



# 16779 - Lyman alpha absorption from the only mini Neptune with measured helium outflow

Cycle: 29, Proposal Category: GO  
(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) HD-73583 WAVE	STIS/CCD STIS/FUV-MAMA	5	09-Jul-2021 09:00:32.0	yes
02	(1) HD-73583 WAVE	STIS/CCD STIS/FUV-MAMA	5	09-Jul-2021 09:00:35.0	yes
03	(1) HD-73583 WAVE	STIS/CCD STIS/FUV-MAMA	5	09-Jul-2021 09:00:37.0	yes

15 Total Orbits Used

## ABSTRACT

TOI 560.01 is a mini Neptune orbiting a young (400-600 Myr) and nearby (32 pc) K star, the first and only mini Neptune with measured helium absorption from its photoevaporating atmosphere. We propose to observe three transits of the planet with STIS/G140M in order to measure Lyman alpha absorption from the outflow. Photoevaporation is especially interesting to probe in this regime because it predominantly occurs in the active

youth of a star's life, creating the "Fulton gap" in radius which divides super-Earths (1--1.8 REarth) from mini-Neptunes (2--3 REarth). These observations will allow us to measure the size, shape, and kinematic structure of the exosphere, constrain the mass loss rate, and evaluate the magnitude of any visit-to-visit variability in the outflow structure. The combination of Lyman alpha and He I 1083 nm observations will provide stringent constraints on hydrodynamical models. These two wavelengths provide complementary information: Ly alpha probes high-velocity hydrogen in the tenuous outer reaches of the exosphere, while helium probes low-velocity helium in the denser part of the exosphere, much closer to the planet surface. Finally, recent TESS observations indicate that there may be another transiting planet in the TOI 560 system on an exterior orbit, although it has not yet been confirmed. Multi-planet systems are ideal for studying mass loss because the two planets share the same high-energy irradiation history and similar formation histories, making comparative planetology possible.

### **OBSERVING DESCRIPTION**

Our program will observe 3 transits of HD 73583b. Each transit observation will consist of 5 consecutive orbits. Between 1 and 2 of these orbits are in-transit, depending on the exact phase of the start of observations. We set the phase requirements to  $\pm 0.5$  hours for two visits (Centrist 1/2), but set a much more stringent requirement for one visit (Hail Mary) to maximize the amount of in-transit observation time, at the cost of schedulability. We'll probably adjust the phase requirements as visits are completed to try to maximize the phase coverage. The ephemeris uncertainty is negligible, at less than 2 minutes.

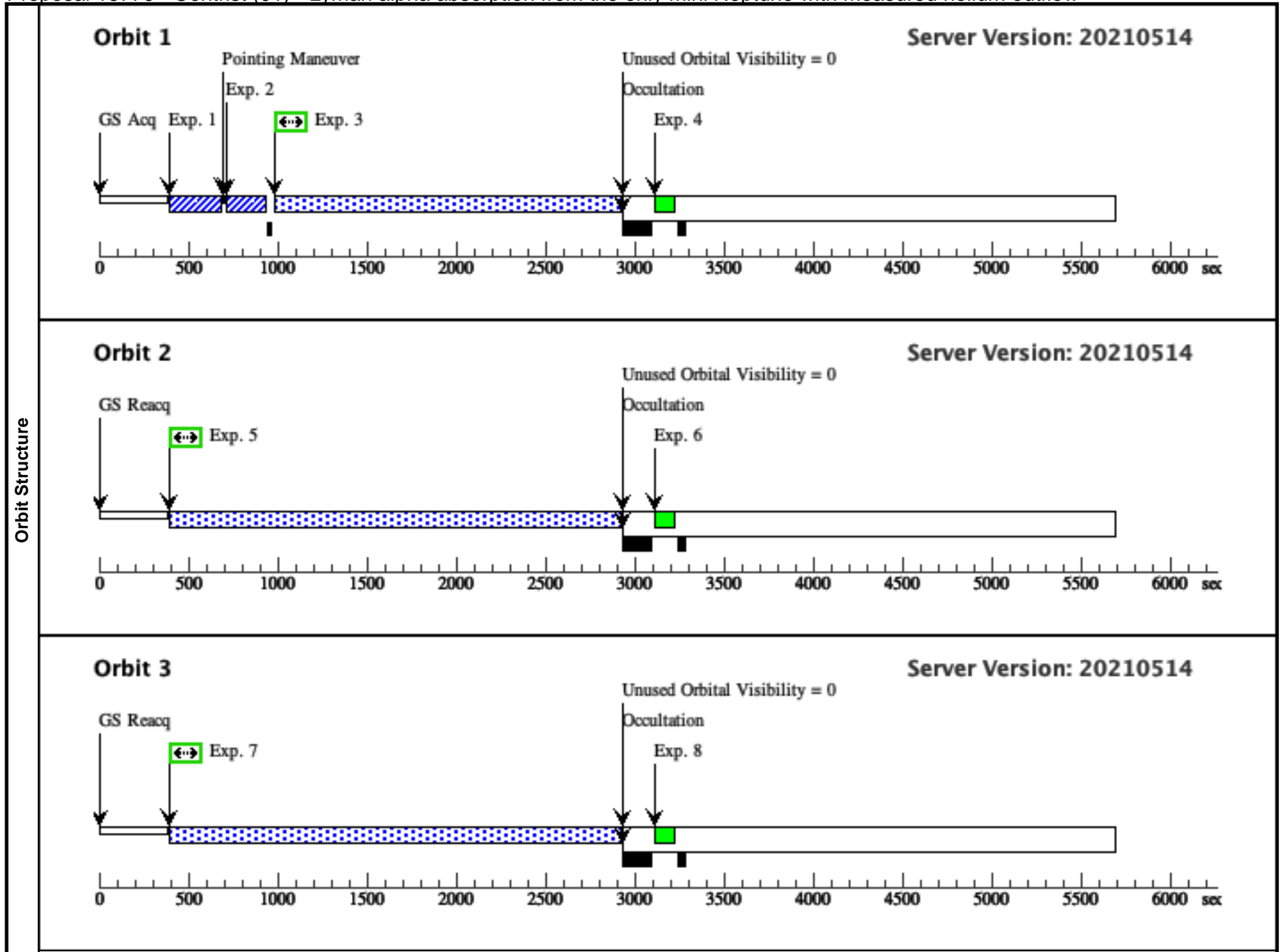
We planned our observations so that the first orbit of each visit has an ACQ and ACQ-PEAKUP exposure, followed by a science exposure and wavelength calibration. Subsequent orbits only have a science exposure and a wavelength calibration exposure, with no ACQ or ACQ-PEAKUP. Because the few minutes' difference in orbital visibility due to precession has minimal impact on our science, we change the schedulability parameter from 30 to 90 to make scheduling easier. If possible, we kindly ask the Program Coordinator to expand our science observations to fill up the entire orbital visibility for the orbits that are actually scheduled.

