



13764 - The Physics of the Jets of Powerful Radio Galaxies and Quasars

Cycle: 22, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Prof. Eric S. Perlman (PI) (Contact)	Florida Institute of Technology	eperlman@fit.edu
Dr. Markos Georganopoulos (CoI)	University of Maryland Baltimore County	georgano@umbc.edu
Dr. William B. Sparks (CoI)	Space Telescope Science Institute	sparks@stsci.edu
Dr. John A. Biretta (CoI)	Space Telescope Science Institute	biretta@stsci.edu
Dr. Christopher P. O'Dea (CoI)	Rochester Institute of Technology	odea@cis.rit.edu
Dr. Stefi A. Baum (CoI)	Rochester Institute of Technology	baum@cis.rit.edu
Dr. Chi C. Cheung (CoI)	Naval Research Laboratory	teddy.cheung@nrl.navy.mil
Dr. Mark Birkinshaw (CoI) (ESA Member)	University of Bristol	mark.birkinshaw@bristol.ac.uk
Dr. Diana M. Worrall (CoI) (ESA Member)	University of Bristol	d.worrall@bristol.ac.uk
Dr. Andre Martel (CoI)	Space Telescope Science Institute	martel@stsci.edu
Prof. Claudia Megan Urry (CoI)	Yale University	meg.urry@yale.edu
Dr. Lukasz Stawarz (CoI)	ISAS, Japan Aerospace Exploration Agency	stawarz@astro.isas.jaxa.jp
Prof. Paolo Coppi (CoI)	Yale University	coppi@astro.yale.edu
Dr. Yasunobu Uchiyama (CoI)	Rikkyo University	y.uchiyama@rikkyo.ac.jp
Dr. Mihai Cara (CoI)	Space Telescope Science Institute	mcara@fit.edu
Dr. Klaus Meisenheimer (CoI) (ESA Member)	Max-Planck-Institut für Astronomie, Heidelberg	meise@mpia.de
Prof. Mitchell C. Begelman (CoI)	University of Colorado at Boulder	mitch@jila.colorado.edu

VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) 3C-273	ACS/WFC	4	25-Nov-2014 21:02:01.0	yes

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
02	(1) 3C-273	ACS/WFC	3	25-Nov-2014 21:02:04.0	yes
03	(1) 3C-273	ACS/WFC	3	25-Nov-2014 21:02:05.0	yes

10 Total Orbits Used

ABSTRACT

We propose HST polarimetry of the jet of 3C 273. Polarization is a critical parameter for understanding jet flows, and only HST has the resolution and capability to perform this measurement. The data will confirm which mechanisms are operating to create its optical and X-ray emission, and will show locations where the magnetic fields are being structured by shocks and shears. This will greatly advance modeling efforts for this jet and nail down its kinetic power, a key unknown parameter for understanding quasars and their cosmological effects. Comparison with in-hand radio and ground-based near-IR (AO) optical polarimetry at matched resolution will measure the flow speed in the plasma as a function of particle energy, in the same way as in our analysis of our earlier HST polarimetry data on low-power jets.

This proposal builds on our observations of two other quasar jets, where we measured high polarization in the X-ray brightest knots, and so showed that their optical and X-ray emission is most likely due to the synchrotron model, since the alternative, IC/CMB model fails to match those objects' steep radio spectra and modest variability, and requires exceptionally fast flows ($\Gamma > 30$) at hundreds of kpc and super-Eddington kinetic power. The proposed observations will provide much stronger constraints because this iconic jet, because of its brightness, exceptional angular separation from the core and low redshift ($z=0.158$). Our modelling techniques will also provide much information on the jet's internal structure, including shocks and the sites of particle acceleration.

OBSERVING DESCRIPTION

The goal of this proposal is to obtain HST polarimetry of the 3C 273 jet using the ACS/WFC + POLVIS + F606W filters. We are using F606W because it gives the optimal mix between rejection of cross-polarized light and high throughput of parallel polarized light with the POLVIS filters. In addition, the F606W band was shown by Jester et al. (2005, 2006, 2007) to lie on the same spectral component as the Chandra X-ray emission, so these observations will allow us to perform critical tests of the X-ray emission mechanism of the jet.

The observations have been constructed in a very simple way. All long integrations with the same POL filter are in a single visit. Thus POL0 observations are in Visit 01, POL60 observations are in Visit 02, and POL120 observations are in Visit 03. All of these orbits use standard dither

patterns - orbit 1 is a 2-point ACS-WFC-DITHER-LINE and orbits 2 & 3 are a 4 point ACS-WFC-DITHER-BOX. This allows maximum efficiency by placing readouts during Earth-shadow times and maximizes exposure time.

We are also doing several short observations, for calibration purposes. All of these are in orbit 4 of Visit 01. The 60-s observations with the polarizers will allow us to calibrate the PSF so that the quasar, which will be saturated in the long-exposure images, can be modeled correctly and subtracted out of the long-exposure images along with the galaxy to reveal the inner jet components, which previous HST polarimetry was not deep enough to reveal. The 20-s observation without the polarizers will allow a check on the flux and polarization calibration, a strategy which we have used for our previous ACS polarization programs 9847 and 11138. Note that we cannot use previous observations of 3C 273 for this purpose because the quasar is variable. All of the calibration observations use a 2-position dither, also in a standard ACS-WFC-DITHER-LINE configuration.

We have specified four fairly wide, 40 degree orientation windows so that the jet can be placed near to or along a chip diagonal. We have required SAME-ORIENT so that the chip is then oriented identically and the jet is in the same chip quadrant in all three visits, thus minimizing calibration issues. This was recommended by Andre' Martel, a member of the team and also a previous member of the ACS instrument team.

Proposal 13764 - 3C273 POL0 (01) - The Physics of the Jets of Powerful Radio Galaxies and Quasars

Wed Nov 26 02:02:06 GMT 2014

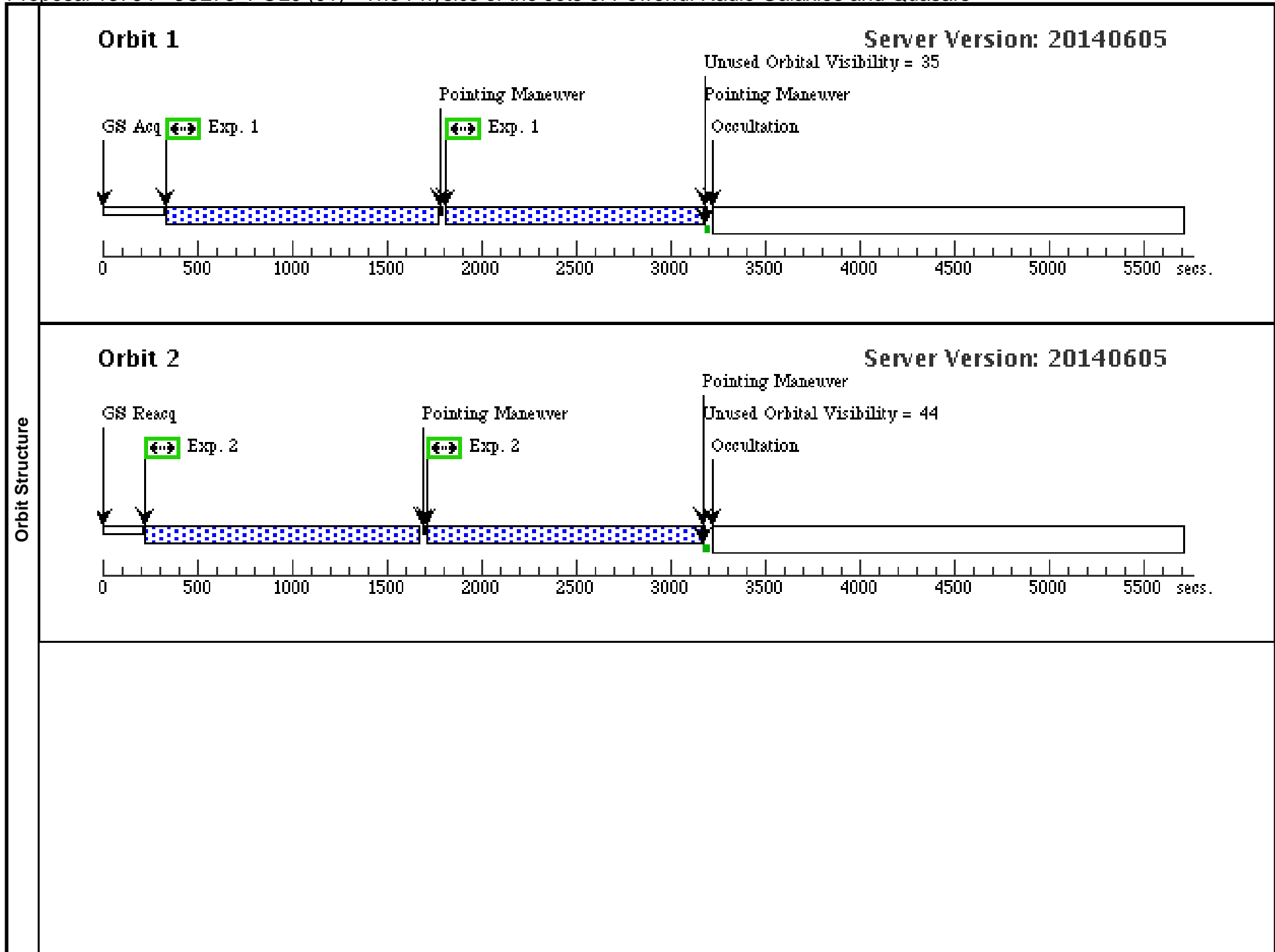
Visit	Proposal 13764, 3C273_POL0 (01), implementation		
	Diagnostic Status: No Diagnostics		
	Scientific Instruments: ACS/WFC		
	Special Requirements: ORIENT 37.2D TO 77.2 D; ORIENT 127.2D TO 167.2 D; ORIENT 217.2D TO 257.2 D; ORIENT 307.2D TO 347.2 D		

Patterns	#	Primary Pattern	Secondary Pattern	Exposures	
	(1)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187	Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=false		(2)
	(2)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=3.011 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false		(1), (3-5), (6)

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	3C-273	RA: 12 29 6.6997 (187.2779154d) Dec: +02 03 8.60 (2.05239d) Equinox: J2000		V=12.86	Reference Frame: ICRS

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

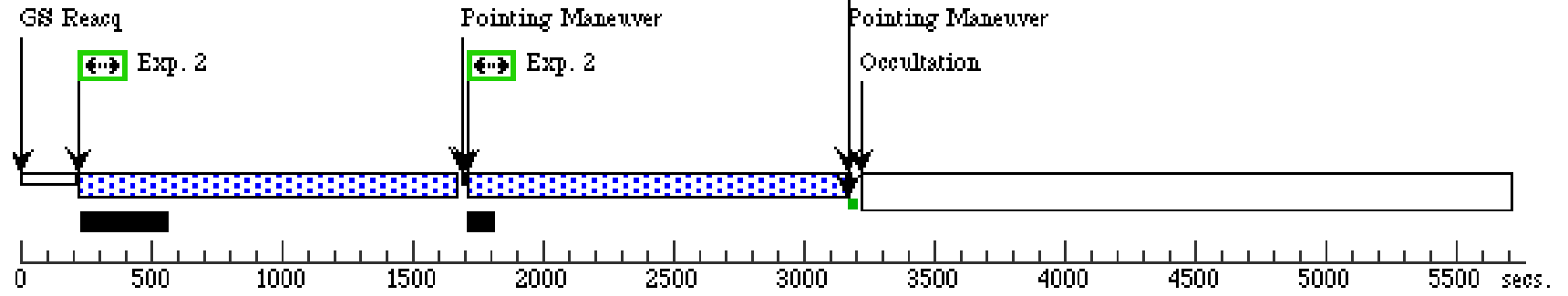
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) 3C-273	(1) 3C-273	ACS/WFC, ACCUM, WFC1	F606W POL0V			Pattern 2, Exps 1-1 in 3C273_POL0 (01) (2)	1186 Secs (2372 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	2	(1) 3C-273	(1) 3C-273	ACS/WFC, ACCUM, WFC1	F606W POL0V		POS TARG 1.0,1.0	Pattern 1, Exps 2-2 in 3C273_POL0 (01) (1)	1280 Secs (5120 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]	[2] [3]
	3	(1) 3C-273	(1) 3C-273	ACS/WFC, ACCUM, WFC1	F606W POL0V			Pattern 2, Exps 3-5 in 3C273_POL0 (01) (2)	60 Secs (120 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[4]
	4	(1) 3C-273	(1) 3C-273	ACS/WFC, ACCUM, WFC1	F606W POL60V			Pattern 2, Exps 3-5 in 3C273_POL0 (01) (2)	60 Secs (120 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[4]
	5	(1) 3C-273	(1) 3C-273	ACS/WFC, ACCUM, WFC1	F606W POL120V			Pattern 2, Exps 3-5 in 3C273_POL0 (01) (2)	60 Secs (120 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[4]
	6	(1) 3C-273	(1) 3C-273	ACS/WFC, ACCUM, WFC1	F606W			Pattern 2, Exps 6-6 in 3C273_POL0 (01) (2)	20 Secs (40 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[4]



Orbit 3

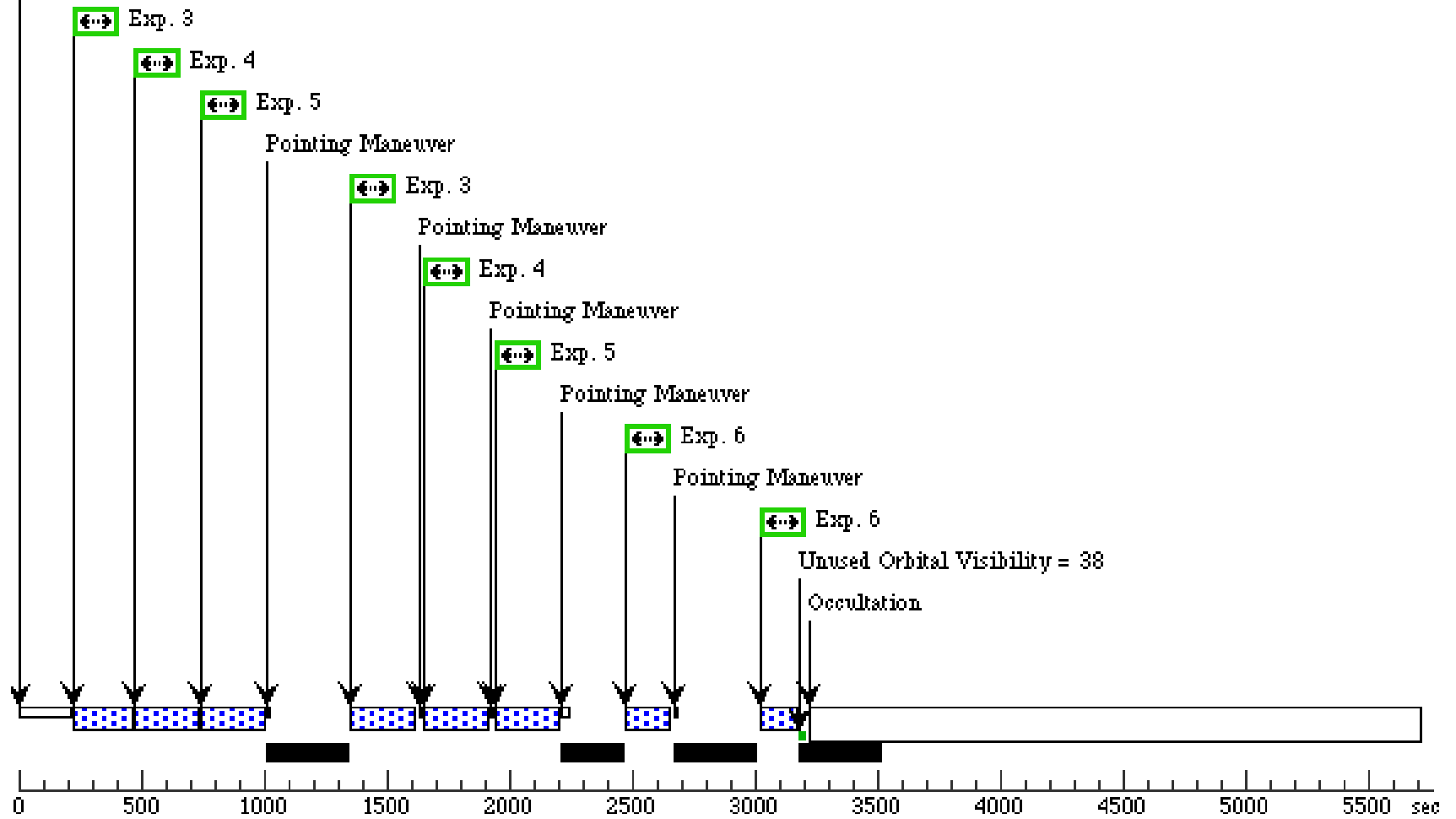
Server Version: 20140605

Unused Orbital Visibility = 44



Orbit 4

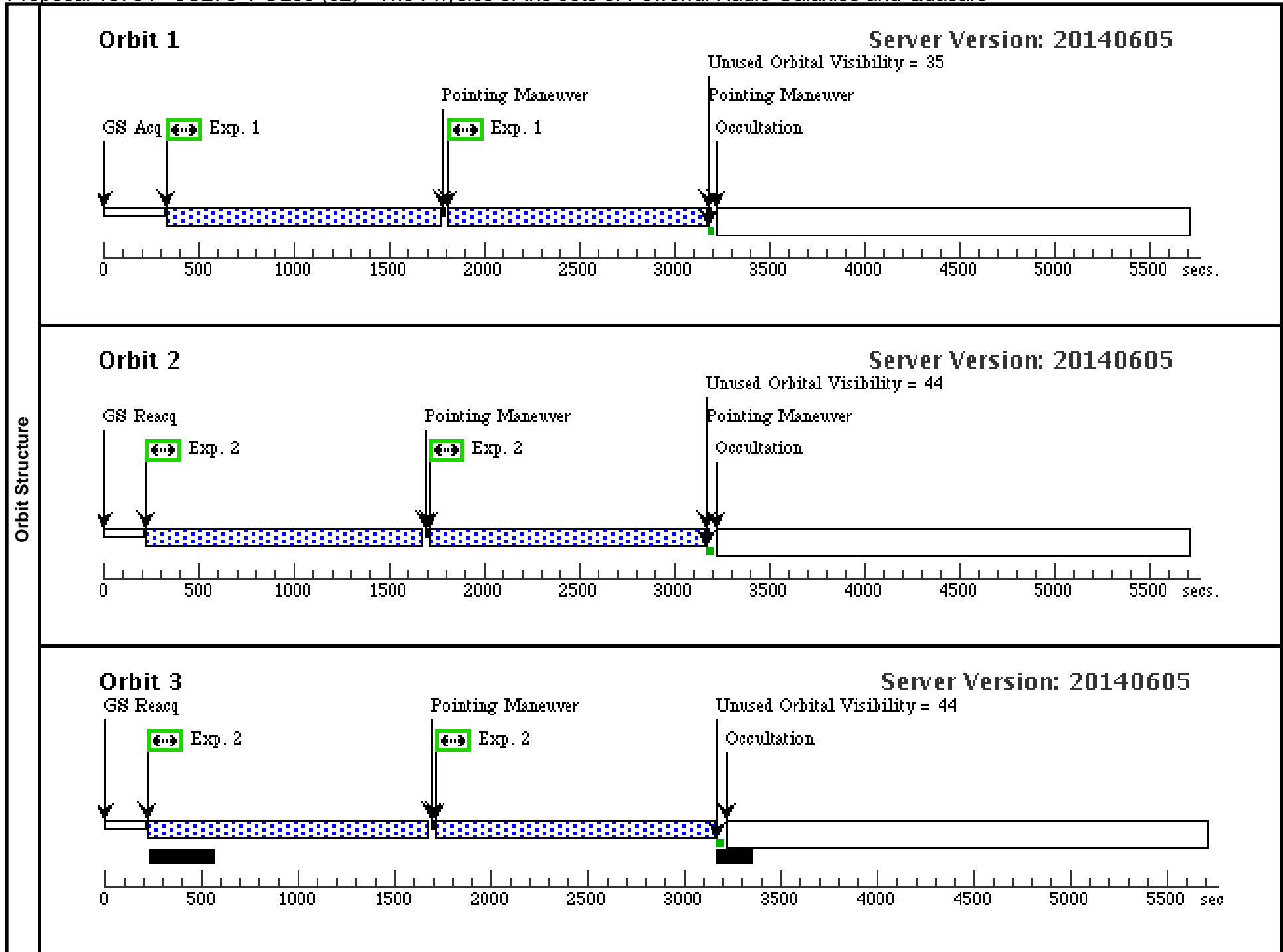
GS Reacq



Proposal 13764 - 3C273 POL60 (02) - The Physics of the Jets of Powerful Radio Galaxies and Quasars

Wed Nov 26 02:02:07 GMT 2014

Visit	Proposal 13764, 3C273_POL60 (02), implementation Diagnostic Status: No Diagnostics Scientific Instruments: ACS/WFC Special Requirements: SAME ORIENT AS 01; AFTER 01 BY 0 D TO 14 D									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
		(1)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187	Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=false		(2)				
	(2)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=3.011 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false		(1)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	3C-273	RA: 12 29 6.6997 (187.2779154d) Dec: +02 03 8.60 (2.05239d) Equinox: J2000		V=12.86	Reference Frame: ICRS				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) 3C-273	ACS/WFC, ACCUM, WFC1	F606W POL60V			Pattern 2, Exps 1-1 in 3C273_POL60 (02) (2)	1186 Secs (2372 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	2		(1) 3C-273	ACS/WFC, ACCUM, WFC1	F606W POL60V		POS TARG 1.0,1.0	Pattern 1, Exps 2-2 in 3C273_POL60 (02) (1)	1280 Secs (5120 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]	[2] [3]



Orbit Structure

Proposal 13764 - 3C273 POL120 (03) - The Physics of the Jets of Powerful Radio Galaxies and Quasars

Wed Nov 26 02:02:07 GMT 2014

Visit	Proposal 13764, 3C273_POL120 (03), implementation Diagnostic Status: No Diagnostics Scientific Instruments: ACS/WFC Special Requirements: SAME ORIENT AS 01; AFTER 01 BY 0 D TO 14 D									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
		(1)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187	Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=false		(2)				
	(2)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=3.011 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false		(1)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	3C-273	RA: 12 29 6.6997 (187.2779154d) Dec: +02 03 8.60 (2.05239d) Equinox: J2000		V=12.86	Reference Frame: ICRS				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) 3C-273	ACS/WFC, ACCUM, WFC1	F606W POL120V			Pattern 2, Exps 1-1 i n 3C273_POL120 (0 3) (2)	1186 Secs (2372 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	2		(1) 3C-273	ACS/WFC, ACCUM, WFC1	F606W POL120V		POS TARG 1.0,1.0	Pattern 1, Exps 2-2 i n 3C273_POL120 (0 3) (1)	1280 Secs (5120 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]	[2] [3]

