



18415 - Hydrodynamic escape in a young sub-Neptune progenitor

Cycle: 34, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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Dr. Vincent Bourrier (CoI) (ESA Member)	University of Geneva, Department of Astronomy
Dr. Joshua D. Lothringer (CoI)	Space Telescope Science Institute

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) DS-TUC-A	COS/FUV COS/NUV	2	14-Aug-2026 13:00:35.0	yes
02	(1) DS-TUC-A	COS/FUV COS/NUV	5	14-Aug-2026 13:00:36.0	yes
03	(1) DS-TUC-A	COS/FUV COS/NUV	2	14-Aug-2026 13:00:37.0	yes
04	(1) DS-TUC-A	COS/FUV COS/NUV	5	14-Aug-2026 13:00:39.0	yes

14 Total Orbits Used

ABSTRACT

During their early lives (< 100 Myr), planets experience hydrodynamic escape, a process in which their H+He envelopes evaporate vigorously to space and entrain metallic species (such as C, N, O and Mg) in their outflows. This is thought to be the their main evolutionary channel of young (< 100 Myr) sub-Jovian worlds and is used as a convincing explanation for demographic features in the exoplanet population. Although predicted by theory, including for our own early Solar System rocky planets, to this day we lack decisive observational evidence for hydrodynamic escape occurring in a sub-Jovian exoplanet younger than 100 Myr. Thus, this key hypothesis that is foundational for our understanding of planetary evolution remains to be tested against observations. In this program, we propose to observe escaping metals in the young (45 Myr) Neptune-sized exoplanet DS Tuc Ab, which is predicted to be a progenitor to a sub-Neptune, the most common type of exoplanet in the solar neighborhood. We used a leading-edge modeling framework to simulate the transmission spectrum of DS Tuc Ab and a well-tested experimental design to predict observable escape signals; we estimate that, within two transits, we can securely detect escaping carbon and tentatively other species in the upper atmosphere of the planet. The results of this observational campaign will allow us to accurately measure the mass-loss rate of DS Tuc Ab, which has challenging to obtain with previous observations of this planet using escaping H and He. This measurement will enable us to perform the first empirical test to hypotheses involving the role of hydrodynamic escape in exoplanet evolution.

OBSERVING DESCRIPTION

We shall observe two transits of the young exoplanet DS Tuc Ab using COS/FUV. The objective is to detect metals escaping from the planet, and producing in-transit absorption in emission lines between 1100 and 1400 angstrom. DS Tuc is a binary system where the A component is brighter, so it is automatically acquired instead of the companion DS Tuc B. The angular separation between the components is 5 arcsec, so DS Tuc B will be outside of the COS aperture.

This program is time sensitive because it can only be executed when the planet transits. Thus, we setup this 14-orbit program in the following structure:

- Visit 1, pre-transit 1 baseline: 2 consecutive orbits happening ~ 12 hours before the transit 1 midpoint to establish the out-of-transit spectrum temporally far from the transit center.
- Visit 2, transit 1: 5 consecutive orbits starting a few hours before transit center
- Visit 3, pre-transit 2 baseline: 2 consecutive orbits happening ~ 11.25 hours before the transit 2 midpoint (the offset from 12 h is necessary to cover the Earth occultation gaps from transit 1)

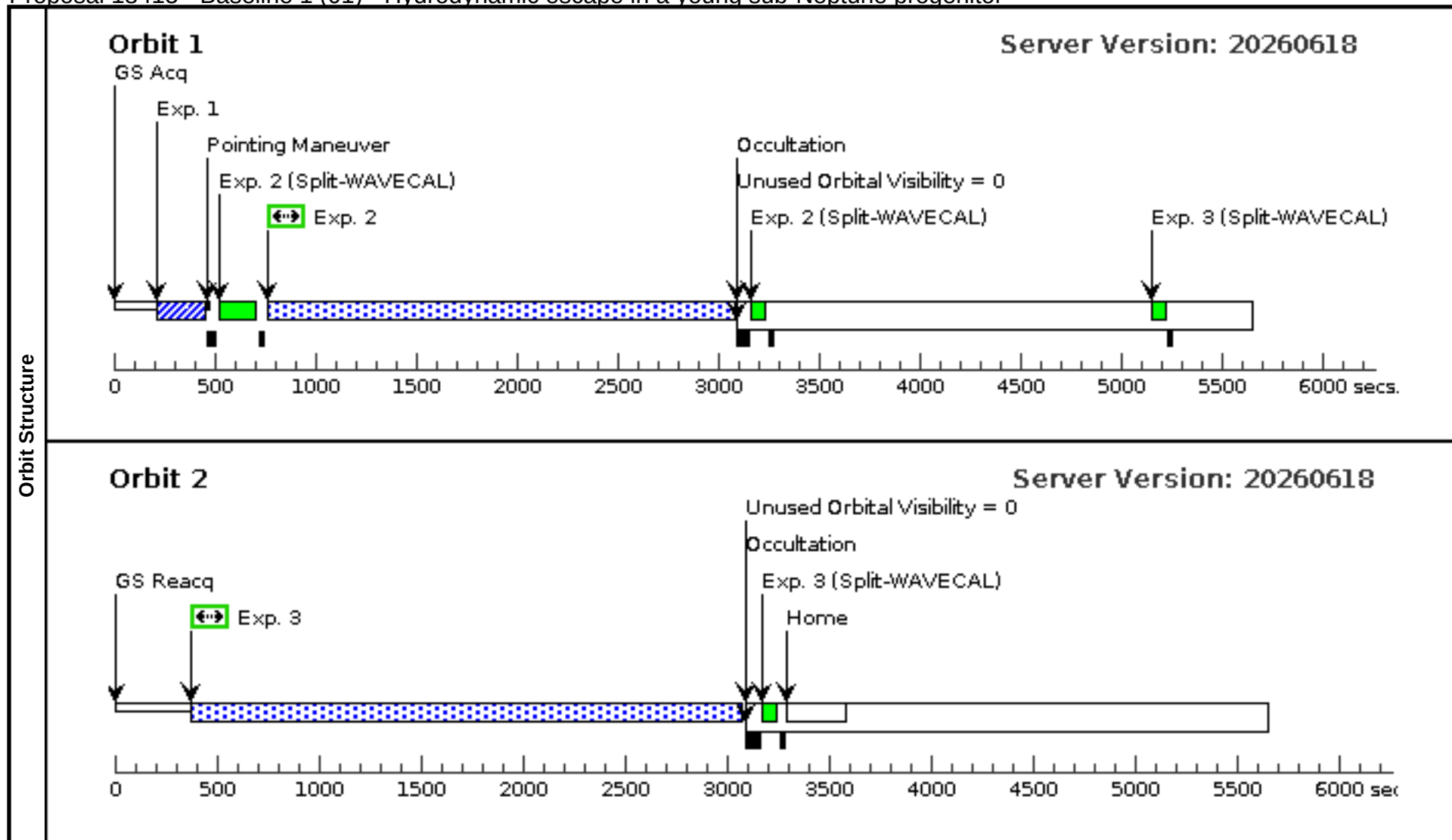
- Visit 4, transit 2: 5 consecutive orbits starting a few hours before transit center

The program is broken into 4 visits instead of 2 because UV visits are limited to a maximum of 5 consecutive orbits. So, we establish pre-transit exposures with enough offset from the transits visits to avoid the SAA passages. To achieve this observing setup, we set phase constraints on the pre-transit visits and set an "After Visit" constraint for the transit visits with enough flexibility in the after range to facilitate scheduling.

We will use the G130M grating centered at 1291 angstrom with the PSA aperture and both SEGMENTS on aiming for the best wavelength coverage, including $z=0$ Lyman-alpha. We will use the TIME-TAG mode to allow us to break down each exposure into sub-exposures, which in turn is necessary to obtain a precise time series of fluxes. As described in the Phase 2 instructions, we shall use LP7 and FP-POS=3, 4.

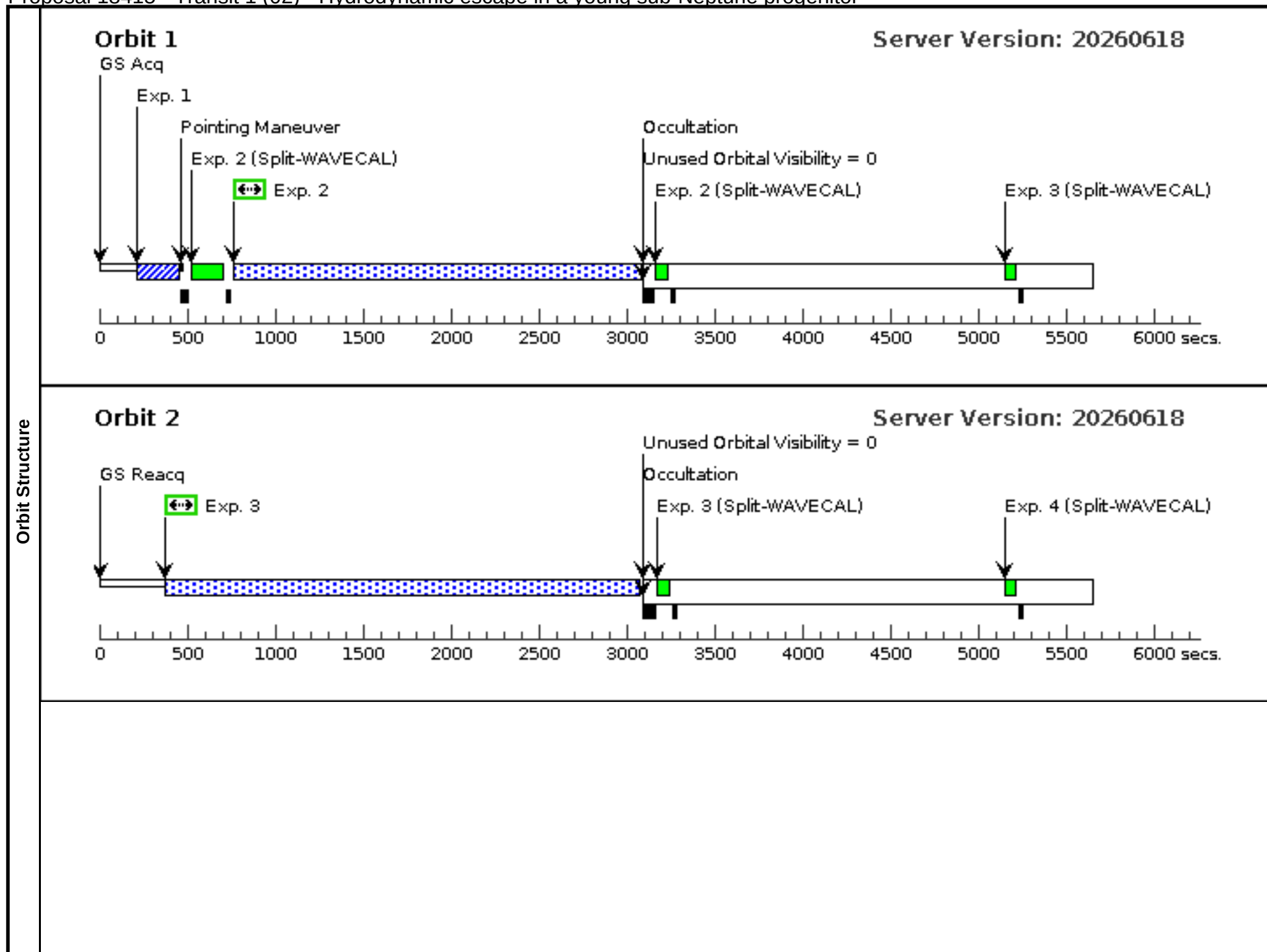
Proposal 18415 - Baseline 1 (01) - Hydrodynamic escape in a young sub-Neptune progenitor

Visit	Proposal 18415, Baseline 1 (01)										Fri Aug 14 17:00:39 GMT 2026
	Diagnostic Status: No Diagnostics										
	Scientific Instruments: COS/FUV, COS/NUV										
	Special Requirements: Period 8.138268 D AND ZERO-PHASE HJD2458332.30997										
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous		
	(1)	DS-TUC-A	RA: 23 39 39.4808 (354.9145033d)		Proper Motion RA: 79.529 mas/yr		V=8.226		Reference Frame: ICRS		
		Alt Name1: HD-222259A	Dec: -69 11 44.71 (-69.19575d)		Proper Motion Dec: -67.55100000646053 mas/yr		B=9.161,				
			Equinox: J2000		Parallax: 0.022636700000000003"		R=9.28,				
					Epoch of Position: 2000		J=7.122				
					Radial Velocity: 7.785 km/sec						
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.										
	Category=EXT-STAR										
	Description=[EXTRA-SOLAR PLANETARY SYSTEM, G 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 (COS.ta.236 4705)	(1) DS-TUC-A	COS/NUV, ACQ/IMAGE, BOA	MIRRORA		PHASE 0.91333946 40399325 TO 0.9184 593085408345		8 Secs (8 Secs)		
									[>=>]	[1]	
	2	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2265 Secs)		
						FP-POS=3;			[>=>2265.0 Secs]	[1]	
						LIFETIME-POS=L P7					
	3	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2652 Secs)		
						FP-POS=4;			[>=>2652.0 Secs]	[2]	
						LIFETIME-POS=L P7					



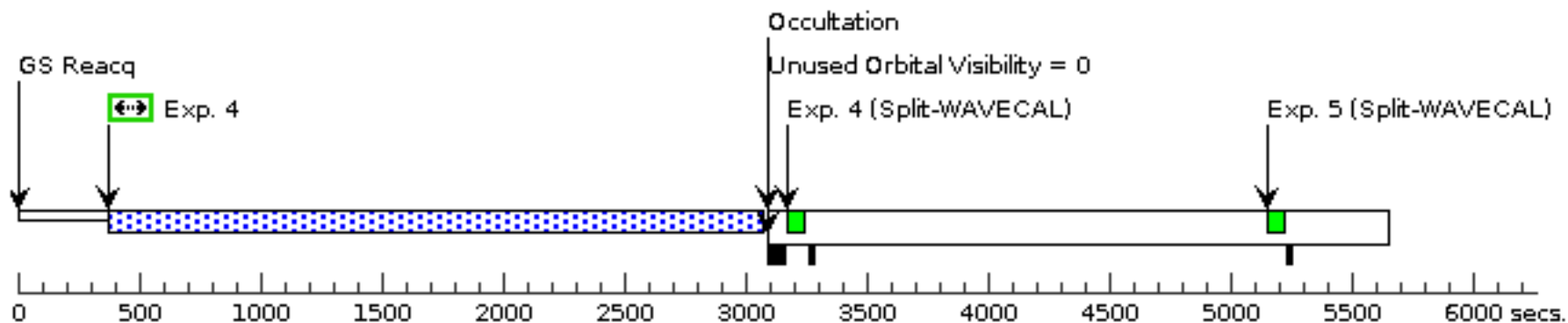
Proposal 18415 - Transit 1 (02) - Hydrodynamic escape in a young sub-Neptune progenitor

Visit	Proposal 18415, Transit 1 (02)										Fri Aug 14 17:00:39 GMT 2026
	Diagnostic Status: No Diagnostics										
	Scientific Instruments: COS/FUV, COS/NUV										
	Special Requirements: AFTER 01 BY 11.5 H TO 12.5 H										
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous		
	(1)	DS-TUC-A	RA: 23 39 39.4808 (354.9145033d)		Proper Motion RA: 79.529 mas/yr		V=8.226		Reference Frame: ICRS		
		Alt Name1: HD-222259A	Dec: -69 11 44.71 (-69.19575d)		Proper Motion Dec: -67.55100000646053 mas/yr		B=9.161,				
			Equinox: J2000		Parallax: 0.022636700000000003"		R=9.28,				
					Epoch of Position: 2000		J=7.122				
	Radial Velocity: 7.785 km/sec										
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.										
	Category=EXT-STAR										
	Description=[EXTRA-SOLAR PLANETARY SYSTEM, G 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 (COS.ta.236 4705)	(1) DS-TUC-A	COS/NUV, ACQ/IMAGE, BOA	MIRRORA				8 Secs (8 Secs)		
									[==>]		[1]
	2	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2265 Secs)		
						FP-POS=3;			[==>2265.0 Secs]		[1]
						LIFETIME-POS=L P7					
	3	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2652 Secs)		
						FP-POS=3;			[==>2652.0 Secs]		[2]
						LIFETIME-POS=L P7					
	4	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2652 Secs)		
					FP-POS=3;			[==>2652.0 Secs]		[3]	
					LIFETIME-POS=L P7						
5	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2652 Secs)			
					FP-POS=4;			[==>2652.0 Secs]		[4]	
					LIFETIME-POS=L P7						
6	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2652 Secs)			
					FP-POS=4;			[==>2652.0 Secs]		[5]	
					LIFETIME-POS=L P7						



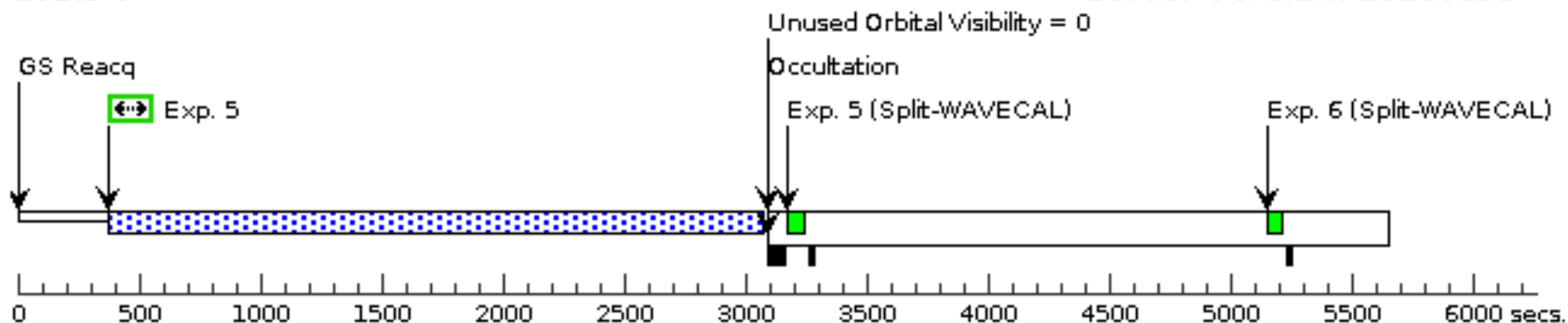
Orbit 3

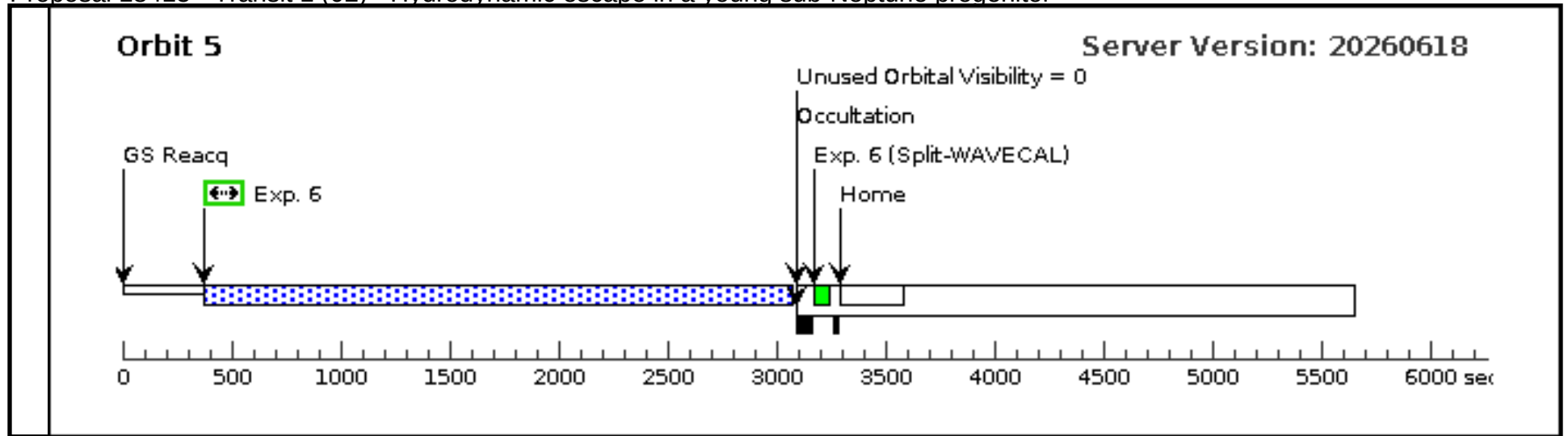
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Orbit 4

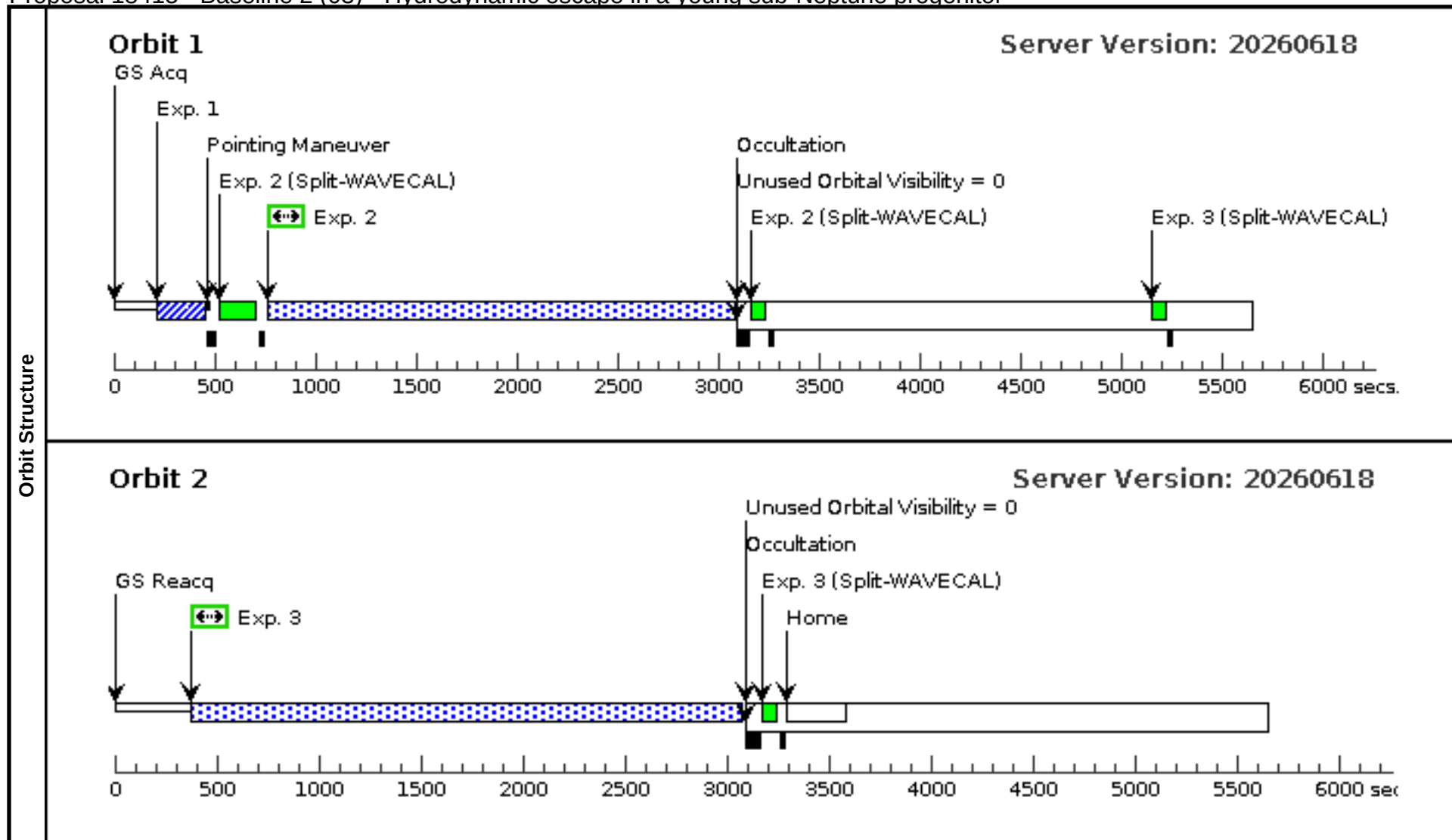
Server Version: 20260618





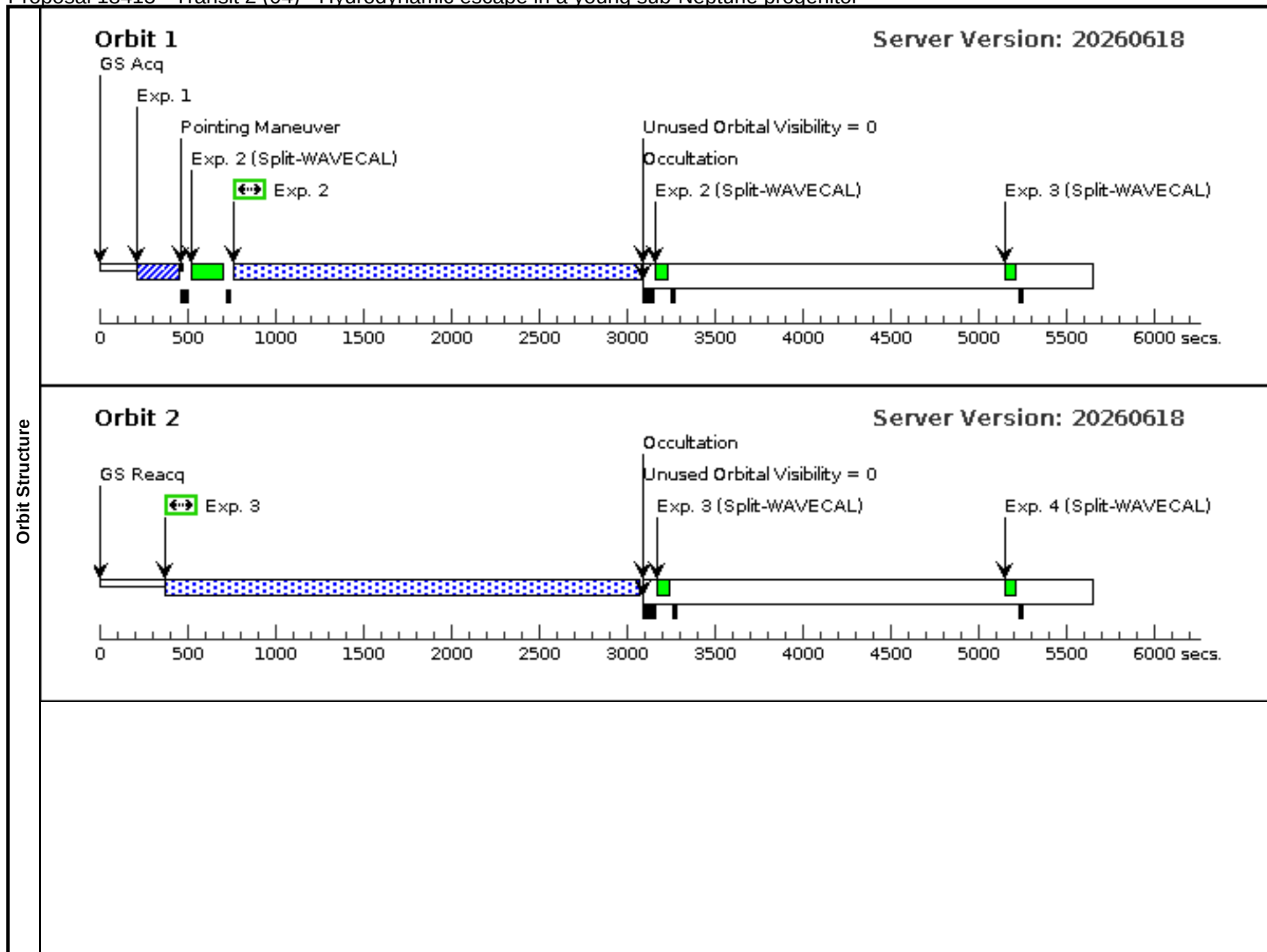
Proposal 18415 - Baseline 2 (03) - Hydrodynamic escape in a young sub-Neptune progenitor

Visit	Proposal 18415, Baseline 2 (03)										Fri Aug 14 17:00:39 GMT 2026
	Diagnostic Status: No Diagnostics										
	Scientific Instruments: COS/FUV, COS/NUV										
	Special Requirements: Period 8.138268 D AND ZERO-PHASE HJD2458332.30997										
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous		
	(1)	DS-TUC-A	RA: 23 39 39.4808 (354.9145033d)		Proper Motion RA: 79.529 mas/yr		V=8.226		Reference Frame: ICRS		
		Alt Name1: HD-222259A	Dec: -69 11 44.71 (-69.19575d)		Proper Motion Dec: -67.55100000646053 mas/yr		B=9.161,				
			Equinox: J2000		Parallax: 0.022636700000000003"		R=9.28,				
					Epoch of Position: 2000		J=7.122				
					Radial Velocity: 7.785 km/sec						
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.										
	Category=EXT-STAR										
	Description=[EXTRA-SOLAR PLANETARY SYSTEM, G 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 (COS.ta.236 4705)	(1) DS-TUC-A	COS/NUV, ACQ/IMAGE, BOA	MIRRORA		PHASE 0.91717934 7415609 TO 0.92229 9191916511		8 Secs (8 Secs)		
									[>=>]	[1]	
	2	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2265 Secs)		
						FP-POS=3;			[>=>2265.0 Secs]	[1]	
						LIFETIME-POS=L P7					
	3	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2652 Secs)		
						FP-POS=4;			[>=>2652.0 Secs]	[2]	
						LIFETIME-POS=L P7					



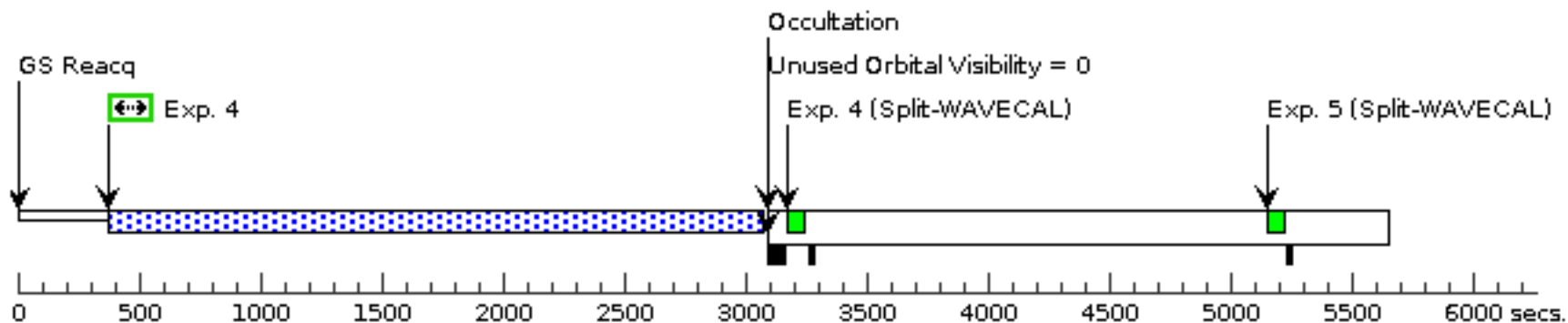
Proposal 18415 - Transit 2 (04) - Hydrodynamic escape in a young sub-Neptune progenitor

Visit	Proposal 18415, Transit 2 (04)										Fri Aug 14 17:00:39 GMT 2026
	Diagnostic Status: No Diagnostics										
	Scientific Instruments: COS/FUV, COS/NUV										
	Special Requirements: AFTER 03 BY 11.5 H TO 12.5 H										
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous		
	(1)	DS-TUC-A	RA: 23 39 39.4808 (354.9145033d)		Proper Motion RA: 79.529 mas/yr		V=8.226		Reference Frame: ICRS		
		Alt Name1: HD-222259A	Dec: -69 11 44.71 (-69.19575d)		Proper Motion Dec: -67.55100000646053 mas/yr		B=9.161,				
			Equinox: J2000		Parallax: 0.022636700000000003"		R=9.28,				
					Epoch of Position: 2000		J=7.122				
	Radial Velocity: 7.785 km/sec										
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.										
	Category=EXT-STAR										
	Description=[EXTRA-SOLAR PLANETARY SYSTEM, G 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 (COS.ta.236 4705)	(1) DS-TUC-A	COS/NUV, ACQ/IMAGE, BOA	MIRRORA				8 Secs (8 Secs)		
									[==>]		[1]
	2	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2265 Secs)		
						FP-POS=3;			[==>2265.0 Secs]		[1]
						LIFETIME-POS=L P7					
	3	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2652 Secs)		
						FP-POS=3;			[==>2652.0 Secs]		[2]
						LIFETIME-POS=L P7					
	4	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2652 Secs)		
					FP-POS=3;			[==>2652.0 Secs]		[3]	
					LIFETIME-POS=L P7						
5	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2652 Secs)			
					FP-POS=4;			[==>2652.0 Secs]		[4]	
					LIFETIME-POS=L P7						
6	SCI (COS.sp.236 4706)	(1) DS-TUC-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=41 21;			2000 Secs (2652 Secs)			
					FP-POS=4;			[==>2652.0 Secs]		[5]	
					LIFETIME-POS=L P7						



Orbit 3

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Orbit 4

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