C3.1.3. Submission status.

An email will be sent to you when your observation has been verified and is on the ExoClock Observations database – Figure C3.1.4

Dear Roger,

thank you very much for submitting your observation to ExoClock. It has now been published at:
https://www.exoclock.space/database/observations/WASP-43b_Roger_Dymock_MicroObservatorylocatedatWhippleObservatory_Maksutovreflector_2021-02-21

Best Regards,
the ExoClock admin team

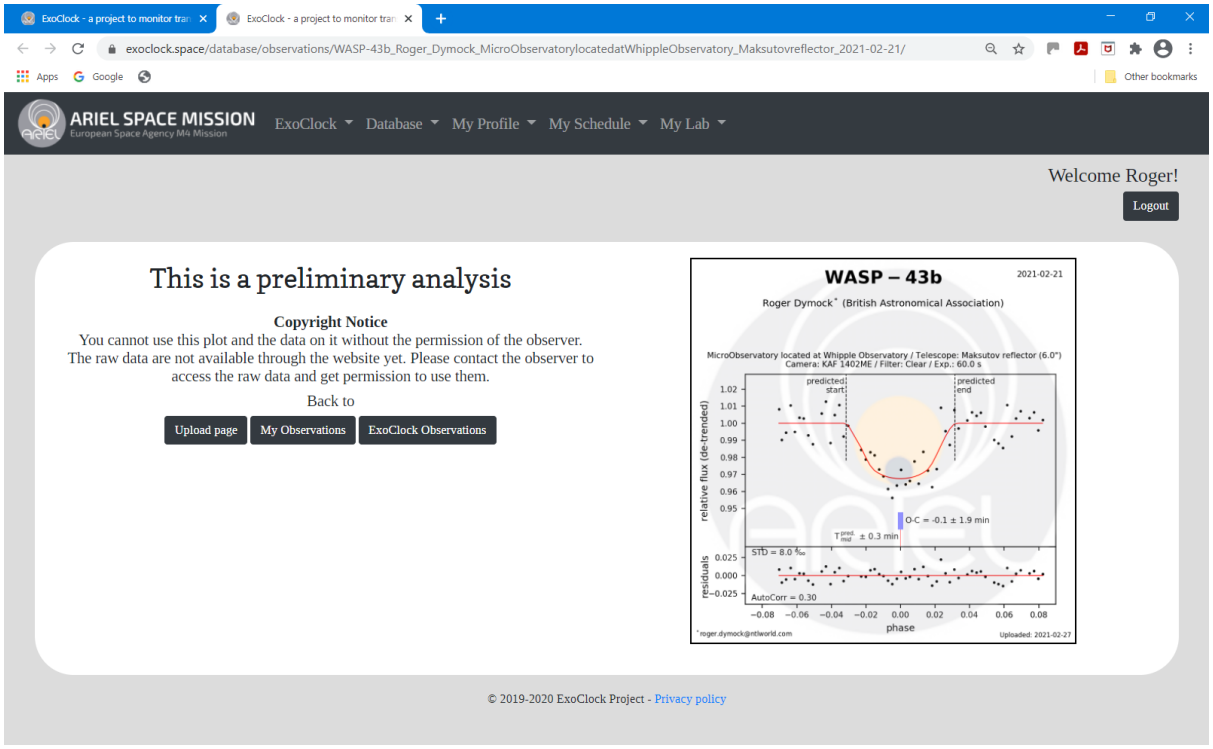


Figure C3.1.4 Accepted observation

3.2 Submitting results to the Exoplanet Transit Database (ETD)

You will need an image of the Field of View of the target. There is a pdf of same listed under PHOTOMETRY. I load a screen shot into Corel PaintShop Pro and create a jpg – Figure C3.2.1

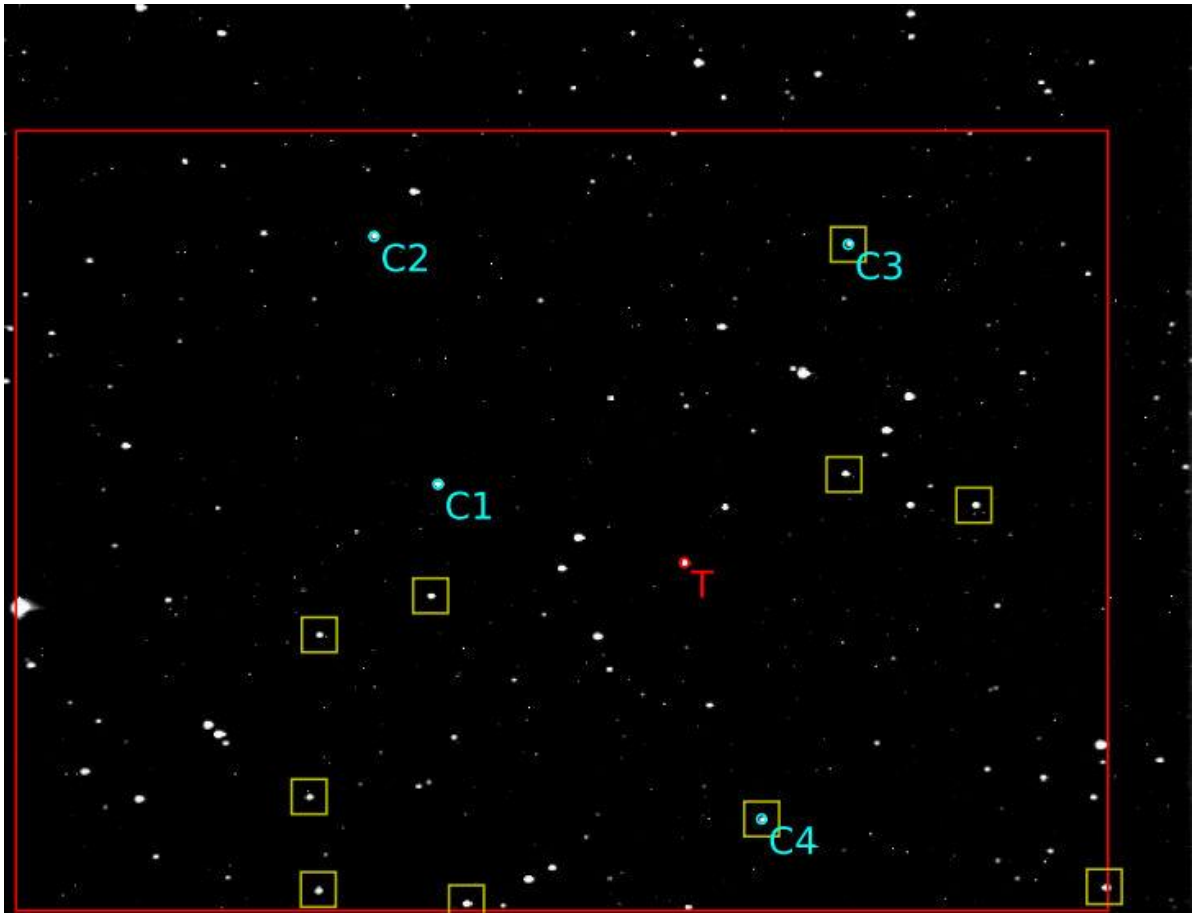


Figure C3.2.1. WASP-43b FOV

Access the ETD , select 'How to contribute to ETD' and then 'on-line protocol' in paragraph 2. Figure C3.2.2 shows this screen with the exoplanet name and file chosen – HOPS-PHOTOMETRY_6_APERTURE_2021-02-21_wasp-43b_Clear_60.0s_for_ETD.txt

You do not need to be registered to input to the TRESCA database but, should you wish to, you can do so here

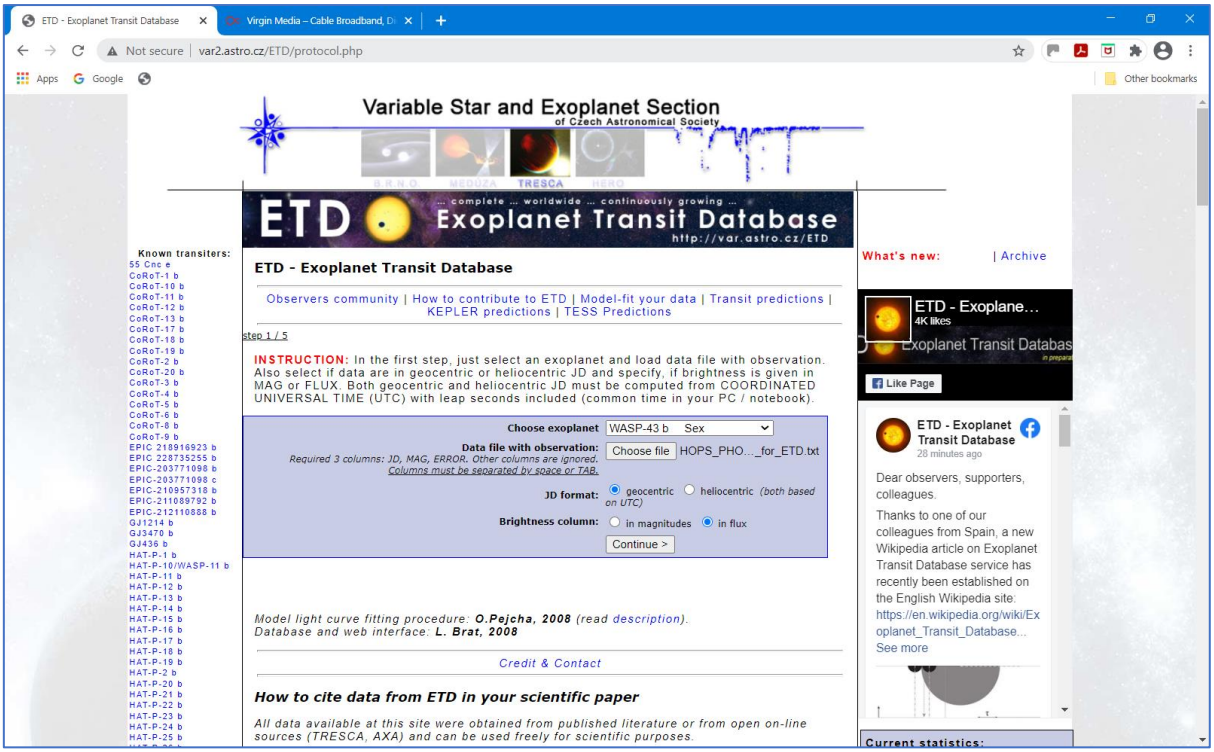


Figure C3.2.2 ETD input, Step1 of 5

Click on ‘Continue>’ to go to Step 2 – Figure C3.2.3

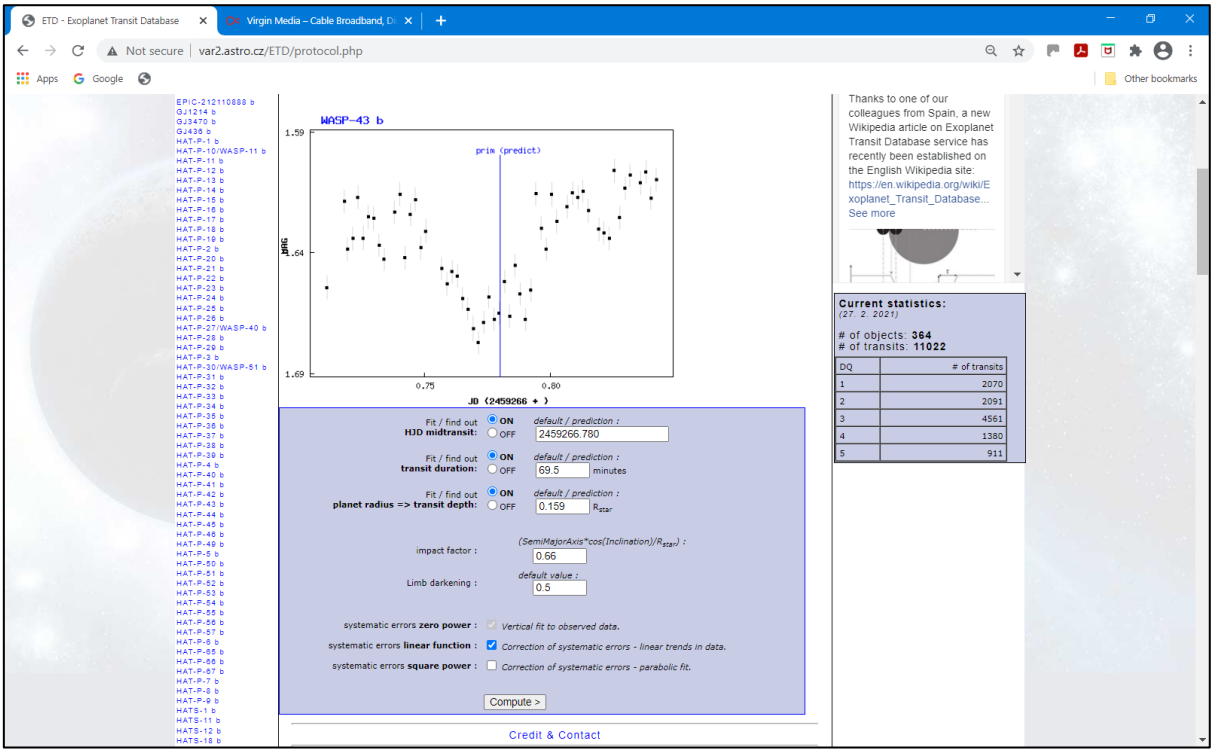


Figure C3.2.3 Step 2

If accepting the defaults select ’Compute>’ to go to Step 3 – Figure C3.2.4

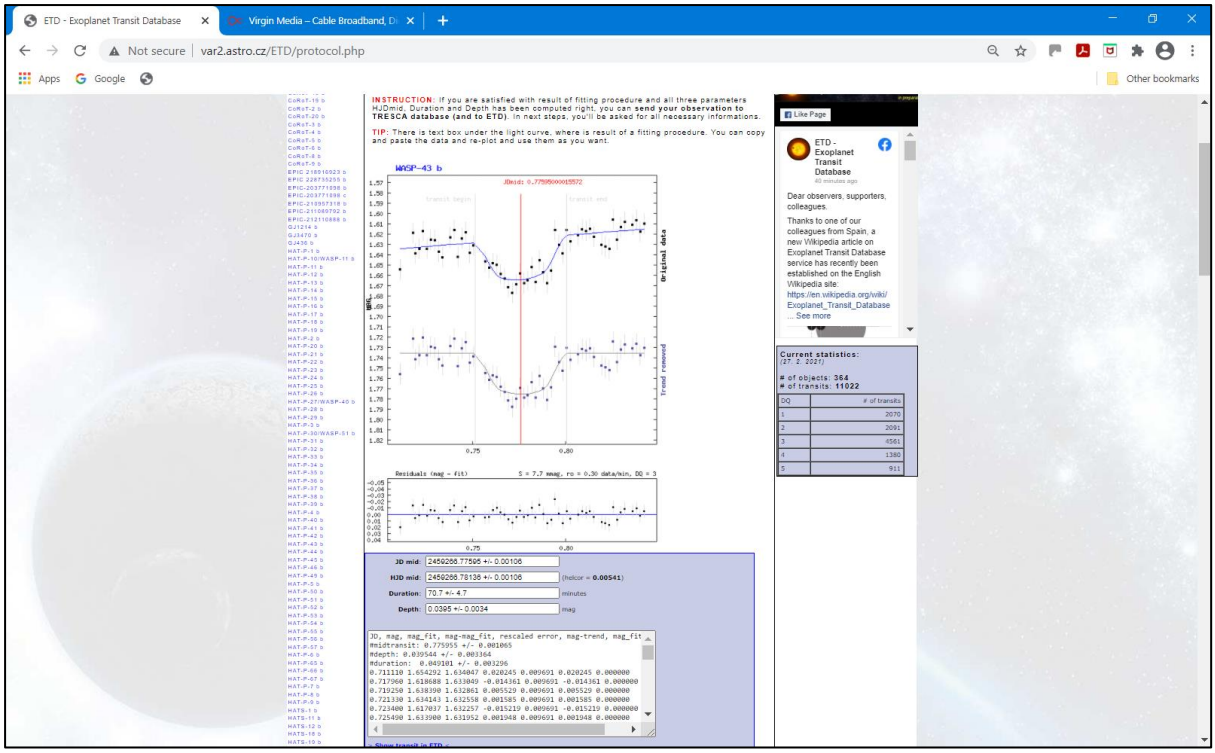


Figure C3.2.4. Step 3

If satisfied with the results select ‘Send protocol to TRESCA database>’ to go to Step 4 - Figure C3.2.5 (necessary information added)