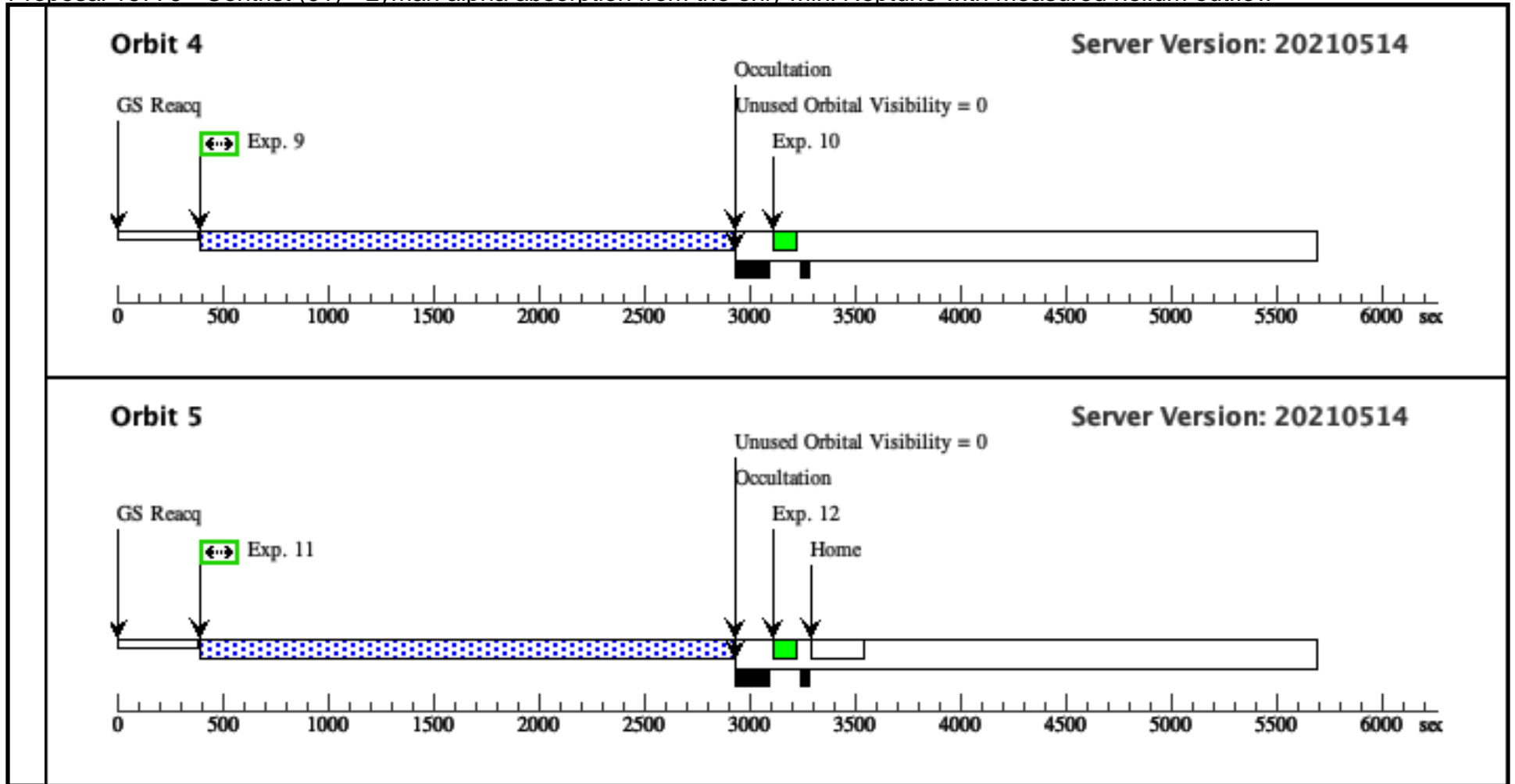
Reduced gyro mode impacts our program by limiting the number of scheduling opportunities. Otherwise, we do not foresee major impacts from RGM.

Proposal 16779 - Centrist (01) - Lyman alpha absorption from the only mini Neptune with measured helium outflow

Fri Jul 09 13:00:37 GMT 2021

Visit	Proposal 16779, Centrist (01)									
	Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: SCHED 90%; Period 6.39805423 D AND ZERO-PHASE HJD2458767.21461									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	HD-73583	RA: 08 38 45.1903 (129.6882929d) Dec: -13 15 23.48 (-13.25652d) Equinox: J2000	Proper Motion RA: -63.8 mas/yr Proper Motion Dec: 38.48 mas/yr Parallax: 0.03166" Epoch of Position: 2016	V=9.63	Reference Frame: ICRS				
Comments: The coordinates and proper motion were obtained from Gaia EDR3. Category=STAR Description=[EXTRA-SOLAR PLANET, EXTRA-SOLAR PLANETARY SYSTEM, K V-IV] Extended=NO										
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.152 2729)	(1) HD-73583	STIS/CCD, ACQ, F28X50OIII	MIRROR		PHASE 0.97370 TO 0.98021	Sequence 1-4 Non-Int in Centrist (01)	5 Secs (5 Secs) [==>]	[1]
	2	ACQ/PEAK (STIS.ta.152 2727)	(1) HD-73583	STIS/CCD, ACQ/PEAK, 52X0.1	MIRROR			Sequence 1-4 Non-Int in Centrist (01)	0.1 Secs (0.1 Secs) [==>]	[1]
	3	Science (STIS.sp.15 22731)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A		WAVECAL=NO; BUFFER-TIME=1500	Sequence 1-4 Non-Int in Centrist (01)	1802 Secs (1802 Secs) [==>]	[1]
	4	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 1-4 Non-Int in Centrist (01)	[==>]	[1]
	5	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A		WAVECAL=NO; BUFFER-TIME=1500	Sequence 5-6 Non-Int in Centrist (01)	2517 Secs (2517 Secs) [==>]	[2]
	6	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 5-6 Non-Int in Centrist (01)	[==>]	[2]
	7	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A		WAVECAL=NO; BUFFER-TIME=1500	Sequence 7-8 Non-Int in Centrist (01)	2517 Secs (2517 Secs) [==>]	[3]
	8	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 7-8 Non-Int in Centrist (01)	[==>]	[3]
	9	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A		WAVECAL=NO; BUFFER-TIME=1500	Sequence 9-10 Non-Int in Centrist (01)	2517 Secs (2517 Secs) [==>]	[4]
	10	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 9-10 Non-Int in Centrist (01)	[==>]	[4]
	11	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A		WAVECAL=NO; BUFFER-TIME=1500	Sequence 11-12 Non-Int in Centrist (01)	2517 Secs (2517 Secs) [==>]	[5]
12	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 11-12 Non-Int in Centrist (01)	[==>]	[5]	

