17120 - Are all massive Kuiper belt objects built the same?

Cycle: 30, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Dr. Carl Melis (PI) (Contact)	**University of California - San Diego**
Dr. Patrick Dufour (CoI) (CSA Member)	Universite de Montreal
Dr. Alycia J. Weinberger (CoI)	Carnegie Institution of Washington
Dr. Beth L. Klein (CoI)	University of California - Los Angeles
Prof. Ben M. Zuckerman (CoI)	University of California - Los Angeles
Dr. Siyi Xu (CoI)	NOIRLab - Gemini North (HI)

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) GAIA-EDR3-5550706714197581824	COS/FUV COS/NUV	5	31-Jul-2024 12:00:33.0	yes
51	(1) GAIA-EDR3-5550706714197581824	COS/FUV COS/NUV	5	31-Jul-2024 12:00:34.0	yes
52	(1) GAIA-EDR3-5550706714197581824	COS/FUV COS/NUV	2	31-Jul-2024 12:00:35.0	yes
53	(1) GAIA-EDR3-5550706714197581824	COS/FUV COS/NUV	2	31-Jul-2024 12:00:36.0	yes

14 Total Orbits Used

ABSTRACT

We have identified GaiaJ0628-5054 as a single, polluted, white dwarf star that is accreting extremely oxygen- and hydrogen-rich material that is otherwise depleted in all other rocky elements, suggesting that it is being polluted by a massive icy body. Similarities with the hitherto unique extrasolar Kuiper belt object-ingesting WD1425+540 suggest GaiaJ0628-5054 is being polluted by what could be a rare second example of an extrasolar Kuiper belt object. We propose COS FUV spectroscopic observations of GaiaJ0628-5054 that will allow us to confirm our interpretation and then explore the range of rocky mass fractions for extrasolar Kuiper belt object analogs. These observations will have immediate value in assessing the validity of internal structure models for Pluto, Charon, and Arrokoth by providing a contrast of New Horizons interpretations for outer solar system bodies against what is observed in other planetary systems.

OBSERVING DESCRIPTION

Our primary goal is to further assess the O-rich and rocky element-poor (Si, Fe) nature of the polluted white dwarf star GaiaJ0628-5054 and determine how much C, N, and S are present to identify the origin of the accreted parent body. Our secondary goal is then to characterize additional elements that may enhance our understanding of the accreted material which appears to be a Kuiper belt object analog. Modeling of absorption lines shows that the desired elements can be measured or sufficiently strongly constrained with observations in the 1100-1350 Angstrom range. We will perform medium spectral resolution ultraviolet spectroscopy with COS and the G130M grating to cover the 1100-1350 Angstrom range.

No GALEX-measured FUV flux exists for GaiaJ0628-5054; we instead estimate an FUV AB magnitude of 17.0 based off of spectral energy distribution fitting to optical and infrared data combined with an accurate atmospheric model that fits them. We estimate how much time on source is necessary to obtain our desired signal-to-noise with this estimated FUV magnitude and a small amount of interstellar reddening (consistent with its location in the Galaxy). It should be possible to obtain average signal-to-noise~20 in the 1100-1350 Angstrom wavelength range with total on-source exposure time of roughly 12,000 seconds. These estimates are made using the COS ETC assuming standard background parameters and with a white dwarf spectral energy distribution matched to the parameters and flux level of our target. Our requested time estimates for COS are increased assuming 20 minutes of instrument overhead (including all acquisition and exposure overheads as suggested in the COS manual) per visit and 6 minutes of observatory overhead per orbit (spacecraft acquisition). In sum, we request 5 orbits total for COS observations of Gaia J0628-5054.

Observations will be done in the TIME-TAG mode using TAG-FLASH wavelength calibration.

The target white dwarf is an ICRS object (Gaia DR3 position with less than 0.4" positional uncertainty), has an estmated UV flux, and is safe for the COS detectors in our desired setups.

Visit

Proposal 17120, GaiaJ0628 (01), failed Wed Jul 31 16:00:36 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Comments: G130M grating observations of GaiaJ0628-5054.

Diagnostics

(GaiaJ0628 (01)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS
(GaiaJ0628 (01)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS
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(GaiaJ0628 (01)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS
(GaiaJ0628 (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN
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(GaiaJ0628 (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

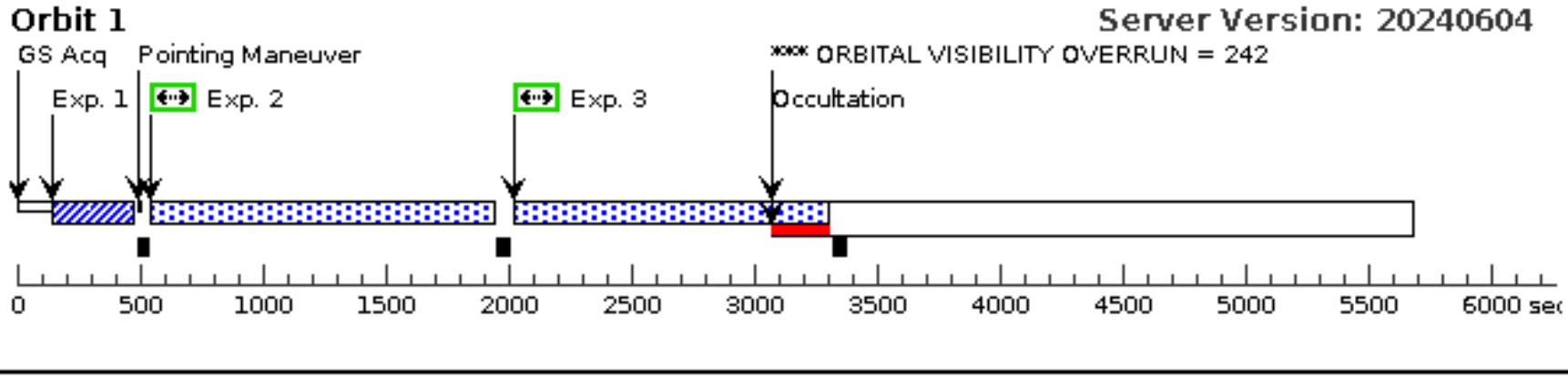
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GAIA-EDR3-5550706714197581824 Alt Name1: GAIAJ0628-5054	RA: 06 28 27.1885 (97.1132854d) Dec: -50 54 47.32 (-50.91314d) Equinox: J2000	Proper Motion RA: 53.653 mas/yr Proper Motion Dec: 56.542 mas/yr Parallax: 0.0137792" Epoch of Position: 2016.0	V=16.0+/-0.05 mFUV~17	Reference Frame: ICRS

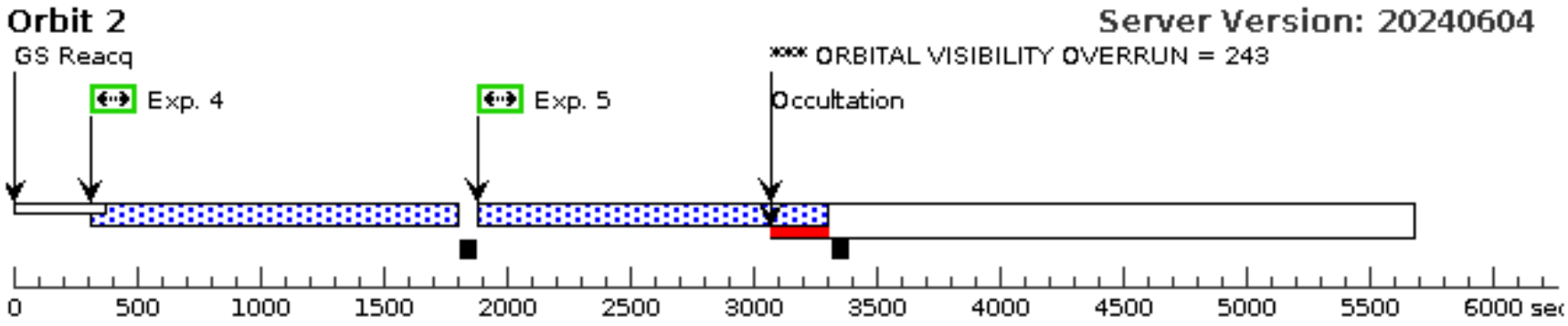
Comments: Gaia DR3 Main astrometry.
Category=STAR
Description=[DB]
Extended=NO

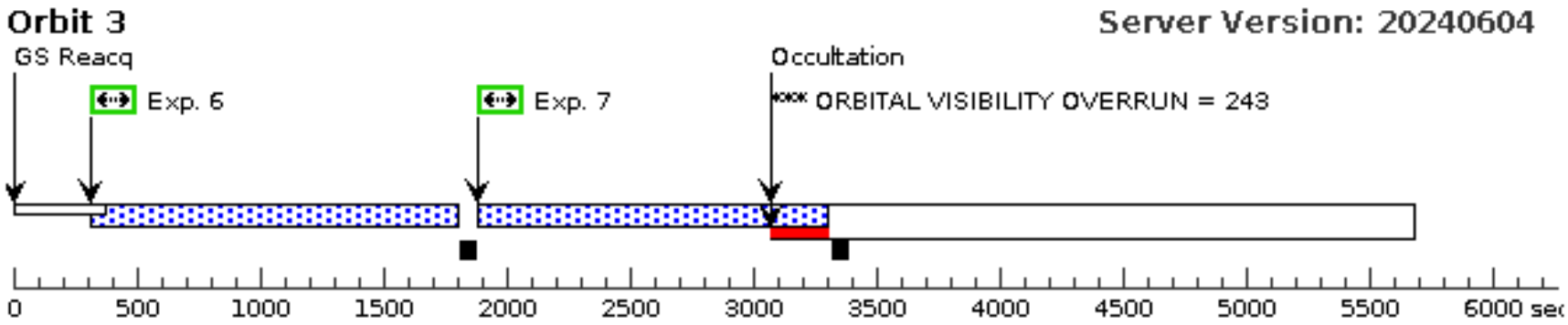
Exposures

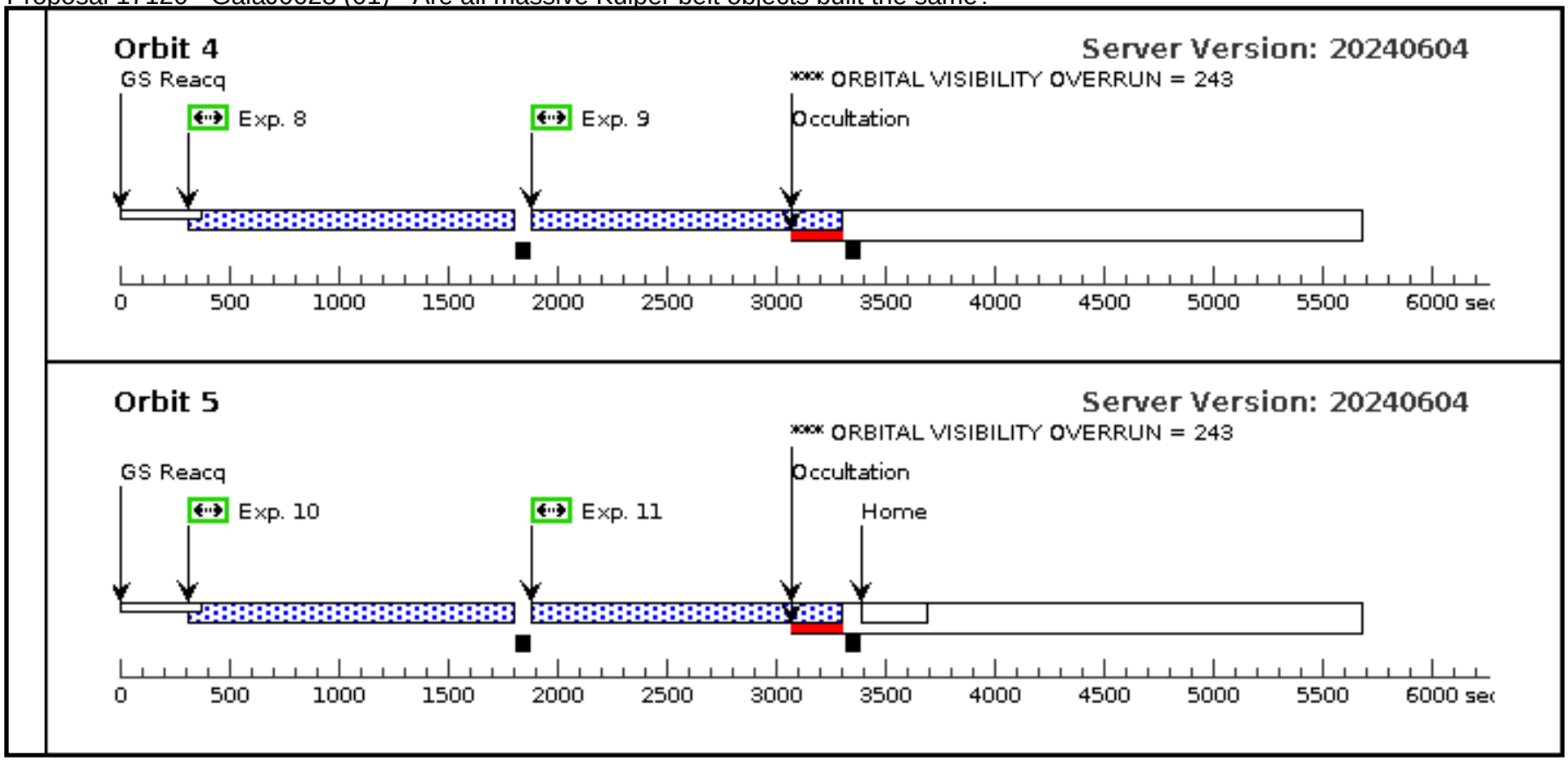
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	GaiaJ0628acq (COS.ta.1808804)	(1) GAIA-EDR3-5550706714197581824	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				20 Secs (20 Secs) *[==>]*	***[1]***
2	GaiaJ0628G130MFP3 (COS.sp.1808806)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1226 Secs (1226 Secs) *[==>]*	***[1]***
3	GaiaJ0628G130MFP4 (COS.sp.1808806)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1227 Secs (1227 Secs) *[==>]*	***[1]***
4	GaiaJ0628G130MFP3-2 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[2]***
5	GaiaJ0628G130MFP4-2 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[2]***
6	GaiaJ0628G130MFP3-3 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[3]***
7	GaiaJ0628G130MFP4-3 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[3]***
8	GaiaJ0628G130MFP3-4 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[4]***
9	GaiaJ0628G130MFP4-4 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[4]***
10	GaiaJ0628G130MFP3-5 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[5]***
11	GaiaJ0628G130MFP4-5 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[5]***

