



17751 - Imaging a monster: HST observations of the asymmetric edge-on disk IRAS 23077+6707 (Dracula's Chivito)

Cycle: 32, 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) IRAS23077+6707	WFC3/IR WFC3/UVIS	3	16-Oct-2024 17:00:17.0	yes

3 Total Orbits Used

ABSTRACT

We propose the first sub-arcsecond imaging campaign of the giant, asymmetric edge-on disk IRAS 23077+6707 (Dracula's Chivito/DraChi) to study its dust grain structure and evolution from 0.4-1.7 microns. DraChi is enormous: spanning approx. 14 arcsec on the sky, it is far in excess of any average protoplanetary disk extents, making it the largest protoplanetary disk thus far discovered. Moreover, this disk is highly asymmetric, yet has only been imaged at low resolution from the ground with Pan-STARRS. These images show not only two faint filaments in the disk's northern part that extend well beyond 20 arcsec, but also various brightness asymmetries. We propose the imaging of this enigmatic disk in only three HST orbits using the WFC3/UVIS broadband filters F438W, F606W and F814W and the WFC3/IR broadband filters F105W, F125W and F160W to map at unprecedented angular scales the wavelength dependence of the disk's midplane thickness, determine the dust grain properties and the degree of their vertical settling and ultimately probe the extent to which ongoing planet formation is driving DraChi's asymmetric substructures.

OBSERVING DESCRIPTION

We require HST observations using in total three WFC3 UVIS and three IR filters. For WFC3/UVIS we selected filters F438W, F606W and F814W to cover the full breadth of the optical spectrum previously only studied by Pan-STARRS. These filters will image the scattered light emission arising from the smallest, sub-micron-sized dust grains entrained in the uppermost layers of the disk's atmosphere. As a bonus, the combination of filters F606W and F814W is ideal for distinguishing faint jet emission (if present) from the disk's reflected light, which is present in both bands, while jet-emission should be nearly absent in F814W. Similar filter combinations have proven highly successful in previous cycles targeting other edge-on disks. In order to leverage HST's full IR-capabilities and obtain the first resolved IR images of DraChi, the images from the optical filters will be combined with three rather short IR exposures obtained by WFC3/IR using the F105W, F125W and F160W filters. This filter combination will allow us to probe the scattered light emission arising from larger dust grains that are located in deeper and less elevated layers than the optically scattering dust and thus allow us to measure DraChi's vertical disk extent across a decade of wavelengths.

Exposure times for each filter were chosen such that the faint, northern filaments will be detected with an SNR of at least 60, while ensuring the observations will not saturate for the bright, central regions of the disk, for which we estimate obtaining an SNR of at least 1000. While being a non-standard approach, we will not perform any dither maneuvers for the UVIS filters, as the combination of dithered images is usually done using interpolation, which however blurs the final image. Typical scale heights of previously studied edge-on disks are close to 7 au (e.g. Williams & Cieza 2011, Stapelfeldt et al. 2014), which is close to 0.05 arcsec at the distance to nearby star-forming regions. The undithered HST PSF is approx. 0.1 arcsec at F606W, but blurs to approx. 0.15 arcsec when the dithered images are combined. Consequently, dithering would make it significantly harder to retrieve the disk's scale height from fitting of the combined images, which is one of our main science goals. Instead we will opt for CR-splitting the UVIS-exposures with no dither, and subsequently remove the hot pixels via median filtering. For WFC3/IR, however, the pixel scale is

Proposal 17751 (STScI Edit Number: 0, Created: Wednesday, October 16, 2024, 4:00:18PM Eastern Standard Time) - Overview

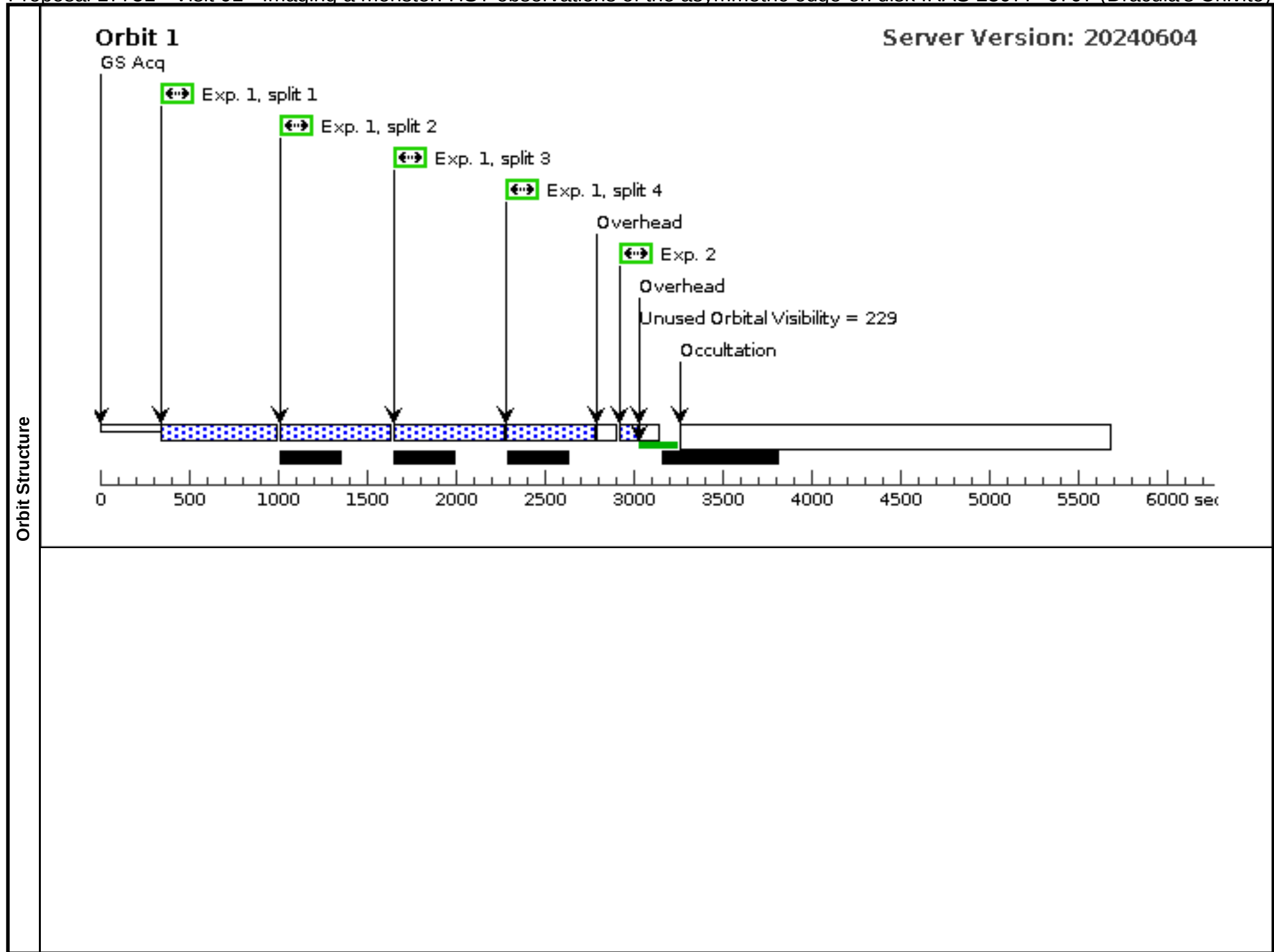
about 3x larger than for WFC3/UVIS, and thus blurring from dithered images matters a lot less at IR-wavelengths and consequently a 4-point dither maneuver will be performed for each WFC3/IR exposure. Additionally, for WFC3/IR the 512x512 subarray will be used, which reduces the data volume and the overheads for buffer readout.

Proposal 17751 - Visit 01 - Imaging a monster: HST observations of the asymmetric edge-on disk IRAS 23077+6707 (Dracula's Chivito)

Visit	Proposal 17751, Visit 01, implementation Wed Oct 16 21:00:18 GMT 2024				
	Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR, WFC3/UVIS Special Requirements: SCHED 50%				
Patterns	#	Primary Pattern	Secondary Pattern		Exposures
	(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=5.26 Line Spacing=5.26	Coordinate Frame=POS-TARG Pattern Orientation=0 Angle Between Sides=90 Center Pattern=false		(6), (7), (8)
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes
	(1)	IRAS23077+6707	RA: 23 09 43.6450 (347.4318542d) Dec: +67 23 38.94 (67.39415d) Equinox: J2000	Epoch of Position: 2015.5	V=14.23+/-0.1 Pan-STARRS g: 14.40, r: 14.09, i: 13.94, z: 13.85, y: 13.69
	Miscellaneous Reference Frame: SIMBAD				
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Fluxes were calculated within a 14arcsec aperture centred on the source position. Category=STAR Description=[HERBIG AE/BE, PRE-MAIN SEQUENCE STAR, PROTOPLANETARY DISK]				

Proposal 17751 - Visit 01 - Imaging a monster: HST observations of the asymmetric edge-on disk IRAS 23077+6707 (Dracula's Chivito)

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	F438W long	(1) IRAS23077+6707	WFC3/UVIS, ACCUM, UVIS1	F438W	CR-SPLIT=4; FLASH=15			2000 Secs (2000 Secs) [==>(Split 1)] [==>(Split 2)] [==>(Split 3)] [==>(Split 4)]	[1]
	2	F438W short	(1) IRAS23077+6707	WFC3/UVIS, ACCUM, UVIS1	F438W	CR-SPLIT=NO; FLASH=20			100 Secs (100 Secs) [==>]	[1]
	3	F606W	(1) IRAS23077+6707	WFC3/UVIS, ACCUM, UVIS1	F606W	CR-SPLIT=2; FLASH=5			600 Secs (600 Secs) [==>(Split 1)] [==>(Split 2)]	[2]
	4	F814W long	(1) IRAS23077+6707	WFC3/UVIS, ACCUM, UVIS1	F814W	CR-SPLIT=2; FLASH=10			950 Secs (950 Secs) [==>(Split 1)] [==>(Split 2)]	[2]
	5	F814W short	(1) IRAS23077+6707	WFC3/UVIS, ACCUM, UVIS1	F814W	CR-SPLIT=NO; FLASH=15			70 Secs (70 Secs) [==>]	[2]
	6		(1) IRAS23077+6707	WFC3/IR, MULTIACCUM, IRSUB512	F125W	SAMP-SEQ=SPARS 25; NSAMP=8		Sequence 6-8 Non-Int in Visit 01 Pattern 1, Exps 6-6 in Sequence 6-8 Non-Int in Visit 01 (1)	161.301784 Secs (645.207 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[3]
	7		(1) IRAS23077+6707	WFC3/IR, MULTIACCUM, IRSUB512	F105W	SAMP-SEQ=SPARS 25; NSAMP=8		Sequence 6-8 Non-Int in Visit 01 Pattern 1, Exps 7-7 in Sequence 6-8 Non-Int in Visit 01 (1)	161.301784 Secs (645.207 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[3]
	8		(1) IRAS23077+6707	WFC3/IR, MULTIACCUM, IRSUB512	F160W	SAMP-SEQ=SPARS 25; NSAMP=8		Sequence 6-8 Non-Int in Visit 01 Pattern 1, Exps 8-8 in Sequence 6-8 Non-Int in Visit 01 (1)	161.301784 Secs (645.207 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[3]



Orbit 2

Server Version: 20240604

