10812 - Space Motions for the Draco and Sextans Dwarf Spheroidal Galaxies

Cycle: 15, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Slawomir Stanislaw Piatek (PI)	**New Jersey Institute of Technology**	**piatek@physics.rutgers.edu**
Dr. Carlton P. Pryor (CoI)	Rutgers the State University of New Jersey	pryor@physics.rutgers.edu
Dr. Edward W. Olszewski (CoI)	University of Arizona	edo@as.arizona.edu
Dr. Mario L. Mateo (CoI)	University of Michigan	mateo@astro.lsa.umich.edu
Dr. Christopher Tinney (CoI)	Anglo-Australian Observatory	cgt@aaoepp.aao.gov.au

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) SEX-QSO-J1012-0130	WFPC2	3	22-May-2007 21:00:56.0	yes
02	(2) SEX-QSO-J1013-0143	WFPC2	3	22-May-2007 21:01:05.0	yes
03	(3) DRA-QSO-J1721+5758	WFPC2	3	22-May-2007 21:01:12.0	yes
04	(4) DRA-QSO-J1720+5755	ACS/WFC	3	22-May-2007 21:01:27.0	yes
05	(5) DRA-QSO-J1719+5758	WFPC2	3	22-May-2007 21:01:36.0	yes

15 Total Orbits Used

ABSTRACT

We will use the powerful astrometric capabilities of HST to measure proper motions for the Draco and Sextans dwarf spheroidal galaxies that will yield tangential velocities accurate to about 30 km/s. These two galaxies are the last inside a galactocentric radius of 200~kpc without measured proper motions. Knowing their orbits is critical for our understanding of the low-luminosity satellites of the Milky Way. In particular they are critical for understanding why Ursa Minor has survived tidal disruption on its plunging orbit and how Carina formed a large intermediate-age stellar population despite its small mass.

OBSERVING DESCRIPTION

Piatek et al. (2002b; P02) and Piatek et al. (2003) describe our method for deriving proper motions for dSphs with WFPC2 or STIS imaging. In brief, we use images at three epochs of fields which contain a QSO that provides the ?zero-velocity? reference point. This proposal will use the same methods as our previous program, except with ACS, to measure the proper motion of the Draco and Sextans dSphs. Recently, SDSS (Rave et al. 2003) and a member of our original team (Harris & Munn 2003) have independently discovered several QSOs behind Draco. The 2DF team has found QSOs behind Sextans (Croom et al. 2001). We have used these data to select QSOs that are within or just slightly beyond the core radius and have magnitudes fainter than 19.8. Both of these conditions are required to ensure enough stars belonging to the dSph in the field with adequate S/N. This yields three fields in Draco and two in Sextans. Unfortunately, no field contains more than one QSO. Multiple fields both reduce the final uncertainty by averaging the measurements and provide critical checks on the accuracy the proper motions. If the multiple measurements do not agree within their uncertainties, then something is wrong. Three fields potentially allows the rejection of one discrepant measurement.

We will observe each field in each of cycles 13, 14, and 15. Having three measurements instead of two again provides a check on discrepant data. The advantage of the checking provided by having multiple fields and epochs is discussed more fully in Piatek et al. (2003). We cannot take more than one epoch per year because of the constraints imposed by the HST roll angle. Our observations at second and later epochs are designed to reproduce the locations on the CCD that the QSO and stars had in the first-epoch. This approach removes errors caused by geometrical distortion in the camera, which alters the apparent separation between a QSO and a star. Such distortion is not characterized accurately enough to simply correct for its effect. We have obtained good results with this approach and so strongly prefer to continue with it for these new observations. P02 shows that applying the above method to observations at three epochs spread over two years in a single field produces a proper motion that is accurate to about 20 milliarcsec/century in each coordinate. Data for three fields in Draco and two in Sextans will yield uncertainties in the tangential velocity, vt, of at most 30 km/s and 35 km/s, respectively.

Observations in cycles 13 and 15 yield our desired two-year baseline. The cancelation of SM4 means that it is somewhat unlikely that HST will still have three-gyro guiding (or even be operating at all) for cycle 15. In these circumstances, our cycle 14 epoch provides insurance that we will obtain proper motions, albeit with uncertainties larger by a factor of two. Our assumed uncertainties are based on our experience of what can be achieved with STIS and WFPC2. It is possible that the larger field and improved throughput of ACS will yield more accurate proper motions. Our improved understanding of how to dither, discussed later in this section, should also produce a small reduction in the final uncertainties. Thus, we feel a result based on a one-year baseline would still be a large improvement over no knowledge of the proper motion at all. If we are granted observing time, we will work with STScI to schedule our first epoch observations as early in cycle 13 as possible. We would also explore the feasibility of using the imaging with an increased jitter in one direction that will result for two-gyro guiding.

Anderson & King (1999, 2003; AK), Kuijken & Rich (2002; KR), P02, and Piatek et al. (2003) have demonstrated that it is possible to measure positions for stars and QSOs accurate to about 0.01 pixel or better using HST and from these to derive a proper motion. All of these studies derive a point-spread function (PSF) which is subsequently used to measure the positions of stars and QSOs. An accurate PSF is essential for deriving accurate positions. Its derivation in undersampled images requires a large number of stars with high S/N (we use S/N > 15) distributed throughout an image. The two features of our work on dSphs that distinguish it from studies of globular clusters (AK) or field stars (KR) are: 1) the dSph fields contain several tens to a few hundred stars compared to thousands or tens of thousands in fields towards a globular cluster and 2) the requirement for the presence of a ?zero-velocity? reference point, a QSO, in the field. Point 1) requires multiple, dithered exposures to increase the sampling of the PSF. Point 2) restricts the number of dSph stars in the fields with adequate S/N because of the requirement that the QSO be unsaturated.

The average magnitudes of the QSOs are in the range V = 18.9 ? 20.5. Our adopted exposure times are conservative to avoid having the variability of the QSO saturate its image. The ideal (conservative) exposure time produces the largest number of stars with S/N > 15 while aiming to keep the brightest QSO pixel about 1/3 of full well. We can often come close to this ideal.
We have opted to use the ACS WFC for the new fields in Draco and Sextans. The rationale for the choice of the ACS WFC over the ACS HRC, which has smaller pixels that better sample the stellar images, is as follows. We use our observations of Ursa Minor with STIS to estimate the number of stars expected and their S/N with different observing strategies? Ursa Minor has a similar stellar density to Draco and Sextans and the QSO in this Ursa Minor field is similar in brightness (V =20) to those in the Draco and Sextans fields. In two CVZ orbits we obtained 6 images at each of 8 dither positions with an exposure time of 176 s each. In a single image, there

are 17 stars with a S/N > 20 (these have a positional uncertainty of 0.05 pixel or less in each coordinate) and 35 stars with a S/N > 10 (uncertainties of 0.1 pixel or less). The ETC shows that ACS HRC with the F606W filter is about as efficient as the unfiltered STIS. However, HRC has only a quarter of the field of view of STIS, so only 4 stars with S/N > 20 are expected to be in the field and this is too few to construct an accurate PSF. Even the unsupported unfiltered mode of HRC would only gain a factor of two in the number of stars (and, in this mode, the PSF is degraded). An exposure time that is four or more times longer might bring the number of stars up to a marginally acceptable level, but the observing strategy described below using ACS WFC is more efficient and will still yield excellent proper motions.

We prefer to use ACS WFC and the F606W or F775 filter over STIS because: 1) It has an 8x larger field (we cannot measure the separation of the two WFC CCDs and so will use the data from just one). 2) It has a more constant PSF across the field (confirmed by Anderson at the last HST Calibration Conference). 3) Its geometrical distortions will be accurately characterized (Jay again). 4) Its throughput is three times larger. 5) Finally, it will probably have fewer damaged pixels. The pixels of the WFC are the same size as those of STIS. The STIS data produce good results, therefore WFC should do so too. The WFC has a larger distortion across the field than STIS does. As was discussed above, placing the stars and QSO on nearly the same pixel at every epoch minimizes the impact of this distortion. This placement requires that all epochs of a given field be taken with the same roll angle of the telescope. The roll angle is not pre-determined, but will become fixed after the first-epoch observations. Although the associated overhead is high, the requirement that stars be placed back on the same pixels is critical.

An exposure time of 340 s with WFC and the F606W filter results in about three times the number of electrons for a comparable star than does the exposure for Ursa Minor using STIS described above. Because of the larger field and higher throughput, such a WFC image will have about 250 stars with S/N > 20 per field in Draco and Sextans. This number of stars is comparable to, or greater than, the largest number of stars which we have achieved with STIS for any dSph. The exposure time of 340 s is just long enough to avoid the serious 5.8-minute overhead per image due to serial buffer dumps. For QSOs brighter than V = 20, we want shorter exposure times to keep the QSO image at 1/3 of full well. In this case, we will switch to a narrower filter, keeping the exposure time as close to 340 s as possible. The brightest QSO in Draco causes the biggest problem ? for this field we will use the F775W filter. This approach is more efficient than incurring the buffer dump overhead. We could reduce the minimum exposure time to avoid the buffer dump by reading out only part of the image (since we will use the data from only 1 chip), but this has its own overhead. Thus, we prefer to change filters, using one WFC chip for astrometry and placing data for both chips in the archive. For the faintest QSOs in our fields, an exposure time of 495 s puts the brightest QSO pixel at 1/3 of full well. To keep the exposures for a single field to 2?3 orbits, we compromise at 400 s. The resulting S/N for the QSO and dSph stars is still higher than those obtained in our Ursa Minor STIS field.

For the exposure times which we use, our experience is that hot pixels corrupt many more pixels than cosmic rays do. We also find it unnecessary to reconstruct cosmic-ray-cleaned images. We fit for the positions of objects in all of the images and simply ignore those instances that are too strongly affected by corrupted pixels. Cosmic-ray splits are useful for identifying cosmic rays, but our software is able to identify corrupted pixels without them. Thus, the dithering between each image will combine integer-pixel offsets -- to reduce the number of instances when an object is lost to hot pixels -- with fractional pixel offsets -- to increase the number of samples of the PSF. This approach produces more independent samples of the image of each QSO or star with fewer images (hence, fewer readout times) than does our previous scheme of 3 images at 8 dither positions used with STIS. Draco is in the CVZ and 18 (21) exposures of length 400 s (340 s) will fit into two orbits. For Sextans, three non-CVZ orbits are enough for 12 - 14 such images. This scheme produces at least 1.5X the number of samples for each object than what we have been getting with STIS. It also obtains at least 20% more electrons per comparable object than the Ursa Minor STIS observations. These ACS observations will require a total of 12 orbits in each cycle -- 2 orbits for each of the 3 Draco fields and 3 orbits for each of the 2 Sextans fields.

In summary, our program will require 12 orbits in cycle 13, 12 orbits in cycle 14, and 12 orbits in cycle 15. The total is 36 orbits spread over the three cycles.

Visit

Proposal 10812, Visit 01, pi Wed May 23 01:01:39 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: PCS MODE FINE

Comments: This visit takes 12 exposures of our SEX-QSO-J1012-0130 field. It uses an 8-point dither pattern consisting of interlaced quartets. The quartets have a side of 2.5 pixels and are offset by 1.25 pixels. 'We do not want exposure times to exceed 350 s because of the possibility of saturating the QSO.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SEX-QSO-J1012-0130	RA: 10 12 43.7000 (153.1820833d) Dec: -01 30 43.00 (-1.51194d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position: Redshift: 1.382	V=20.0	Reference Frame: 2dF QSO survey

Comments: The QSO J1012-0130 is centered in this field. The field also contains stars of the Sextans dwarf spheroidal galaxy.

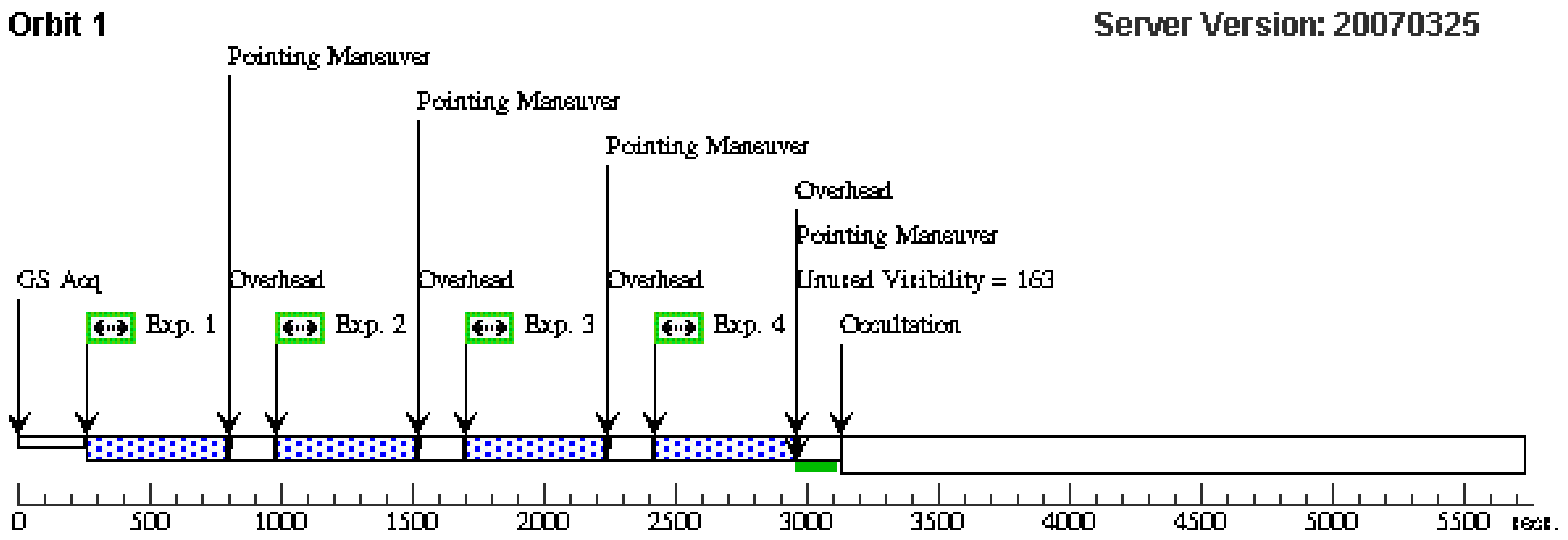
Exposures

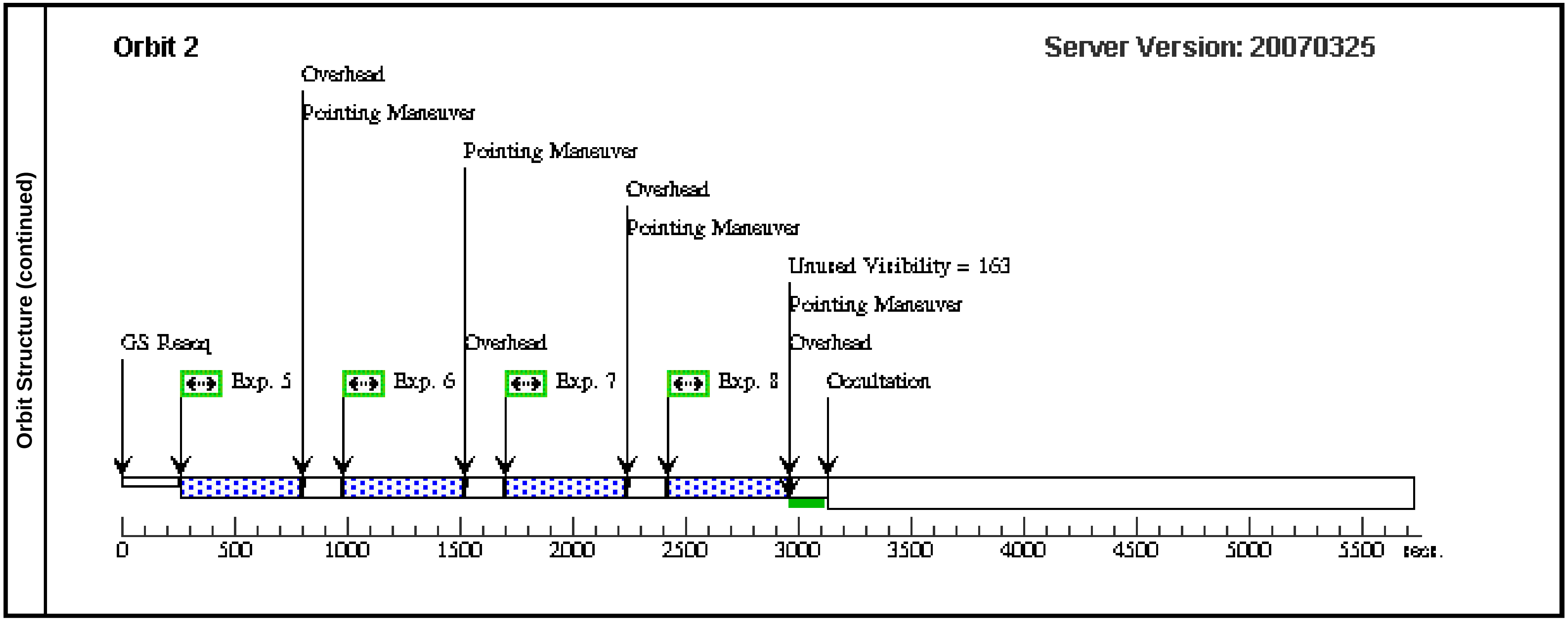
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) SEX-QSO-J1012-0130	WFPC2, IMAGE, PC1	F606W		POS TARG 0.1138,0; EXP PCS MODE FINE; GS ACQ SCENARIO SINGLE		350.0 Secs *[==>]*	*[1]*
2		(1) SEX-QSO-J1012-0130	WFPC2, IMAGE, PC1	F606W		POS TARG 0.1707,0.0569		350.0 Secs *[==>]*	*[1]*
3		(1) SEX-QSO-J1012-0130	WFPC2, IMAGE, PC1	F606W		POS TARG 0.2276,0.1138		350.0 Secs *[==>]*	*[1]*
4		(1) SEX-QSO-J1012-0130	WFPC2, IMAGE, PC1	F606W		POS TARG 0.2845,0.1707		350.0 Secs *[==>]*	*[1]*
5		(1) SEX-QSO-J1012-0130	WFPC2, IMAGE, PC1	F606W		POS TARG 0.2276,0.2276		350.0 Secs *[==>]*	*[2]*
6		(1) SEX-QSO-J1012-0130	WFPC2, IMAGE, PC1	F606W		POS TARG 0.1707,0.1707		350.0 Secs *[==>]*	*[2]*
7		(1) SEX-QSO-J1012-0130	WFPC2, IMAGE, PC1	F606W		POS TARG 0.1138,0.1138		350.0 Secs *[==>]*	*[2]*
8		(1) SEX-QSO-J1012-0130	WFPC2, IMAGE, PC1	F606W		POS TARG 0.0569,0.0569		350.0 Secs *[==>]*	*[2]*
9		(1) SEX-QSO-J1012-0130	WFPC2, IMAGE, PC1	F606W				350.0 Secs *[==>]*	*[3]*
10		(1) SEX-QSO-J1012-0130	WFPC2, IMAGE, PC1	F606W		POS TARG -0.0569,0.0569		350.0 Secs *[==>]*	*[3]*

Exposures (continued)

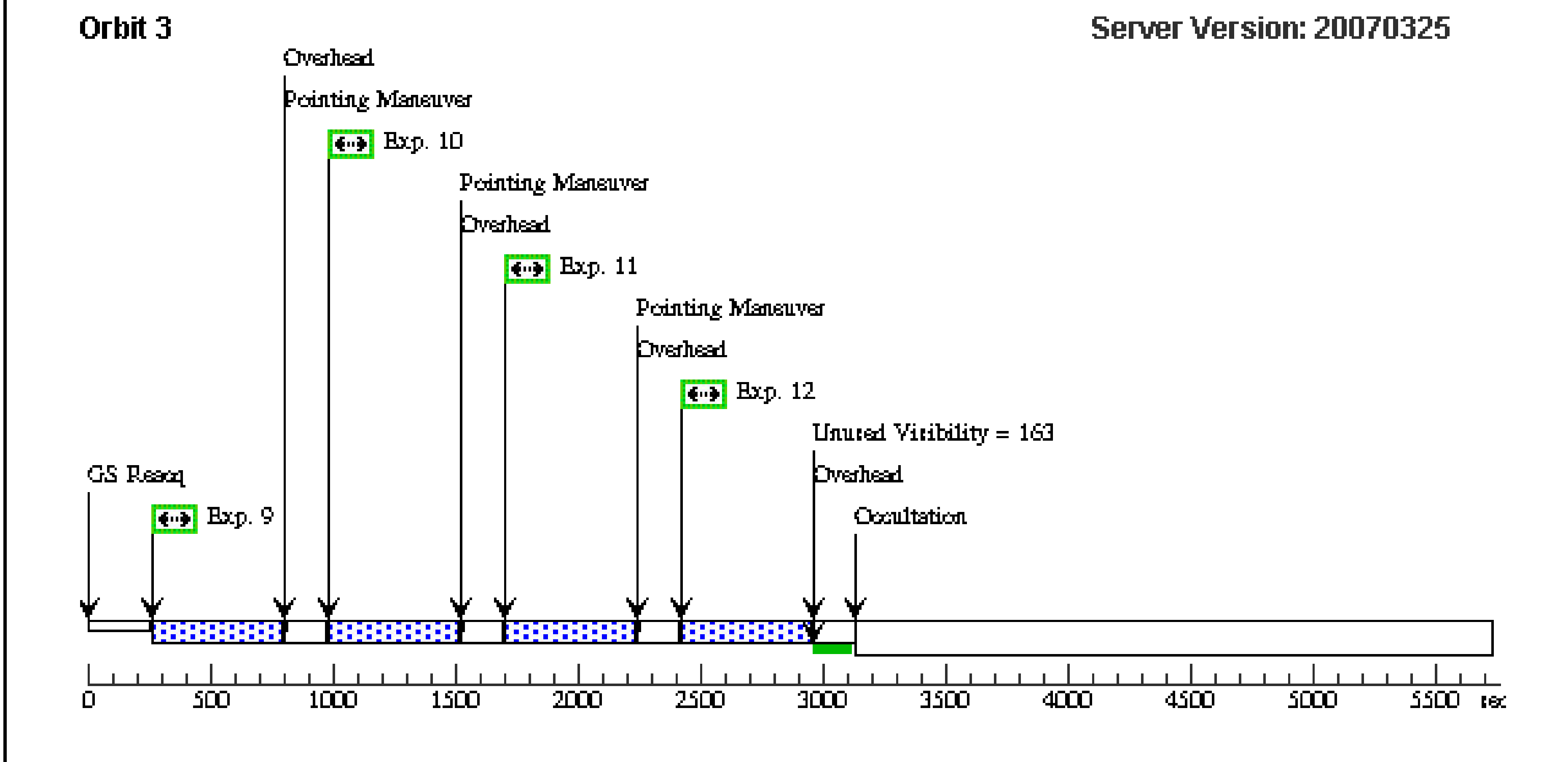
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
11		(1) SEX-QSO-J1012 -0130	WFPC2, IMAGE, PC1	F606W		POS TARG 0,0.1138		350.0 Secs [==>]	[3]
12		(1) SEX-QSO-J1012 -0130	WFPC2, IMAGE, PC1	F606W		POS TARG 0.0569,0 .1707		350.0 Secs [==>]	[3]

Orbit Structure




Orbit Structure (continued)
Orbit 2
Server Version: 20070325
Overhead
Pointing Maneuver
Pointing Maneuver
Overhead
Pointing Maneuver
Unused Visibility = 163
Pointing Maneuver
GS Reacq
Overhead
Overhead
Exp. 5
Exp. 6
Exp. 7
Exp. 8
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.

Orbit Structure (continued)



Visit

Proposal 10812, Visit 02, pi Wed May 23 01:01:41 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: PCS MODE FINE

Comments: This visit takes 9 images of the SEX-QSO-J1013-0143 field. The 8-point dither pattern consists of two interlaced quartets. The quartets have a side of 2.50 pixel and are displaced by 1.25 pixel.

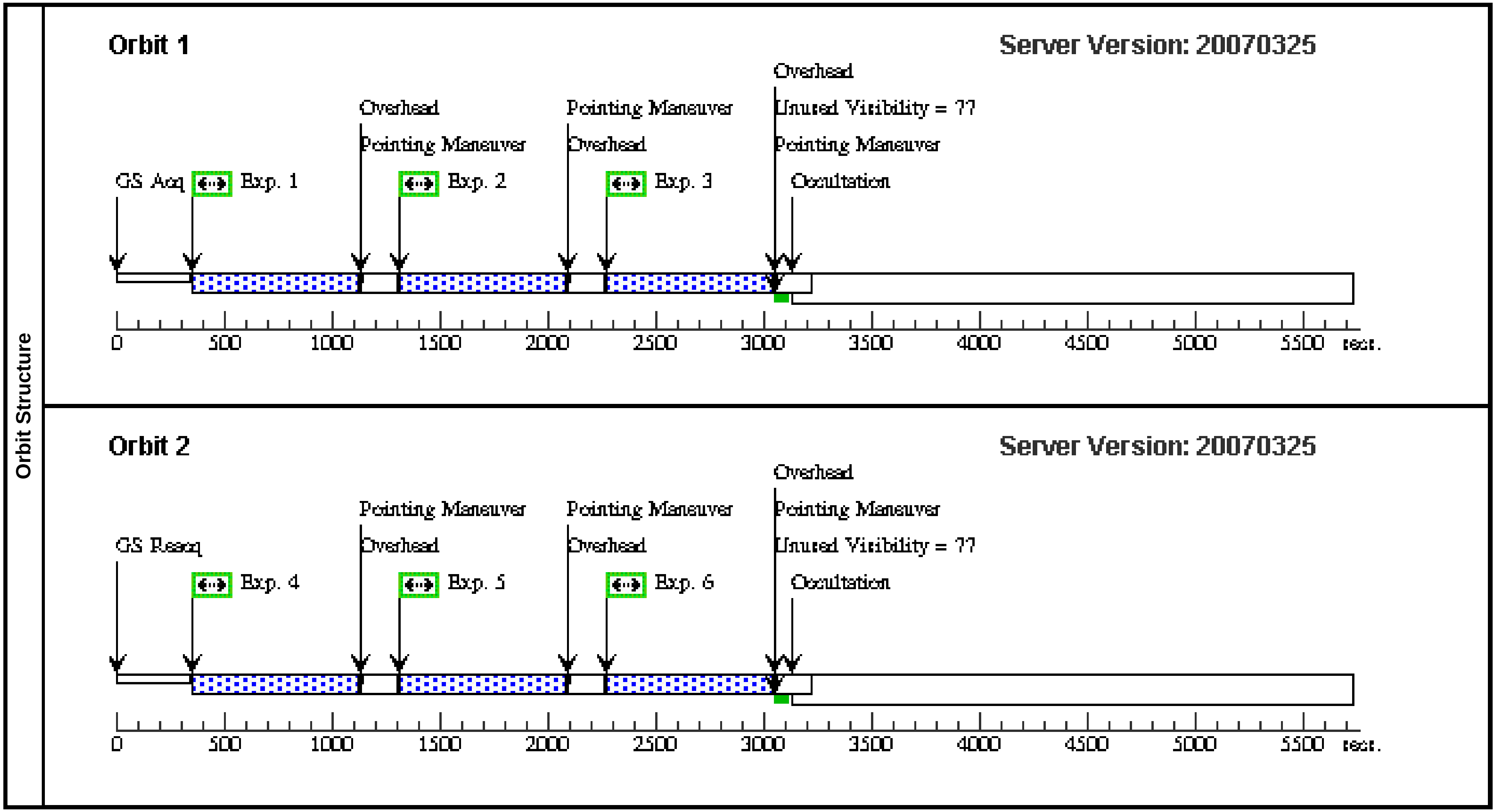
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SEX-QSO-J1013-0143	RA: 10 13 56.1000 (153.4837500d) Dec: -01 43 20.00 (-1.72222d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position: Redshift: 2.117	V=20.67	Reference Frame: 2dF QSO Survey

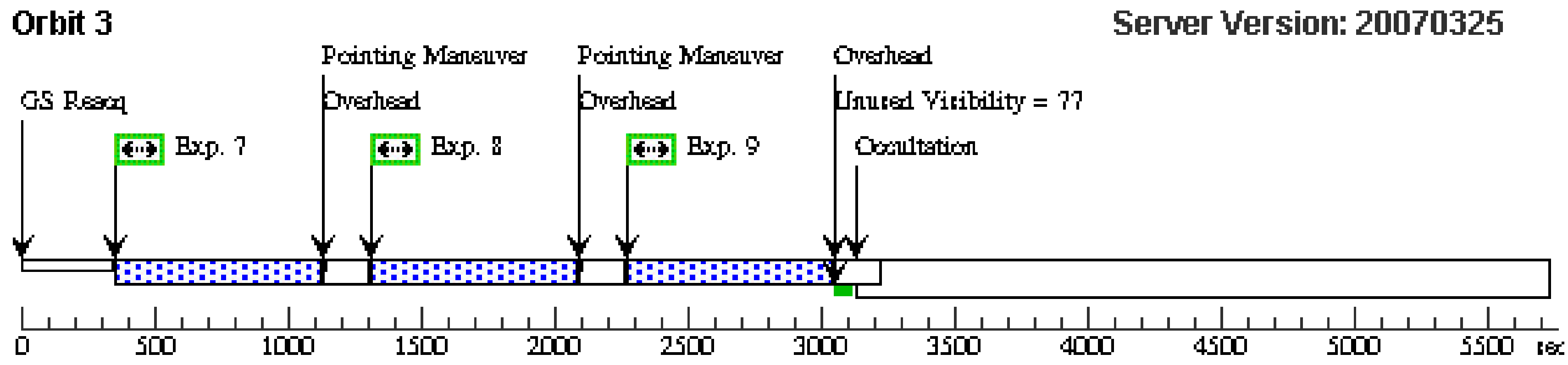
Comments: There is a QSO centered in the field. The field also contains stars of the Sextans dwarf spheroidal galaxy.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(2) SEX-QSO-J1013-0143	WFPC2, IMAGE, PC1	F606W		POS TARG 0.0569,-0.0569		600.0 Secs *[==>600.0 Secs]*	*[1]*
2		(2) SEX-QSO-J1013-0143	WFPC2, IMAGE, PC1	F606W		POS TARG 0.1138,0		600.0 Secs *[==>600.0 Secs]*	*[1]*
3		(2) SEX-QSO-J1013-0143	WFPC2, IMAGE, PC1	F606W		POS TARG 0.1707,0.0569		600.0 Secs *[==>600.0 Secs]*	*[1]*
4		(2) SEX-QSO-J1013-0143	WFPC2, IMAGE, PC1	F606W		POS TARG 0.1138,0.1138		600.0 Secs *[==>600.0 Secs]*	*[2]*
5		(2) SEX-QSO-J1013-0143	WFPC2, IMAGE, PC1	F606W		POS TARG 0.0569,0.0569		600.0 Secs *[==>600.0 Secs]*	*[2]*
6		(2) SEX-QSO-J1013-0143	WFPC2, IMAGE, PC1	F606W				600.0 Secs *[==>600.0 Secs]*	*[2]*
7		(2) SEX-QSO-J1013-0143	WFPC2, IMAGE, PC1	F606W		POS TARG -0.0569, 0.0569		600.0 Secs *[==>600.0 Secs]*	*[3]*
8		(2) SEX-QSO-J1013-0143	WFPC2, IMAGE, PC1	F606W		POS TARG 0,0.1138		600.0 Secs *[==>600.0 Secs]*	*[3]*
9		(2) SEX-QSO-J1013-0143	WFPC2, IMAGE, PC1	F606W		POS TARG 0.0569,0.1707		600.0 Secs *[==>600.0 Secs]*	*[3]*


Orbit Structure
Orbit 1
Server Version: 20070325
GS Acq
Exp. 1
Overhead
Pointing Maneuver
Exp. 2
Pointing Maneuver
Overhead
Exp. 3
Overhead
Unused Visibility = 77
Pointing Maneuver
Occultation
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 secs.
Orbit 2
Server Version: 20070325
GS Reacq
Exp. 4
Pointing Maneuver
Overhead
Exp. 5
Pointing Maneuver
Overhead
Exp. 6
Overhead
Pointing Maneuver
Unused Visibility = 77
Occultation
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 secs.

Orbit Structure (continued)



Visit

Proposal 10812, Visit 03, pi Wed May 23 01:01:41 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: PCS MODE FINE; CVZ

Comments: This visit takes 12 images of the DRA-QSO-J1721+5758 field. It uses an octet dither pattern consisting of two interlaced quartets. The sides of the quartets are 2.50 pixels and the offset between them is 1.25 pixels.

Fixed Targets

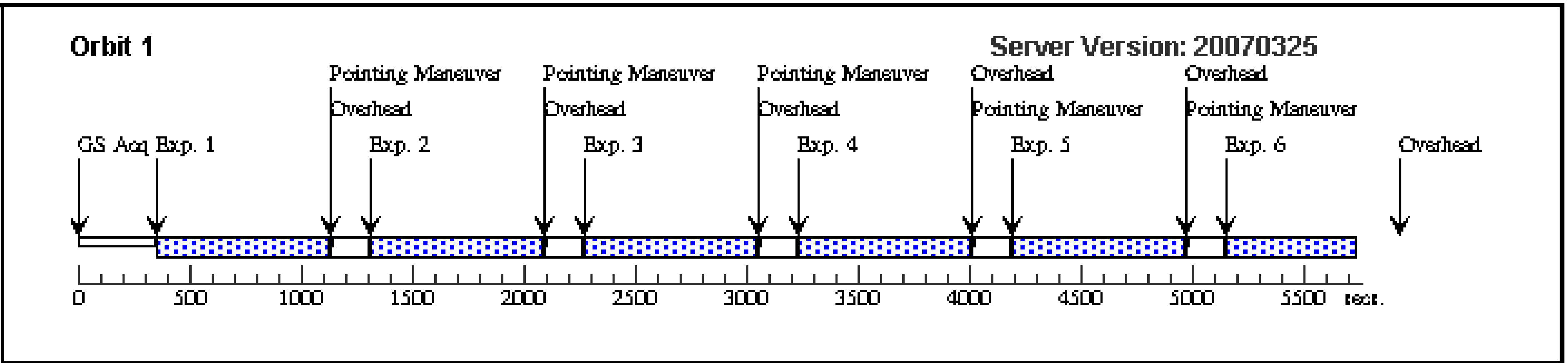
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	DRA-QSO-J1721+5758	RA: 17 21 48.3000 (260.4512500d)	Proper Motion RA: 0.0s/yr	V=20.3	Reference Frame: SDSS
		Dec: +57 58 5.40 (57.96817d)	Proper Motion Dec: 0.0"/yr		
		Equinox: J2000	Epoch of Position:		

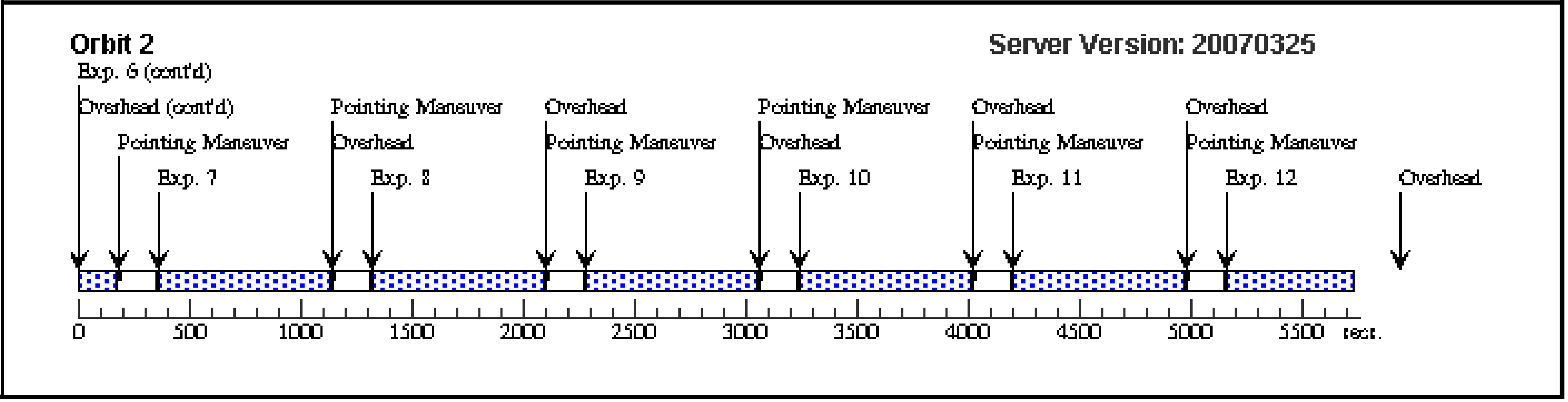
Comments: There is a QSO centered in the field. The field also contains stars of the Draco dwarf spheroidal galaxy.

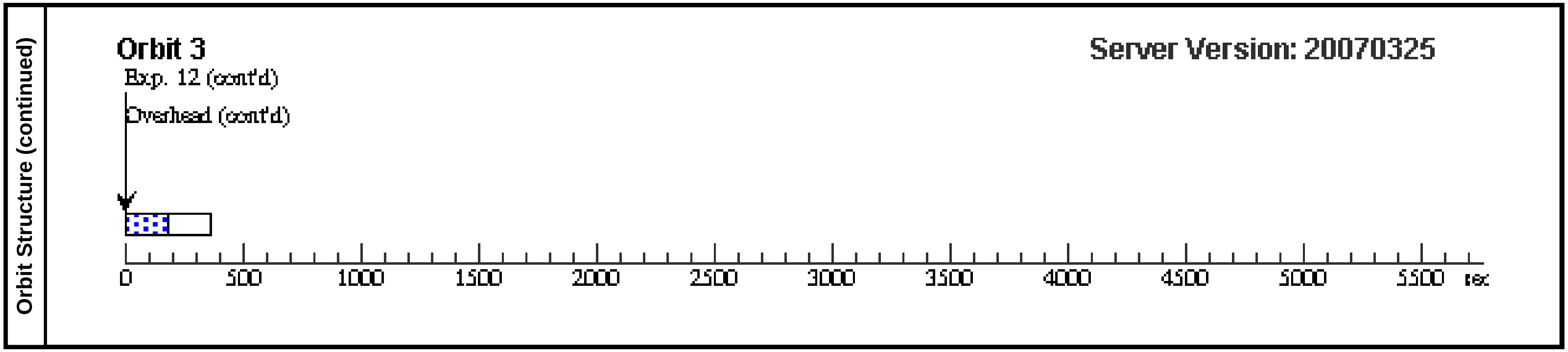
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W		POS TARG 0.0569,-0.0569		600.0 Secs [==>]	[1]
2		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W		POS TARG 0.1138,0		600.0 Secs [==>]	[1]
3		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W		POS TARG 0.1707,0 .0569		600.0 Secs [==>]	[1]
4		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W		POS TARG 0.2276,0 .1138		600.0 Secs [==>]	[1]
5		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W		POS TARG 0.2845,0 .1707		600.0 Secs [==>]	[1]
6		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W		POS TARG 0.2276,0 .2276		600.0 Secs [==>]	[1]
7		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W		POS TARG 0.1707,0 .1707		600.0 Secs [==>]	[2]
8		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W		POS TARG 0.1138,0 .1138		600.0 Secs [==>]	[2]
9		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W		POS TARG 0.0569,0 .0569		600.0 Secs [==>]	[2]
10		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W				600.0 Secs [==>]	[2]
11		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W		POS TARG -0.0569, 0.0569		600.0 Secs [==>]	[2]
12		(3) DRA-QSO-J1721 +5758	WFPC2, IMAGE, PC1	F606W		POS TARG 0,0.1138		600.0 Secs [==>]	[2]

Orbit Structure






Orbit Structure (continued)
Orbit 3
Server Version: 20070325
Exp. 12 (cont'd)
Overhead (cont'd)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 10812, Visit 04, completed Wed May 23 01:01:42 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: PCS MODE FINE; CVZ; ORIENT 55.73D TO 56.03 D

Comments: The ORIENT parameter is the value of PA_V3 from the header of j93404ebq_flt.fits, the first image of our cycle 13 data for the DRA-QSO-J1720+5755 field, minus 180 degrees.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	DRA-QSO-J1720+5755	RA: 17 20 52.3100 (260.2179583d) Dec: +57 55 13.40 (57.92039d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position: Redshift: 0.9465	V=19.82	Reference Frame: SDSS

Comments: There is a QSO centered in the field. The field also contains stars of the Draco dwarf spheroidal galaxy.

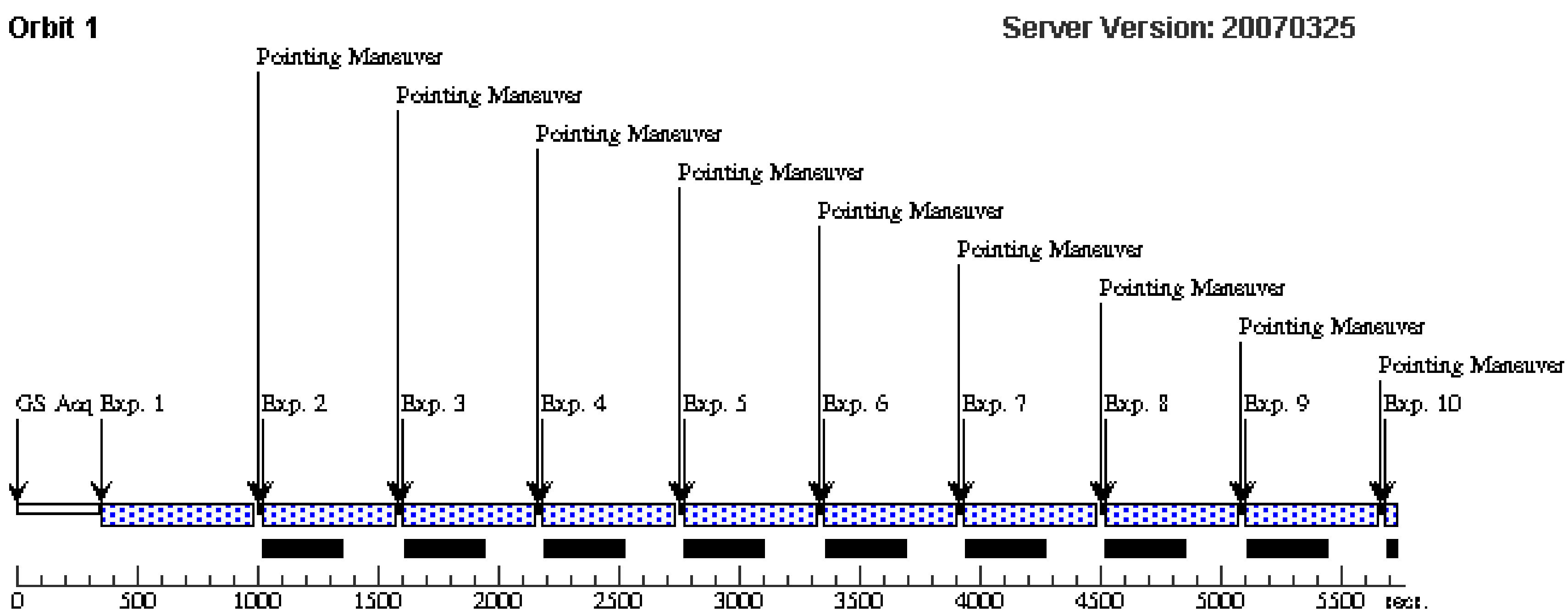
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO			428.0 Secs *[==>]*	*[1]*
2		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG 0.062,0.0669		428.0 Secs *[==>]*	*[1]*
3		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG 0.124,0.1089		427.0 Secs *[==>]*	*[1]*
4		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG 0.1488,0.1854		428.0 Secs *[==>]*	*[1]*
5		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG 0.2232,0.2408		427.0 Secs *[==>]*	*[1]*
6		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG 0.2852,0.2828		427.0 Secs *[==>]*	*[1]*
7		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG 0.3348,0.3611		428.0 Secs *[==>]*	*[1]*
8		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG 0.3596,0.4127		427.0 Secs *[==>]*	*[1]*
9		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG 0.4092,0.4414		427.0 Secs *[==>]*	*[1]*
10		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG 0.4712,0.4834		428.0 Secs *[==>]*	*[1]*
11		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG -0.0496,-0.0535		427.0 Secs *[==>]*	*[2]*
12		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG -0.0868,-0.0936		427.0 Secs *[==>]*	*[2]*

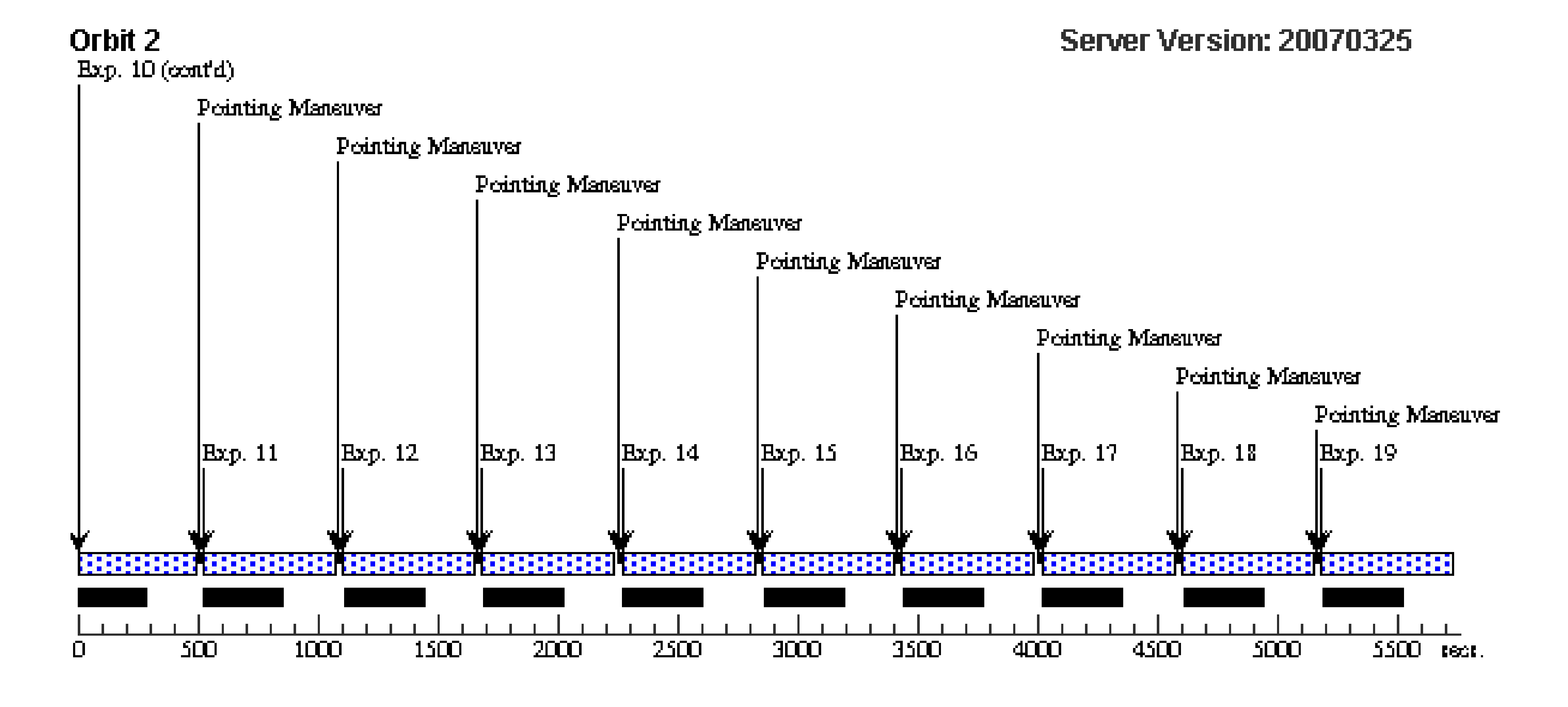
Exposures (continued)

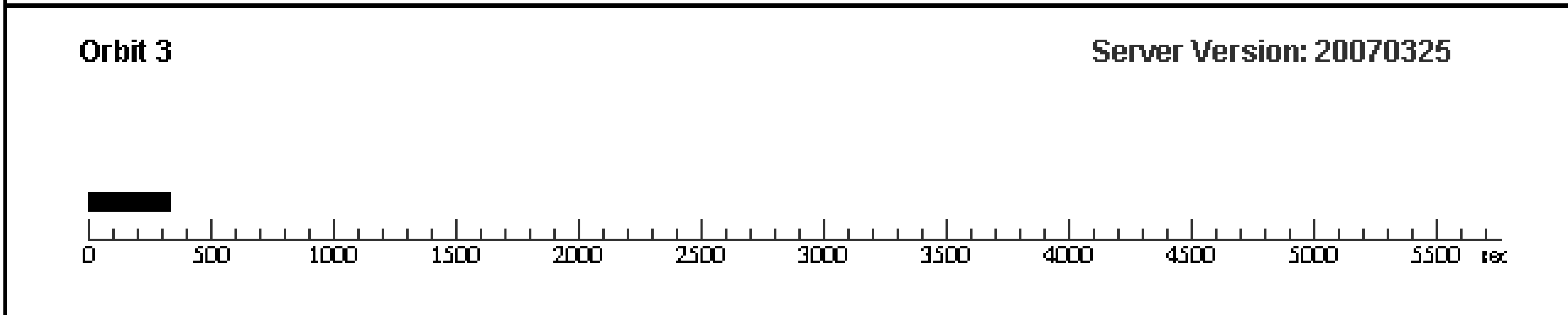
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
13		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG -0.124,-0.1586		428.0 Secs *[==>]*	*[2]*
14		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG -0.1984, -0.1892		427.0 Secs *[==>]*	*[2]*
15		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG -0.2232, -0.2408		427.0 Secs *[==>]*	*[2]*
16		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG -0.2604, -0.3057		427.0 Secs *[==>]*	*[2]*
17		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG -0.3348, -0.3363		427.0 Secs *[==>]*	*[2]*
18		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG -0.3596, -0.3879		427.0 Secs *[==>]*	*[2]*
19		(4) DRA-QSO-J1720 +5755	ACS/WFC, ACCUM, WFC1	F606W	CR-SPLIT=NO	POS TARG -0.4464, -0.4815		427.0 Secs *[==>]*	*[2]*

Orbit Structure



Orbit Structure (continued)





Visit

Proposal 10812, Visit 05, pi Wed May 23 01:01:44 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: PCS MODE FINE; CVZ

Comments: This visit takes 12 images of the DRA-QSO-J1719+5758 field. It uses an 8-point dither pattern consisting of two interlaced quartets. The quartets have a side of 2.50 pixel and are displaced by 1.25 pixel.

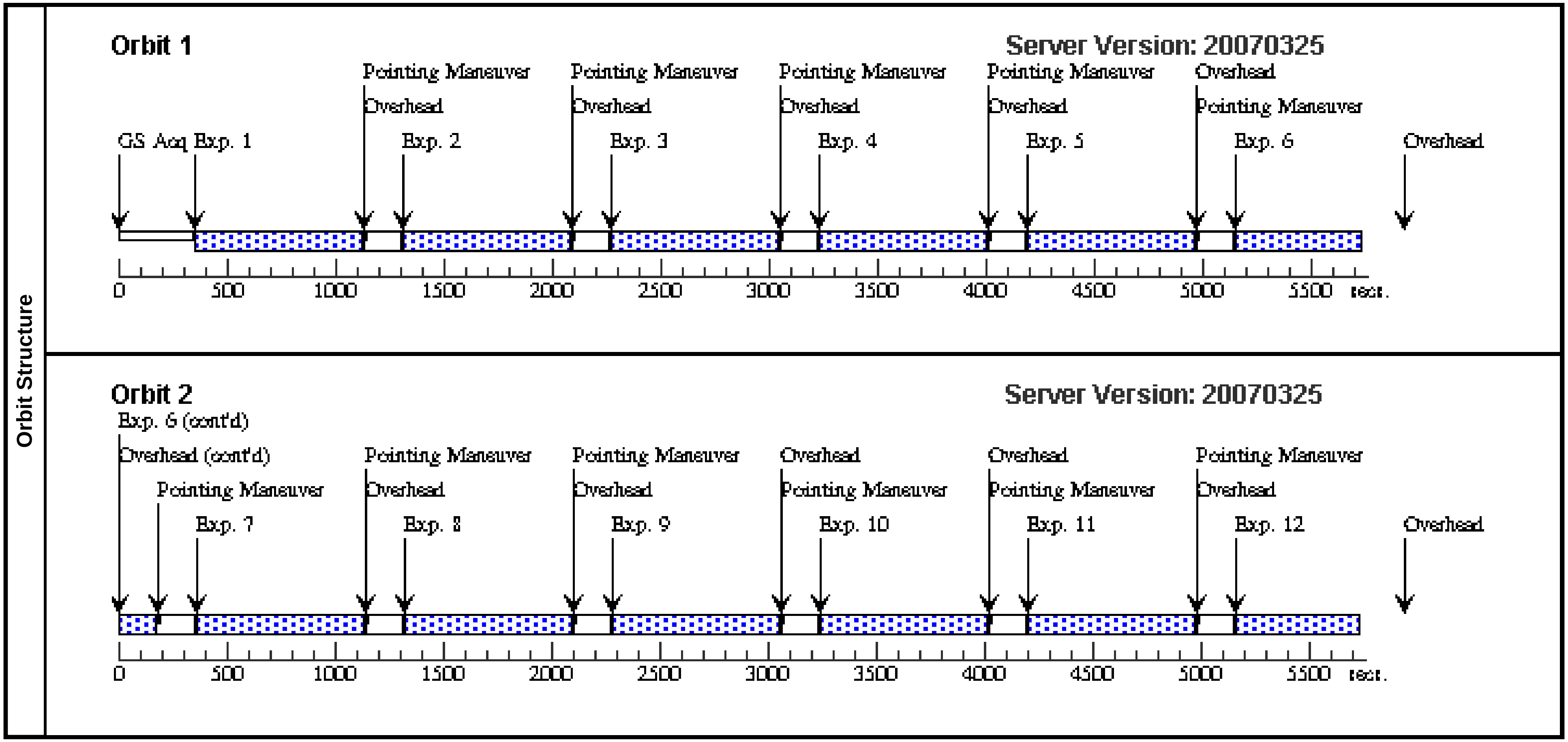
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(5)	DRA-QSO-J1719+5758	RA: 17 19 34.4300 (259.8934583d) Dec: +57 58 49.80 (57.98050d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position: Redshift: 0.6125	V=18.94	Reference Frame: SDSS

Comments: There is a QSO centered in this field. The field also contains stars of the Draco dwarf spheroidal galaxy.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W		POS TARG 0.1138,0		600.0 Secs *[==>]*	*[1]*
2		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W		POS TARG 0.1707,0 .0569		600.0 Secs *[==>]*	*[1]*
3		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W		POS TARG 0.2276,0 .1138		600.0 Secs *[==>]*	*[1]*
4		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W		POS TARG 0.2845,0 .1707		600.0 Secs *[==>]*	*[1]*
5		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W		POS TARG 0.2276,0 .2276		600.0 Secs *[==>]*	*[1]*
6		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W		POS TARG 0.1707,0 .1707		600.0 Secs *[==>]*	*[1]*
7		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W		POS TARG 0.1138,0 .1138		600.0 Secs *[==>]*	*[2]*
8		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W		POS TARG 0.0569,0 .0569		600.0 Secs *[==>]*	*[2]*
9		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W				600.0 Secs *[==>]*	*[2]*
10		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W		POS TARG -0.0569, 0.0569		600.0 Secs *[==>]*	*[2]*
11		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W		POS TARG 0,0.1138		600.0 Secs *[==>]*	*[2]*
12		(5) DRA-QSO-J1719 +5758	WFPC2, IMAGE, PC1	F555W		POS TARG 0.0569,0 .1707		600.0 Secs *[==>]*	*[2]*


Orbit Structure
Orbit 1
Server Version: 20070325
GS Acq
Exp. 1
Pointing Maneuver
Overhead
Exp. 2
Pointing Maneuver
Overhead
Exp. 3
Pointing Maneuver
Overhead
Exp. 4
Pointing Maneuver
Overhead
Exp. 5
Overhead
Pointing Maneuver
Exp. 6
Overhead
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 secs.
Orbit 2
Server Version: 20070325
Exp. 6 (cont'd)
Overhead (cont'd)
Pointing Maneuver
Exp. 7
Pointing Maneuver
Overhead
Exp. 8
Pointing Maneuver
Overhead
Exp. 9
Overhead
Pointing Maneuver
Exp. 10
Overhead
Pointing Maneuver
Exp. 11
Pointing Maneuver
Overhead
Exp. 12
Overhead
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 secs.

Orbit Structure (continued)