



## 17816 - The largest BAL acceleration: testing disk wind models

Cycle: 32, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

### INVESTIGATORS

<i>Name</i>	<i>Institution</i>
<b>Dr. Nahum Arav (PI) (Contact)</b>	<b>Virginia Polytechnic Institute and State University</b>
Dr. Xinfeng Xu (CoI)	Northwestern University
Dr. Gerard A. Kriss (CoI)	Space Telescope Science Institute
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Dr. Maryam Dehghanian (CoI)	University of Kentucky
Mr. Mayank Sharma (CoI) (Contact)	Virginia Polytechnic Institute and State University
Dr. Doyee Byun (CoI)	University of Michigan

### 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) 2MASS-J10424423+1646560	COS/FUV COS/NUV	3	21-Jan-2026 15:00:29.0	yes
02	(1) 2MASS-J10424423+1646560	COS/FUV COS/NUV	3	21-Jan-2026 15:00:32.0	yes
03	(1) 2MASS-J10424423+1646560	COS/FUV COS/NUV	3	21-Jan-2026 15:00:33.0	yes
04	(1) 2MASS-J10424423+1646560	COS/FUV COS/NUV	2	21-Jan-2026 15:00:35.0	yes

<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>
05	(1) 2MASS-J10424423+1646560	COS/FUV COS/NUV	3	21-Jan-2026 15:00:37.0	yes

14 Total Orbits Used

## **ABSTRACT**

Quasar outflows are invoked as the major agent of AGN feedback and are crucial for the mass inflow/outflow balance in the vicinity of super massive black holes. Significant effort was invested over the past 3 decades in creating theoretical models for the formation and acceleration of these outflows. However, there is no decisive empirical test that confirms or refutes such models. These models have specific predictions for an outflow found in its acceleration phase. Recently, an outflow with the largest acceleration ever detected was found, and it is the ideal candidate to test acceleration models. Previous HST observations in 2011 and 2017 showed that the outflow's velocity shifted by -1550 km/s (the largest shift observed to date). Any one episode of acceleration can be accommodated by a disk-wind model solution. However, that solution predicts specific acceleration and distance values for future times and thus can be tested.

We propose a 3rd epoch of observations, which will yield both the velocity and distance from the central source for the outflow. Thus, we will obtain a full empirical test for the acceleration models, and more generally, an unprecedented observational study of a broad absorption line outflow acceleration.

## **OBSERVING DESCRIPTION**

To accurately determine the outflow distance to the central source ( $R$ ), a minimal spectral resolution of 5000 is needed as well as high throughput. Therefore, the use of COS G130M and G160M is necessary.

The photoionization solution (PIS) derived from the 2017 epoch and the corresponding electron number density ( $n_e$ ) (and therefore  $R$ ) are loosely constrained. The PIS can be better constrained if we can measure the ionic column densities ( $N_{ion}$ ) for both O IV and Na IX, as compared with the current upper limits. Our simulations for a range of S/N show that to obtain a meaningful constraint on the M95 acceleration model, a S/N of 30 per a  $R = 5000$  resolution element is required. Using the COS ETC, we determine that the desired S/N can be obtained in 7 ks and 13 ks for the G130M and G160M gratings, respectively. Taking into account the overheads, this translates to a total of 11 orbits.

In selecting our grating settings, we have chosen central wavelengths to avoid placing the gap between the COS detectors on any of the crucial

