13945 - Solving the X-ray Origin Problem in Large-scale Jets with Chandra and Fermi Observations

Cycle: 22, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Eileen T Meyer (PI) (Contact)	**Space Telescope Science Institute**	**meyer@stsci.edu**
Dr. William B. Sparks (CoI)	Space Telescope Science Institute	sparks@stsci.edu
Dr. Markos Georganopoulos (CoI)	University of Maryland Baltimore County	georgano@umbc.edu
Dr. Aneta Siemiginowska (CoI)	Smithsonian Institution Astrophysical Observatory	asiemiginowska@cfa.harvard.edu
Prof. Eric S. Perlman (CoI)	Florida Institute of Technology	eperlman@fit.edu
Dr. Marco Chiaberge (CoI) (ESA Member)	Space Telescope Science Institute - ESA	marcoc@stsci.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) 3C9	WFC3/IR	1	09-Dec-2014 21:02:48.0	yes
02	(2) 0234+285	WFC3/IR	1	09-Dec-2014 21:02:50.0	yes
03	(1) 3C9	ACS/WFC	1	09-Dec-2014 21:02:52.0	yes
04	(2) 0234+285	ACS/WFC	1	09-Dec-2014 21:02:53.0	yes

4 Total Orbits Used

ABSTRACT

We propose deep ACIS-S observations of five kpc-scale powerful quasar jets, previously detected in short exposures 10-13 years ago, to accurately measure the X-ray flux level and spectral index for individual knots in the resolved jet. We are motivated by our recent results that in two powerful

sources, 3C 273 and PKS 1136-135, the X-rays are synchrotron, rather than the widely believed IC emission off the CMB. These two models imply radically different jets and deep Chandra imaging is necessary to distinguish between them with the help of existing Fermi data. The proposed targets have been selected to cover almost 2 orders of magnitude in jet power, which allows us to evaluate the X-ray emission mechanism over a wide range of jet powers.

OBSERVING DESCRIPTION

Four HST orbits for 2 targets were granted as part of a Chandra X-ray observing proposal. Those targets are two quasars with 5-8" resolved radio jets. The source positions given are of the core (nucleus). The science target is the large-scale jet, which will be observed in the IR (WFC3 F160W) and optical (ACS/WFC F814W) with the goal of detecting the individual knots (0.5-1" in extent) in the jet. 3C9 has a jet extending to the southeast (PA 132 degrees) for ~8", and also shows a hotspot on the side 180 from the jet, also ~8" from the core position. QSO 0234+285 has only a one-sided jet extending due North (PA 0 degrees) for ~5" before making a 90 degree turn to the West. We considered the PA of the jet to run through angles 330-360 degrees for the purposes of roll angle constraints. For the IR observations, we used a modified line-dither pattern and roll angle constraints to ensure no problems with persistence from the bright cores would affect the pixels centered on the jet knots. For the ACS/WFC imaging, we centered the target on the WFC1 chip and applied roll angle constraints to avoid any blooming/streaking from a saturated core from over-running the jet. No other bright objects are in the vicinity of the targets.

Visit

Proposal 13945, 3C9-IR (01), implementation Wed Dec 10 02:02:54 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 0D TO 70 D

Comments: 3C 9 is a radio galaxy with a relatively bright core. The science target(s) are a series of bright knots in the radio jet extending out ~ 8 arcseconds to the southeast. To avoid persistance from the core accidentally contaminating pixels which image the jet in subsequent exposures, the dithering pattern extends out more or less in a line, using the standard 3-pt line dither with an additional POSTARG offset. Roll angle constraints are used to ensure this line does not end up going over the jet.

