

14900 - Confirming the Presence of an Hydrogen Exosphere around the Earth-sized Temperate Planet TRAPPIST-1c

Cycle: 24, Proposal Category: GO/DD (Availability Mode: AVAILABLE)

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VISITS

Propo	sal 14900 (STScl Edit Number: 2, 0	Created: Tuesday, December 13, 20	16 9:13:08	PM EST) - Overview	
Visit	Targets used in Visit	Configurations used in Visit	Orbits Used	Last Orbit Planner Run	OP Current with Visit
01	(2) 2MASS-J23062928-0502285- COPY WAVE	STIS/CCD STIS/FUV-MAMA	5	13-Dec-2016 21:13:06.0	yes

5 Total Orbits Used

ABSTRACT

We have recently completed reconnaissance studies of the TRAPPIST-1 system with the Spitzer and Hubble Space Telescopes. Owing to a 20-d long follow-up with Spitzer, we have now constrained the system architecture up to the ice line. Thanks to 4 non-consecutive HST/STIS orbits, we have determined the potential for further studies of the system in the UV--notably to search for hydrogen exospheres--and characterized the UV environment of TRAPPIST-1's planets, which is an essential contributing factor to their potential habitability. These reconnaissance studies with the synergetic Great Observatories emphasize the system uniqueness for Earth-sized comparative planetology and for the search for extrasolar habitats.

We request here 5 consecutive HST/STIS orbits to build upon our UV exploratory program and confirm the presence of an extended exosphere exosphere around TRAPPIST-1~c. These observations will inform us on its volatile reservoir while complementing the insights gained with HST/WFC3 (GOs 14500 and 14873). Our request for immediate HST/STIS followup will fulfill the urgent need to inform the community about TRAPPIST-1 planets in order to guide their follow-up, notably in the context of the upcoming JWST Cycle 1 proposal.

OBSERVING DESCRIPTION

We propose to observe the transits of TRAPPIST-1's planets with WFC3 on Dec.4, Dec. 29, and Jan. 10 to obtain their tansmission spectra and assess the presence of extended atmospheres.

Proposal 14900 - Visit 01 - Confirming the Presence of an Hydrogen Exosphere around the Earth-sized Temperate Planet TRAPPIST-...

	Proposal 14900, Visit 01, implementation Wed Dec 14 02:13:08 GMT 2016						
si	Diagnostic Status: No Diagnostics						
Ξ	Scientific Instruments: STIS/CCD, STIS/FUV-MAMA						
	Special Rec	quirements: BETWEEN 25-	DEC-2016:03:00:00 AND 25-DEC-2016:11:00:	00			
	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	
	(2)	2MASS-J23062928-	RA: 23 06 30.3400 (346.6264167d)	Proper Motion RA: 922.1 mas/yr	V=18.798+/-0.082	Reference Frame: ICRS	
S		0502285-COPY	Dec: -05 02 36.44 (-5.04346d)	Proper Motion Dec: -471.9 mas/yr	V=18.80+-0.08,		
jet		Alt Name1: TRAPPIST-1	Equinox: J2000	Parallax: 0.08258"	R=16.47+-0.07,		
arc				Epoch of Position: 2015.86	I=14.0+-0.1,		
				Radial Velocity: -51.688 km/sec	J=11.35+-0.02,		
ĕ					K=10.30+-0.02		
Ę	Comments: We measured the J2000 equatorial coordinates of TRAPPIST-1 in the 2015 TRAPPIST images, using 29 stars from the UCAC2 catalog and the Pulkovo Observatory Izmccd astrometric software (we use the mean epoch of these observations secured between September and December 2015). We adopt uncertainties on RA and Dec as those for 2MASS for this object. We checked that the input coordinates and those given in SIMBAD at Epoch 2000 yield the same position in the APT target confirmation chart at Epoch 1991.68. We also checked independently that these coordinates and proper motion match with the position of the star in POSS image (1953) and 2MASS image (1998). Radial velocity comes from Barnes et al. 2014						

