



15636 - What is on the black hole menu? Joint HST/COS and XMM/EPIC spectroscopy of the X-ray binary M33 X-7.

Cycle: 26, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Dr. Lida Oskinova (PI) (ESA Member) (Contact)	Universitat Potsdam	lida@astro.physik.uni-potsdam.de
Dr. Oleg Y. Kargaltsev (CoI)	George Washington University	kargaltsev@gwu.edu
Dr. Wolf-Rainer Hamann (CoI) (ESA Member)	Universitat Potsdam	wrh@astro.physik.uni-potsdam.de
Dr. Enrico Bozzo (CoI) (ESA Member)	University of Geneva-Department of Astronomy	enrico.bozzo@unige.ch
Dr. Andreas Sander (CoI) (ESA Member)	Armagh Observatory	andreas.sander@armagh.ac.uk
Dr. Tomer Shenar (CoI) (ESA Member)	Katholieke Universiteit Leuven	tomer.shenar@kuleuven.be
Dr. Rainer Hainich (CoI) (ESA Member)	Universitat Potsdam	rhainich@astro.physik.uni-potsdam.de
Dr. Jose Miguel Torrejon (CoI) (ESA Member)	Universidad de Alicante, Dpto de Fisica	jmt@ua.es
Dr. Derck L. Massa (CoI) (AdminUSPI)	Space Science Institute	dmassa@spacescience.org
Dr. John Blondin (CoI)	North Carolina State University	john_blondin@ncsu.edu
Prof. Konstantin Postnov (CoI)	Sternberg State Astronomical Institute	kpostnov@gmail.com

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) NAME-M33-X-7 (2) ACQUISITION-STAR	COS/FUV COS/NUV	4	03-Sep-2020 16:00:17.0	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>
02	(1) NAME-M33-X-7 (2) ACQUISITION-STAR	COS/FUV COS/NUV	4	03-Sep-2020 16:00:18.0	yes
52	(1) NAME-M33-X-7 (2) ACQUISITION-STAR	COS/FUV COS/NUV	1	03-Sep-2020 16:00:19.0	yes
03	(1) NAME-M33-X-7 (2) ACQUISITION-STAR	COS/FUV COS/NUV	4	03-Sep-2020 16:00:19.0	yes

13 Total Orbits Used

ABSTRACT

We request 12 HST orbits to obtain the first UV spectra of the most massive known high-mass X-ray binary M33 X-7. This eclipsing system consists of a very massive O-type star and a 16 solar mass black hole immersed in the O star wind and feeding on it. The archival optical spectroscopy does not provide information on wind parameters of the donor star. Our immediate objective is to secure COS spectroscopy of M33 X-7 at different orbital phases. Obtaining these data is imperative to characterize the mass flow in this key system - a likely binary black hole progenitor. M33 X-7 is a strong source of X-rays which influence the donor star wind and affect its dynamics. Therefore, we request 25 ks of XMM-Newton time to obtain X-ray spectroscopy simultaneously with the UV observations.

We propose observations at three key orbital phases, tracing the BH eclipse, egress, and inferior conjunction. From the eclipse spectrum we will accurately measure the wind velocity and mass-loss rate of the donor star which has a metallicity ten times lower than solar. Realistic wind parameters are crucially needed to develop the models of massive binary evolution towards binary black holes. Coordinated UV and X-ray measurements in eclipse and egress will describe the gas flows towards the BH and empirically establish its accretion efficiency, thus probing the theories of accretion onto a BH. This innovative study is possible only jointly with the HST and XMM and will have a long lasting science legacy.

OBSERVING DESCRIPTION

COORDINATES:

Our target has Gaia DR2 coordinates which we use in Phase II. These are slightly different from SIMBAD coordinates/

ACQUISITION:

The target is located in a relatively crowded field. Within the COS aperture (2.5 arcsec) there is a little cluster of stars, 0.9 arcsec away from the target. This cluster has similar brightness to our target.

We are not sure how well the standard ACQ would work in this busy field and can suggest the following strategies 1) We can select a nearby point source which also has GAIA DR2 coordinates.

Then we can make offset to our target. Please advise how to do it in the APT? 2) If we center the COS aperture on our source, then the nearby cluster is in the aperture. In this case we need to introduce a roll angle constrain. Please advise how to determine it so that we can well separate the dispersed spectra? 3) Maybe we can place the aperture such that the nearby cluster is not in the aperture.

But then our source will not be in the center. Is it possible and does it make sense at all?

PHASE and ROLL ANGLE CONSTRAIN:

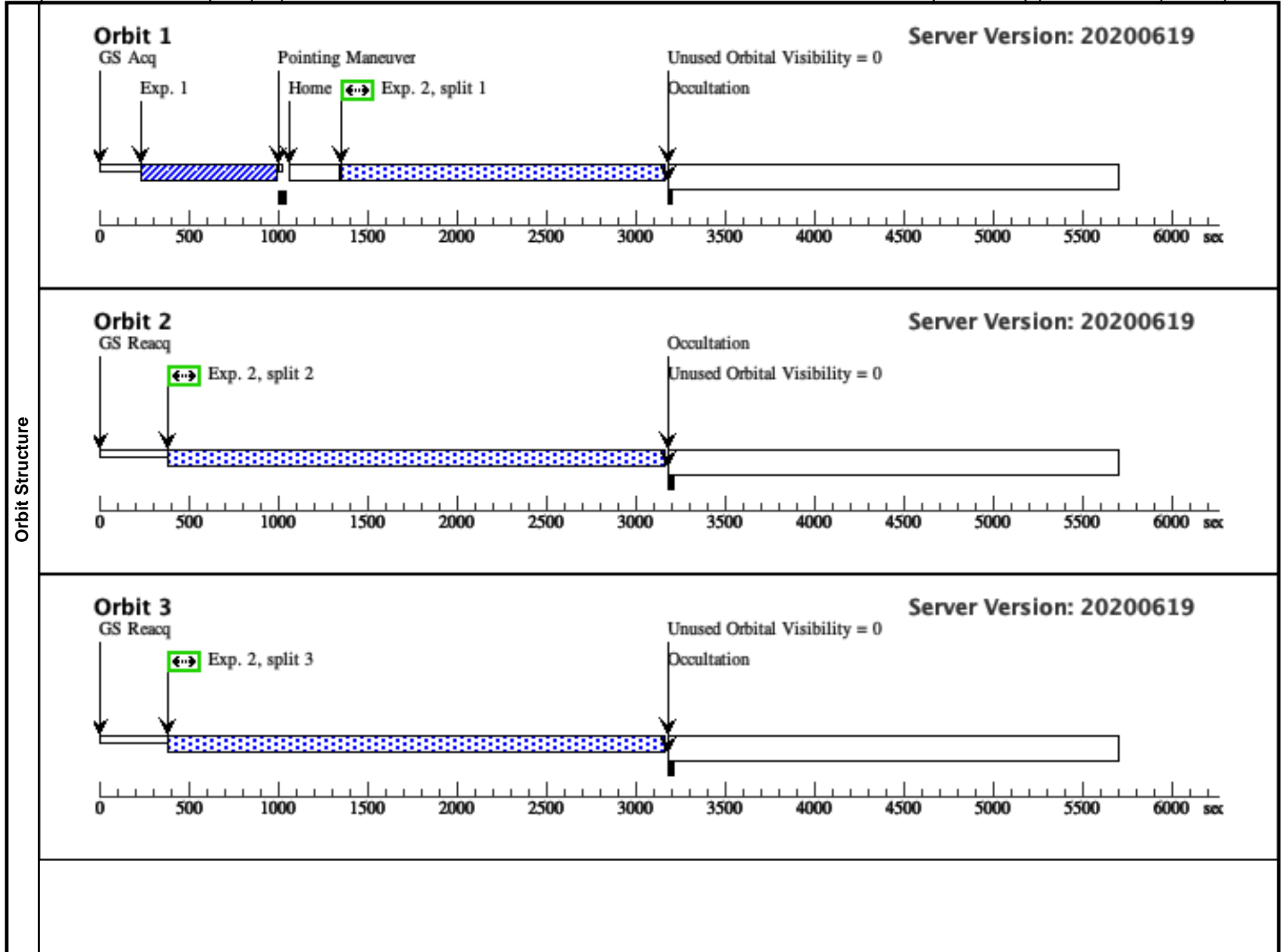
We are observing an eclipsing binary. The observations are therefore constrained in binary orbit phase. The ephemeris are reasonably well known.

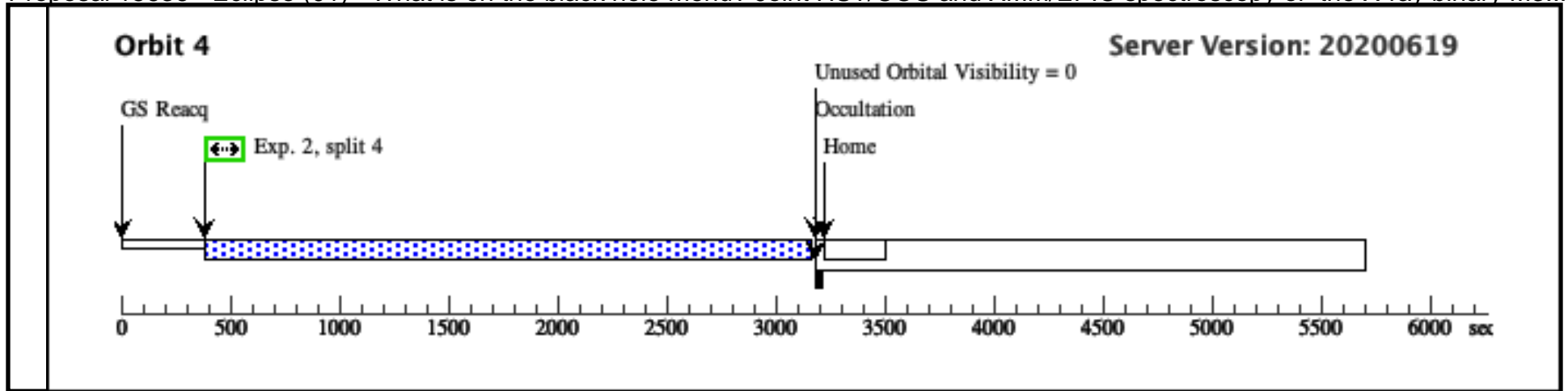
We need to introduce a roll angle constrain to be able to separate the spectra of sources which fall in the COS aperture. We would like to discuss this with our Contact and Instrument Scientists to make our program as little constrained as possible, but the same time to be able to extract the spectra.

Proposal 15636 - Eclipse (01) - What is on the black hole menu? Joint HST/COS and XMM/EPIC spectroscopy of the X-ray binary M3...

Thu Sep 03 20:00:20 GMT 2020

Visit	Proposal 15636, Eclipse (01), implementation Diagnostic Status: No Diagnostics Scientific Instruments: COS/FUV, COS/NUV Special Requirements: ORIENT 135D TO 232 D; ORIENT 315D TO 35 D; Period 3.453014 D AND ZERO-PHASE HJD2453967.157										
	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous					
Fixed Targets	(1)	NAME-M33-X-7	Offset from ACQUISITION-STAR RA Offset: -0.6475 Secs Dec Offset: -0.33 Arcsec	Radial Velocity: 0 km/sec	V=18.7+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter	Offset Position (NAME-M33-X-7)					
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The coordinates and their uncertainty is updated using GAIA DR2 catalog: source name Gaia DR2 303377286991610752 Category=EXT-STAR Description=[GIANT O] Extended=NO</i>										
Fixed Targets	(2)	ACQUISITION-STAR	RA: 01 33 34.7801 (23.3949171d) Dec: +30 32 11.69 (30.53658d) Equinox: J2000	Proper Motion RA: -0.513 mas/yr Proper Motion Dec: 0.283 mas/yr Parallax: 0" Epoch of Position: 2015.5 Radial Velocity: 0 km/sec	V=18.8+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter	Reference Frame: ICRS					
	<i>Comments: Coordinates from Gaia DR2 The spectral type is a plausible guess. Category=STAR Description=[B0-B2 III-I] Extended=NO</i>										
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	ACQ1 (COS.sa.131 2587)	(2) ACQUISITION-STAR	COS/NUV, ACQ/IMAGE, PSA	MIRRORA		GS ACQ SCENARI O BASE1BE	Same Guide Stars in Eclipse (01)	270 Secs (270 Secs) [==>]	[1]	
	2	eclipse 1 (1301678)	(1) NAME-M33-X-7	COS/FUV, TIME-TAG, PSA	G140L 1280 A		BUFFER-TIME=18 000; SEGMENT=BOTH; FLASH=YES; FP-POS=ALL	PHASE 0.9 TO 0.1; GS ACQ SCENARI O BASE1BE	Same Guide Stars in Eclipse (01)	480 Secs (9770 Secs)	
										[==>1598.0 Secs (Split 1)]	[1]
										[==>2724.0 Secs (Split 2)]	[2]
[==>2724.0 Secs (Split 3)]										[3]	
[==>2724.0 Secs (Split 4)]	[4]										

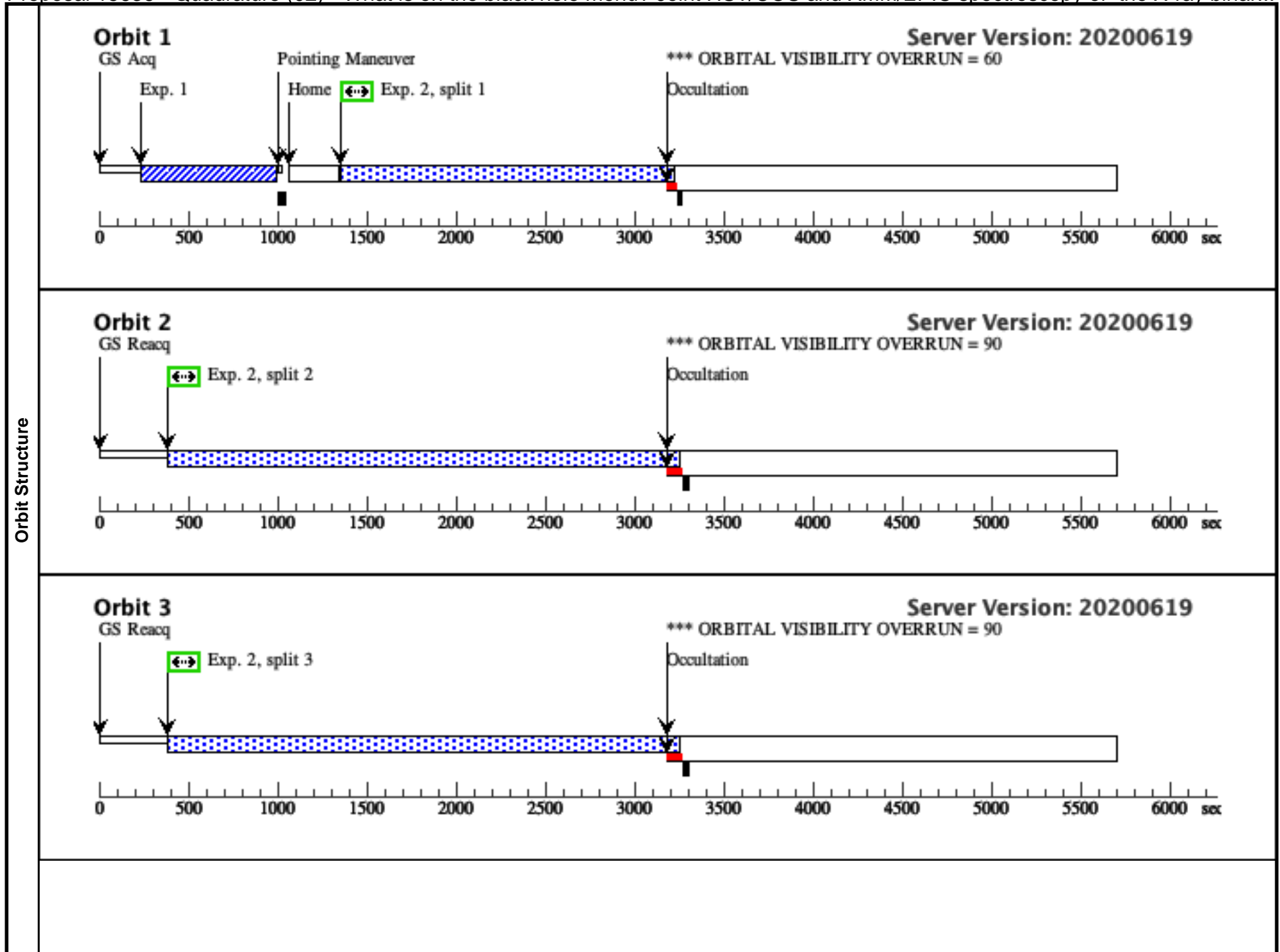


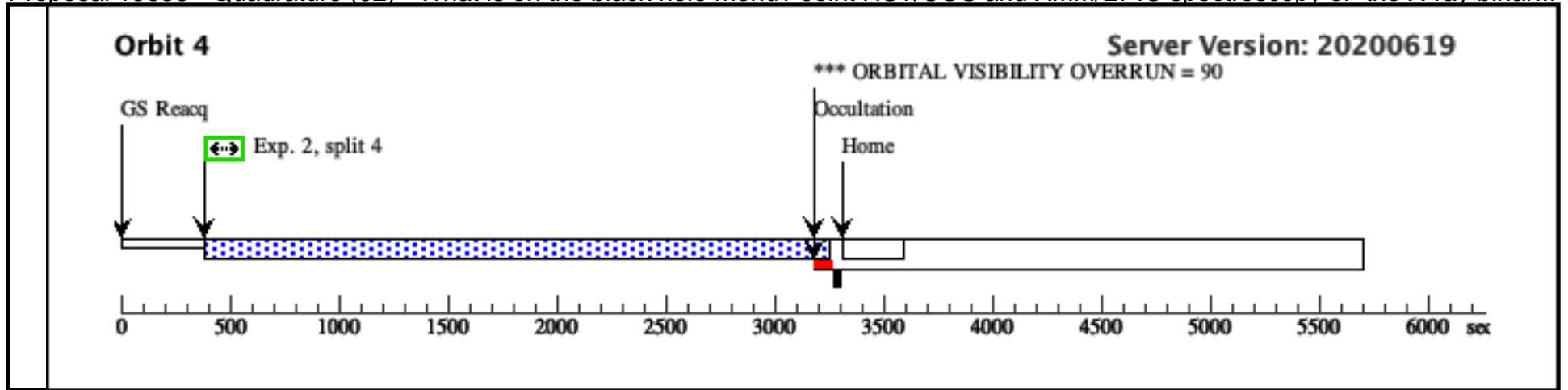


Proposal 15636 - Quadrature (02) - What is on the black hole menu? Joint HST/COS and XMM/EPIC spectroscopy of the X-ray binar...

Thu Sep 03 20:00:20 GMT 2020

Visit	<p>Proposal 15636, Quadrature (02), failed</p> <p>Diagnostic Status: Warning</p> <p>Scientific Instruments: COS/FUV, COS/NUV</p> <p>Special Requirements: Period 3.453 D AND ZERO-PHASE HJD2453967.157</p> <p><i>Comments: Simultaneous XMM-Newton observations requested</i></p>										
	<p>(Quadrature (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN</p> <p>(Quadrature (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN</p> <p>(Quadrature (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN</p> <p>(Quadrature (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN</p>										
Diagnosics											
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous					
	(1)	NAME-M33-X-7	Offset from ACQUISITION-STAR RA Offset: -0.6475 Secs Dec Offset: -0.33 Arcsec	Radial Velocity: 0 km/sec	V=18.7+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter	Offset Position (NAME-M33-X-7)					
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The coordinates and their uncertainty is updated using GAIA DR2 catalog: source name Gaia DR2 303377286991610752 Category=EXT-STAR Description=[GIANT O] Extended=NO</i></p>											
(2)	ACQUISITION-STAR	RA: 01 33 34.7801 (23.3949171d) Alt Name1: GAIA-DR2-303377286991607936 Dec: +30 32 11.69 (30.53658d) Equinox: J2000	Proper Motion RA: -0.513 mas/yr Proper Motion Dec: 0.283 mas/yr Parallax: 0" Epoch of Position: 2015.5 Radial Velocity: 0 km/sec	V=18.8+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter	Reference Frame: ICRS						
<p><i>Comments: Coordinates from Gaia DR2 The spectral type is a plausible guess. Category=STAR Description=[B0-B2 III-I] Extended=NO</i></p>											
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	ACQ2 (COS.sa.131 2587)	(2) ACQUISITION-STAR	COS/NUV, ACQ/IMAGE, PSA	MIRRORA			Same Guide Stars in Quadrature (02)	270 Secs (270 Secs) [==>]	[1]	
	2	Quadrature (1301678)	(1) NAME-M33-X-7	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=18 000; SEGMENT=BOTH; FLASH=YES; FP-POS=ALL	PHASE 0.15 TO 0.3 5	Same Guide Stars in Quadrature (02)	480 Secs (10100 Secs) [==>1658.0 Secs (Split 1)] [==>2814.0 Secs (Split 2)] [==>2814.0 Secs (Split 3)] [==>2814.0 Secs (Split 4)]	[1] [2] [3] [4]	

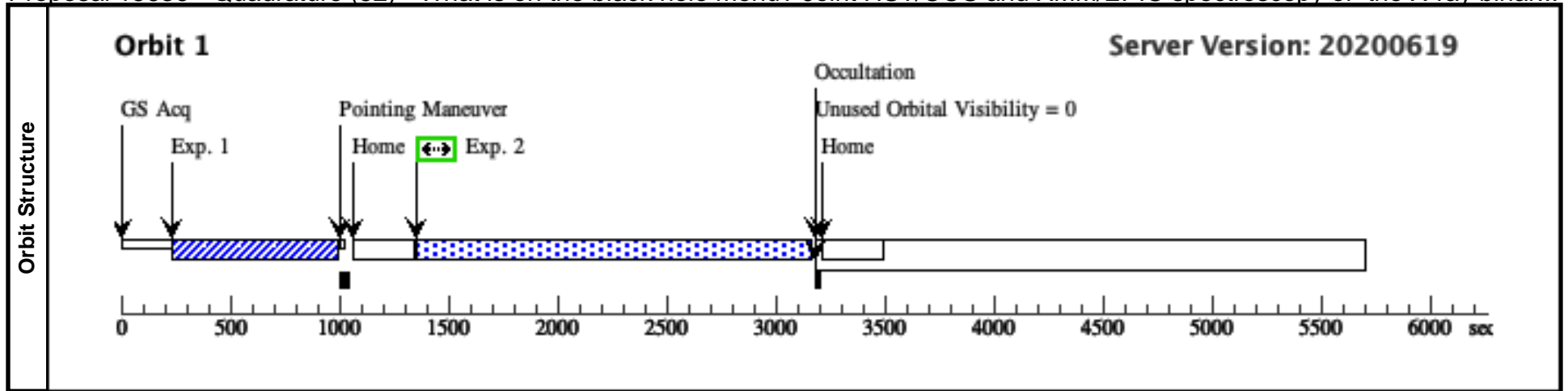




Proposal 15636 - Quadrature (52) - What is on the black hole menu? Joint HST/COS and XMM/EPIC spectroscopy of the X-ray binar...

Thu Sep 03 20:00:20 GMT 2020

Visit	Proposal 15636, Quadrature (52), completed Diagnostic Status: No Diagnostics Scientific Instruments: COS/FUV, COS/NUV Special Requirements: Period 3.453 D AND ZERO-PHASE HJD2453967.157 <i>Comments: Simultaneous XMM-Newton observations are not requested</i>									
	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
Fixed Targets	(1)	NAME-M33-X-7	Offset from ACQUISITION-STAR RA Offset: -0.6475 Secs Dec Offset: -0.33 Arcsec	Radial Velocity: 0 km/sec	V=18.7+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter	Offset Position (NAME-M33-X-7)				
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The coordinates and their uncertainty is updated using GAIA DR2 catalog: source name Gaia DR2 303377286991610752 Category=EXT-STAR Description=[GIANT O] Extended=NO</i>									
Fixed Targets	(2)	ACQUISITION-STAR	RA: 01 33 34.7801 (23.3949171d) Dec: +30 32 11.69 (30.53658d) Equinox: J2000	Proper Motion RA: -0.513 mas/yr Proper Motion Dec: 0.283 mas/yr Parallax: 0" Epoch of Position: 2015.5 Radial Velocity: 0 km/sec	V=18.8+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter	Reference Frame: ICRS				
	<i>Comments: Coordinates from Gaia DR2 The spectral type is a plausible guess. Category=STAR Description=[B0-B2 III-I] Extended=NO</i>									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	ACQ2 (COS.sa.131 2587)	(2) ACQUISITION-STAR	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				Same Guide Stars in Quadrature (52)	270 Secs (270 Secs) [==>]
2	Quadrature (1301678)	(1) NAME-M33-X-7	COS/FUV, TIME-TAG, PSA	G140L 1280 A		BUFFER-TIME=18000; SEGMENT=BOTH; FLASH=YES; FP-POS=3	PHASE 0.15 TO 0.3 5	Same Guide Stars in Quadrature (52)	480 Secs (1598 Secs) [==>1598.0 Secs]	[1]



Proposal 15636 - Inferior conjunction (03) - What is on the black hole menu? Joint HST/COS and XMM/EPIC spectroscopy of the X-r...

Thu Sep 03 20:00:20 GMT 2020

Visit	Proposal 15636, Inferior conjunction (03), completed Diagnostic Status: Warning Scientific Instruments: COS/FUV, COS/NUV Special Requirements: Period 3.453 D AND ZERO-PHASE HJD2453967.157 <i>Comments: Simultaneous XMM-Newton observations requested</i>																																													
	Diagnosics (Inferior conjunction (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Inferior conjunction (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Inferior conjunction (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Inferior conjunction (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN																																													
Fixed Targets	<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>NAME-M33-X-7</td> <td>Offset from ACQUISITION-STAR RA Offset: -0.6475 Secs Dec Offset: -0.33 Arcsec</td> <td>Radial Velocity: 0 km/sec</td> <td>V=18.7+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter</td> <td>Offset Position (NAME-M33-X-7)</td> </tr> <tr> <td colspan="6"> <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The coordinates and their uncertainty is updated using GAIA DR2 catalog: source name Gaia DR2 303377286991610752 Category=EXT-STAR Description=[GIANT O] Extended=NO</i> </td> </tr> <tr> <td>(2)</td> <td>ACQUISITION-STAR</td> <td>RA: 01 33 34.7801 (23.3949171d) Dec: +30 32 11.69 (30.53658d) Equinox: J2000</td> <td>Proper Motion RA: -0.513 mas/yr Proper Motion Dec: 0.283 mas/yr Parallax: 0" Epoch of Position: 2015.5 Radial Velocity: 0 km/sec</td> <td>V=18.8+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter</td> <td>Reference Frame: ICRS</td> </tr> <tr> <td colspan="6"> <i>Comments: Coordinates from Gaia DR2 The spectral type is a plausible guess. Category=STAR Description=[B0-B2 III-I] Extended=NO</i> </td> </tr> </tbody> </table>										#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	NAME-M33-X-7	Offset from ACQUISITION-STAR RA Offset: -0.6475 Secs Dec Offset: -0.33 Arcsec	Radial Velocity: 0 km/sec	V=18.7+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter	Offset Position (NAME-M33-X-7)	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The coordinates and their uncertainty is updated using GAIA DR2 catalog: source name Gaia DR2 303377286991610752 Category=EXT-STAR Description=[GIANT O] Extended=NO</i>						(2)	ACQUISITION-STAR	RA: 01 33 34.7801 (23.3949171d) Dec: +30 32 11.69 (30.53658d) Equinox: J2000	Proper Motion RA: -0.513 mas/yr Proper Motion Dec: 0.283 mas/yr Parallax: 0" Epoch of Position: 2015.5 Radial Velocity: 0 km/sec	V=18.8+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter	Reference Frame: ICRS	<i>Comments: Coordinates from Gaia DR2 The spectral type is a plausible guess. Category=STAR Description=[B0-B2 III-I] Extended=NO</i>											
	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous																																								
(1)	NAME-M33-X-7	Offset from ACQUISITION-STAR RA Offset: -0.6475 Secs Dec Offset: -0.33 Arcsec	Radial Velocity: 0 km/sec	V=18.7+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter	Offset Position (NAME-M33-X-7)																																									
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The coordinates and their uncertainty is updated using GAIA DR2 catalog: source name Gaia DR2 303377286991610752 Category=EXT-STAR Description=[GIANT O] Extended=NO</i>																																														
(2)	ACQUISITION-STAR	RA: 01 33 34.7801 (23.3949171d) Dec: +30 32 11.69 (30.53658d) Equinox: J2000	Proper Motion RA: -0.513 mas/yr Proper Motion Dec: 0.283 mas/yr Parallax: 0" Epoch of Position: 2015.5 Radial Velocity: 0 km/sec	V=18.8+/-0.1 ABmag 19.2 in wfc3_uvis_f275 w filter	Reference Frame: ICRS																																									
<i>Comments: Coordinates from Gaia DR2 The spectral type is a plausible guess. Category=STAR Description=[B0-B2 III-I] Extended=NO</i>																																														
Exposures	<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>ACQ2 (COS.sa.131 2587)</td> <td>(2) ACQUISITION-STAR</td> <td>COS/NUV, ACQ/IMAGE, PSA</td> <td>MIRRORA</td> <td></td> <td></td> <td>Same Guide Stars in Inferior conjunction (03)</td> <td>270 Secs (270 Secs) [==>]</td> <td>[1]</td> </tr> <tr> <td rowspan="4">2</td> <td rowspan="4">Inferior conjunction (1301678)</td> <td rowspan="4">(1) NAME-M33-X-7</td> <td rowspan="4">COS/FUV, TIME-TAG, PSA</td> <td rowspan="4">G140L 1280 A</td> <td rowspan="4">BUFFER-TIME=18000; SEGMENT=BOTH; FLASH=YES; FP-POS=ALL</td> <td rowspan="4">PHASE 0.4 TO 0.6</td> <td rowspan="4">Same Guide Stars in Inferior conjunction (03)</td> <td>480 Secs (10100 Secs) [==>1658.0 Secs (Split 1)]</td> <td>[1]</td> </tr> <tr> <td>[==>2814.0 Secs (Split 2)]</td> <td>[2]</td> </tr> <tr> <td>[==>2814.0 Secs (Split 3)]</td> <td>[3]</td> </tr> <tr> <td>[==>2814.0 Secs (Split 4)]</td> <td>[4]</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	ACQ2 (COS.sa.131 2587)	(2) ACQUISITION-STAR	COS/NUV, ACQ/IMAGE, PSA	MIRRORA			Same Guide Stars in Inferior conjunction (03)	270 Secs (270 Secs) [==>]	[1]	2	Inferior conjunction (1301678)	(1) NAME-M33-X-7	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=18000; SEGMENT=BOTH; FLASH=YES; FP-POS=ALL	PHASE 0.4 TO 0.6	Same Guide Stars in Inferior conjunction (03)	480 Secs (10100 Secs) [==>1658.0 Secs (Split 1)]	[1]	[==>2814.0 Secs (Split 2)]	[2]	[==>2814.0 Secs (Split 3)]	[3]	[==>2814.0 Secs (Split 4)]	[4]
	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit																																				
	1	ACQ2 (COS.sa.131 2587)	(2) ACQUISITION-STAR	COS/NUV, ACQ/IMAGE, PSA	MIRRORA			Same Guide Stars in Inferior conjunction (03)	270 Secs (270 Secs) [==>]	[1]																																				
	2	Inferior conjunction (1301678)	(1) NAME-M33-X-7	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=18000; SEGMENT=BOTH; FLASH=YES; FP-POS=ALL	PHASE 0.4 TO 0.6	Same Guide Stars in Inferior conjunction (03)	480 Secs (10100 Secs) [==>1658.0 Secs (Split 1)]	[1]																																				
									[==>2814.0 Secs (Split 2)]	[2]																																				
[==>2814.0 Secs (Split 3)]									[3]																																					
[==>2814.0 Secs (Split 4)]									[4]																																					