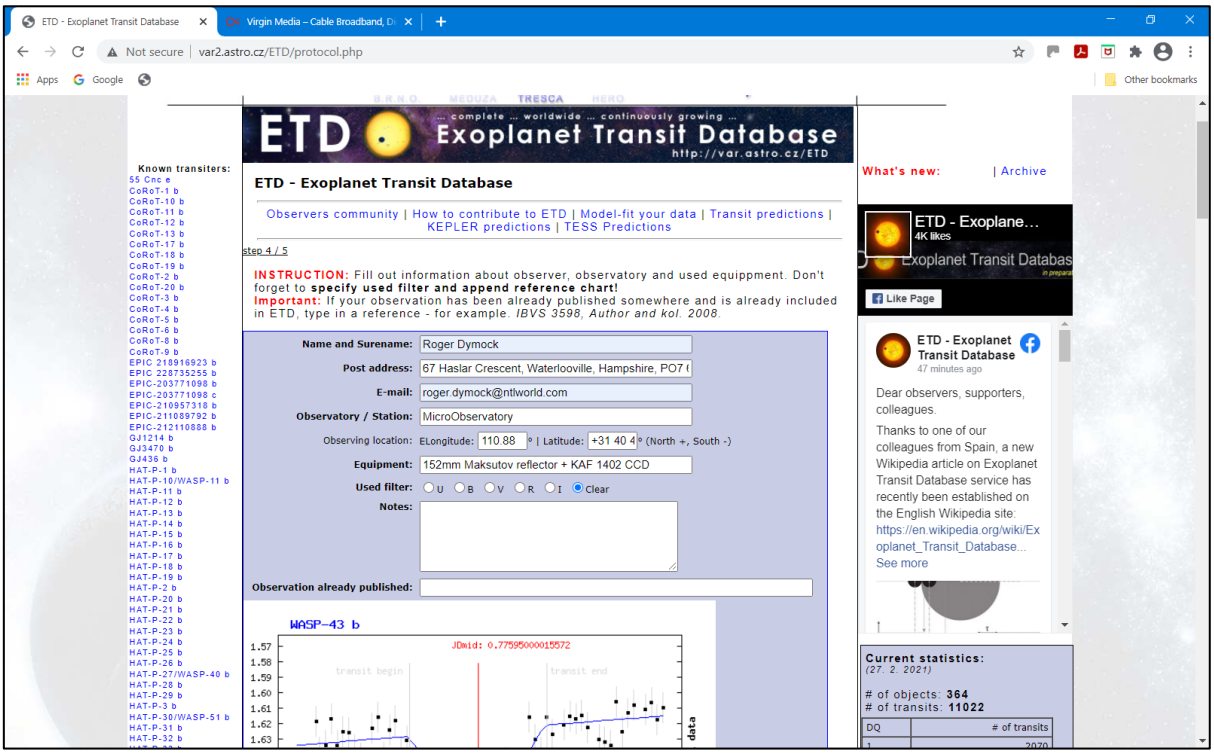


Figure C3.2.5. Step 4 – completed input

Deliberate mistake in this screen shot of which I was advised later in the process. Longitude and Latitude must be input to the nearest degree – minute and seconds not required,

The image of your FOV is added in this step – ‘Append map/reference CCD frame’. Having done so select ‘! SAVE PROTOCOL! To complete your input - Figure C3.2.6.

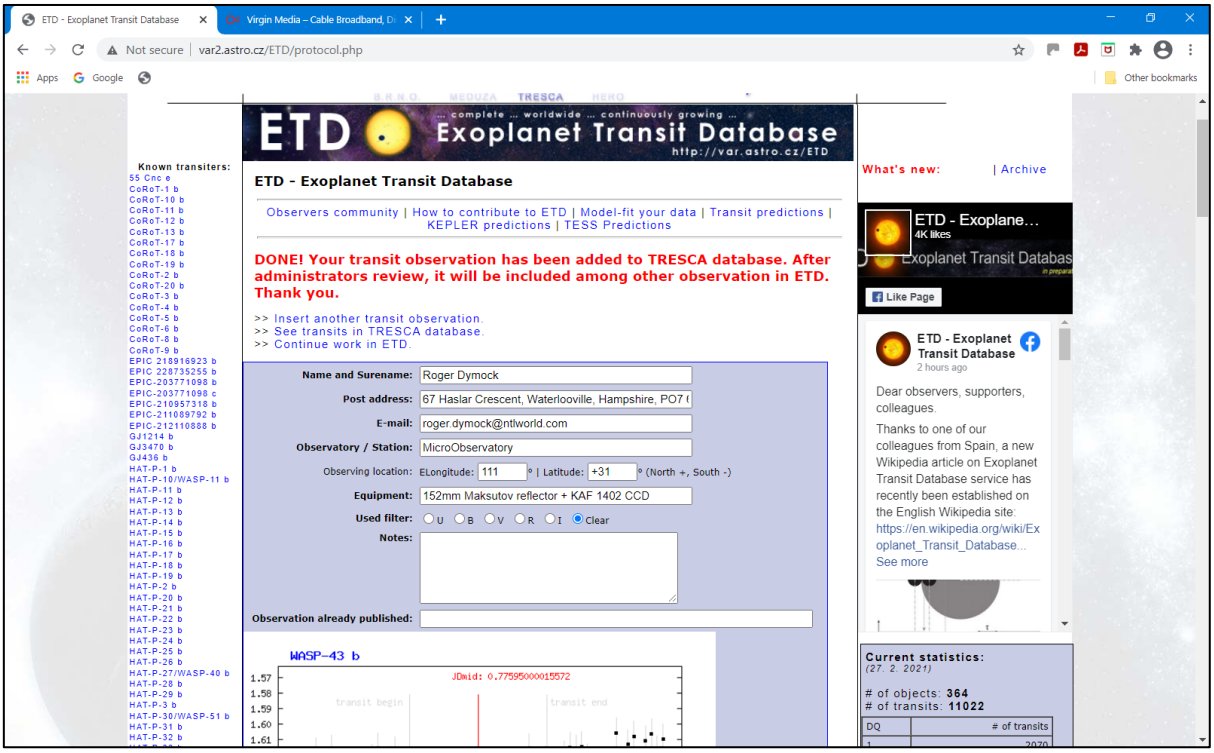


Figure C3.2.6. Input complete.

The observation then appears in the [TRESCA database] under ‘New transits in TRESCA’. Selecting your observation displays the screen shown in Figures C3.2.7/8/9/10.

