17604 - An unbound accretion flow in the quiescent binary Cen X-4

Cycle: 31, Proposal Category: GO

(UV Initiative)

(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) V-V822-CEN	STIS/CCD STIS/FUV-MAMA	2	06-Jun-2025 12:00:13.0	yes
03	(1) V-V822-CEN	STIS/CCD STIS/FUV-MAMA	1	06-Jun-2025 12:00:13.0	yes
02	(1) V-V822-CEN	STIS/CCD STIS/FUV-MAMA	2	06-Jun-2025 12:00:14.0	yes

5 Total Orbits Used

ABSTRACT

Accretion is a fundamental aspect of many different astronomical objects, including black holes and neutron stars. These compact objects predominantly accrete at very low rates. Therefore, understanding this regime is of vital scientific importance. However, it is currently not established how accretion flows organise themselves at these low rates. Accretion flows are proposed to be radiatively inefficient (RIAFs) in

quiescence, but there is no self-consistent model for these flows, and there is little to no observational evidence for RIAFs or their properties. Some proposed models predict bound or unbound RIAFs, but neither of these solutions have ever been confirmed. We have recently discovered a tentative P-Cygni outflow feature in the low-ionisation O I triplet in archival FUV data of the quiescent neutron star X-ray binary Cen X-4, which we propose could be a hint of an unbound RIAF. If this outflow feature can be confirmed, this will both be one of the first observational studies proving the existence of RIAFs, as well as the first ever study to detect an unbound RIAF, which would have a vast impact of our understanding of accretion at low rates. Therefore, we propose HST-STIS FUV spectroscopic observations of Cen X-4, in order to confirm and characterise the outflow identified for the O I triplet. Moreover, the proposed HST-STIS observations will allow us to place better constraints on the origin of the UV emission, the morphology of the accretion flow, and the evolutionary stage and history of the binary.

OBSERVING DESCRIPTION

This programme consists of 4 HST orbits, in order to obtain a continuum signal-to-noise around the O I 1305A line of S/N~3. To obtain the required SNR, we spread this over 2 visits that consist of 2 orbits each (STIS.sp.1897134). Each first orbit will consist of a STIS/CCD ACQ, and complemented with the spectroscopic exposures taken with the STIS/FUV G140L

The source position is accurately known (to within 0.11 mas; Gaia EDR3), so target acquisition can be performed using ACQ (a S/N of 55 is obtained for a 20-s exposure for V~18.8; ECT ID STIS.ta.1903019). Since the UV emission can vary with a factor of ~2 on a timescale of days, we ensure that the TA exposure time is sufficient for the low end (V~18.8) and high end (V~17.7) of the expected brightness.

Visit

Proposal 17604, Orbit 1 (01), failed Fri Jun 06 16:00:14 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: (none)

Fixed Targets

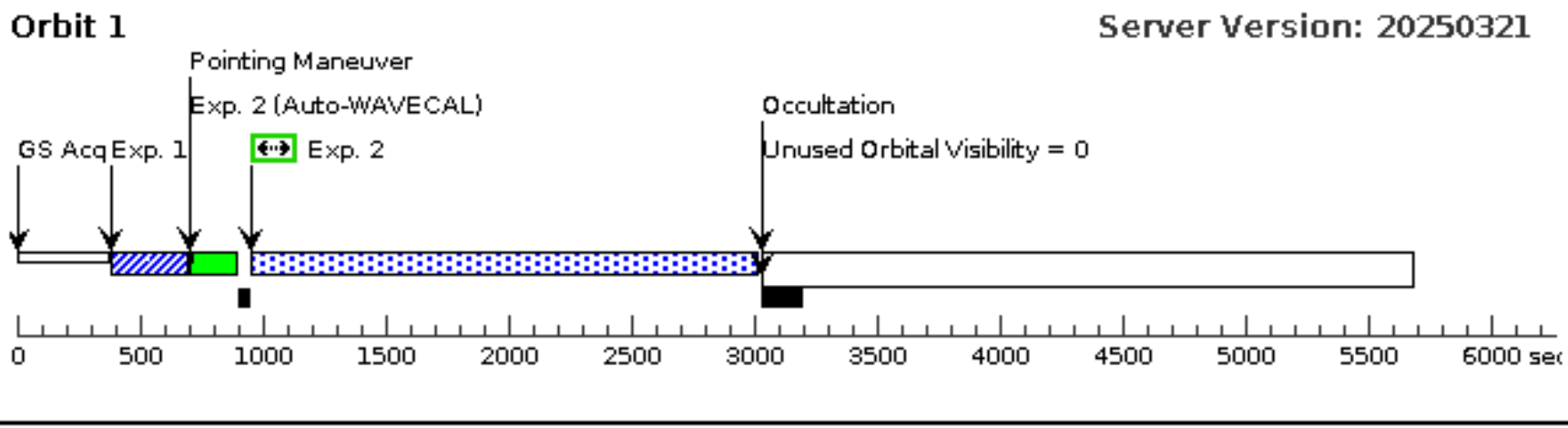
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	V-V822-CEN Alt Name1: CENX-4 Alt Name2: V822CEN	RA: 14 58 21.9348 (224.5913950d) Dec: -31 40 7.52 (-31.66876d) Equinox: J2000	Proper Motion RA: 0.844 mas/yr Proper Motion Dec: -55.68200001562218 mas/yr Parallax: 0.0005" Epoch of Position: 2000	V=18.78+/-0.13 uvot uvw2=18.3	Reference Frame: ICRS

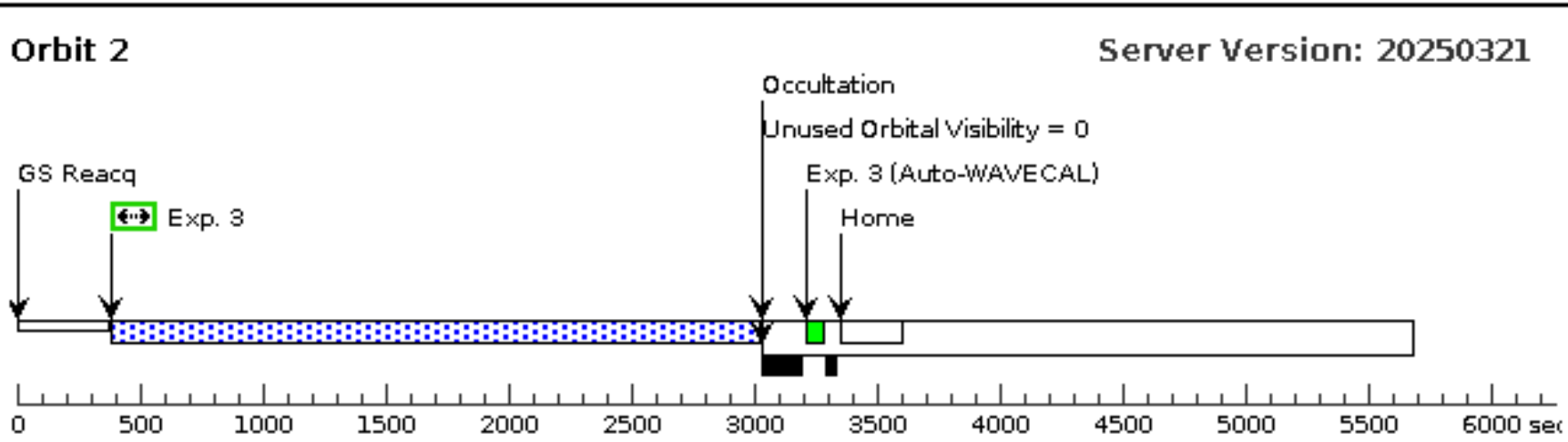
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[ACCRETION DISK, LMXB, NEUTRON STAR]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	TA (STIS.ta.1903019)	(1) V-V822-CEN	STIS/CCD, ACQ, F28X50LP	MIRROR				20 Secs (20 Secs) *[==>]*	***[1]***
2	SCI FP1 (STIS.sp.1897134)	(1) V-V822-CEN	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=1050			3110 Secs (2047 Secs) *[==>2047.0 Secs]*	***[1]***
3	SCI FP2 (STIS.sp.1897134)	(1) V-V822-CEN	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=1350			3110 Secs (2626 Secs) *[==>2626.0 Secs]*	***[2]***

Orbit Structure





Visit

Proposal 17604, Orbit 1 (03) Fri Jun 06 16:00:14 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: (none)

Comments: This is a copy to repeat the failed orbit

Fixed Targets

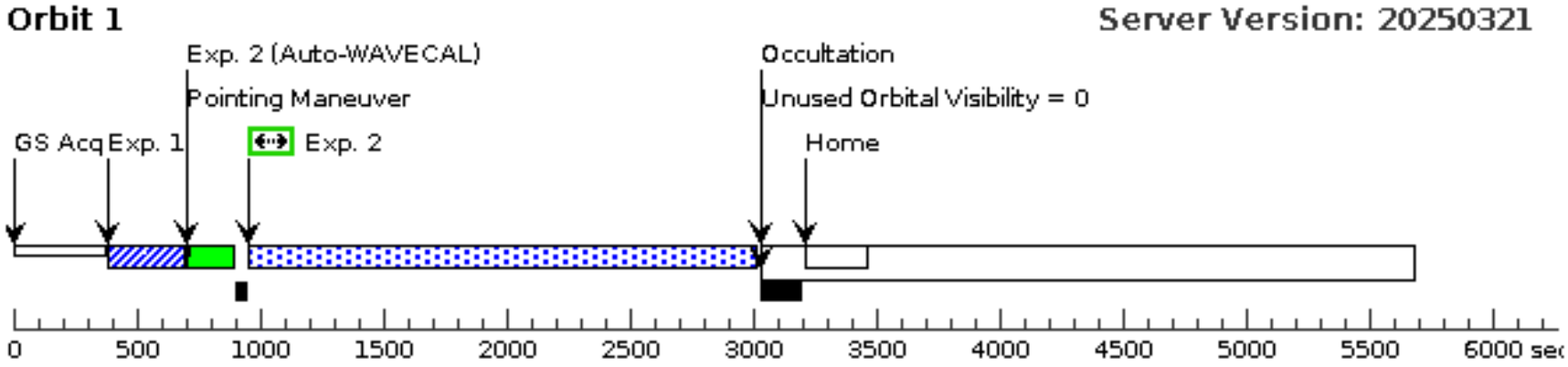
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	V-V822-CEN Alt Name1: CENX-4 Alt Name2: V822CEN	RA: 14 58 21.9348 (224.5913950d) Dec: -31 40 7.52 (-31.66876d) Equinox: J2000	Proper Motion RA: 0.844 mas/yr Proper Motion Dec: -55.68200001562218 mas/yr Parallax: 0.0005" Epoch of Position: 2000	V=18.78+/-0.13 uvot uvw2=18.3	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[ACCRETION DISK, LMXB, 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	TA (STIS.ta.1903019)	(1) V-V822-CEN	STIS/CCD, ACQ, F28X50LP	MIRROR				20 Secs (20 Secs) *[==>]*	*[1]*
2	SCI FP1 (STIS.sp.1897134)	(1) V-V822-CEN	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=1050			3110 Secs (2047 Secs) *[==>2047.0 Secs]*	*[1]*

Orbit Structure



Visit

Proposal 17604, Orbit 2 (02), completed Fri Jun 06 16:00:14 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	V-V822-CEN Alt Name1: CENX-4 Alt Name2: V822CEN	RA: 14 58 21.9348 (224.5913950d) Dec: -31 40 7.52 (-31.66876d) Equinox: J2000	Proper Motion RA: 0.844 mas/yr Proper Motion Dec: -55.68200001562218 mas/yr Parallax: 0.0005" Epoch of Position: 2000	V=18.78+/-0.13 uvot uvw2=18.3	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[ACCRETION DISK, LMXB, 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	TA (STIS.ta.1903019)	(1) V-V822-CEN	STIS/CCD, ACQ, F28X50LP	MIRROR				20 Secs (20 Secs) *[==>]*	***[1]***
2	SCI FP1 (STIS.sp.1897134)	(1) V-V822-CEN	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=1050			3110 Secs (2047 Secs) *[==>2047.0 Secs]*	***[1]***
3	SCI FP2 (STIS.sp.1897134)	(1) V-V822-CEN	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=1350			3110 Secs (2626 Secs) *[==>2626.0 Secs]*	***[2]***

Orbit Structure