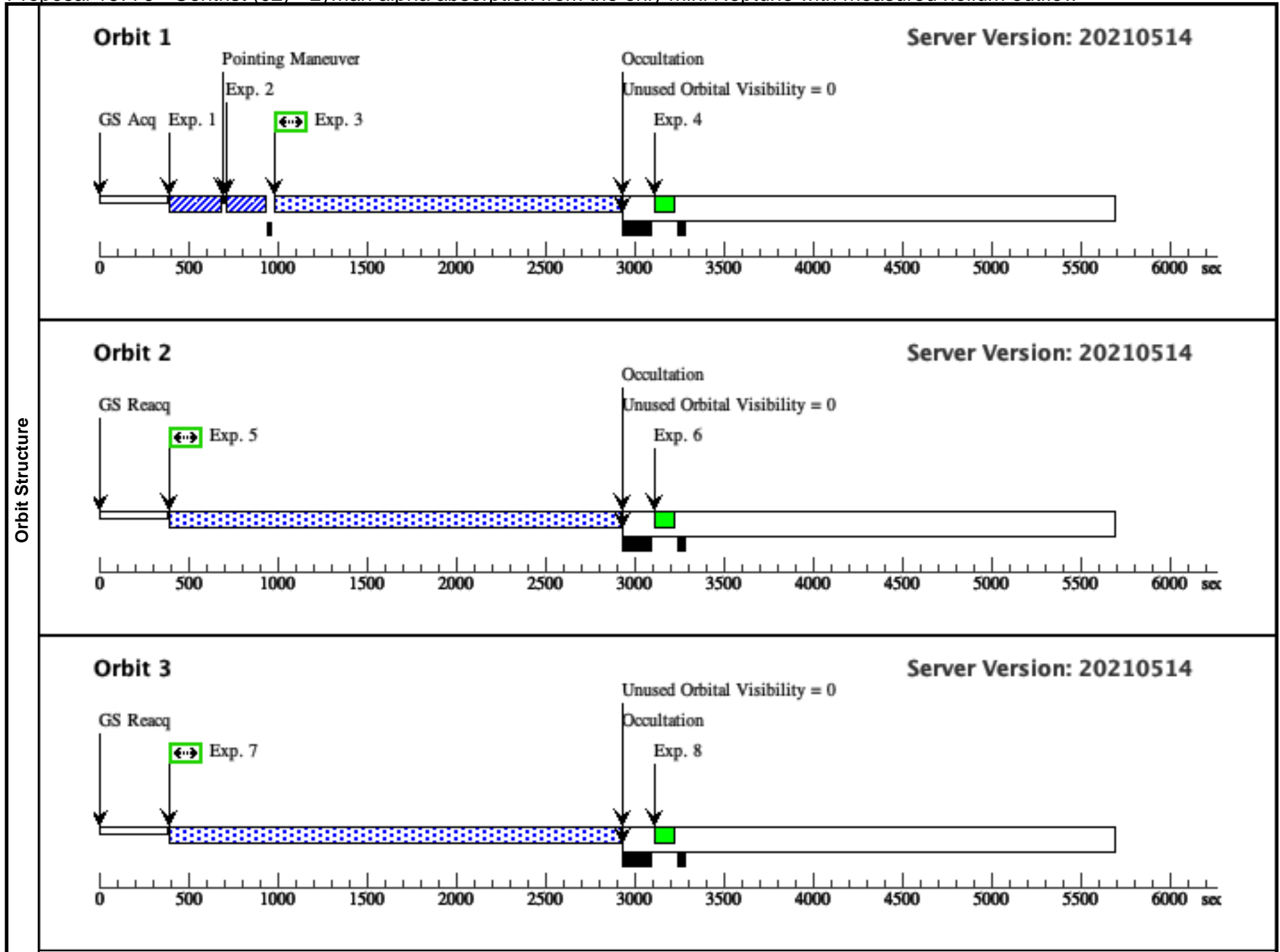


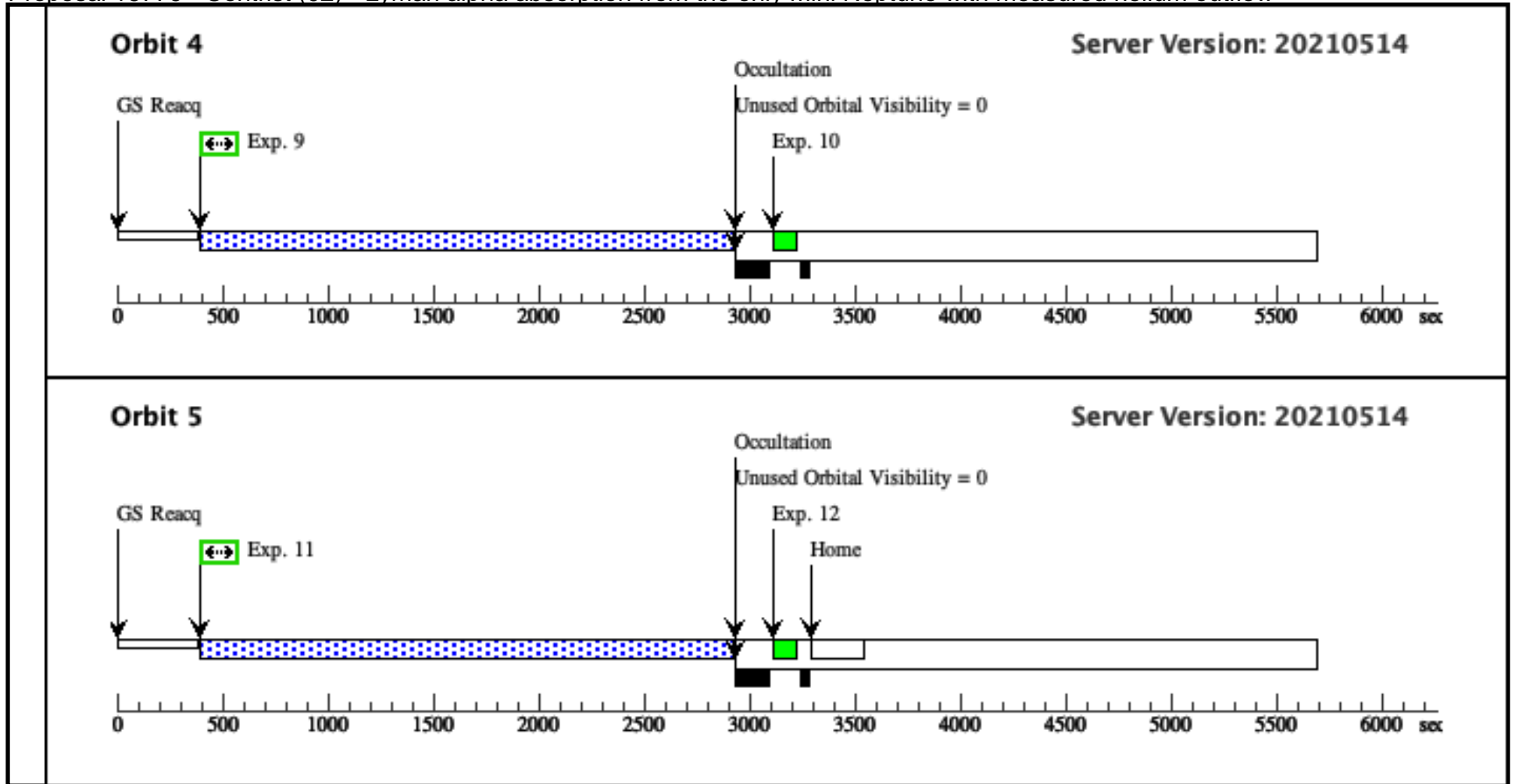


Proposal 16779 - Centrist (02) - Lyman alpha absorption from the only mini Neptune with measured helium outflow

Fri Jul 09 13:00:38 GMT 2021

Visit	<b>Proposal 16779, Centrist (02)</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: SCHED 90%; Period 6.39805423 D AND ZERO-PHASE HJD2458767.21461									
	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
Fixed Targets	(1)	HD-73583	RA: 08 38 45.1903 (129.6882929d) Dec: -13 15 23.48 (-13.25652d) Equinox: J2000	Proper Motion RA: -63.8 mas/yr Proper Motion Dec: 38.48 mas/yr Parallax: 0.03166" Epoch of Position: 2016	V=9.63	Reference Frame: ICRS				
	Comments: The coordinates and proper motion were obtained from Gaia EDR3. Category=STAR Description=[EXTRA-SOLAR PLANET, EXTRA-SOLAR PLANETARY SYSTEM, K V-IV] Extended=NO									
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.152 2729)	(1) HD-73583	STIS/CCD, ACQ, F28X50OIII	MIRROR		PHASE 0.97370 TO 0.98021	Sequence 1-4 Non-Int in Centrist (02)	5 Secs (5 Secs) [==>]	[1]
	2	ACQ/PEAK (STIS.ta.152 2727)	(1) HD-73583	STIS/CCD, ACQ/PEAK, 52X0.1	MIRROR			Sequence 1-4 Non-Int in Centrist (02)	0.1 Secs (0.1 Secs) [==>]	[1]
	3	Science (STIS.sp.15 22731)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	WAVECAL=NO; BUFFER-TIME=1500		Sequence 1-4 Non-Int in Centrist (02)	1802 Secs (1802 Secs) [==>]	[1]
	4	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 1-4 Non-Int in Centrist (02)	[==>]	[1]
	5	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	WAVECAL=NO; BUFFER-TIME=1500		Sequence 5-6 Non-Int in Centrist (02)	2517 Secs (2517 Secs) [==>]	[2]
	6	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 5-6 Non-Int in Centrist (02)	[==>]	[2]
	7	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	WAVECAL=NO; BUFFER-TIME=1500		Sequence 7-8 Non-Int in Centrist (02)	2517 Secs (2517 Secs) [==>]	[3]
	8	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 7-8 Non-Int in Centrist (02)	[==>]	[3]
	9	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	WAVECAL=NO; BUFFER-TIME=1500		Sequence 9-10 Non-Int in Centrist (02)	2517 Secs (2517 Secs) [==>]	[4]
	10	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 9-10 Non-Int in Centrist (02)	[==>]	[4]
	11	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	WAVECAL=NO; BUFFER-TIME=1500		Sequence 11-12 Non-Int in Centrist (02)	2517 Secs (2517 Secs) [==>]	[5]
12	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 11-12 Non-Int in Centrist (02)	[==>]	[5]	





Proposal 16779 - Hail Mary (03) - Lyman alpha absorption from the only mini Neptune with measured helium outflow

Fri Jul 09 13:00:38 GMT 2021

Visit	Proposal 16779, Hail Mary (03)									
	Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: SCHED 90%; Period 6.39805423 D AND ZERO-PHASE HJD2458767.21461									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	HD-73583	RA: 08 38 45.1903 (129.6882929d) Dec: -13 15 23.48 (-13.25652d) Equinox: J2000	Proper Motion RA: -63.8 mas/yr Proper Motion Dec: 38.48 mas/yr Parallax: 0.03166" Epoch of Position: 2016	V=9.63	Reference Frame: ICRS				
Comments: The coordinates and proper motion were obtained from Gaia EDR3. Category=STAR Description=[EXTRA-SOLAR PLANET, EXTRA-SOLAR PLANETARY SYSTEM, K V-IV] Extended=NO										
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.152 2729)	(1) HD-73583	STIS/CCD, ACQ, F28X50OIII	MIRROR		PHASE 0.97382 TO 0.98032	Sequence 1-4 Non-Int in Hail Mary (03)	5 Secs (5 Secs) [==>]	[1]
	2	ACQ/PEAK (STIS.ta.152 2727)	(1) HD-73583	STIS/CCD, ACQ/PEAK, 52X0.1	MIRROR			Sequence 1-4 Non-Int in Hail Mary (03)	0.1 Secs (0.1 Secs) [==>]	[1]
	3	Science (STIS.sp.15 22731)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	WAVECAL=NO; BUFFER-TIME=1500		Sequence 1-4 Non-Int in Hail Mary (03)	1802 Secs (1802 Secs) [==>]	[1]
	4	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 1-4 Non-Int in Hail Mary (03)	[==>]	[1]
	5	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	WAVECAL=NO; BUFFER-TIME=1500		Sequence 5-6 Non-Int in Hail Mary (03)	2517 Secs (2517 Secs) [==>]	[2]
	6	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 5-6 Non-Int in Hail Mary (03)	[==>]	[2]
	7	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	WAVECAL=NO; BUFFER-TIME=1500		Sequence 7-8 Non-Int in Hail Mary (03)	2517 Secs (2517 Secs) [==>]	[3]
	8	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 7-8 Non-Int in Hail Mary (03)	[==>]	[3]
	9	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	WAVECAL=NO; BUFFER-TIME=1500		Sequence 9-10 Non-Int in Hail Mary (03)	2517 Secs (2517 Secs) [==>]	[4]
	10	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 9-10 Non-Int in Hail Mary (03)	[==>]	[4]
	11	Science (STIS.sp.15 22732)	(1) HD-73583	STIS/FUV-MAMA, TIME-TAG, 52X0.1	G140M 1222 A	WAVECAL=NO; BUFFER-TIME=1500		Sequence 11-12 Non-Int in Hail Mary (03)	2517 Secs (2517 Secs) [==>]	[5]
12	WAVECAL WAVE		STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 11-12 Non-Int in Hail Mary (03)	[==>]	[5]	

