17476 - The most puzzling UV-optical-NIR spectrum of an isolated neutron star: A disk or a magnetosphere?

Cycle: 31, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
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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) RXJ2143+0654	ACS/SBC	1	13-Jun-2024 18:00:15.0	yes
02	(1) RXJ2143+0654	WFC3/UVIS	2	13-Jun-2024 18:00:16.0	yes
03	(1) RXJ2143+0654	ACS/WFC	2	13-Jun-2024 18:00:17.0	yes
05	(1) RXJ2143+0654	ACS/SBC	1	13-Jun-2024 18:00:17.0	yes
04	(1) RXJ2143+0654	WFC3/IR	2	13-Jun-2024 18:00:18.0	yes

8 Total Orbits Used

ABSTRACT

Unlike the commonly known rotation-powered pulsars, X-ray thermal isolated neutron stars (XTINSs) do not show radio/gamma-ray emission or other signs of magnetospheric activity but emit purely thermal soft X-ray radiation. A few HST observations of these sources have shown very puzzling results, with possible contribution from neutron star magnetospheres or fallback disks, challenging the simplistic model of a purely thermal

emitter. However, because most XTINSs only have HST coverage in two spectral bands, the actual spectral shape and the origin of the XTINS UV-optical-IR emission remain unknown.

RX J1243.0+0654, the most intriguing XTINS, provides the best opportunity to clarify the origin of the XTINS emission. We propose photometric measurements with high S/N in five spectral bands in the wavelength range of 0.14-1.7 microns. Fits of the five flux density points with different spectral models will help to understand the nature of this and other XTINSs.

Using the same observations, we will also check for long-term variability of the target in two bands and measure its (currently unknown) proper motion with an uncertainty not exceeding 2 mas/yr, much lower than expected proper motion values. This will allow us to locate the birth place of this neutron star and estimate its kinematic age. These properties are required to constrain the neutron star cooling models and learn about evolutionary links between the diverse neutron star populations.

OBSERVING DESCRIPTION

To infer the shape of the UVOIR spectrum of the target neutron star and confront it with the available models, we will measure its fluxes in 5 bands.

The far-UV emission will be observed in the ACS/SBC F140LP filter (two one-orbit visits). We choose two visits to minimize the effect of dark current (thermal glow) and simplify scheduling. In each orbit we will use a two-point dither line for better removal of detector blemishes and improving the PSF sampling. The starting points of the dither lines in the two orbits will be offset by 0.5 arcsec in the X and Y directions with POSTARG for better coverage.

The near-UV observation will be carried out with the WFC3/UVIS F300X filter (one two-orbit visit). We chose the UVIS aperture UVIS2-C512C-CTE, which places our faint target near the C readout amplifier to minimize CTE losses but reads out the full detector for better astrometry. We will also mitigate CTE losses using FLASH = 13 electrons. We will use the WFC3-UVIS-DITHER-LINE-3PT in each orbit, which provides optimal 3-step sampling of the PSF and produces spacings of >1 column for removal of hot columns.

The observational setup for the two-orbit visit with ACS/WFC F475W repeats that used in the program #11564. The main goals of this observation is measuring the target's proper motion and checking possible flux variabilty. This observation uses ACS-WFC-DITHER BOX in each of the two orbits.

The near-IR emission of the target will be observed in two WFC3/IR filters, F110W and F160W, in one two-orbit visit. Since the F110W filter can suffer from unpredictable background variations from the He I airglow in the upper atmosphere (see WFC3/ISR 2013-03), we will sandwich the F110W exposures with F160W exposures at the beginning and end of each of the two orbits. In each orbit we will put the target in two positions, defined with POSTARG values, which provides some sampling of the PSF. We will use the readout mode SAMP-SEQ = 100, NSAMP = 12, 13 or 14 for most part of the visit, and SAMP-SEQ = 50, NSAMP = 14 for two exposures to get an optimal exposure time. We have checked the 2MASS and VLT images of this field and concluded that diffraction spikes from the sparse nearby stars would not be a problem at any ORIENT value.

The HEALTH flag raised by BOT for a source at 21 43 1.5894, +06 54 26.74 (~29 arcsec from target) comes from GSC2. GALEX also lists the UV counterpart of this star (Gaia DR3 Teff=5300K) at 21 43 1.5475, +06 54 26.62 (agreement within 0.63 arcsec), but the GALEX Flag is "SAFE". Considering in addition that a similar SBC observation has already been carried out successfully, there is no BOT safety concern for any of our exposures.

Visit

Proposal 17476, fuv1 (01), completed

Thu Jun 13 22:00:19 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: ACS/SBC

Special Requirements: (none)

Diagnostics

(fuv1 (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(9)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

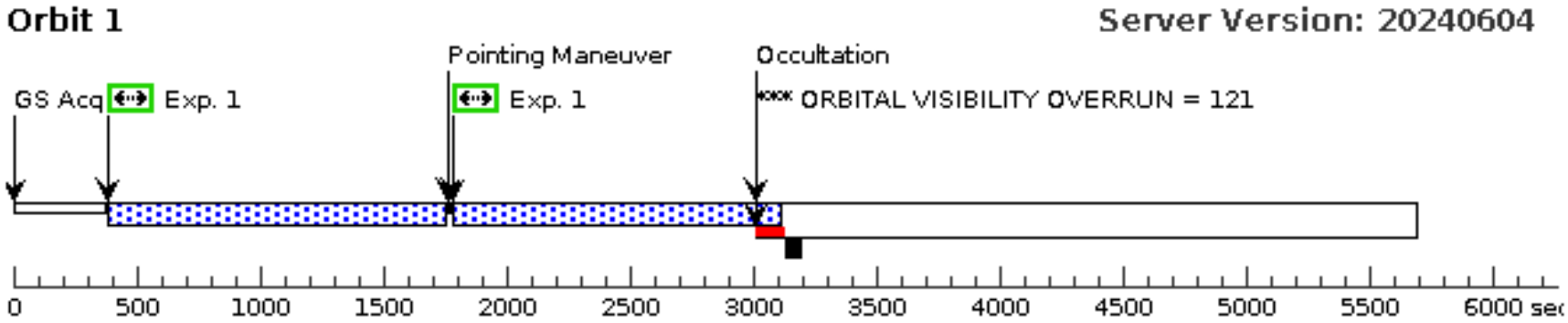
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	RXJ2143+0654	RA: 21 43 3.3800 (325.7640833d) Dec: +06 54 17.53 (6.90487d) Equinox: J2000		V=27+/-1	Reference Frame: ICRS

Comments:
Category=STAR
Description=[NEUTRON STAR]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(ACS.im.1888630)	(1) RXJ2143+0654	ACS/SBC, ACCUM, SBC	F140LP			Pattern 9, Exps 1-1 in fuv1 (01) (9)	1305 Secs (2610 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 17476, nuv (02), completed Thu Jun 13 22:00:19 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(nuv (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(nuv (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(10)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1-2)

Fixed Targets

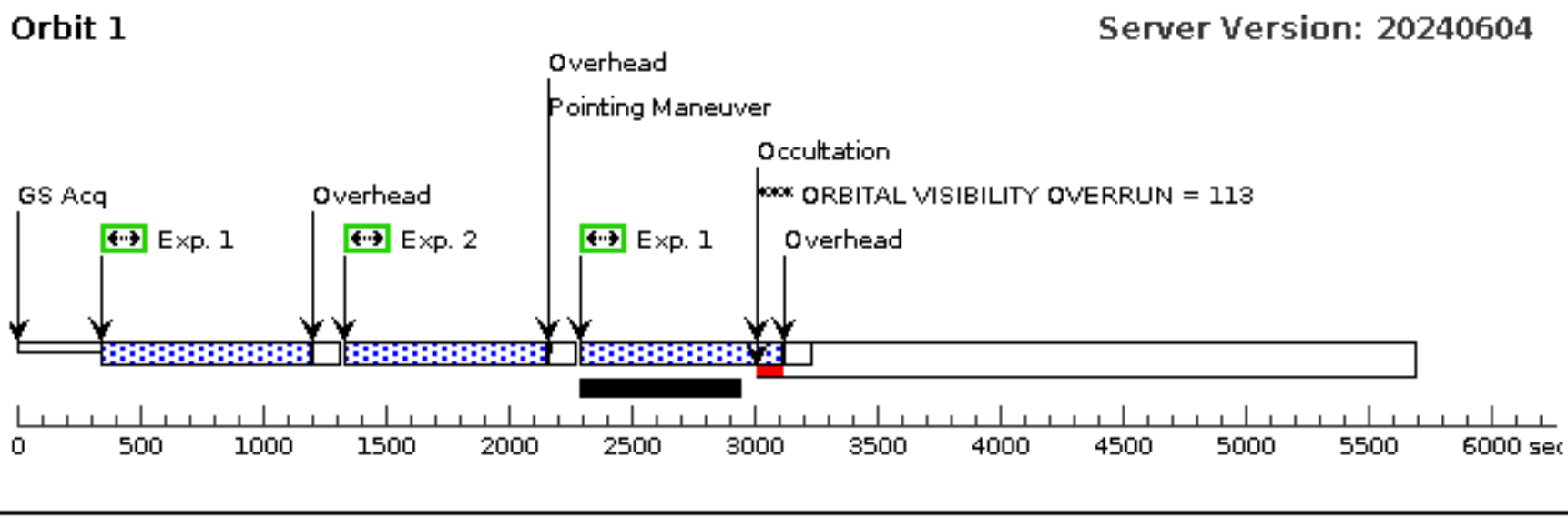
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	RXJ2143+0654	RA: 21 43 3.3800 (325.7640833d) Dec: +06 54 17.53 (6.90487d) Equinox: J2000		V=27+/-1	Reference Frame: ICRS

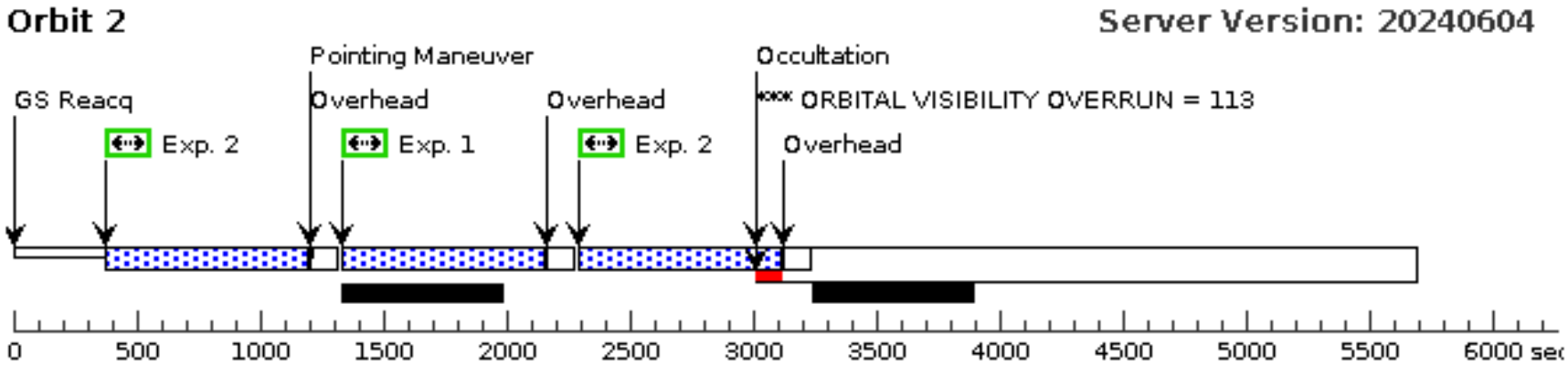
Comments:
Category=STAR
Description=[NEUTRON STAR]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) RXJ2143+0654	WFC3/UVIS, ACCUM, UVIS2-C512C-CTE	F300X	FLASH=13		Pattern 10, Exps 1-2 in nuv (02) (10)	821 Secs (2463 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
2		(1) RXJ2143+0654	WFC3/UVIS, ACCUM, UVIS2-C512C-CTE	F300X	FLASH=13		Pattern 10, Exps 1-2 in nuv (02) (10)	821 Secs (2463 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	

Orbit Structure





Visit

Proposal 17476, blue (03), completed Thu Jun 13 22:00:19 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Diagnostics

(blue (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(blue (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(5)	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), (2)

Fixed Targets

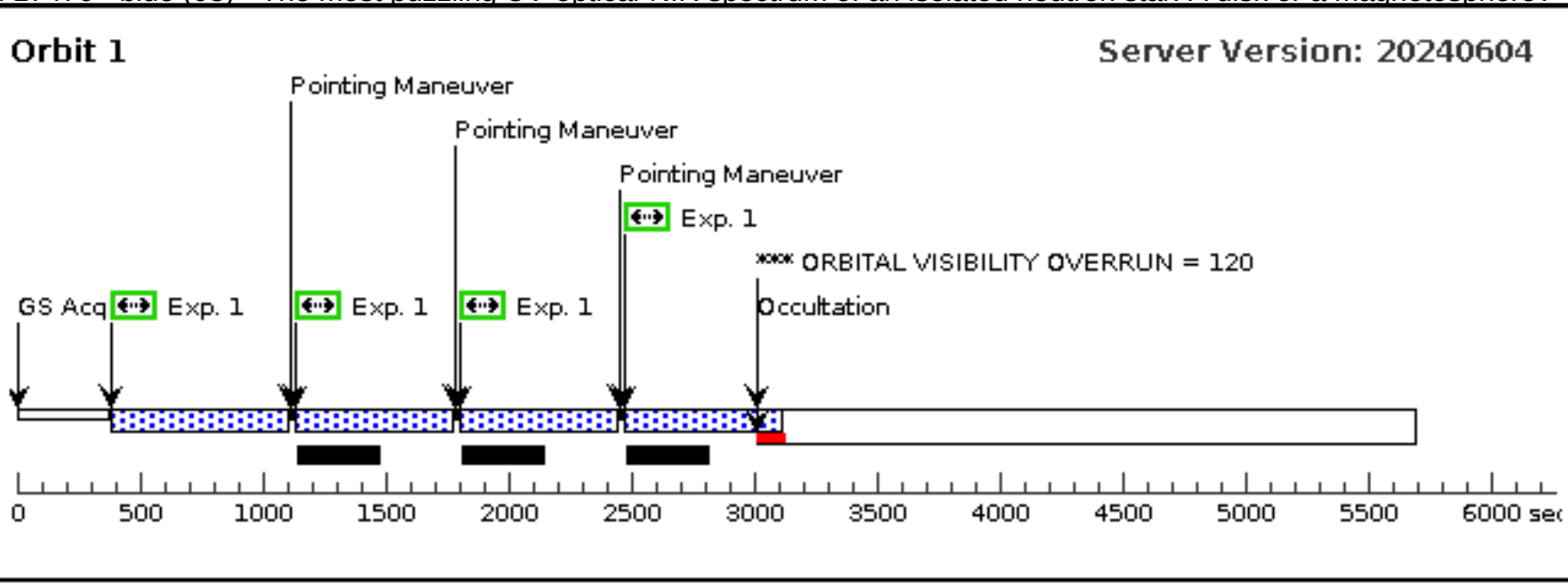
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	RXJ2143+0654	RA: 21 43 3.3800 (325.7640833d) Dec: +06 54 17.53 (6.90487d) Equinox: J2000		V=27+/-1	Reference Frame: ICRS

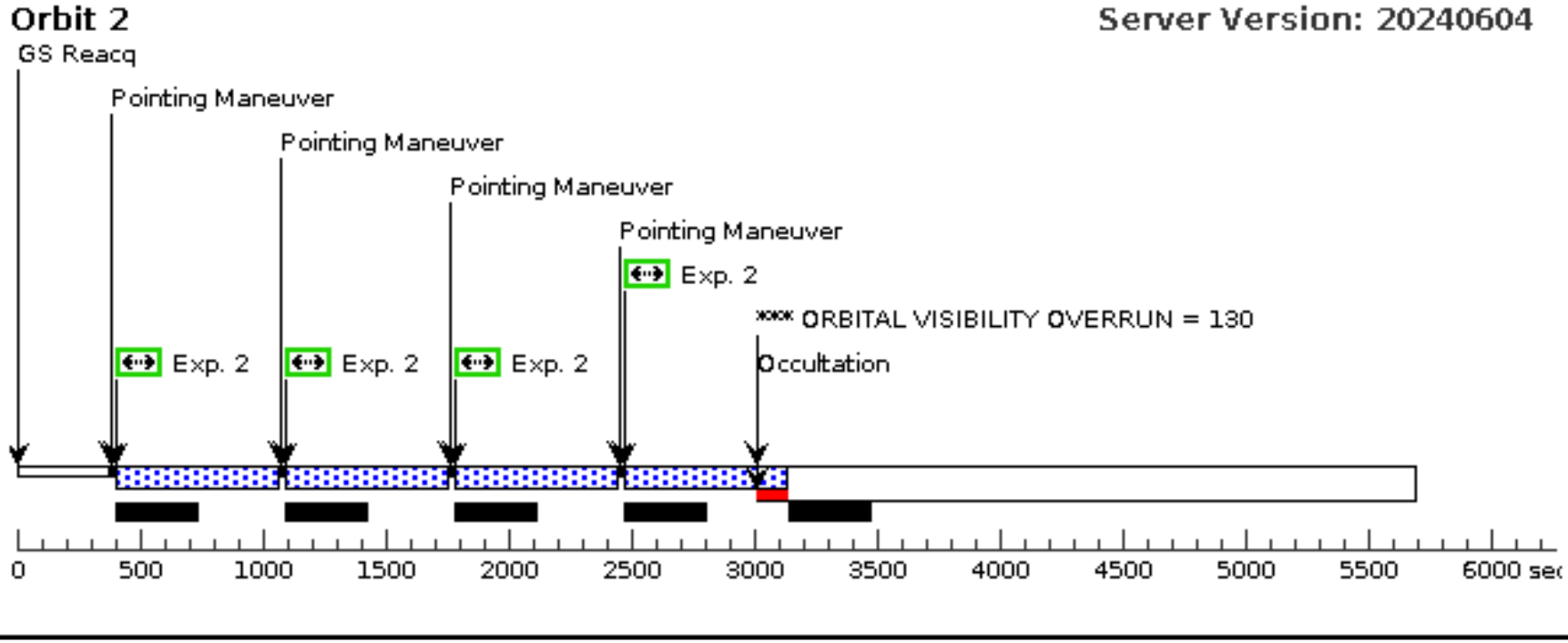
Comments:
Category=STAR
Description=[NEUTRON STAR]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	2143-WFC1	(1) RXJ2143+0654	ACS/WFC, ACCUM, WFC1	F475W			Pattern 5, Exps 1-1 in blue (03) (5)	514 Secs (2056 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	2143-WFC	(1) RXJ2143+0654	ACS/WFC, ACCUM, WFC1	F475W		POS TARG 0.5,0.5	Pattern 5, Exps 2-2 in blue (03) (5)	532 Secs (2128 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***

Orbit Structure





Visit

Proposal 17476, fuv2 (05), scheduling Thu Jun 13 22:00:19 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(9)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

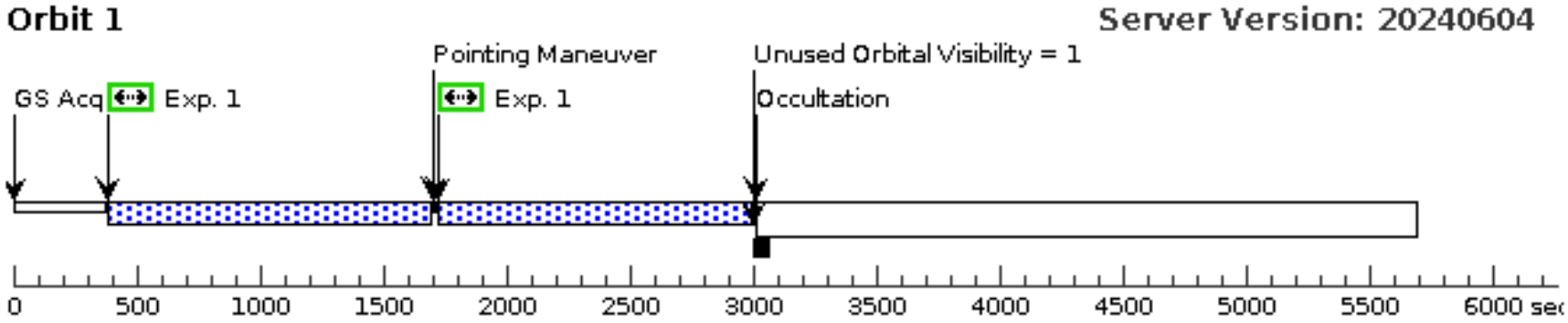
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	RXJ2143+0654	RA: 21 43 3.3800 (325.7640833d) Dec: +06 54 17.53 (6.90487d) Equinox: J2000		V=27+/-1	Reference Frame: ICRS

Comments:
Category=STAR
Description=[NEUTRON STAR]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(ACS.im.1888630)	(1) RXJ2143+0654	ACS/SBC, ACCUM, SBC	F140LP		POS TARG 0.5,0.5	Pattern 9, Exps 1-1 in fuv2 (05) (9)	1305 Secs (2488 Secs) *[==>1244.0 Secs (Pattern 1)]* *[==>1244.0 Secs (Pattern 2)]*	*[1]*

Orbit Structure



Visit

Proposal 17476, nir (04), implementation Thu Jun 13 22:00:19 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	RXJ2143+0654	RA: 21 43 3.3800 (325.7640833d) Dec: +06 54 17.53 (6.90487d) Equinox: J2000		V=27+/-1	Reference Frame: ICRS

Comments:
Category=STAR
Description=[NEUTRON STAR]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F160W_pos 1	(1) RXJ2143+0654	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP100; NSAMP=13	POS TARG 0,0		699.232615 Secs (699.233 Secs) *[==>]*	 ***[1]***
2	F110W_pos 1	(1) RXJ2143+0654	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=13; SAMP-SEQ=STEP100	POS TARG 0,0		699.232615 Secs (699.233 Secs) *[==>]*	 ***[1]***
3	F110W_pos 2	(1) RXJ2143+0654	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=14; SAMP-SEQ=STEP50	POS TARG 0.542,0.182		449.233834 Secs (449.234 Secs) *[==>]*	 ***[1]***
4	F160W_pos 2	(1) RXJ2143+0654	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP100; NSAMP=12	POS TARG 0.542,0.182		599.232292 Secs (599.232 Secs) *[==>]*	 ***[1]***
5	F160W_pos 3	(1) RXJ2143+0654	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP100; NSAMP=14	POS TARG 0.339,0.485		799.232938 Secs (799.233 Secs) *[==>]*	 ***[2]***
6	F110W_pos 3	(1) RXJ2143+0654	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=12; SAMP-SEQ=STEP100	POS TARG 0.339,0.485		599.232292 Secs (599.232 Secs) *[==>]*	 ***[2]***
7	F110W_pos 4	(1) RXJ2143+0654	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=12; SAMP-SEQ=STEP100	POS TARG -0.203,0.303		599.232292 Secs (599.232 Secs) *[==>]*	 ***[2]***
8	F160W_pos 4	(1) RXJ2143+0654	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP50; NSAMP=13	POS TARG -0.203,0.303		399.233383 Secs (399.233 Secs) *[==>]*	 ***[2]***

Orbit Structure