Proposal 14900 - Visit 01 - Confirming the Presence of an Hydrogen Exosphere around the Earth-sized Temperate Planet TRAPPIST-Label Target Config,Mode,Aperture Spectral Els. **Opt. Params.** Special Regs. Groups Exp. Time (Total)/[Actual Dur.] Orbit (ETC Run) ACO (2) 2MASS-J230629 STIS/CCD, ACQ, F28X50LP MIRROR Sequence 1-4 Non-In 5 Secs (5 Secs) (STIS.ta.781 28-0502285-COPY t in Visit 01 l = = > l[1] 643) Comments: We use the F28X50LP filter for this ACO image, as recommended for this star with V magnitude of 18.8. It also ensures the brightness is weighted most strongly toward red wavelengths, where the target s. ar is brightest. We estimated the exposure time for several stellar models close to the target star (STIS.ta.781640, STIS.ta.781641, STIS.ta.781643). Exposure times to reach a SNR of 40 range from 1.5 to 3.6s, and min imum saturation time is 290s. We thus choose an exposure time of 5s. We used Aladin to check that the closest star is at a distance of more than 220 arcsec. There is thus no chance that STIS acquires another object in the 5x5 arcsec search area. ACO/PEAK (2) 2MASS-J230629 STIS/CCD, ACO/PEAK, MIRROR Sequence 1-4 Non-In 10 Secs (10 Secs) (STIS.ta.783 28-0502285-COPY 52X0.05D1 t in Visit 01 [==>] [1] 365) Comments: The ETC lists a time to saturation through the 52X0.05 slit of 1086s (for a black body model with the same temperature as the star). With our 10s exposure, we should reach 5600 source electrons, above the e 5000 required for peak-up with the mirror element. SCIENCE (2) 2MASS-J230629 STIS/FUV-MAMA, TIME-TAG, G140M BUFFER-TIME=90 Sequence 1-4 Non-In 1945 Secs (1945 Secs) (STIS.sp.41 28-0502285-COPY 52X0.05D1 t in Visit 01 0: 1222 A [==>] 5432) [1] WAVECAL=NO *Comments: Following the same observational strategy as GO14493 for this target.* STIS/FUV-MAMA, ACCUM, GO-WAVE WAVE G140M Sequence 1-4 Non-In l = = > lCAL 52X0.05 t in Visit 01 [1] 1222 A ACO (2) 2MASS-J230629 STIS/CCD, ACQ, F28X50LP MIRROR Sequence 5-8 Non-In 5 Secs (5 Secs) (STIS.ta.781 28-0502285-COPY t in Visit 01 l = = > l[2] 643) Comments: We use the F28X50LP filter for this ACO image, as recommended for this star with V magnitude of 18.8. It also ensures the brightness is weighted most strongly toward red wavelengths, where the target s. ar is brightest. We estimated the exposure time for several stellar models close to the target star (STIS.ta.781640, STIS.ta.781641, STIS.ta.781643). Exposure times to reach a SNR of 40 range from 1.5 to 3.6s, and min imum saturation time is 290s. We thus choose an exposure time of 5s. Exposur We used Aladin to check that the closest star is at a distance of more than 220 arcsec. There is thus no chance that STIS acquires another object in the 5x5 arcsec search area. ACO/PEAK (2) 2MASS-J230629 STIS/CCD, ACO/PEAK, MIRROR Sequence 5-8 Non-In 10 Secs (10 Secs) (STIS.ta.783 28-0502285-COPY 52X0.05D1 t in Visit 01 [==>] [2] 365) Comments: The ETC lists a time to saturation through the 52X0.05 slit of 1086s (for a black body model with the same temperature as the star). With our 10s exposure, we should reach 5600 source electrons, above the e 5000 required for peak-up with the mirror element. SCIENCE (2) 2MASS-J230629 STIS/FUV-MAMA, TIME-TAG, G140M BUFFER-TIME=90 Sequence 5-8 Non-In 1888 Secs (1888 Secs) (STIS.sp.41 28-0502285-COPY 52X0.05D1 0: t in Visit 01 1222 A [==>] 5432) [2] WAVECAL=NO *Comments: Following the same observational strategy as GO14493 for this target.* GO-WAVE WAVE STIS/FUV-MAMA, ACCUM, G140M Sequence 5-8 Non-In l = = > lCAL 52X0.05 t in Visit 01 [2] 1222 A (2) 2MASS-J230629 STIS/CCD, ACQ, F28X50LP MIRROR Sequence 9-12 Non-I 5 Secs (5 Secs) 9 ACQ (STIS.ta.781 28-0502285-COPY nt in Visit 01 l = = > l[3] 643) Comments: We use the F28X50LP filter for this ACQ image, as recommended for this star with V magnitude of 18.8. It also ensures the brightness is weighted most strongly toward red wavelengths, where the target s. ar is brightest. We estimated the exposure time for several stellar models close to the target star (STIS.ta.781640, STIS.ta.781641, STIS.ta.781643). Exposure times to reach a SNR of 40 range from 1.5 to 3.6s, and min imum saturation time is 290s. We thus choose an exposure time of 5s. We used Aladin to check that the closest star is at a distance of more than 220 arcsec. There is thus no chance that STIS acquires another object in the 5x5 arcsec search area. ACO/PEAK (2) 2MASS-J230629 STIS/CCD, ACO/PEAK, 10 MIRROR Sequence 9-12 Non-I 10 Secs (10 Secs) (STIS.ta.783 28-0502285-COPY 52X0.05D1 nt in Visit 01 [==>] [3] 365) Comments: The ETC lists a time to saturation through the 52X0.05 slit of 1086s (for a black body model with the same temperature as the star). With our 10s exposure, we should reach 5600 source electrons, above the e 5000 required for peak-up with the mirror element. 11 SCIENCE (2) 2MASS-J230629 STIS/FUV-MAMA, TIME-TAG, G140M BUFFER-TIME=90 Sequence 9-12 Non-I 1888 Secs (1888 Secs) (STIS.sp.41 28-0502285-COPY 52X0.05D1 nt in Visit 01 0: 1222 A [==>] 5432) [3] WAVECAL=NO Comments: Following the same observational strategy as GO14493 for this target.

12	COWAVE WAVE		STIS/ELIV MAMA ACCUM			Seguence 0, 12 Non I		_
	CAL	WAVE	52X0.05	1222 A		nt in Visit 01	[==>]	[3]
13	ACQ	(2) 2MASS-J230629	STIS/CCD, ACQ, F28X50LP	MIRROR		Sequence 13-16 Non	5 Secs (5 Secs)	
	(STIS.ta.781 643)	28-0502285-COPY				-Int in Visit 01	[==>]	[4]
Cor ar i mu We	nments: We use s brightest. We im saturation ti- used Aladin to	the F28X50LP filter f estimated the exposure ne is 290s. We thus ch check that the closest	or this ACQ image, as recommended e time for several stellar models close oose an exposure time of 5s. star is at a distance of more than 220	for this star with V to the target star (arcsec. There is th	magnitude of 18.8. It also ensures the b STIS.ta.781640, STIS.ta.781641, STIS.ta us no chance that STIS acquires another	rightness is weighted most stro 1.781643). Exposure times to re • object in the 5x5 arcsec searcl	ngly toward red wavelengths, where ach a SNR of 40 range from 1.5 to 3 1 area.	the targe .6s, and n
14	ACQ/PEAK	(2) 2MASS-J230629	STIS/CCD, ACQ/PEAK,	MIRROR		Sequence 13-16 Non	10 Secs (10 Secs)	
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		52X0.05D1	1222 A	0;	-Int in Visit 01	[==>]	[4]	
	5452)				WAVECAL=NO			[4]
Cor	nments: Follow	ing the same observati	ional strategy as GO14493 for this tar	rget.				
6	GO-WAVEWAVESTIS/FUV-MAMA, ACAL52X0.05	STIS/FUV-MAMA, ACCUM,	G140M		Sequence 13-16 Non	[==>]	[4]	
		5220.05	1222 A		-int in visit 01		[4]	
7	ACQ	(2) 2MASS-J230629	STIS/CCD, ACQ, F28X50LP	MIRROR		Sequence 17-20 Non	5 Secs (5 Secs)	
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	643)						[==>]	[5]
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Cor er i mu <u>Ve</u> 8	643) mments: We use is brightest. We m saturation th used Aladin to ACQ/PEAK (STIS.ta.783 365)	the F28X50LP filter f estimated the exposur ne is 290s. We thus ch check that the closest s (2) 2MASS-J230629 28-0502285-COPY	for this ACQ image, as recommended e time for several stellar models close oose an exposure time of 5s. star is at a distance of more than 220 STIS/CCD, ACQ/PEAK, 52X0.05D1	for this star with V to the target star (arcsec. There is th MIRROR	magnitude of 18.8. It also ensures the b STIS.ta.781640, STIS.ta.781641, STIS.ta us no chance that STIS acquires another	rightness is weighted most stro 1.781643). Exposure times to re 1. object in the 5x5 arcsec search Sequence 17-20 Non -Int in Visit 01	<pre>[1==>] ngly toward red wavelengths, where ach a SNR of 40 range from 1.5 to 3 n area. 10 Secs (10 Secs) [==>]</pre>	[5] the target .6s, and m [5]
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