14213 - Defining New IR-Bright Flux Standards for Cosmology Applications

Cycle: 23, Proposal Category: GO

(UV Initiative)

(Availability Mode: AVAILABLE)

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) WD1327-083 NONE WAVE	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA WFC3/IR	2	27-Oct-2015 21:21:33.0	yes
02	(2) WD2341+322 NONE WAVE	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA WFC3/IR	2	27-Oct-2015 21:21:37.0	yes

4 Total Orbits Used

ABSTRACT

The uncertainties on the determination of the nature of the dark energy, that is driving the observed accelerating cosmic expansion, depend critically on the stellar flux standards that are used to calibrate the relative flux of redshifted type Ia supernovae. Currently, the most precise and internally consistent set of fluxes are HST spectrophotometry which are based on computed models atmospheres for three hot pure-hydrogen white dwarfs. Our proposal will directly address the accuracy of this calibration, one of the current current barriers to understand the nature of dark energy.

We request 4 orbits to observe two nearby pure-hydrogen atmosphere white dwarfs with significantly cooler temperatures than the current hot white dwarf HST standards. These cooler objects are now accurately modeled by our state-of-the-art 3D model atmospheres and do not suffer from the known shortcomings in models of hot white dwarfs and main-sequence stars. In addition to providing the first robust external confirmation of the HST flux scale in the optical, these new flux standards will be especially useful in the JWST era as standards for the near-IR and IR regions, and their colors will be more similar to those of high-redshift supernovae and galaxies. Furthermore, the parallax of such close stars can be measured with higher precision, so that the absolute flux level can be established as well as the relative flux vs. wavelength.

OBSERVING DESCRIPTION

We request to observe two cool, bright, and close WDs to compare directly with STIS data for the current three hot primary WDs (Teff = 30,000-60,000 K). These cool WDs will confirm the internal consistency of the HST flux vs. wavelength scale and they will be employed to calibrate future IR-surveys such as JWST. We have scanned the White Dwarf Catalog (McCook & Sion 1999) for targets, requesting objects with Teff < 20,000 K so that the SEDs are significantly different to those of the current hot WD stars. We further impose that the atmosphere is pure-hydrogen with no evidence of accretion from evolved planetary systems, which would lead to a metal contamination (Zuckerman et al. 2010). The new standards should have no magnetic field, no companion or close bright object, and no pulsations, the latter excluding most WDs in the 11,000 < Teff (K) < 13,000 range (Gianninas et al. 2011). The targets should also have well constrained atmospheric parameters from optical ground based observations. We have selected the brightest objects that satisfied these requirements to minimize the number of HST orbits.

Our first target is WD 1327-083 with with V = 12.34, Teff = 14,571 +/- 235 K, log g = 7.99 +/- 0.04, and pi = 55.5 +/- 3.77 mas. The second target is WD 2341+322 with V = 12.95, Teff = 13,128 +/- 198 K, log g = 7.92 +/- 0.04, and pi = 56.8 +/- 1.8 mas. The atmospheric parameters are constrained from fits of the Balmer lines (Giammichele et al. 2012), and the error is the sum in quadrature of the internal uncertainty from the fitting procedure and the external uncertainty obtained by repeating the procedure with spectra secured from different ground based facilities. We note that Gaia will increase by a factor of ten the precision of the current parallax measurements. Both targets have been confirmed multiple times to be

photometrically constant, i.e. non-pulsating (Gianninas et al. 2005). We have compared the observed 2MASS JHK colors to predicted colors using the published atmospheric parameters and it agrees within 1-sigma for both targets, which corresponds to a constraint at the 4% level on the near-IR flux, still well above our 1% precision goal. It nevertheless confirms that our targets have no unresolved companions, even though they are both in very wide binaries with main-sequence companions, with separations of 174.7 and 503.3 arcsec, respectively (Farihi et al. 2005).

Ground based spectroscopy (0.36-0.6 micron) with a rough flux calibration is sufficient to extract the atmospheric parameters from the Balmer lines of our targets. As a consequence, the precise spectrophotometric observations that are necessary to establish the model SEDs as flux standards do not exist. We therefore require STIS low-resolution observations covering the range 0.115-1 micron, which implies exposures with the STIS/G140L, G230L, G430L, and G750L filters for each target. This is a sufficient resolution for flux calibration since the only spectral features are broad Balmer lines. We also request to observe our targets with the WFC3 grisms G141 and G102 that will extend the coverage to 1.7 microns, an important aspect of establishing new standards for the near-IR and comparing their accuracies to hot WDs. We require a signal-to-noise ratio of >100, in broad delta lambda = 50-100 A bands, which is necessary to constrain the flux calibration at the 1% level. We computed model SEDs on the effective temperatures, surface gravities, and V-band magnitudes from Giammichele et al. (2012), and fed them into the STIS and WFC3 Exposure Time Calculator (ETC). Given the brightness of our targets, the four STIS exposures fit in 1.5 orbits. Only a partial orbit is required for WFC3 to reach S/N > 100, hence we have a strong requirement to change instrument mid-orbit to acheive our science goals. The best compromise is to use WFC3 first and then STIS, allowing STIS wave calibrations and fringe flat in the occultation at the ends of the orbits. We therefore request 1 visit and 2 orbits for each of the 2 targets.

Visit

Proposal 14213, WD1327 - IR Sub (01), implementation Wed Oct 28 01:21:39 GMT 2015

Diagnostic Status: Warning

Scientific Instruments: STIS/CCD, WFC3/IR, STIS/FUV-MAMA, STIS/NUV-MAMA

Special Requirements: SCHED 80%; ORIENT 130D TO 210 D; ORIENT 310D TO 30 D

Diagnostics

(WD1327 - IR Sub (01)) Warning (Orbit Planner): MISSING FRINGE FLAT CALIBRATION

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

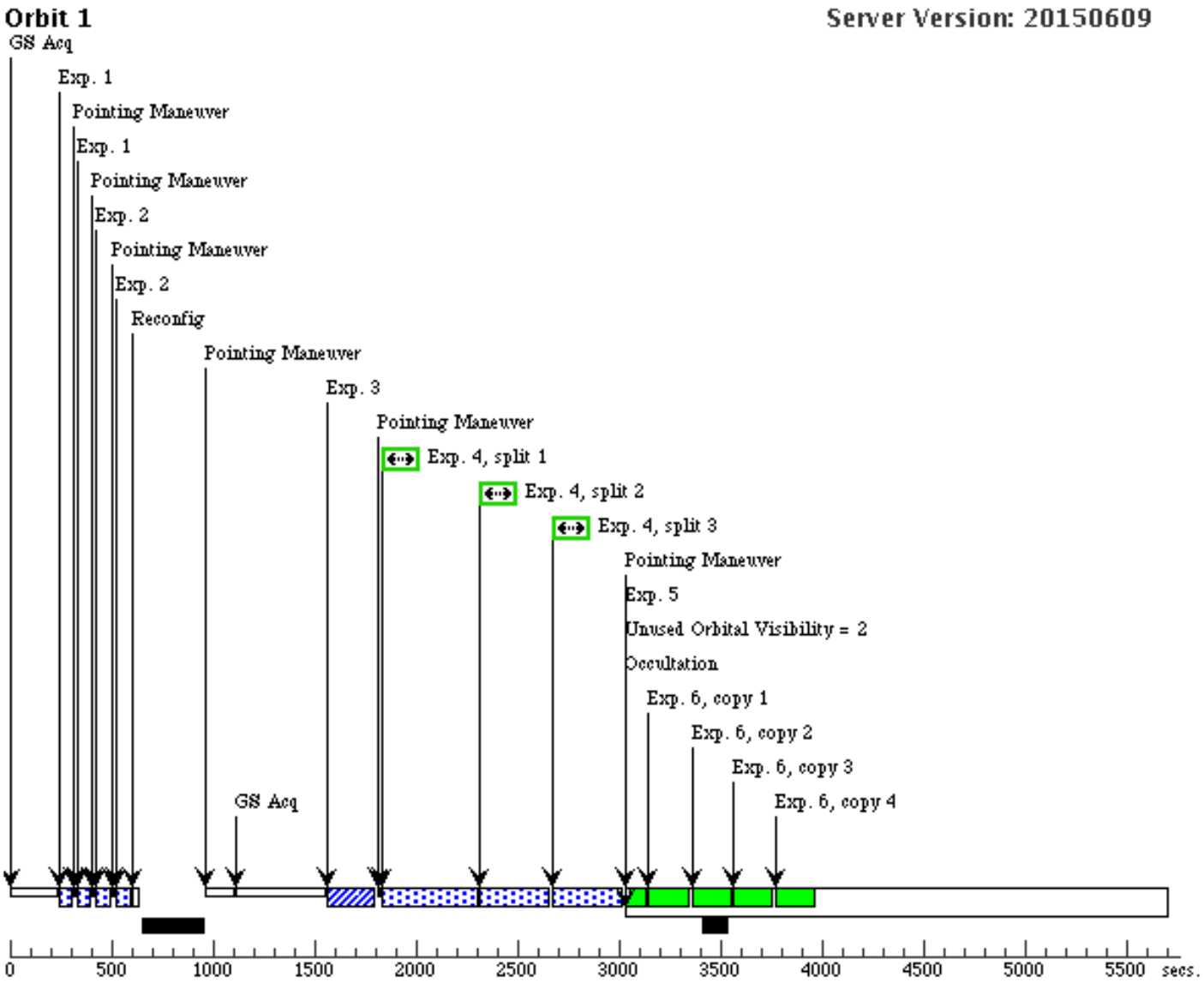
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WD1327-083	RA: 13 30 13.6402 (202.5568342d) Dec: -08 34 29.50 (-8.57486d) Equinox: J2000	Proper Motion RA: -1106.30 mas/yr Proper Motion Dec: -475.97 mas/yr Parallax: 0.05755" Epoch of Position: 2000	V=12.34+/-0.05	Reference Frame: ICRS

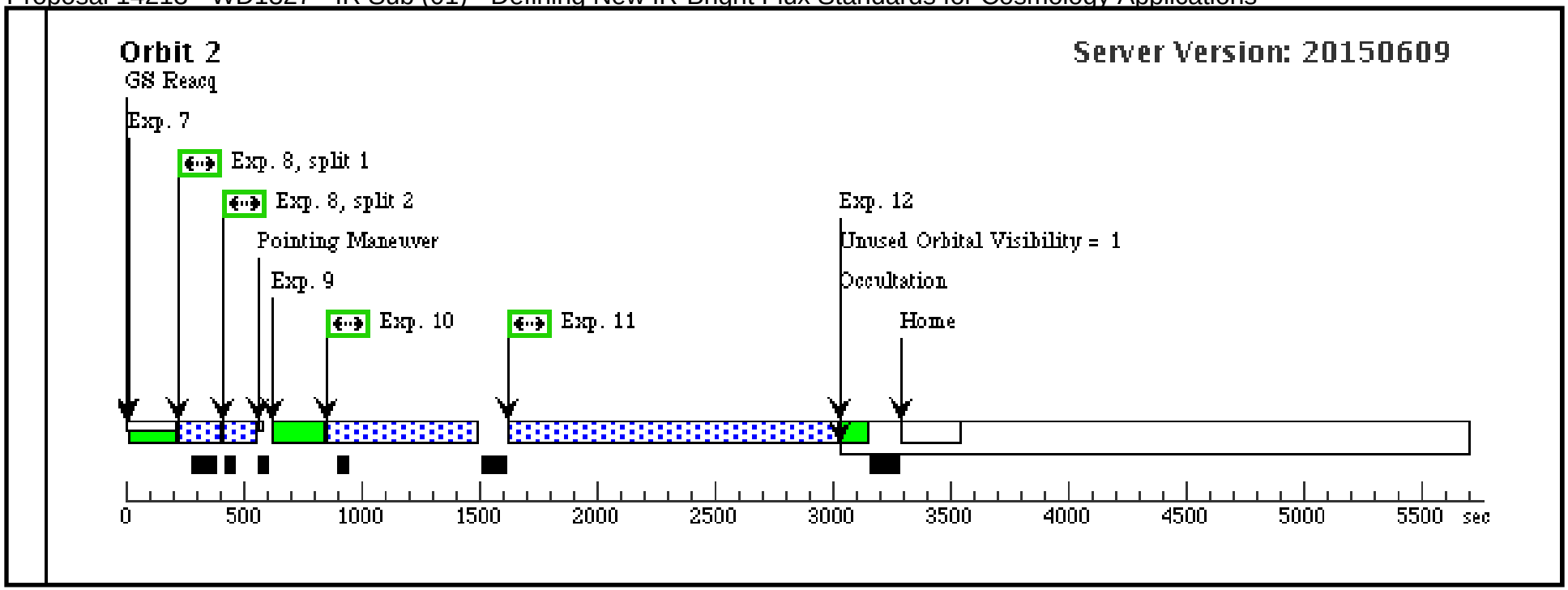
Comments: Coordinates and proper motions from Hipparcos.

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	1 WFC3 G141 (WFC3IR.sp.727691)	(1) WD1327-083	WFC3/IR, MULTIACCUM, GRISM512	G141	NSAMP=11; SAMP-SEQ=SPARS5	GS ACQ SCENARIO ONEB1B3	Pattern 2, Exps 1-1 in WD1327 - IR Sub (01) (2)	30.068097 Secs (60.136 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***
	Comments: 2 point dither in both x and y direction to mitigate against bad pixels and avoid saturation								
2	2 WFC3 G102 (WFC3IR.sp.727689)	(1) WD1327-083	WFC3/IR, MULTIACCUM, GRISM512	G102	NSAMP=15; SAMP-SEQ=SPARS5		Pattern 2, Exps 2-2 in WD1327 - IR Sub (01) (2)	41.754125 Secs (83.508 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***
	Comments: 2 point dither in both x and y direction to mitigate against bad pixels and avoid saturation								
3	3 STIS ACQ	(1) WD1327-083	STIS/CCD, ACQ, F28X50LP	MIRROR		GS ACQ SCENARIO BASE1B3		1 Secs (1 Secs) *[==>]*	***[1]***
4	4 STIS G750L (STIS.sp.727504)	(1) WD1327-083	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=3; GAIN=4; WAVECAL=NO			936 Secs (936 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]*	***[1]***
	Comments: Manual fringe flat used instead of default to get higher S/N.								
5	5 STIS G750L WAVE	WAVE	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>]*	***[1]***
6	6 STIS G750L fringe	NONE	STIS/CCD, ACCUM, 0.3X0.09	G750L 7751 A	LAMP=TUNGSTEN; GAIN=4			120 Secs X 4 (480 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]*	***[1]***
7	7 STIS G430L WAVE	WAVE	STIS/CCD, ACCUM, 52X0.1	G430L 4300 A				*[==>]*	***[2]***
8	8 STIS G430L E1 (STIS.sp.732780)	(1) WD1327-083	STIS/CCD, ACCUM, 52X2E1	G430L 4300 A	CR-SPLIT=2; GAIN=4; WAVECAL=NO			200 Secs (200 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[2]***
9	9 STIS G230L Wave	WAVE	STIS/NUV-MAMA, ACCUM, 31X0.05NDC	G230L 2376 A				*[==>]*	***[2]***
10	10 STIS G230L (STIS.sp.732777)	(1) WD1327-083	STIS/NUV-MAMA, ACCUM, 52X2	G230L 2376 A	WAVECAL=NO			605 Secs (605 Secs) *[==>]*	***[2]***
11	11 STIS G140L (STIS.sp.732775)	(1) WD1327-083	STIS/FUV-MAMA, ACCUM, 52X2	G140L 1425 A	WAVECAL=NO			1244 Secs (1244 Secs) *[==>]*	***[2]***
	Comments: BOT has a safety warning but it comes from our target, and the ETC information above confirms the safety of the observations.								
12	12 STIS G140L WAVE	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140L 1425 A				*[==>]*	***[2]***

Orbit Structure




Orbit 2
Server Version: 20150609
GS Reacq
Exp. 7
Exp. 8, split 1
Exp. 8, split 2
Pointing Maneuver
Exp. 9
Exp. 10
Exp. 11
Exp. 12
Unused Orbital Visibility = 1
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 14213, WD2341 - IR Sub (02), implementation Wed Oct 28 01:21:39 GMT 2015

Diagnostic Status: Warning

Scientific Instruments: STIS/CCD, WFC3/IR, STIS/FUV-MAMA, STIS/NUV-MAMA

Special Requirements: (none)

Diagnostics

(WD2341 - IR Sub (02)) Warning (Orbit Planner): MISSING FRINGE FLAT CALIBRATION

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

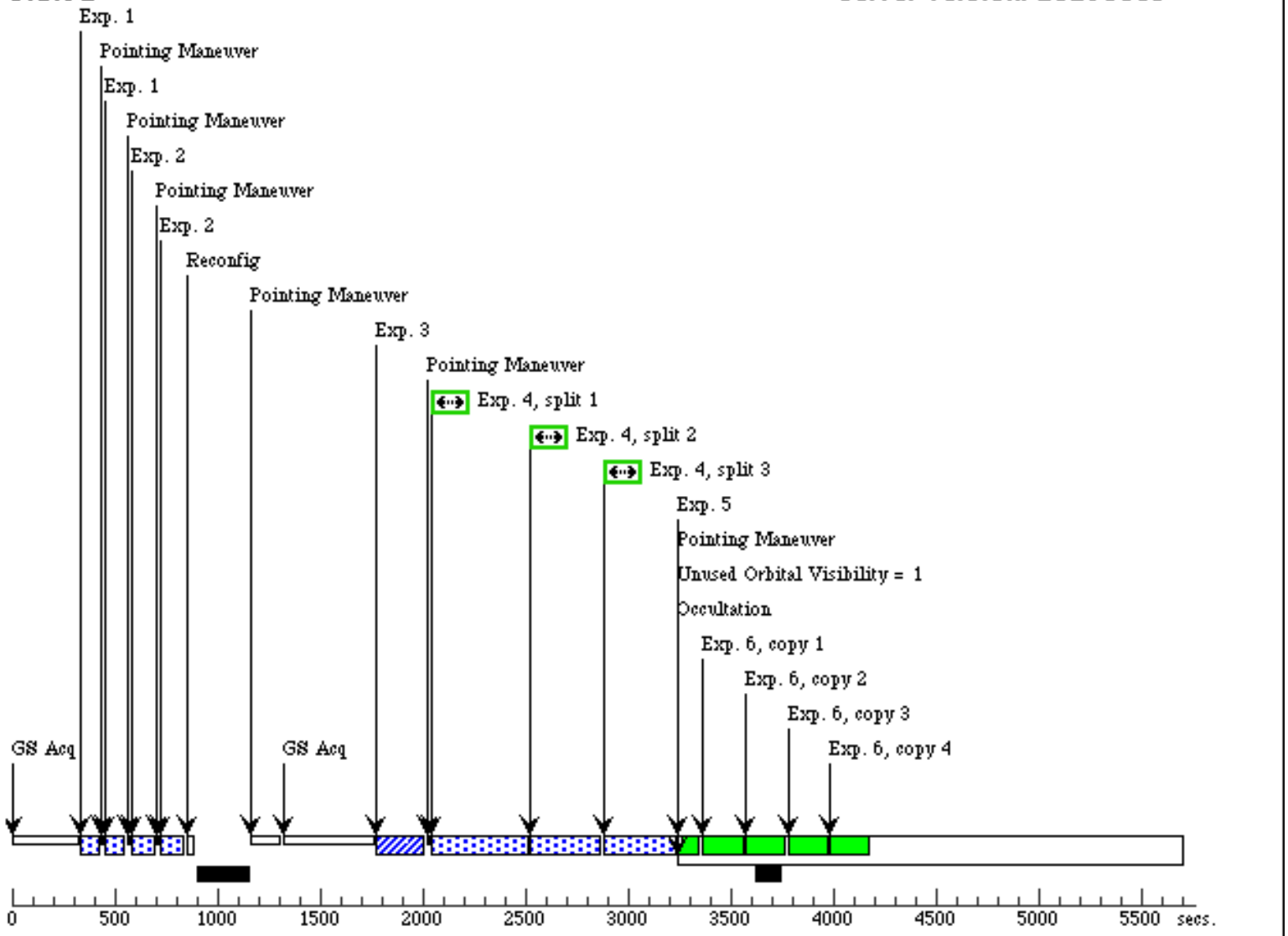
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	WD2341+322	RA: 23 43 50.7202 (355.9613342d) Dec: +32 32 46.76 (32.54632d) Equinox: J2000	Proper Motion RA: -209.07 mas/yr Proper Motion Dec: -69.08 mas/yr Parallax: 0.05839" Epoch of Position: 2000	V=12.95+/-0.05	Reference Frame: ICRS

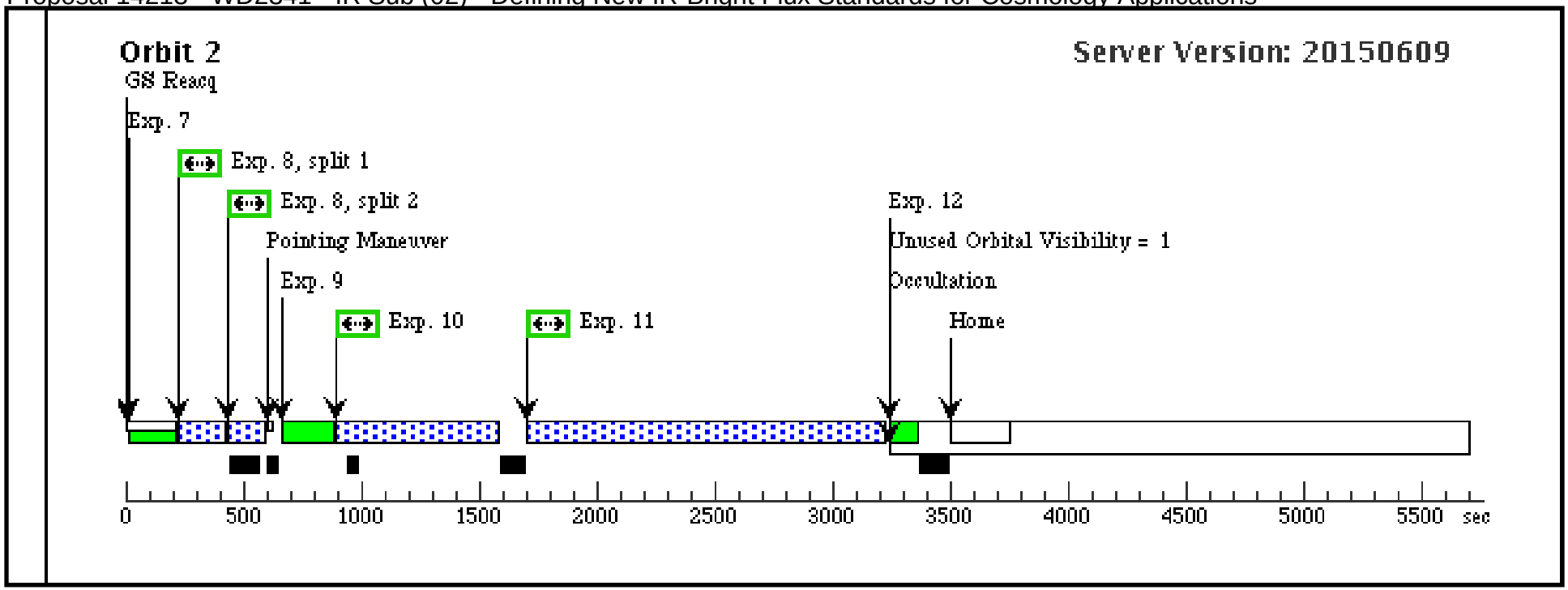
Comments: Coordinates and proper motions from Hipparcos.

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	1 WFC3 G141 (WFC3IR.sp.727692)	(2) WD2341+322	WFC3/IR, MULTIACCUM, GRISM512	G141	NSAMP=9; SAMP-SEQ=SPARS10		Pattern 2, Exps 1-1 in WD2341 - IR Sub (02) (2)	64.226619 Secs (128.453 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***
2	2 WFC3 G102 (WFC3IR.sp.727693)	(2) WD2341+322	WFC3/IR, MULTIACCUM, GRISM512	G102	NSAMP=12; SAMP-SEQ=SPARS10		Pattern 2, Exps 2-2 in WD2341 - IR Sub (02) (2)	87.991716 Secs (175.983 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***
3	3 STIS ACQ	(2) WD2341+322	STIS/CCD, ACQ, F28X50LP	MIRROR				1 Secs (1 Secs) *[==>]*	***[1]***
4	4 STIS G750L (STIS.sp.727527)	(2) WD2341+322	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=3; GAIN=4; WAVECAL=NO			939.0 Secs (939 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]*	***[1]***
Comments: Manual fringe flat used instead of default to get higher S/N.									
5	5 STIS G750L WAVE	WAVE	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>]*	***[1]***
6	6 STIS G750L fringe	NONE	STIS/CCD, ACCUM, 0.3X0.09	G750L 7751 A	LAMP=TUNGSTEN; GAIN=4			120 Secs X 4 (480 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]*	***[1]***
7	7 STIS G430L WAVE	WAVE	STIS/CCD, ACCUM, 52X0.1	G430L 4300 A				*[==>]*	***[2]***
8	8 STIS G430L E1 (STIS.sp.732786)	(2) WD2341+322	STIS/CCD, ACCUM, 52X2E1	G430L 4300 A	CR-SPLIT=2; GAIN=4; WAVECAL=NO			240.0 Secs (240 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[2]***
9	9 STIS G230L Wave	WAVE	STIS/NUV-MAMA, ACCUM, 31X0.05NDC	G230L 2376 A				*[==>]*	***[2]***
10	10 STIS G230L (STIS.sp.732787)	(2) WD2341+322	STIS/NUV-MAMA, ACCUM, 52X2	G230L 2376 A	WAVECAL=NO			650 Secs (650 Secs) *[==>]*	***[2]***
11	13 STIS G140L (STIS.sp.732788)	(2) WD2341+322	STIS/FUV-MAMA, ACCUM, 52X2	G140L 1425 A	WAVECAL=NO			1370 Secs (1370 Secs) *[==>]*	***[2]***
12	14 STIS G140L WAVE	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140L 1425 A				*[==>]*	***[2]***

Orbit Structure

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GS Reacq
Exp. 7
Exp. 8, split 1
Exp. 8, split 2
Pointing Maneuver
Exp. 9
Exp. 10
Exp. 11
Exp. 12
Unused Orbital Visibility = 1
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec