



# 17489 - Hunting for Hazes in the Atmosphere of a Warm Super-Puff

Cycle: 31, Proposal Category: GO

(UV Initiative)

(Availability Mode: AVAILABLE)

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>
<b>Dr. Shreyas Vissapragada (PI) (Contact)</b>	<b>Harvard University</b>
Dr. Mercedes Lopez-Morales (CoI)	Smithsonian Institution Astrophysical Observatory
Carlos Gascon (CoI)	Harvard University
David W Latham (CoI)	Smithsonian Institution Astrophysical Observatory
Dr. Khalid Barkaoui (CoI) (ESA Member)	Université de Liège
Dr. Jessica Spake (CoI)	California Institute of Technology

## 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) TOI-1420	WFC3/UVIS	5	12-Jun-2024 16:01:33.0	yes
02	(1) TOI-1420	WFC3/UVIS	5	12-Jun-2024 16:01:35.0	yes

10 Total Orbits Used

## ABSTRACT

We aim to constrain the presence of aerosols in the atmosphere of TOI-1420b, a warm ( $T_{eq} = 960$  K) super-puff planet with an exceptionally low density (0.08 g/cc). A leading hypothesis for the apparently inflated radii of super-puffs is high-altitude dust/haze lofted by atmospheric outflows. The atmospheres of this planet is indeed outflowing as evidenced by ground-based He 10830 Å measurements, making it an ideal laboratory to study the interplay between aerosols and atmospheric outflows. In particular, lofted haze should produce a strong Rayleigh or super-Rayleigh scattering slope for the transmission spectrum in the optical/near-ultraviolet (NUV). In an efficient 10 orbit program with WFC3/UVIS G280, we will obtain an

optical transmission spectrum for TOI-1420b between 200--800~nm to either confirm or rule out the presence of hazes. If hazes are ruled out by our observations, our measurement would instead implicate alternate mechanisms like tidal inflation.

### **OBSERVING DESCRIPTION**

We will measure the transmission spectrum of TOI-1420b using WFC3 UVIS/G280. We require two transit observations to achieve the required SNR and to mitigate the effects of stellar activity. We acquire in F300X at the beginning of each observation for wavelength calibration. We verified that none of our exposures come close to saturating the detectors using the ETC. Following successful observing methodologies demonstrated by the HUSTLE program, we center the target on chip2 of the detector using POS TARG Y = -50 arcsec. We use the SIZEAXIS keywords to minimize data volume, and the CENTERAXIS keywords to center the subarray readout on the target. On the F300X image, we use FLASH to avoid poor CTE as recommended by the ETC. All of these instrument settings have been extensively tested in previous WFC3 UVIS/G280 exoplanet programs, most notably the HUSTLE treasury program (17183), which limits risk.

Proposal 17489 - TOI-1420 T1 (01) - Hunting for Hazes in the Atmosphere of a Warm Super-Puff

<b>Visit</b>	Proposal 17489, TOI-1420 T1 (01), pi <span style="float: right;">Wed Jun 12 20:01:35 GMT 2024</span> Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: Period 6.9561063 D AND ZERO-PHASE HJD2459517.43305					
	<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>
(1)		TOI-1420	RA: 21 31 46.0342 (322.9418092d) Dec: +66 20 56.42 (66.34901d) Equinox: J2000	Proper Motion RA: 0.007558329922736845 sec of time/yr Proper Motion Dec: 0.031874 arcsec/yr Epoch of Position: 2015.5	V=11.65	Reference Frame: SIMBAD
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=STAR Description=[G V-IV]						

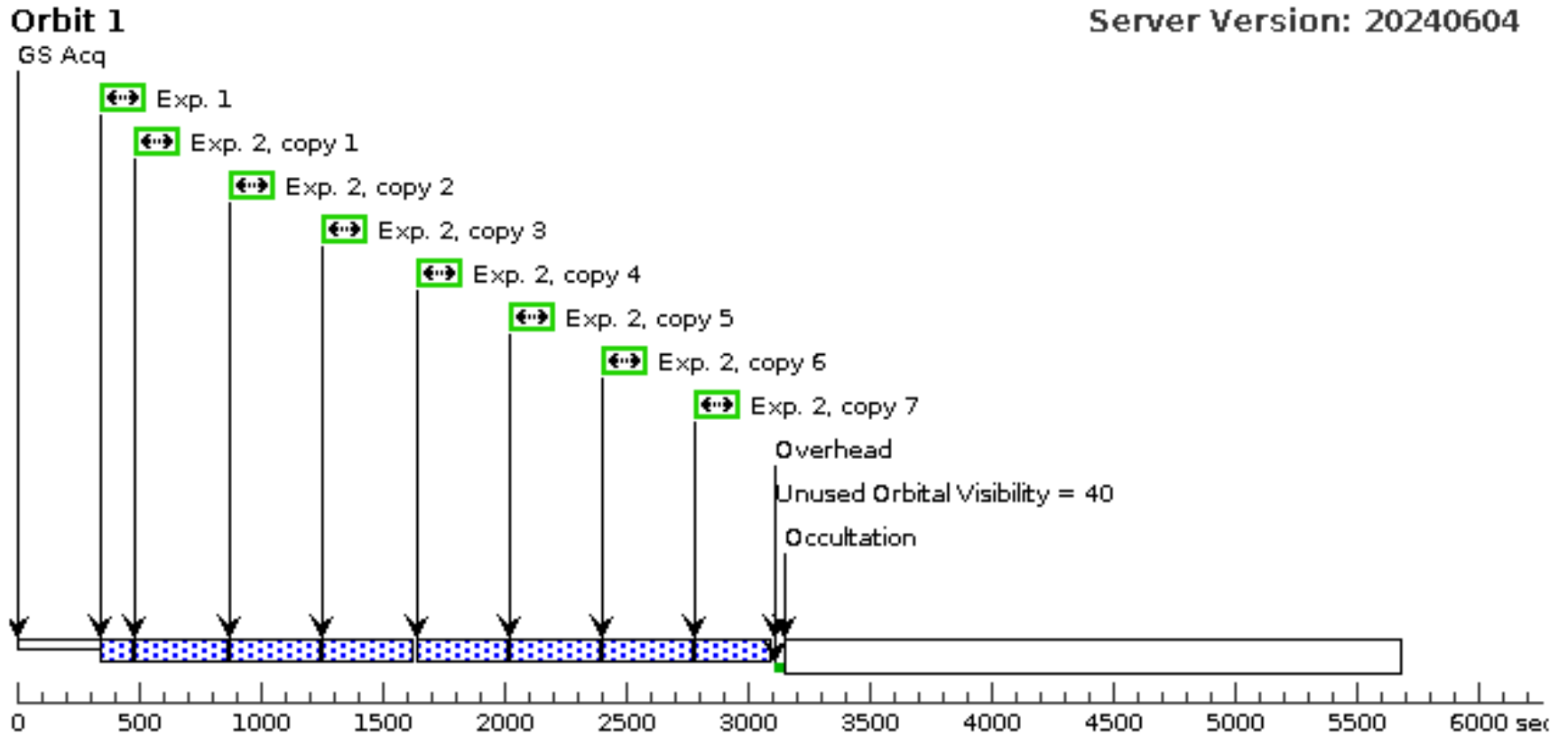
Proposal 17489 - TOI-1420 T1 (01) - Hunting for Hazes in the Atmosphere of a Warm Super-Puff

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
Exposures	1	(WFC3UVI S.im.189098 8)	(1) TOI-1420	WFC3/UVIS, ACCUM, G280-REF	F300X	FLASH=16; CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50; PHASE 0.97504191 23 TO 0.9770385593	Sequence 1-2 Non-Int in TOI-1420 T1 (01 )	30 Secs (30 Secs) [==>]	[1]
	2	(WFC3UVI S.sp.189099 0)	(1) TOI-1420	WFC3/UVIS, ACCUM, UVIS	G280	CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50	Sequence 1-2 Non-Int in TOI-1420 T1 (01 )	312 Secs X 7 (2184 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)]	[1]
	3	(WFC3UVI S.sp.189099 0)	(1) TOI-1420	WFC3/UVIS, ACCUM, UVIS	G280	CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50	Sequence 3-3 Non-Int in TOI-1420 T1 (01 )	284 Secs X 8 (2272 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)]	[2]
	4	(WFC3UVI S.sp.189099 0)	(1) TOI-1420	WFC3/UVIS, ACCUM, UVIS	G280	CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50; NEW OBSET FULL ACQ	Sequence 4-4 Non-Int in TOI-1420 T1 (01 )	284 Secs X 8 (2272 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)]	[3]
	5	(WFC3UVI S.sp.189099 0)	(1) TOI-1420	WFC3/UVIS, ACCUM, UVIS	G280	CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50	Sequence 5-5 Non-Int in TOI-1420 T1 (01 )	284 Secs X 8 (2272 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)]	[4]

Proposal 17489 - TOI-1420 T1 (01) - Hunting for Hazes in the Atmosphere of a Warm Super-Puff

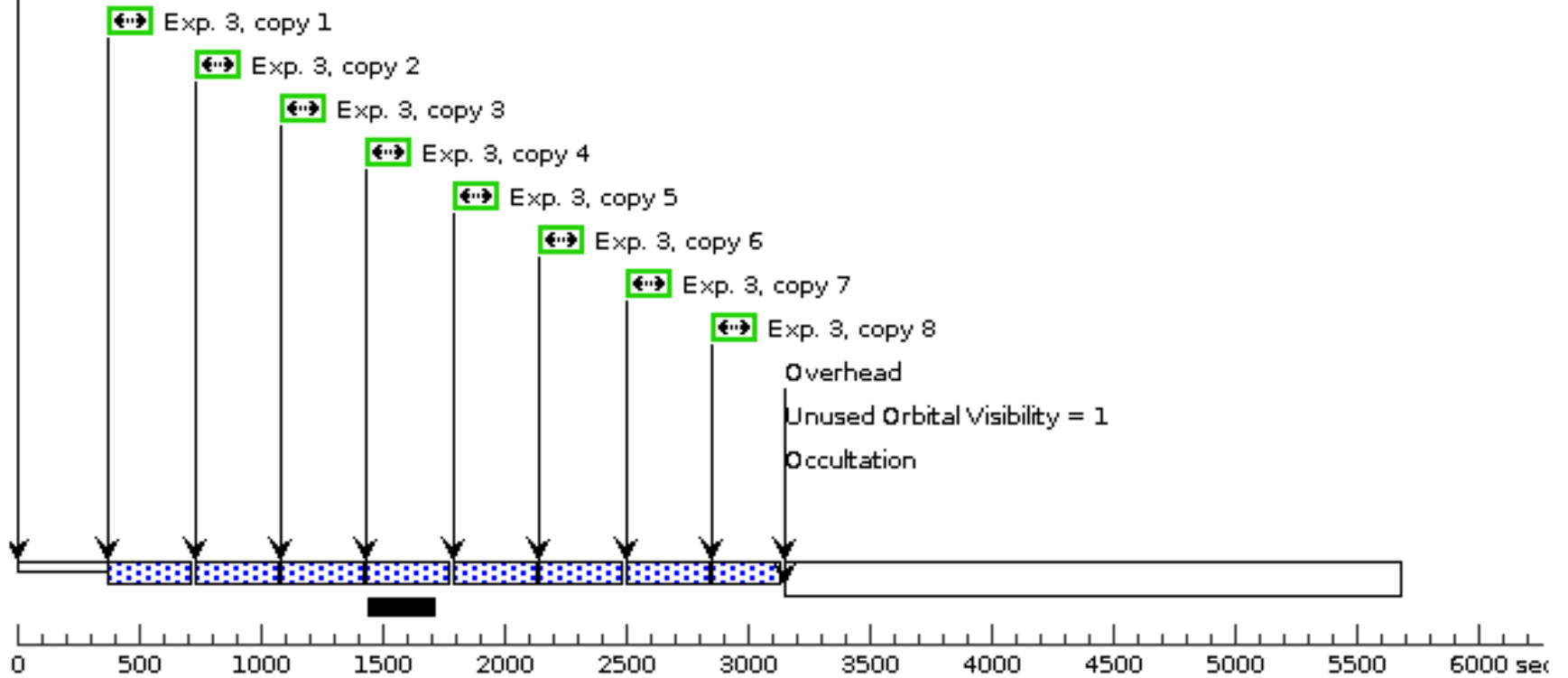
6	(WFC3UVI S.sp.189099 0)	(1) TOI-1420	WFC3/UVIS, ACCUM, UVIS	G280	CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50 Sequence 6-6 Non-Int in TOI-1420 T1 (01 )	284 Secs X 8 (2272 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)]	[5]
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Orbit Structure

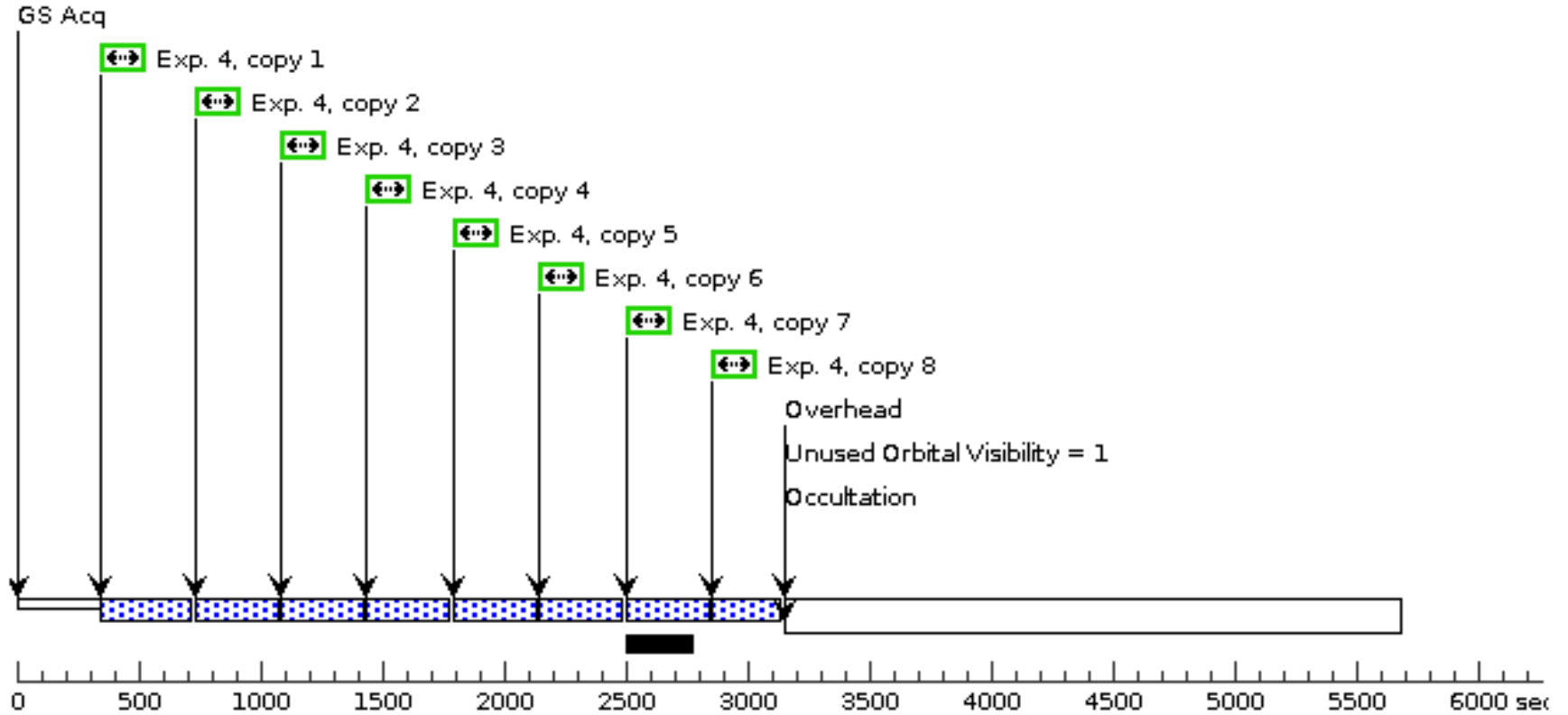


**Orbit 2**

GS Reacq

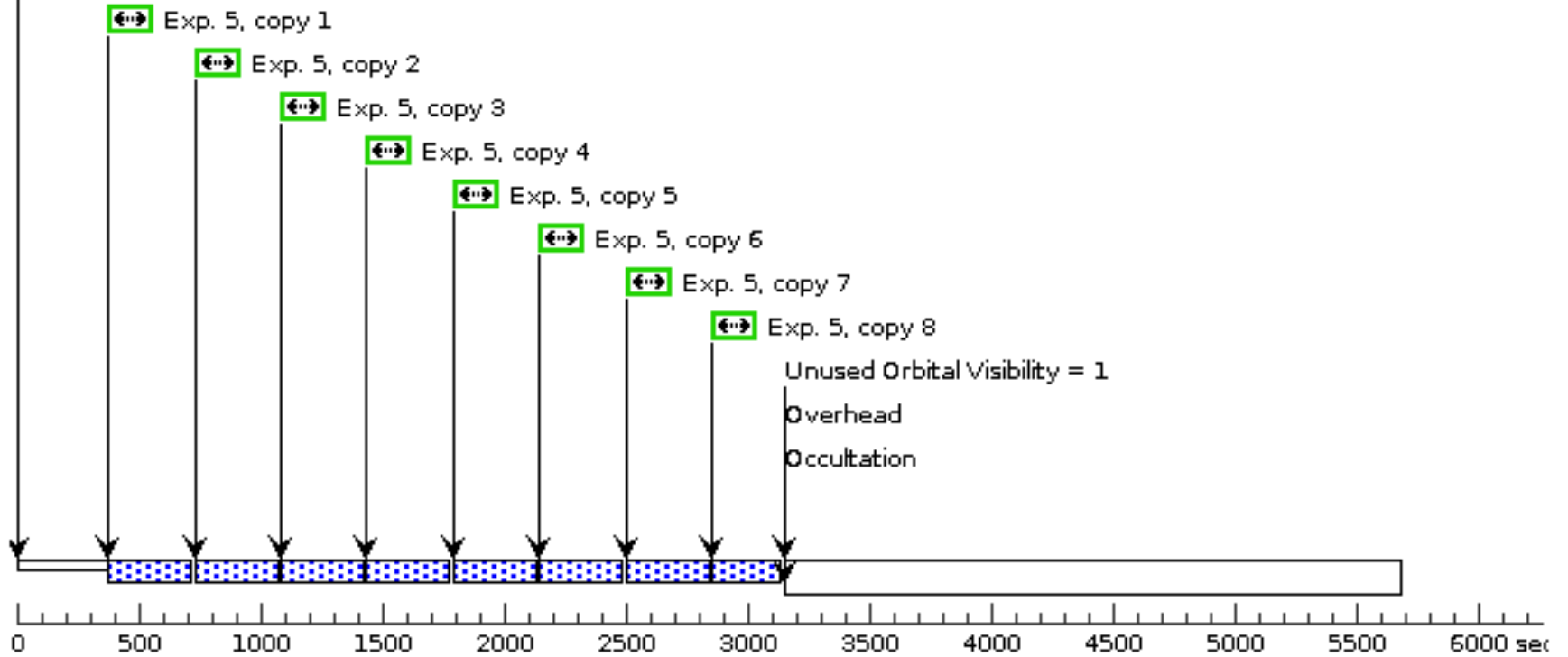


**Orbit 3**



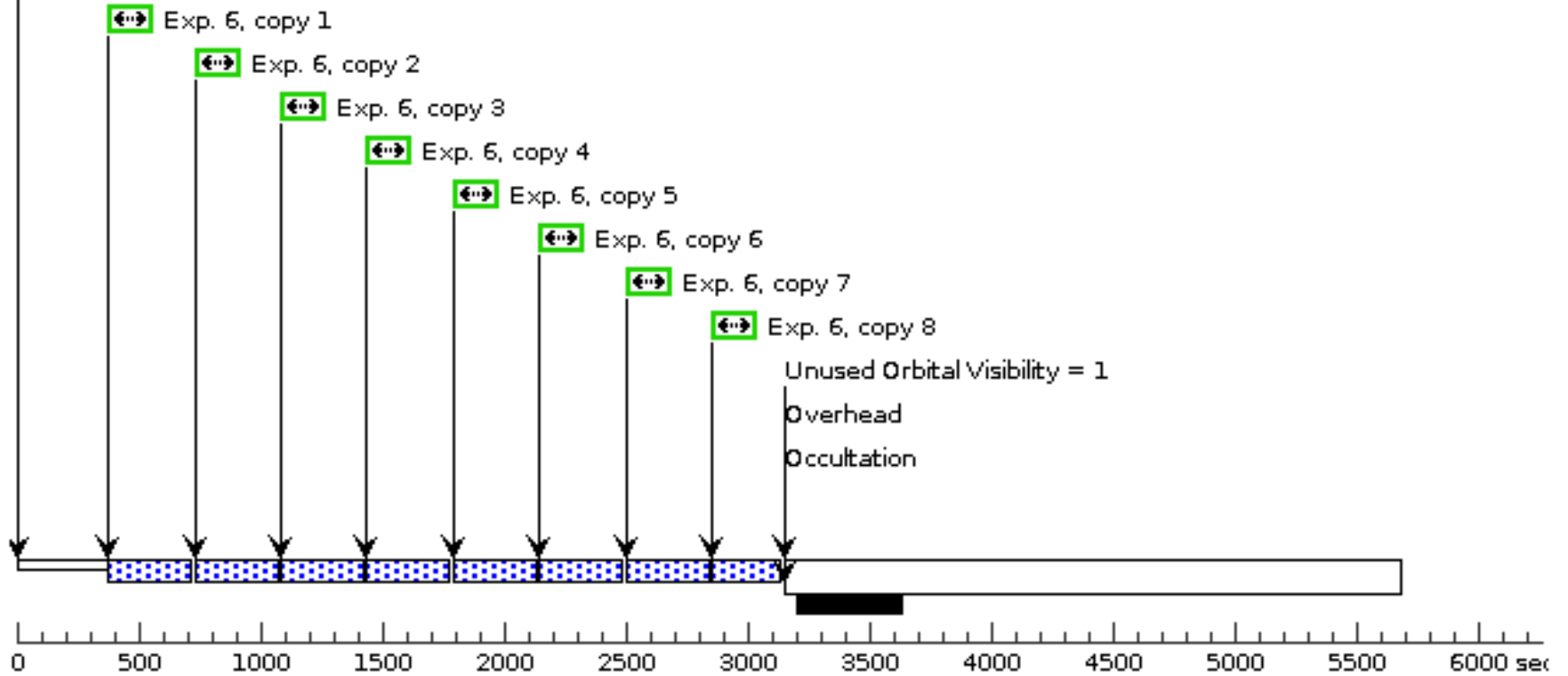
**Orbit 4**

GS Reacq



### Orbit 5

GS Reacq



Proposal 17489 - TOI-1420 T2 (02) - Hunting for Hazes in the Atmosphere of a Warm Super-Puff

<b>Visit</b>	Proposal 17489, TOI-1420 T2 (02), pi <span style="float: right;">Wed Jun 12 20:01:36 GMT 2024</span> Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: Period 6.9561063 D AND ZERO-PHASE HJD2459517.43305					
	<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>
(1)		TOI-1420	RA: 21 31 46.0342 (322.9418092d) Dec: +66 20 56.42 (66.34901d) Equinox: J2000	Proper Motion RA: 0.007558329922736845 sec of time/yr Proper Motion Dec: 0.031874 arcsec/yr Epoch of Position: 2015.5	V=11.65	Reference Frame: SIMBAD
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=STAR Description=[G V-IV]						

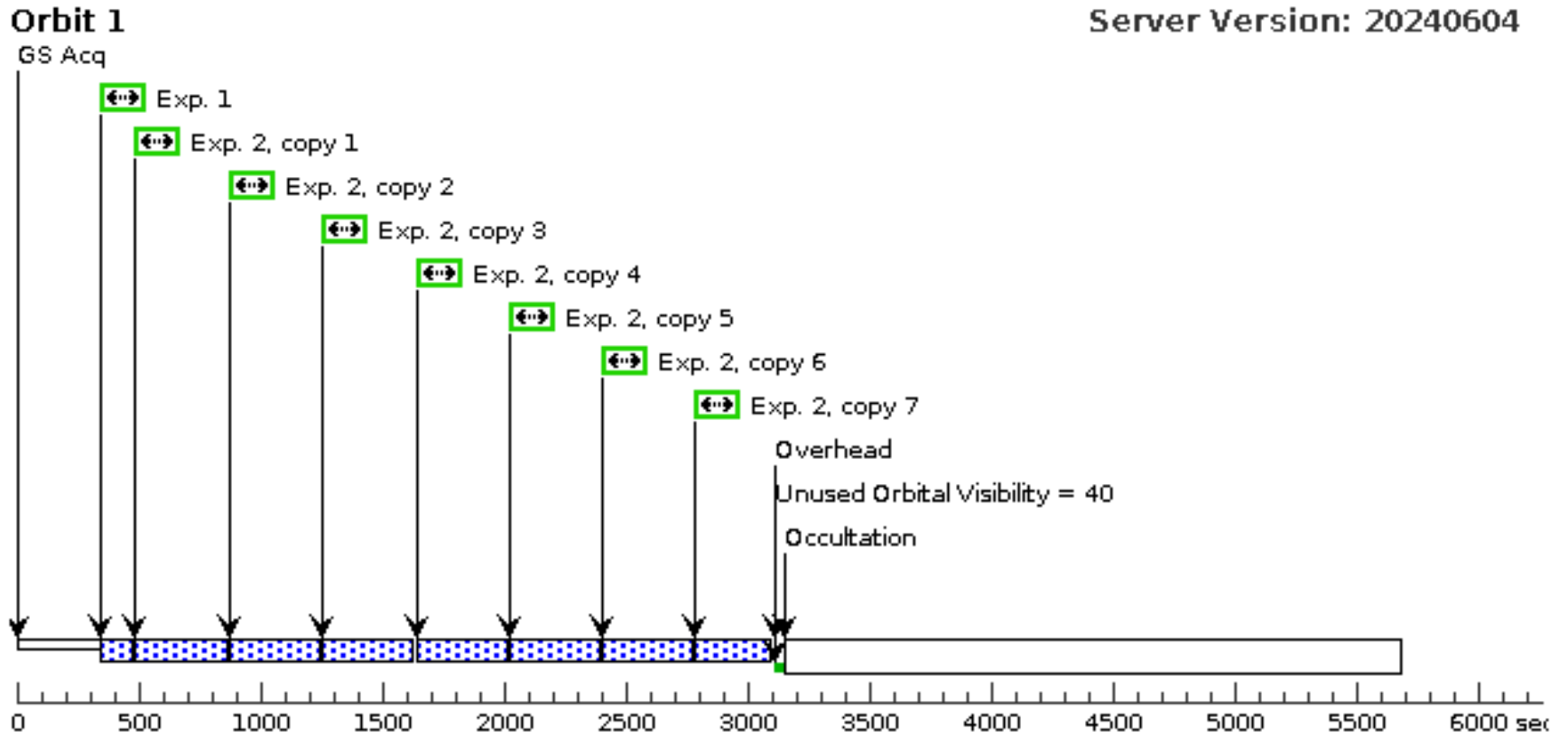
Proposal 17489 - TOI-1420 T2 (02) - Hunting for Hazes in the Atmosphere of a Warm Super-Puff

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Exposures	1	(WFC3UVI S.im.189098 8)	(1) TOI-1420	WFC3/UVIS, ACCUM, G280-REF	F300X	FLASH=16; CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50; PHASE 0.97504191 23 TO 0.9770385593	Sequence 1-2 Non-Int in TOI-1420 T2 (02 )	30 Secs (30 Secs) [==>]	[1]
	2	(WFC3UVI S.sp.189099 0)	(1) TOI-1420	WFC3/UVIS, ACCUM, UVIS	G280	CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50	Sequence 1-2 Non-Int in TOI-1420 T2 (02 )	312 Secs X 7 (2184 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)]	[1]
	3	(WFC3UVI S.sp.189099 0)	(1) TOI-1420	WFC3/UVIS, ACCUM, UVIS	G280	CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50	Sequence 3-3 Non-Int in TOI-1420 T2 (02 )	284 Secs X 8 (2272 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)]	[2]
	4	(WFC3UVI S.sp.189099 0)	(1) TOI-1420	WFC3/UVIS, ACCUM, UVIS	G280	CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50	Sequence 4-4 Non-Int in TOI-1420 T2 (02 )	284 Secs X 8 (2272 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)]	[3]
	5	(WFC3UVI S.sp.189099 0)	(1) TOI-1420	WFC3/UVIS, ACCUM, UVIS	G280	CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50	Sequence 5-5 Non-Int in TOI-1420 T2 (02 )	284 Secs X 8 (2272 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)]	[4]

Proposal 17489 - TOI-1420 T2 (02) - Hunting for Hazes in the Atmosphere of a Warm Super-Puff

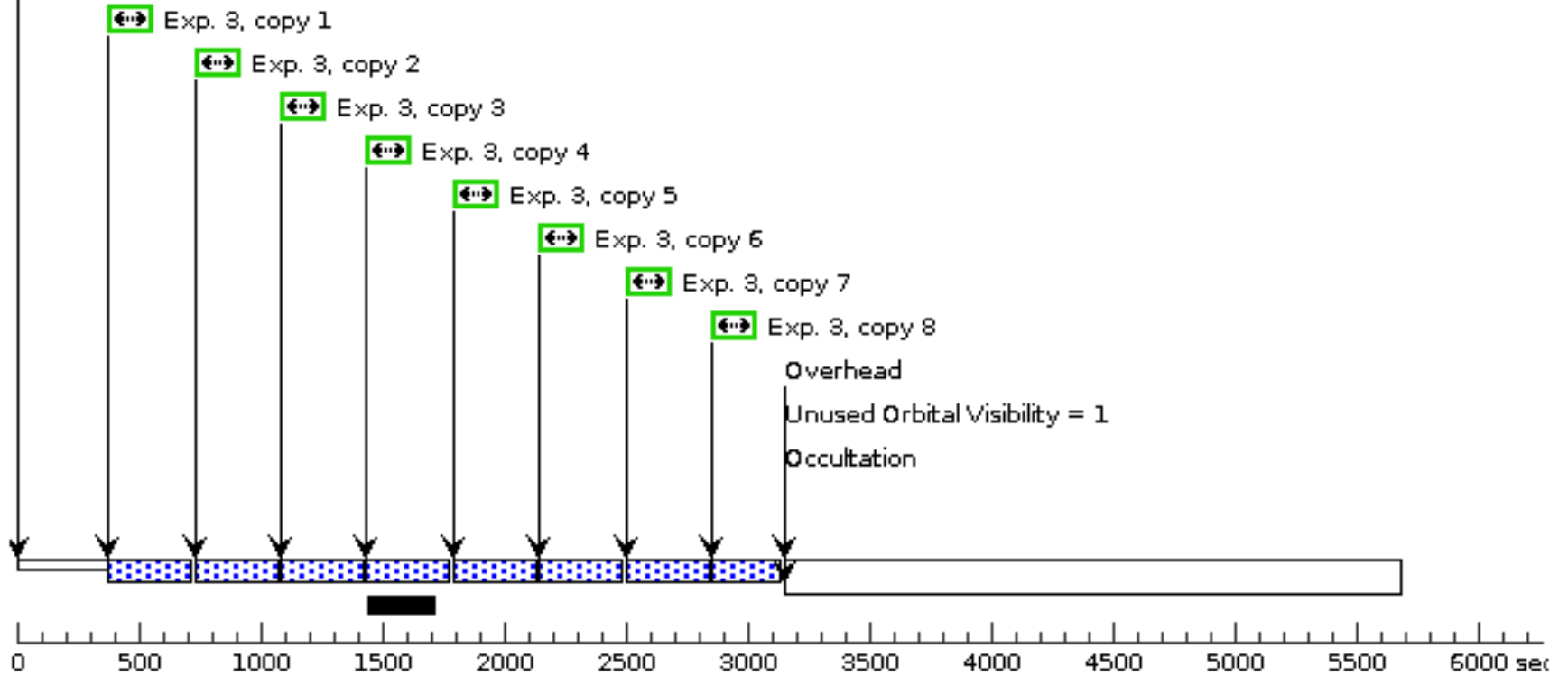
6	(WFC3UVI S.sp.189099 0)	(1) TOI-1420	WFC3/UVIS, ACCUM, UVIS	G280	CENTERAXIS1=21 48; CENTERAXIS2=12 08; SIZEAXIS1=2100; SIZEAXIS2=600	POS TARG null,-50 Sequence 6-6 Non-In t in TOI-1420 T2 (02 )	284 Secs X 8 (2272 Secs) [==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)] [==>(Copy 7)] [==>(Copy 8)]	[5]
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Orbit Structure



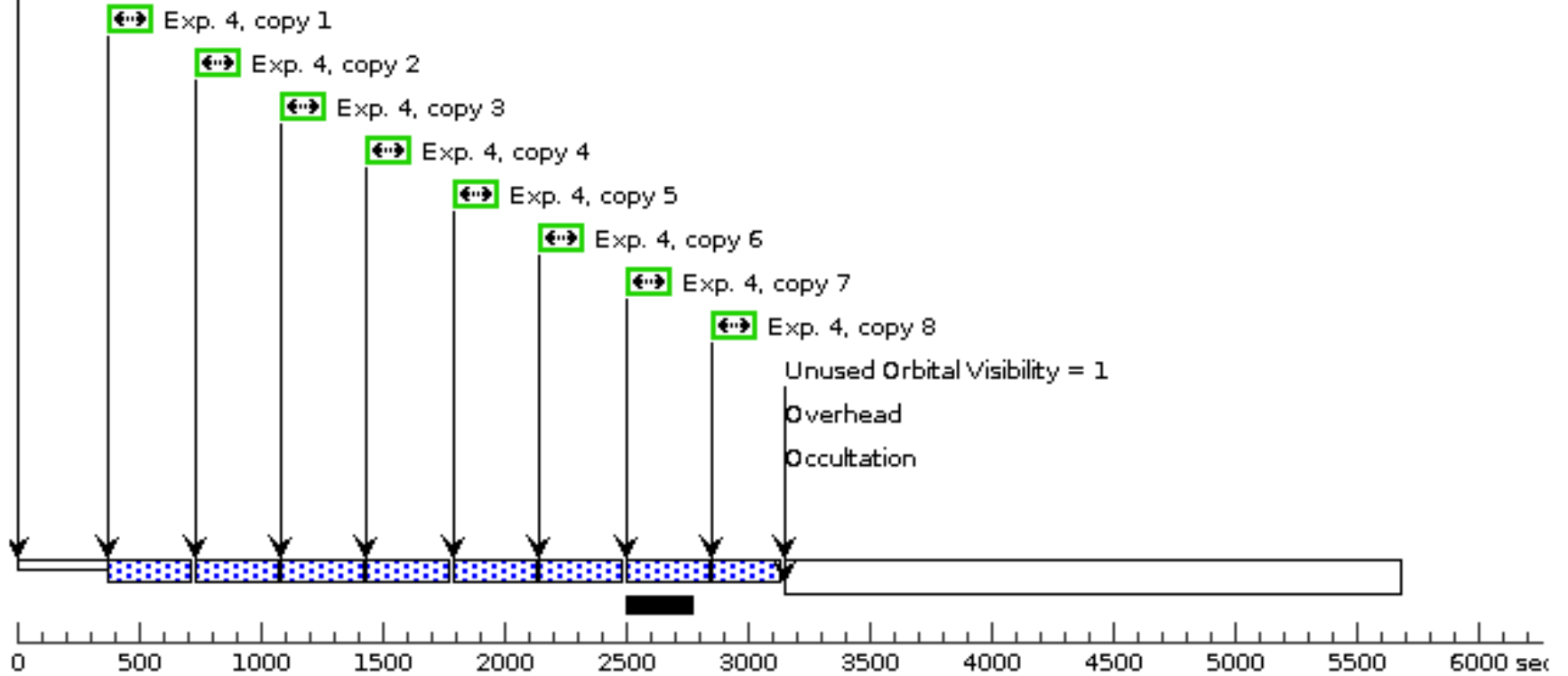
**Orbit 2**

GS Reacq



### Orbit 3

GS Reacq



### Orbit 4

GS Reacq

