



15148 - Tracing Interactions of a Protoplanet with its Circumstellar Disk

Cycle: 25, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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) 2MASS-J16222099-2304025	ACS/WFC	1	24-Oct-2017 11:05:03.0	yes
02	(1) 2MASS-J16222099-2304025	WFC3/UVIS	2	24-Oct-2017 11:05:04.0	yes
03	(1) 2MASS-J16222099-2304025	WFC3/IR	2	24-Oct-2017 11:05:06.0	yes

5 Total Orbits Used

ABSTRACT

A candidate companion to a very young star has been discovered in HST snapshot optical images. The object is projected at the outer radius of an edge-on protoplanetary disk and is aligned with the disk plane. Keck LGS photometry results indicate the object has the same temperature as brown dwarf GQ Lupi b but with 10x less luminosity - consistent with a planetary mass companion. Because the edge-on disk suppresses the light of the central star, the companion is uniquely accessible to follow-up studies with minimal starlight residuals. We propose HST/WFC3 imaging and spectroscopy of the system to 1) fully define the morphology of the disk scattered light, particularly at the disk outer edge near the companion; 2)

search for H α emission from the companion as evidence that it is actively accreting; and 3) complete spectral characterization of the companion using G141 spectroscopy. Confirmation of a substellar spectrum, accretion, and disk interaction action would establish this object as a leading example of an accreting protoplanet at 100 AU and offer support to models for planet formation by gravitational instability.

OBSERVING DESCRIPTION

We will use ACS WFC to make a full-orbit CR-SPLIT F814W image and WFC3 UVIS to make full-orbit CR-SPLIT images in F555W and F656N. The two broadband filter images are designed to detect the structure and extent of the scattered light along with the F606W image made in the Cycle 23 snapshot, will provide continuum level references needed to quantify the strength of the companion's H α emission line from the F656N image. The deep F656N image will also reveal any emission knots tracing an outflow from the primary star or the companion. We will use WFC3 IR to make a full-orbit F160W image of the system to trace the scattered light for comparison with the optical frames. Vertical and radial density gradients in the disk will be apparent from any changes in the distribution of scattered light with wavelength. In addition, a full-orbit G141 staring spectrum of the companion will achieve S/N of 60 in the 1.3 μ m water band according to the WFC3 IR spectroscopy exposure time calculator.

The companion has an H magnitude of 16.6. To avoid saturation in F160W the WFC3/IR MULTIACCUM exposures need to be limited to 150 sec. Our science goal is a deep exposure on the reflected light nebulosity at H band, while also looking closely at the companion to resolve any extension. Thus we need to fill the full orbit with 150 sec exposures, each of which will be SPARS25 NSAMP=7. To fully sample the PSF in x and y, a box dither pattern is needed. To move the source completely off itself, we select box sides of 5 and 4 arcsec, multiplying the default IRdithboxmin parameters by 9 and 11 in the two axes. A full frame readout of 16 short exposures would force buffer dumps that would result in a poor duty cycle. Since our target is <10" across we opt to take 512x512 subarray images; these prevent the buffer from filling and allow a high duty cycle. The 4 point dither pattern is repeated 4 times to fill the orbit dedicated to F160W imaging.

For the G141 grism observations it is crucial that the spectrum of the central object and the companion do not overlap. The objects are separated by 0.9" along PA 157. The APT visualization tools were used to select an ORIENT range that should accomplish this goal, which also providing a guide star in one of the FGS pickles. Saturation of the grism spectrum is not an issue. Dithering of the grism observations is now implemented, using a line dither pattern that is intended to moving the source perpendicular to the dispersion direction over four positions.

The ACS and WFC3 UVIS orbits are not dithered in order to avoid blurring of the image that would result from aligning & resampling the two CR-SPLIT images. Local medians will instead be used to remove hot pixels.

In phase I the F814W image was intended to also be taken with WFC3 UVIS. A comparison of the sensitivities of the two cameras showed that ACS would be almost a factor of two more sensitive at this wavelength, so we elect to move this exposure to ACS. Because half-orbit exposures would saturate the primary star at this wavelength, the F814W sequence starts with an unsaturated 120 second exposure, and then CR-SPLITS the remaining time in the orbit.

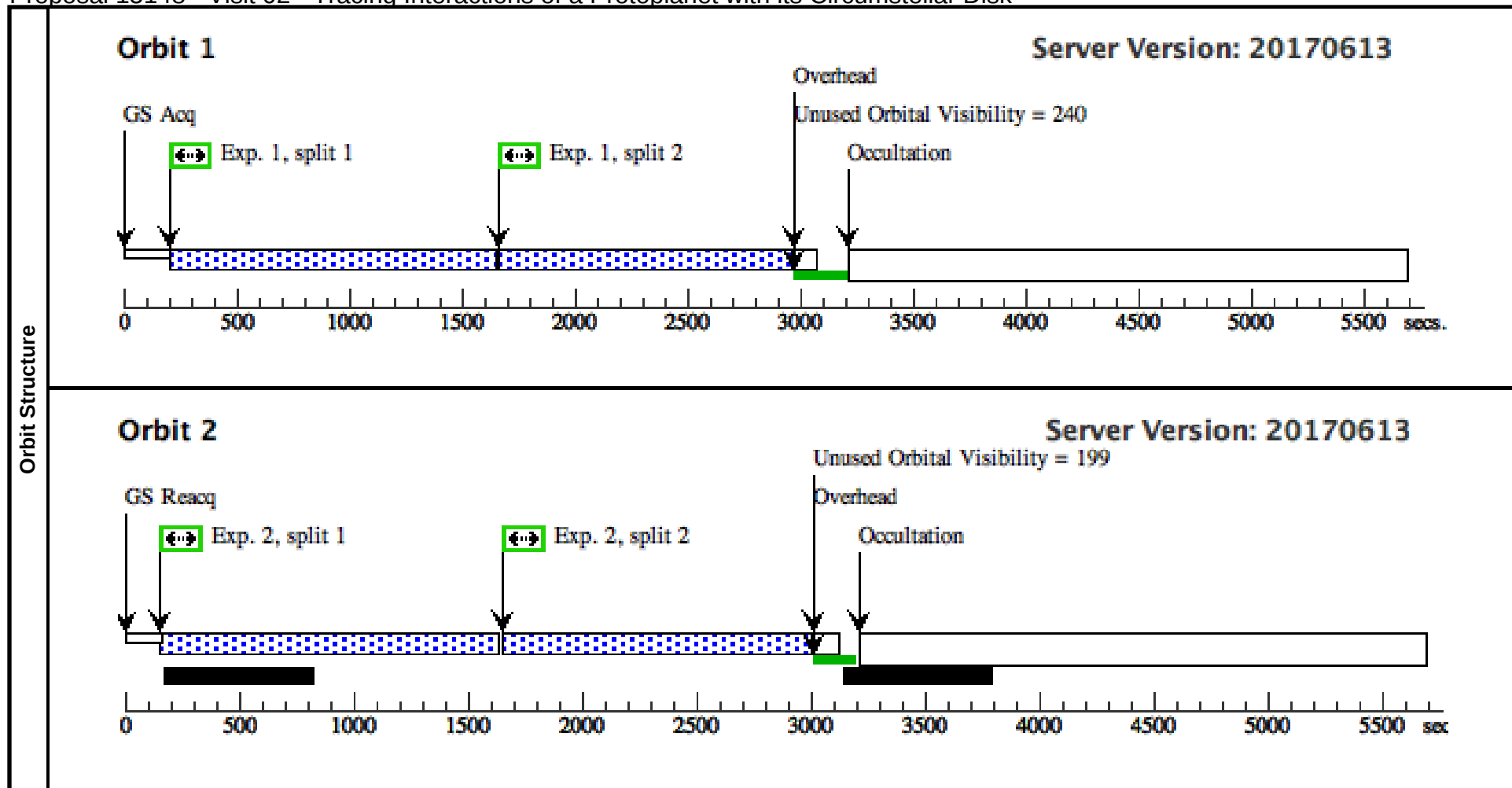
Visit 1 is the single orbit of ACS, Visit 2 is 2 orbits of WFC3 UVIS, and Visit 3 is 2 orbits of WFC3 IR.

Proposal 15148 - Visit 01 - Tracing Interactions of a Protoplanet with its Circumstellar Disk

Visit	Proposal 15148, Visit 01, implementation										Tue Oct 24 15:05:08 GMT 2017	
	Diagnostic Status: No Diagnostics											
	Scientific Instruments: ACS/WFC											
	Special Requirements: GROUP 01,02 WITHIN 0.5D											
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous			
	(1)	2MASS-J16222099-2304025	RA: 16 22 21.0000 (245.5875000d) Dec: -23 04 2.50 (-23.06736d) Equinox: J2000				V=18.0		Reference Frame: SIMBAD			
	Comments: This object was generated by the target selector and retrieved from the SIMBAD database.											
Exposures	#	Label	Target	Config,Mode,Aperture		Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit
	1		(1) 2MASS-J16222099-2304025	ACS/WFC, ACCUM, WFC1		F814W				120 Secs (120 Secs)		
										[==>]		[1]
	2		(1) 2MASS-J16222099-2304025	ACS/WFC, ACCUM, WFC1		F814W	CR-SPLIT=2			2200 Secs (2200 Secs)		
										[==>(Split 1)] [==>(Split 2)]		[1]
Orbit Structure	Orbit 1 GS Acq Exp. 1 Exp. 2, split 1 Exp. 2, split 2 Occultation Unused Orbital Visibility = 64											
	0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 sec											

Proposal 15148 - Visit 02 - Tracing Interactions of a Protoplanet with its Circumstellar Disk

Visit	Proposal 15148, Visit 02, implementation								Tue Oct 24 15:05:08 GMT 2017	
	Diagnostic Status: No Diagnostics									
	Scientific Instruments: WFC3/UVIS									
	Special Requirements: (none)									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections		Fluxes		Miscellaneous		
	(1)	2MASS-J16222099-2304025	RA: 16 22 21.0000 (245.5875000d) Dec: -23 04 2.50 (-23.06736d) Equinox: J2000			V=18.0		Reference Frame: SIMBAD		
	Comments: This object was generated by the target selector and retrieved from the SIMBAD database.									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) 2MASS-J16222099-2304025	WFC3/UVIS, ACCUM, UVIS1	F555W	CR-SPLIT=2	GS ACQ SCENARI O SINGLE		2600 Secs (2600 Secs)	
									[==>(Split 1)] [==>(Split 2)]	[1]
	2		(1) 2MASS-J16222099-2304025	WFC3/UVIS, ACCUM, UVIS1	F656N	FLASH=9; CR-SPLIT=2			2700 Secs (2700 Secs)	
									[==>(Split 1)] [==>(Split 2)]	[2]



Proposal 15148 - Visit 03 - Tracing Interactions of a Protoplanet with its Circumstellar Disk

Visit	Proposal 15148, Visit 03, implementation Tue Oct 24 15:05:08 GMT 2017				
	Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: ORIENT 298D TO 318 D				
Patterns	#	Primary Pattern		Secondary Pattern	Exposures
	(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=5.148 Line Spacing=4.015	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1)
	(2)	Pattern Type=LINE Purpose=DITHER Number Of Points=4 Point Spacing=6.084 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=90.48 Angle Between Sides= Center Pattern=false		(2-3)
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes
	(1)	2MASS-J16222099-2304025	RA: 16 22 21.0000 (245.5875000d) Dec: -23 04 2.50 (-23.06736d) Equinox: J2000		V=18.0
Comments: This object was generated by the target selector and retrieved from the SIMBAD database.					
Miscellaneous Reference Frame: SIMBAD					

Proposal 15148 - Visit 03 - Tracing Interactions of a Protoplanet with its Circumstellar Disk

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) 2MASS-J162220 99-2304025	WFC3/IR, MULTIACCUM, IRSUB512	F160W	SAMP-SEQ=SPARS 25; NSAMP=7	GS ACQ SCENARI O SINGLE	Pattern 1, Exps 1-1 i n Visit 03 (1)	138.380533 Secs X 4 (2214.089 Sec s)	
									[==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)]	[1]
	2		(1) 2MASS-J162220 99-2304025	WFC3/IR, MULTIACCUM, GRISM1024	F140W	NSAMP=5; SAMP-SEQ=SPAR S5		Sequence 2-3 Non-In t in Visit 03 Pattern 2, Exps 2-3 i n Sequence 2-3 Non- Int in Visit 03 (2)	22.935375 Secs (91.742 Secs)	
									[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[2]
	3		(1) 2MASS-J162220 99-2304025	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=13; SAMP-SEQ=SPAR S50		Sequence 2-3 Non-In t in Visit 03 Pattern 2, Exps 2-3 i n Sequence 2-3 Non- Int in Visit 03 (2)	602.937703 Secs (2411.751 Secs)	
									[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[2]

