



18209 - Narrowband observations of protostellar outflows in M20

Cycle: 32, Proposal Category: GO/DD

(Availability Mode: SUPPORTED)

INVESTIGATORS

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Miranda Brugman (CoI)	Space Telescope Science Institute

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>
11	(1) HH-399 ANY	ACS/WFC WFC3/UVIS	1	22-Oct-2025 16:00:15.0	yes
12	(1) HH-399 ANY	ACS/WFC WFC3/UVIS	1	22-Oct-2025 16:00:16.0	yes
13	(1) HH-399 ANY	ACS/WFC WFC3/UVIS	1	22-Oct-2025 16:00:16.0	yes
14	(1) HH-399 ANY	ACS/WFC WFC3/UVIS	1	22-Oct-2025 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>
15	(1) HH-399 ANY	ACS/WFC WFC3/UVIS	1	22-Oct-2025 16:00:17.0	yes
16	(1) HH-399 ANY	ACS/WFC WFC3/UVIS	1	22-Oct-2025 16:00:18.0	yes

6 Total Orbits Used

ABSTRACT

We propose to image dense pillars within the star forming nebula, M20. Imaging in F502N, F656N, and F673N will identify variations of density and ionization in the atomic gas surrounding this active area of star formation and highlight protostellar outflows emerging from the pillar, the proper motion of which will be measured in comparison to archival observations of the region. Broadband imaging in F475W and F814W will enable accurate measurement of stellar colors in the field.

OBSERVING DESCRIPTION

We will obtain high signal-to-noise imaging of the M20 "Snail" (HH 399) in narrowband filters F502N, F656N, and F673N, as well as broadband filters F475W and F814W. The B and I filters will provide a balanced color profile to the stars in the image, while the [O III], H-alpha, and [SII] narrowband filters will highlight regions of differing density and ionization state through the nebula. Additionally, the F656N filter will enable a direct comparison to archival WFPC2 H-alpha images in order to highlight the proper motion of the jet. We propose a single WFC3 pointing which will adequately cover the entire object at the Position Angles available in Reduced Gyro Mode. We will employ a dither pattern which fills the chip gaps and enables cosmic ray rejection. We calculate exposure times from archival observations of this object with WFPC2. Using the WFC3 ETC, we estimate that we can achieve the high signal-to-noise needed for imaging with 6 orbits, with approximately 5 ks for F656N, 6 ks for F502N, and 7 ks for F673N. The broadband filter exposures can be placed as short bookends to the narrowband observations. Proper motion was measurable as early as 5 years after the initial observations in 1997 taken under HST program ID 6857 (PI Trauger), in data taken in 2002 under HST program ID 11121 (PI Yusef-Zadeh) (Yusef-Zadeh, Biretta, & Wardle, 2005).

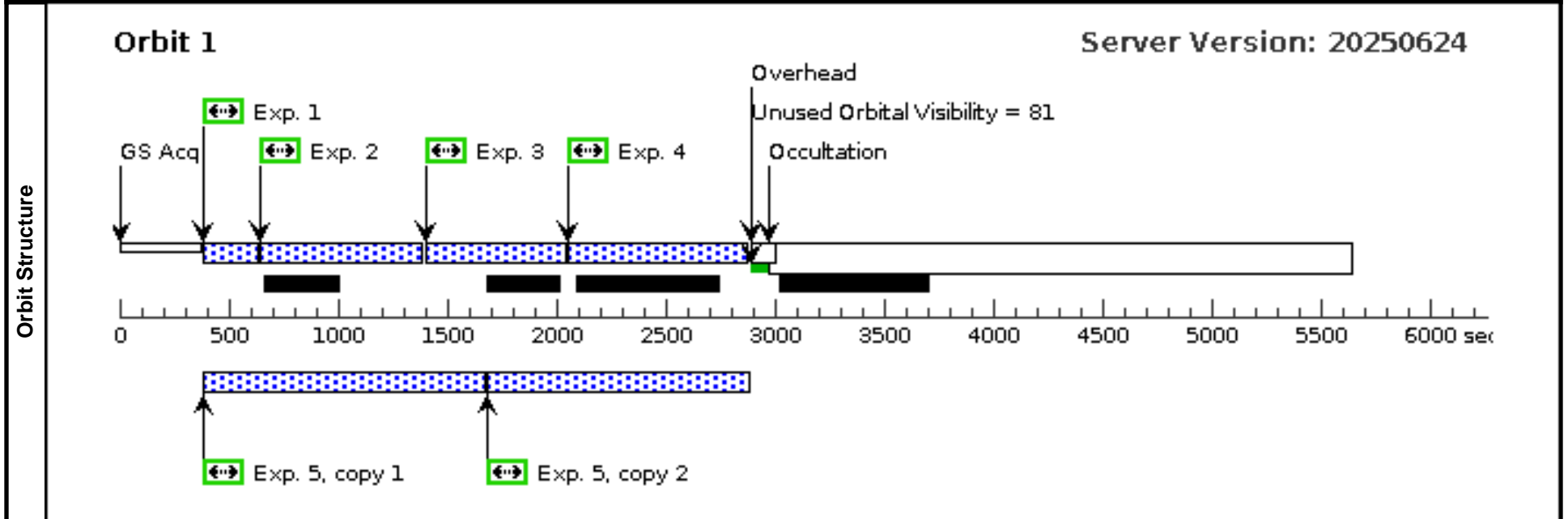
Proposal 18209 - M20 snail (11) - Narrowband observations of protostellar outflows in M20

Wed Oct 22 20:00:18 GMT 2025

Visit	Proposal 18209, M20 snail (11) Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS, ACS/WFC Special Requirements: ORIENT 265D TO 275 D; BEFORE 16-MAR-2026:00:00:00				

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	HH-399	RA: 18 02 28.5950 (270.6191458d) Dec: -23 04 26.07 (-23.07391d) Equinox: J2000	Epoch of Position: 2000	V=18+/-6	Reference Frame: ICRS
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=ISM Description=[HERBIG-HARO OBJECT] Extended=YES					

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F475W	FLASH=15	POS TARG -0.2,-3.0	Prime + Parallel Group 1-5 in M20 snail (11)	90 Secs (90 Secs) [==>]	[1]
	2		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=20	POS TARG -0.2,-3.0	Prime + Parallel Group 1-5 in M20 snail (11)	600 Secs (600 Secs) [==>]	[1]
	3		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=20	POS TARG -0.2,-3.0	Prime + Parallel Group 1-5 in M20 snail (11)	500 Secs (500 Secs) [==>]	[1]
	4		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F673N	FLASH=20	POS TARG -0.2,-3.0	Prime + Parallel Group 1-5 in M20 snail (11)	800 Secs (800 Secs) [==>]	[1]
	5	ANY	ACS/WFC, ACCUM, WFCENTER	F658N				Prime + Parallel Group 1-5 in M20 snail (11)	1080 Secs X 2 (2160 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]



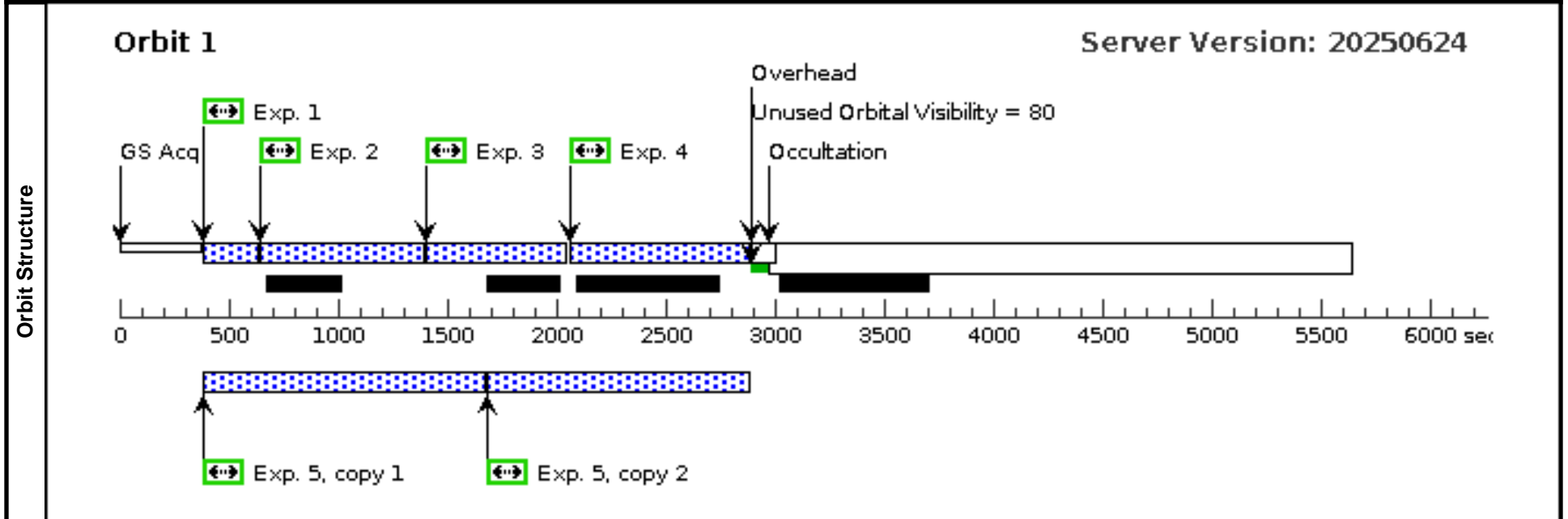
Proposal 18209 - M20 snail (12) - Narrowband observations of protostellar outflows in M20

Wed Oct 22 20:00:18 GMT 2025

Visit	Proposal 18209, M20 snail (12)				
	Diagnostic Status: No Diagnostics				
	Scientific Instruments: WFC3/UVIS, ACS/WFC				
	Special Requirements: SAME ORIENT AS 11; BEFORE 16-MAR-2026:00:00:00				

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	HH-399	RA: 18 02 28.5950 (270.6191458d) Dec: -23 04 26.07 (-23.07391d) Equinox: J2000	Epoch of Position: 2000	V=18+/-6	Reference Frame: ICRS
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					
	Category=ISM Description=[HERBIG-HARO OBJECT] Extended=YES					

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=15	POS TARG -0.2,-3.0	Prime + Parallel Group 1-5 in M20 snail (12)	90 Secs (90 Secs) [==>]	[1]
	2		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=20	POS TARG -0.2,-3.0	Prime + Parallel Group 1-5 in M20 snail (12)	600 Secs (600 Secs) [==>]	[1]
	3		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=20	POS TARG -0.2,-3.0	Prime + Parallel Group 1-5 in M20 snail (12)	500 Secs (500 Secs) [==>]	[1]
	4		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F673N	FLASH=20	POS TARG -0.2,-3.0	Prime + Parallel Group 1-5 in M20 snail (12)	800 Secs (800 Secs) [==>]	[1]
	5	ANY		ACS/WFC, ACCUM, WFCENTER	F658N			Prime + Parallel Group 1-5 in M20 snail (12)	1080 Secs X 2 (2160 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]



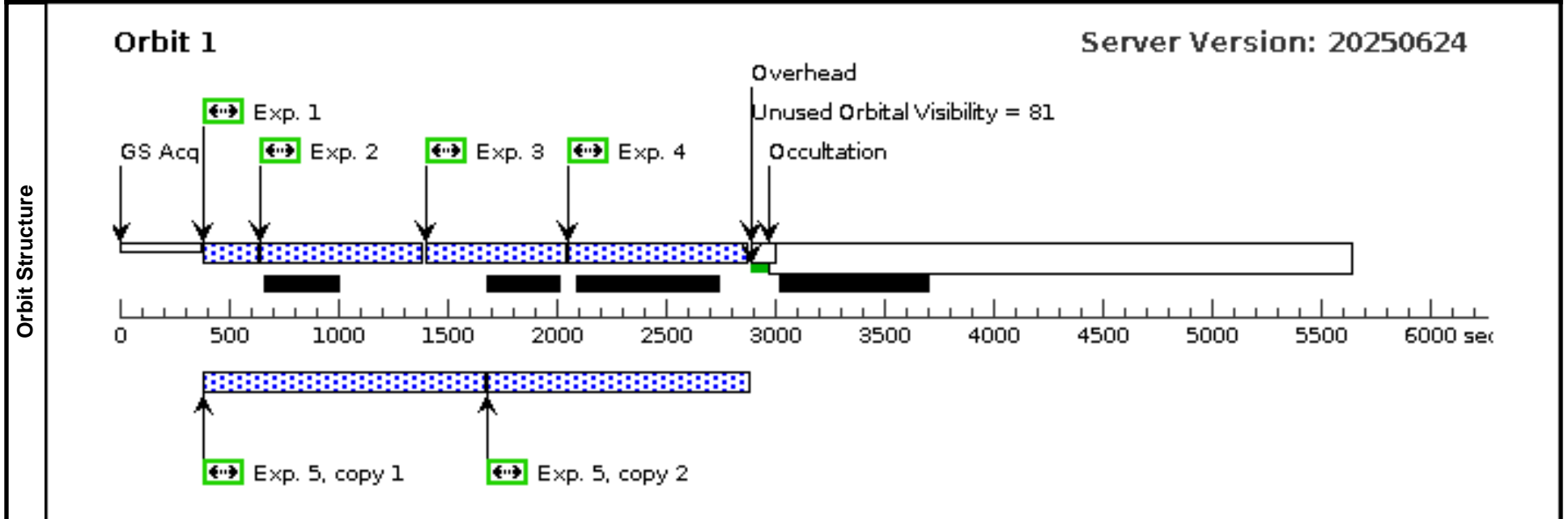
Proposal 18209 - M20 snail (13) - Narrowband observations of protostellar outflows in M20

Wed Oct 22 20:00:18 GMT 2025

Visit	Proposal 18209, M20 snail (13)				
	Diagnostic Status: No Diagnostics				
	Scientific Instruments: WFC3/UVIS, ACS/WFC				
	Special Requirements: SAME ORIENT AS 11; BEFORE 16-MAR-2026:00:00:00				

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	HH-399	RA: 18 02 28.5950 (270.6191458d) Dec: -23 04 26.07 (-23.07391d) Equinox: J2000	Epoch of Position: 2000	V=18+/-6	Reference Frame: ICRS
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					
	Category=ISM Description=[HERBIG-HARO OBJECT] Extended=YES					

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F475W	FLASH=15		Prime + Parallel Group 1-5 in M20 snail (13)	90 Secs (90 Secs) [==>]	[1]
	2		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=20		Prime + Parallel Group 1-5 in M20 snail (13)	600 Secs (600 Secs) [==>]	[1]
	3		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=20		Prime + Parallel Group 1-5 in M20 snail (13)	500 Secs (500 Secs) [==>]	[1]
	4		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F673N	FLASH=20		Prime + Parallel Group 1-5 in M20 snail (13)	800 Secs (800 Secs) [==>]	[1]
	5	ANY	ANY	ACS/WFC, ACCUM, WFCENTER	F658N			Prime + Parallel Group 1-5 in M20 snail (13)	1080 Secs X 2 (2160 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]



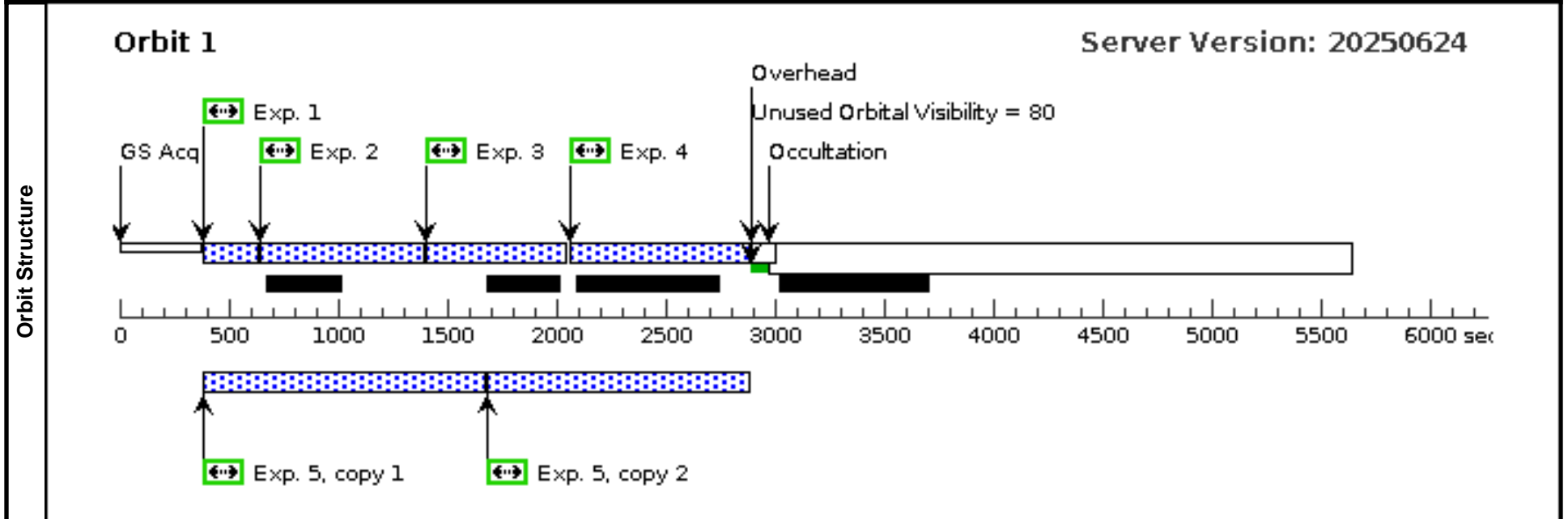
Proposal 18209 - M20 snail (14) - Narrowband observations of protostellar outflows in M20

Wed Oct 22 20:00:18 GMT 2025

Visit	Proposal 18209, M20 snail (14)				
	Diagnostic Status: No Diagnostics				
	Scientific Instruments: WFC3/UVIS, ACS/WFC				
	Special Requirements: SAME ORIENT AS 11; BEFORE 16-MAR-2026:00:00:00				

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	HH-399	RA: 18 02 28.5950 (270.6191458d) Dec: -23 04 26.07 (-23.07391d) Equinox: J2000	Epoch of Position: 2000	V=18+/-6	Reference Frame: ICRS
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					
	Category=ISM Description=[HERBIG-HARO OBJECT] Extended=YES					

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=15		Prime + Parallel Group 1-5 in M20 snail (14)	90 Secs (90 Secs) [==>]	[1]
	2		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=20		Prime + Parallel Group 1-5 in M20 snail (14)	600 Secs (600 Secs) [==>]	[1]
	3		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=20		Prime + Parallel Group 1-5 in M20 snail (14)	500 Secs (500 Secs) [==>]	[1]
	4		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F673N	FLASH=20		Prime + Parallel Group 1-5 in M20 snail (14)	800 Secs (800 Secs) [==>]	[1]
	5	ANY	ANY	ACS/WFC, ACCUM, WFCENTER	F658N			Prime + Parallel Group 1-5 in M20 snail (14)	1080 Secs X 2 (2160 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]



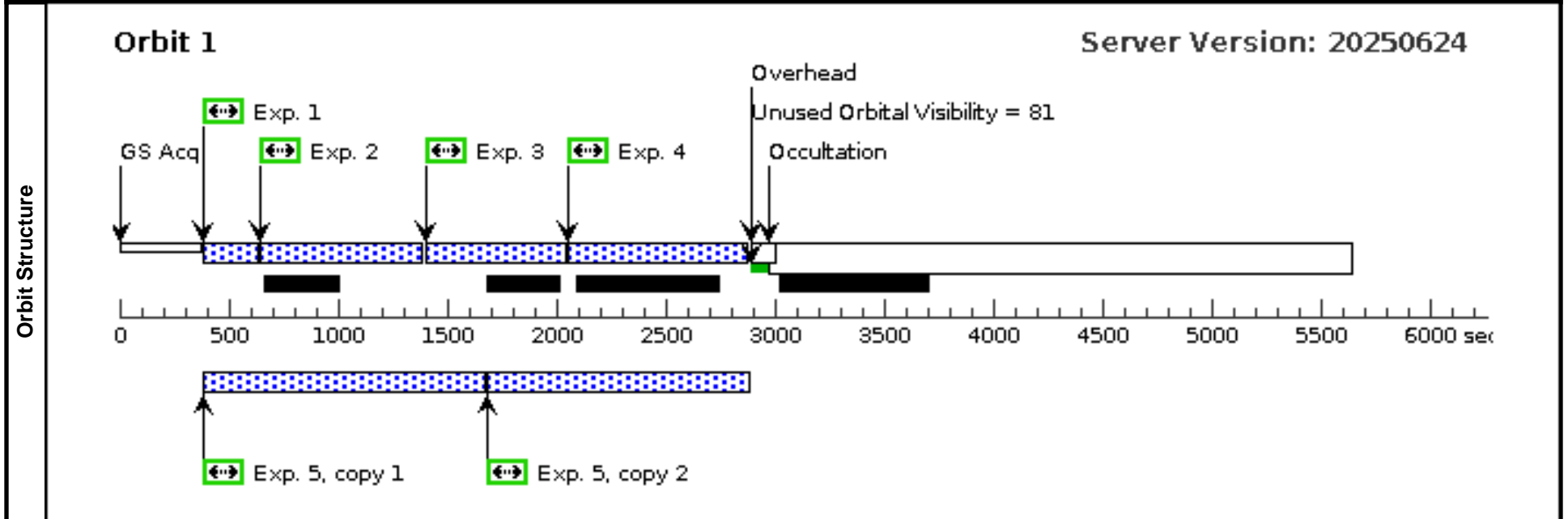
Proposal 18209 - M20 snail (15) - Narrowband observations of protostellar outflows in M20

Wed Oct 22 20:00:18 GMT 2025

Visit	Proposal 18209, M20 snail (15)				
	Diagnostic Status: No Diagnostics				
	Scientific Instruments: WFC3/UVIS, ACS/WFC				
	Special Requirements: SAME ORIENT AS 11; BEFORE 16-MAR-2026:00:00:00				

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	HH-399	RA: 18 02 28.5950 (270.6191458d) Dec: -23 04 26.07 (-23.07391d) Equinox: J2000	Epoch of Position: 2000	V=18+/-6	Reference Frame: ICRS
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					
	Category=ISM Description=[HERBIG-HARO OBJECT] Extended=YES					

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F475W	FLASH=15	POS TARG 0.2,3,0	Prime + Parallel Group 1-5 in M20 snail (15)	90 Secs (90 Secs) [==>]	[1]
	2		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=20	POS TARG 0.2,3,0	Prime + Parallel Group 1-5 in M20 snail (15)	600 Secs (600 Secs) [==>]	[1]
	3		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=20	POS TARG 0.2,3,0	Prime + Parallel Group 1-5 in M20 snail (15)	500 Secs (500 Secs) [==>]	[1]
	4		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F673N	FLASH=20	POS TARG 0.2,3,0	Prime + Parallel Group 1-5 in M20 snail (15)	800 Secs (800 Secs) [==>]	[1]
	5	ANY		ACS/WFC, ACCUM, WFCENTER	F658N			Prime + Parallel Group 1-5 in M20 snail (15)	1080 Secs X 2 (2160 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]



Proposal 18209 - M20 snail (16) - Narrowband observations of protostellar outflows in M20

Wed Oct 22 20:00:18 GMT 2025

Visit	Proposal 18209, M20 snail (16)				
	Diagnostic Status: No Diagnostics				
	Scientific Instruments: WFC3/UVIS, ACS/WFC				
	Special Requirements: SAME ORIENT AS 11; BEFORE 16-MAR-2026:00:00:00				

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	HH-399	RA: 18 02 28.5950 (270.6191458d) Dec: -23 04 26.07 (-23.07391d) Equinox: J2000	Epoch of Position: 2000	V=18+/-6	Reference Frame: ICRS
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					
	Category=ISM Description=[HERBIG-HARO OBJECT] Extended=YES					

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F475W	FLASH=15	POS TARG 0.2,3,0	Prime + Parallel Group 1-5 in M20 snail (16)	90 Secs (90 Secs) [==>]	[1]
	2		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=20	POS TARG 0.2,3,0	Prime + Parallel Group 1-5 in M20 snail (16)	600 Secs (600 Secs) [==>]	[1]
	3		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=20	POS TARG 0.2,3,0	Prime + Parallel Group 1-5 in M20 snail (16)	500 Secs (500 Secs) [==>]	[1]
	4		(1) HH-399	WFC3/UVIS, ACCUM, UVIS-CENTER	F673N	FLASH=20	POS TARG 0.2,3,0	Prime + Parallel Group 1-5 in M20 snail (16)	800 Secs (800 Secs) [==>]	[1]
	5	ANY		ACS/WFC, ACCUM, WFCENTER	F658N			Prime + Parallel Group 1-5 in M20 snail (16)	1080 Secs X 2 (2160 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]

