17444 - Mapping the geometry of the new lensed quasar eRASS1 J050129.5-073309 using high resolution imaging of the lens and quasar host

Cycle: 31, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Mr. Dusan Tubin (PI) (ESA Member) (Contact)	**Leibniz-Institut f|*|r Astrophysik Potsdam (AIP)**
Dr. Georg Lamer (CoI) (ESA Member)	Leibniz-Institut für Astrophysik Potsdam (AIP)

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) ERASS1J050129.5-073309	ACS/WFC	2	25-Jun-2024 16:00:32.0	yes
02	(1) ERASS1J050129.5-073309	ACS/WFC	2	25-Jun-2024 16:00:34.0	yes

4 Total Orbits Used

ABSTRACT

The newly discovered lensed quasar eRASS1 J050129.5-073309 at z = 2.47 represents a perfect laboratory to estimate the Hubble constant via time-delay cosmography, study ongoing microlensing effects, and also characterize the host galaxy properties of the quasar. The two lensed images show a time delay of 107.8 +- 8.5 days. This time-delay timescale, the brightness of the quasar, and the separation of the images make it a unique source for time-delay cosmography studies. Imaging and image modeling reveal both the lensing galaxy and tentatively the lensed image of the quasar host galaxy. We propose HST observations, with a resolution of ~0.1", to investigate the mass profile of the lensing galaxy in order to obtain an accurate model of the lens, aiming to calculate the Hubble constant via time-delay cosmography. The high-resolution observation will also confirm the presence of lensed arcs which correspond to the host galaxy of the quasar, allowing us to constrain even more the mass distribution of the lensing

galaxy.

OBSERVING DESCRIPTION

The goal of this proposal is to obtain a reliable mass profile measurement of the lensing galaxy and confirm the presence of the quasar host galaxy lensed arcs in the newly discovered eRASS1 J050129.5-073309 lensed quasar. We request imaging of the lens system in the F814W and F606W filters. We choose the F814W broad filter because of the high transmission and wavelength coverage in the red bands where the lensing galaxy is brightest. This filter is ideal to map the lens which is likely an elliptical galaxy at redshift z ~ 0.7..1.0. The quasar host galaxy lensed arcs are significantly bluer in the LS DR10 images. The host galaxy dominates in the g and r band images which are covered by the ACS F606W filter. Hence the images in the two HST filters can be used to disentangle the two components in the lensed system. We use the ACS imaging exposure time calculator to deduce the exposure times for the proposed observations. GALFIT modeling of the lensing galaxy with a de-Vaucouleurs profile results in an effective radius of r = 2.7" and Sloan magnitude of i = 19.16 for the lensing galaxy. Adopting this model, 6200 seconds of exposure time in F814W are required to reach a SNR=5.0 in a 2x2 pixel box at the effective radius of the galaxy, where the surface brightness is 24.7 mag/arcsec**2 in the i-band. Hence 2 orbits are sufficient to map the lensing galaxy with the full resolution of 0.1 arcsec out to its effective radius, well beyond the positions of the QSO images and the lensing arc. In the case of the filter F606W, where the lensing galaxy is fainter (r = 20.14) with the same exposure time we obtain SNR = 6 per 2x2 pixel box for a surface brightness of 24.5 mag/arcsec**2. This will be sufficient to map the profile of the lensing galaxy out to r ~ 1.5 arcsec. In the r and g bands the lensing arcs are brighter than the lensing galaxy and therefore it will be possible to image them lensed host galaxy arcs with the full resolution of HST. We note that the uncertainty on the redshift of the lens does not affect our exposure time calculation. The worst scenario is when the lensing galaxy is at z ~ 0.7. In this case, two orbits will provide images with SNR=4, which is still ideal to map and model the gravitational potential of the lensing galaxy.

Visit

Proposal 17444, Visit 01, implementation Tue Jun 25 20:00:34 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.2637 Line Spacing=0.1856	Coordinate Frame=POS-TARG Pattern Orientation=20.7 Angle Between Sides=69.02 Center Pattern=false		(1), (3)

Fixed Targets

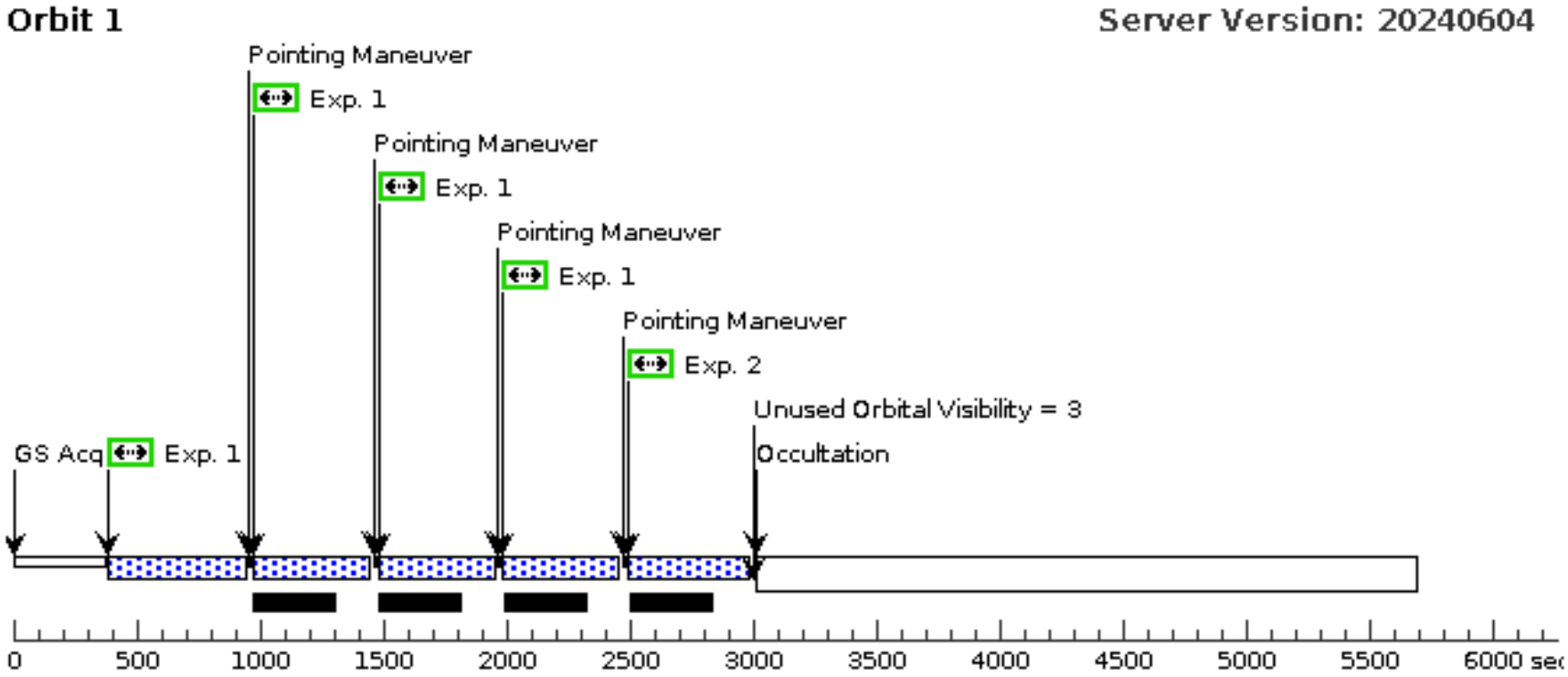
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ERASS1J050129.5-073309	RA: 05 01 29.4480 (75.3727000d) Dec: -07 33 5.76 (-7.55160d) Equinox: J2000	Parallax: 0"	V=21.26+/-0.02 g=21.26, r=20.59, i=20.01, z=19.68	Reference Frame: ICRS

