



15694 - UV reconnaissance of the evaporating super-Neptune WASP-107b

Cycle: 26, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) WASP-107 WAVE	STIS/CCD STIS/FUV-MAMA	1	12-Apr-2019 19:58:40.0	yes
02	(1) WASP-107 WAVE	STIS/CCD STIS/FUV-MAMA	1	12-Apr-2019 19:58:41.0	yes

2 Total Orbits Used

ABSTRACT

The population of close-in exoplanets features a desert of hot Neptunes thought to have lost their atmosphere under strong stellar irradiation. Direct observations of extended atmospheres and mass loss are essential to constrain this scenario. Exoplanets surviving at the border of the desert are ideal

targets to determine the conditions that lead from stable atmospheres to dramatic mass loss. Recently, the near-infrared helium triplet (10833 Å) was revealed as a probe of extended thermospheres, complementing traditional observations of the exosphere at UV wavelengths. Combining the two tracers for the same exoplanet would bring much more detailed information about its upper atmospheric structure and better constrain its mass loss. Here we propose a reconnaissance program of WASP-107b with HST/STIS in the Lyman-alpha line. The first exoplanet where helium was detected, this warm super-Neptune stands at the border of the desert and at the transition between stable Jupiter-mass planets and hot Neptunes that fully lost their atmosphere. The age and UV emission of WASP-107, as well as the interstellar medium density toward this star, are uncertain. Two HST orbits scheduled out- and in- of the transit will allow us to determine if a) the stellar Lyman-alpha line is measurable, and b) the giant neutral hydrogen exosphere expected to surround the planet is detectable. A mid-cycle program is the perfect opportunity to justify the investment required to fully characterize WASP-107b in the UV, and to best plan the use of HST UV capabilities in next cycles.

OBSERVING DESCRIPTION

We will use the two allocated HST orbits to observe the star WASP-107, which hosts a transiting exoplanet WASP-107b. Observations will make use of the STIS/FUV-MAMA and the G140M grism centered on a wavelength of 1222 Å to observe the Ly-alpha line.

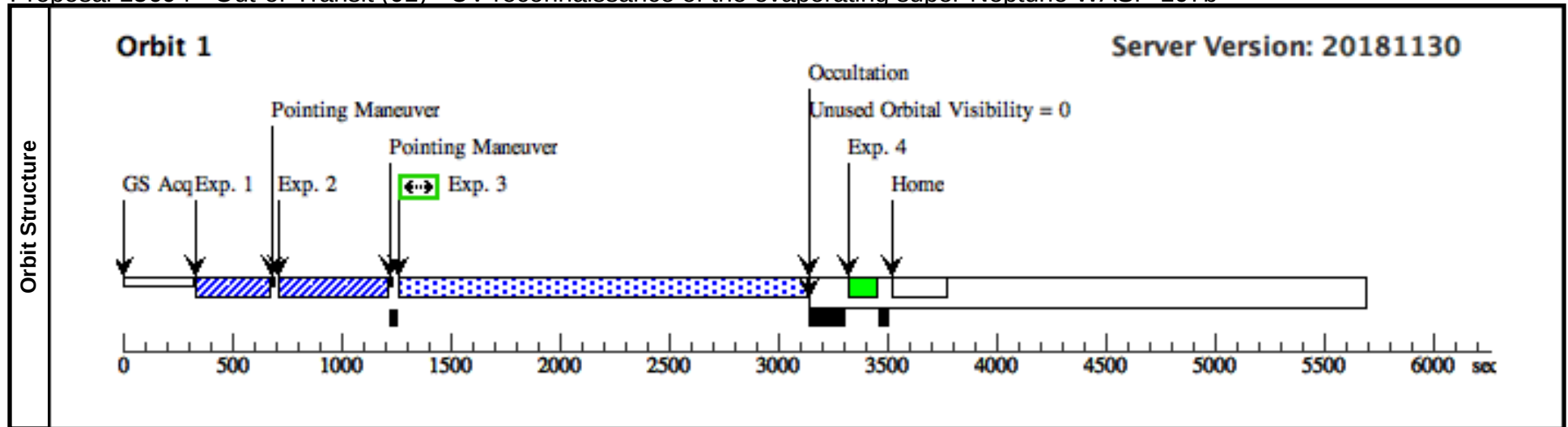
- Visit #01: One HST orbit will be performed before the transit of WASP-107b (when its orbital phase is within 0.5 to 0.85), to try and measure the intrinsic stellar line while avoiding potential absorption by a hydrogen trail trailing the planet (which would occult the star after the planet transit).
- Visit #02: One HST orbit will be performed during the planet transit, when absorption by the putative exosphere of neutral hydrogen is expected to be maximal. The comparison between the out- and in-transit HST exposures will allow detecting the signature of the exosphere if the Ly-alpha line is bright enough.

We would like the two visits to be scheduled as close as possible from one another, ideally within one orbital period of the planet (5.7 days). We defined visits constraints accordingly. If this constraint makes the visits too difficult to schedule, we will relax them.

As in past programs from our team (GO#13820 and #12681, PI: D. Ehrenreich; GO#14143, PI: V. Bourrier) we moved the AUTO-WAVECAL to GO-WAVECAL during Earth occultation. The time gained for the scientific exposures would be very useful, in particular because the star is faint, and the ACQ-PEAK takes a relatively long time to perform.

Proposal 15694 - Out-of-Transit (01) - UV reconnaissance of the evaporating super-Neptune WASP-107b

Visit	Proposal 15694, Out-of-Transit (01), implementation						Fri Apr 12 23:58:42 GMT 2019			
	Diagnostic Status: No Diagnostics									
	Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: Period 5.721474 D AND ZERO-PHASE HJD2457584.329897; GROUP 01,02 WITHIN 6D Comments: This visit must be obtained far from the time of transit of planet WASP-107b, to provide a clean estimate of the baseline UV flux from the star. Experience from GJ436b (GO #12965) suggests that, in an extreme case, it might be possible for Ly-alpha to be absorbed from the phase of transit all the way to anti-transit. We thus request in the timing requirements that the planet is between orbital phases 0.5 to 0.85. We further request that Visit #02 is scheduled within 6 days (one orbital period of the planet) after Visit#01. This constraint can be relaxed if it makes the scheduling of the program too difficult.									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	WASP-107 Alt Name1: K2-235 Alt Name2: EPIC-228724232	RA: 12 33 32.8441 (188.3868504d) Dec: -10 08 46.22 (-10.14617d) Equinox: J2000	Proper Motion RA: -96.64679623568028 mas/yr Proper Motion Dec: -9.482605647713257 mas/yr Parallax: 0.015417519178256992" Epoch of Position: 2000 Radial Velocity: 13.74 km/sec	V=11.47 B 14.62, G 11.1740, J 9.378, H 8.777, K 8.637	Reference Frame: ICRS				
	Comments: All target properties come from the SIMBAD and GAIA databases. We used the confirmation charts to check that the coordinates and proper motion were correct. Category=STAR Description=[EXTRA-SOLAR PLANETARY SYSTEM]									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	ACQ (STIS.ta.134 8312)	(1) WASP-107	STIS/CCD, ACQ, F28X500II	MIRROR		PHASE 0.5 TO 0.85	Sequence 1-4 Non-Int in Out-of-Transit (0 1)	20 Secs (20 Secs) [==>]	[1]
	Comments: The target is too bright for the longpass filter, and the F28X500II was selected instead. Time to reach signal to noise ratio of 40 is estimated at 16s, with time to saturation 1660s. We set exposure time to 20s									
	2	ACQ/PEAK (STIS.ta.134 8315)	(1) WASP-107	STIS/CCD, ACQ/PEAK, 52X0.05D1	G430L 4300 A			Sequence 1-4 Non-Int in Out-of-Transit (0 1)	10 Secs (10 Secs) [==>]	[1]
	Comments: 10s allows to reach over S/N=43 with STIS/CCD/G430L at 4300 Angstroms, and is well below the time to saturation (325s). The Spectroscopic ETC yields a warning about the issue with charge transfer efficiency for low background, but we are just using the CCD for the target acquisition, after which we switch to the MAMA.									
	3	SCIENCE (STIS.sp.41 5446)	(1) WASP-107	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A	BUFFER-TIME=90 WAVECAL=NO		Sequence 1-4 Non-Int in Out-of-Transit (0 1)	1500 Secs (1722 Secs) [==>1722.0 Secs]	[1]
	Comments: We are basically photon-starved and set the exposure time to the maximum possible value. The star is later-type (K6) than the K0 stars HD189733 (see above ETC run) and HD97658, observed with the same settings in previous programs, and it is farther away and fainter. We thus expect lower count rates, and set the buffer-time as Texp/2.									
	4	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140M 1222 A			Sequence 1-4 Non-Int in Out-of-Transit (0 1)	[==>]	[1]



Proposal 15694 - In-Transit (02) - UV reconnaissance of the evaporating super-Neptune WASP-107b

Visit	Proposal 15694, In-Transit (02), implementation								Fri Apr 12 23:58:42 GMT 2019	
	Diagnostic Status: No Diagnostics									
	Scientific Instruments: STIS/CCD, STIS/FUV-MAMA									
	Special Requirements: Period 5.721474 D AND ZERO-PHASE HJD2457584.329897									
	Comments: This visit targets the transit of planet WASP-107b, and we indicate relevant lower/upper phase constraints in the ACQ subexposure.									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	WASP-107	RA: 12 33 32.8441 (188.3868504d)	Proper Motion RA: -96.64679623568028 mas/yr	V=11.47	Reference Frame: ICRS				
		Alt Name1: K2-235	Dec: -10 08 46.22 (-10.14617d)	Proper Motion Dec: -9.482605647713257 mas/yr	B 14.62,					
		Alt Name2: EPIC-228724232	Equinox: J2000	Parallax: 0.015417519178256992"	G 11.1740,					
				Epoch of Position: 2000	H 8.777,					
			Radial Velocity: 13.74 km/sec	K 8.637						
	Comments: All target properties come from the SIMBAD and GAIA databases. We used the confirmation charts to check that the coordinates and proper motion were correct.									
	Category=STAR									
	Description=[EXTRA-SOLAR PLANETARY SYSTEM]									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	ACQ (STIS.ta.134 8312)	(1) WASP-107	STIS/CCD, ACQ, F28X500II	MIRROR		PHASE 0.993 TO 0.002	Sequence 1-4 Non-Int in In-Transit (02)	20 Secs (20 Secs)	
									[==>]	[1]
	Comments: The target is too bright for the longpass filter, and the F28X500II was selected instead. Time to reach signal to noise ratio of 40 is estimated at 16s, with time to saturation 1660s. We set exposure time to 20s									
	2	ACQ/PEAK (STIS.ta.134 8315)	(1) WASP-107	STIS/CCD, ACQ/PEAK, 52X0.05D1	G430L 4300 A			Sequence 1-4 Non-Int in In-Transit (02)	10 Secs (10 Secs)	
									[==>]	[1]
	Comments: 10s allows to reach over S/N=43 with STIS/CCD/G430L at 4300 Angstroms, and is well below the time to saturation (325s). The Spectroscopic ETC yields a warning about the issue with charge transfer efficiency for low background, but we are just using the CCD for the target acquisition, after which we switch to the MAMA.									
3	SCIENCE (STIS.sp.41 5432)	(1) WASP-107	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A	BUFFER-TIME=900; WAVECAL=NO		Sequence 1-4 Non-Int in In-Transit (02)	1500 Secs (1722 Secs)		
								[==>1722.0 Secs]	[1]	
Comments: We are basically photon-starved and set the exposure time to the maximum possible value. The star is later-type (K6) than the K0 stars HD189733 (see above ETC run) and HD97658, observed with the same settings in previous programs, and it is farther away and fainter. We thus expect lower count rates, and set the buffer-time as Texp/2 for the orbits of all visits.										
4	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140M 1222 A			Sequence 1-4 Non-Int in In-Transit (02)	[==>]	[1]	

