



15124 - Measuring the Accretion Disk Size in Mrk 509 using Continuum Reverberation Mapping

Cycle: 25, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

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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-509 CCDFLAT	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	19-Jul-2017 12:02:19.0	yes

2 Total Orbits Used

ABSTRACT

Continuum reverberation mapping from X-rays through optical wavelengths provides a unique probe of accretion disk structure in active galactic nuclei (AGN) on spatial scales of light-days. Recent Swift monitoring campaigns for NGC 5548 and NGC 4151 have provided dramatic evidence that accretion disk sizes are too large to be compatible with standard thin-disk models, requiring a major revision of our understanding of AGN accretion disks. We are currently carrying out an intensive 9-month Swift and ground-based monitoring campaign targeting Mrk 509, an AGN with luminosity an order of magnitude greater than other recent Swift monitoring targets, to map its accretion disk size. The UV and optical filter bands used for photometric monitoring include significant contamination by reprocessed emission from the broad-line region (BLR), including broad emission lines, Balmer continuum, and Fe II emission. In order to quantify the effect of this BLR emission on the accretion disk time delays, we propose to obtain a STIS UV/optical spectrum of the nucleus of Mrk 509 while our Swift campaign is in progress. We will use the STIS spectrum to determine the contribution of broad-line, Balmer continuum, and Fe II emission to each of the UV and optical filters. By correcting for this BLR contamination we will derive wavelength-dependent time delays for the AGN continuum that will provide an accurate measure of the accretion disk size and structure. Our new STIS data will additionally provide new diagnostics of broad-line region and narrow-line region physical conditions and a direct comparison of black hole mass estimates from broad emission lines including H-beta, C IV, and Mg II.

OBSERVING DESCRIPTION

This program is designed to obtain a complete and simultaneous UV/optical spectrum of the AGN Mrk 509 concurrent with a long-duration Swift and ground-based monitoring campaign, in order to determine the contributions of various broad emission lines to the UV and optical photometric filters, which is necessary for accurate interpretation of the broad-band continuum reverberation lags measured from the Swift and ground-based data. We will use the STIS G140L, G230L, G430L, and G750L gratings to obtain complete coverage of the AGN spectrum.

The AGN nucleus is very compact and we will use ACQTYPE=POINT for the STIS acquisition. Following STIS target acquisition, the first orbit will be used for G140L, and the second orbit will be used for G230L, G430L, and G750L. We will use the 0.2 arcsec slit width for all spectroscopic

Proposal 15124 (STIScl Edit Number: 0, Created: Wednesday, July 19, 2017 11:02:21 AM EST) - Overview

exposures. For the CCD exposures, the E1 aperture position will be used to minimize CTE losses. With each grating, we will obtain dithered exposures using the STIS-ALONG-SLIT pattern to remove the effect of bad pixels and cosmic-ray hits in the CCD data and to maximize S/N in the MAMA data following Section 12.5.1 of the STIS Instrument Handbook. We prefer to use ACCUM rather than TIME-TAG mode for the MAMA exposures because using TIME-TAG with dithered exposures results in extra overheads and some loss of on-source integration time.

For G750M we will obtain fringe flats at the end of the orbit. Following Table 11.1 of the STIS Instrument Handbook, the 52X0.1 slit will be used for the G750L fringe flats. We choose not to use the 52X0.2E2 aperture position for the G750L observation of the AGN because this will negatively impact the throughput and measurement of the spectral shape when combined with the other grating settings. We will use GAIN=4 for the CCD exposures to ensure that the peaks of the H α and [OIII] lines are well below the saturation level, based on STIS ETC calculations using observed spectra of Mrk 509.

Since this AGN is highly variable on timescales of days to weeks, it is critically important that the entire program be carried out in a single visit, so that we can obtain an accurate overall spectral shape for the AGN. The total on-source integration time for the CCD exposures is 600 seconds and the total time required for the STIS CCD observations (including overheads) is less than 30 minutes during the visibility period of the 2nd orbit.

The scheduling requirement is that the visit should take place sometime before the end of the Swift monitoring campaign, which will be completed on December 15, 2017. There are no orientation or other requirements.

Proposal 15124 - Visit 01 - Measuring the Accretion Disk Size in Mrk 509 using Continuum Reverberation Mapping

Wed Jul 19 16:02:21 GMT 2017

Visit	Proposal 15124, Visit 01 Diagnostic Status: No Diagnostics Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, STIS/FUV-MAMA Special Requirements: BEFORE 15-DEC-2017:00:00:00					
	#	Primary Pattern	Secondary Pattern	Exposures		
Patterns	(1)	Pattern Type=STIS-ALONG-SLIT Coordinate Frame=POS-TARG Purpose=DITHER Pattern Orientation=90.0 Number Of Points=4 Angle Between Sides= Point Spacing=0.15 Center Pattern=false Line Spacing=		(4), (5)		
	(2)	Pattern Type=STIS-ALONG-SLIT Coordinate Frame=POS-TARG Purpose=DITHER Pattern Orientation=90.0 Number Of Points=2 Angle Between Sides= Point Spacing=0.4 Center Pattern=false Line Spacing=		(3)		
	(3)	Pattern Type=STIS-ALONG-SLIT Coordinate Frame=POS-TARG Purpose=DITHER Pattern Orientation=90.0 Number Of Points=3 Angle Between Sides= Point Spacing=0.4 Center Pattern=false Line Spacing=		(2)		
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	MRK-509	RA: 20 44 9.7681 (311.0407004d) Dec: -10 43 24.45 (-10.72346d) Equinox: J2000		V=13.12	Reference Frame: ICRS
<i>Comments: ICRS coordinates and uncertainty are from Andrei et al 2009, A&A 505, 385 (consistent with SIMBAD lookup), and checked against 2MASS and GSC2. NED lookup gives slightly discrepant coordinates for RA, different by about 0.4 arcsec.</i>						

Proposal 15124 - Visit 01 - Measuring the Accretion Disk Size in Mrk 509 using Continuum Reverberation Mapping

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) MRK-509	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			2 Secs (2 Secs)	
									[==>]	[1]
	2	(STIS.sp.10 08264)	(1) MRK-509	STIS/FUV-MAMA, ACCUM, 52X0.2	G140L 1425 A			Pattern 3, Exps 2-2 i n Visit 01 (3)	736 Secs (2208 Secs)	
									[==>(Pattern 1)]	
									[==>(Pattern 2)]	[1]
									[==>(Pattern 3)]	
	3	(STIS.sp.10 08265)	(1) MRK-509	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A			Pattern 2, Exps 3-3 i n Visit 01 (2)	575 Secs (1150 Secs)	
									[==>(Pattern 1)]	
									[==>(Pattern 2)]	[2]
4		(1) MRK-509	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A	CR-SPLIT=NO; GAIN=4		Pattern 1, Exps 4-4 i n Visit 01 (1)	100 Secs (400 Secs)		
								[==>(Pattern 1)]		
								[==>(Pattern 2)]		
								[==>(Pattern 3)]	[2]	
								[==>(Pattern 4)]		
5		(1) MRK-509	STIS/CCD, ACCUM, 52X0.2E1	G750L 7751 A	CR-SPLIT=NO; GAIN=4		Pattern 1, Exps 5-5 i n Visit 01 (1)	50 Secs (200 Secs)		
								[==>(Pattern 1)]		
								[==>(Pattern 2)]		
								[==>(Pattern 3)]	[2]	
								[==>(Pattern 4)]		
6		CCDFLAT	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				[==>(Copy 1)]		
								[==>(Copy 2)]	[2]	