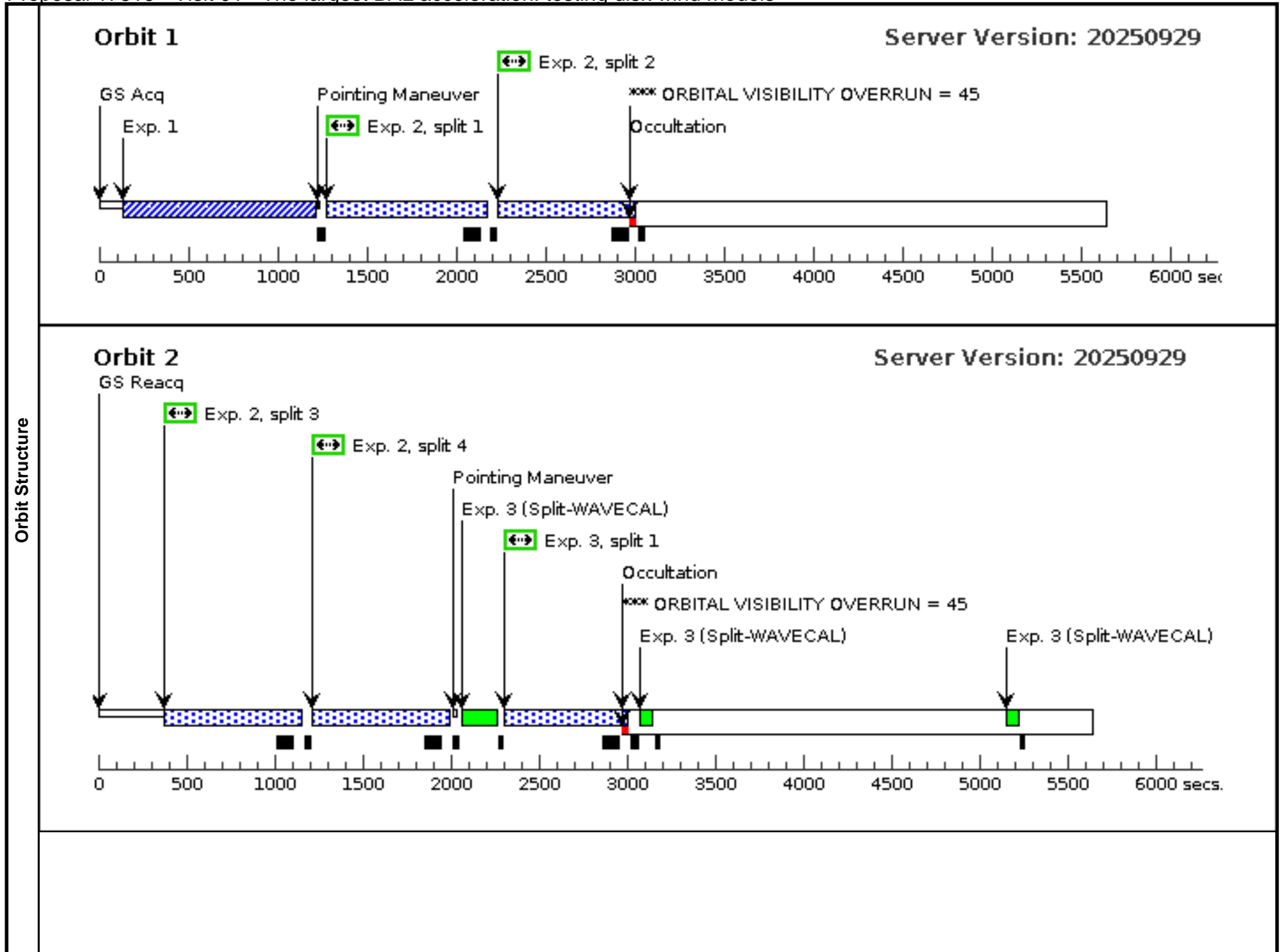
Proposal 17816 (STScI Edit Number: 1, Created: Wednesday, January 21, 2026, 3:00:37PM Eastern Standard Time) - Overview

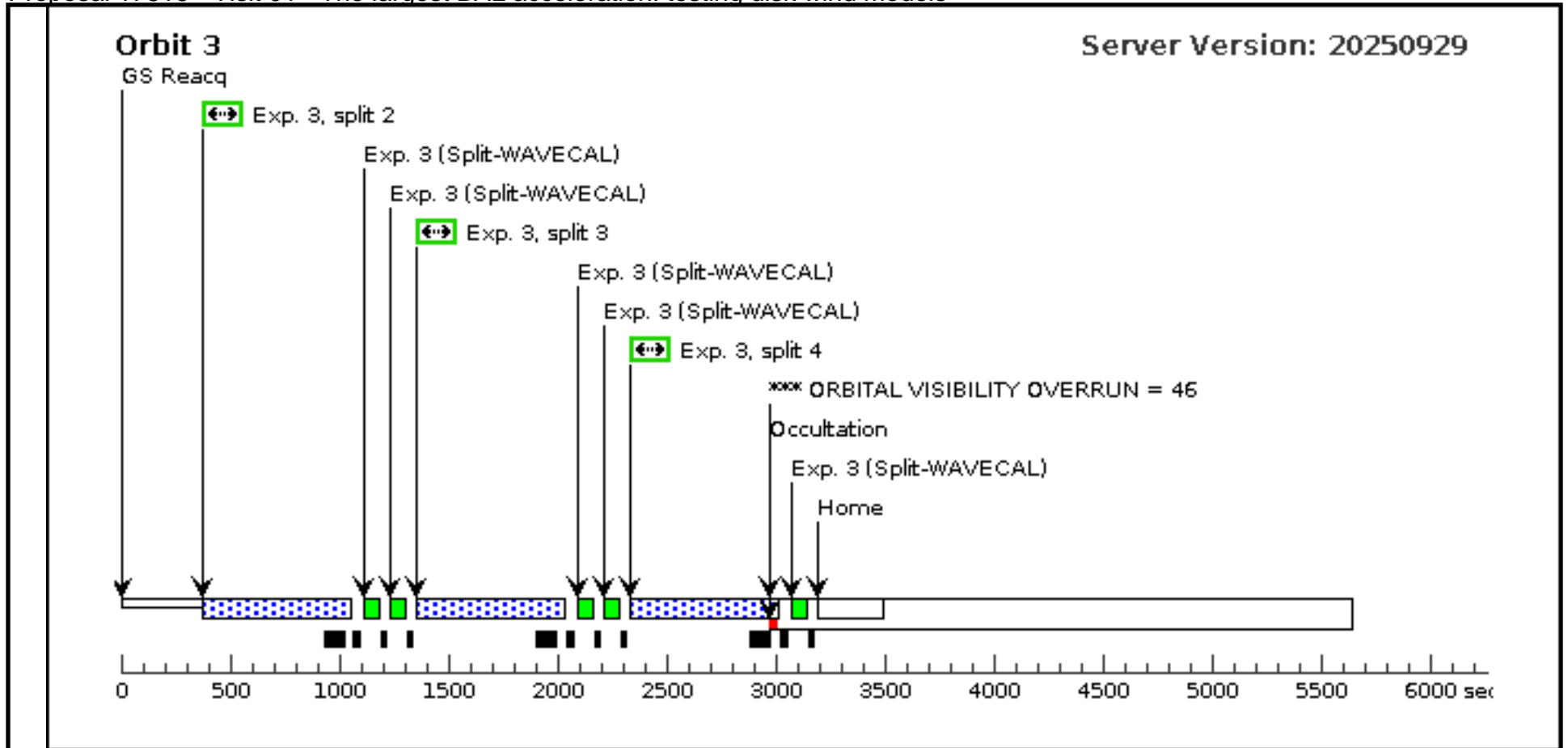
spectral features we will use in our analysis. For ETC calculations we use the FOS-based QSO composite spectrum at the redshift of the object with a foreground  $E(B-V)$  as given by NED. Since the object has been observed safely with COS before, there are no bright object concerns for our observations. To plan our observations, we use ETC calculations that are conservative (both fainter and brighter) to ensure success. We plan target acquisition exposure times for minimum flux that is 3x lower than the observed flux, and set BUFFER-TIME for flux 3x brighter, and use the factor of 2/3 recommended by the ETC. In practice, all BUFFER times from the ETC are >4000 secs, so, to optimize buffer usage and minimize overheads, we generally choose BUFFER-TIME such that  $\text{BUFFER-TIME} = \text{ExposureTime} - 110 \text{ s}$ .

Proposal 17816 - Visit 01 - The largest BAL acceleration: testing disk wind models

Wed Jan 21 20:00:37 GMT 2026

<b>Visit</b>	<b>Proposal 17816, Visit 01, scheduling</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)									
	(Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN									
<b>Diagnosics</b>										
<b>Fixed Targets</b>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	2MASS-J10424423+1646560	RA: 10 42 44.2385 (160.6843271d) Dec: +16 46 56.09 (16.78225d) Equinox: J2000	Epoch of Position: 2000 Redshift: 0.978063	V=16.75+/-0.5 1.3e-15 at 1516 A	Reference Frame: ICRS				
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=GALAXY Description=[NUCLEUS, QSO, WIND] Extended=NO										
<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(COS.ta.192 7870)	(1) 2MASS-J104244 23+1646560	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				385 Secs (385 Secs)	
									[==>]	[1]
	2	(COS.sp.192 8300)	(1) 2MASS-J104244 23+1646560	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=60 0; FP-POS=ALL			710 Secs (2884 Secs)	
									[==>715.0 Secs (Split 1)]	[1]
									[==>715.0 Secs (Split 2)]	
									[==>727.0 Secs (Split 3)]	[2]
								[==>727.0 Secs (Split 4)]		
3	(COS.sp.192 8302)	(1) 2MASS-J104244 23+1646560	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=52 0; FP-POS=ALL			630 Secs (2525 Secs)		
								[==>647.0 Secs (Split 1)]	[2]	
								[==>626.0 Secs (Split 2)]		
								[==>626.0 Secs (Split 3)]	[3]	
								[==>626.0 Secs (Split 4)]		

