



16723 - Resolving the dichotomy of atmospheric escape in the young planet DS Tuc

A b

Cycle: 29, 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) HD-222259 WAVE	STIS/CCD STIS/FUV-MAMA	5	10-Aug-2022 18:00:19.0	yes
02	(1) HD-222259 WAVE	STIS/CCD STIS/FUV-MAMA	5	10-Aug-2022 18:00:22.0	yes
52	(1) HD-222259 WAVE	STIS/CCD STIS/FUV-MAMA	5	10-Aug-2022 18:00:25.0	yes

15 Total Orbits Used

ABSTRACT

One of the biggest aims in exoplanet science is to understand how planets and their atmospheres evolve. Among the several challenges faced while inching towards this goal is the severe lack of observational constraints on the high-energy environments of young exoplanets and their early history of atmospheric escape. In particular, we do not know how well Neptune-sized and smaller planets can survive atmospheric erosion during the first billion years and retain their primary atmospheres. In this context, the recently discovered planet DS Tuc A b (45 Myr) is the best target to study atmospheric escape in the first 100 Myr in the life of a Neptune-sized exoplanet, and is likely going to become a testbed to investigate the primordial chemistry of exoplanetary atmospheres with JWST. A previous transit observation with HST suggest that this planet is currently undergoing intense hydrodynamic escape, but the result is ambiguous due to insufficient phase coverage and potential stellar activity contamination. In this program, we aim to observe two more transits, which are necessary to confirm that the feature is not spurious and to study the shape of the planet's exosphere. Either a detection or a non-detection will be crucial to interpret the evolution of exoplanetary atmospheres of this young planet and other similar worlds.

OBSERVING DESCRIPTION

We will observe two transits of DS Tuc A b using HST/STIS with the G140M grating centered on 122.2 nm. Since DS Tuc is a binary (separation = 5 arcsec = 100 pixels), it is imperative to insert the correct star in the slit. In principle, it could be advantageous to set both stars in the slit to allow for differential spectroscopy, but that would introduce an ORIENT constraint, and this is not strictly necessary for the program. The target DS Tuc A is approximately 1 magnitude brighter than DS Tuc B at visible wavelengths, so the telescope should automatically center the correct target assuming everything goes well. There is also another bright star 3 arcmin east of the DS Tuc system. We will use the narrowest slit width (0.05") to minimize airglow contamination as much as possible. We understand that this choice can introduce slit losses, but we can correct for these losses when analyzing the data (on the other hand, the extra noise introduced by the airglow cannot be corrected).

The ACQ exposure is performed following the recommendations from the ETC. Our target star is very bright, so we always get warnings for the ACQ/PEAK when running it in the ETC. We decided to use the same ACQ/PEAK configuration as in program GO#16085, which also observed this target. We set the timing constraints in the SCIENCE exposure to match an observing window of 10 hours around the exoplanet transit midcenter (period = 8.138268 days), which roughly corresponds to 5 orbits and some "wiggle room" for flexibility; this timing constraint covers the transit and the baseline flux of the star in the most reliable, yet flexible way. In addition, in Visit 1 we also shift the phase constraints by -96 minutes (one HST

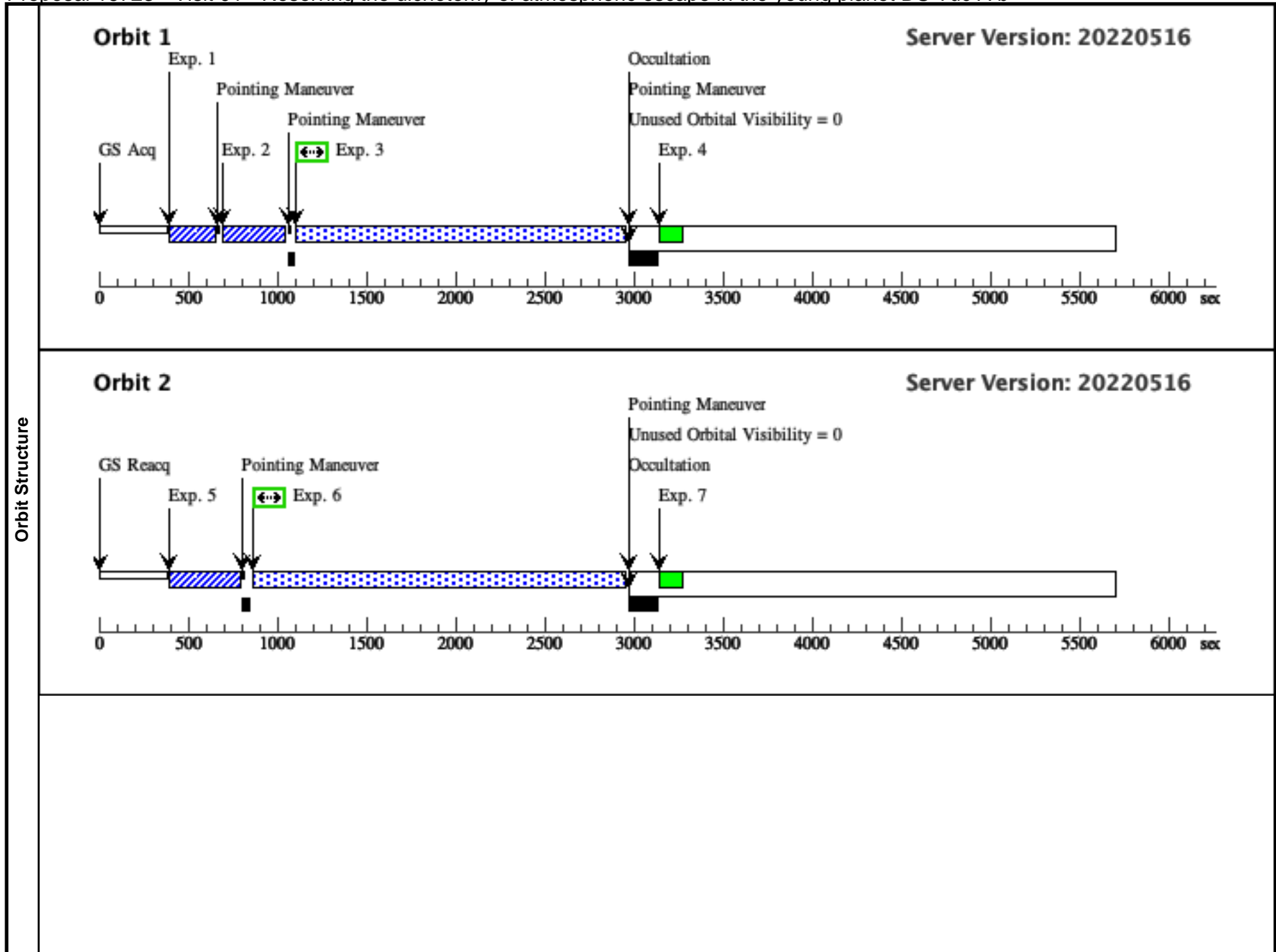
Proposal 16723 (STScI Edit Number: 1, Created: Wednesday, August 10, 2022 at 5:00:26 PM Eastern Standard Time) - Overview
orbit) in relation to program GO#16085 to provide a more extensive out-of-transit baseline; Visit 2 is shifted by +96 minutes. We set the
schedulability constraint to 100 in order to maximize observation opportunities.

Proposal 16723 - Visit 01 - Resolving the dichotomy of atmospheric escape in the young planet DS Tuc A b

Visit	Proposal 16723, Visit 01, scheduled Wed Aug 10 22:00:26 GMT 2022 Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: SCHED 100%; Period 8.138268 D AND ZERO-PHASE HJD2458332.30997					
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes
(1)		HD-222259 Alt Name1: DS-TUC-A	RA: 23 39 39.4804 (354.9145017d) Dec: -69 11 44.71 (-69.19575d) Equinox: J2000	Proper Motion RA: 79.30 mas/yr Proper Motion Dec: -67.62 mas/yr Epoch of Position: 2000	V=8.226	Reference Frame: ICRS
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=STAR Description=[EXTRA-SOLAR PLANETARY SYSTEM, G V-IV, RS CVN STAR] Extended=NO						

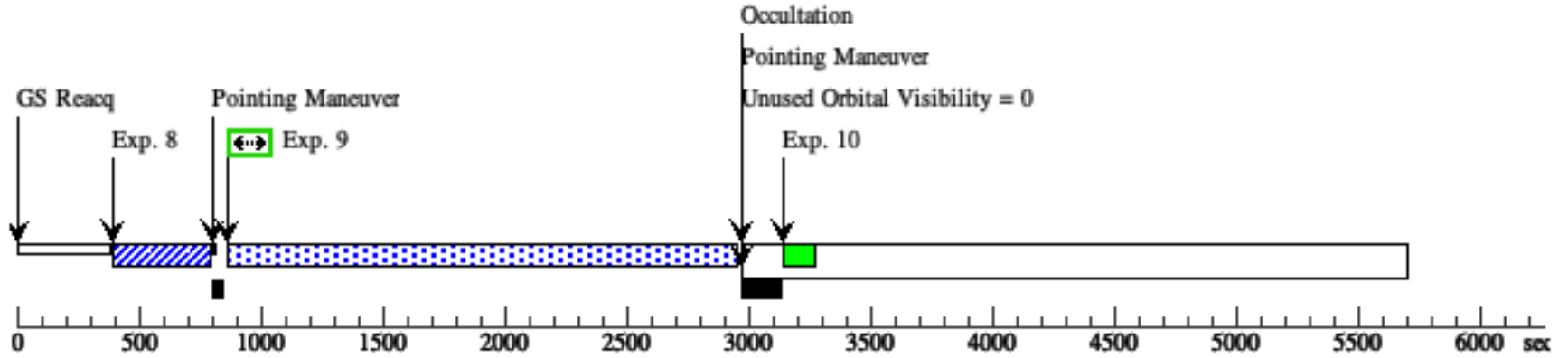
Proposal 16723 - Visit 01 - Resolving the dichotomy of atmospheric escape in the young planet DS Tuc A b

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
Exposures	1	ACQ (STIS.ta.142 1053)	(1) HD-222259	STIS/CCD, ACQ, F28X500II	MIRROR		PHASE 0.96620901 749549 TO 0.017407 462504509967	Sequence 1-4 Non-Int in Visit 01	1 Secs (1 Secs) [==>]	[1]
	2	ACQ/PEAK (STIS.sp.14 41098)	(1) HD-222259	STIS/CCD, ACQ/PEAK, 52X0.05D1	G430L 4300 A			Sequence 1-4 Non-Int in Visit 01	1 Secs (1 Secs) [==>]	[1]
	3	SCIENCE (STIS.sp.14 21064)	(1) HD-222259	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A		BUFFER-TIME=90 00; WAVECAL=NO	Sequence 1-4 Non-Int in Visit 01	1573 Secs (1703 Secs) [==>1703.0 Secs]	[1]
	4	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140M 1222 A			Sequence 1-4 Non-Int in Visit 01	[==>]	[1]
	5	ACQ/PEAK (STIS.sp.14 41098)	(1) HD-222259	STIS/CCD, ACQ/PEAK, 52X0.05D1	G430L 4300 A			Sequence 5-7 Non-Int in Visit 01	1 Secs (1 Secs) [==>]	[2]
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	12	SCIENCE (STIS.sp.14 21064)	(1) HD-222259	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A		BUFFER-TIME=90 00; WAVECAL=NO	Sequence 11-13 Non-Int in Visit 01	1573 Secs (1954 Secs) [==>1954.0 Secs]	[4]
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	15	SCIENCE (STIS.sp.14 21064)	(1) HD-222259	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A		BUFFER-TIME=90 00; WAVECAL=NO	Sequence 14-16 Non-Int in Visit 01	1573 Secs (1954 Secs) [==>1954.0 Secs]	[5]
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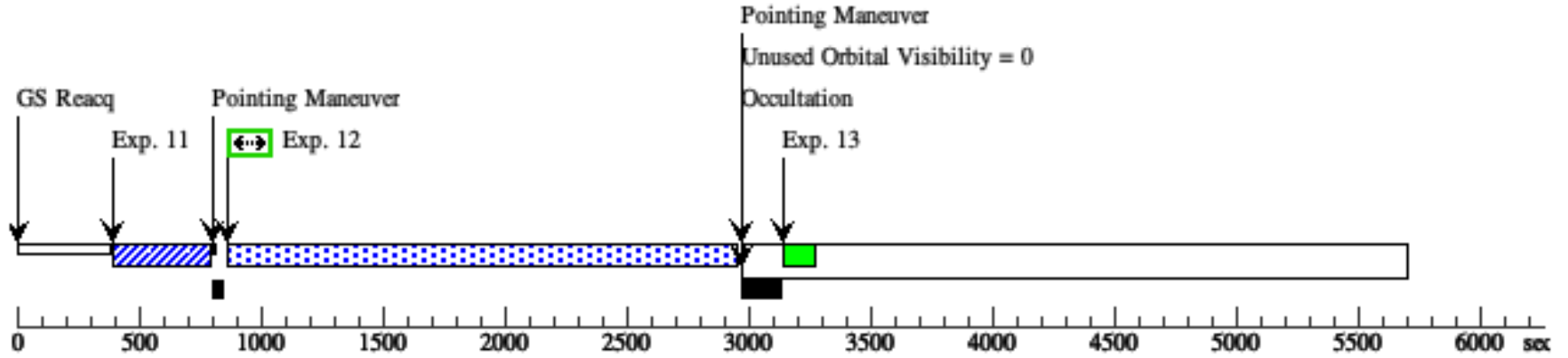
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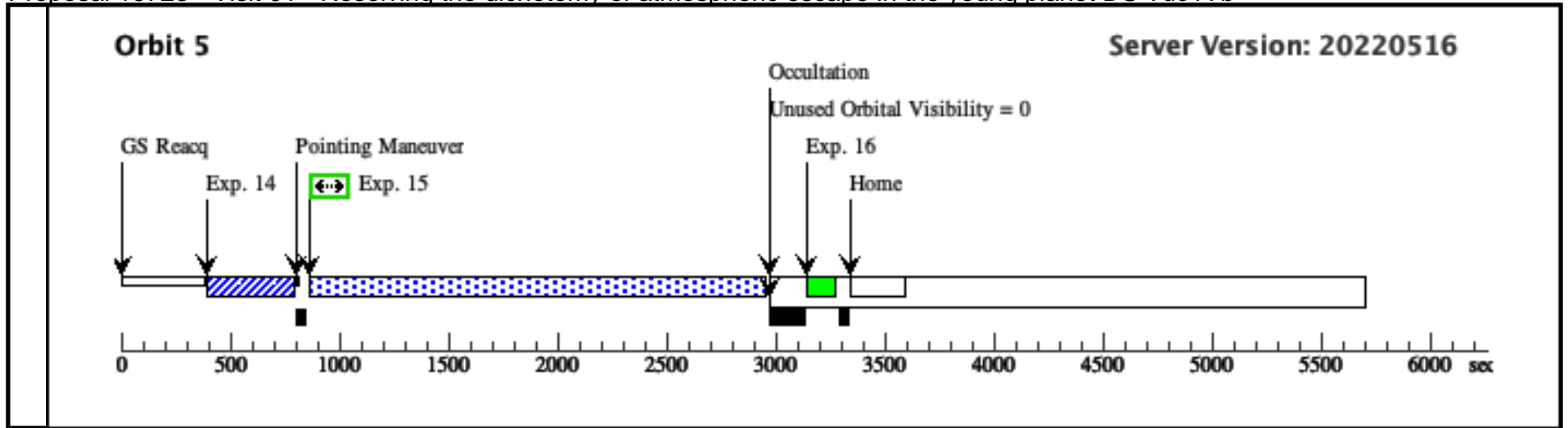
Server Version: 20220516



Orbit 4

Server Version: 20220516





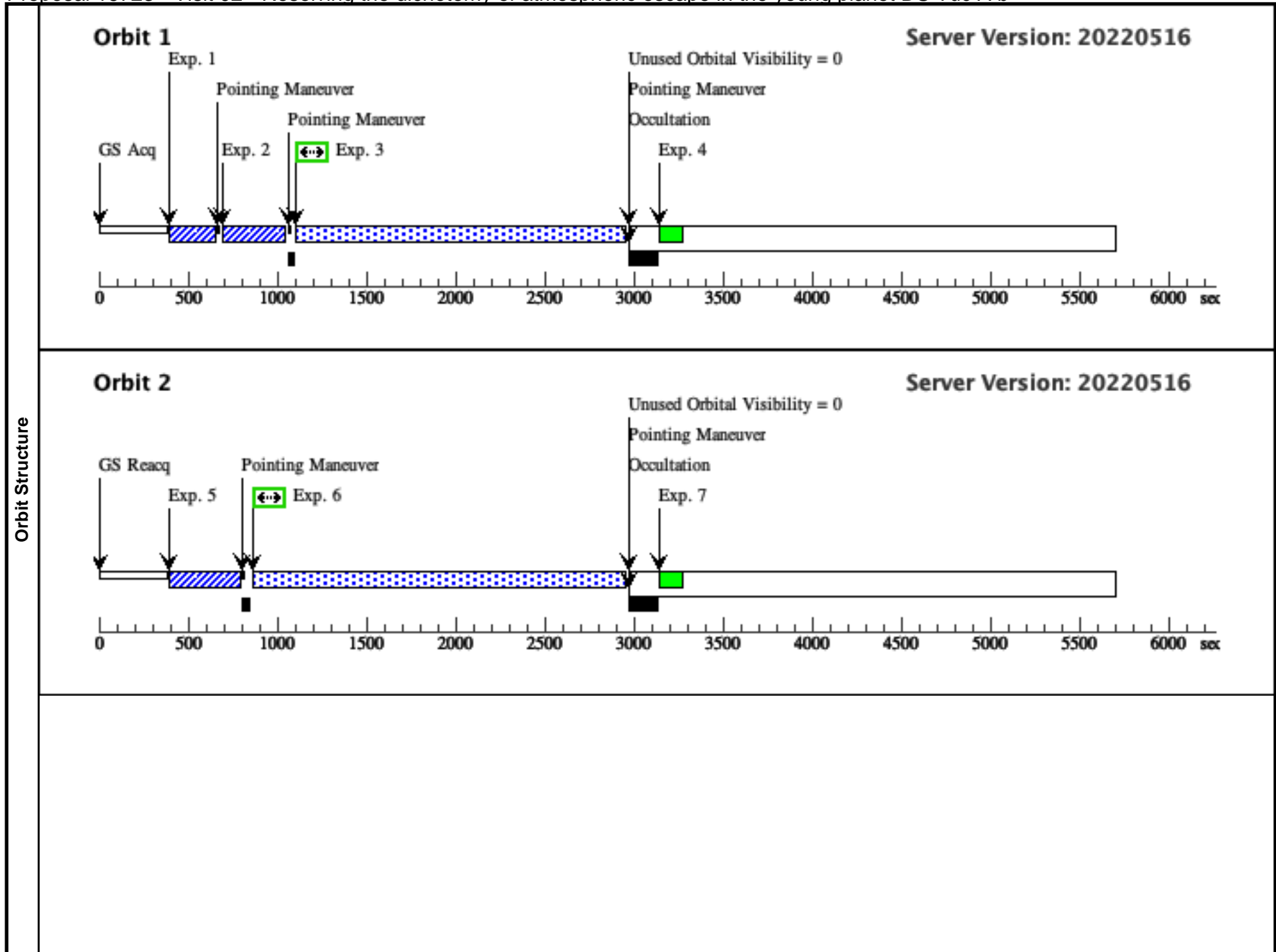
Proposal 16723 - Visit 02 - Resolving the dichotomy of atmospheric escape in the young planet DS Tuc A b

Wed Aug 10 22:00:26 GMT 2022

Visit	Proposal 16723, Visit 02, failed Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: SCHED 100%; Period 8.138268 D AND ZERO-PHASE HJD2458332.30997																								
	Fixed Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>HD-222259</td> <td>RA: 23 39 39.4804 (354.9145017d)</td> <td>Proper Motion RA: 79.30 mas/yr</td> <td>V=8.226</td> <td>Reference Frame: ICRS</td> </tr> <tr> <td></td> <td>Alt Name1: DS-TUC-A</td> <td>Dec: -69 11 44.71 (-69.19575d)</td> <td>Proper Motion Dec: -67.62 mas/yr</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>Equinox: J2000</td> <td>Epoch of Position: 2000</td> <td></td> <td></td> </tr> </tbody> </table> <p> <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=STAR Description=[EXTRA-SOLAR PLANETARY SYSTEM, G V-IV, RS CVN STAR] Extended=NO </p>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	HD-222259	RA: 23 39 39.4804 (354.9145017d)	Proper Motion RA: 79.30 mas/yr	V=8.226	Reference Frame: ICRS		Alt Name1: DS-TUC-A	Dec: -69 11 44.71 (-69.19575d)	Proper Motion Dec: -67.62 mas/yr					Equinox: J2000	Epoch of Position: 2000	
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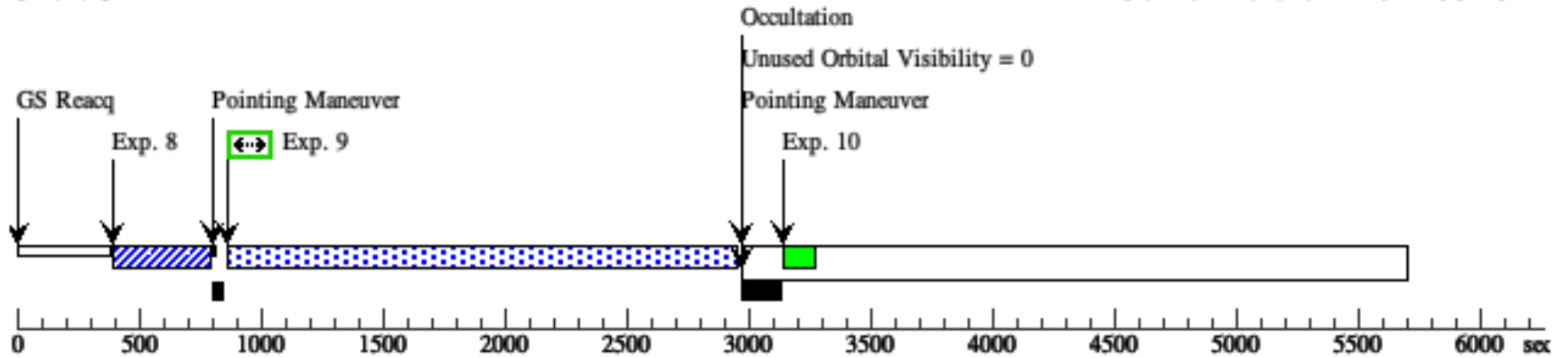
Proposal 16723 - Visit 02 - Resolving the dichotomy of atmospheric escape in the young planet DS Tuc A b

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	2	ACQ/PEAK (STIS.sp.14 41098)	(1) HD-222259	STIS/CCD, ACQ/PEAK, 52X0.05D1	G430L 4300 A			Sequence 1-4 Non-Int in Visit 02	1 Secs (1 Secs) [==>]	[1]
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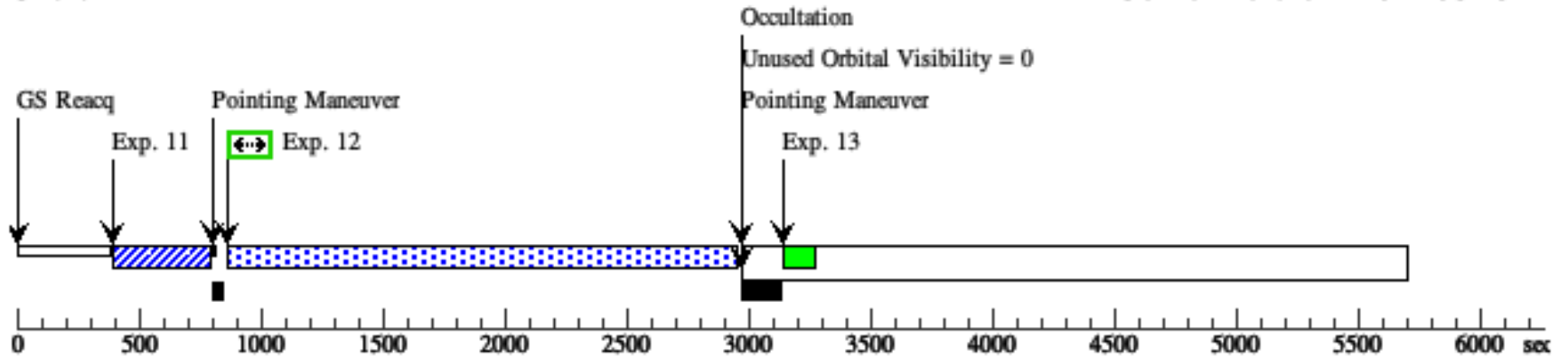
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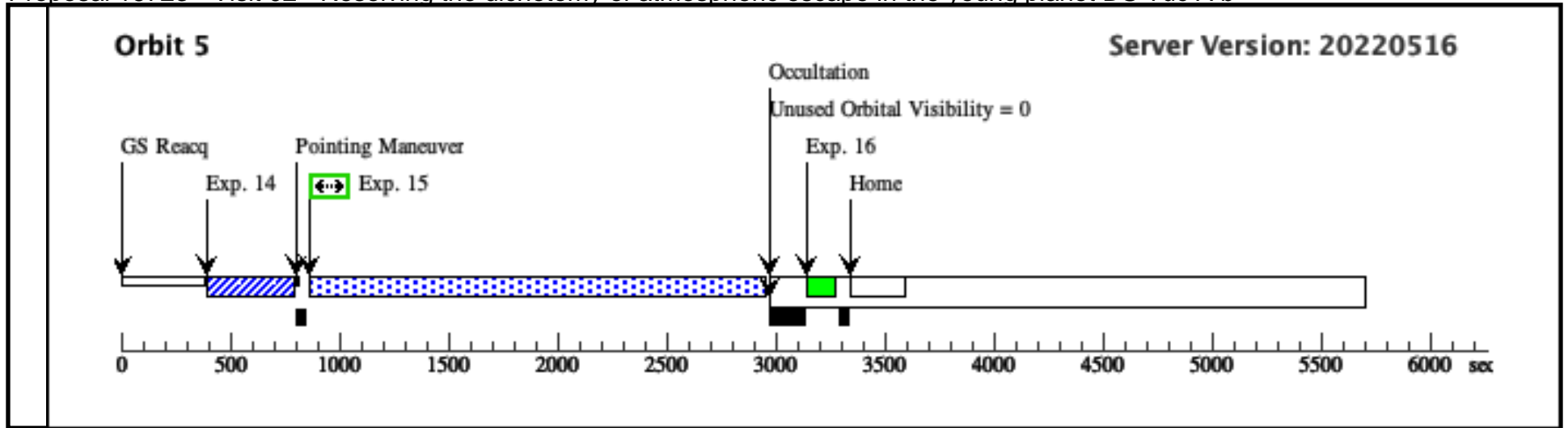
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Orbit 4

Server Version: 20220516





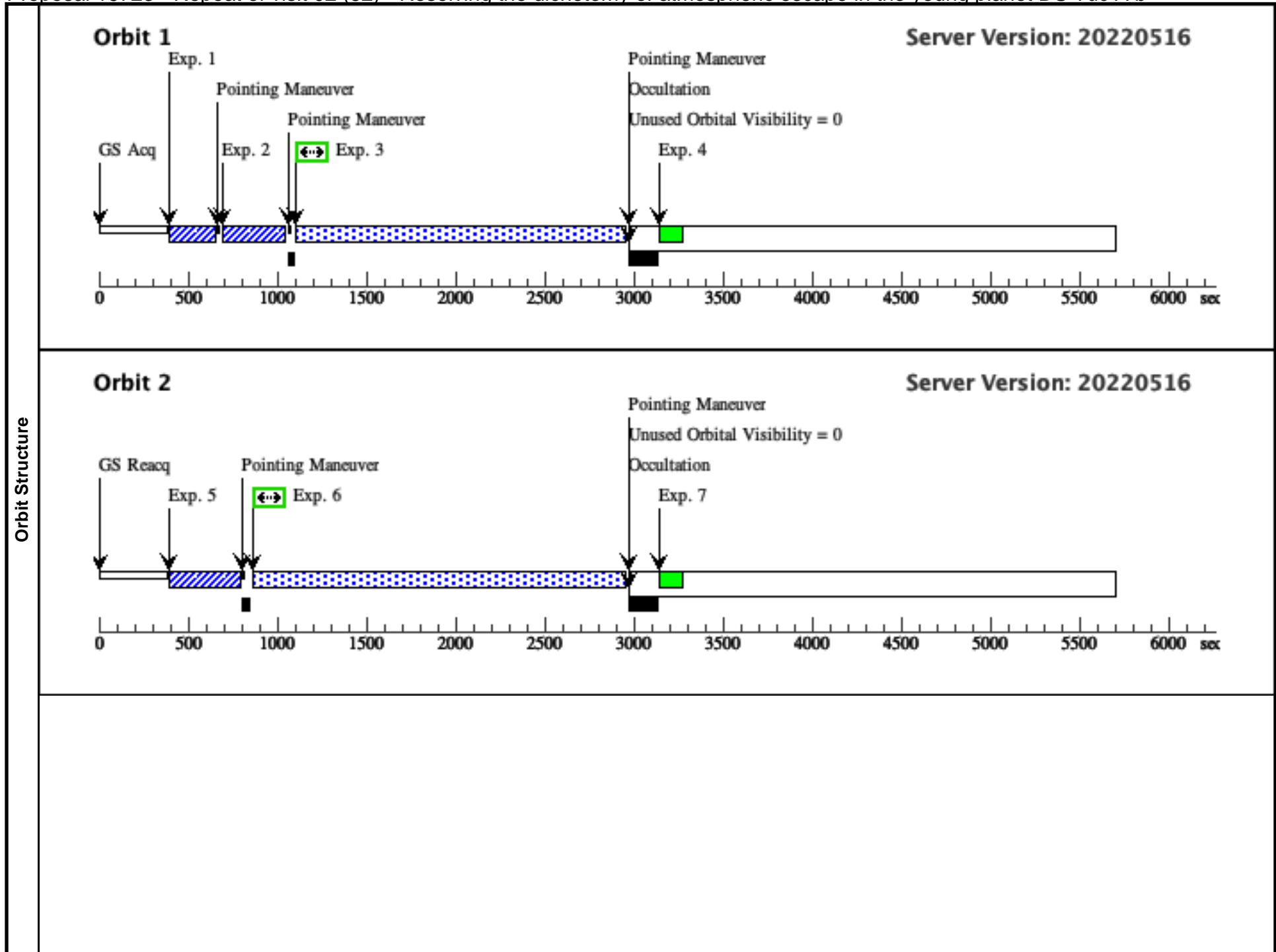
Proposal 16723 - Repeat of visit 02 (52) - Resolving the dichotomy of atmospheric escape in the young planet DS Tuc A b

Wed Aug 10 22:00:26 GMT 2022

Visit	Proposal 16723, Repeat of visit 02 (52) Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: SCHED 100%; Period 8.138268 D AND ZERO-PHASE HJD2458332.30997																								
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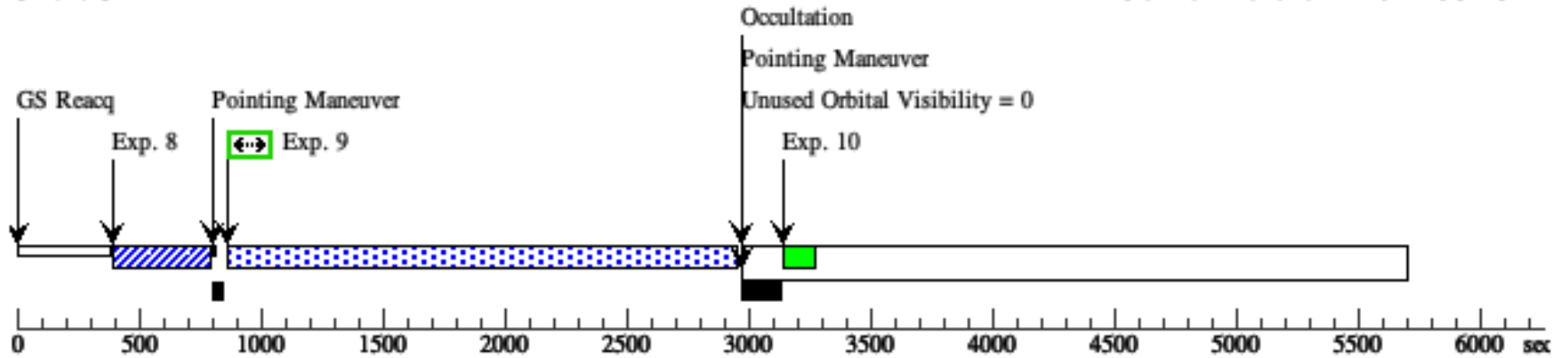
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	2	ACQ/PEAK (STIS.sp.14 41098)	(1) HD-222259	STIS/CCD, ACQ/PEAK, 52X0.05D1	G430L 4300 A				Sequence 1-4 Non-Int in Repeat of visit 02 (52)	1 Secs (1 Secs) [==>]	[1]
	3	SCIENCE (STIS.sp.14 21064)	(1) HD-222259	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A		BUFFER-TIME=9000; WAVECAL=NO		Sequence 1-4 Non-Int in Repeat of visit 02 (52)	1573 Secs (1703 Secs) [==>1703.0 Secs]	[1]
	4	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140M 1222 A				Sequence 1-4 Non-Int in Repeat of visit 02 (52)	[==>]	[1]
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	13	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140M 1222 A				Sequence 11-13 Non-Int in Repeat of visit 02 (52)	[==>]	[4]
	14	ACQ/PEAK (STIS.sp.14 41098)	(1) HD-222259	STIS/CCD, ACQ/PEAK, 52X0.05D1	G430L 4300 A				Sequence 14-16 Non-Int in Repeat of visit 02 (52)	1 Secs (1 Secs) [==>]	[5]
	15	SCIENCE (STIS.sp.14 21064)	(1) HD-222259	STIS/FUV-MAMA, TIME-TAG, 52X0.05D1	G140M 1222 A		BUFFER-TIME=9000; WAVECAL=NO		Sequence 14-16 Non-Int in Repeat of visit 02 (52)	1573 Secs (1954 Secs) [==>1954.0 Secs]	[5]
16	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140M 1222 A				Sequence 14-16 Non-Int in Repeat of visit 02 (52)	[==>]	[5]	



Orbit 3

Server Version: 20220516



Orbit 4

Server Version: 20220516