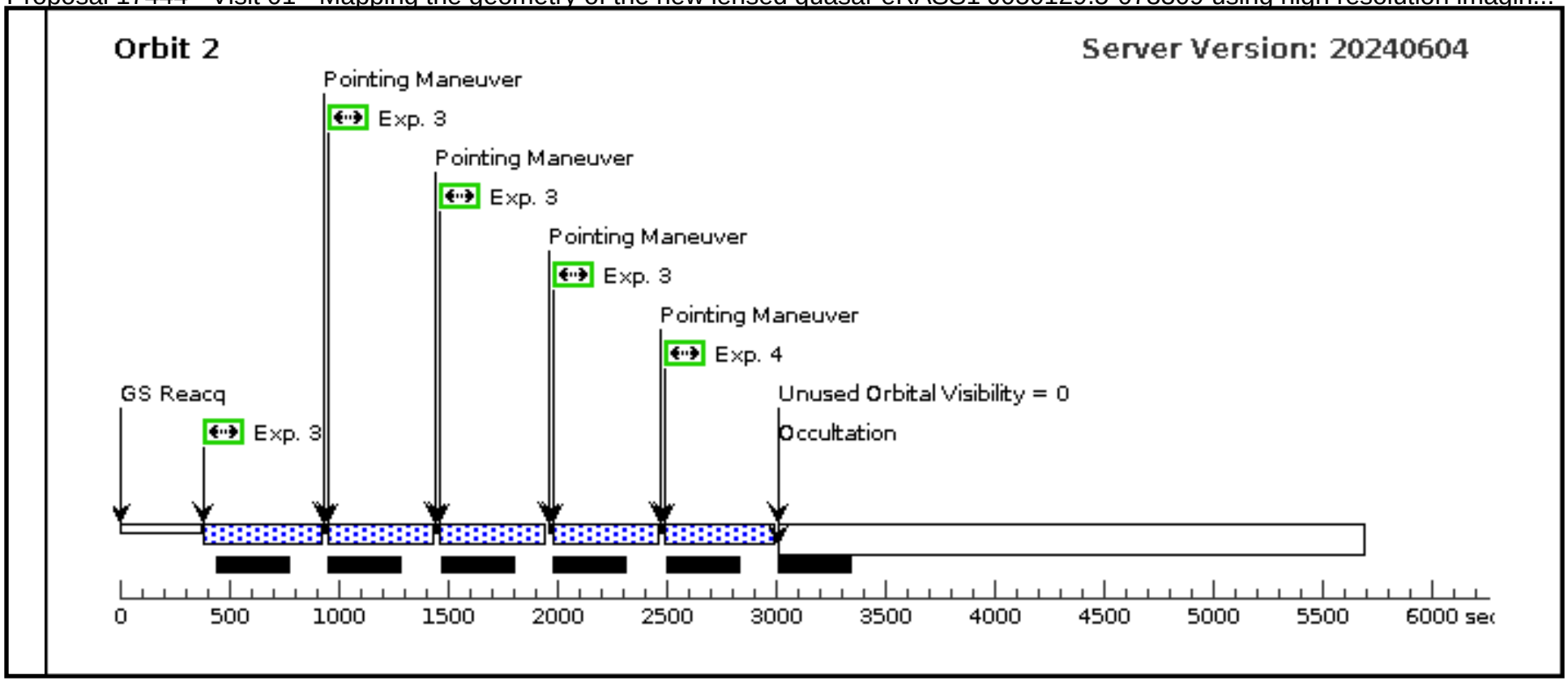
Comments:
Category=GALAXY
Description=[ELLIPTICAL, GRAVITATIONAL LENS, QUASAR]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) ERASS1J050129.5-073309	ACS/WFC, ACCUM, WFC2	F606W			Pattern 2, Exps 1-1 in Visit 01 (2)	350 Secs (1404 Secs)	
								[==>351.0 Secs (Pattern 1)] *[==>351.0 Secs (Pattern 2)]* *[==>351.0 Secs (Pattern 3)]* *[==>351.0 Secs (Pattern 4)]*	***[1]***
2		(1) ERASS1J050129.5-073309	ACS/WFC, ACCUM, WFC2	F606W				50 Secs (371 Secs)	
								[==>371.0 Secs]	***[1]***
3		(1) ERASS1J050129.5-073309	ACS/WFC, ACCUM, WFC2	F814W			Pattern 2, Exps 3-3 in Visit 01 (2)	350 Secs (1428 Secs)	
								[==>357.0 Secs (Pattern 1)] *[==>357.0 Secs (Pattern 2)]* *[==>357.0 Secs (Pattern 3)]* *[==>357.0 Secs (Pattern 4)]*	***[2]***
4		(1) ERASS1J050129.5-073309	ACS/WFC, ACCUM, WFC2	F814W				73 Secs (377 Secs)	
								[==>377.0 Secs]	***[2]***

Orbit Structure




Orbit 2
Server Version: 20240604
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 4
GS Reacq
Exp. 3
Unused Orbital Visibility = 0
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 17444, Visit 02, implementation Tue Jun 25 20:00:34 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
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Fixed Targets

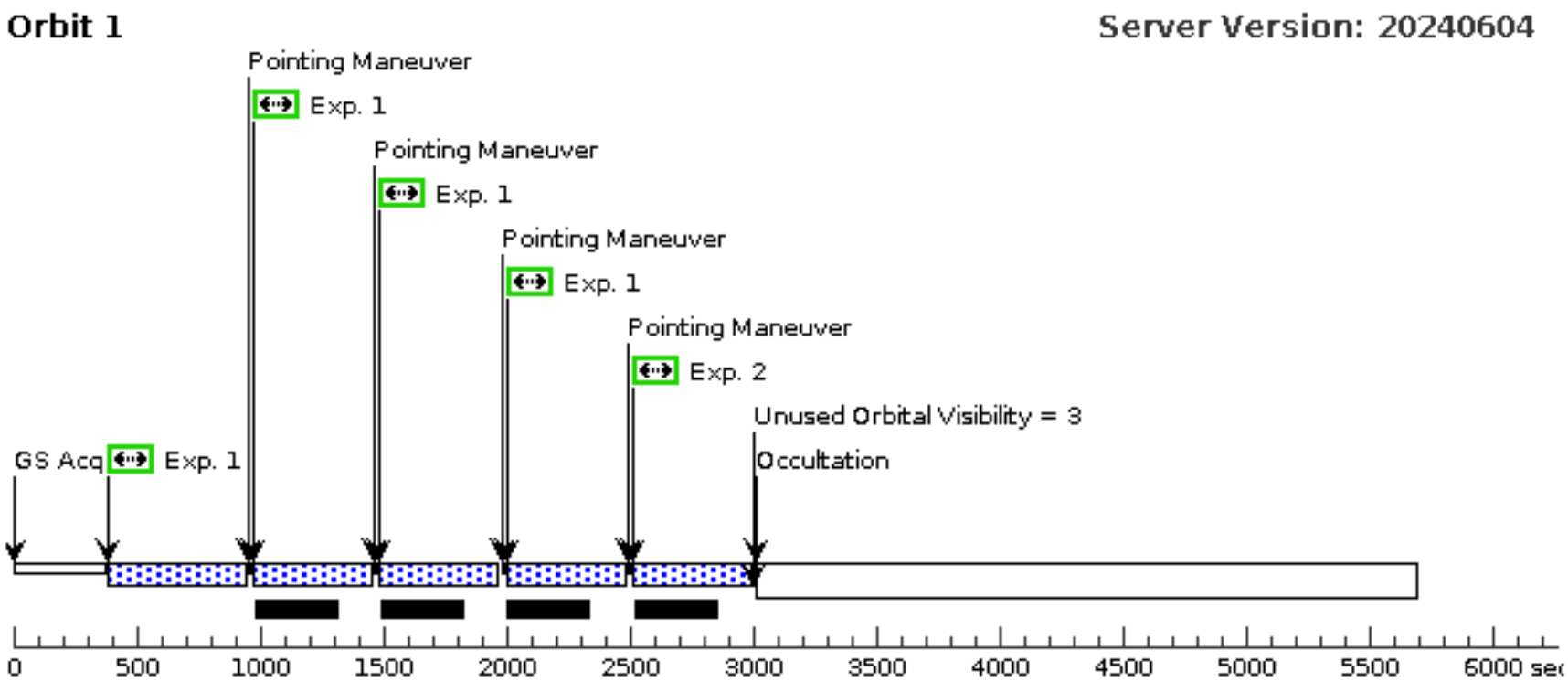
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ERASS1J050129.5-073309	RA: 05 01 29.4480 (75.3727000d) Dec: -07 33 5.76 (-7.55160d) Equinox: J2000	Parallax: 0"	V=21.26+/-0.02 g=21.26, r=20.59, i=20.01, z=19.68	Reference Frame: ICRS

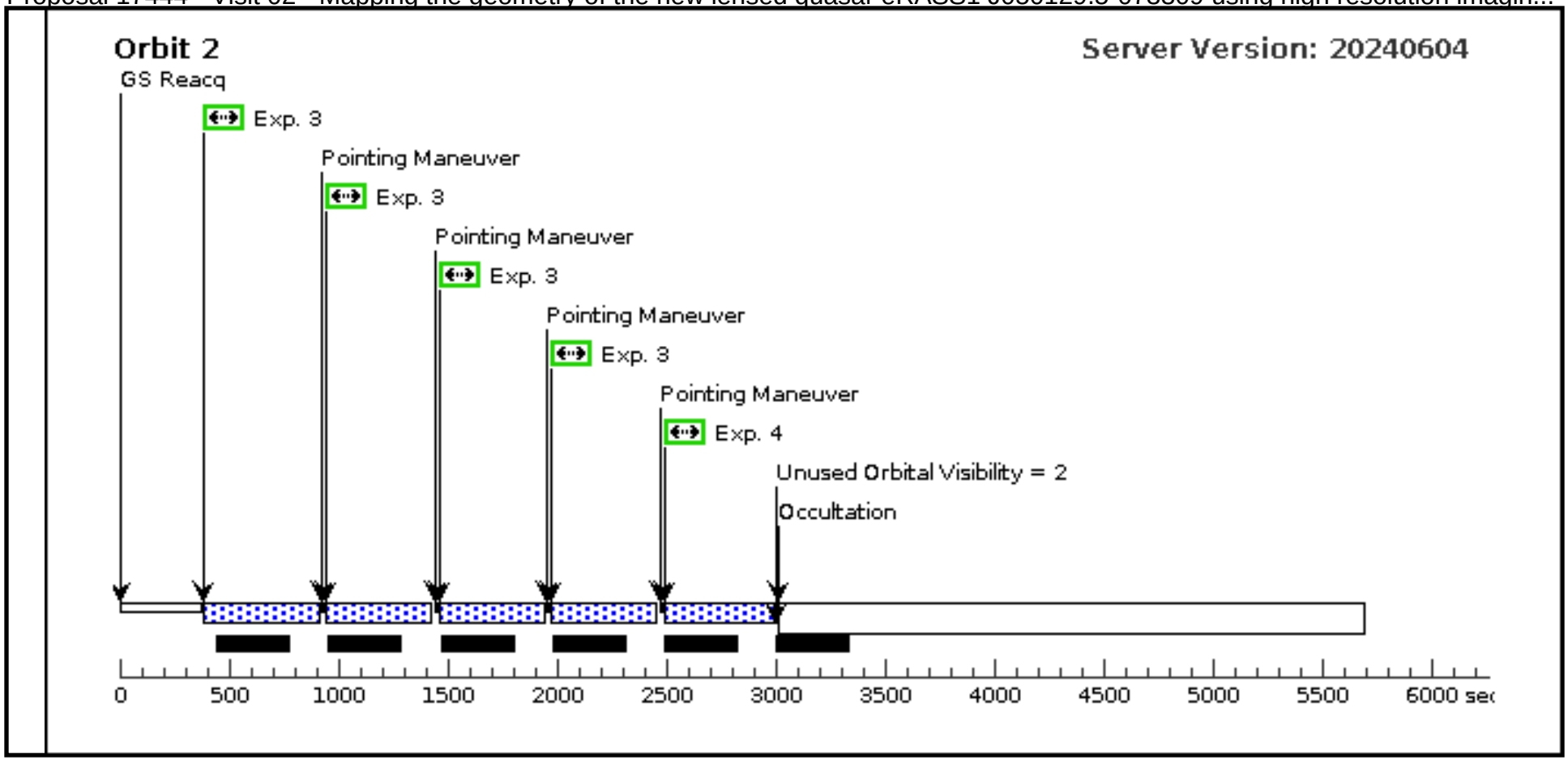
Comments:
Category=GALAXY
Description=[ELLIPTICAL, GRAVITATIONAL LENS, QUASAR]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) ERASS1J050129.5-073309	ACS/WFC, ACCUM, WFC2	F606W			Pattern 2, Exps 1-1 in Visit 02 (2)	350 Secs (1420 Secs)	
								[==>355.0 Secs (Pattern 1)] *[==>355.0 Secs (Pattern 2)]* *[==>355.0 Secs (Pattern 3)]* *[==>355.0 Secs (Pattern 4)]*	***[1]***
2		(1) ERASS1J050129.5-073309	ACS/WFC, ACCUM, WFC2	F606W				50 Secs (355 Secs)	
								[==>355.0 Secs]	***[1]***
3		(1) ERASS1J050129.5-073309	ACS/WFC, ACCUM, WFC2	F814W			Pattern 2, Exps 3-3 in Visit 02 (2)	350 Secs (1424 Secs)	
								[==>356.0 Secs (Pattern 1)] *[==>356.0 Secs (Pattern 2)]* *[==>356.0 Secs (Pattern 3)]* *[==>356.0 Secs (Pattern 4)]*	***[2]***
4		(1) ERASS1J050129.5-073309	ACS/WFC, ACCUM, WFC2	F814W				73 Secs (379 Secs)	
								[==>379.0 Secs]	***[2]***

Orbit Structure




Orbit 2
Server Version: 20240604
GS Reacq
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 4
Unused Orbital Visibility = 2
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec