12544 - Confirming Ultra-cold (Teff < 500K) Brown Dwarf Suspects Identified with WISE

Cycle: 19, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Michael C. Cushing (PI)	**University of Toledo**	**michael.cushing@gmail.com**
Dr. J. Davy Kirkpatrick (CoI)	California Institute of Technology	davy@ipac.caltech.edu
Dr. Christopher R. Gelino (CoI)	California Institute of Technology	cgelino@ipac.caltech.edu
Dr. Amanda K. Mainzer (CoI)	Jet Propulsion Laboratory	amanda.k.mainzer@jpl.nasa.gov
Mr. Roger L. Griffith (CoI)	Jet Propulsion Laboratory	griffith.rl@gmail.com
Dr. Michael F. Skrutskie (CoI)	The University of Virginia	s4n@virginia.edu
Dr. Kenneth A. Marsh (CoI)	California Institute of Technology	kam@ipac.caltech.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(6) WISE05351-75002	WFC3/IR	1	20-Mar-2012 21:09:24.0	yes
02	(2) WISE04102+15024	WFC3/IR	1	20-Mar-2012 21:09:34.0	yes
03	(4) WISE09430+36072	WFC3/IR	1	20-Mar-2012 21:09:43.0	yes
04	(1) WISE22096+27114	WFC3/IR	1	20-Mar-2012 21:09:54.0	yes

4 Total Orbits Used

ABSTRACT

Despite the spectacular success of wide-field, sky surveys (2MASS, SDSS, and UKIDSS) in uncovering a large population of brown dwarfs in the solar neighborhood, a gap of nearly 400 K remains between the coolest brown dwarfs known (Teff ~ 500 K) and Jupiter (Teff ~ 128 K). Yet it is exactly these cold, low-mass brown dwarfs that are essential to measuring the functional form of the low-mass mass function and determining the lower mass limit of star formation. With atmospheric conditions similar to those of giant planets, cold brown dwarfs are also excellent proxies with which to test the ultracool model atmospheres that are critical to our understanding of exoplanets. One of the primary science goals of the Wide-field Infrared Survey Explorer (WISE), a NASA mission that recently completed a survey of the entire sky at four mid-infrared wavelengths, is to discover a large population of these cool brown dwarfs. As part of a larger followup campaign that involves both ground- and space-based observatories, we were awarded 12 orbits in Cycle 18 (as part of a Cycle 7 Spitzer program) to obtain near-infrared WFC3 grism spectroscopy of twelve of our faintest and reddest, and thus presumably coldest, brown dwarf candidates. We here propose to obtain spectra of an additional four objects that, along with the twelve Cycle 18 targets, constitute the best cold brown dwarf candidates that we have identified in roughly half of the sky. These objects are too faint for spectroscopic verification from the ground so HST/WFC3 observations are the only avenue for confirming their ultracool nature.

OBSERVING DESCRIPTION

Proper spectral classification of T dwarfs requires spectra covering at least the 1.11.7 m wavelength range (see Figure 4). We will therefore use the G141 grism in WFC3 which provides a resolving power of / 130 over the 1.11.7 m wavelength range to observe 4 WISE brown dwarf candidates with J > 19.5. We will also obtain F125W imaging of each source in order to establish the wavelength zero-point of the spectra and set the absolute flux level of the resulting spectra.

Based on our previous experience with the spectral classification and modeling of late- type T dwarf spectra, we require a minimum S/N of 15 at the FWHM points of the J-band peak and a S/N of 20 for the direct images in order to absolutely flux calibrate the spectrum to 5%. We used the spectrum of the T8 standard 2MASS 04150935 and the WFC3 Exposure Time Calculator to estimate the exposure time required to reach the required S/N for each source. Including all overheads (guide star aquisition, instrument, dithers, and buffer dump) we can obtain the required S/N in a single orbit per object so in total we request 4 orbits. All observations will be dithered to aid with the removal of bad/hot pixels.

Visit

Proposal 12544, Visit 01, implementation Wed Mar 21 01:10:01 GMT 2012

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 282D TO 282 D

Comments: WISE 0535-75002

Patterns

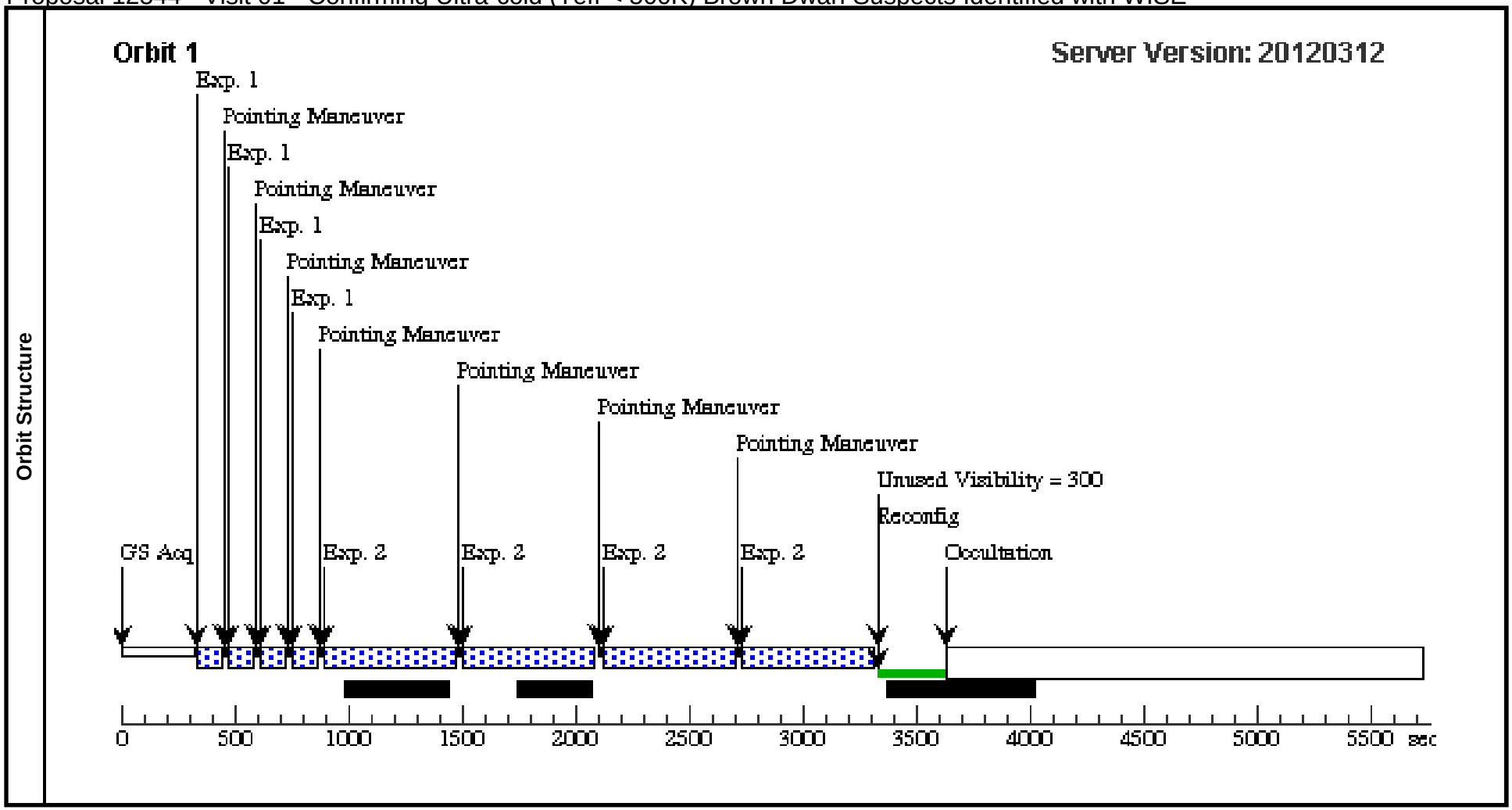
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(6)	WISE05351-75002	RA: 05 35 16.8100 (83.8200417d) Dec: -75 00 25.27 (-75.00702d) Equinox: J2000		V=35+/-5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F140W imaging	(6) WISE05351-75002	WFC3/IR, MULTIACCUM, GRISM1024	F140W	SAMP-SEQ=SPARS25; NSAMP=4		Pattern 1, Exps 1-1 in Visit 01 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	G141 spectroscopy	(6) WISE05351-75002	WFC3/IR, MULTIACCUM, GRISM1024	G141	SAMP-SEQ=SPARS50; NSAMP=12		Pattern 1, Exps 2-2 in Visit 01 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20120312
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 300
Reconfig
GS Acq
Exp. 2
Exp. 2
Exp. 2
Exp. 2
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12544, Visit 02, implementation Wed Mar 21 01:10:02 GMT 2012

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 12D TO 18 D; ORIENT 39D TO 43 D; ORIENT 88D TO 90 D; ORIENT 96D TO 100 D; ORIENT 168D TO 172 D; ORIENT 192D TO 198 D; ORIENT 219D TO 223 D; ORIENT 268D TO 270 D; ORIENT 276D TO 280 D; ORIENT 348D TO 352 D

Comments: WISE 04102+15024

Patterns

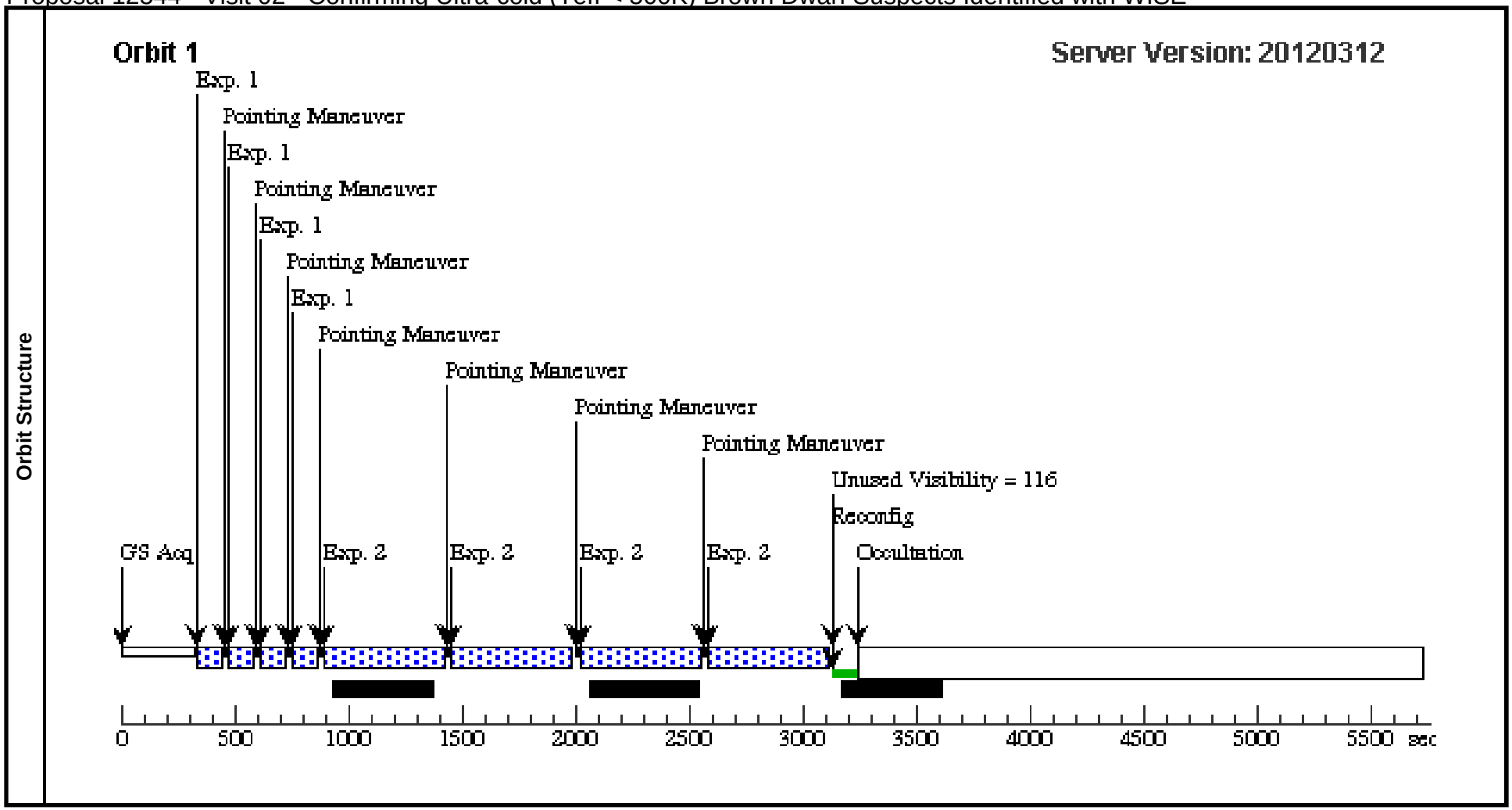
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	WISE04102+15024	RA: 04 10 22.7200 (62.5946667d) Dec: +15 02 48.55 (15.04682d) Equinox: J2000		V=(?) J=19.5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F140W Imaging	(2) WISE04102+15024	WFC3/IR, MULTIACCUM, GRISM1024	F140W	SAMP-SEQ=SPARS25; NSAMP=4		Pattern 1, Exps 1-1 in Visit 02 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	G141 spectroscopy	(2) WISE04102+15024	WFC3/IR, MULTIACCUM, GRISM1024	G141	SAMP-SEQ=SPARS50; NSAMP=11		Pattern 1, Exps 2-2 in Visit 02 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20120312
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 116
Reconfig
GS Acq
Exp. 2
Exp. 2
Exp. 2
Exp. 2
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12544, Visit 03, implementation Wed Mar 21 01:10:03 GMT 2012

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 8D TO 12 D; ORIENT 37D TO 46 D; ORIENT 71D TO 74 D; ORIENT 81D TO 85 D; ORIENT 149D TO 152 D; ORIENT 188D TO 192 D; ORIENT 217D TO 226 D; ORIENT 251D TO 254 D; ORIENT 261D TO 265 D; ORIENT 329D TO 332 D

Comments: WISE 09430+36072

Patterns

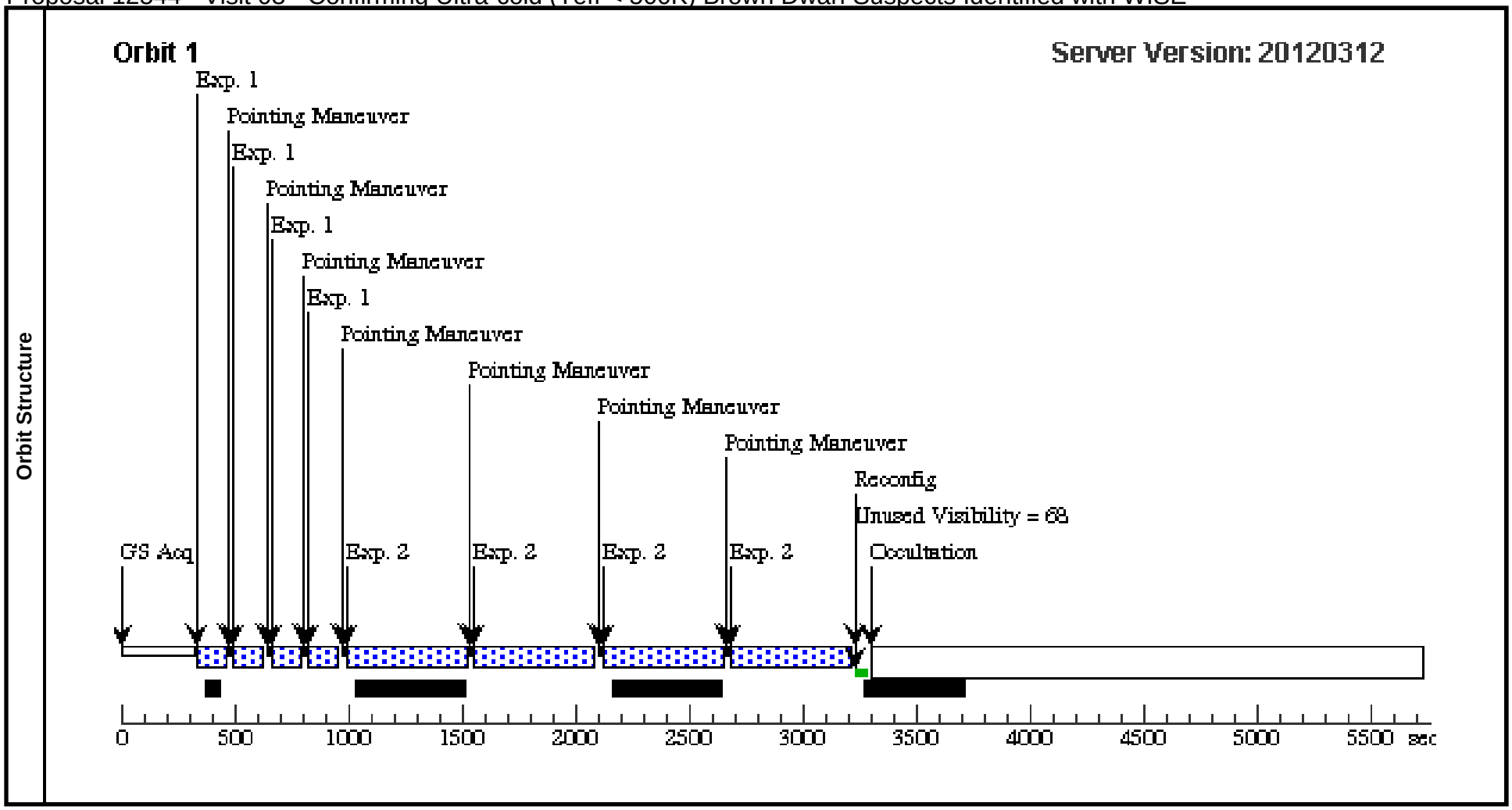
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	WISE09430+36072	RA: 09 43 5.9900 (145.7749583d) Dec: +36 07 23.55 (36.12321d) Equinox: J2000		V=(?) J=19.8	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F140W imaging	(4) WISE09430+36072	WFC3/IR, MULTIACCUM, GRISM1024	F140W	SAMP-SEQ=SPARS25; NSAMP=5		Pattern 1, Exps 1-1 in Visit 03 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	G141 spectroscopy	(4) WISE09430+36072	WFC3/IR, MULTIACCUM, GRISM1024	G141	SAMP-SEQ=SPARS50; NSAMP=11		Pattern 1, Exps 2-2 in Visit 03 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20120312
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Reconfig
Unused Visibility = 68
GS Acq
Exp. 2
Exp. 2
Exp. 2
Exp. 2
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12544, Visit 04, implementation Wed Mar 21 01:10:04 GMT 2012

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 13D TO 15 D; ORIENT 40D TO 41 D; ORIENT 46D TO 47 D; ORIENT 51D TO 52 D; ORIENT 135D TO 136 D; ORIENT 141D TO 142 D; ORIENT 193D TO 195 D; ORIENT 220D TO 221 D; ORIENT 226D TO 227 D; ORIENT 231D TO 232 D; ORIENT 315D TO 316 D; ORIENT 321D TO 322 D

Comments: WISE 22094+27114

Patterns

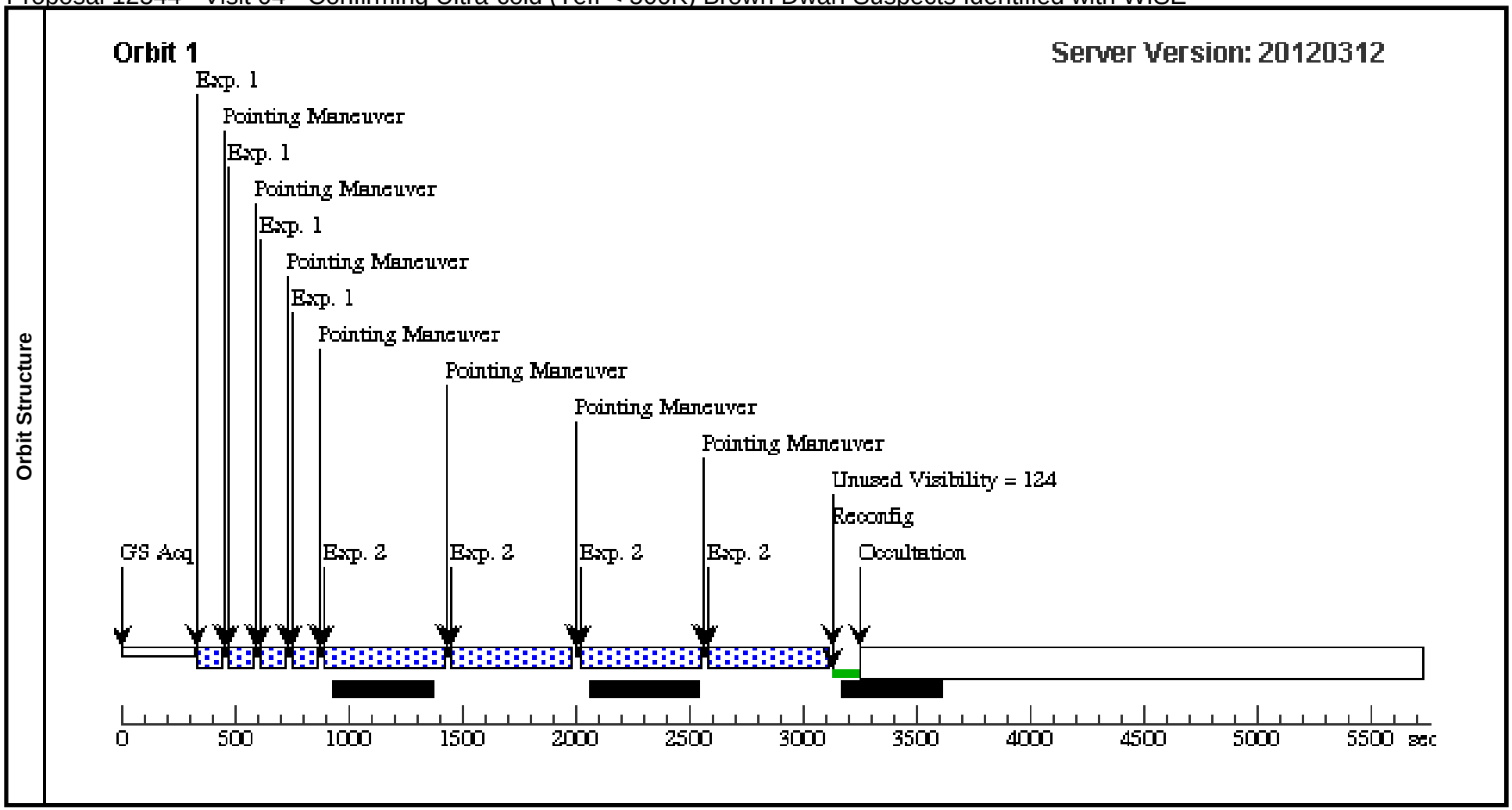
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WISE22096+27114	RA: 22 09 5.7300 (332.2738750d) Dec: +27 11 44.00 (27.19556d) Equinox: J2000		V=(?) J=19.6	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F140W imaging	(1) WISE22096+27114	WFC3/IR, MULTIACCUM, GRISM1024	F140W	SAMP-SEQ=SPARS25; NSAMP=4		Pattern 1, Exps 1-1 in Visit 04 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	G141 spectroscopy	(1) WISE22096+27114	WFC3/IR, MULTIACCUM, GRISM1024	G141	SAMP-SEQ=SPARS50; NSAMP=11		Pattern 1, Exps 2-2 in Visit 04 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20120312
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 124
Reconfig
GS Acq
Exp. 2
Exp. 2
Exp. 2
Exp. 2
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec