11672 - Microlensing of the Broad Line Region in the Most Anomalous Lensed Quasar

Cycle: 17, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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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) SDSS-J0924+0219-IMG-A	STIS/CCD	1	14-Jul-2009 21:16:13.0	yes
02	(1) SDSS-J0924+0219-IMG-A	STIS/CCD	1	14-Jul-2009 21:16:17.0	yes
03	(1) SDSS-J0924+0219-IMG-A	STIS/CCD	1	14-Jul-2009 21:16:20.0	yes
04	(2) SDSS-J0924+0219-IMG-A-OFFSET (3) SDSS-J0924+0219-GAL	STIS/CCD	1	14-Jul-2009 21:16:24.0	yes

4 Total Orbits Used

ABSTRACT

The gravitationally lensed quasar SDSS J0924+0219 has highly anomalous flux ratios: image D is more than a factor of 10 fainter than expected if the lens galaxy has a smooth mass distribution. From previous HST spectra (Keeton et al. 2006) and photometric variability (Morgan et al. 2006) we

know the anomalous continuum flux ratios are caused by microlensing by stars in the lens galaxy. However, with existing data we do not know whether the anomalous emission line flux ratios are caused by microlensing by stars or millilensing by dark matter clumps. With just four orbits we can measure spectra at two more epochs and determine unambiguously whether the quasar's broad line region (BLR) is microlensed. If the emission line flux ratios vary, that would prove the BLR is microlensed and make SDSS0924 only the second known quasar with microlensing of an optical broad emission line. In this case we would be able to constrain the BLR size and and relative densities of stars and dark matter in the lens galaxy. Conversely, if the emission line flux ratios do not vary, that would prove the BLR is millilensed rather than microlensed, and make SDSS0924 the first lens known to have both microlensing (of the continuum) and millilensing (of the BLR). This would usher in a new and rich field of multiscale lensing. The conclusions about small-scale structure in galaxies and quasars will be exciting in either case. This experiment is infeasible with ground-based telescopes, but with HST it is easy and fast to make this powerful test of small-scale structure in SDSS0924.

OBSERVING DESCRIPTION

Our target, SDSS 0924+0219, is a strong gravitational lens system featuring four images of a background quasar surrounding a foreground early-type galaxy. Our goal is to determine whether and how the spectra of the quasar images vary with time. In May 2005 we obtained dispersed images of our target using ACS/HRC with the sapphire prism PR200L (program GO-9854). With proposal 11672 we were approved to repeat those observations to look for spectral variability, but since ACS/HRC is no longer available we now propose to switch to STIS. With the G430L grating we will obtain wavelength coverage that matches well with our previous observations and provides significantly improved spectral resolution. In three of the orbits we will place a longslit over the lensed images A and D in order to obtain simultaneous spectra of the two most important quasar images. In the fourth orbit we will shift the slit to obtain a spectrum of the lens galaxy, in order to remove any galaxy contamination of the quasar spectra. We specify ORIENT constraints in order to get both quasar images in the slit, and use the same constraints when observing the galaxy in order to enable accurate subtraction. (Note that we are principally interested in flux ratios between the quasar images, so precise absolute calibration across epochs is not essential.)

Visit

Proposal 11672, Visit 01, pi Wed Jul 15 01:16:27 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: ORIENT 352.6D TO 354.3 D; GROUP 01,02,03,04 WITHIN 14D

