13721 - The Windy Milky Way Galaxy

Cycle: 22, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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) NGC104-BS	COS/FUV	1	05-Dec-2014 21:06:17.0	yes
02	(2) NGC6254-ZNG1	COS/FUV	2	05-Dec-2014 21:06:20.0	yes
03	(3) NGC7099-214018-231323	COS/FUV	3	05-Dec-2014 21:06:23.0	yes
04	(4) NGC6121-Y453	COS/FUV COS/NUV	3	05-Dec-2014 21:06:25.0	yes
05	(5) NGC5024-131310+180735	COS/FUV COS/NUV	5	05-Dec-2014 21:06:27.0	yes

14 Total Orbits Used

ABSTRACT

The Milky Way is the only galaxy in which we can directly measure the three dimensional density, kinematics, metallicity, and multi-phase structure of a Galactic wind. There are two major outflow regions suspected to exist in the Galaxy: a nuclear outflow associated with the Fermi Bubble and an annular wind associated with the star formation activity in the Molecular Ring/Scutum-Centaurus spiral arm. We request 14 orbits to observe five UV-bright sources in globular clusters in front of and behind the Scutum-Centaurus spiral arm. The interstellar absorption data will provide unique constraints on the vertical outflow velocity and radial extent of this outflow. We will combine these results with archival data to develop the next generation of multiphase, rotating wind models and use these models to estimate the energetics, mass outflow, and angular momentum flux of this galactic outflow. We expect that the insights gained here will be valuable in understanding the nature of local systems and the ubiquitous winds present in the universe at z=2. An analysis of the sources themselves will also provide valuable insights into the late stages of stellar evolution in low-metallicity populations.

OBSERVING DESCRIPTION

This program aims to obtain FUV spectra of five UV-bright stars in globular clusters using the G130M and G160M gratings of COS. Exposure times are sufficient to obtain S/N ~ 30 in each spectrum.

Three of our stars are in the GSC2 or the 2MASS Point-Source Catalog, so we use their GSC2 or 2MASS coordinates and employ an ACQ/IMAGE acquisition. Coordinates for the other two stars are determined from GALEX observations, so are uncertain at the 0.5 arcsec level. We begin their target acquisitions with a small ACQ/SEARCH.

NGC7099-214018-231323 and NGC5024-131310+180735 have been observed only with GALEX, so we have a weak handle on the stellar color -- and thus temperature. To compute exposure times suffient to achieve the required S/N, we assume that the star is cool (18,700 K) when modeling the G130M spectrum and warm (44,500 K) when modeling the G160M spectrum. For the other three stars, we use published temperatures or archival FUV spectra.

Visit

Proposal 13721, NGC104_BS (01), implementation Sat Dec 06 02:06:28 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NGC104-BS Alt Name1: NGC104-BRIGHT-STAR	RA: 00 23 58.1858 (5.9924408d) Dec: -72 05 30.49 (-72.09180d) Equinox: J2000	Radial Velocity: -30 km/sec	V=10.73 GALEX FUV=13.069	Reference Frame: ICRS

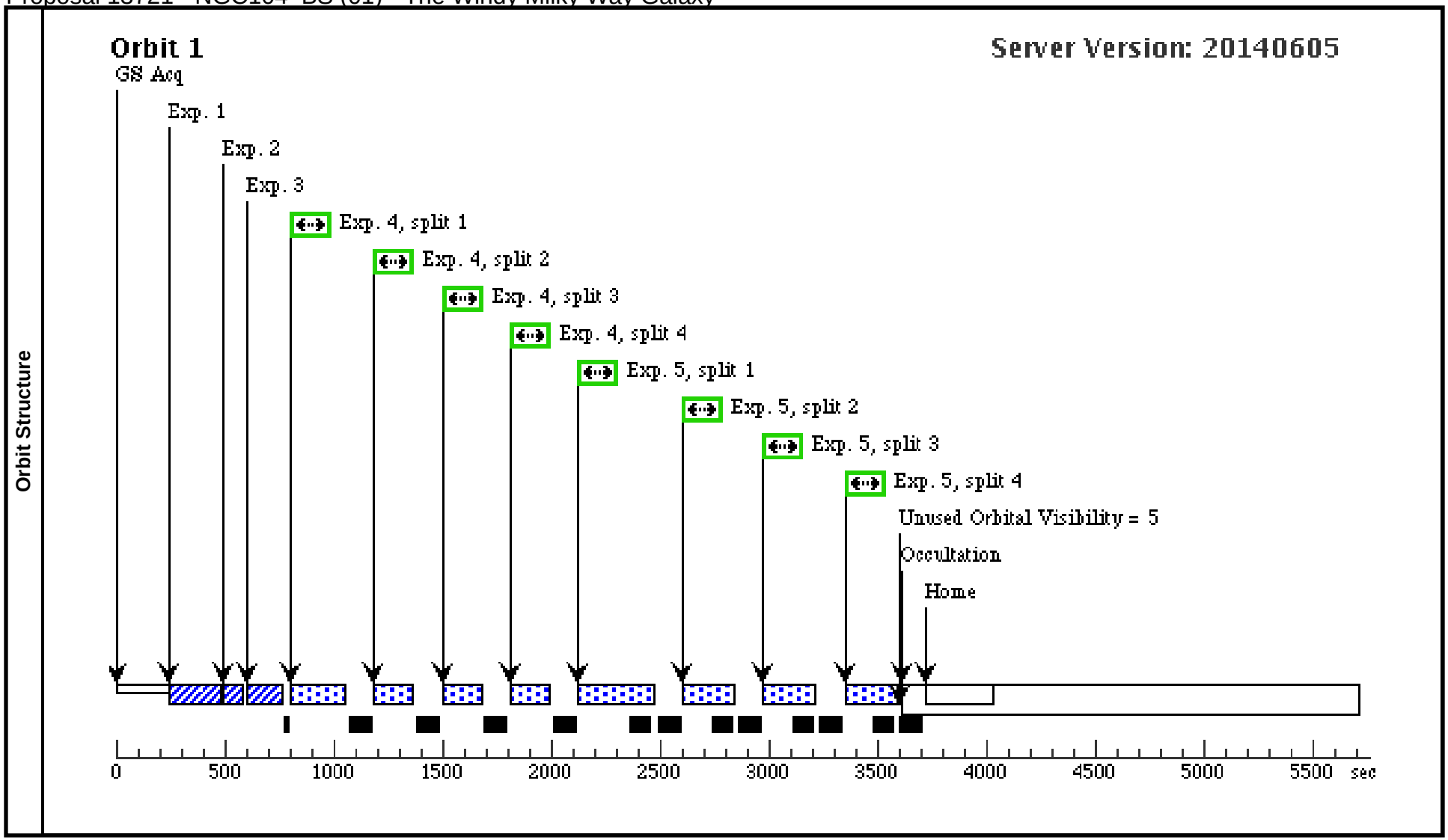
Comments: Star is 67981 from the catalog of Anderson et al. (2008, AJ, 135, 2055), retrieved from the HLA.
The star is 0.5" from a redder companion, so we use an FUV spectroscopic TA.
Teff = 11,000 K, log g = 2.5, E(B-V) = 0.04, F(1300) = 4E-13, F(1600) = 4E-13

Using data from HUT235505 and IUE LWR07507:
G130M/1291 gives S/N = 30 in 303 s (COS.sp.615190)
G160M/1600 gives S/N = 30 in 601 s (COS.sp.615191)
Both generate warnings that count rate is too bright for an irregularly-variable source, but target is not variable.

Bright-Object Check: GSC2 reports 2 stars, both safe. GALEX reports one star of unknown brightness. It is in fact the target, with bad coordinates. Catalog of Schiavon et al. (2012; retrieved from Cosmic Lab) includes no GALEX sources within 45" of target. FUSE observed the star with a 30"x30" aperture; there is no evidence for a second UV-bright star in the field.

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	NGC104-SEARCH (COS.sa.615199)	(1) NGC104-BS	COS/FUV, ACQ/SEARCH, PSA	G130M 1291 A	SCAN-SIZE=2			1 Secs (1 Secs) *[==>]*	*[1]*
	Comments: S/N = 40 in 0.3 s for Segment A, 0.1 s for A + B.								
2	NGC104-PEAKXD (COS.sa.615199)	(1) NGC104-BS	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A				1 Secs (1 Secs) *[==>]*	*[1]*
	Comments: See previous comment								
3	NGC104-PEAKD (COS.sa.615199)	(1) NGC104-BS	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	NUM-POS=5; STEP-SIZE=0.9; CENTER=DEF			1 Secs (1 Secs) *[==>]*	*[1]*
	Comments: See previous comment								
4	NGC104-G130M (COS.sp.615190)	(1) NGC104-BS	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=136; FP-POS=ALL			100 Secs (524 Secs) *[==>131.0 Secs (Split 1)]* *[==>131.0 Secs (Split 2)]* *[==>131.0 Secs (Split 3)]* *[==>131.0 Secs (Split 4)]*	*[1]*
	*Comments: S/N = 30 in 303 s (G130M+1291, BT=2/3*204 = 136)*								
5	NGC104-G160M (COS.sp.615191)	(1) NGC104-BS	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=97; FP-POS=ALL			200 Secs (764 Secs) *[==>191.0 Secs (Split 1)]* *[==>191.0 Secs (Split 2)]* *[==>191.0 Secs (Split 3)]* *[==>191.0 Secs (Split 4)]*	*[1]*
	*Comments: S/N = 30 in 601 s (G160M+1600, BT=2/3*243 = 162)* *Use BT=97 to reduce overheads.*								


Orbit Structure
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Exp. 2
Exp. 3
Exp. 4, split 1
Exp. 4, split 2
Exp. 4, split 3
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Exp. 5, split 1
Exp. 5, split 2
Exp. 5, split 3
Exp. 5, split 4
Unused Orbital Visibility = 5
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 13721, NGC6254-ZNG1 (02), implementation Sat Dec 06 02:06:29 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC6254-ZNG1 Alt Name1: 2MASS-J16570924-0404243	RA: 16 57 9.2429 (254.2885121d) Dec: -04 04 24.39 (-4.07344d) Equinox: J2000	Radial Velocity: 75 km/sec	V=13.23 GALEX FUV=13.876	Reference Frame: ICRS

Comments: Using 2MASS coordinates, which are consistent with those listed in the GALEX UV photometric database of globular clusters (cosmic-lab.eu).
Teff = 27,000 K, log g = 3.6 (Mooney et al. 2004), E(B-V) = 0.28 (Harris 1996/2010)

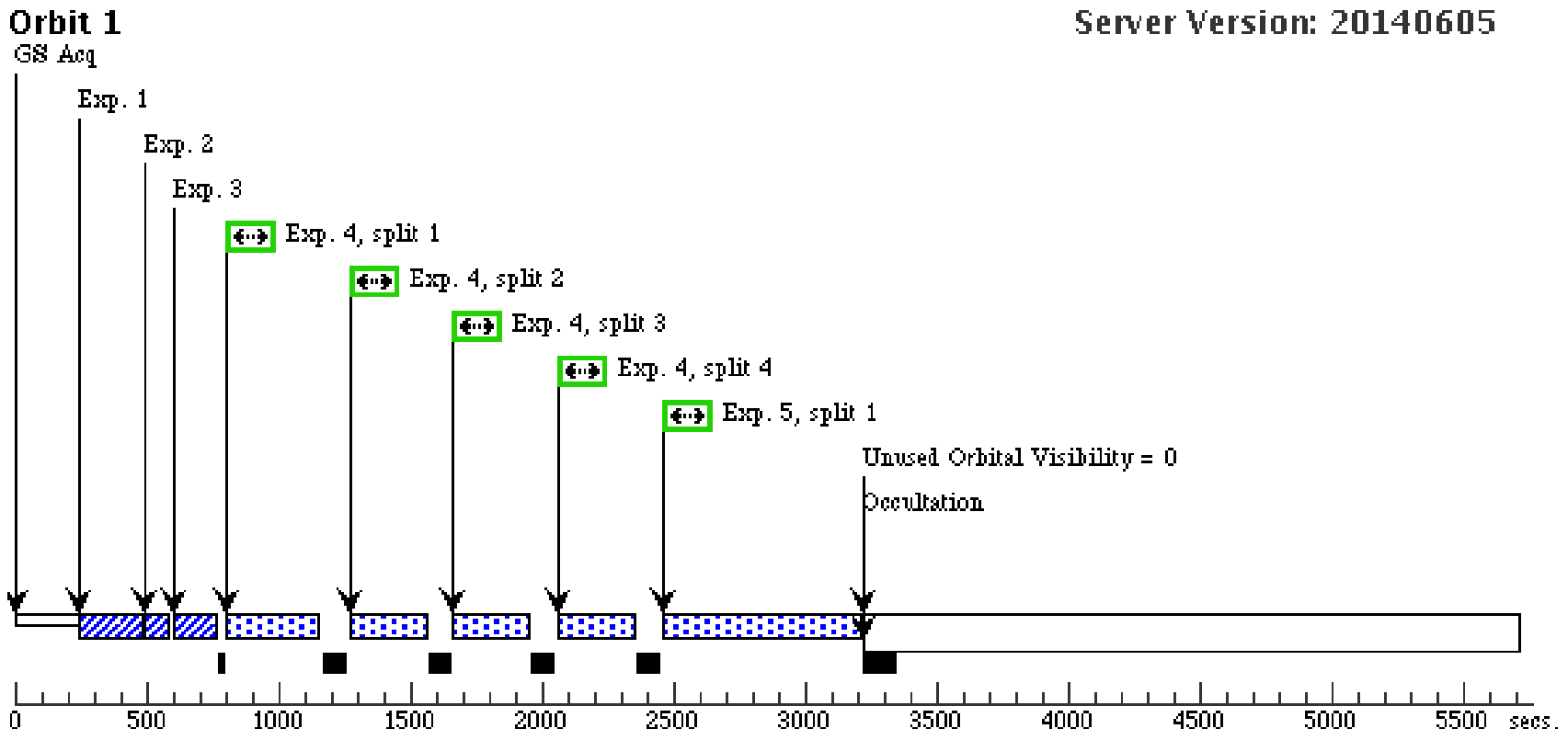
Using Kurucz Models B1V 25400 3.9, E(B-V) = 0.28, scaled to GALEX FUV mag:
G130M/1291 gives S/N = 30 in 745 s (COS.sp.615356)
G160M/1600 gives S/N = 30 in 2216 s (COS.sp.615357)

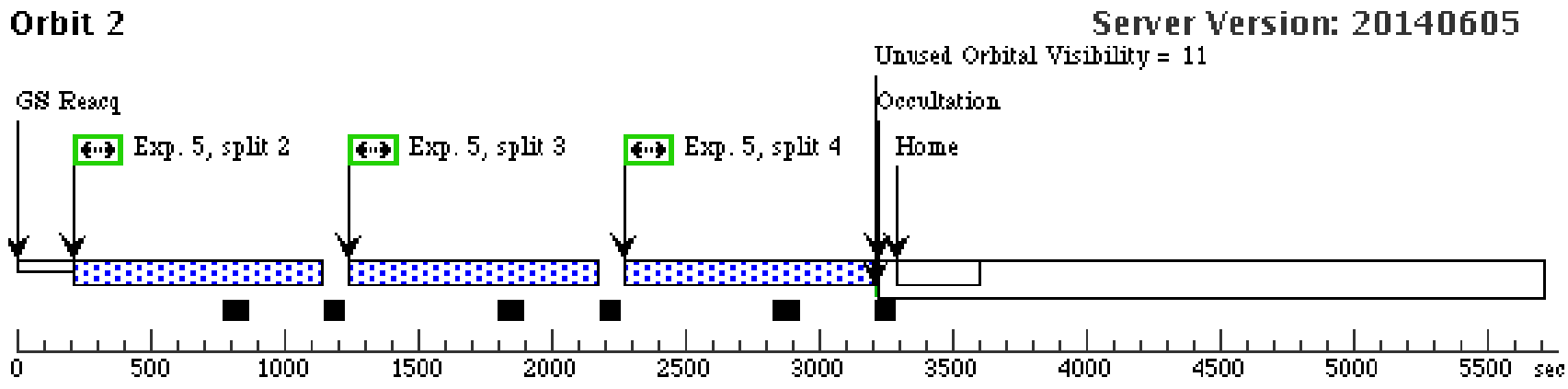
Bright-Object Check: GSC2 has no data for this field. GALEX reports two objects, both safe, but they combine to raise global count rate on side B above limit. Both objects are copies of the target, with bad coordinates. Catalog of Schiavon et al. (2012; retrieved from Cosmic Lab) shows that nearest GALEX source is 17" from target.

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	NGC6254-SEARCH (COS.sa.648455)	(2) NGC6254-ZNG1	COS/FUV, ACQ/SEARCH, PSA	G130M 1291 A	SCAN-SIZE=2			1 Secs (1 Secs) *[==>]*	*[1]*
	Comments: S/N = 40 in 0.9 s for Segment A, 0.4 s for A + B								
2	NGC6254-PEAKXD (COS.sa.648455)	(2) NGC6254-ZNG1	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A				1 Secs (1 Secs) *[==>]*	*[1]*
	Comments: See previous comment								
3	NGC6254-PEAKD (COS.sa.648455)	(2) NGC6254-ZNG1	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	NUM-POS=5; STEP-SIZE=0.9; CENTER=DEF			1 Secs (1 Secs) *[==>]*	*[1]*
	Comments: See previous comment								
4	NGC6254-G130M (COS.sp.615356)	(2) NGC6254-ZNG1	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=3100; FP-POS=ALL			200 Secs (936 Secs) *[==>234.0 Secs (Split 1)]* *[==>234.0 Secs (Split 2)]* *[==>234.0 Secs (Split 3)]* *[==>234.0 Secs (Split 4)]*	*[1]*
	*Comments: S/N = 30 in 745 s (G130M+1291, BT=2/3*465 = 310)*								
5	NGC6254-G160M (COS.sp.615357)	(2) NGC6254-ZNG1	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=524; FP-POS=ALL			550 Secs (3203 Secs) *[==>584.0 Secs (Split 1)]* *[==>873.0 Secs (Split 2)]* *[==>873.0 Secs (Split 3)]* *[==>873.0 Secs (Split 4)]*	*[1]* *[2]*
	*Comments: S/N = 30 in 2216 s (G160M+1600, BT=2/3*786 = 524)*								

Orbit Structure





Visit

Proposal 13721, NGC7099-214018-231323 (03), implementation Sat Dec 06 02:06:29 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	NGC7099-214018-231323	RA: 21 40 18.0647 (325.0752696d) Dec: -23 13 22.83 (-23.22301d) Equinox: J2000		V=15.6 GALEX FUV=14.763	Reference Frame: ICRS

Comments: Target is NGC7099-10 from Schiavon et al. (2012, AJ, 143, 121).
Coordinates from the GALEX UV photometric database of globular clusters (cosmic-lab.eu).
GALEX colors imply Teff = 24,000 K, but uncertainty is large. To guarantee S/N = 30, assume that star is 18,700 K when observing through G130M and 44,500 K when observing through G160M. VMAG is estimated from Kurucz model scaled to GALEX FUV. E(B-V) = 0.03 (Harris 1996/2010).

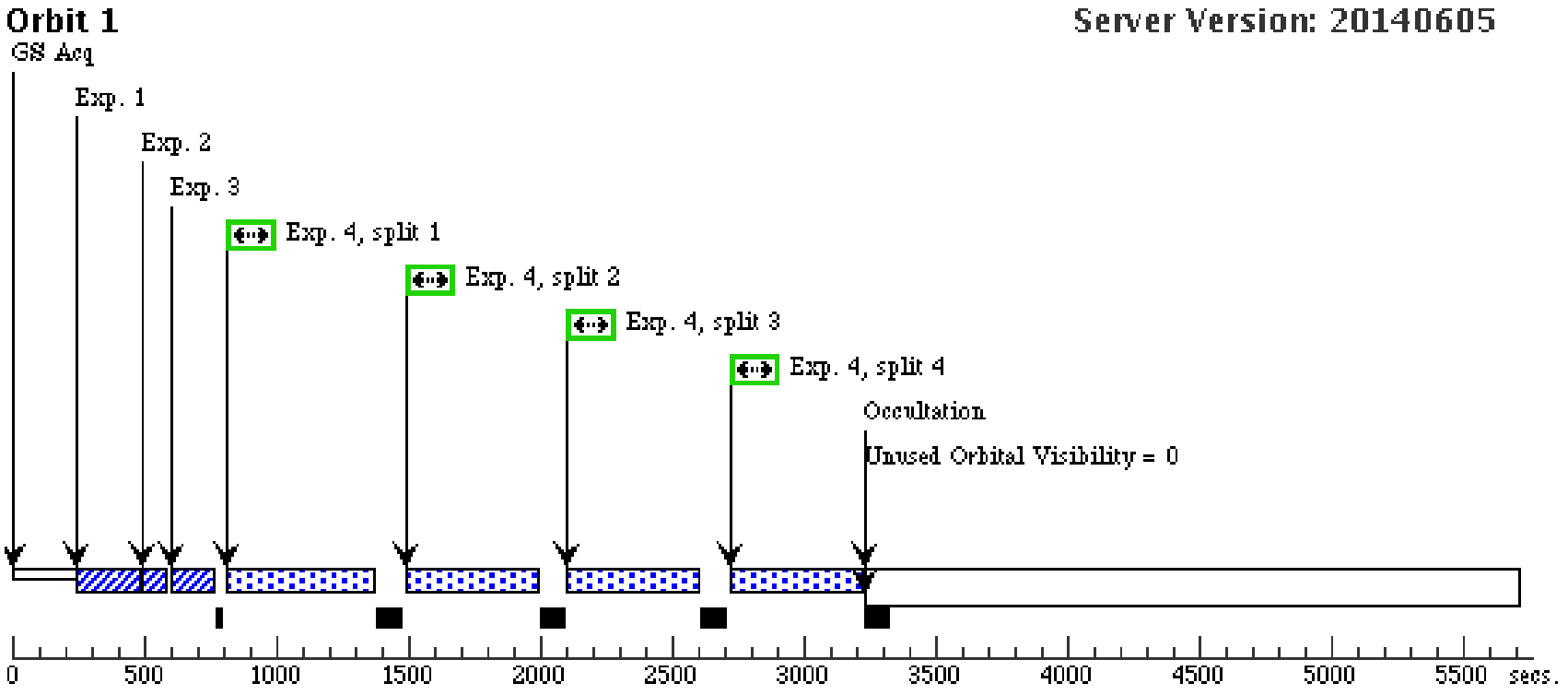
G130M/1291 gives S/N = 30 in 1500 s (COS.sp.615595)
G160M/1600 gives S/N = 30 in 5563 s (COS.sp.615598)

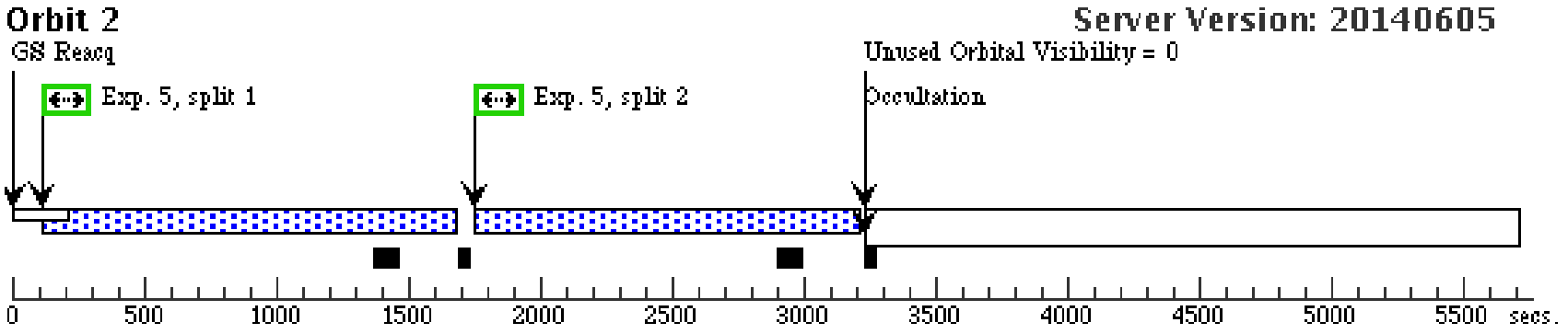
Bright-Object Check: GSC2 has no data for this field. GALEX reports one object and declares it safe. Aladin shows two GALEX sources with slightly different coordinates and similar magnitudes. Both are copies of the target.

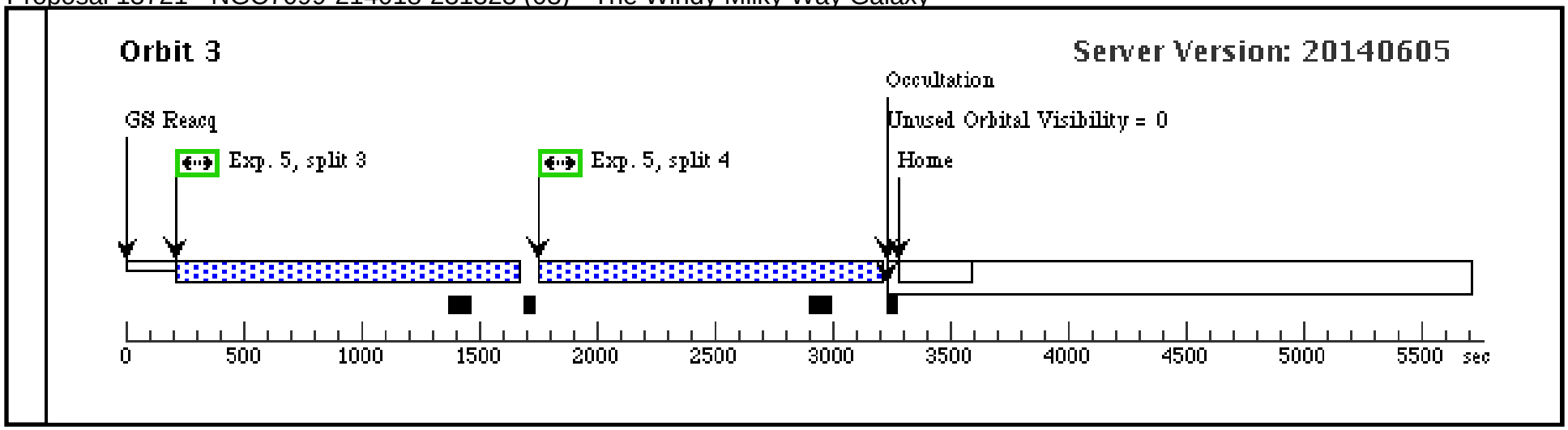
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	NGC7099-SEARCH (COS.sa.615598)	(3) NGC7099-214018-231323	COS/FUV, ACQ/SEARCH, PSA	G130M 1291 A	SCAN-SIZE=2			1 Secs (1 Secs) *[==>]*	*[1]*
Comments: S/N = 40 in 1.8 s for Segment A, 0.8 s for A + B									
2	NGC7099-PEAKXD (COS.sa.615598)	(3) NGC7099-214018-231323	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A				2 Secs (2 Secs) *[==>]*	*[1]*
Comments: See previous comment									
3	NGC7099-PEAKD (COS.sa.615598)	(3) NGC7099-214018-231323	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	NUM-POS=5; STEP-SIZE=0.9; CENTER=DEF			1 Secs (1 Secs) *[==>]*	*[1]*
Comments: See previous comment									
4	NGC7099-G130M (COS.sp.615595)	(3) NGC7099-214018-231323	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=537; FP-POS=ALL			375 Secs (1772 Secs) *[==>443.0 Secs (Split 1)]* *[==>443.0 Secs (Split 2)]* *[==>443.0 Secs (Split 3)]* *[==>443.0 Secs (Split 4)]*	*[1]*
*Comments: S/N = 30 in 1500 s (G130M+1291, BT=2/3*805 = 537)*									
5	NGC7099-G160M (COS.sp.615597)	(3) NGC7099-214018-231323	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=1116; FP-POS=ALL			1400 Secs (5642 Secs) *[==>1410.0 Secs (Split 1)]* *[==>1410.0 Secs (Split 2)]* *[==>1411.0 Secs (Split 3)]* *[==>1411.0 Secs (Split 4)]*	*[2]* *[3]*
*Comments: S/N = 30 in 5563 s (G160M+1600, BT=2/3*1674 = 1116)*									

Orbit Structure






Orbit 3
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Occultation
GS Reacq
Unused Orbital Visibility = 0
Exp. 5, split 3
Exp. 5, split 4
Home
0
500
1000
1500
2000
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3000
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4500
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sec

Visit

Proposal 13721, NGC6121-Y453 (04), implementation Sat Dec 06 02:06:29 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	NGC6121-Y453 Alt Name1: 2MASS-J16232230-2628035	RA: 16 23 22.3000 (245.8429167d) Dec: -26 28 3.52 (-26.46764d) Equinox: J2000	Radial Velocity: 31 km/sec	V=15.86 UIT F(1620) = 4.3+/-0.5 E-14	Reference Frame: ICRS

Comments: Target is 2MJF17RF in the GSC2; it was imported from 2MASS.
Teff = 58,800 K, log g = 5.15 (Moehler et al. 1998)
E(B-V) = 0.35 (Harris 1996/2010), Rv = 4.0 (Peterson, Rees, & Cudworth 1995)

Note: the extinction is variable across M4, but Mochejska et al. (2002) find that the NW quadrant, which includes our target, has relatively uniform extinction that is slightly higher [E(B-V) = 0.4) than the mean cluster value quoted by Harris.

Using Lanz & Hubeny OSTAR2002 model T5500g475v10 with Z/Zo = 10, E(B-V) = 0.35, and Rv = 4.0, scaled to UIT flux:
NUV/PSA/MIRRORB gives S/N = 40 in 9.4 s (COS.ta.649827)
G130M/1291 gives S/N = 30 in 2148 s (COS.sp.649829)
G160M/1600 gives S/N = 30 in 6270 s (COS.sp.649830)

Bright-Object Check: GSC2 reports 23 stars, all safe. GALEX has no information for this field.

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	NGC6121-IMAGE (COS.ta.649827)	(4) NGC6121-Y453	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				15 Secs (15 Secs) *[==>]*	 ***[1]***

Comments: S/N = 40 in 9.4 s (NUV, MIRRORB, PSA)

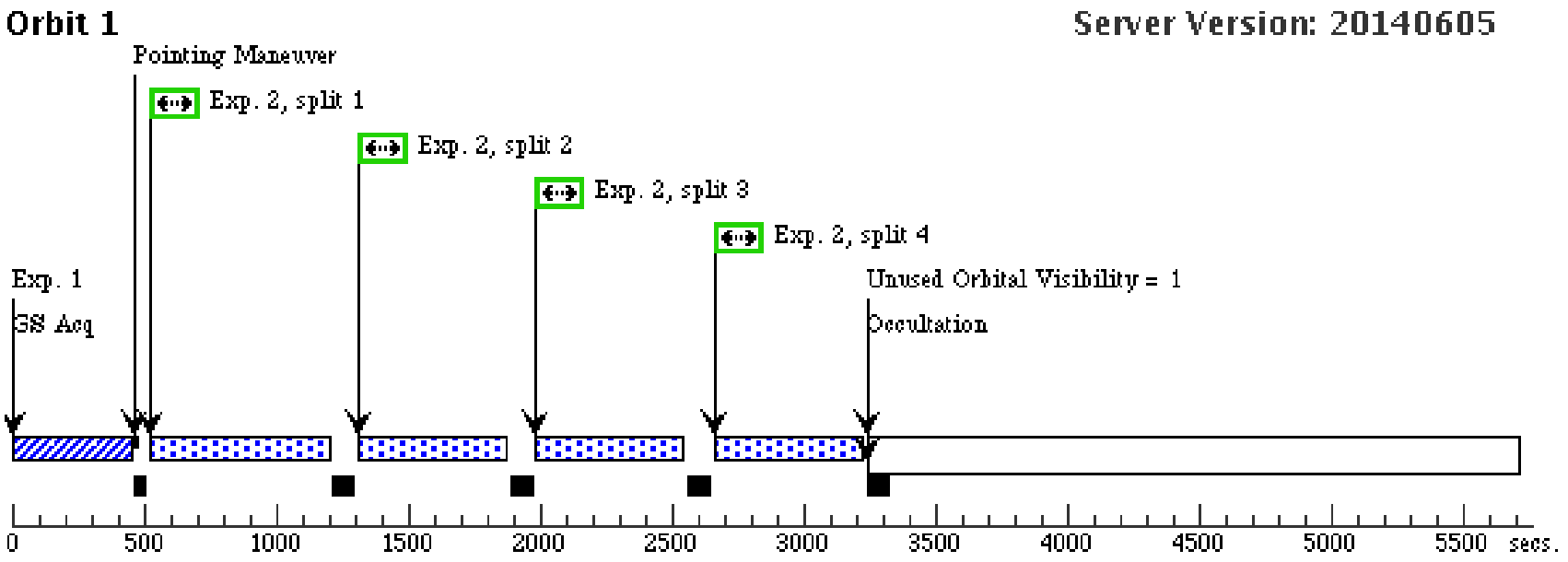
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
2	NGC6121-G130M (COS.sp.649829)	(4) NGC6121-Y453	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=705; FP-POS=ALL			500 Secs (2048 Secs) *[==>512.0 Secs (Split 1)]* *[==>512.0 Secs (Split 2)]* *[==>512.0 Secs (Split 3)]* *[==>512.0 Secs (Split 4)]*	 ***[1]***

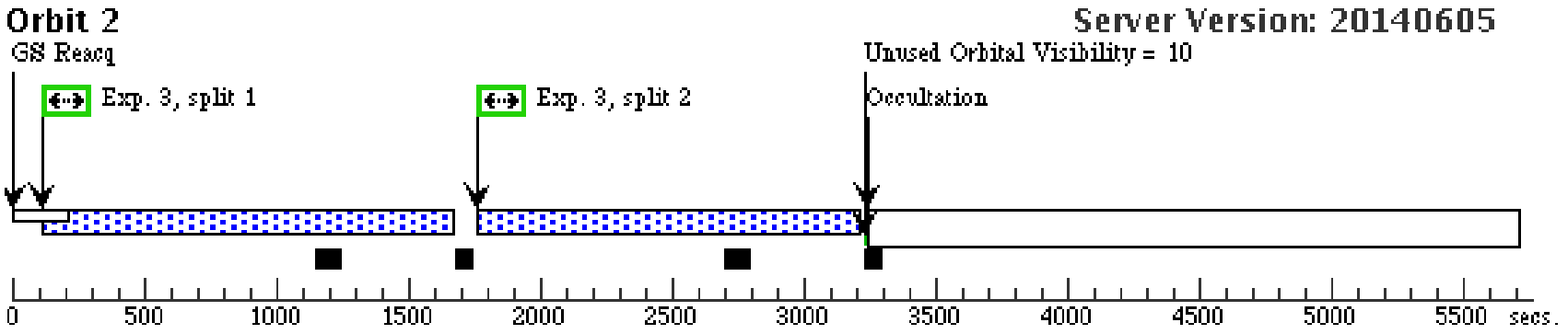
*Comments: S/N = 30 in 2148 s (G130M+1291, BT=2/3*1057 = 705)*
Current plan yields 95% of required exposure time.

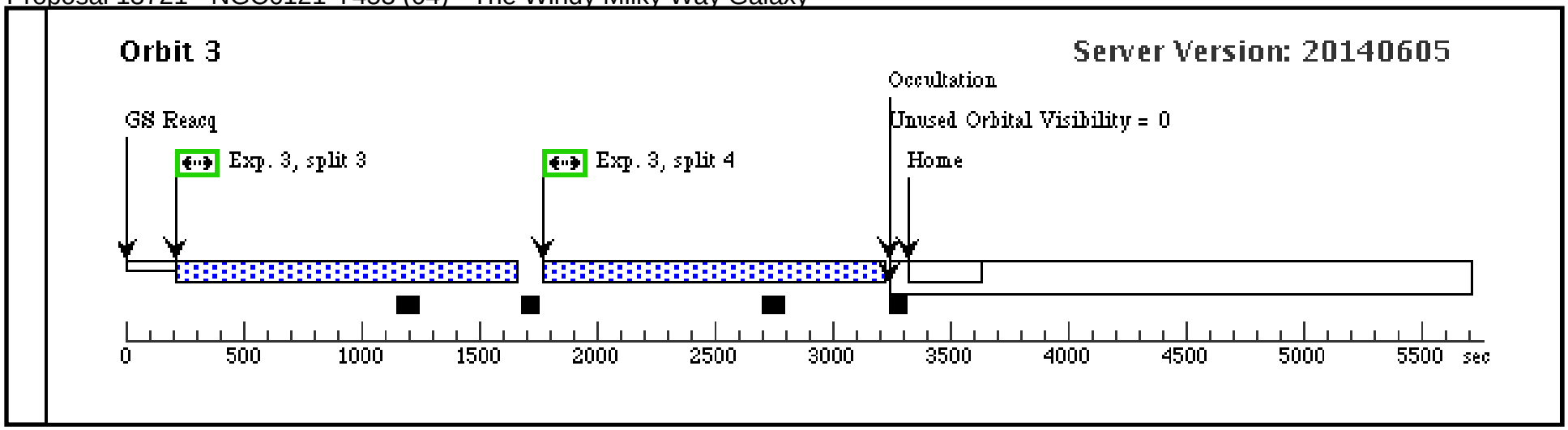
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
3	NGC6121-G160M (COS.sp.649830)	(4) NGC6121-Y453	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=900; FP-POS=ALL			1400 Secs (5602 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>1401.0 Secs (Split 3)]* *[==>1401.0 Secs (Split 4)]*	 ***[2]*** ***[3]***

*Comments: S/N = 30 in 6270 s (G160M+1600, BT=2/3*2012 = 1341)*
Current plan yields 89% of required exposure time.
Use BT = 900 to reduce overheads.

Orbit Structure






Orbit 3
Server Version: 20140605
Occultation
GS Reacq
Unused Orbital Visibility = 0
Exp. 3, split 3
Exp. 3, split 4
Home
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sec

Visit

Proposal 13721, NGC5024-131310+180735 (05), implementation Sat Dec 06 02:06:30 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(5)	NGC5024-131310+180735	RA: 13 13 10.4736 (198.2936400d) Dec: +18 07 35.14 (18.12643d) Equinox: J2000		V=16.83 GALEX FUV=15.506, GALEX NUV = 15.832	Reference Frame: ICRS

Comments: Target is NGC5024-7 from Schiavon et al. (2012, AJ, 143, 121). Galex FUV and NUV magnitudes quoted in this proposal are from this paper. See also the GALEX UV photometric database of globular clusters (cosmic-lab.eu).
Using coordinates and VMAG of star N5IG002352 in the GSC2.
GALEX colors imply Teff = 25,000 K, but uncertainty is large. To guarantee S/N = 30, assume that star is 18,700 K when observing through G130M and 44,500 K when observing through G160M. E(B-V) = 0.02 (Harris 1996/2010).

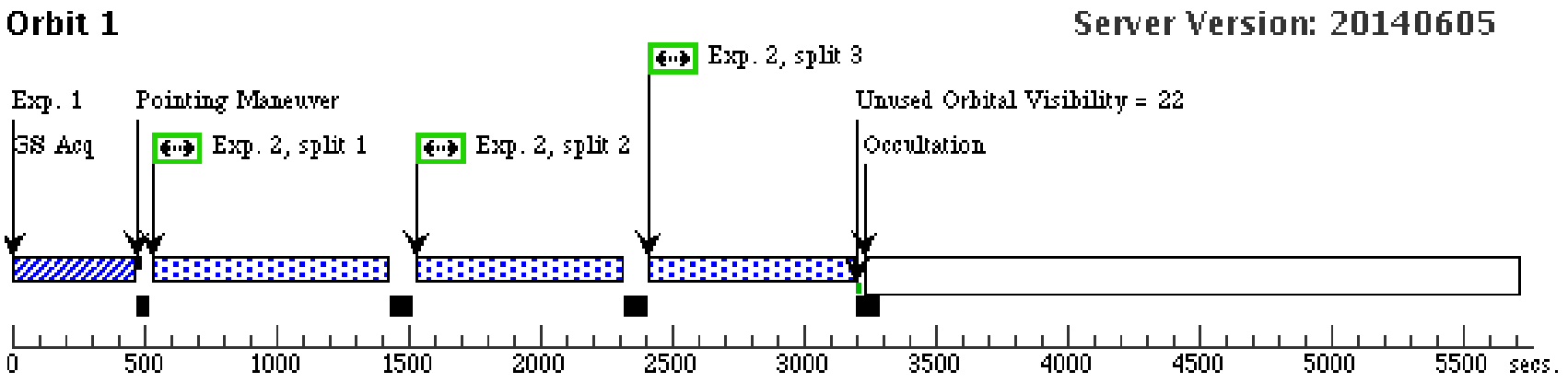
NUV/PSA/MIRRORB gives S/N = 40 in 13.9 s (COS.ta.618717)
G130M/1291 gives S/N = 30 in 2940 s (COS.sp.615639)
G160M/1600 gives S/N = 30 in 11,122 s (COS.sp.615646)

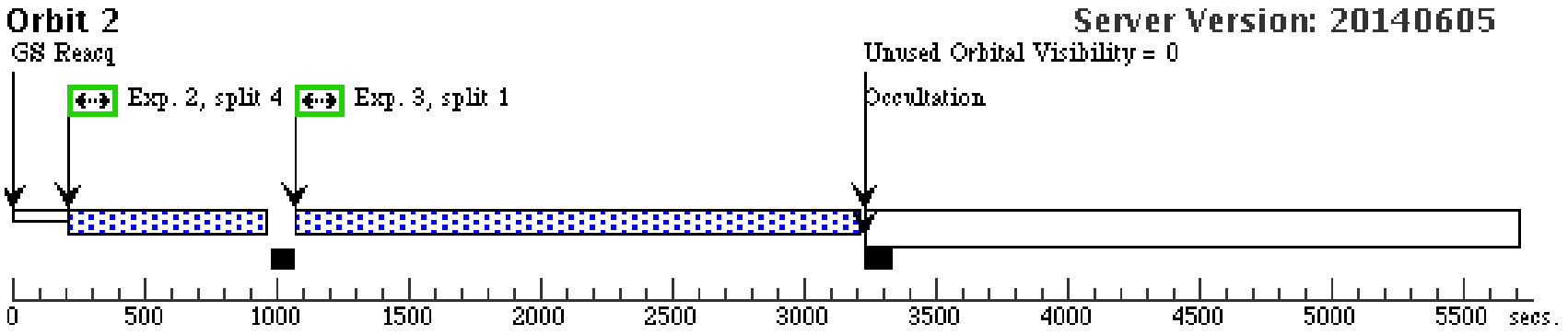
Bright-Object Check: GSC2 reports 16 stars, all safe. GALEX reports 2 stars, both safe.

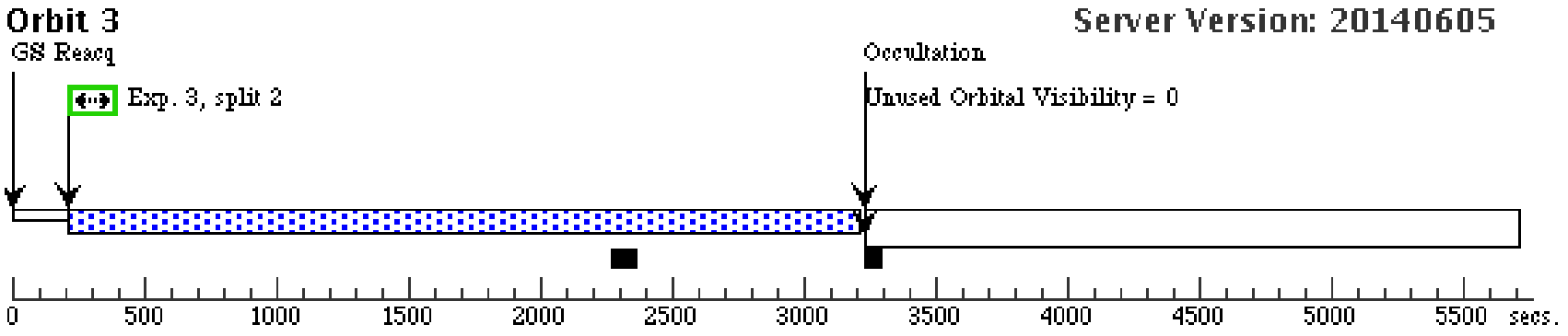
Exposures

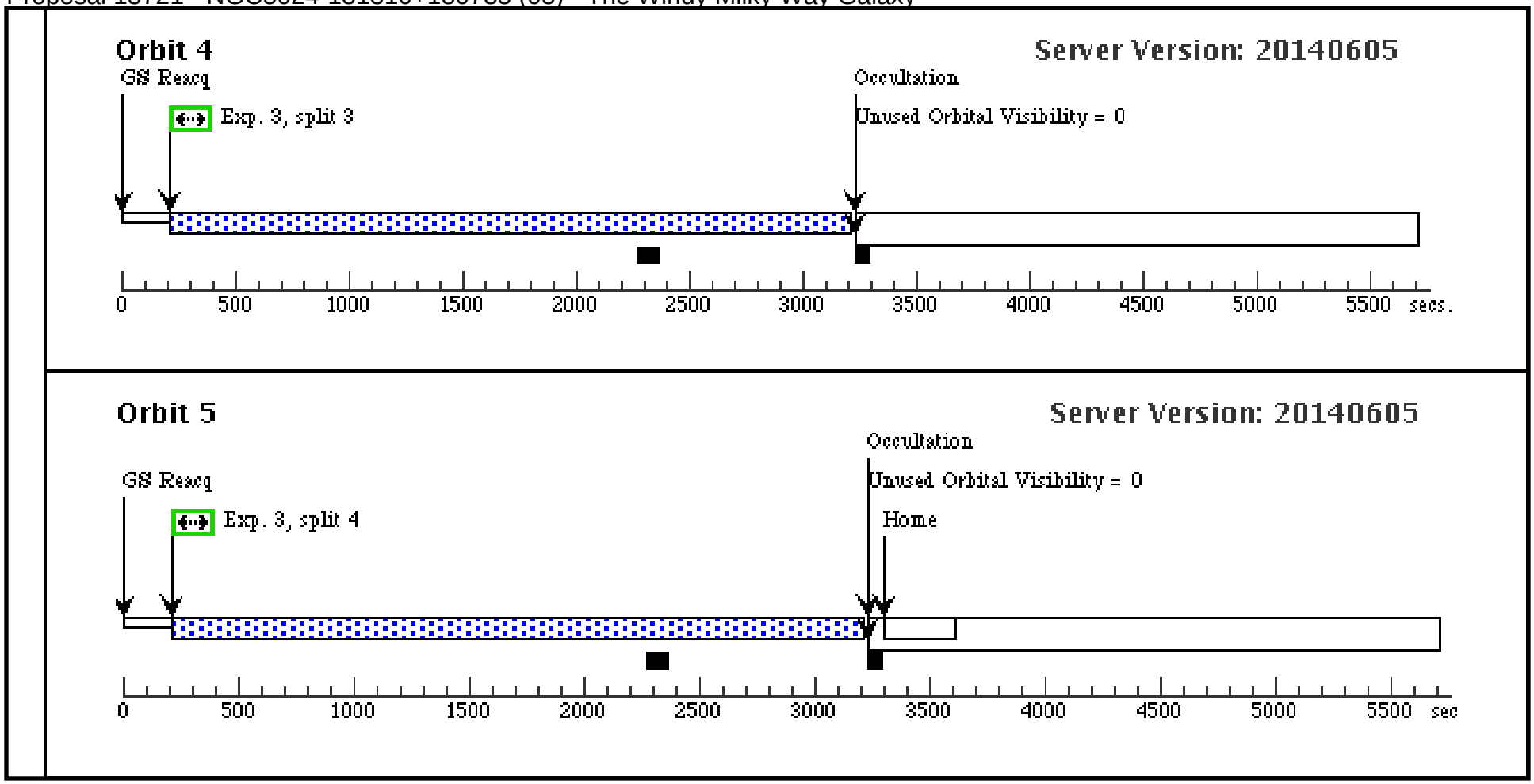
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	NGC5024-IMAGE (COS.ta.618717)	(5) NGC5024-131310+180735	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				20 Secs (20 Secs) *[==>]*	 ***[1]***
	Comments: S/N = 40 in 13.9 s (NUV, MIRRORB, PSA) *We scale this model to GALEX NUV, which better matches COS NUV bandpass.*								
2	NGC5024-G130M (COS.sp.615639)	(5) NGC5024-131310+180735	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=933; FP-POS=ALL			660 Secs (2865 Secs) *[==>723.0 Secs (Split 1)]* *[==>723.0 Secs (Split 2)]* *[==>723.0 Secs (Split 3)]* *[==>696.0 Secs (Split 4)]*	 ***[1]*** ***[2]***
	*Comments: S/N = 30 in 2940 s (G130M+1291, BT=2/3*1400 = 933)* *Current plan yields 97% of required exposure time in each band.*								
3	NGC5024-G160M (COS.sp.615646)	(5) NGC5024-131310+180735	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=2020; FP-POS=ALL			1940 Secs (10811 Secs) *[==>1976.0 Secs (Split 1)]* *[==>2945.0 Secs (Split 2)]* *[==>2945.0 Secs (Split 3)]* *[==>2945.0 Secs (Split 4)]*	 ***[2]*** ***[3]*** ***[4]*** ***[5]***
	*Comments: S/N = 30 in 11,122 s (G160M+1600, BT=2/3*3030 = 2020)* *Current plan yields 97% of required exposure time in each band.*								

Orbit Structure








Orbit 4
Server Version: 20140605
GS Reacq
Exp. 3, split 3
Occultation
Unused Orbital Visibility = 0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.
Orbit 5
Server Version: 20140605
Occultation
GS Reacq
Unused Orbital Visibility = 0
Exp. 3, split 4
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec