12548 - Constraining Planet Formation in the Unique Evolved Binary HR 637 (GJ 86)

Cycle: 19, Proposal Category: GO

(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) GJ86A	WFC3/UVIS	1	03-Apr-2012 21:23:49.0	yes
02	(1) GJ86A (2) GJ86B	STIS/CCD	2	03-Apr-2012 21:24:18.0	yes

3 Total Orbits Used

ABSTRACT

An intriguing characteristic of the known exoplanets is the existence of gas giants in moderately close binary systems. Among these planet-hosting binaries, the HR 637 (GJ 86) system is particularly interesting; the exoplanet GJ 86b executes a 0.1 AU orbit about an early K dwarf that is in turn bound to a white dwarf near 20 AU. The progenitor of GJ 86B was originally the more massive stellar component, orbiting near 12 AU until post-

main sequence mass loss expanded its separation. This picture presents a gravitational challenge to planet formation at GJ86A: how does a giant planet form around a solar-mass star in such close proximity to an intermediate-mass star? Also, did GJ 86b form at the same epoch as the stars, or during the post-main sequence evolution of the secondary? To model the formation of GJ 86b, a knowledge of the current and primordial stellar masses and separations is required.

We propose WFC3 imaging of this high-contrast, 2 arcsec binary in several bandpasses, and subsequent STIS optical spectroscopy of the white dwarf GJ 86B. The imaging is essential to determine the precise location of the companion for STIS spectroscopy, while the broad-band colors will yield the temperature of the white dwarf. The spectroscopy will reveal the atmospheric composition -- including refractory pollutants -- of the white dwarf, and together with its known parallax, determine its radius and mass, the mass of its progenitor, the original binary separation, and total system age. From these data, we will be able to strongly constrain planet formation scenarios in this relatively close binary, and potentially obtain evidence of terrestrial planets within the system.

OBSERVING DESCRIPTION

WFC3 imaging observations over 1 orbit must be both executed and analyzed prior to STIS scheduling, which entails spectroscopy for the subsequent 2 orbits. The WFC3 image analysis will determine the precise binary offset and absolute position for spectroscopy of the faint stellar companion to the bright primary in this Sirius-type system.

ADDITIONAL COMMENTS

The WFC3 and STIS observations must be done so that bleeding columns and diffraction spikes from the bright primary do not affect the faint companion. For the WFC3 imaging, we have constrained the ORIENT parameter so that the companion should fall within +- 10 degrees of the same array row as the bright primary. For STIS spectroscopy, we have done the same based on the expected PA of the companion, but expect to more precisely constrain the ORIENT parameter after analyzing the WFC3 data. We have put the STIS visits on hold until the completion of the WFC3 observations and analysis.

Visit

Proposal 12548, Visit 01, completed Wed Apr 04 01:24:30 GMT 2012

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 90.8D TO 167.2 D; ORIENT 180.8D TO 208 D; ORIENT 230D TO 257.2 D; ORIENT 270.8D TO 347.2 D; ORIENT 0.8D TO 28 D; ORIENT 50D TO 77.2 D

Comments: ORIENT angles are specified to avoid faint companion lying near diffraction spikes or bleeding columns of bright primary, for expected PA of 84 degrees.

Diagnostics

(Visit 01) Warning (Orbit Planner): INVALID GS ACQ SCENARIO SPECIAL REQUIREMENT

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1-2), (3), (4), (5), (6), (7), (8), (9)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GJ86A Alt Name1: HR637A Alt Name2: HD13445A	RA: 02 10 25.9342 (32.6080592d) Dec: -50 49 25.41 (-50.82373d) Equinox: J2000	Proper Motion RA: 2092.86 mas/yr Proper Motion Dec: 653.21 mas/yr Parallax: .09274" Epoch of Position: 2000.0	V=6.17	Reference Frame: ICRS

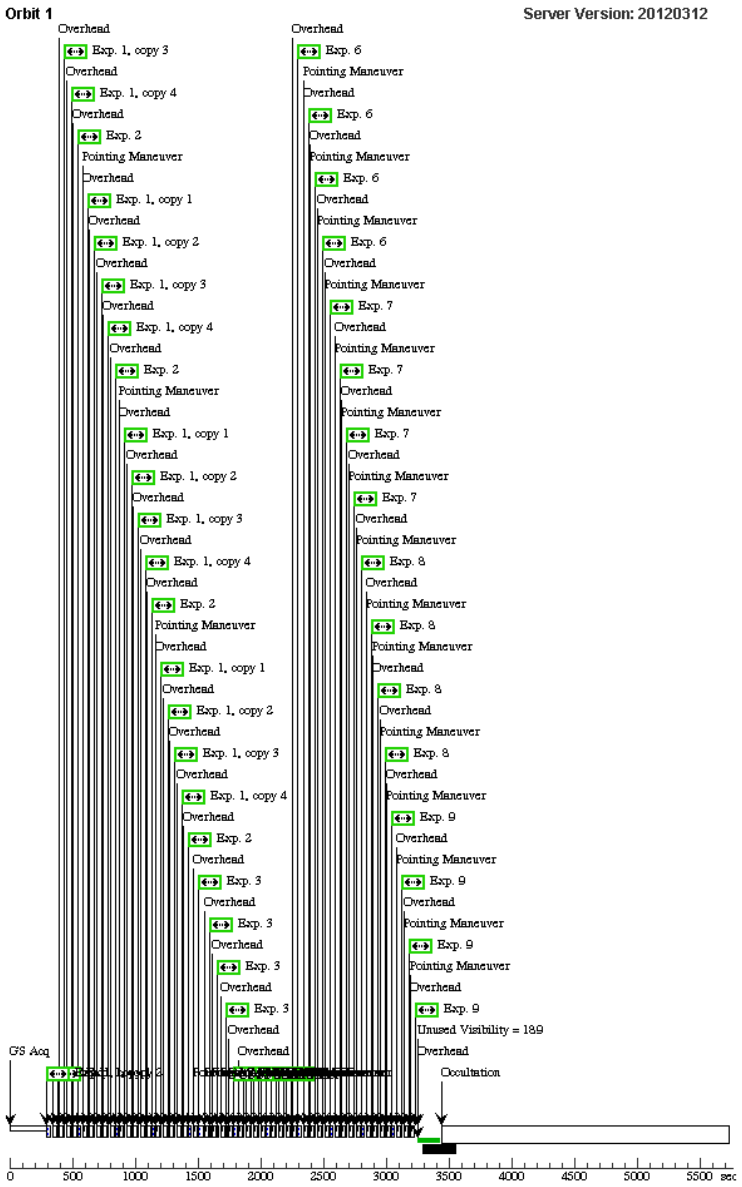
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F225W-A Imaging	(1) GJ86A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F225W		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-2 in Visit 01 (1)	1.0 Secs X 4 *[==>(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	F225W-B Imaging	(1) GJ86A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F225W		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-2 in Visit 01 (1)	20 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
3	F275W Imaging	(1) GJ86A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F275W			Pattern 1, Exps 3-3 in Visit 01 (1)	10.0 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
4	F336W Imaging	(1) GJ86A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F336W			Pattern 1, Exps 4-4 in Visit 01 (1)	5.0 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
5	F390W Imaging	(1) GJ86A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F390W			Pattern 1, Exps 5-5 in Visit 01 (1)	4.0 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
6	F438W Imaging	(1) GJ86A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F438W			Pattern 1, Exps 6-6 in Visit 01 (1)	4.0 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***

	7	F555W Imaging	(1) GJ86A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F555W	Pattern 1, Exps 7-7 in Visit 01 (1)	2.0 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
	8	F625W Imaging	(1) GJ86A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F625W	Pattern 1, Exps 8-8 in Visit 01 (1)	2.0 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
	9	F814W Imaging	(1) GJ86A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F814W	Pattern 1, Exps 9-9 in Visit 01 (1)	3.0 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***

Orbit Structure



Visit

Proposal 12548, Visit 02, implementation Wed Apr 04 01:24:33 GMT 2012

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: PCS MODE FINE; SCHED 60%; ORIENT 33.6D TO 53.6 D; ORIENT 213.6D TO 233.6 D; AFTER 01 BY 14 D TO 140 D

Comments: STIS observation of GJ 86B.
Consists of an acquisition image of GJ 86A, an acquisition peakup on GJ 86B, and spectra in G430L, G750M, and G430M.

ORIENT requirements are to place GJ 86 B halfway between the diffraction spikes of A. Will be revised when WFC3 images from Visit 01 are analyzed. Visit is ON HOLD awaiting the WFC3 frames.
ORIENT values updated based on recent WFC3 frames 4/2/12 by H. E. Bond. Observation is now ready to be scheduled.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(3), (4)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.40624	Center Pattern=true		
	Line Spacing=			
(4)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(5)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=4	Angle Between Sides=		
	Point Spacing=0.40624	Center Pattern=true		
	Line Spacing=			

Fixed Targets

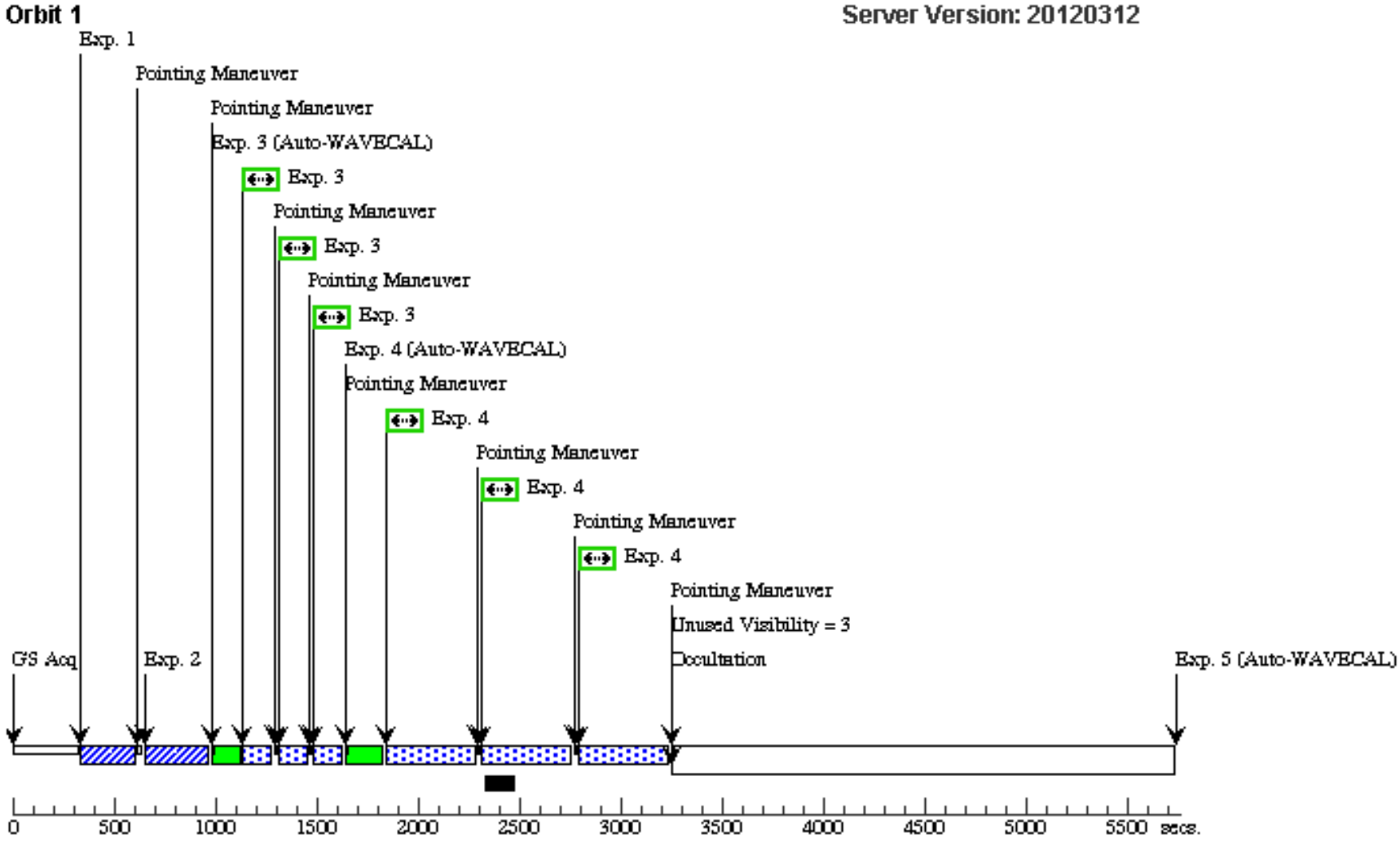
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GJ86A	RA: 02 10 25.9342 (32.6080592d)	Proper Motion RA: 2092.86 mas/yr	V=6.17	Reference Frame: ICRS
	Alt Name1: HR637A	Dec: -50 49 25.41 (-50.82373d)	Proper Motion Dec: 653.21 mas/yr		
	Alt Name2: HD13445A	Equinox: J2000	Parallax: .09274"		
			Epoch of Position: 2000.0		
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.					
(2)	GJ86B	Offset from GJ86A by		V=14.0	Offset Position (GJ86B)
	Alt Name1: HR637B	RA Offset: 0.249023 Secs			Reference Frame: ICRS
	Alt Name2: HD13445B	Dec Offset: 0.05723 Arcsec			

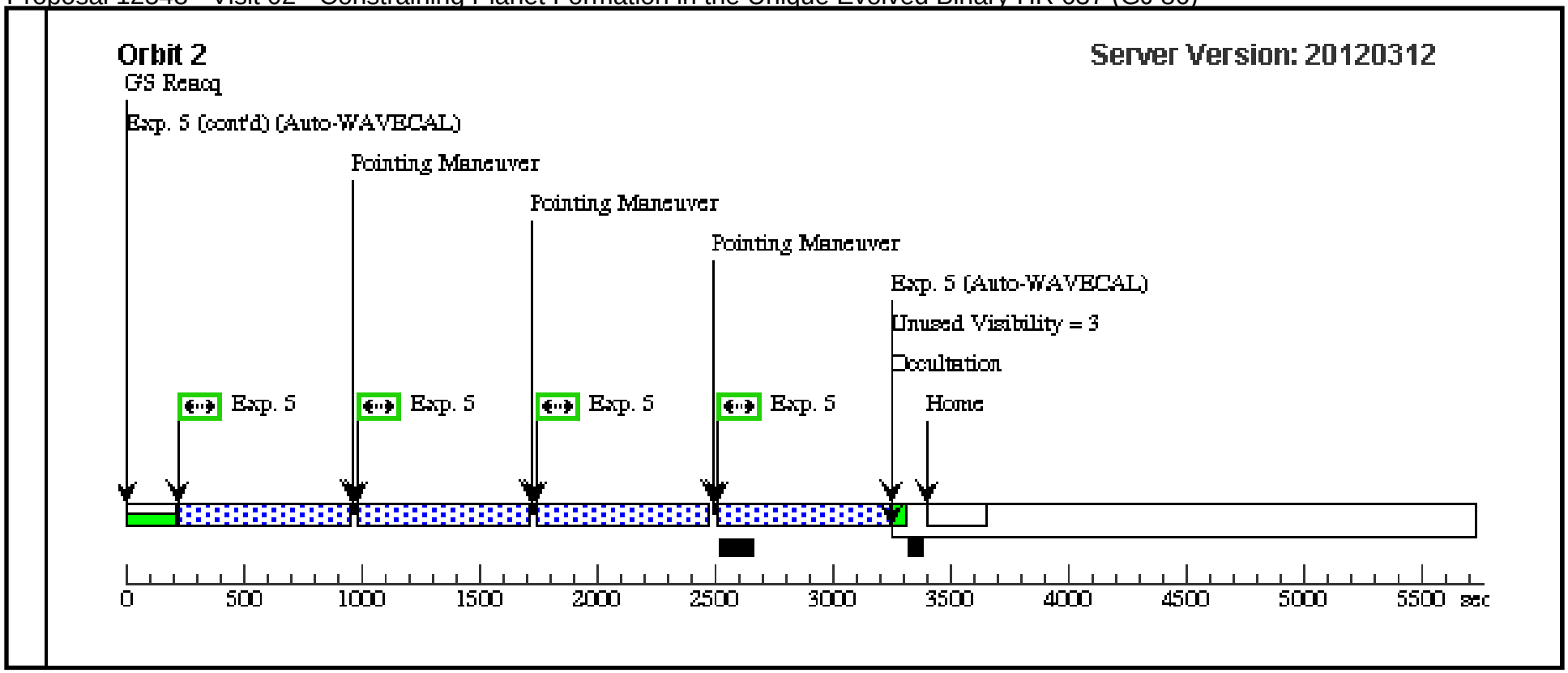
Comments: Offset values currently are from an approximate visual orbit by Lagrange et al. These will be improved after we obtain the WFC3 images.
New offset values based on WFC3 frames entered 4/2/12 by H. E. Bond

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	GJ86A acq (183994)	(1) GJ86A	STIS/CCD, ACQ, F28X50OIII	MIRROR	ACQTYPE=POINT			0.5 Secs *[==>]*	***[1]***
2	GJ 86B acq/ peak	(2) GJ86B	STIS/CCD, ACQ/PEAK, 52X0.05E1	MIRROR				1.6 Secs *[==>]*	***[1]***
3	GJ 86B STIS-G430L (183862)	(2) GJ86B	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A	CR-SPLIT=NO; GAIN=1		Pattern 3, Exps 3-3 in Visit 02 (3)	100 Secs *[==>106.0 Secs (Pattern 1)]* *[==>106.0 Secs (Pattern 2)]* *[==>106.0 Secs (Pattern 3)]*	***[1]***
4	GJ 86B STIS-G750M (183863)	(2) GJ86B	STIS/CCD, ACCUM, 52X0.2E1	G750M 6581 A	CR-SPLIT=NO; GAIN=1		Pattern 3, Exps 4-4 in Visit 02 (3)	400 Secs *[==>406.0 Secs (Pattern 1)]* *[==>406.0 Secs (Pattern 2)]* *[==>406.0 Secs (Pattern 3)]*	***[1]***
5	GJ 86B STIS-G430M (183864)	(2) GJ86B	STIS/CCD, ACCUM, 52X0.2E1	G430M 3936 A	CR-SPLIT=NO; GAIN=1		Pattern 4, Exps 5-5 in Visit 02 (4)	600 Secs *[==>693.0 Secs (Pattern 1)]* *[==>693.0 Secs (Pattern 2)]* *[==>693.0 Secs (Pattern 3)]* *[==>693.0 Secs (Pattern 4)]*	***[2]***

Orbit Structure




Orbit 2
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GS Reacq
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Pointing Maneuver
Pointing Maneuver
Exp. 5 (Auto-WAVECAL)
Unused Visibility = 3
Occultation
Exp. 5
Exp. 5
Exp. 5
Exp. 5
Home
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500
1000
1500
2000
2500
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sec