Patterns

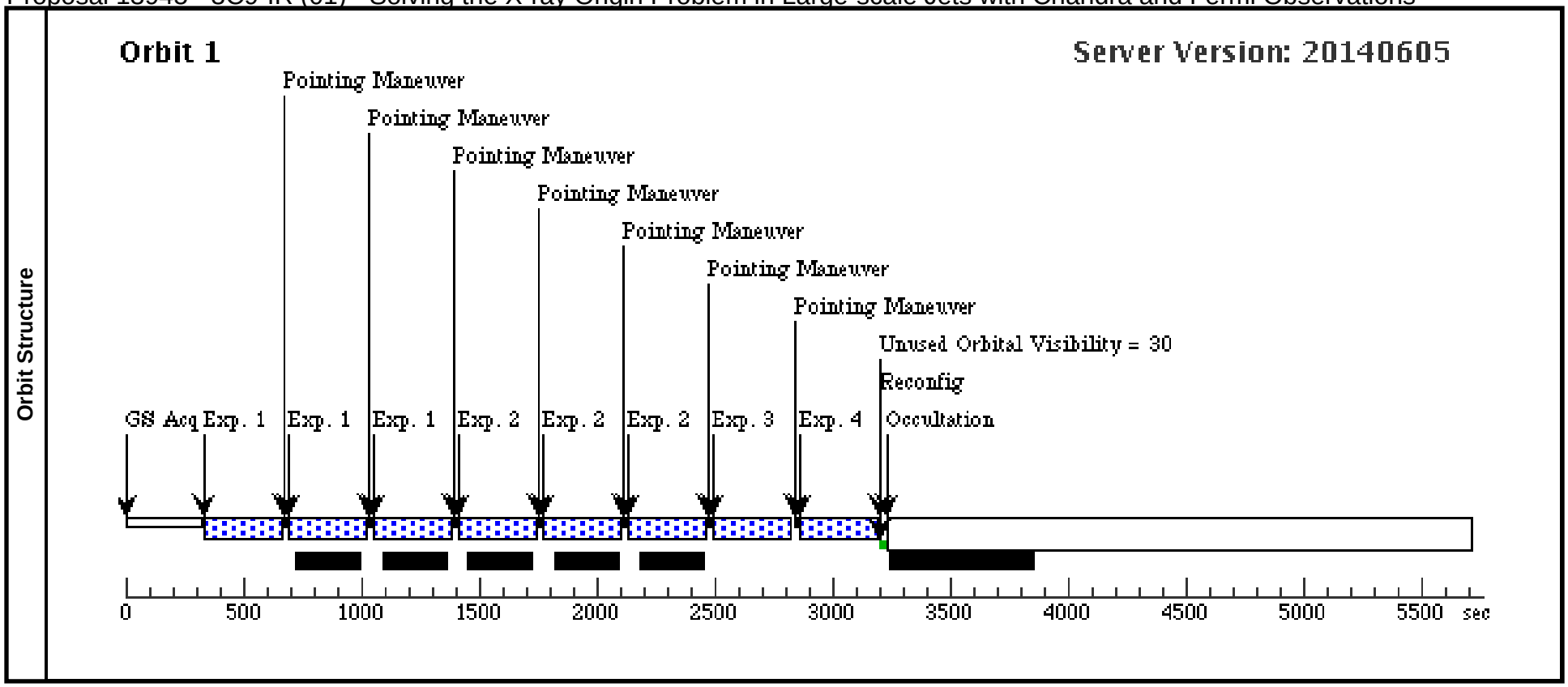
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.605 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	3C9	RA: 00 20 25.2000 (5.1050000d) Dec: +15 40 55.00 (15.68194d) Equinox: J2000		V=17+/-1	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 3C9	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP50; NSAMP=11	POS TARG 0,0	Pattern 1, Exps 1-1 in 3C9-IR (01) (1)	299.232481 Secs (897.697 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2		(1) 3C9	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP50; NSAMP=11	POS TARG 1,1	Pattern 1, Exps 2-2 in 3C9-IR (01) (1)	299.232481 Secs (897.697 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
3		(1) 3C9	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP50; NSAMP=11	POS TARG 2,2		299.232481 Secs (299.232 Secs) *[==>]*	***[1]***
4		(1) 3C9	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP50; NSAMP=11	POS TARG 2.5,2.5		299.232481 Secs (299.232 Secs) *[==>]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20140605
Pointing Maneuver
Pointing Maneuver
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Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Orbital Visibility = 30
Reconfig
GS Acq
Exp. 1
Exp. 1
Exp. 1
Exp. 2
Exp. 2
Exp. 2
Exp. 3
Exp. 4
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 13945, 0234p285-IR (02), implementation Wed Dec 10 02:02:54 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 219D TO 290 D; ORIENT 50D TO 130 D

Comments: QSO 0234-285, like 3C 9 has a relatively bright core. The science target is a resolved jet extending out ~5" to the west. Similar precautions as with 3c9 were taken with the line-dither pattern and roll angle constraints to avoid any persistent flux from the bright core from contaminating pixels which later center on the jet which is the main science target.

Patterns

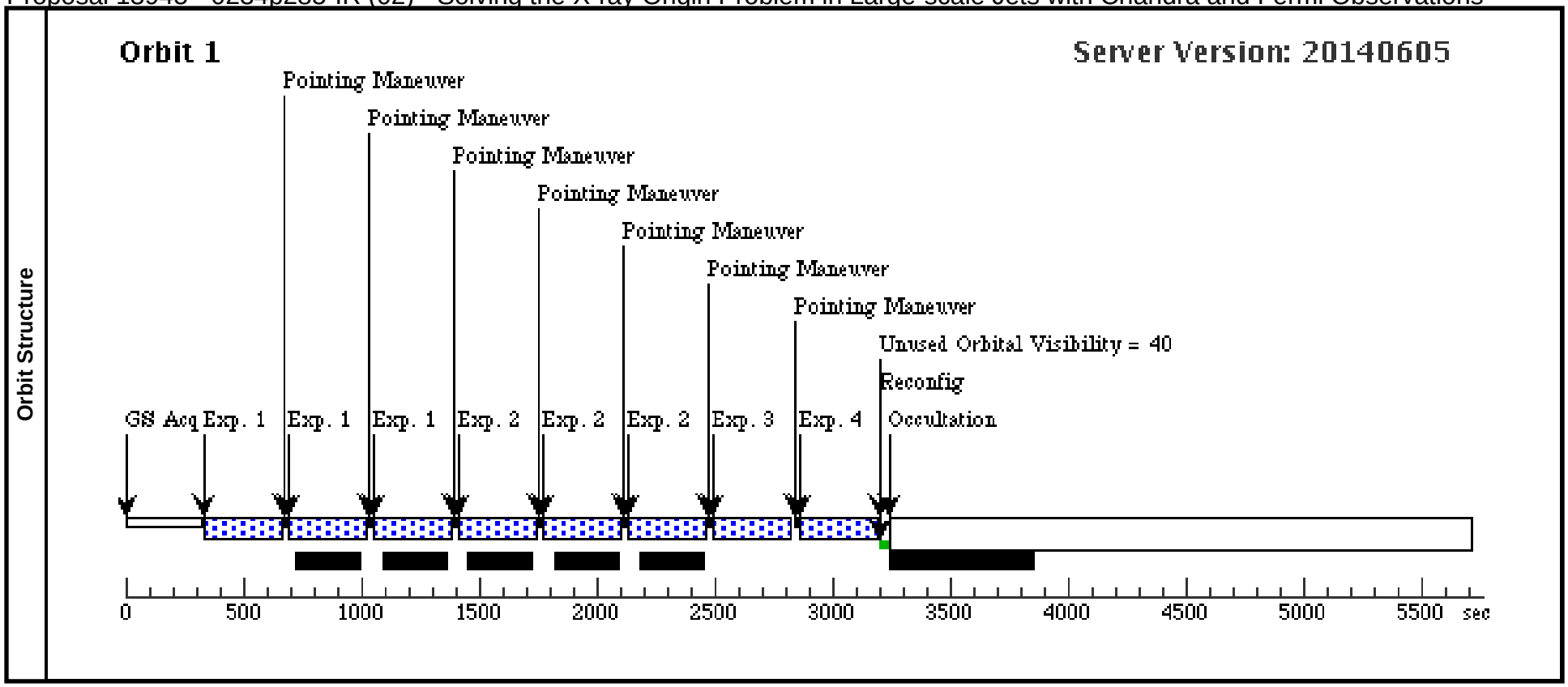
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.605 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	0234+285	RA: 02 37 52.4000 (39.4683333d) Dec: +28 48 9.00 (28.80250d) Equinox: J2000		V=18+/-1	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) 0234+285	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP50; NSAMP=11	POS TARG 0,0	Pattern 1, Exps 1-1 in 0234p285-IR (02) (1)	299.232481 Secs (897.697 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2		(2) 0234+285	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP50; NSAMP=11	POS TARG 1.2,1.2	Pattern 1, Exps 2-2 in 0234p285-IR (02) (1)	299.232481 Secs (897.697 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
3		(2) 0234+285	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP50; NSAMP=11	POS TARG 2.4,2.4		299.232481 Secs (299.232 Secs) *[==>]*	***[1]***
4		(2) 0234+285	WFC3/IR, MULTIACCUM, IR	F160W	SAMP-SEQ=STEP50; NSAMP=11	POS TARG 3,3		299.232481 Secs (299.232 Secs) *[==>]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20140605
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
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Pointing Maneuver
Unused Orbital Visibility = 40
Reconfig
GS Acq
Exp. 1
Exp. 1
Exp. 1
Exp. 2
Exp. 2
Exp. 2
Exp. 3
Exp. 4
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 13945, 3c9-Optical (03), implementation Wed Dec 10 02:02:55 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: ORIENT 75D TO 80 D; ORIENT 265D TO 281 D; ORIENT 350D TO 8 D; ORIENT 247D TO 254 D; ORIENT 97D TO 100 D

Comments: Roll Angle (ORIENT) constraints are specified to avoid any blooming or streaking from the core from over-running the jet, and also to avoid placing bright stars either in the chip gap or near the edge of a dector (to avoid "dragon's breath" and reflection problems). We applied a 5-pt dithering pattern to optimize PSF sampling, with the last two exposures offset by 4" in y in order to cover the chip gap, in order to increase the archive utility of the images. The POS_TARGS are also set to move the target nearer to the B readouts, to minimize CTE since the jet target is expected to be faint.

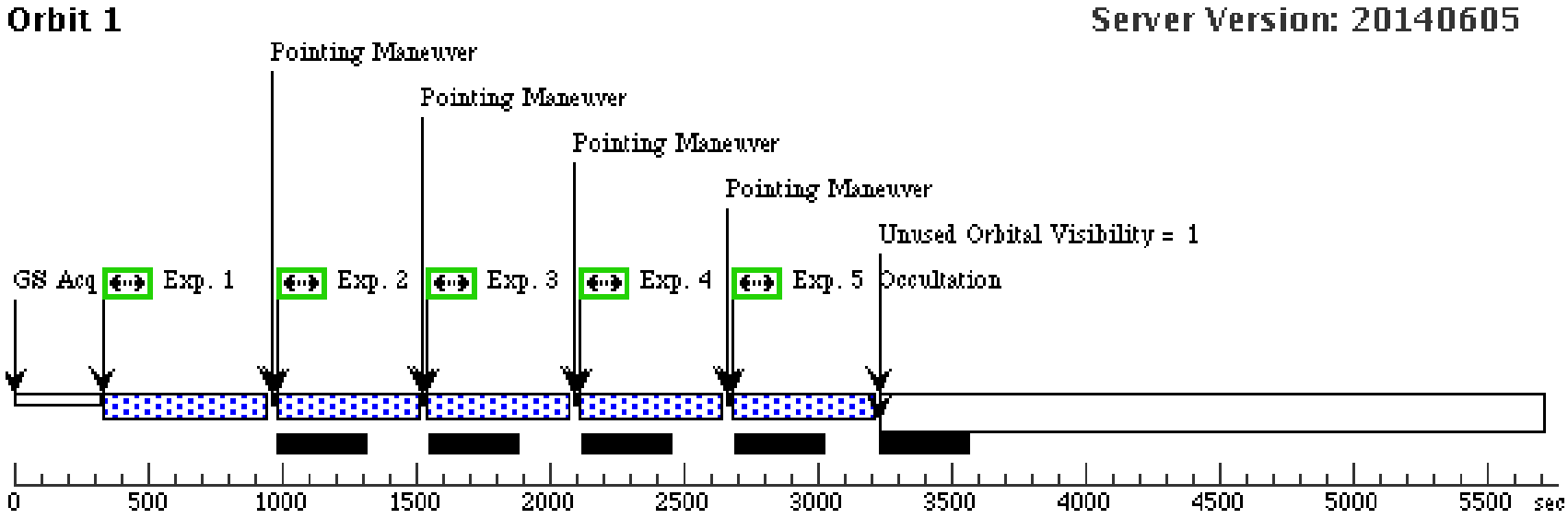
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	3C9	RA: 00 20 25.2000 (5.1050000d) Dec: +15 40 55.00 (15.68194d) Equinox: J2000		V=17+/-1	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 3C9	ACS/WFC, ACCUM, WFC1	F814W		POS TARG -50,0		408 Secs (408 Secs)	
								[==>]	***[1]***
2		(1) 3C9	ACS/WFC, ACCUM, WFC1	F814W		POS TARG -50.159 14,0.23969		408 Secs (408 Secs)	
								[==>]	***[1]***
3		(1) 3C9	ACS/WFC, ACCUM, WFC1	F814W		POS TARG -50.316 41,0.08319		408 Secs (408 Secs)	
								[==>]	***[1]***
4		(1) 3C9	ACS/WFC, ACCUM, WFC1	F814W		POS TARG -50.079 90,4.19413		408 Secs (408 Secs)	
								[==>]	***[1]***
5		(1) 3C9	ACS/WFC, ACCUM, WFC1	F814W		POS TARG -50.287 71,4.28896		408 Secs (408 Secs)	
								[==>]	***[1]***

Orbit Structure



Visit

Proposal 13945, 0234p285-Optical (04), implementation Wed Dec 10 02:02:55 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: ORIENT 34D TO 53 D; ORIENT 145D TO 155 D; ORIENT 310D TO 340 D; ORIENT 290D TO 300 D; ORIENT 125D TO 132 D; ORIENT 61D TO 67 D

Comments: Roll Angle (ORIENT) constraints are specified to avoid any blooming or streaking from the core from over-running the jet, and also to avoid placing bright stars either in the chip gap or near the edge of a dector (to avoid "dragon's breath" and reflection problems). We applied a 5-pt dithering pattern to optimize PSF sampling, with the last two exposures offset by 4" in y in order to cover the chip gap, in order to increase the archive utility of the images. The POS_TARGS are also set to move the target nearer to the A readouts, to minimize CTE since the jet target is expected to be faint.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	0234+285	RA: 02 37 52.4000 (39.4683333d) Dec: +28 48 9.00 (28.80250d) Equinox: J2000		V=18+/-1	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) 0234+285	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 40,15		410 Secs (410 Secs)	
								[==>]	***[1]***
2		(2) 0234+285	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 40.1591 4,15.23969		410 Secs (410 Secs)	
								[==>]	***[1]***
3		(2) 0234+285	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 40.3164 1,15.08319		410 Secs (410 Secs)	
								[==>]	***[1]***
4		(2) 0234+285	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 40.0799 0,19.19413		410 Secs (410 Secs)	
								[==>]	***[1]***
5		(2) 0234+285	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 40.2877 1,19.28896		410 Secs (410 Secs)	
								[==>]	***[1]***

Orbit Structure