15413 - Accretion disk reverberation mapping of the high Eddington rate Seyfert 1 Mrk 110

Cycle: 25, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) MRK-110 CCDFLAT	STIS/CCD STIS/NUV-MAMA	1	27-Nov-2017 20:01:02.0	yes
02	(1) MRK-110 CCDFLAT	STIS/CCD STIS/NUV-MAMA	1	27-Nov-2017 20:01:05.0	yes
03	(1) MRK-110 CCDFLAT	STIS/CCD STIS/NUV-MAMA	1	27-Nov-2017 20:01:07.0	yes

3 Total Orbits Used

ABSTRACT

Through measuring wavelength-dependent continuum time lags, accretion disk reverberation mapping campaigns are now seriously challenging the standard thin disk/reprocessing model. Our recent results have found accretion disk sizes that are larger than predicted by the standard disk model; X-ray to UV lags suggesting the presence of a second X-ray/UV reprocessor; and evidence that continuum emission from the broad line region can be a significant contribution to continuum reverberation lags. We have a Swift Key Project taking place from 2017 Oct 29 - 2018 Jan 27 to perform accretion disk reverberation mapping of the nearby, bright AGN Mrk 110 with a substantially larger Eddington ratio than previously studied. Mrk 110 will be monitored with Swift every ~8 hr for 90 days. The UV and optical filter bands used for photometric monitoring include significant contamination by reprocessed emission from the broad-line region, including broad emission lines, Balmer continuum, and Fe II emission. Here, we propose 3 one-orbit STIS observations of Mrk 110 in order to assess the strengths of each of these components to the photometric bands. We can then correct the lags for these contaminants and obtain an accurate measure of the accretion disk size and structure in this high Eddington rate AGN.

OBSERVING DESCRIPTION

We have 3 orbits approved during Phase I. Each orbit is a separate visit of Mrk 110, and during each orbit we will obtain STIS observations in G230L, G430L and G750L. This provides broadband spectroscopic coverage of this AGN coinciding with our Swift monitoring of this object.

This program is supporting a Swift Key Project to monitor Mrk 110. That monitoring began on October 28, 2017 and will continue until January 27, 2018. As detailed in the Phase I proposal, we request that our three 1-orbit observations be taken during this Swift monitoring period. The 3 separate visits allows us to both get a high-quality mean spectrum taken concurrently with our Swift campaign, in addition to getting a measure of the variable spectrum - important for identifying which components contribute to the continuum lags.

While scheduling of the 3 separate orbits can be flexible, the maximum science return will be from them being spread out during this period and not all clustered together. However, we do stress that scheduling all 3 orbits is more important than the exact spacing of the observations. We have increased the schedulability to allow maximal flexibility in scheduling, but have added a minimum of 5 days between visits, to avoid clustering (this can be changed if needed).

The AGN nucleus is compact and we will use ACQTYPE=POINT for the STIS acquisition. Following STIS target acquisition, the spectra will be obtained with the G230L, G430L, and G750L gratings using a 0.2 arcsec slit. 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. Moreover, it is the variability between visits, rather than during a visit that is important here scientifically.

For G750L 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 Halpha and [OIII] lines are well below the saturation level, based on STIS ETC calculations using recent photometry of Mrk 110, and a standard type I quasar spectrum.

Visit

Proposal 15413, Visit 01, implementation Tue Nov 28 01:01:08 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: SCHED 90%; BEFORE 28-JAN-2018:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT Purpose=DITHER Number Of Points=3 Point Spacing=0.2 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=90.0 Angle Between Sides= Center Pattern=false		(3), (4)
(2)	Pattern Type=STIS-ALONG-SLIT Purpose=DITHER Number Of Points=2 Point Spacing=0.4 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=90.0 Angle Between Sides= Center Pattern=false		(2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	MRK-110	RA: 09 25 12.8712 (141.3036300d) Dec: +52 17 10.50 (52.28625d) Equinox: J2000		V=16.41	Reference Frame: ICRS

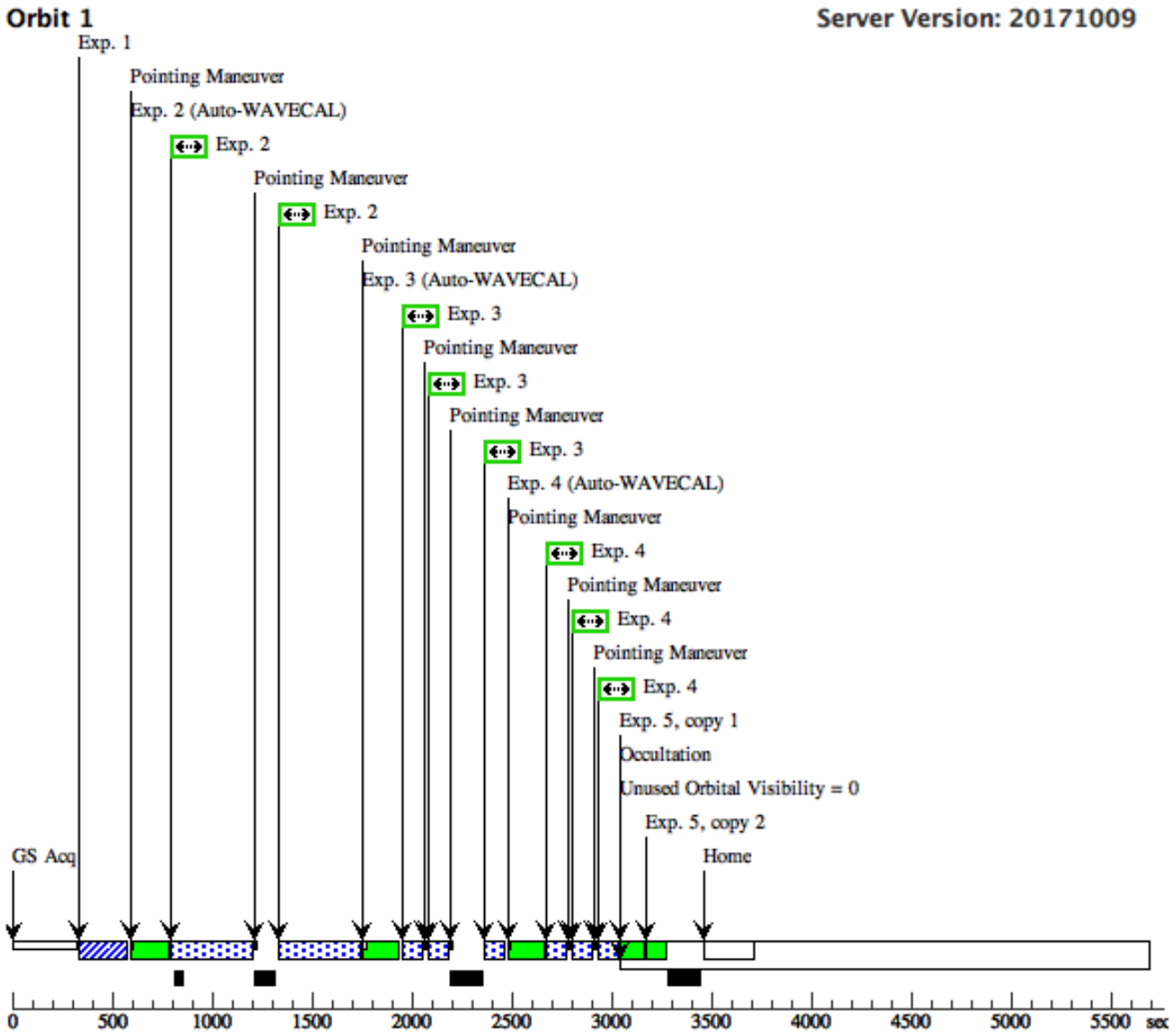
Comments: Position is from the Large Quasar Reference Frame, Andrei et al. 2009: http://simbad.u-strasbg.fr/simbad/sim-ref?bibcode=2009A%26A...505..385A

This is consistent with the 2MASS position to better than 0.3 arcsec in both RA and Dec.

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) MRK-110	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			4 Secs (4 Secs) *[==>]*	***[1]***
2	(STIS.sp.10 36560)	(1) MRK-110	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A			Pattern 2, Exps 2-2 in Visit 01 (2)	400 Secs (800 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***
3	(STIS.sp.10 36575)	(1) MRK-110	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A	CR-SPLIT=NO; GAIN=4		Pattern 1, Exps 3-3 in Visit 01 (1)	60 Secs (180 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
4	(STIS.sp.10 36577)	(1) MRK-110	STIS/CCD, ACCUM, 52X0.2E1	G750L 7751 A	CR-SPLIT=NO; GAIN=4		Pattern 1, Exps 4-4 in Visit 01 (1)	60 Secs (180 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
5		CCDFLAT	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***

Orbit Structure



Visit

Proposal 15413, Visit 02, implementation Tue Nov 28 01:01:08 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: SCHED 90%; SAME ORIENT AS 01; AFTER 01 BY 5 D TO 60 D; BEFORE 28-JAN-2018:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT Purpose=DITHER Number Of Points=3 Point Spacing=0.2 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=90.0 Angle Between Sides= Center Pattern=false		(3), (4)
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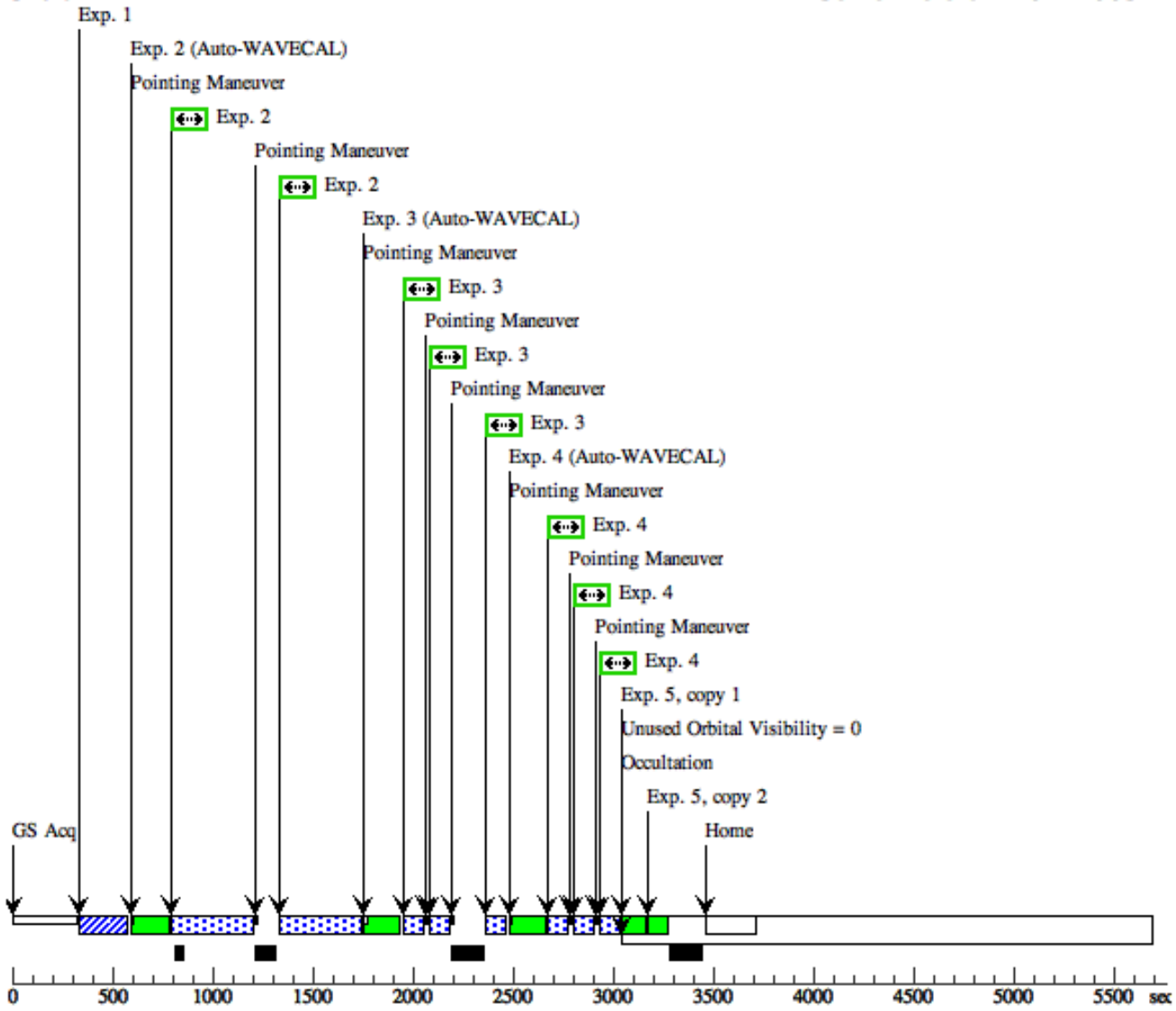
2	(STIS.sp.10 36560)	(1) MRK-110	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A			Pattern 2, Exps 2-2 in Visit 02 (2)	400 Secs (800 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***
3	(STIS.sp.10 36575)	(1) MRK-110	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A	CR-SPLIT=NO; GAIN=4		Pattern 1, Exps 3-3 in Visit 02 (1)	60 Secs (180 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
4	(STIS.sp.10 36577)	(1) MRK-110	STIS/CCD, ACCUM, 52X0.2E1	G750L 7751 A	CR-SPLIT=NO; GAIN=4		Pattern 1, Exps 4-4 in Visit 02 (1)	60 Secs (180 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
5		CCDFLAT	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***

Orbit Structure



Visit

Proposal 15413, Visit 03, implementation Tue Nov 28 01:01:08 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: SCHED 90%; SAME ORIENT AS 01; AFTER 02 BY 5 D TO 60 D; BEFORE 28-JAN-2018:00:00:00

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5		CCDFLAT	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***

Orbit Structure