13285 - WFC3 imaging and galaxy subtraction for the Kepler BL Lac W2R1926+42

Cycle: 21, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Richard Edelson (PI) (Contact)	**University of Maryland**	**rickedelson@gmail.com**
Prof. Matthew A. Malkan (CoI)	University of California - Los Angeles	malkan@astro.ucla.edu
Dr. Simon Allan Vaughan (CoI) (ESA Member)	University of Leicester	sav2@le.ac.uk
Dr. Richard Mushotzky (CoI)	University of Maryland	richard@astro.umd.edu
Dr. Ranjan Vasudevan (CoI)	University of Maryland	ranjan@astro.umd.edu
Dr. Guy Gibson Pooley (CoI) (ESA Member)	University of Cambridge	ggp1@cam.ac.uk

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) W2R1926+42	WFC3/UVIS	1	05-Aug-2014 21:00:33.0	yes

1 Total Orbits Used

ABSTRACT

We request a single GO orbit for WFC3 imaging to measure the underlying galaxy in W2R1926+42, the only known rapidly-variable BL Lac in the Kepler field. Kepler is producing a light curve of unprecedented detail and quality, sampled once every minute with ~1% errors and ~90% duty cycle, eventually to span many years. This will be >3 orders of magnitude longer than previous quasi-continuous BL Lac optical monitoring.

Lower cadence Kepler monitoring demonstrates that so-called "blazar microvariability" (previously hinted at in short ~12 hr light curve snippets) is the result of strong, rapid flaring (>10% in ~1 hr) interspersed with much longer periods (days) of relative quiescence. These data have allowed the first measurement of the optical PSD of a BL Lac, indicating a ~4 hr timescale. They also show an approximately lognormal distribution of fluxes as

well as a correlation between rms variability and flux, relations that have previously been associated with Seyfert 1 accretion disks. This is interesting because beamed jet emission, not accretion disk emission, is believed to dominate the output in BL Lacs.

However the analysis is complicated by a large and unknown flux offset (up to ~88% of the mean flux) introduced because the underlying galaxy contaminates the light curve measured with Kepler's large (~4") pixels. The WFC3 has a factor of ~100 higher resolution, providing much more suitable data for resolving the galaxy, determining its contribution, and correcting the light curve. Accurate subtraction of this non-variable component will allow improved constraints on the physical processes responsible for the variability.

OBSERVING DESCRIPTION

These observations will utilize the WFC3-UVIS in imaging mode. We used the APT Phase II Orbit Planner to tailor the observations to fit into a single HST orbit. These utilize the 1kx1k subarray (e.g., UVIS1-C1K1C-SUB) in order to assure inclusion PSF stars while minimizing overhead so no readout will be required during the orbit. No dithering is used because this source can show significant variations in as little as 20 min.

The bulk of our observations will be with the broad-bandpass F350LP filter in order to minimize the exposure time needed to obtain adequate S/N. This filter is a good match to the Kepler 4200-9000 A bandpass in the red but extends somewhat further into the blue. Using the same assumptions as before (integrated B = 18.1 evenly divided between the galaxy and point source, corresponding to B = 18.7 in the point source), a flat continuum in F_nu, and defaults for all other inputs, the WFC3 Exposure Time Calculator indicated that the point source would saturate at ~160 sec. (Because this magnitude was derived from USNO photographic photometry, it should be considered an upper limit to the flux). Conservatively using 66 sec exposures, our APT simulations indicated that we can fit 16 into the first part of the orbit. Following that will be a series of short exposures (1 min F606W / 2 min F336W / 1 min F606W) to yield colors of the point source and host galaxy. The symmetrical coverage protects against variability to the first order, while the much lower throughput of these filters means that saturation is not a concern.

Visit

Proposal 13285, Visit 01, implementation Wed Aug 06 01:00:34 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1), (2), (3), (4)
(2)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(5), (6)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	W2R1926+42	RA: 19 26 31.0500 (291.6293750d) Dec: +42 09 59.00 (42.16639d) Equinox: J2000		V=17.5+/-1 B = 18.1	Reference Frame: ICRS

Proposal 13285 - Visit 01 - WFC3 imaging and galaxy subtraction for the Kepler BL Lac W2R1926+42

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) W2R1926+42	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F350LP	FLASH=5		Pattern 1, Exps 1-1 in Visit 01 (1)	66 Secs (224 Secs)	
								[==>56.0 Secs (Pattern 1)]	***[1]***
								[==>56.0 Secs (Pattern 2)]	
								[==>56.0 Secs (Pattern 3)]	
								[==>56.0 Secs (Pattern 4)]	
2		(1) W2R1926+42	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F350LP	FLASH=5		Pattern 1, Exps 2-2 in Visit 01 (1)	66 Secs (224 Secs)	
								[==>56.0 Secs (Pattern 1)]	***[1]***
								[==>56.0 Secs (Pattern 2)]	
								[==>56.0 Secs (Pattern 3)]	
								[==>56.0 Secs (Pattern 4)]	
3		(1) W2R1926+42	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F350LP	FLASH=5		Pattern 1, Exps 3-3 in Visit 01 (1)	66 Secs (224 Secs)	
								[==>56.0 Secs (Pattern 1)]	***[1]***
								[==>56.0 Secs (Pattern 2)]	
								[==>56.0 Secs (Pattern 3)]	
								[==>56.0 Secs (Pattern 4)]	
4		(1) W2R1926+42	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F350LP	FLASH=5		Pattern 1, Exps 4-4 in Visit 01 (1)	66 Secs (224 Secs)	
								[==>56.0 Secs (Pattern 1)]	***[1]***
								[==>56.0 Secs (Pattern 2)]	
								[==>56.0 Secs (Pattern 3)]	
								[==>56.0 Secs (Pattern 4)]	
5		(1) W2R1926+42	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	FLASH=8		Pattern 2, Exps 5-5 in Visit 01 (2)	66 Secs (112 Secs)	
								[==>56.0 Secs (Pattern 1)]	***[1]***
								[==>56.0 Secs (Pattern 2)]	
6		(1) W2R1926+42	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=12		Pattern 2, Exps 6-6 in Visit 01 (2)	66 Secs (112 Secs)	
								[==>56.0 Secs (Pattern 1)]	***[1]***
								[==>56.0 Secs (Pattern 2)]	

Orbit Structure