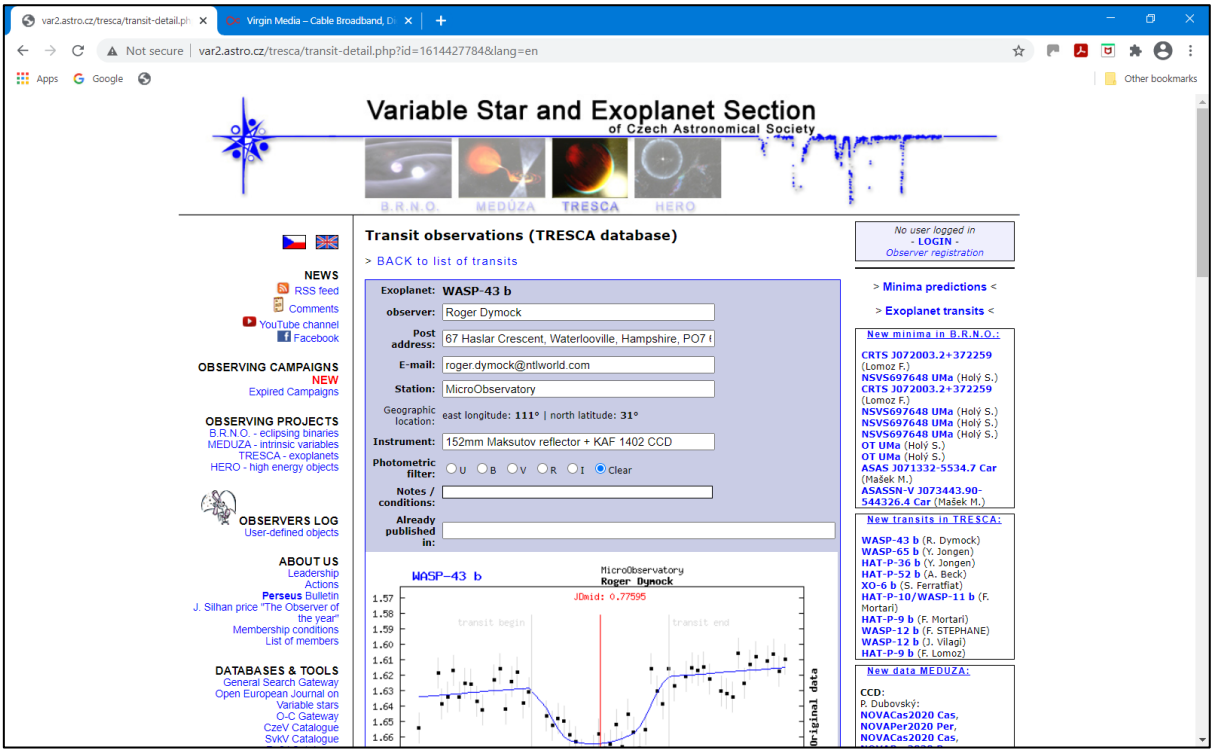


Figure C3.2.7. Data held in TRESCA database

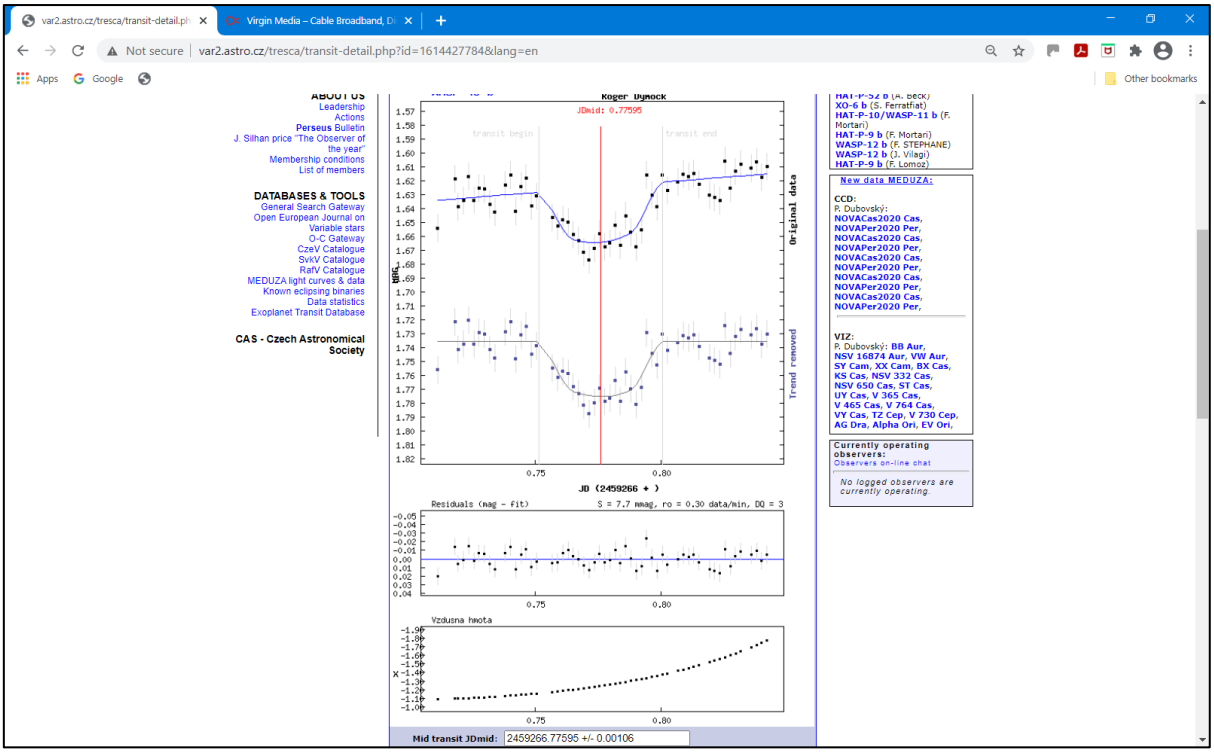


Figure C3.2.8. Data held in TRESCA database

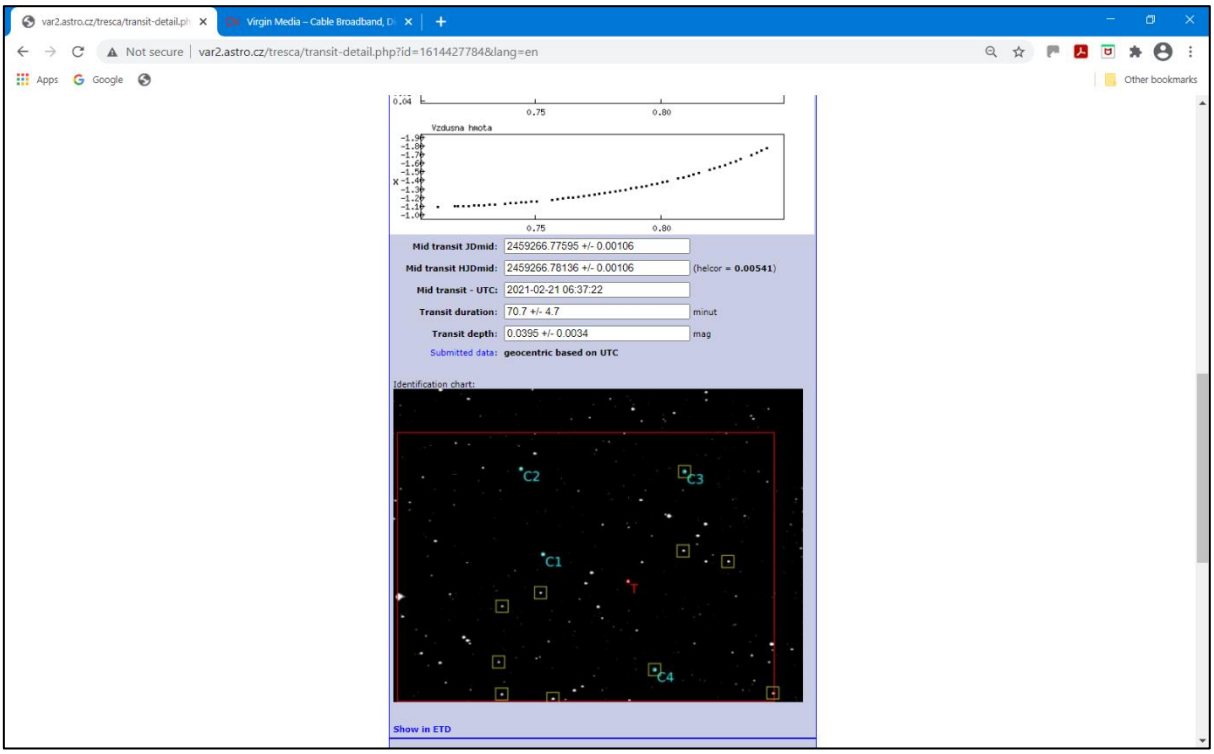


Figure C3.2.9. Data held in TRESCA database

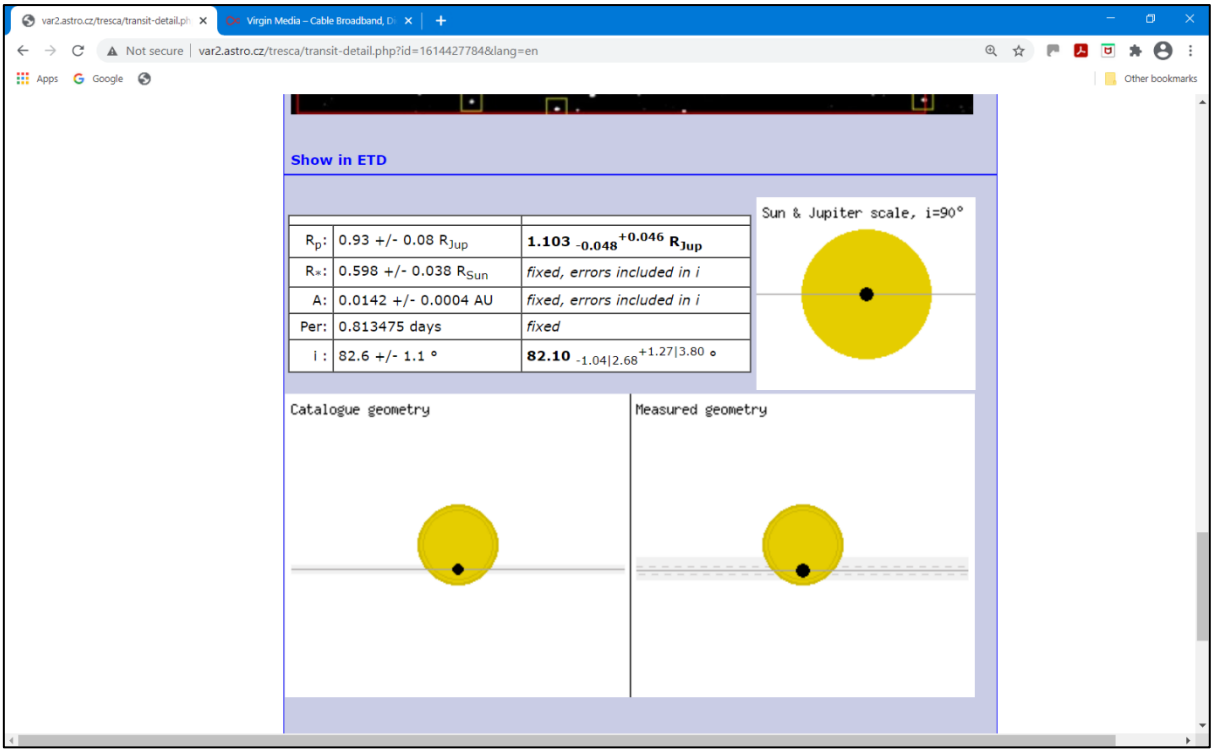


Figure C3.2.10. Data held in TRESCA database

After review your observation will appear in the ETD database.

Roger Dymock
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2020 July 14