



14613 - Searching for the Peak of the Initial Mass Function in Galactic Center Star Clusters

Cycle: 24, 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) ARCHES	WFC3/IR	3	29-Jul-2016 13:59:38.0	yes
02	(2) QUINTUPLET	WFC3/IR	3	29-Jul-2016 13:59:42.0	yes

6 Total Orbits Used

ABSTRACT

We propose to re-observe the Arches and Quintuplet clusters at the Galactic Center with WFC3-IR to measure the Initial Mass Function (IMF) down to 1 Msun using proper motions with 3x longer baseline and precision. These clusters are ideal targets as they probe one of the most extreme environments in which stellar populations can be spatially resolved and IMFs can be measured accurately. The proposed observations build on our previous two-year proper motion program where we demonstrated the ability to identify cluster members using proper motions down to 2.5 Msun (Hosek et al. 2015). In Clarkson et al. (2012), we used high-precision astrometry in the Arches cluster core to show that the cluster's dynamical mass

is too low for a "universal" mass function, indicating that peak of the IMF is likely between 1-2 Msun. The proposed observations extend our cluster sample to 1 Msun, allowing us to directly search for the predicted peak while definitively establishing the high-mass slope of the IMF. The additional epoch of astrometry also makes it possible to measure the velocity dispersion profiles of the clusters, allowing us to constrain their orbits and model the impact of dynamical evolution on their observed mass functions. Ultimately, these observations will result in the deepest and cleanest measurement of the IMF in the Galactic Center environment.

OBSERVING DESCRIPTION

The goal of our observations is to obtain another epoch of high-precision astrometric measurements of the Arches and Quintuplet clusters. These clusters are optically obscured and have a large (~120") spatial extent. Therefore, all observations will be conducted with WFC3 in the near infrared (F153M). The specific requirements and exposure times for the observations are described below. Our group has significant experience in working with high precision astrometric and photometric data sets both in general and from HST.

Astrometry:

We will duplicate the observing conditions of program GO-12318 and observe with WFC3's longest-wavelength medium filter (F153M) to obtain astrometry. We use a many-step spiral dither pattern that fully samples the pixel phase in order to reduce the effects of the undersampled PSF. The total extent of the dither pattern is less than 20 pixels. To minimize the impact of any residual distortions, we request that the astrometric observations within each cluster have the SAME ORIENT and POS TARG offsets as our previous HST measurements (i.e., we want the stars in the exact same positions on the detector). We use the same filter as our previous observations to prevent any filter-dependent distortions from reducing the precision of our relative proper motions.

We also obtain two short exposures of each cluster using the 512x512 subarray and RAPID read mode to provide much better coverage of saturated stars than can be achieved with the full-frame readout modes. This fills unused visibility at the end of each visit.

Our observations will consist of a series of exposures with $t_{\text{exp}}=349.2$ to accommodate 12 MULTIACCUM readouts (STEP 50 readout pattern). This should achieve SNR ~ 100 for an H=21 star ($\sim 1.2 M_{\text{sun}}$). Individual exposure times are limited by the effects of persistence from saturated sources, which can negatively impact astrometry. We chose a medium band filter for our astrometry rather than a wide filter in order to avoid saturating the brightest sources in the field (H=10) prior to the first detector read. Some saturated sources are inevitable since the brightest sources are H=10 in the Quintuplet and H=12 in the Arches. These sources will saturate in less than 3 s; however, the density of bright stars is low enough that

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hard-saturating all stars with $H < 15$ (<100 stars in the 120" field of view) should produce persistence images with a low enough density that dithering can shift sources in subsequent exposures on to persistence-free portions of the detector. Many saturated sources will be recoverable from the earliest reads of the up-the-ramp samples used by WFC3. The maximum possible exposure time to avoid persistence images from stars fainter than $H=15$ is ~350 s, hence our t_{exp} of 349.2 s.

Proposal 14613 - Visit 01 - Searching for the Peak of the Initial Mass Function in Galactic Center Star Clusters

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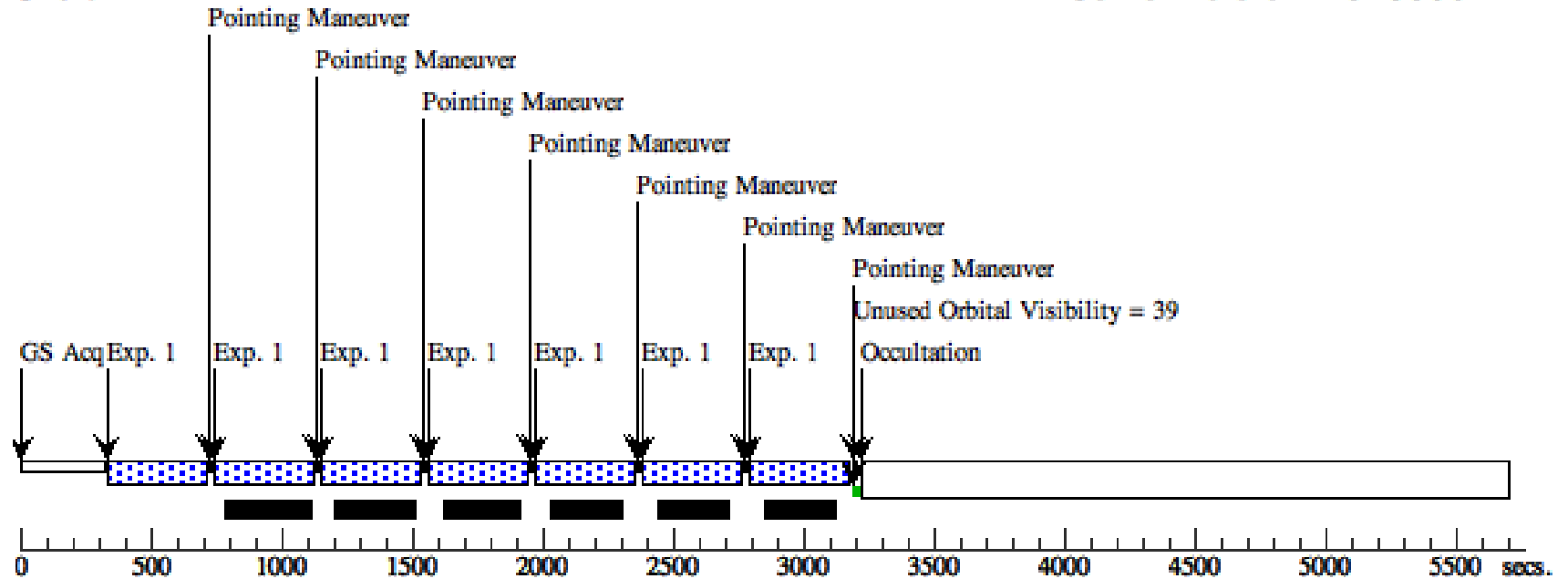
Visit	Proposal 14613, Visit 01 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: ORIENT 90D TO 90 D Comments: <i>Arches F153M Astrometry.</i> We specify the required ORIENT to match our previous HST observations. This is necessary to achieve the astrometric precision we require.					
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures	
(2)		Pattern Type=SPIRAL Purpose=DITHER Number Of Points=21 Point Spacing=0.42 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=15 Angle Between Sides= Center Pattern=false		(1)	
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	ARCHES	RA: 17 45 50.5000 (266.4604167d) Dec: -28 49 20.00 (-28.82222d) Equinox: J2000		V=16.5+/-0.1 J=11.5, H=10.5, K=10.2	Reference Frame: ICRS
Comments: <i>The V-magnitude is for the brightest optical star in the field of view</i>						

Proposal 14613 - Visit 01 - Searching for the Peak of the Initial Mass Function in Galactic Center Star Clusters

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
Exposures	1	(1) ARCHES	WFC3/IR, MULTIACCUM, IR-FIX	F153M	SAMP-SEQ=STEP5 0; NSAMP=12		Pattern 2, Exps 1-1 i n Visit 01 (2)	349.232932 Secs (7333.892 Secs)	
								[==>(Pattern 1)]	[1]
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	[2]
								[==>(Pattern 5)]	
								[==>(Pattern 6)]	
								[==>(Pattern 7)]	[3]
								[==>(Pattern 8)]	
								[==>(Pattern 9)]	
							[==>(Pattern 10)]	[3]	
							[==>(Pattern 11)]		
							[==>(Pattern 12)]		
							[==>(Pattern 13)]	[3]	
							[==>(Pattern 14)]		
							[==>(Pattern 15)]		
							[==>(Pattern 16)]	[3]	
							[==>(Pattern 17)]		
							[==>(Pattern 18)]		
							[==>(Pattern 19)]	[3]	
							[==>(Pattern 20)]		
							[==>(Pattern 21)]		
2	Short_exp_s ubarray_end	(1) ARCHES	WFC3/IR, MULTIACCUM, IRSUB512-FIX	F153M	SAMP-SEQ=RAPID ; NSAMP=15			12.795405 Secs (12.795 Secs)	
								[==>]	[3]
3	Short_exp_s ubarray_end _dither	(1) ARCHES	WFC3/IR, MULTIACCUM, IRSUB512-FIX	F153M	SAMP-SEQ=RAPID ; NSAMP=15	POS TARG 0.6075,0 .4235		12.795405 Secs (12.795 Secs)	
								[==>]	[3]

Orbit 1

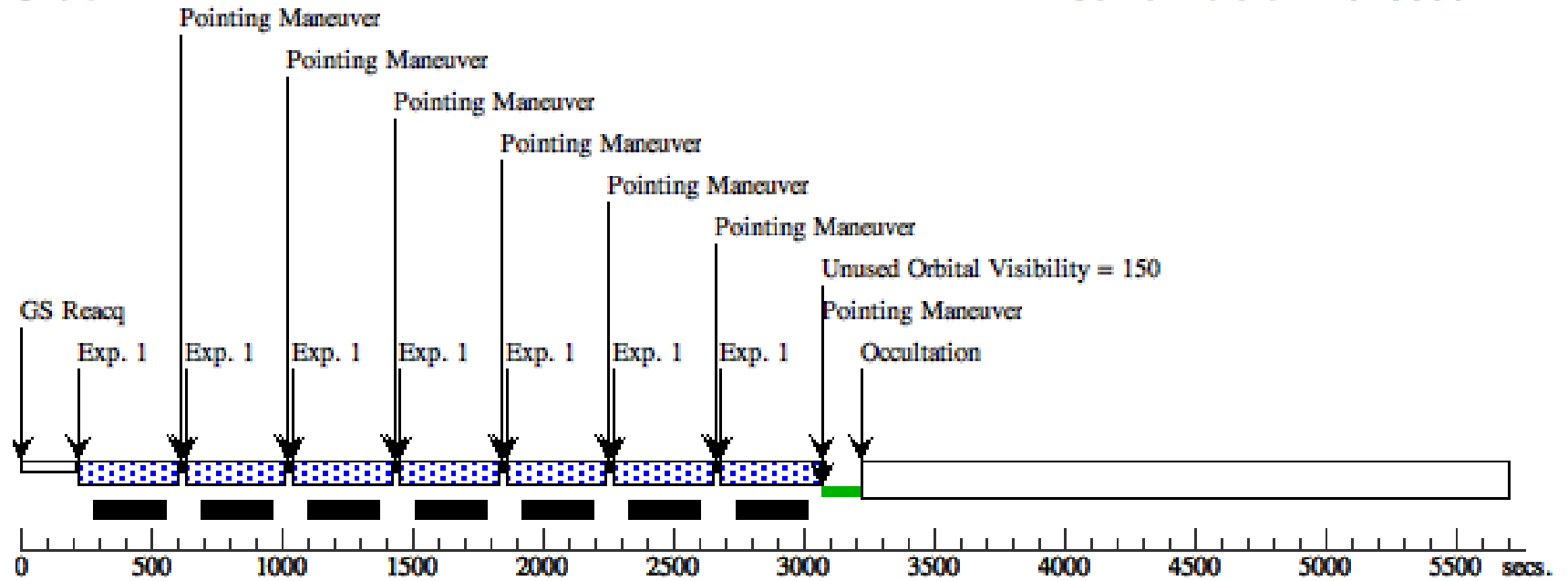
Server Version: 20160601

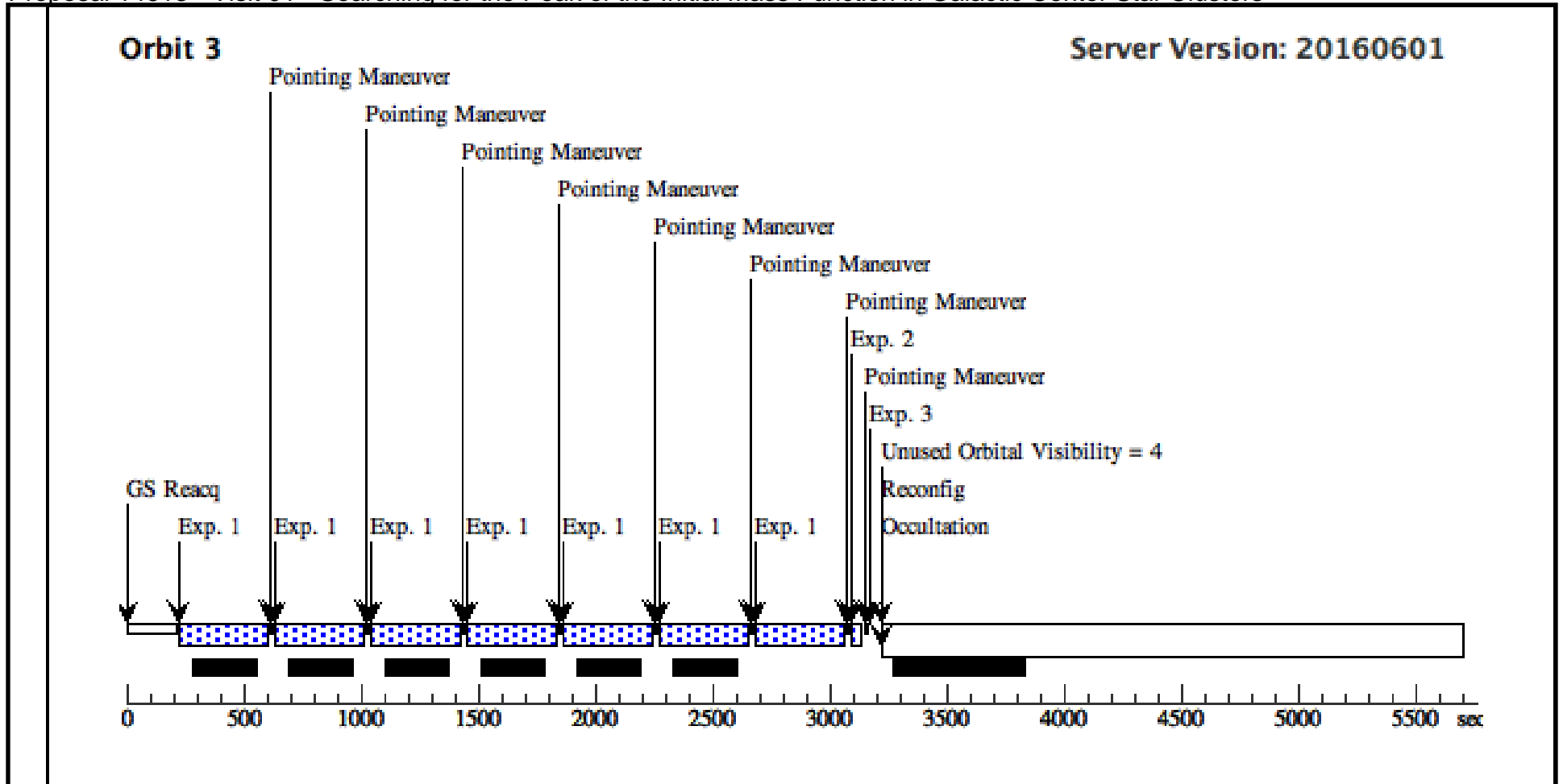


Orbit Structure

Orbit 2

Server Version: 20160601





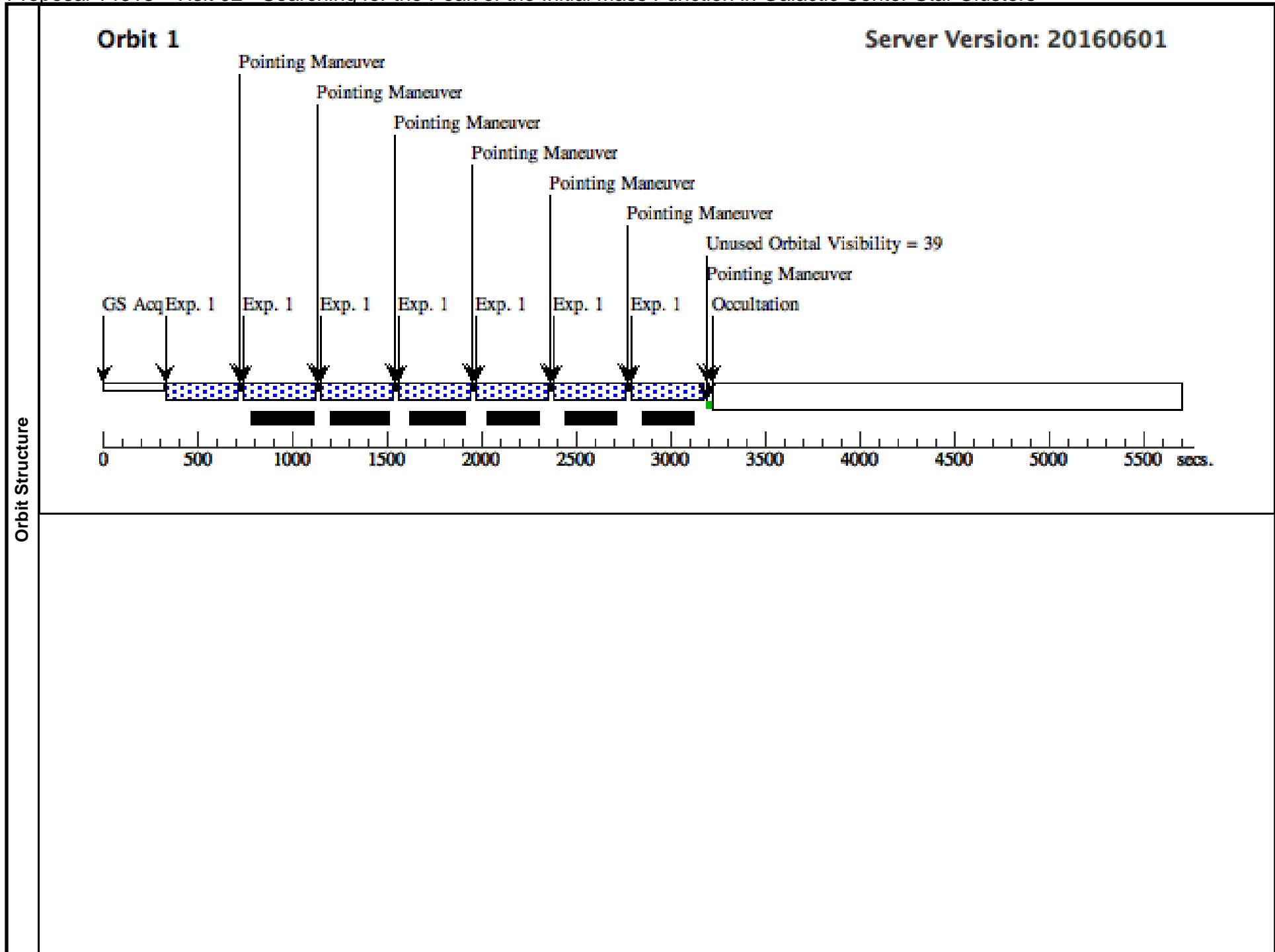
Proposal 14613 - Visit 02 - Searching for the Peak of the Initial Mass Function in Galactic Center Star Clusters

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Visit	Proposal 14613, Visit 02 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: ORIENT 93D TO 93 D Comments: <i>Quintuplet F153M Astrometry.</i> <i>We specify the required ORIENT to match our previous HST observations. This is necessary to achieve the astrometric precision we require.</i>					
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures	
	(2)	Pattern Type=SPIRAL Purpose=DITHER Number Of Points=21 Point Spacing=0.42 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=15 Angle Between Sides= Center Pattern=false		(1)	
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(2)	QUINTUPLET	RA: 17 46 13.9000 (266.5579167d) Dec: -28 49 48.00 (-28.83000d) Equinox: J2000		V=15.6+/-0.1 J=11.8, H=8.9, K=7.29	Reference Frame: ICRS
	Comments: <i>The fluxes are for the brightest star in the WFC3 field of view. The brightest optical star is difference from the brightest near-infrared star</i>					

Proposal 14613 - Visit 02 - Searching for the Peak of the Initial Mass Function in Galactic Center Star Clusters

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
Exposures	1	(2) QUINTUPLET	WFC3/IR, MULTIACCUM, IR-FIX	F153M	SAMP-SEQ=STEP50; NSAMP=12		Pattern 2, Exps 1-1 in Visit 02 (2)	349.232932 Secs (7333.892 Secs)	
								[==>(Pattern 1)]	[1]
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	[2]
								[==>(Pattern 5)]	
								[==>(Pattern 6)]	
								[==>(Pattern 7)]	[3]
								[==>(Pattern 8)]	
								[==>(Pattern 9)]	
							[==>(Pattern 10)]	[3]	
							[==>(Pattern 11)]		
							[==>(Pattern 12)]		
							[==>(Pattern 13)]	[3]	
							[==>(Pattern 14)]		
							[==>(Pattern 15)]		
							[==>(Pattern 16)]	[3]	
							[==>(Pattern 17)]		
							[==>(Pattern 18)]		
							[==>(Pattern 19)]	[3]	
							[==>(Pattern 20)]		
							[==>(Pattern 21)]		
2	Short_exp_s ubarray_end	(2) QUINTUPLET	WFC3/IR, MULTIACCUM, IRSUB512-FIX	F153M	NSAMP=15; SAMP-SEQ=RAPID			12.795405 Secs (12.795 Secs)	
								[==>]	[3]
3	Short_exp_s ubarray_end _dither	(2) QUINTUPLET	WFC3/IR, MULTIACCUM, IRSUB512-FIX	F153M	SAMP-SEQ=RAPID NSAMP=15	POS TARG 0.6075,0 .4235		12.795405 Secs (12.795 Secs)	
								[==>]	[3]



Orbit 2

Server Version: 20160601