Orbit Structure





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6000 sec

Visit

Proposal 17120, GaiaJ0628 (51), failed Wed Jul 31 16:00:37 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Comments: G130M grating observations of GaiaJ0628-5054. HOPR copy of visit 01.

Diagnostics

(GaiaJ0628 (51)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS
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(GaiaJ0628 (51)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

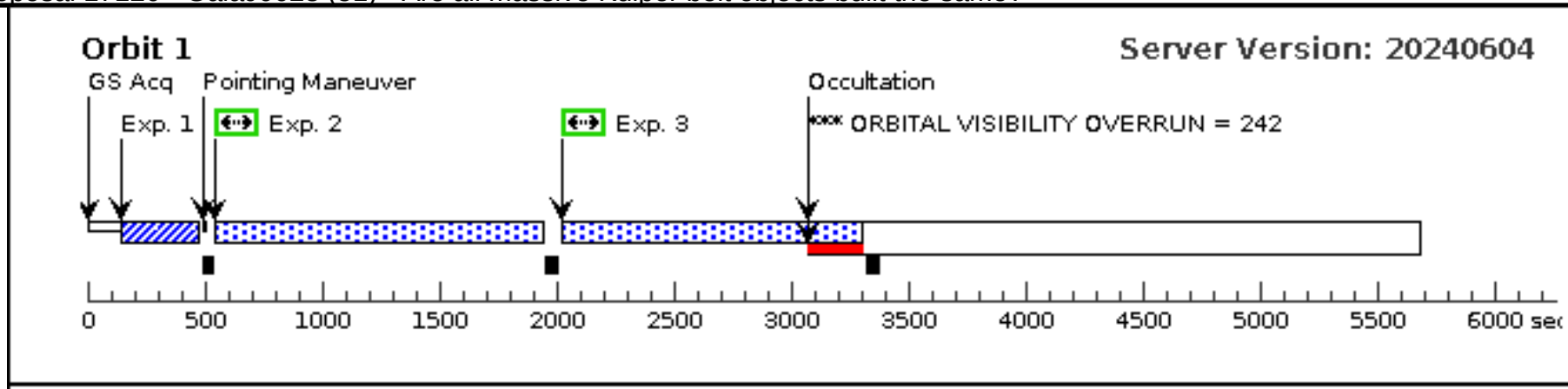
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GAIA-EDR3-5550706714197581824 Alt Name1: GAIAJ0628-5054	RA: 06 28 27.1885 (97.1132854d) Dec: -50 54 47.32 (-50.91314d) Equinox: J2000	Proper Motion RA: 53.653 mas/yr Proper Motion Dec: 56.542 mas/yr Parallax: 0.0137792" Epoch of Position: 2016.0	V=16.0+/-0.05 mFUV~17	Reference Frame: ICRS

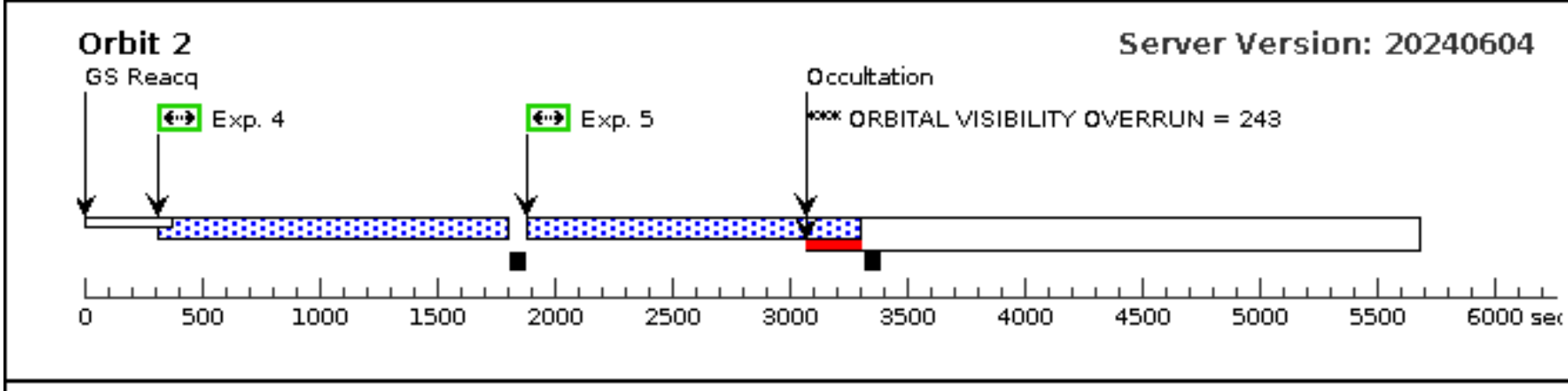
Comments: Gaia DR3 Main astrometry.
Category=STAR
Description=[DB]
Extended=NO

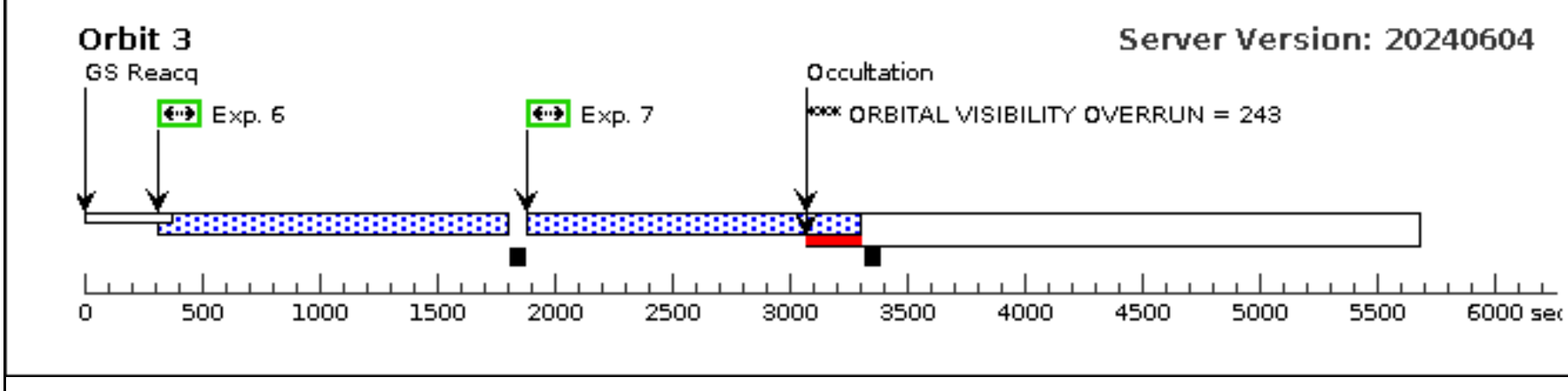
Exposures

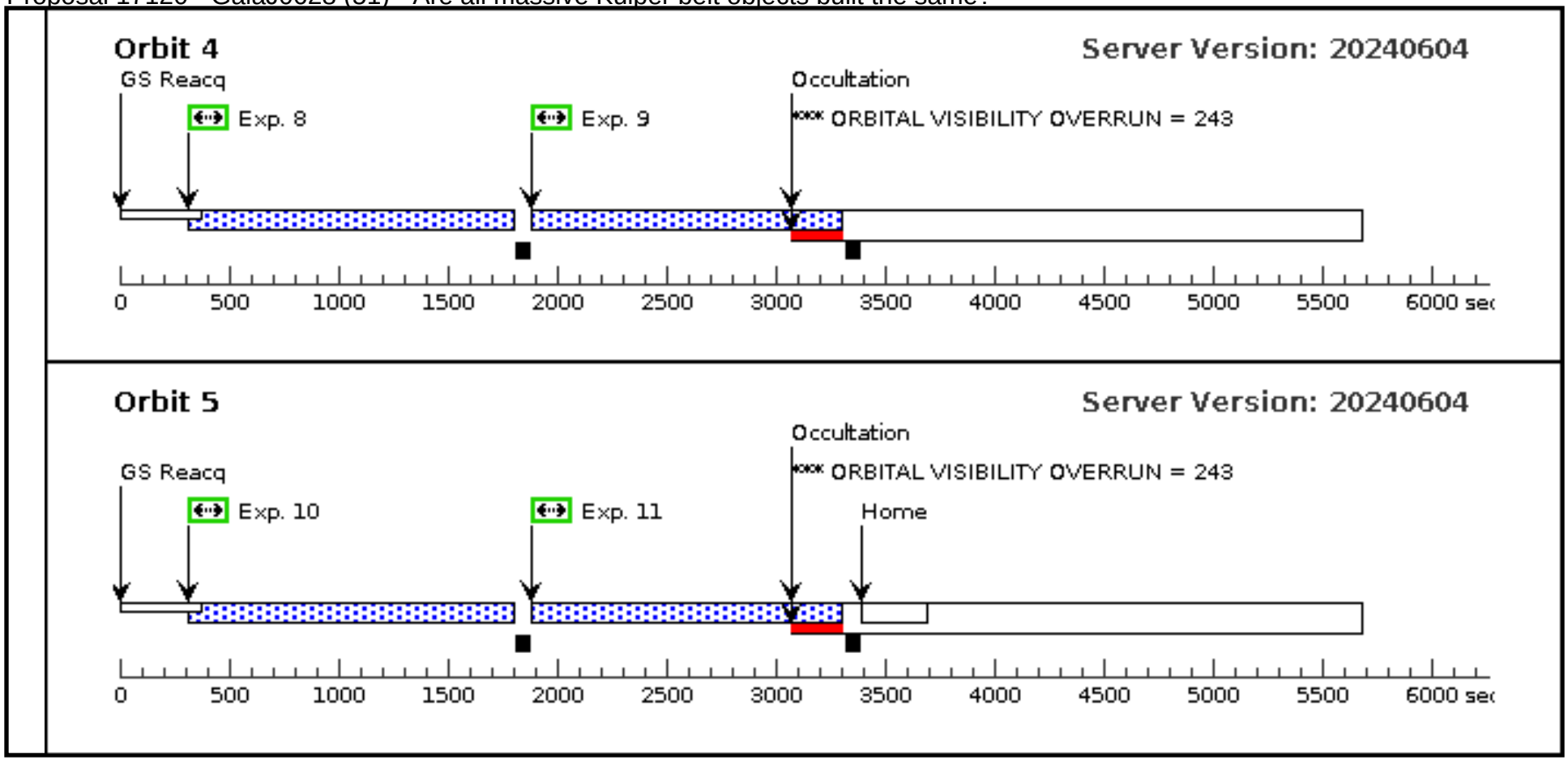
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	GaiaJ0628acq (COS.ta.1808804)	(1) GAIA-EDR3-5550706714197581824	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				20 Secs (20 Secs) *[==>]*	***[1]***
2	GaiaJ0628G130MFP3 (COS.sp.1808806)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1226 Secs (1226 Secs) *[==>]*	***[1]***
3	GaiaJ0628G130MFP4 (COS.sp.1808806)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1227 Secs (1227 Secs) *[==>]*	***[1]***
4	GaiaJ0628G130MFP3-2 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[2]***
5	GaiaJ0628G130MFP4-2 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[2]***
6	GaiaJ0628G130MFP3-3 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[3]***
7	GaiaJ0628G130MFP4-3 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[3]***
8	GaiaJ0628G130MFP3-4 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[4]***
9	GaiaJ0628G130MFP4-4 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[4]***
10	GaiaJ0628G130MFP3-5 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[5]***
11	GaiaJ0628G130MFP4-5 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1367 Secs (1367 Secs) *[==>]*	***[5]***

Orbit Structure





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Visit

Proposal 17120, GaiaJ0628 (52), failed Wed Jul 31 16:00:37 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Comments: G130M grating observations of GaiaJ0628-5054. Re-try to get last 2 orbits.

Diagnostics

(GaiaJ0628 (52)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS

Fixed Targets

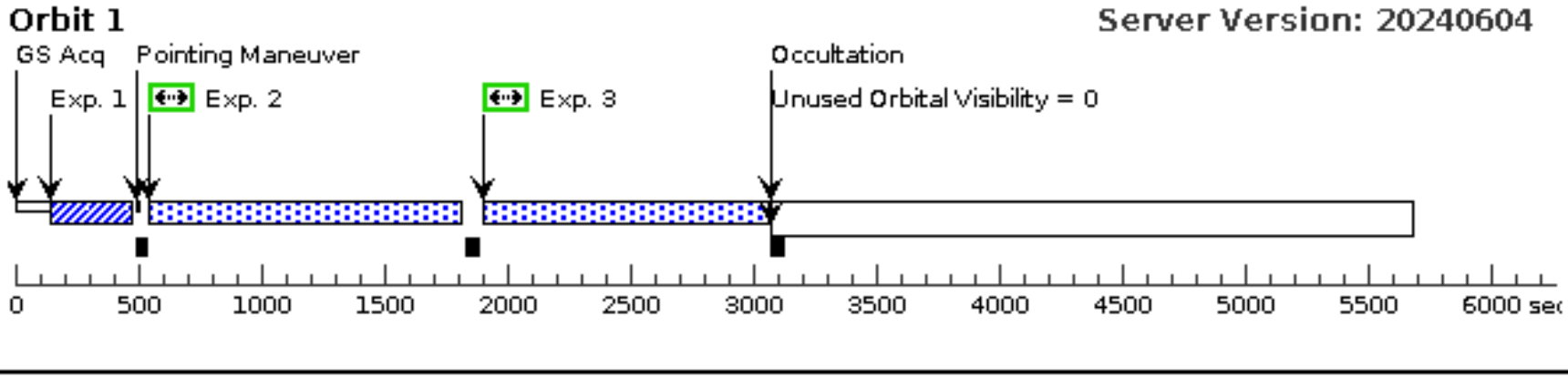
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GAIA-EDR3-5550706714197581824 Alt Name1: GAIAJ0628-5054	RA: 06 28 27.1885 (97.1132854d) Dec: -50 54 47.32 (-50.91314d) Equinox: J2000	Proper Motion RA: 53.653 mas/yr Proper Motion Dec: 56.542 mas/yr Parallax: 0.0137792" Epoch of Position: 2016.0	V=16.0+/-0.05 mFUV~17	Reference Frame: ICRS

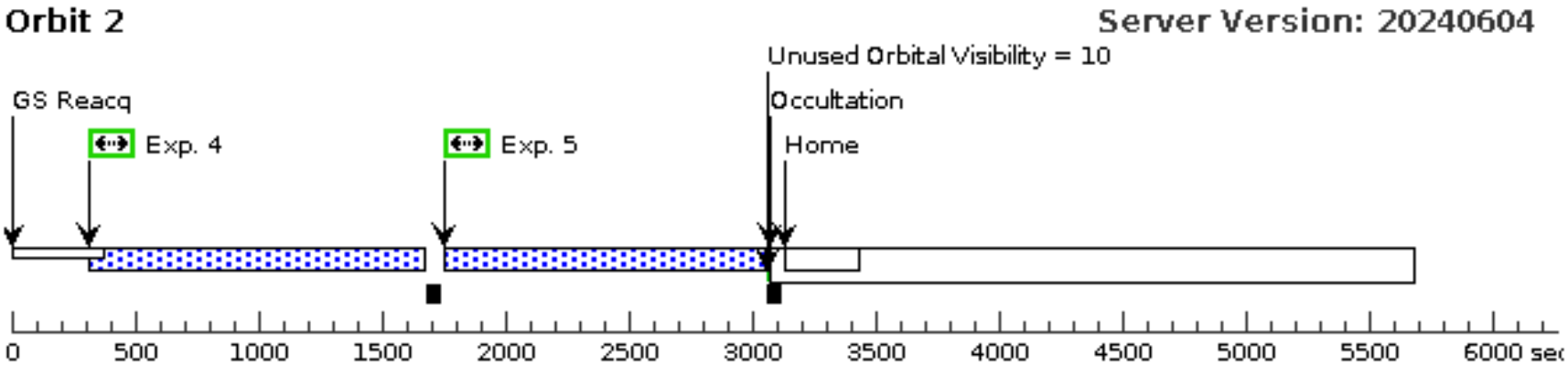
Comments: Gaia DR3 Main astrometry.
Category=STAR
Description=[DB]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	GaiaJ0628acq (COS.ta.1808804)	(1) GAIA-EDR3-5550706714197581824	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				20 Secs (20 Secs) *[==>]*	***[1]***
2	GaiaJ0628G130MFP3 (COS.sp.1808806)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1196 Secs (1105 Secs) *[==>1105.0 Secs]*	***[1]***
3	GaiaJ0628G130MFP4 (COS.sp.1808806)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1197 Secs (1106 Secs) *[==>1106.0 Secs]*	***[1]***
4	GaiaJ0628G130MFP3-2 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1362 Secs (1245 Secs) *[==>1245.0 Secs]*	***[2]***
5	GaiaJ0628G130MFP4-2 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1362 Secs (1245 Secs) *[==>1245.0 Secs]*	***[2]***

Orbit Structure





Visit

Proposal 17120, GaiaJ0628 (53) Wed Jul 31 16:00:37 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Comments: HOPR repeat of visit 52

Diagnostics

(GaiaJ0628 (53)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GAIA-EDR3-5550706714197581824 Alt Name1: GAIAJ0628-5054	RA: 06 28 27.1885 (97.1132854d) Dec: -50 54 47.32 (-50.91314d) Equinox: J2000	Proper Motion RA: 53.653 mas/yr Proper Motion Dec: 56.542 mas/yr Parallax: 0.0137792" Epoch of Position: 2016.0	V=16.0+/-0.05 mFUV~17	Reference Frame: ICRS

Comments: Gaia DR3 Main astrometry.
Category=STAR
Description=[DB]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	GaiaJ0628acq (COS.ta.1808804)	(1) GAIA-EDR3-5550706714197581824	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				20 Secs (20 Secs) *[==>]*	***[1]***
2	GaiaJ0628G130MFP3 (COS.sp.1808806)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1196 Secs (1105 Secs) *[==>1105.0 Secs]*	***[1]***
3	GaiaJ0628G130MFP4 (COS.sp.1808806)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1197 Secs (1106 Secs) *[==>1106.0 Secs]*	***[1]***
4	GaiaJ0628G130MFP3-2 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=3; BUFFER-TIME=3000			1362 Secs (1245 Secs) *[==>1245.0 Secs]*	***[2]***
5	GaiaJ0628G130MFP4-2 (COS.sp.1808807)	(1) GAIA-EDR3-5550706714197581824	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FLASH=YES; FP-POS=4; BUFFER-TIME=3000			1362 Secs (1245 Secs) *[==>1245.0 Secs]*	***[2]***

Orbit Structure