



# 17828 - An HST probe of JWST white dwarf debris disk mineralogies: energetic impacts or extrasolar crusts?

Cycle: 32, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>
<b>Dr. Carl Melis (PI) (Contact)</b>	<b>University of California - San Diego</b>
Prof. Jay Farihi (CoI) (ESA Member)	University College London
Dr. Kate Y.L Su (CoI)	Space Science Institute
Dr. Patrick Dufour (CoI) (CSA Member)	Universite de Montreal
Dr. Seth Redfield (CoI)	Wesleyan University

## 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) UCAC4-207-006574	STIS/CCD STIS/NUV-MAMA	2	08-Aug-2024 09:00:16.0	yes
02	(2) GAIA-DR2-1081504483467714176	STIS/CCD STIS/NUV-MAMA	3	08-Aug-2024 09:00:17.0	yes
03	(2) GAIA-DR2-1081504483467714176	STIS/CCD STIS/NUV-MAMA	3	08-Aug-2024 09:00:17.0	yes
04	(2) GAIA-DR2-1081504483467714176	STIS/CCD STIS/NUV-MAMA	4	08-Aug-2024 09:00:19.0	yes

12 Total Orbits Used

## **ABSTRACT**

Recent JWST MIRI spectroscopic observations covering 5-12 microns unveil a dramatic excess of dusty debris over the well-characterized photosphere of three polluted white dwarf stars. The JWST spectra reveal solid-state emission features that require glassy silica (SiO<sub>2</sub>) species associated with energetic impacts or differentiation processes that produced Earth-like crustal material. Ultraviolet spectroscopic observations will provide measurements and constraints on the elemental constituents of the debris, including those that dominate terrestrial rocks (Si, Mg, Fe), as well as other important tracers of planetary assembly and structure. The proposed experiment will distinguish between Fe-poor material in a planetary crust, where the high silica content has resulted from (past) differentiation, and silica resulting from highly energetic impacts between primitive material that may have occurred during the post-main sequence phase.

## **OBSERVING DESCRIPTION**

Our primary goal is to detect Fe, Mg, and Si in two white dwarf stars, GaiaJ0547-4847 and WDJ0802+5631. This goal will require ultraviolet spectroscopy of each white dwarf using their own specific instrumental setup.

GaiaJ0547-4847 will be observed with STIS/G230L as low resolution coverage over the 1800-3000 Ang range is sufficient to probe all desired elements (and will additionally yield detection of or a stringent limit on C). We use the GALEX-measured NUV magnitude of 17.08 to estimate how much time on source is necessary to obtain our desired signal-to-noise assuming a small amount of interstellar reddening (consistent with the location of the star in the Galaxy). Focusing on the spectral region around C, we find that with 4,700 seconds of integration time we can obtain signal-to-noise ~35 per resolution element near 1960 Ang which should lead to signal-to-noise per resolution element of ~60 for spectral regions around Mg, Fe, and Si. The requested signal-to-noise values will allow us to robustly distinguish between a giant impact between primitive rocky bodies and a planetary crust interpretation for the material orbiting and polluting GaiaJ0547-4847.

WDJ0802+5631 will be observed with STIS/E230M to assess narrow absorption lines of Fe, Mg, and Si in the atmosphere of this DA white dwarf. There is no UV flux measurement available for WDJ0802+5631 so we estimate its expected flux level based off of spectral energy distribution fitting to optical and infrared data combined with an accurate atmospheric model that fits them. To distinguish between the two competing models (crustal material or a giant impact) we need to obtain signal-to-noise >~5 per resolution element in the 2500-2800 Ang region. With 25,000 seconds on source we find that we can obtain signal-to-noise between 6-10 in the desired region and thus will be able to achieve our science goals.

All exposure time estimates are made using the STIS ETC assuming standard background parameters and with a white dwarf spectral energy distribution matched to the parameters and flux level of our targets. Our requested time estimates for STIS are increased assuming 21 minutes of overhead (including all spacecraft, acquisition, and exposure overheads as suggested in the STIS manual) per visit and 6.5 minutes of observatory overhead per additional orbit (spacecraft acquisition). We split visits for WDJ0802+5631 into groups of 3 or 4 orbits to aid in scheduling and maintain the health of the MAMA detector. In sum, we request 2 orbits total for STIS observations of GaiaJ0547-4847 and 10 orbits total for WDJ0802+5631.

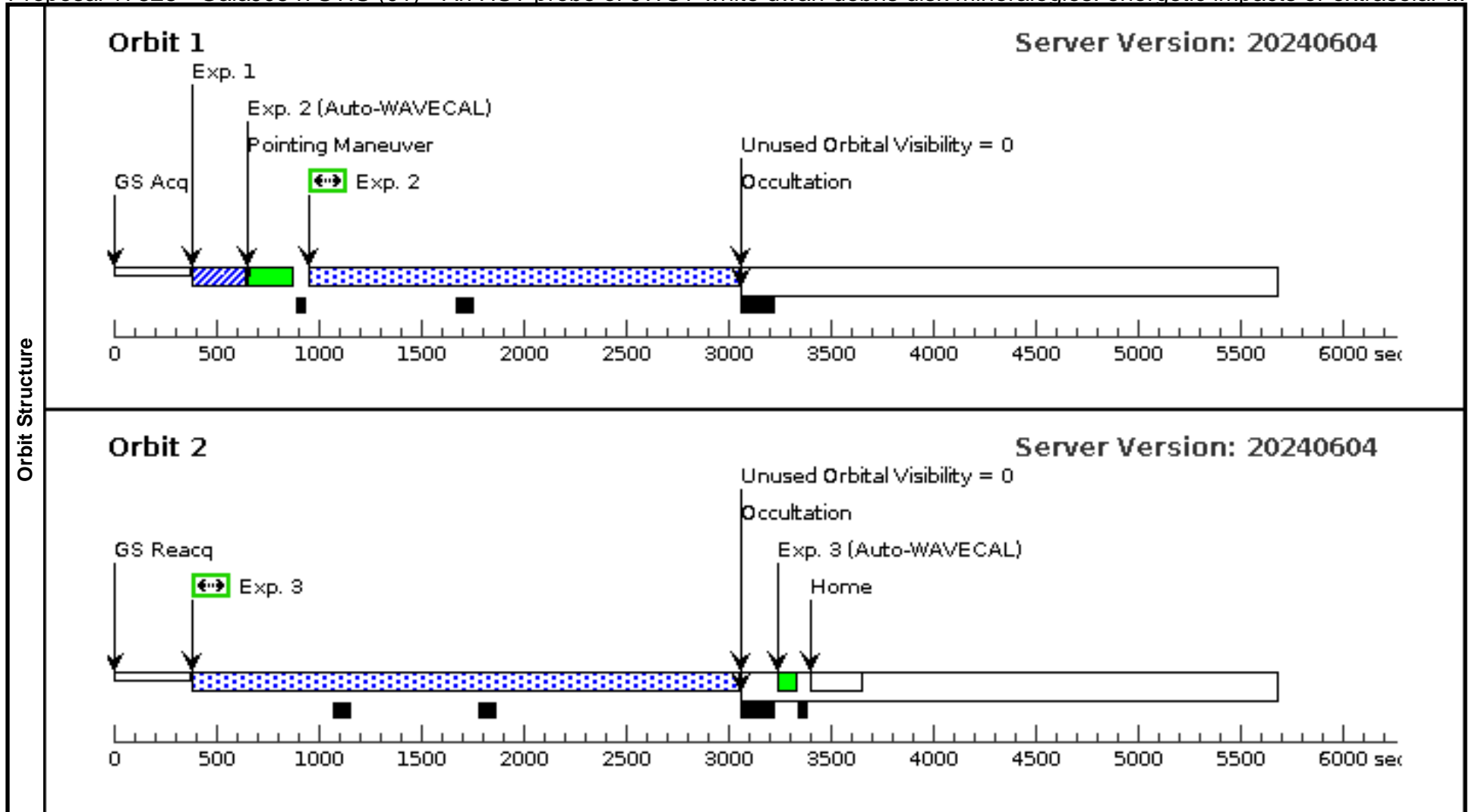
Observations will be done in the TIME-TAG mode and use the STIS CCD for acquisition. We opt for the 50CCD acquisition filter for our generally bluer target stars.

The target white dwarf stars are ICRS objects (Gaia DR3 position with less than 0.1" positional uncertainty), are the brightest sources within a 7" radius (and thus should dominate the 5"x5" acquisition field-of-view regardless of where they land in it), have an estimated or measured UV flux, and are safe for STIS detectors in our desired setups.

Proposal 17828 - GaiaJ0547STIS (01) - An HST probe of JWST white dwarf debris disk mineralogies: energetic impacts or extrasolar ...

Thu Aug 08 13:00:19 GMT 2024

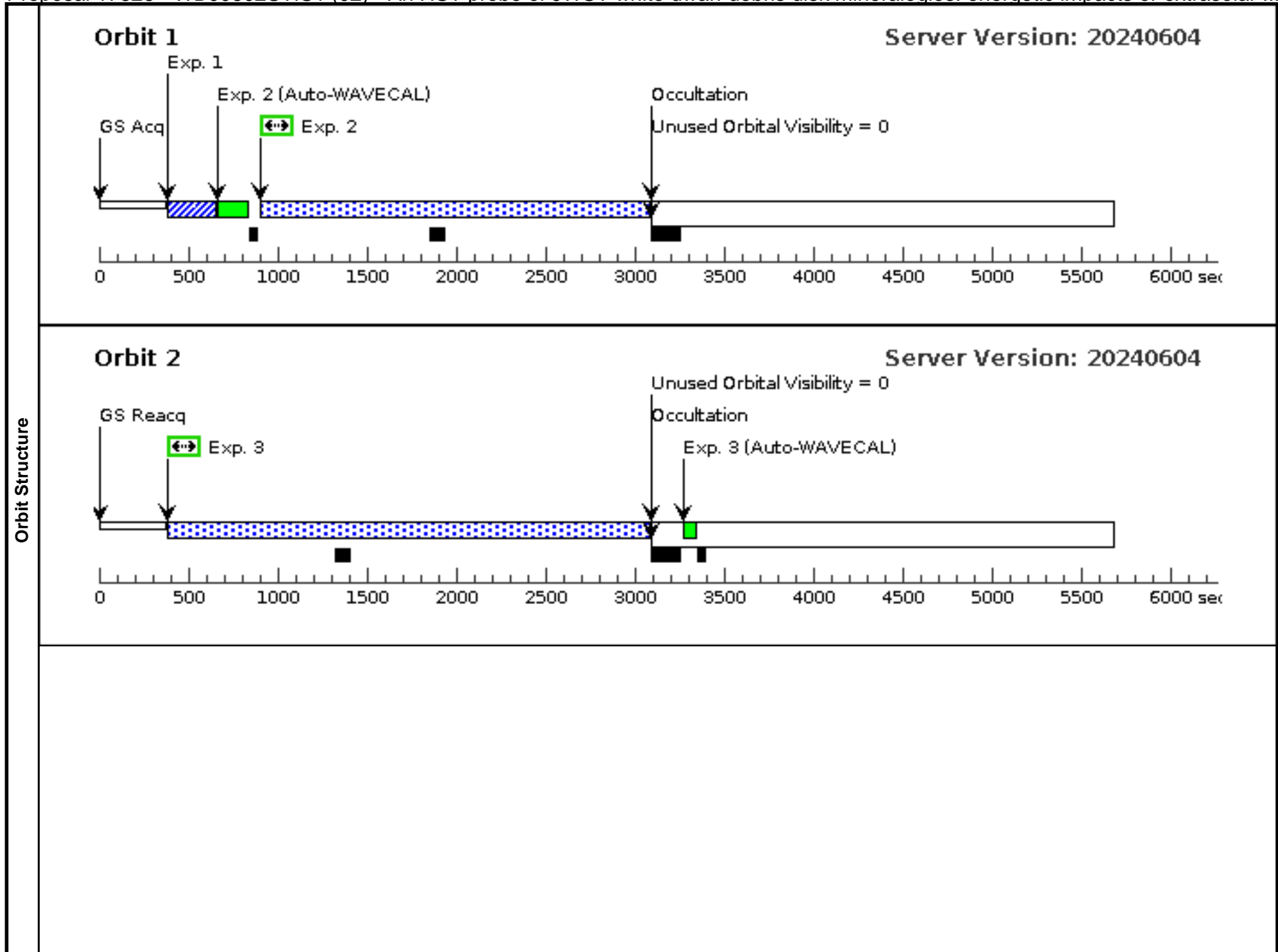
Visit	<b>Proposal 17828, GaiaJ0547STIS (01)</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/NUV-MAMA, STIS/CCD Special Requirements: (none)									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(1)	UCAC4-207-006574 Alt Name1: GAIAJ0547-4847	RA: 05 47 25.6166 (86.8567358d) Dec: -48 47 20.83 (-48.78912d) Equinox: J2000	Proper Motion RA: -85.7 mas/yr Proper Motion Dec: 91.623 mas/yr Parallax: 0.0215077" Epoch of Position: 2016	V=15.8 mNUV=17.08	Reference Frame: ICRS			
	<i>Comments:</i> Category=STAR Description=[DZ] Extended=NO									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	GaiaJ0547acq (STIS.ta.1931016)	(1) UCAC4-207-006574	STIS/CCD, ACQ, 50CCD	MIRROR				5 Secs (5 Secs) [==>]	[1]
	2	GaiaJ0547N UV (STIS.sp.1931035)	(1) UCAC4-207-006574	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=70 0			2058 Secs (2058 Secs) [==>]	[1]
	3	GaiaJ0547N UV (STIS.sp.1931035)	(1) UCAC4-207-006574	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=70 0			2654 Secs (2654 Secs) [==>]	[2]

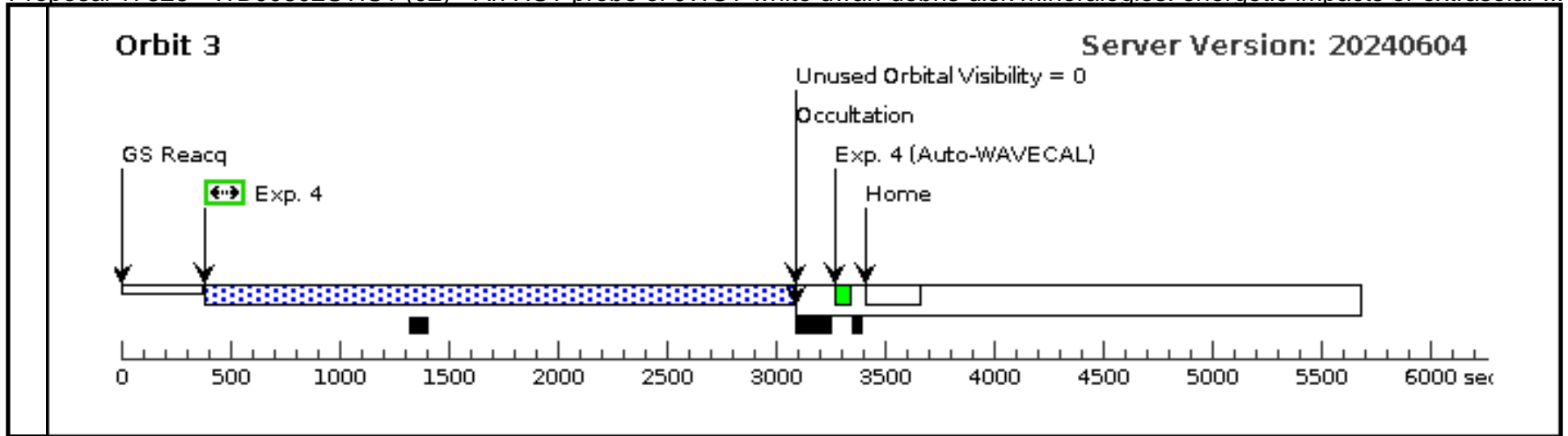


Proposal 17828 - WDJ0802STIS1 (02) - An HST probe of JWST white dwarf debris disk mineralogies: energetic impacts or extrasolar ...

Thu Aug 08 13:00:19 GMT 2024

Visit	<b>Proposal 17828, WDJ0802STIS1 (02)</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/NUV-MAMA, STIS/CCD Special Requirements: (none)									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(2)	GAIA-DR2-1081504483467714176	RA: 08 02 27.6740 (120.6153083d) Dec: +56 31 55.24 (56.53201d) Equinox: J2000	Proper Motion RA: -36.474 mas/yr Proper Motion Dec: -13.368 mas/yr Parallax: 0.0159494" Epoch of Position: 2016	V=16.04	Reference Frame: ICRS			
	<i>Comments:</i> Category=STAR Description=[DA] Extended=NO									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	WDJ0802ac q1 (STIS.ta.193 1052)	(2) GAIA-DR2-1081 504483467714176	STIS/CCD, ACQ, 50CCD	MIRROR				7 Secs (7 Secs) [==>]	[1]
	2	WDJ0802N UVv1 (STIS.sp.19 31053)	(2) GAIA-DR2-1081 504483467714176	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230M 2561 A		BUFFER-TIME=95 0		2163 Secs (2163 Secs) [==>]	[1]
	3	WDJ0802N UVv1 (STIS.sp.19 31053)	(2) GAIA-DR2-1081 504483467714176	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230M 2561 A		BUFFER-TIME=95 0		2689 Secs (2689 Secs) [==>]	[2]
	4	WDJ0802N UVv1 (STIS.sp.19 31053)	(2) GAIA-DR2-1081 504483467714176	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230M 2561 A		BUFFER-TIME=95 0		2689 Secs (2689 Secs) [==>]	[3]

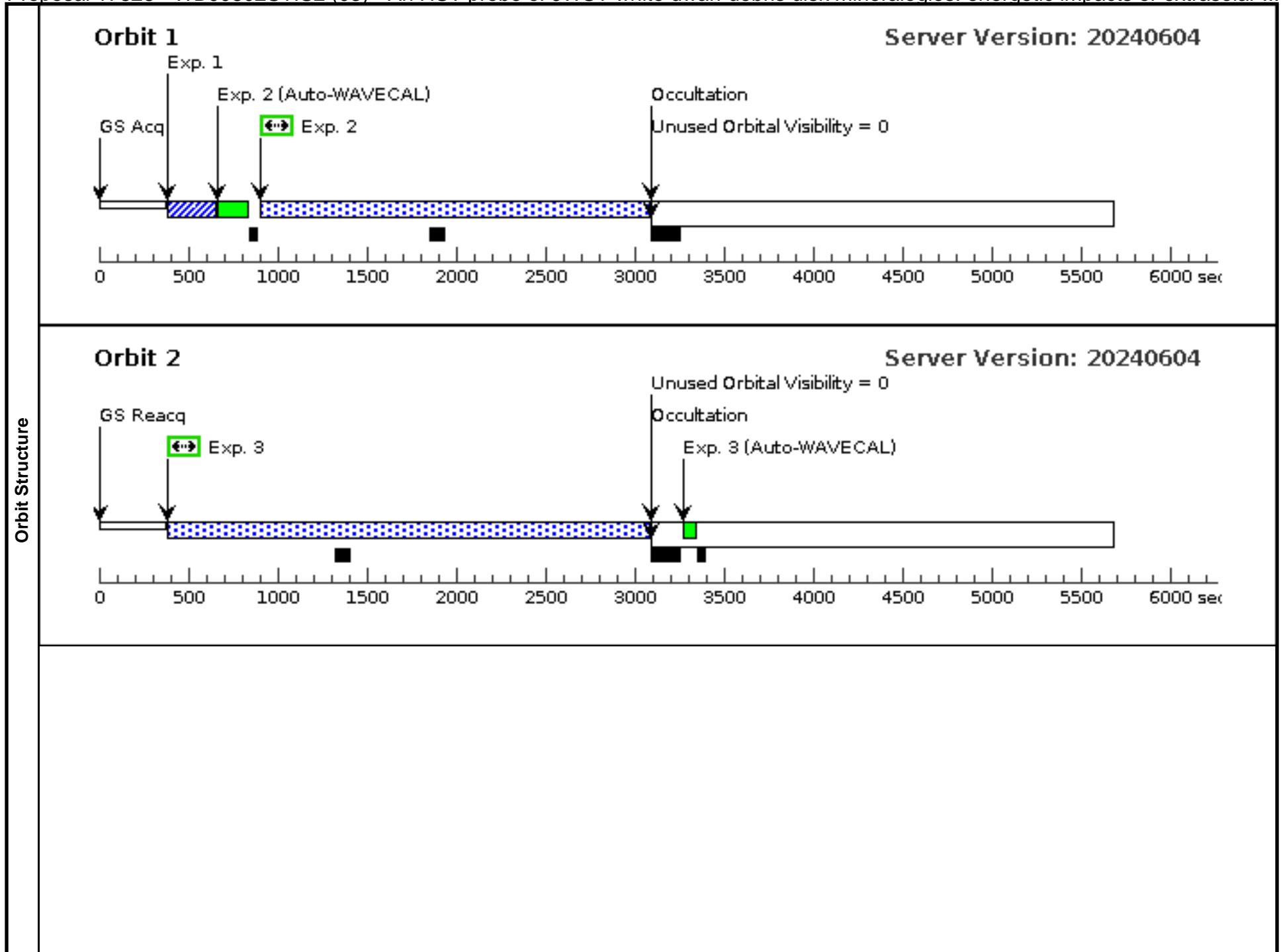


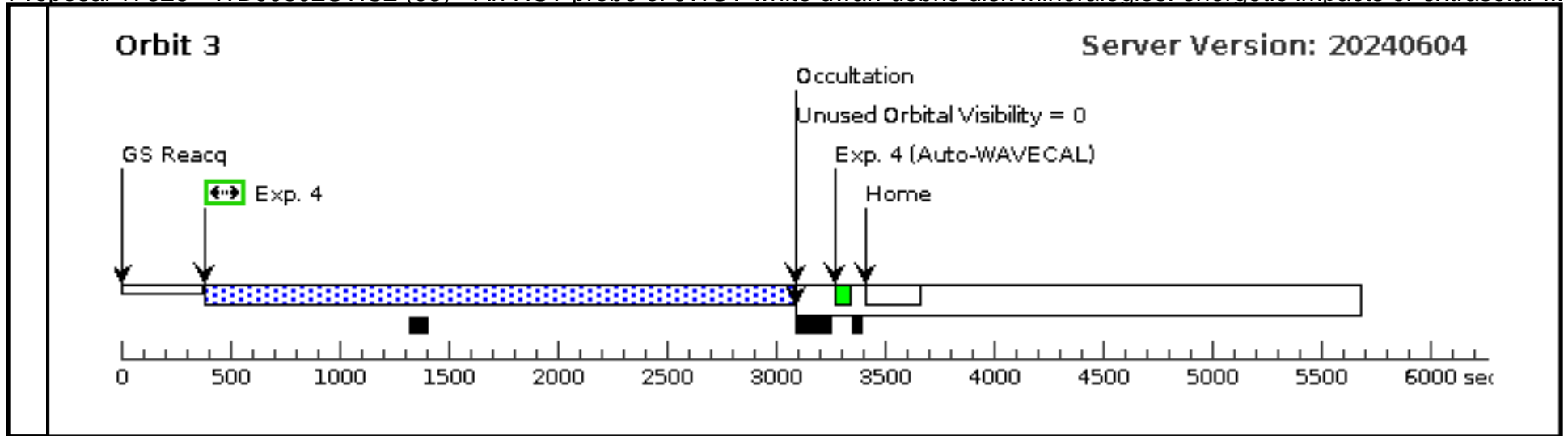


Proposal 17828 - WDJ0802STIS2 (03) - An HST probe of JWST white dwarf debris disk mineralogies: energetic impacts or extrasolar ...

Thu Aug 08 13:00:19 GMT 2024

Visit	<b>Proposal 17828, WDJ0802STIS2 (03)</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/NUV-MAMA, STIS/CCD Special Requirements: (none)																																																		
	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>(2)</td> <td>GAIA-DR2-1081504483467714176</td> <td>RA: 08 02 27.6740 (120.6153083d) Dec: +56 31 55.24 (56.53201d) Equinox: J2000</td> <td>Proper Motion RA: -36.474 mas/yr Proper Motion Dec: -13.368 mas/yr Parallax: 0.0159494" Epoch of Position: 2016</td> <td>V=16.04</td> <td>Reference Frame: ICRS</td> </tr> </tbody> </table> <p><i>Comments:</i>                      Category=STAR                      Description=[DA]                      Extended=NO</p>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(2)	GAIA-DR2-1081504483467714176	RA: 08 02 27.6740 (120.6153083d) Dec: +56 31 55.24 (56.53201d) Equinox: J2000	Proper Motion RA: -36.474 mas/yr Proper Motion Dec: -13.368 mas/yr Parallax: 0.0159494" Epoch of Position: 2016	V=16.04	Reference Frame: ICRS																																					
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Proposal 17828 - WDJ0802STIS3 (04) - An HST probe of JWST white dwarf debris disk mineralogies: energetic impacts or extrasolar ...

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Visit	<b>Proposal 17828, WDJ0802STIS3 (04)</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/NUV-MAMA, STIS/CCD Special Requirements: (none)									
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	1	WDJ0802ac q3 (STIS.ta.193 1052)	(2) GAIA-DR2-1081 504483467714176	STIS/CCD, ACQ, 50CCD	MIRROR				7 Secs (7 Secs) [==>]	[1]
	2	WDJ0802N UVv3 (STIS.sp.19 31053)	(2) GAIA-DR2-1081 504483467714176	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230M 2561 A	BUFFER-TIME=95 0			2163 Secs (2163 Secs) [==>]	[1]
	3	WDJ0802N UVv3 (STIS.sp.19 31053)	(2) GAIA-DR2-1081 504483467714176	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230M 2561 A	BUFFER-TIME=95 0			2689 Secs (2689 Secs) [==>]	[2]
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