12232 - Detection and Mass Measurement of an Isolated Brown Dwarf

Cycle: 18, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. David P. Bennett (PI)	**University of Notre Dame**	**bennett@nd.edu**
Dr. Michael C. Liu (CoI)	University of Hawaii	mliu@ifa.hawaii.edu
Mr. Trent J. Dupuy (CoI)	University of Hawaii	tdupuy@ifa.hawaii.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) MACHO-179-A	WFC3/IR	2	28-Jun-2010 21:16:16.0	yes
02	(1) MACHO-179-A	WFC3/IR	2	28-Jun-2010 21:16:27.0	yes

4 Total Orbits Used

ABSTRACT

We propose observations that are likely to detect the brown dwarf lens object for microlensing event MACHO-179-A, which was observed observed by the MACHO collaboration some 15 years ago. The strong microlensing parallax signal seen in the light curve and follow-up Keck adaptive optics images

imply that the lens is a brown dwarf within about 300 parsecs. If the lens object is at least as massive as 0.015 Solar masses at an age of 1 Gyr or 0.03 Solar masses at an age of 10 Gyr, these observations will detect the lens and measure its relative lens-source proper motion. The relative proper motion can be combined with the microlensing parallax measurement and a precise WFC3/UVIS measurement of the source star brightness to yield a mass measurement of the source star to 3% or better.

OBSERVING DESCRIPTION

We propose WFC3/IR observations in two visits of two orbits each separated by about six months. If the source is not extremely faint, these should yield a parallax measurement for the brown dwarf. This should provide confirmation of our understanding of the microlensing event because the distance to the brown dwarf lens is also determined by eq. 2 of the phase 1 proposal.

In order to maximize our photometric and astrometric sensitivity we seek dithered observations with as many pointings as possible and as many reads as possible without triggering the inefficiency of serial buffer dumps. This leads to the choice of the SPARS25 observing sequence with NSAMP = 15, which have a duration of 352.9 seconds, which is just enough to allow parallel buffer dumps. In two orbits, we have time for 14 SPARS25, SAMP = 15, observing sequences, so request 2 sets of 4-point box dither patterns in the F127M passband and one 4-point box dither pattern plus a 2-point line dither pattern in the F110W passband.

If our brown dwarf target is > 0.04M or is relatively young, then the F110W observations will provide a greater S/N than the F127M observations, but if the brown dwarf is near our proposed magnitude limit, then the F127M observations will provide a higher S/N than F110W. This would be true for an isolated brown dwarf, but the mass-distance relation implied by eqs. 1 and 2 (of the phase 1 proposal) implies that a faint brown dwarf will be slightly less than 0.4 away from the source, and this means that the PSF wing of the source star image will interfere with the detection of the brown dwarf. However, with the F127M filter, the source star-brown dwarf contrast is improved by a factor of ~ 6, and the background from the source star at a distance of 0.38 is well below the background from other sources. As a result, we are able to detect a J = 26.5 brown dwarf lens at a S/N ~ 6.

Visit

Proposal 12232, Visit 01 Tue Jun 29 01:16:33 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: BETWEEN 04-SEP-2010:00:00:00 AND 16-OCT-2010:23:59:59

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)
(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		(3)

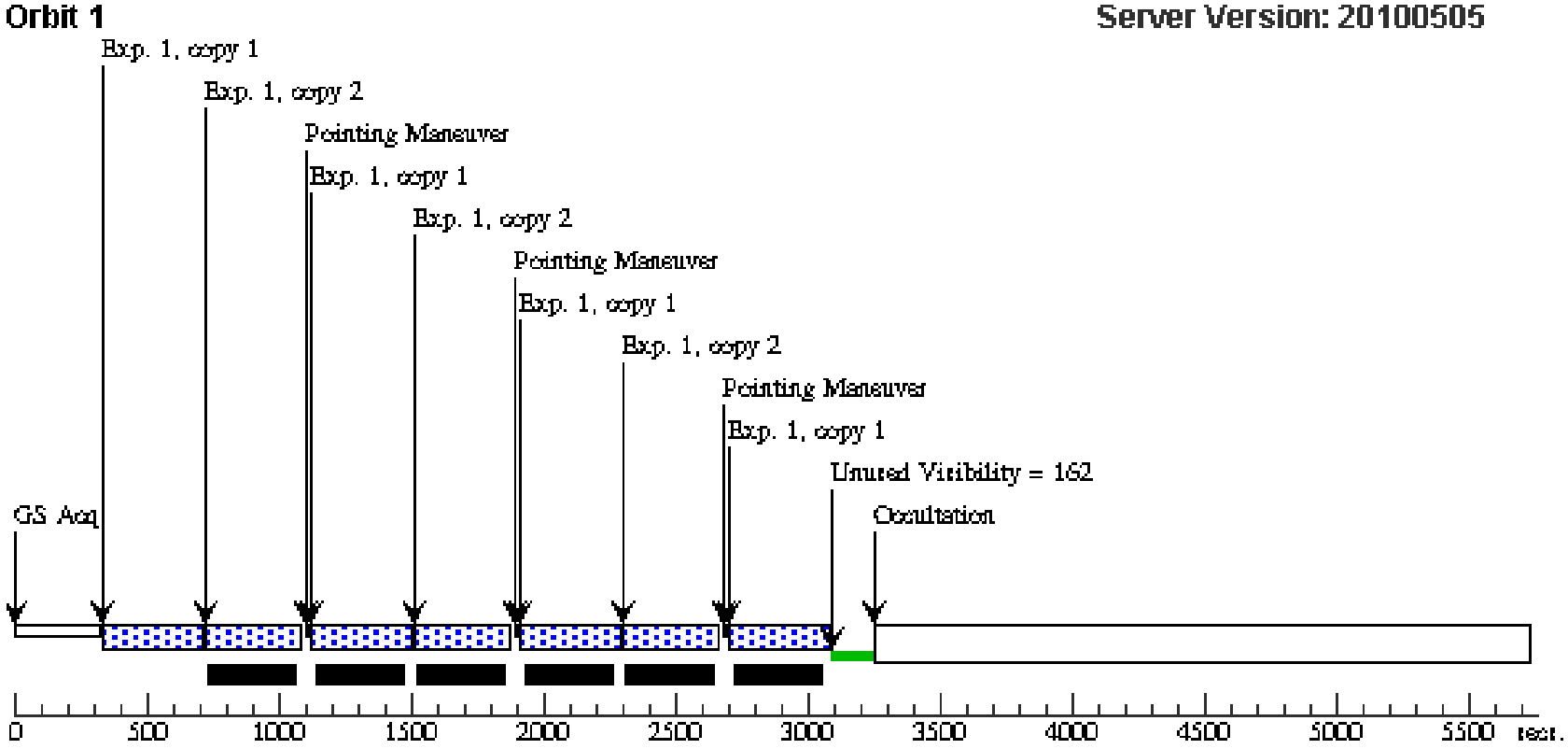
Fixed Targets

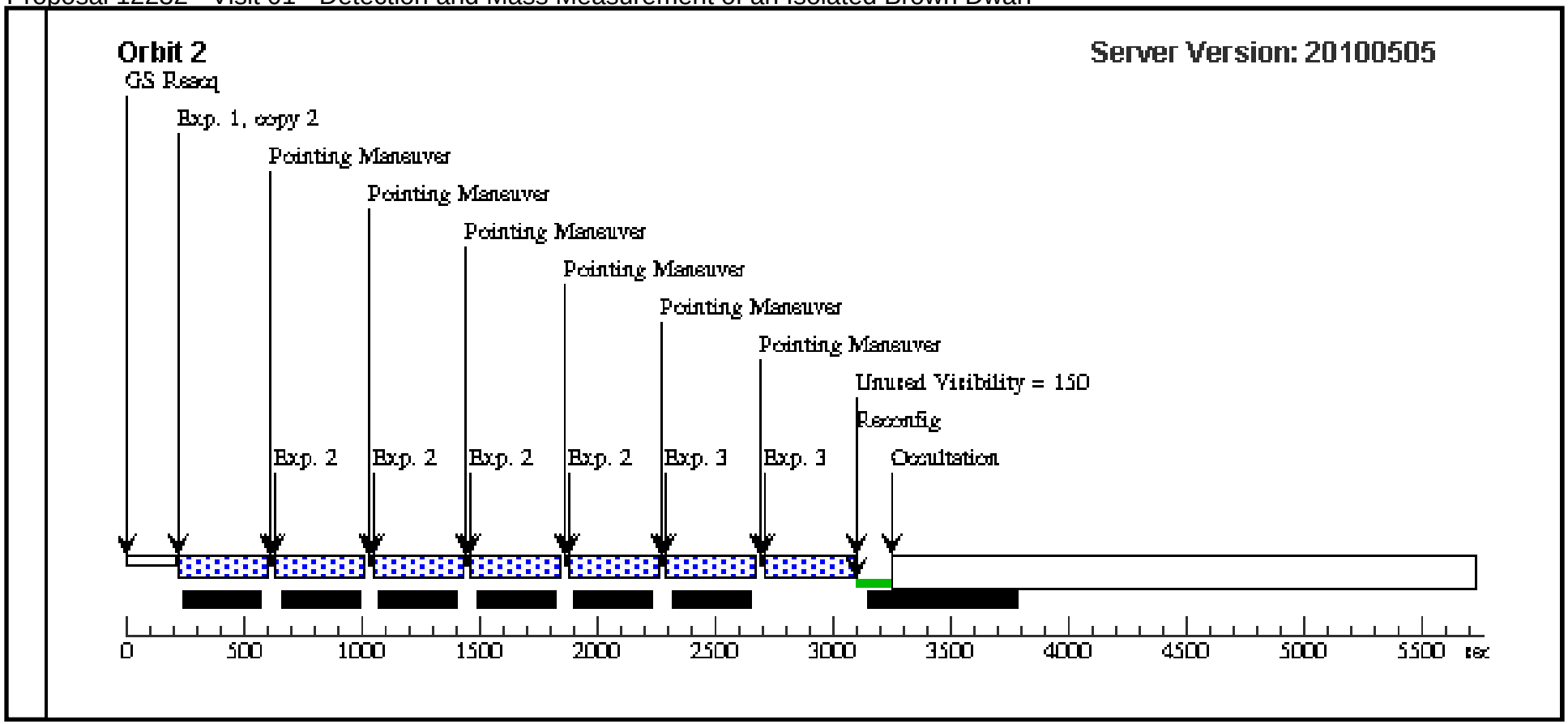
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	MACHO-179-A	RA: 18 08 58.4150 (272.2433958d) Dec: -26 08 7.58 (-26.13544d) Equinox: J2000		V=21.63+/-0.05 R = 20.38 +/- 0.05	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) MACHO-179-A	WFC3/IR, MULTIACCUM, IR	F127M	SAMP-SEQ=SPARS 25; NSAMP=15		Pattern 1, Exps 1-1 (1)	*[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 3, Copy 1)]* *[==>(Pattern 3, Copy 2)]* *[==>(Pattern 4, Copy 1)]*	***[1]***
								[==>(Pattern 4, Copy 2)]	***[2]***
2		(1) MACHO-179-A	WFC3/IR, MULTIACCUM, IR	F110W	SAMP-SEQ=SPARS 25; NSAMP=15		Pattern 1, Exps 2-2 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
3		(1) MACHO-179-A	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=15; SAMP-SEQ=SPAR S25		Pattern 2, Exps 3-3 (2)	*[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[2]***

Orbit Structure




Orbit 2
Server Version: 20100505
GS Reacq
Exp. 1, copy 2
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 150
Reconfig
Exp. 2
Exp. 2
Exp. 2
Exp. 2
Exp. 3
Exp. 3
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 12232, Visit 02 Tue Jun 29 01:16:34 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: BETWEEN 28-FEB-2011:00:00:00 AND 10-APR-2011:23:59:59

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
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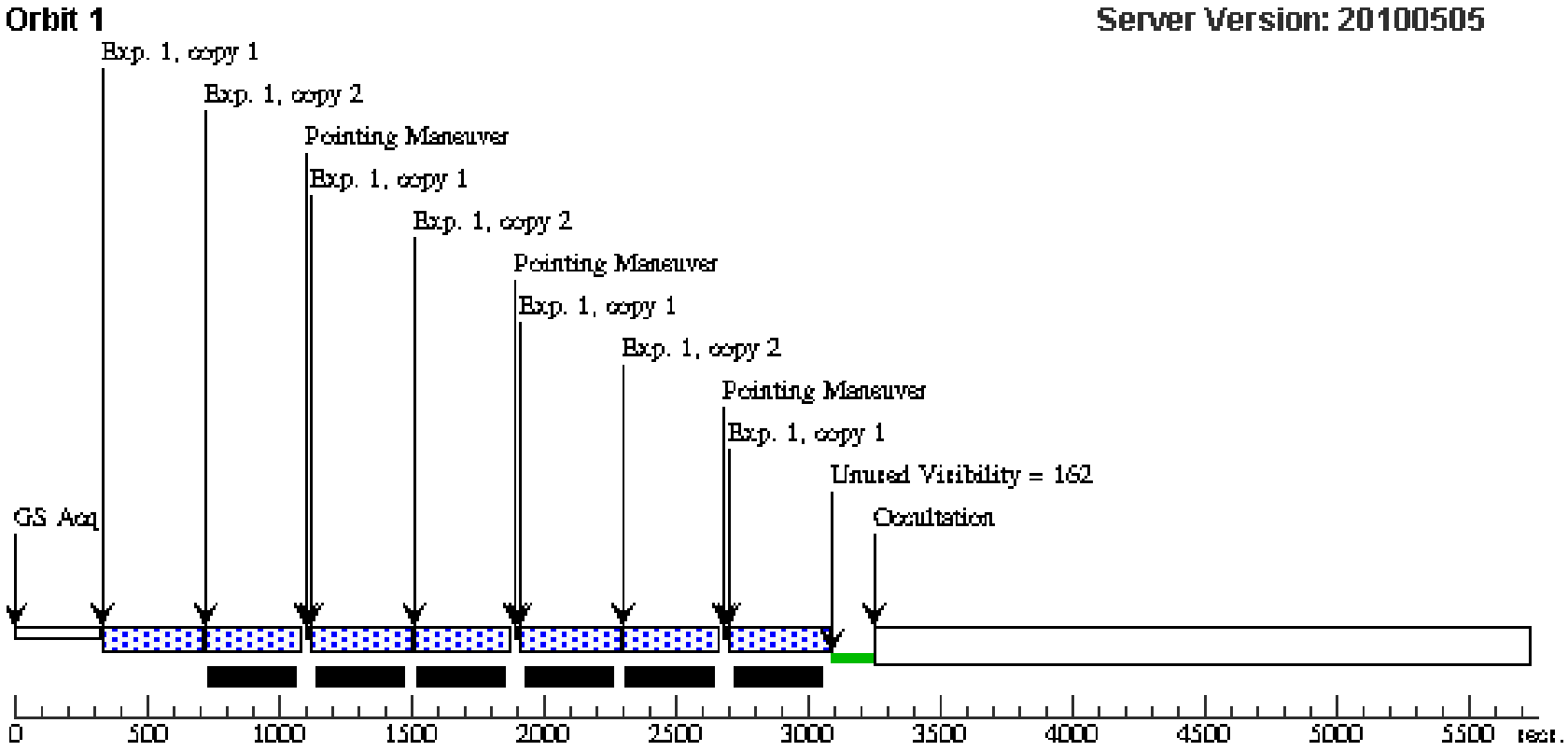
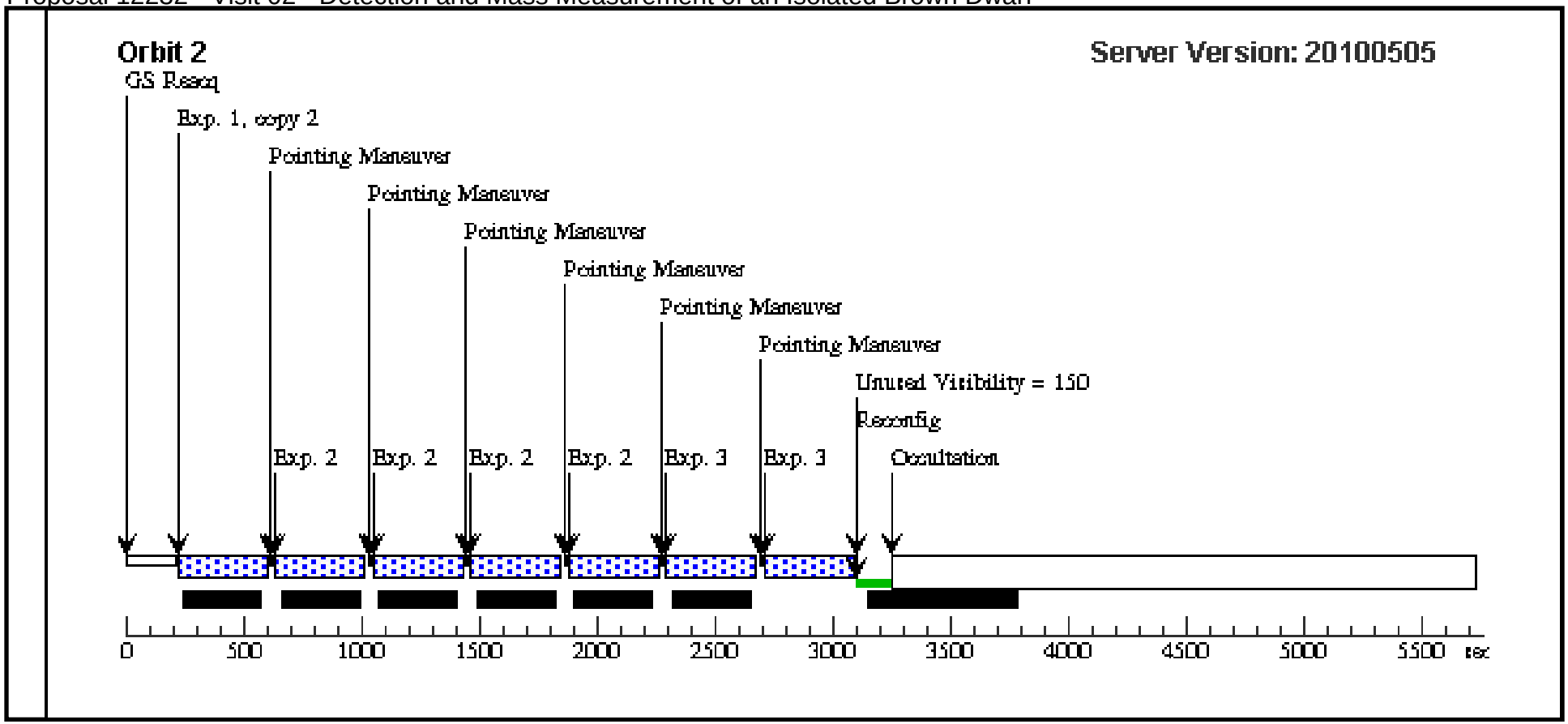
Orbit Structure




Orbit 2
Server Version: 20100505
GS Reacq
Exp. 1, copy 2
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 150
Reconfig
Exp. 2
Exp. 2
Exp. 2
Exp. 2
Exp. 3
Exp. 3
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec