



10873 - The Radio-quiet Jet Flow in Markarian 34

Cycle: 15, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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) MRK-0034	WFPC2	3	16-Mar-2007 21:00:52.0	yes
02	(1) MRK-0034	WFPC2	5	16-Mar-2007 21:00:59.0	yes
03	(1) MRK-0034	WFPC2	4	16-Mar-2007 21:01:06.0	yes

12 Total Orbits Used

ABSTRACT

The properties of AGN jet flows are notoriously difficult to ascertain. We are currently studying jets in Seyferts by combining emission-line diagnostics with radio observations. We have devised a method of analysis which -- with only modest and reasonable assumptions -- leads to a physical description of the jet flow: its mass, momentum and energy flux,

along with its density, velocity and Mach number. We have applied this method to a rich dataset on Markarian 78 and discovered that its jet is very weak, slow, and dense relative to the kind of jets found in radio loud AGN (Whittle & Wilson 2004, Whittle et al 2005, 2006).

Such a difference between radio quiet and radio loud jet flows would be a major result -- if it were found to be generally true. We have more modest observations of a further six Seyferts with jets, but only one of these -- Mkn 34 -- approaches Mkn 78 as a clean enough case to allow our full analysis. Our existing VLA and STIS data are excellent, but the HST archive emission-line and continuum images are of poor quality and low resolution. We are requesting just 3 orbits to obtain higher S/N images at high resolution (ACS/HRC) in [OIII] 5007, [OII] 3727, green and red continuum, bringing the total dataset up to a par with that of Mkn 78. We will then be able to apply our full analysis to determine the nature of the jet flow in this second radio quiet AGN.

OBSERVING DESCRIPTION

This project aims to understand the ionization conditions and jet properties of Mkn 34, by combining ACS imaging and archival STIS spectroscopy of the galaxy nucleus. The central NLR of Mkn 34 extends for about 5 arcsec along the direction of the radio jet-axis and is about 2 arcsec wide at its widest extent. Due to its spatially compact nature and high surface-brightness, we propose to use the ACS/HRC to obtain images of the highest spatial resolution available on HST. We have been awarded 3 orbits of CVZ time for our observing program.

Our choice of filters is governed by the need to observe redshifted [OIII] λ 5007 and [OII] λ 3727 emission-lines, and suitably associated continuum images. For the emission-line images, we choose the FR388N ([OII]) and FR505N ([OIII]) ramp filters, centered at 3920 and

5266 Angstroms respectively. We have verified that these lines are fully sampled within the 2% bandwidth at the redshift of Mkn 34 ($z=0.051$). To calculate exposure times, we have used fluxes derived from ground based spectroscopy and the archive HST [OIII] image. Since the ACS ETC does not support the ramp filter configuration, we used nearby narrow band filters to estimate an exposure time of 50 minutes for FR388N and 30 minutes for FR505N to yield peak S/N ratio of ~ 35 per pixel falling to ~ 20 towards the edge of the emission region.

The continuum images are needed to a.) subtract the continuum contribution to the ramp filter images, and b.) provide a high S/N dust/reddening map of the Seyfert's nuclear environment. The F550M is an obvious choice to use with the [OIII] ramp filter image -- it excludes all significant emission lines and is sufficiently broad to provide high S/N in relatively short exposure time. In the absence of a fixed-band filter to pair with the [OII] image (the F330W contains Balmer nebular emission which seriously undermines the subtraction process, and F435W contains the redshifted [OII] emission), we will use the FR388N ramp-filter configured to image the line-free continuum around 4000 Angstroms. In addition, the F850LP filter will be used to obtain a high S/N I band image. Paired with the F550M and FR388N continuum images, this will yield a detailed color map. Lastly, a moderately deep wide field ACS-WFC image in F606W will allow the detection of possible signatures of an interaction with a neighbouring galaxy hinted at by ground-based optical imaging studies.

Based on ACS ETC calculations with continuum brightnesses measured from our STIS spectra, we estimate a peak S/N ~ 50 per pixel on nucleus dropping to ~ 10 per pixel at the edge of the emission region, for 30 minute exposures in both F550M and F850LP, and an average S/N of ~ 25 for a similar length continuum exposure in FR388N. This is easily adequate for off-band subtraction, but should also yield ratio images which are of sufficient quality to identify any patchy dust features that may in turn be affecting the emission line distribution. A 25 minute exposure in F606W will give complementary S/N in the outer regions of the galaxy disk.

Any early radio outbursts in Mkn 34 should have left their mark in the emission line gas distribution and ionization conditions out to 10-15 arcseconds from the nucleus. Since the emission line surface brightness drops off rapidly beyond the central NLR, reliable construction of ionization and color ratio maps at these distances involves accurate treatment of the background sky emission. By taking a second set of exposures in all HRC filters, but offset by 20 arcseconds (the nuclear FOV of the HRC is not large enough to sample regions outside the host galaxy light distribution), we will be able to accurately correct for this unknown pedestal. While separate sky images are needed for the FR505N, F550M and F850LP filters, only one sky image for both FR388N images is sufficient, since the background is not expected to vary considerably between their bandpasses.

The HRC images will be split in either three or, in the case of the FR388N [OII] image, four subexposures, to limit the effect of cosmic rays. The standard 2-point HRC line dither (integral dither of 5 pixels) will be used for chosen pairs of these subexposures to enable removal of hot pixels, while the WFC image, split into two subexposures, will be offset by a standard 50 pixel line dither pattern to account for the chip gap.

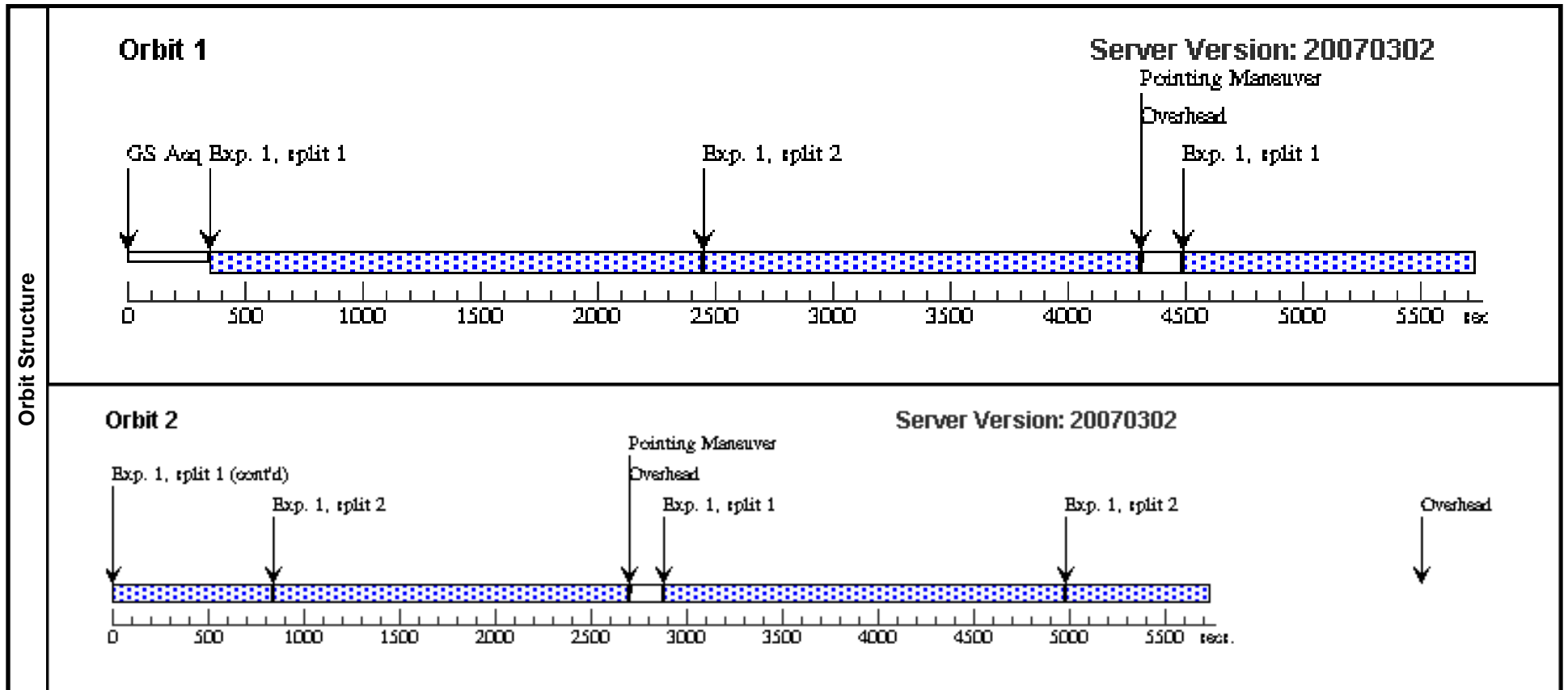
ADDITIONAL COMMENTS

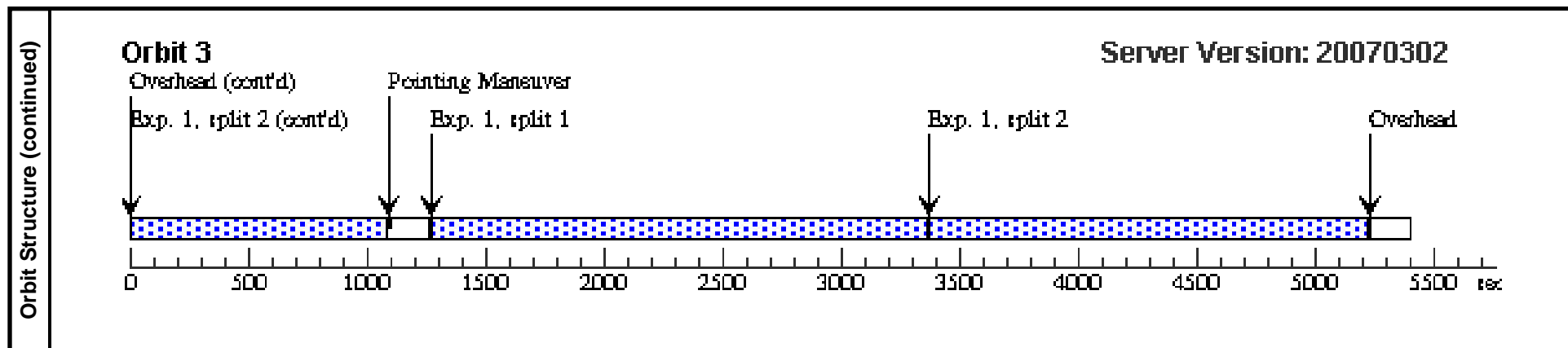
Our original Phase I submission proposed for 3 orbits of non-CVZ time. We have been upgraded to 3 orbits of CVZ time, subject to schedulability, after review of a Program Change Request by the Telescope Time Review Board.

Proposal 10873 - Visit 01 - The Radio-quiet Jet Flow in Markarian 34

Sat Mar 17 01:01:10 GMT 2007

Visit	Proposal 10873, Visit 01, pi Diagnostic Status: Error Scientific Instruments: WFPC2 Special Requirements: CVZ <i>Comments: CVZ, redshifted [OII] with quad filter</i>									
	([OII] Quad (01.001)) Error: This attribute cannot have this value due to other choices: Wavelength=3912.0 The combination of attributes chosen is illegal.									
Diagnosics										
Patterns	#	Primary Pattern		Secondary Pattern		Exposures				
	(1)	Pattern Type=WFPC2-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.559 Line Spacing=0.559	Coordinate Frame=POS-TARG Pattern Orientation=26.6 Angle Between Sides=143.1 Center Pattern=false			(1)				
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	MRK-0034	RA: 10 34 8.5930 (158.5358042d) Dec: +60 01 51.62 (60.03101d) Equinox: J2000	Redshift: 0.051	V=14.78+/-0.3	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	[OII] Quad	(1) MRK-0034	WFPC2, IMAGE, WF3	FQUVN 3912.0 A			Pattern 1-1 (1)	3600.0 Secs	
									[==>(Pattern 1, Split 1)]	
									[==>(Pattern 1, Split 2)]	[1]
									[==>(Pattern 2, Split 1)]	
								[==>(Pattern 2, Split 2)]		
								[==>(Pattern 3, Split 1)]	[2]	
								[==>(Pattern 3, Split 2)]		
								[==>(Pattern 4, Split 1)]		
								[==>(Pattern 4, Split 2)]	[3]	

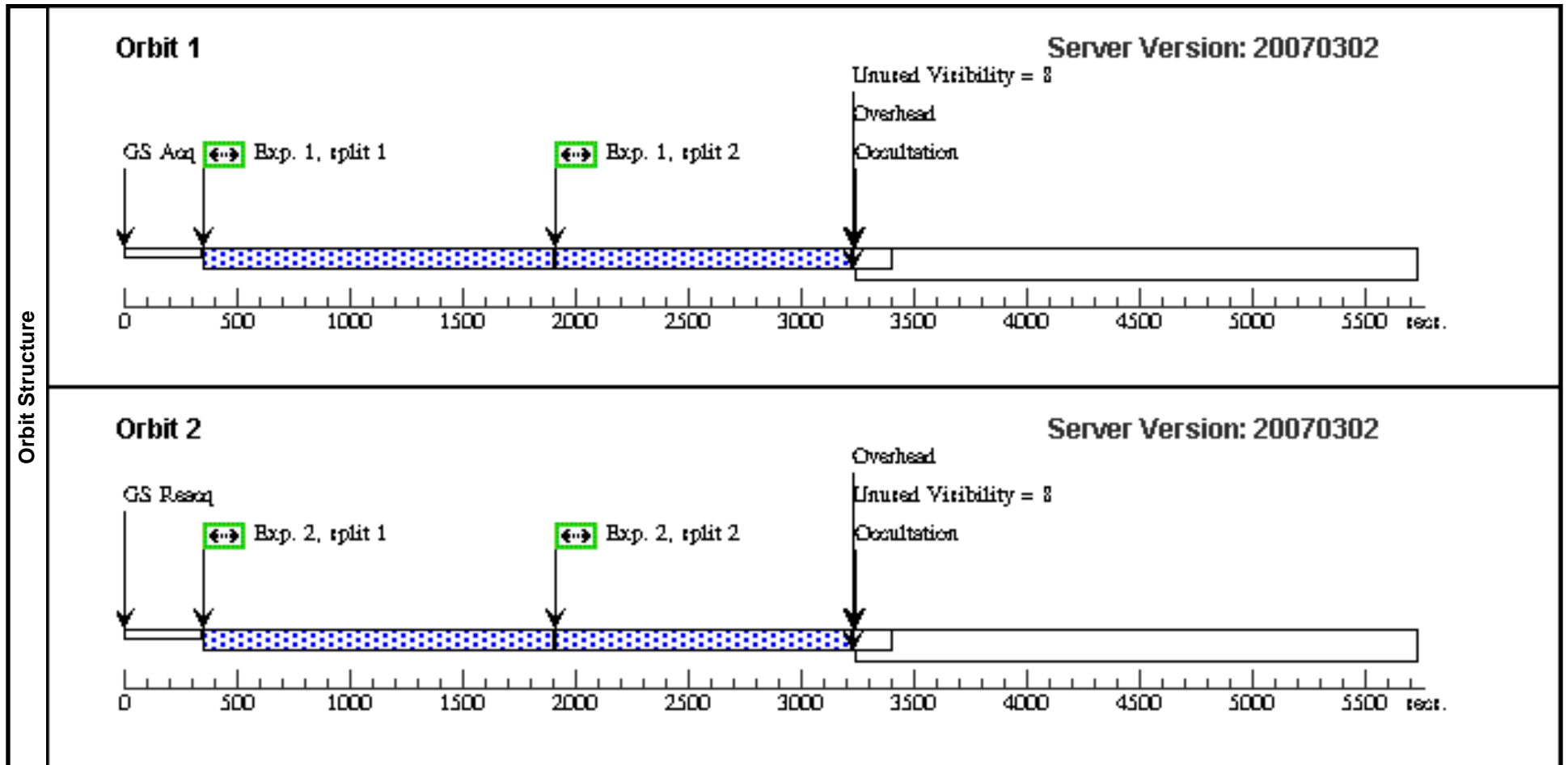


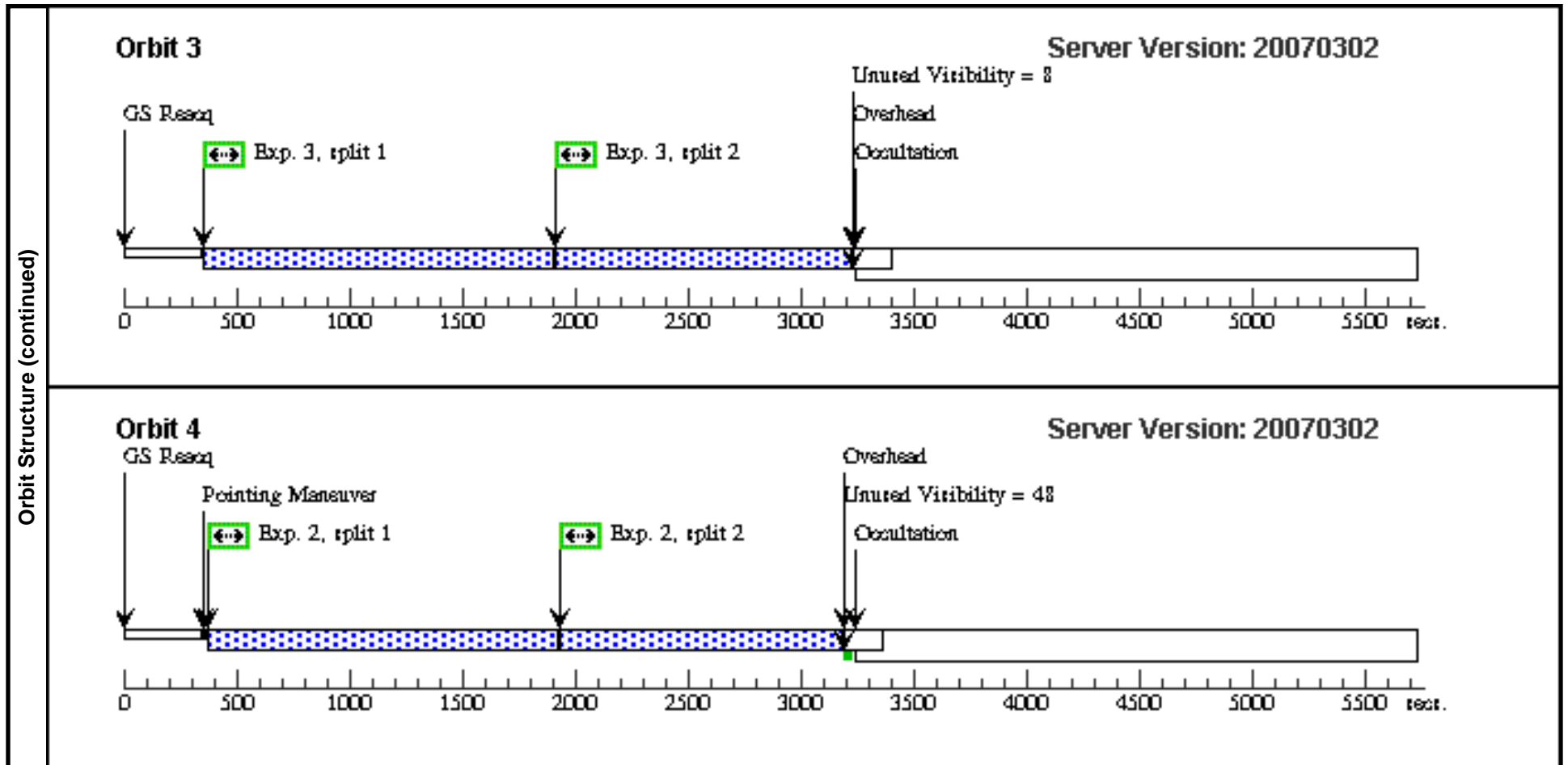


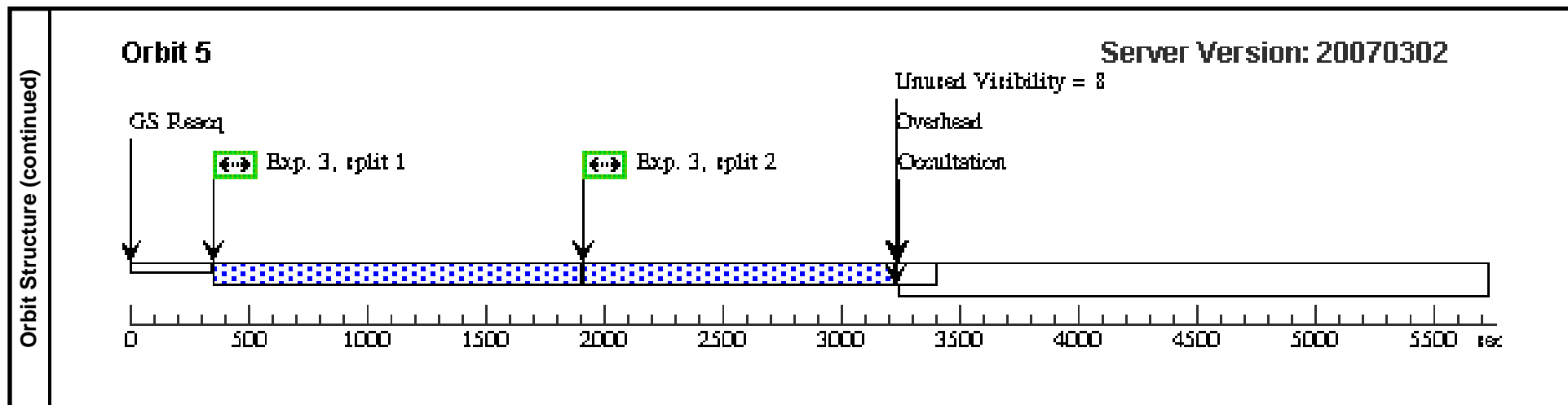
Proposal 10873 - Visit 02 - The Radio-quiet Jet Flow in Markarian 34

Sat Mar 17 01:01:12 GMT 2007

Visit	Proposal 10873, Visit 02 Diagnostic Status: No Diagnostics Scientific Instruments: WFPC2 Special Requirements: (none) <i>Comments: [OIII] line and continuum</i>									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(2)	Pattern Type=WFPC2-LINE Coordinate Frame=POS-TARG Purpose=DITHER Pattern Orientation=45 Number Of Points=2 Angle Between Sides= Point Spacing=0.354 Center Pattern=false Line Spacing=		(2-3)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	MRK-0034	RA: 10 34 8.5930 (158.5358042d) Dec: +60 01 51.62 (60.03101d) Equinox: J2000	Redshift: 0.051	V=14.78+/-0.3	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	[OIII] line	(1) MRK-0034	WFPC2, IMAGE, PC1-FIX	F547M				2400.0 Secs	
									[==>1300.0 Secs (Split 1)]	[1]
									[==>1300.0 Secs (Split 2)]	
	2	[OIII] line	(1) MRK-0034	WFPC2, IMAGE, PC1-FIX	F547M			Pattern 2-3 (2)	2400.0 Secs	
								[==>1300.0 Secs (Pattern 1, Split 1)]	[2]	
								[==>1300.0 Secs (Pattern 1, Split 2)]		
								[==>1300.0 Secs (Pattern 2, Split 1)]	[4]	
								[==>1200.0 Secs (Pattern 2, Split 2)]		
3	[OIII] continuum	(1) MRK-0034	WFPC2, IMAGE, PC1-FIX	F467M				Pattern 2-3 (2)	2400.0 Secs	
								[==>1300.0 Secs (Pattern 1, Split 1)]	[3]	
								[==>1300.0 Secs (Pattern 1, Split 2)]		
								[==>1300.0 Secs (Pattern 2, Split 1)]	[5]	
								[==>1300.0 Secs (Pattern 2, Split 2)]		







Proposal 10873 - Visit 03 - The Radio-quiet Jet Flow in Markarian 34

Sat Mar 17 01:01:13 GMT 2007

Visit	Proposal 10873, Visit 03 Diagnostic Status: No Diagnostics Scientific Instruments: WFPC2 Special Requirements: (none) Comments: [OII] and red continuum									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
		(2)	Pattern Type=WFPC2-LINE Coordinate Frame=POS-TARG Purpose=DITHER Pattern Orientation=45 Number Of Points=2 Angle Between Sides= Point Spacing=0.354 Center Pattern=false Line Spacing=		(1)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	MRK-0034	RA: 10 34 8.5930 (158.5358042d) Dec: +60 01 51.62 (60.03101d) Equinox: J2000	Redshift: 0.051	V=14.78+/-0.3	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	[OII] continuum	(1) MRK-0034	WFPC2, IMAGE, PC1-FIX	F410M			Pattern 1-1 (2)	2400.0 Secs	
									[==>1300.0 Secs (Pattern 1, Split 1)]	[1]
									[==>(Pattern 1, Split 2)]	
									[==>1300.0 Secs (Pattern 2, Split 1)]	[2]
								[==>1300.0 Secs (Pattern 2, Split 2)]		
	2	Red continuum - PC	(1) MRK-0034	WFPC2, IMAGE, PC1-FIX	F673N				2400.0 Secs	
									[==>1300.0 Secs (Split 1)]	[3]
									[==>(Split 2)]	
	Comments: On PC for maximum resolution									
	3	Red continuum - WF	(1) MRK-0034	WFPC2, IMAGE, WFALL-FIX	F673N				2400.0 Secs	
									[==>1300.0 Secs (Split 1)]	[4]
									[==>1300.0 Secs (Split 2)]	
	Comments: On WF-ALL for maximum spatial coverage.									

