15859 - Traveling across the valley: comparative exoplanetology in the GJ 9827 system

Cycle: 27, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) GJ9827 WAVE	STIS/CCD STIS/FUV-MAMA	5	02-Dec-2019 12:00:16.0	yes
02	(1) GJ9827 WAVE	STIS/CCD STIS/FUV-MAMA	5	02-Dec-2019 12:00:19.0	yes

10 Total Orbits Used

ABSTRACT

The transition between rocky and volatile-rich planets is one of the most topical questions. The valley found to split the population of small close-in planets into 2 size regimes is thought to originate from atmospheric escape: some planets lose their atmosphere while others retain their volatile species. The 3-planets system orbiting GJ9827 spans the breadth of the valley: GJ9827c is on its low-radius side, and likely lost its volatile envelope; GJ9827b may be one of the few planets to have formed without an envelope within the valley, or it could have a water-rich envelope resilient to escape; GJ9827d is on the large-radius side, and the most favorable for atmospheric escape detection. GJ9827 is one of the few multi-planet systems whose star is bright and close enough for Ly-alpha transit spectroscopy. GJ9827b is being observed as part of an ongoing HST/UV program, and we propose to complete the exploration of the system by observing 2 transits of GJ9827d with STIS in the Ly-alpha line (10 HST orbits in total). The planet is sufficiently irradiated to evaporate, but a much larger hydrogen escape is expected from a H/He atmosphere compared to a water-rich envelope, both proposed to explain GJ9827d properties. Detecting a giant hydrogen cloud would thus favor an H/He atmosphere, while a non-detection or low hydrogen escape would favor a water-rich envelope acquired beyond the snowline. The program will constrain the nature of GJ9827d and the origin of the GJ9827 system, improve our understanding of the role played by evaporation in the transition from mini-Neptunes to super-Earths, and inform the community for an in-depth characterization of the GJ9827 planets with JWST

OBSERVING DESCRIPTION

This program consists in 2 visits of 5 HST orbits each. In each visit, we will observe the transit of an exoplanet (GJ9827d) in front of its host star. Transits occur every 6.2 days (the orbital period of the planet) and last for 1.2 hours. The goal is to search for a hydrogen exosphere surrounding the planet and occulting the star at Lyman-alpha. The timing requirements are set as phase constraints on the first ACQ exposure of the first orbit in a visit, with allowed start phase range of 25 min.

Visits could be reduced to 4 HST orbits each if scheduling proves too difficult, however our science goals would be better reached with 5 orbits. Two orbits before the planet transit are required to measure the flux from the unocculted star, one orbit is scheduled during the nominal planet transit (when absorption from a putative extended exosphere is maximum), and two orbits scheduled after the transit will allow us to search for and characterize an exospheric tail trailing the planet.

We set BETWEEN constraints for the two visits to avoid time windows when other planets in the system (GJ9827b and GJ9827c) transit as well.

Ideally the two visits should further be scheduled between July 25th 2019 and December 13rd 2019, or between July, 25th 2020 and December, 13rd 2020 to reduce airglow contamination. It would be best for our science goals if the two visits could be scheduled as close as possible to each other, and as closes as possible to the start of these windows. These constraints can however be removed if scheduling proves too difficult.

We use the same settings as GO#15434, which used STIS/FUV-MAMA and the G140M grism centered on a wavelength of 1,222 to observe the transit of GJ9827b at Lyman-alpha.

Visit

Proposal 15859, Visit 01, implementation Mon Dec 02 17:00:20 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: SCHED 100%; Period 6.201467 D AND ZERO-PHASE HJD2457740.96110

Comments: We set a BETWEEN constraint to limit airglow contamination

Fixed Targets

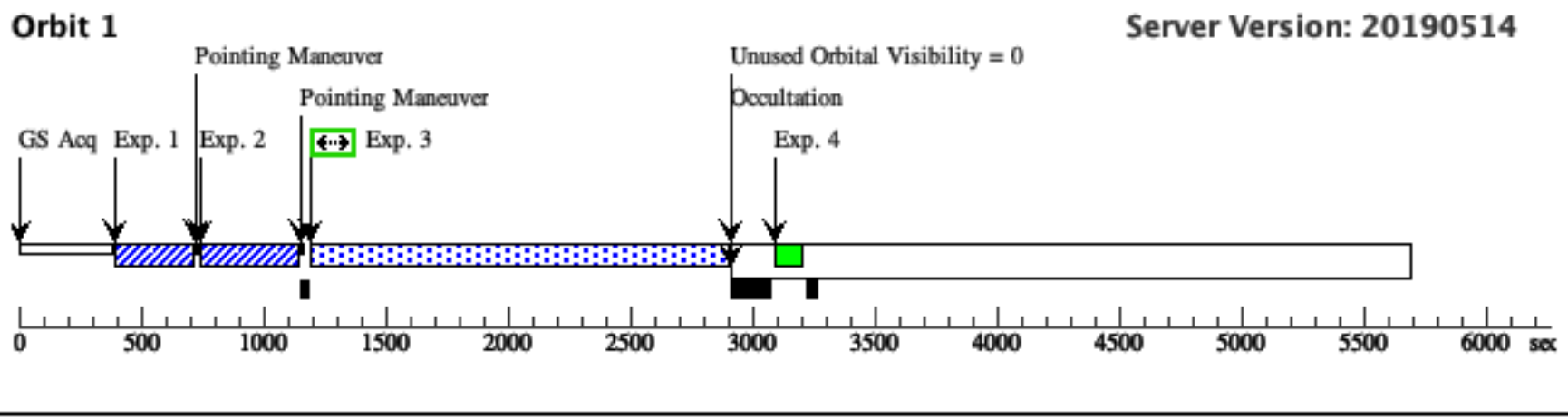
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GJ9827	RA: 23 27 4.8377 (351.7701571d)	Proper Motion RA: 376.019 mas/yr	V=10.1	Reference Frame: ICRS
	Alt Name1: K2-135	Dec: -01 17 10.59 (-1.28627d)	Proper Motion Dec: 216.071 mas/yr	B =11.57,	
	Alt Name2: BD-02D5958	Equinox: J2000	Parallax: 0.0336855"	R =10.09,	
			Epoch of Position: 2000	I =8.89,	
			Radial Velocity: 32.1 km/sec	G =9.8377,	
				J =7.984,	
				H =7.379,	
				K =7.193,	
				i = 9.18	

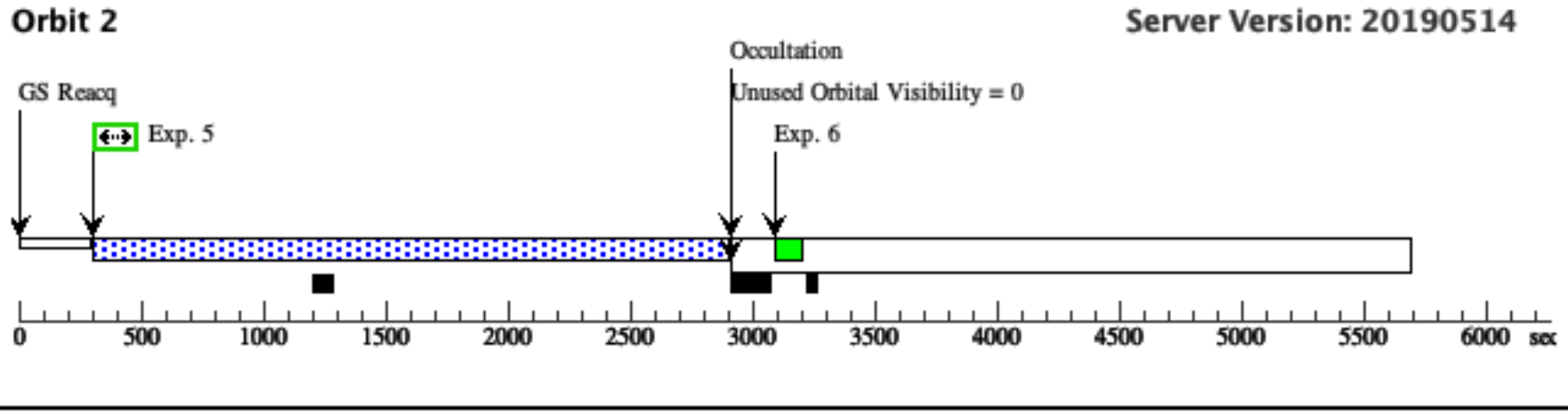
Comments: All target properties come from the SIMBAD database. We used the confirmation charts to check that the coordinates and proper motion were correct.
Category=STAR
Description=[EXTRA-SOLAR PLANET, K V-IV]
Extended=NO

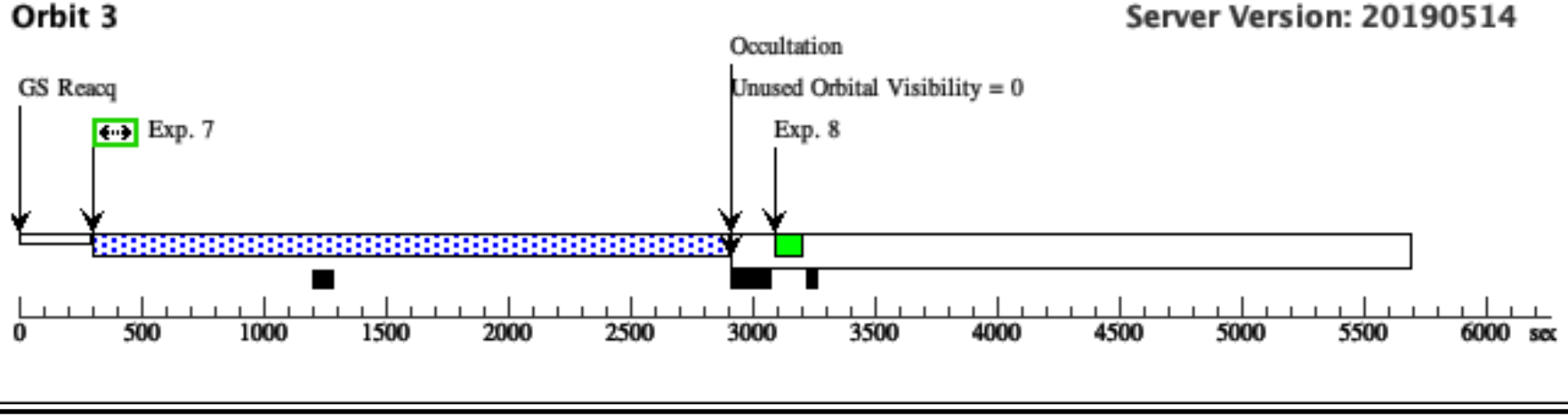
Exposures

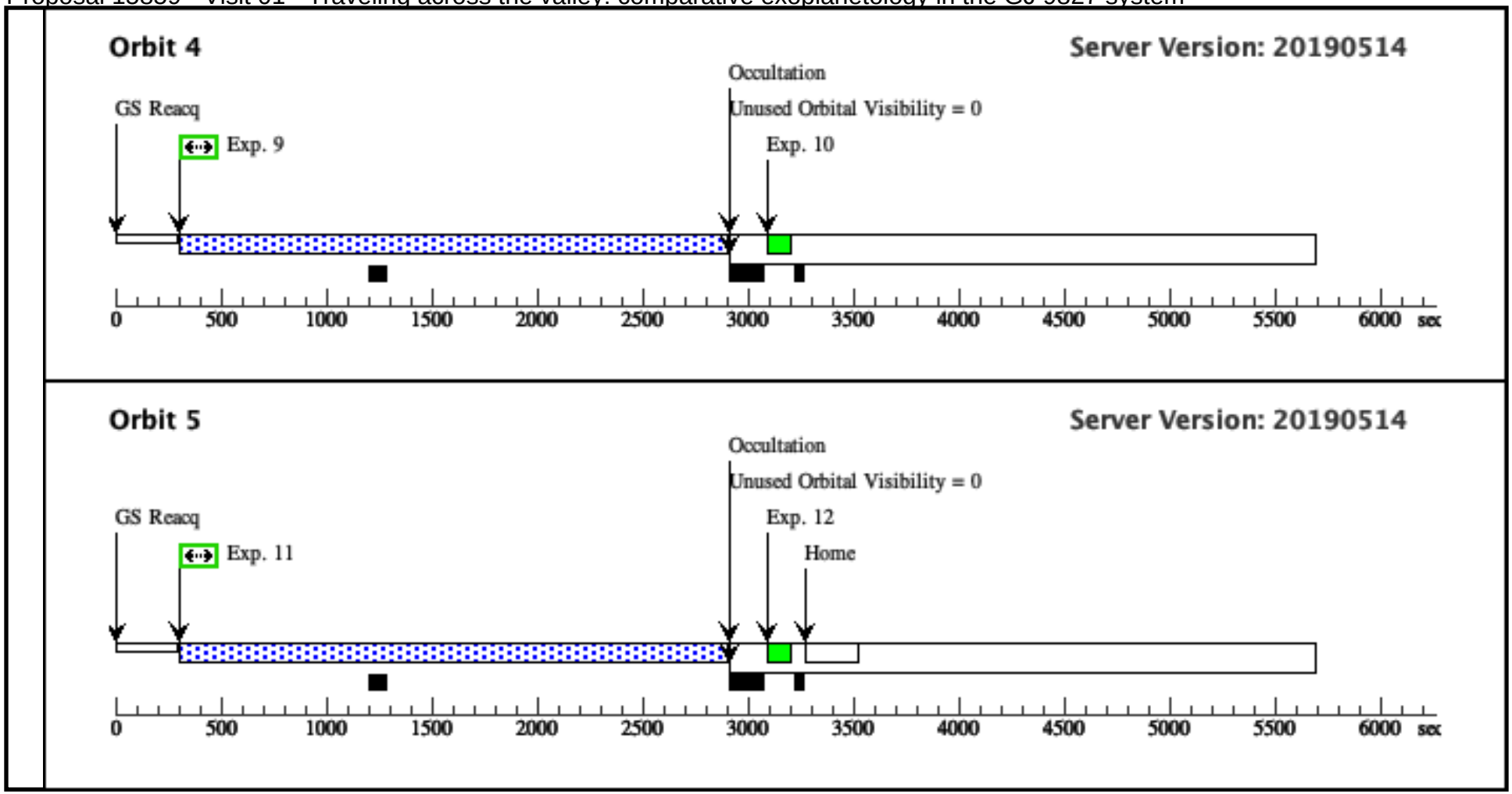
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (STIS.ta.1040017)	(1) GJ9827	STIS/CCD, ACQ, F25ND3	MIRROR	ACQTYPE=POINT	PHASE 0.965 TO 0.9773	Sequence 1-4 Non-Int in Visit 01	6.6 Secs (6.6 Secs) *[==>]*	***[1]***
Comments: Same settings as GO#15434									
2	ACQ/PEAK (STIS.sp.1040054)	(1) GJ9827	STIS/CCD, ACQ/PEAK, 31X0.05NDC	G430L 4300 A			Sequence 1-4 Non-Int in Visit 01	1 Secs (1 Secs) *[==>]*	***[1]***
Comments: Same settings as GO#15434									
3	SCI (STIS.sp.1040055)	(1) GJ9827	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=900; WAVECAL=NO		Sequence 1-4 Non-Int in Visit 01	1786 Secs (1502 Secs) *[==>1502.0 Secs]*	***[1]***
Comments: Same settings as GO#15434									
4	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 1-4 Non-Int in Visit 01	*[==>]*	***[1]***
5	SCI (STIS.sp.1040057)	(1) GJ9827	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=900; WAVECAL=NO		Sequence 5-6 Non-Int in Visit 01	2890 Secs (2586 Secs) *[==>2586.0 Secs]*	***[2]***
6	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 5-6 Non-Int in Visit 01	*[==>]*	***[2]***
7	SCI (STIS.sp.1040057)	(1) GJ9827	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=900; WAVECAL=NO		Sequence 7-8 Non-Int in Visit 01	3000 Secs (2586 Secs) *[==>2586.0 Secs]*	***[3]***
8	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 7-8 Non-Int in Visit 01	*[==>]*	***[3]***
9	SCI (STIS.sp.1040057)	(1) GJ9827	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=900; WAVECAL=NO		Sequence 9-10 Non-Int in Visit 01	3000 Secs (2586 Secs) *[==>2586.0 Secs]*	***[4]***
10	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 9-10 Non-Int in Visit 01	*[==>]*	***[4]***
11	SCI (STIS.sp.1040057)	(1) GJ9827	STIS/FUV-MAMA, TIME-TAG, 52X0.1D1	G140M 1222 A	BUFFER-TIME=900; WAVECAL=NO		Sequence 11-12 Non-Int in Visit 01	3000 Secs (2586 Secs) *[==>2586.0 Secs]*	***[5]***
12	GO-WAVE CAL	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A			Sequence 11-12 Non-Int in Visit 01	*[==>]*	***[5]***

Orbit Structure





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5500
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sec

Visit

Proposal 15859, Visit 02, implementation Mon Dec 02 17:00:20 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: SCHED 100%; Period 6.201467 D AND ZERO-PHASE HJD2457740.96110

Comments: We set a BETWEEN constraint to limit airglow contamination

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
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	Alt Name2: BD-02D5958	Equinox: J2000	Parallax: 0.0336855"	R =10.09,	
			Epoch of Position: 2000	I =8.89,	
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Comments: Same settings as GO#15434									
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Comments: Same settings as GO#15434									
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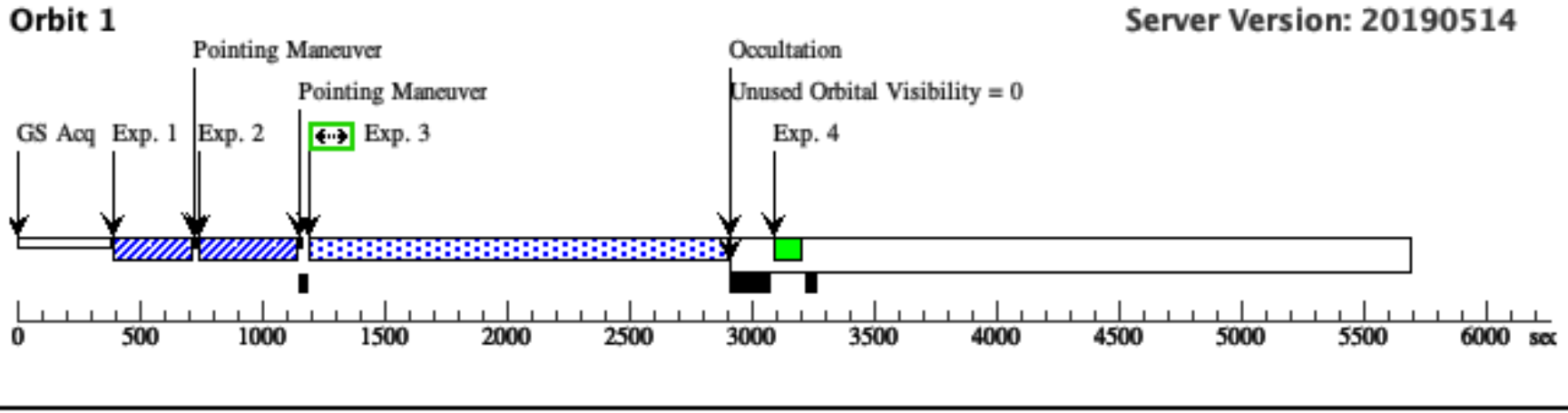
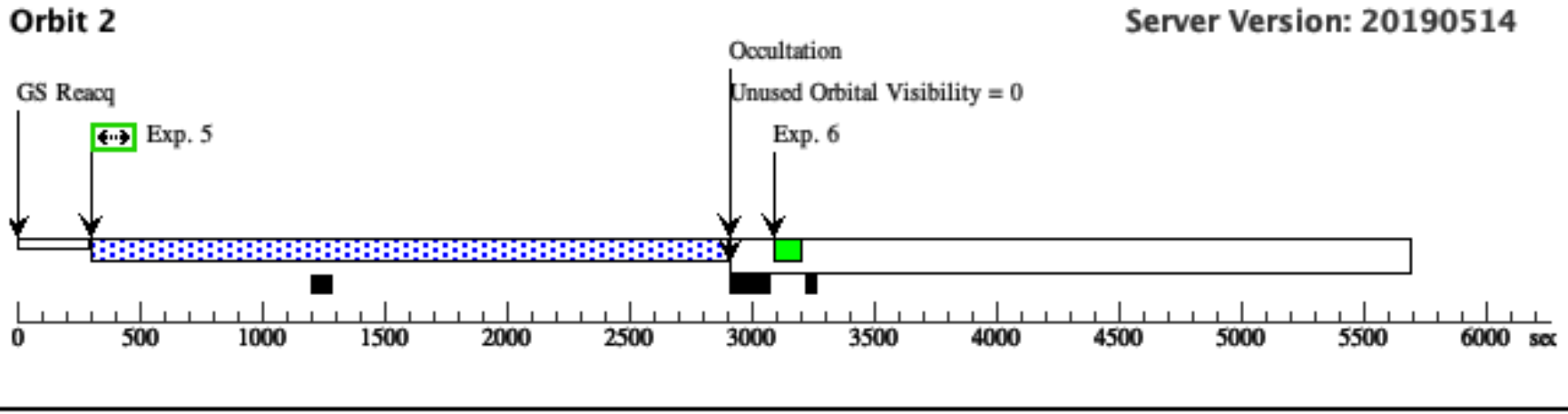
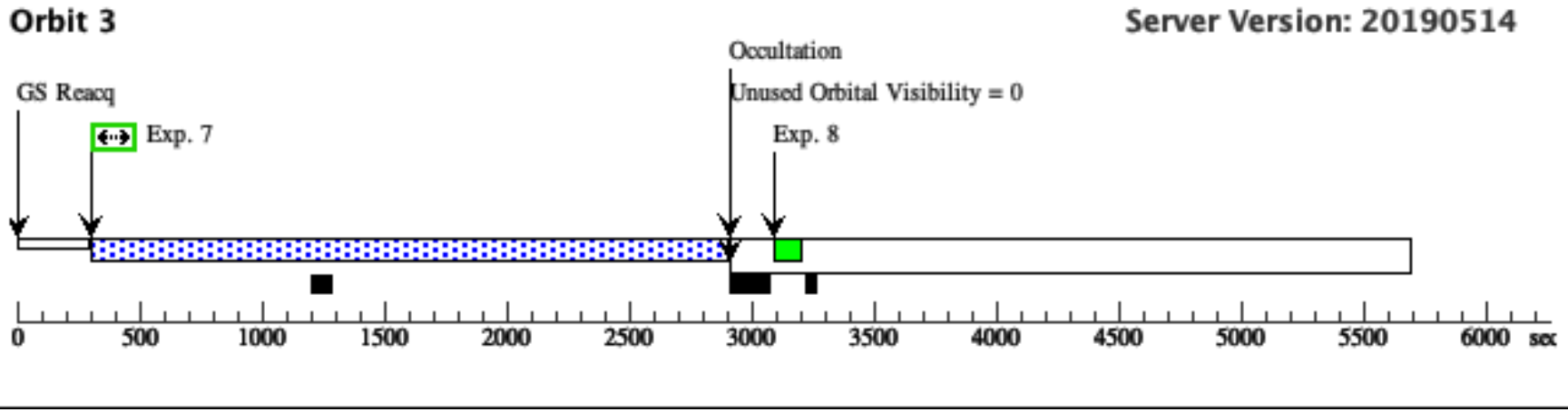
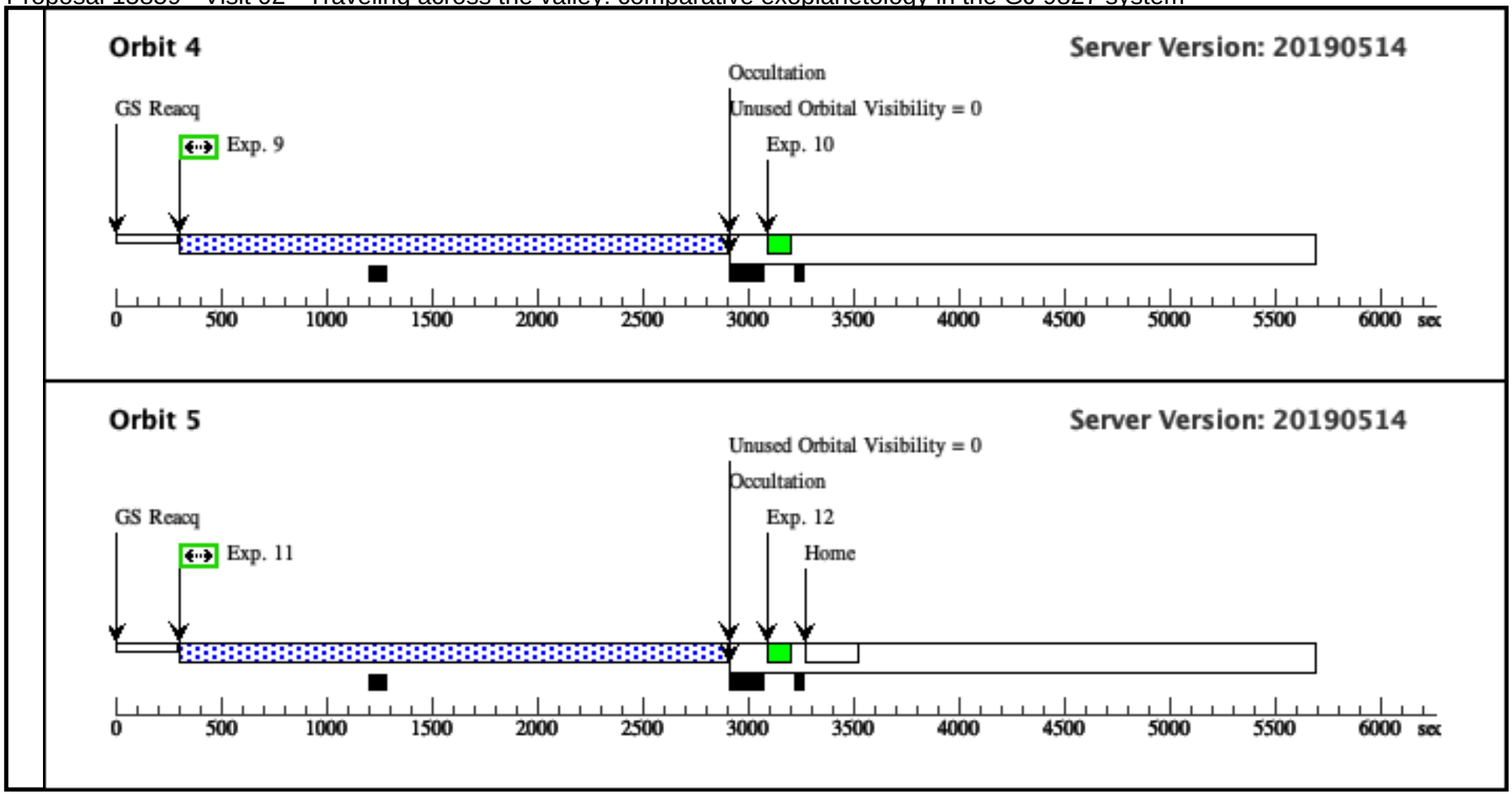
Orbit Structure





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Server Version: 20190514
Occultation
GS Reacq
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