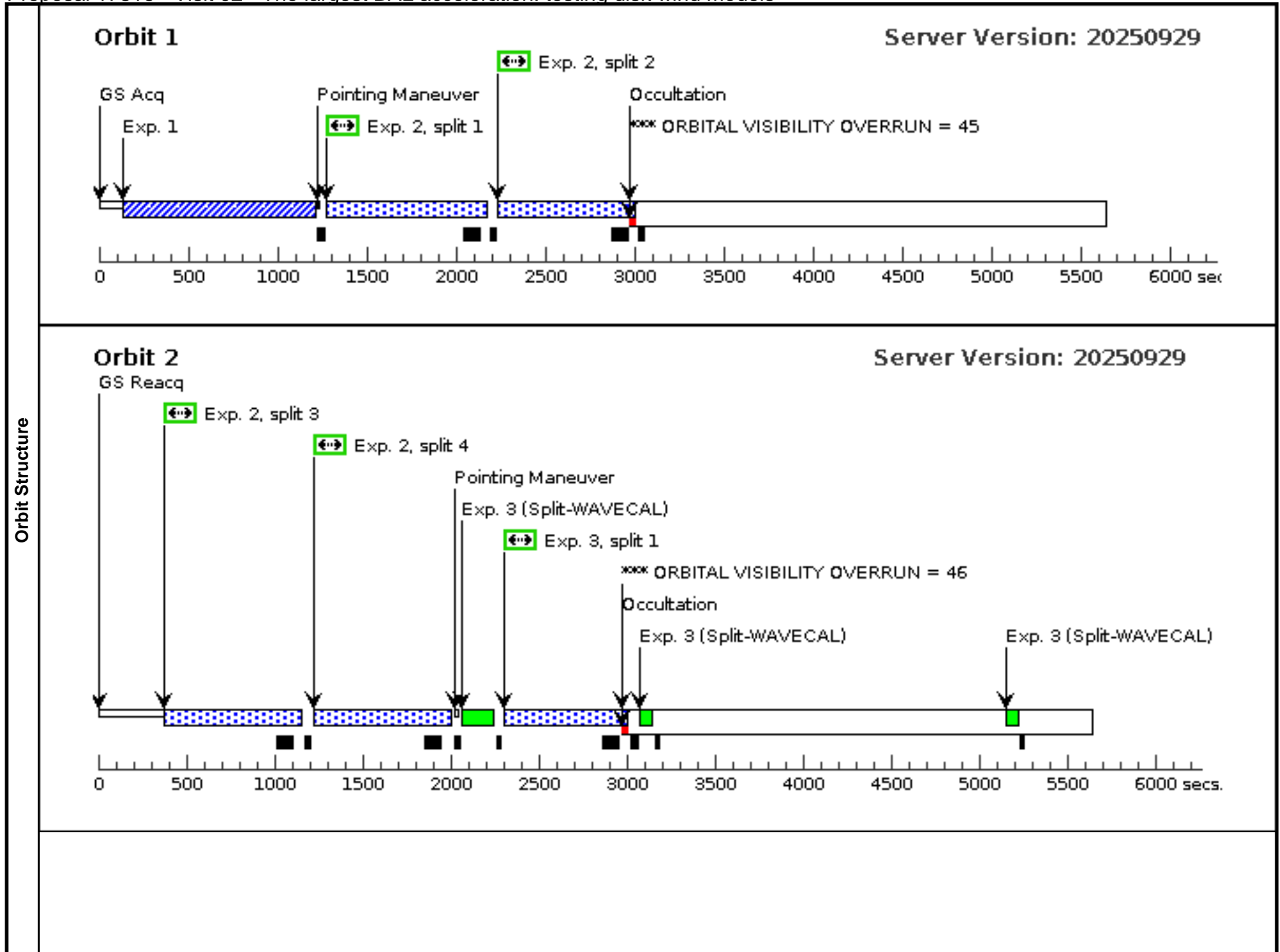


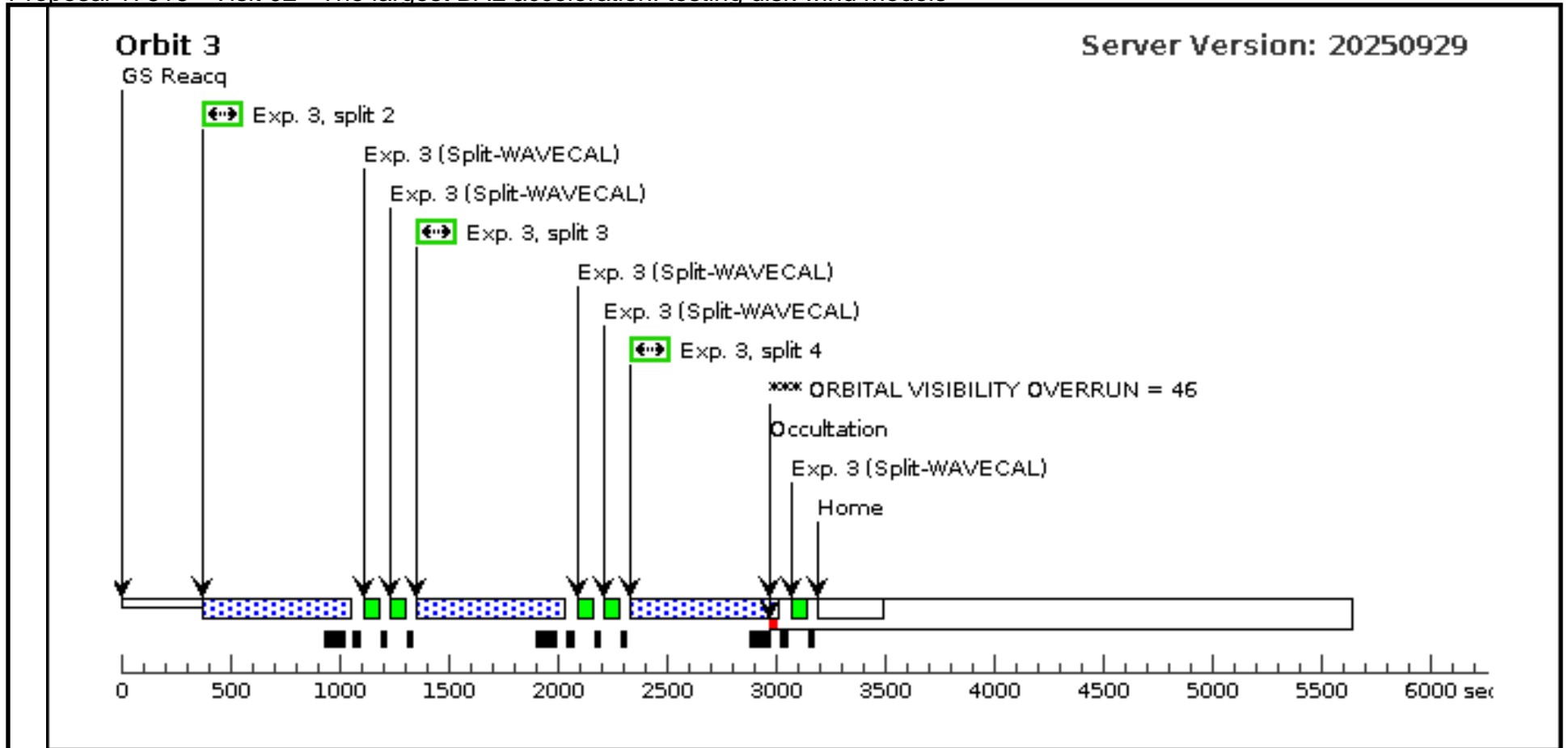


Proposal 17816 - Visit 02 - The largest BAL acceleration: testing disk wind models

Wed Jan 21 20:00:38 GMT 2026

<b>Visit</b>	<b>Proposal 17816, Visit 02, completed</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)																																													
	(Visit 02) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 02) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 02) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN																																													
<b>Diagnosics</b>																																														
<b>Fixed Targets</b>	<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>2MASS-J10424423+1646560</td> <td>RA: 10 42 44.2385 (160.6843271d) Dec: +16 46 56.09 (16.78225d) Equinox: J2000</td> <td>Epoch of Position: 2000 Redshift: 0.978063</td> <td>V=16.75+/-0.5 1.3e-15 at 1516 A</td> <td>Reference Frame: ICRS</td> </tr> </tbody> </table>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	2MASS-J10424423+1646560	RA: 10 42 44.2385 (160.6843271d) Dec: +16 46 56.09 (16.78225d) Equinox: J2000	Epoch of Position: 2000 Redshift: 0.978063	V=16.75+/-0.5 1.3e-15 at 1516 A	Reference Frame: ICRS	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=GALAXY Description=[NUCLEUS, QSO, WIND] Extended=NO																																
	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous																																								
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<b>Exposures</b>	<table border="1"> <thead> <tr> <th>#</th> <th>Label (ETC Run)</th> <th>Target</th> <th>Config,Mode,Aperture</th> <th>Spectral Els.</th> <th>Opt. Params.</th> <th>Special Reqs.</th> <th>Groups</th> <th>Exp. Time (Total)/[Actual Dur.]</th> <th>Orbit</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>(COS.ta.192 7870)</td> <td>(1) 2MASS-J104244 23+1646560</td> <td>COS/NUV, ACQ/IMAGE, PSA</td> <td>MIRRORB</td> <td></td> <td></td> <td></td> <td>385 Secs (385 Secs) [==&gt;]</td> <td>[1]</td> </tr> <tr> <td>2</td> <td>(COS.sp.192 8300)</td> <td>(1) 2MASS-J104244 23+1646560</td> <td>COS/FUV, TIME-TAG, PSA</td> <td>G130M 1222 A</td> <td>BUFFER-TIME=60 0; FP-POS=ALL</td> <td></td> <td></td> <td>710 Secs (2892 Secs) [==&gt;715.0 Secs (Split 1)] [==&gt;715.0 Secs (Split 2)] [==&gt;731.0 Secs (Split 3)] [==&gt;731.0 Secs (Split 4)]</td> <td>[1] [2]</td> </tr> <tr> <td>3</td> <td>(COS.sp.192 8302)</td> <td>(1) 2MASS-J104244 23+1646560</td> <td>COS/FUV, TIME-TAG, PSA</td> <td>G160M 1533 A</td> <td>BUFFER-TIME=52 0; FP-POS=ALL</td> <td></td> <td></td> <td>630 Secs (2529 Secs) [==&gt;651.0 Secs (Split 1)] [==&gt;626.0 Secs (Split 2)] [==&gt;626.0 Secs (Split 3)] [==&gt;626.0 Secs (Split 4)]</td> <td>[2] [3]</td> </tr> </tbody> </table>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	1	(COS.ta.192 7870)	(1) 2MASS-J104244 23+1646560	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				385 Secs (385 Secs) [==>]	[1]	2	(COS.sp.192 8300)	(1) 2MASS-J104244 23+1646560	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=60 0; FP-POS=ALL			710 Secs (2892 Secs) [==>715.0 Secs (Split 1)] [==>715.0 Secs (Split 2)] [==>731.0 Secs (Split 3)] [==>731.0 Secs (Split 4)]	[1] [2]	3	(COS.sp.192 8302)	(1) 2MASS-J104244 23+1646560	COS/FUV, TIME-TAG, PSA	G160M 1533 A	BUFFER-TIME=52 0; FP-POS=ALL			630 Secs (2529 Secs) [==>651.0 Secs (Split 1)] [==>626.0 Secs (Split 2)] [==>626.0 Secs (Split 3)] [==>626.0 Secs (Split 4)]	[2] [3]					
	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit																																				
	1	(COS.ta.192 7870)	(1) 2MASS-J104244 23+1646560	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				385 Secs (385 Secs) [==>]	[1]																																				
	2	(COS.sp.192 8300)	(1) 2MASS-J104244 23+1646560	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=60 0; FP-POS=ALL			710 Secs (2892 Secs) [==>715.0 Secs (Split 1)] [==>715.0 Secs (Split 2)] [==>731.0 Secs (Split 3)] [==>731.0 Secs (Split 4)]	[1] [2]																																				
	3	(COS.sp.192 8302)	(1) 2MASS-J104244 23+1646560	COS/FUV, TIME-TAG, PSA	G160M 1533 A	BUFFER-TIME=52 0; FP-POS=ALL			630 Secs (2529 Secs) [==>651.0 Secs (Split 1)] [==>626.0 Secs (Split 2)] [==>626.0 Secs (Split 3)] [==>626.0 Secs (Split 4)]	[2] [3]																																				

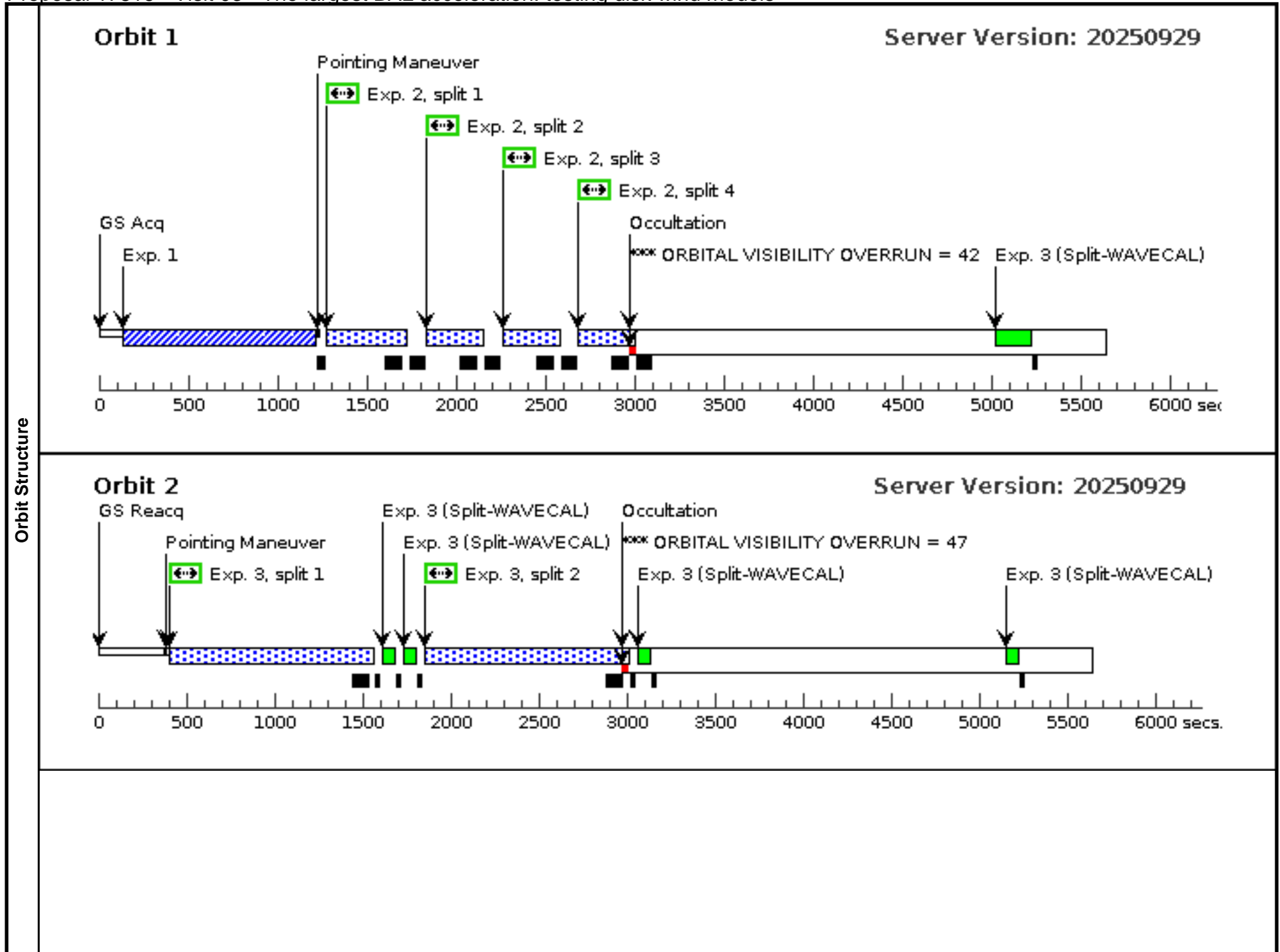


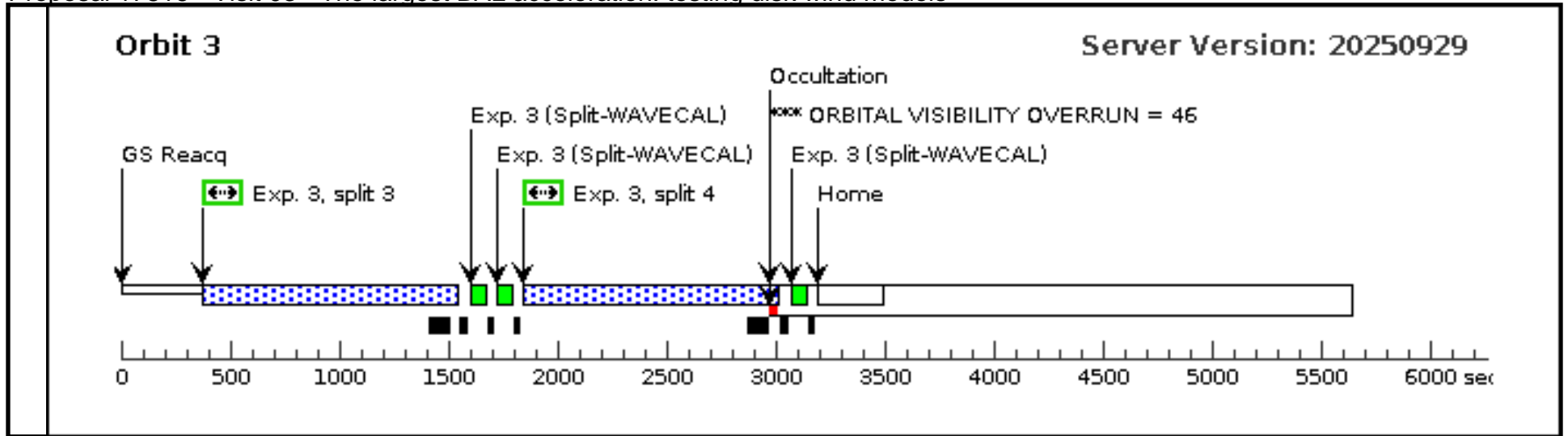


Proposal 17816 - Visit 03 - The largest BAL acceleration: testing disk wind models

Wed Jan 21 20:00:38 GMT 2026

<b>Visit</b>	<b>Proposal 17816, Visit 03, failed</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)									
	(Visit 03) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 03) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 03) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN									
<b>Diagnosics</b>										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>	<b>Miscellaneous</b>				
	(1)	2MASS-J10424423+1646560	RA: 10 42 44.2385 (160.6843271d) Dec: +16 46 56.09 (16.78225d) Equinox: J2000	Epoch of Position: 2000 Redshift: 0.978063	V=16.75+/-0.5 1.3e-15 at 1516 A	Reference Frame: ICRS				
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=GALAXY Description=[NUCLEUS, QSO, WIND] Extended=NO										
<b>Exposures</b>	<b>#</b>	<b>Label (ETC Run)</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time (Total)/[Actual Dur.]</b>	<b>Orbit</b>
	1	(COS.ta.192 7870)	(1) 2MASS-J104244 23+1646560	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				385 Secs (385 Secs) [==>]	[1]
	2	(COS.sp.192 8300)	(1) 2MASS-J104244 23+1646560	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=15 5; FP-POS=ALL			265 Secs (1056 Secs) [==>264.0 Secs (Split 1)] [==>264.0 Secs (Split 2)] [==>264.0 Secs (Split 3)] [==>264.0 Secs (Split 4)]	[1]
	3	(COS.sp.192 8302)	(1) 2MASS-J104244 23+1646560	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=10 00; FP-POS=ALL			1110 Secs (4440 Secs) [==>1105.0 Secs (Split 1)] [==>1105.0 Secs (Split 2)] [==>1115.0 Secs (Split 3)] [==>1115.0 Secs (Split 4)]	[2] [3]





Proposal 17816 - Visit 04 - The largest BAL acceleration: testing disk wind models

Wed Jan 21 20:00:38 GMT 2026

<b>Visit</b>	<b>Proposal 17816, Visit 04, scheduling</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)									
	(Visit 04) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 04) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN									
<b>Diagnosics</b>										
<b>Fixed Targets</b>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	2MASS-J10424423+1646560	RA: 10 42 44.2385 (160.6843271d) Dec: +16 46 56.09 (16.78225d) Equinox: J2000	Epoch of Position: 2000 Redshift: 0.978063	V=16.75+/-0.5 1.3e-15 at 1516 A	Reference Frame: ICRS				
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=GALAXY Description=[NUCLEUS, QSO, WIND] Extended=NO										
<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(COS.ta.192 7870)	(1) 2MASS-J104244 23+1646560	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				385 Secs (385 Secs)	
									[==>]	[1]
	2	(COS.sp.192 8302)	(1) 2MASS-J104244 23+1646560	COS/FUV, TIME-TAG, PSA	G160M 1533 A	BUFFER-TIME=69 0;			800 Secs (3151 Secs)	
						FP-POS=ALL			[==>1387.0 Secs (Split 1)] [==>588.0 Secs (Split 2)] [==>588.0 Secs (Split 3)] [==>588.0 Secs (Split 4)]	[1]   [2]



Proposal 17816 - Visit 03 repeat (05) - The largest BAL acceleration: testing disk wind models

Wed Jan 21 20:00:38 GMT 2026

<b>Visit</b>	<b>Proposal 17816, Visit 03 repeat (05)</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: (none)									
	(Visit 03 repeat (05)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 03 repeat (05)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 03 repeat (05)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN									
<b>Diagnosics</b>										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>	<b>Miscellaneous</b>				
	(1)	2MASS-J10424423+1646560	RA: 10 42 44.2385 (160.6843271d) Dec: +16 46 56.09 (16.78225d) Equinox: J2000	Epoch of Position: 2000 Redshift: 0.978063	V=16.75+/-0.5 1.3e-15 at 1516 A	Reference Frame: ICRS				
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Category=GALAXY Description=[NUCLEUS, QSO, WIND] Extended=NO										
<b>Exposures</b>	<b>#</b>	<b>Label (ETC Run)</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time (Total)/[Actual Dur.]</b>	<b>Orbit</b>
	1	(COS.ta.192 7870)	(1) 2MASS-J104244 23+1646560	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				385 Secs (385 Secs) [==>]	[1]
	2	(COS.sp.192 8300)	(1) 2MASS-J104244 23+1646560	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=15 5; FP-POS=ALL			265 Secs (1056 Secs) [==>264.0 Secs (Split 1)] [==>264.0 Secs (Split 2)] [==>264.0 Secs (Split 3)] [==>264.0 Secs (Split 4)]	[1]
	3	(COS.sp.192 8302)	(1) 2MASS-J104244 23+1646560	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=10 00; FP-POS=ALL			1110 Secs (4440 Secs) [==>1105.0 Secs (Split 1)] [==>1105.0 Secs (Split 2)] [==>1115.0 Secs (Split 3)] [==>1115.0 Secs (Split 4)]	[2] [3]