Patterns

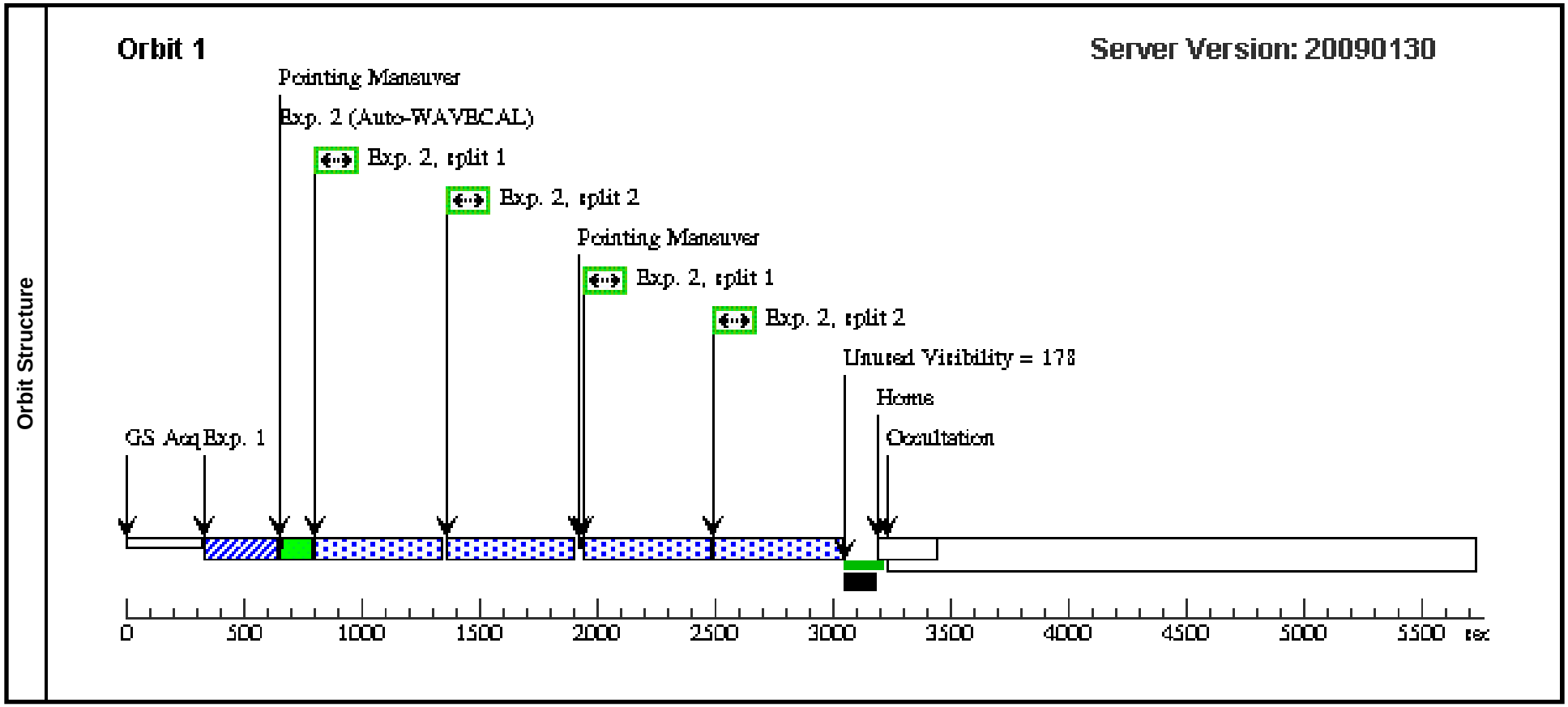
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=0.48241	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSS-J0924+0219-IMG-A	RA: 09 24 55.8293 (141.2326221d) Dec: +02 19 25.36 (2.32371d) Equinox: J2000		V=19.6+/-0.5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) SDSS-J0924+0219-IMG-A	STIS/CCD, ACQ, F28X50LP	MIRROR				20 Secs *[==>]*	*[1]*
2		(1) SDSS-J0924+0219-IMG-A	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A	CR-SPLIT=2		Pattern 1, Exps 2-2 (1)	1020 Secs *[==>(Pattern 1, Split 1)]* *[==>(Pattern 1, Split 2)]* *[==>(Pattern 2, Split 1)]* *[==>(Pattern 2, Split 2)]*	*[1]*


Orbit Structure
Orbit 1
Server Version: 20090130
Pointing Maneuver
Exp. 2 (Auto-WAVECAL)
Exp. 2, split 1
Exp. 2, split 2
Pointing Maneuver
Exp. 2, split 1
Exp. 2, split 2
Unused Visibility = 178
Homs
Occultation
GS Acq
Exp. 1
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 11672, Visit 02, pi Wed Jul 15 01:16:28 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: ORIENT 352.6D TO 354.3 D

Patterns

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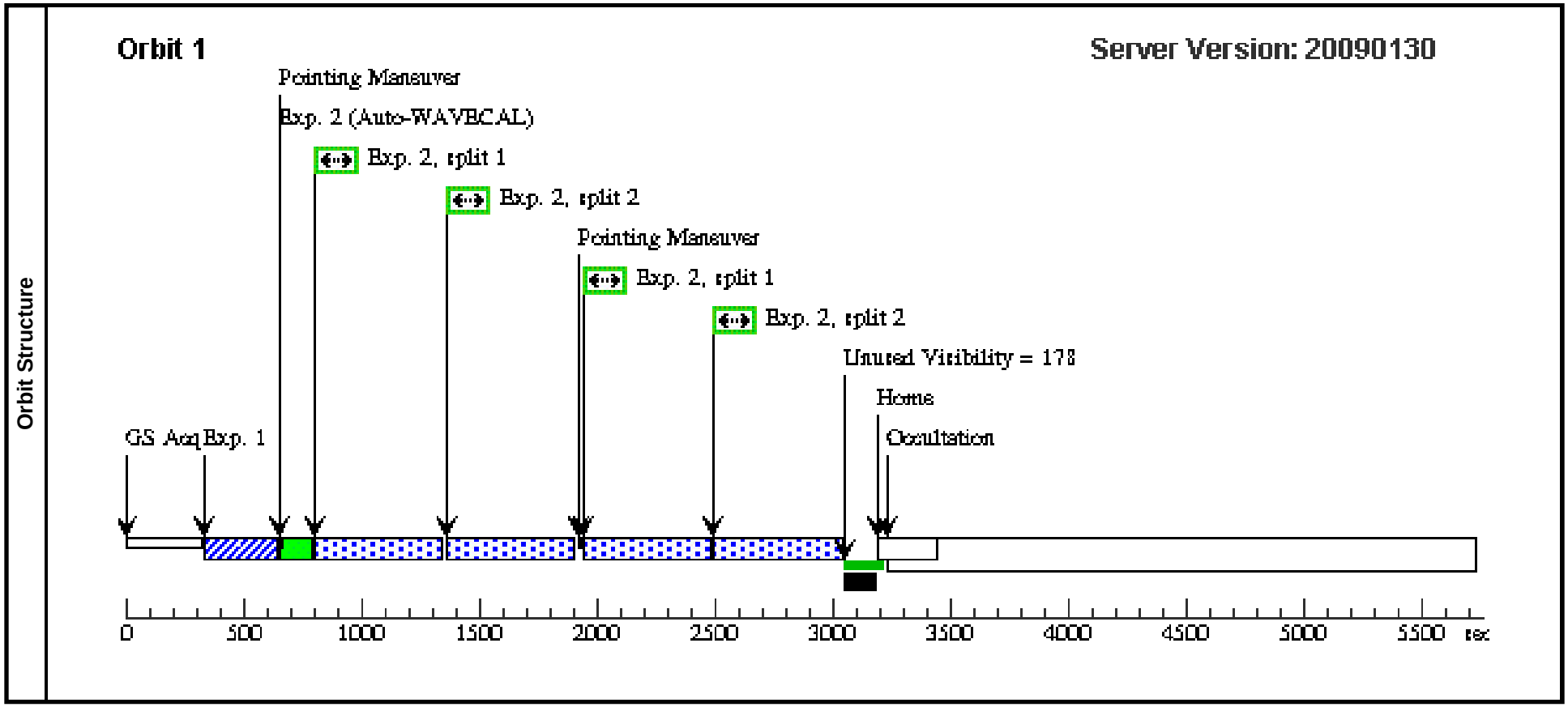
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=0.48241	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSS-J0924+0219-IMG-A	RA: 09 24 55.8293 (141.2326221d) Dec: +02 19 25.36 (2.32371d) Equinox: J2000		V=19.6+/-0.5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) SDSS-J0924+0219-IMG-A	STIS/CCD, ACQ, F28X50LP	MIRROR				20 Secs *[==>]*	*[1]*
2		(1) SDSS-J0924+0219-IMG-A	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A	CR-SPLIT=2		Pattern 1, Exps 2-2 (1)	1020 Secs *[==>(Pattern 1, Split 1)]* *[==>(Pattern 1, Split 2)]* *[==>(Pattern 2, Split 1)]* *[==>(Pattern 2, Split 2)]*	*[1]*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Server Version: 20090130
Pointing Maneuver
Exp. 2 (Auto-WAVECAL)
Exp. 2, split 1
Exp. 2, split 2
Pointing Maneuver
Exp. 2, split 1
Exp. 2, split 2
Unused Visibility = 178
Homs
Occultation
GS Acq
Exp. 1
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 11672, Visit 03, pi Wed Jul 15 01:16:28 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: ORIENT 352.6D TO 354.3 D

Patterns

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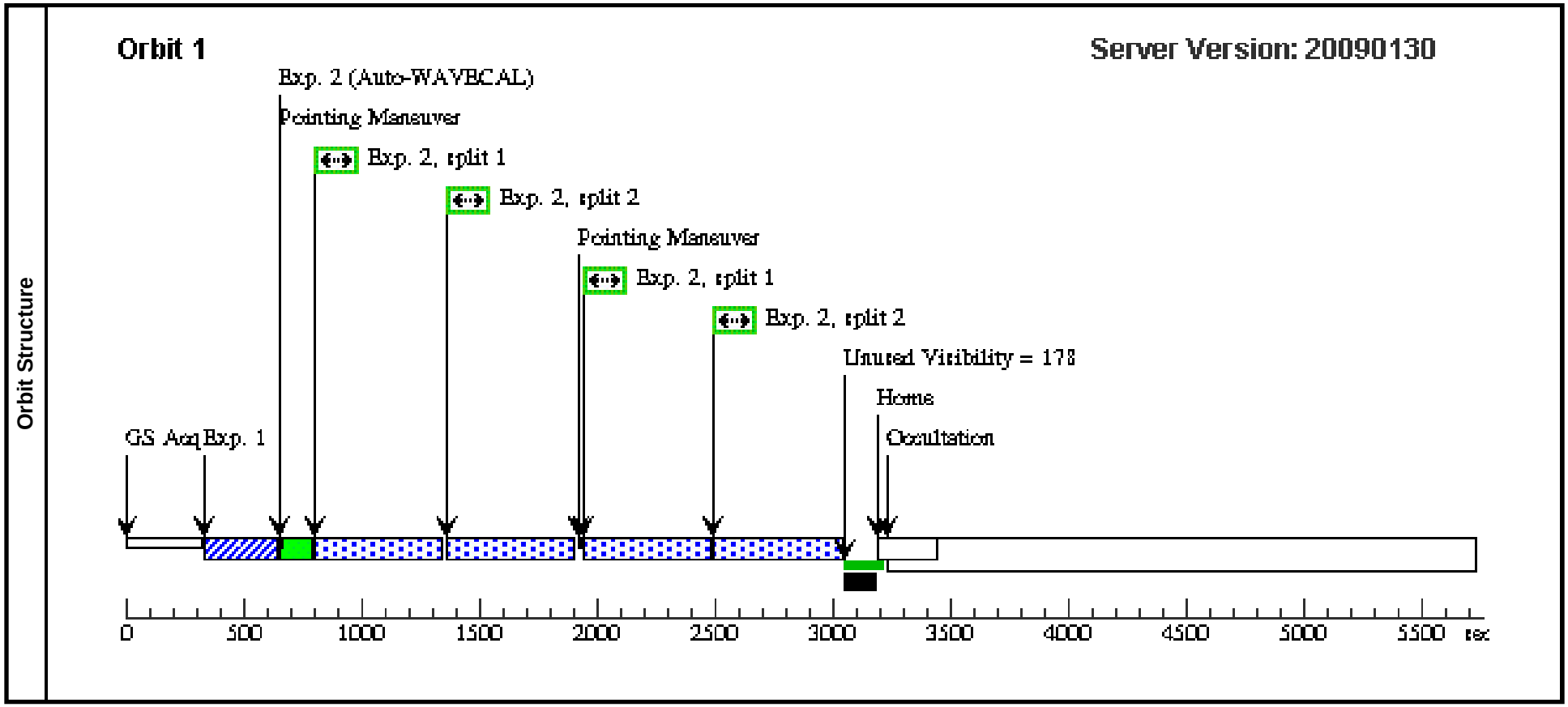
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=0.48241	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSS-J0924+0219-IMG-A	RA: 09 24 55.8293 (141.2326221d) Dec: +02 19 25.36 (2.32371d) Equinox: J2000		V=19.6+/-0.5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) SDSS-J0924+0219-IMG-A	STIS/CCD, ACQ, F28X50LP	MIRROR				20 Secs *[==>]*	*[1]*
2		(1) SDSS-J0924+0219-IMG-A	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A	CR-SPLIT=2		Pattern 1, Exps 2-2 (1)	1020 Secs *[==>(Pattern 1, Split 1)]* *[==>(Pattern 1, Split 2)]* *[==>(Pattern 2, Split 1)]* *[==>(Pattern 2, Split 2)]*	*[1]*


Orbit Structure
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Server Version: 20090130
Exp. 2 (Auto-WAVECAL)
Pointing Maneuver
Exp. 2, split 1
Exp. 2, split 2
Pointing Maneuver
Exp. 2, split 1
Exp. 2, split 2
Unused Visibility = 178
Home
Occultation
GS Acq
Exp. 1
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 11672, Visit 04, pi Wed Jul 15 01:16:29 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: ORIENT 352.6D TO 354.3 D

Patterns

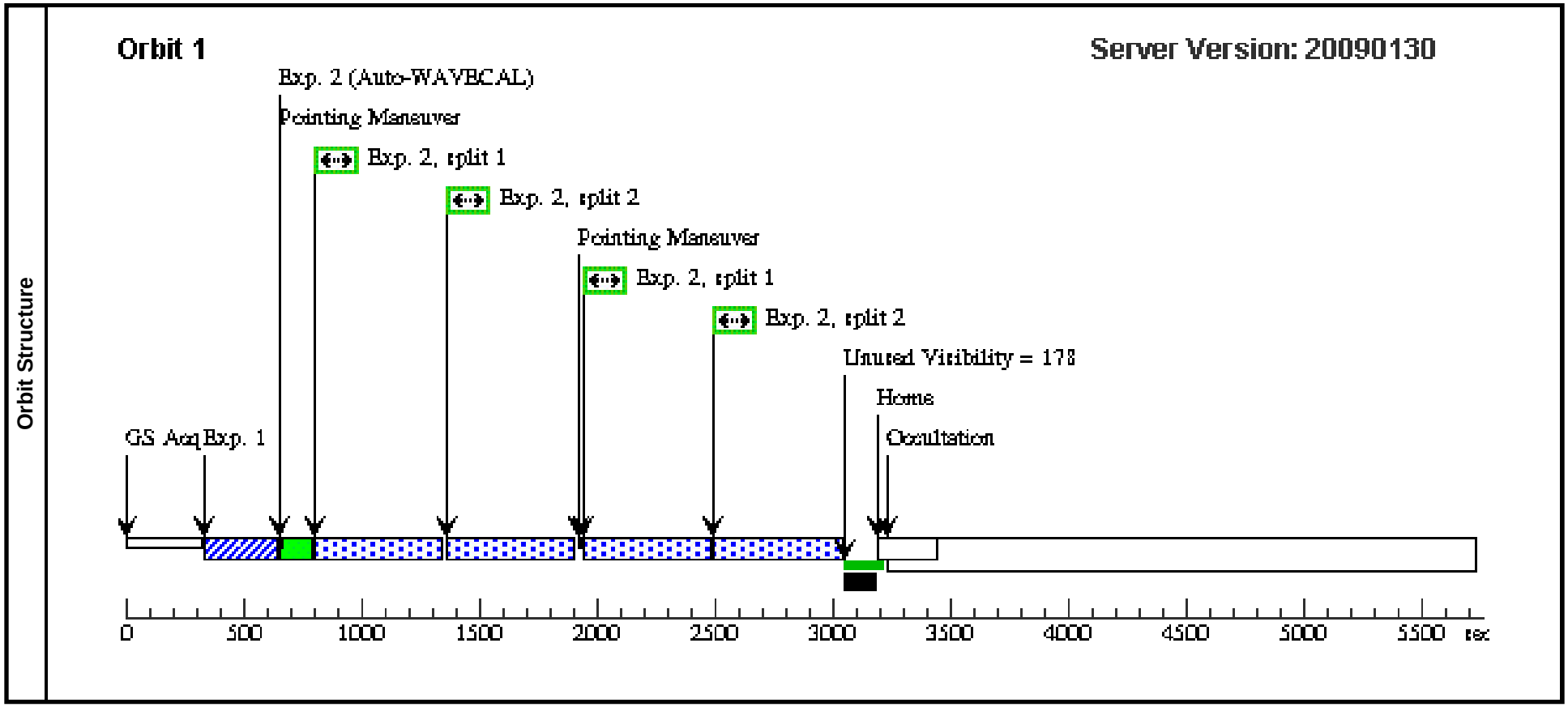
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=0.48241	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SDSS-J0924+0219-IMG-A-OFFSET	RA: 09 24 55.8293 (141.2326221d) Dec: +02 19 25.36 (2.32371d) Equinox: J2000		V=19.6+/-0.5	Reference Frame: ICRS
(3)	SDSS-J0924+0219-GAL	Offset from SDSS-J0924+0219-IMG-A-OFFSET by RA Offset: -0.012 Secs Dec Offset: -0.8685 Arcsec		V=22.7+/-0.5	Offset Position (SDSS-J0924+0219-GAL) Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(2) SDSS-J0924+0219-IMG-A-OFFSET	STIS/CCD, ACQ, F28X50LP	MIRROR				20 Secs	
								[==>]	***[1]***
2		(3) SDSS-J0924+0219-GAL	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A	CR-SPLIT=2		Pattern 1, Exps 2-2 (1)	1020 Secs	
								[==>(Pattern 1, Split 1)] *[==>(Pattern 1, Split 2)]* *[==>(Pattern 2, Split 1)]* *[==>(Pattern 2, Split 2)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20090130
Exp. 2 (Auto-WAVECAL)
Pointing Maneuver
Exp. 2, split 1
Exp. 2, split 2
Pointing Maneuver
Exp. 2, split 1
Exp. 2, split 2
Unused Visibility = 178
Home
Occultation
GS Acq
Exp. 1
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec