12745 - Measuring X-ray and UV Magnetic Activity on the Fast-Rotating K0 Dwarf KIC_11560431

Cycle: 19, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Alexander Brown (PI)	**University of Colorado at Boulder**	**alexander.brown@colorado.edu**
Dr. Suzanne L. Hawley (CoI)	University of Washington	slh@astro.washington.edu
Dr. Thomas R. Ayres (CoI)	University of Colorado at Boulder	thomas.ayres@colorado.edu
Mr. Adam F Kowalski (CoI)	University of Washington	adamfk@u.washington.edu
Dr. Lucianne M. Walkowicz (CoI)	Princeton University	lucianne@astro.princeton.edu
Heidi Kohonen (CoI) (ESA Member)	University of Turku	heidi.h.korhonen@utu.fi
Dr. Svetlana Berdyugina (CoI)	Universitat Freiburg	sveta@kis.uni-freibrug.de

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) KIC11560431 WAVE	COS/FUV COS/NUV STIS/CCD STIS/NUV-MAMA	4	16-Apr-2012 21:12:44.0	yes

4 Total Orbits Used

ABSTRACT

The KEPLER satellite is providing optical photometric light-curves of unprecedented precision and duration that allow studies of magnetic activity on late-type stars that were difficult to attempt previously. We are observing ~200 active, late-type stars in our KEPLER GO programs and as a first step to connect KEPLER investigations of stellar activity into the broader multiwavelength framework, we propose observing the brightest star in our sample that shows starspot rotational modulation, the K0 dwarf KIC 11560431 (V=9.8, P_rot=3.4 d), using contemporaneous Chandra ACIS-I and the HST COS+STIS spectrographs. The X-ray and UV emission will allow the activity level of this star to be measured. The relationship between KEPLER "white light"; flares and their X-ray/FUV counterparts will be studied.

OBSERVING DESCRIPTION

This program will measure the FUV and NUV emission from KIC11560431 using the HST COS and STIS spectrographs and the X-ray emission using ACIS-I observations . Our preference is that these UV and X-ray spectra be obtained contemporaneously. With HST we can acquire medium resolution spectra in the FUV and NUV (1150-3000 A). The observations possible with the COS and STIS spectrographs provide UV spectra of unprecedented quality and sensitivity. KIC11560431 is at 60 pc with low interstellar absorption. KIC11560431 is the brightest star in our Kepler sample that shows starspot rotational modulation. It is a K0 dwarf with V=9.8 -- our Kepler targets typically have V=13.5-14.0. It is even bright enough to have a name other than a KIC number --- it is BD+49 3025. Its photometric modulation period is 3.4 days, which implies that it either relatively young or a spectroscopic binary.

Medium resolution HST ultraviolet spectra provide a vast amount of complementary information that greatly enhances the interpretation of the X-ray spectra from coronal plasma. UV spectra significantly extend the range of plasma temperatures sampled. The easily attainable UV spectral resolution is far higher (R~18,000 with the COS M gratings and ~30,000 with STIS E230M) than possible in X-rays (R up to 1,000 with Chandra ACIS/HETG in 1st order). Therefore, COS and STIS spectra provide resolved profiles for the emission lines formed in the hot plasma and these can be used to study the dynamical conditions, such as turbulence and flows, within regions that are often directly associated with the X-ray emitting plasma.

We shall obtain COS G160M+G130M spectra of the 1150-1780 A spectral region and STIS E240M (2160-2960 A) spectra. COS offers a significant increase in FUV sensitivity at comparable spectral resolution when compared to STIS observing modes. (STIS is still the preferred option in the NUV). These spectra will record the UV transition region and chromospheric emission line spectrum, sampling a wide range of elements and ionization states -- e.g strong lines of C I->IV, O III->IV, Si I->IV, N V, He II, Mg II, and Fe II. G130M provides simultaneous observation of chromospheric, transition region and coronal emission lines. G160M 1577 setting provides simultaneous observation of the two strongest transition

region doublets, C IV and Si IV.

The COS and STIS data will be obtained in TIME-TAG mode, which allows study of any temporal variability. The proposed observing strategy is based on our prior experience for stars of very similar brightness. We shall use the COS 2.5 arcsec diameter PSA (Prime Science Aperture), which is small enough to allow observation of the target star individually, and the STIS 0.2x0.2 arcsec aperture.

Acquisition Strategy:

******* REVISED ACQUISITION STRATEGY --- 2012 April 13

The observations will be obtained in a single 4 orbit visit. The star will be acquired with a pair of COS NUV ACQ/IMAGE in the BOA using MIRRORA with 100 second exposure times. The remainder of the first orbit and part of orbit 2 will observe with the G130M grating, while the remainder of the second and all the third orbits will use G160M. The final orbit will be used to obtain STIS NUV E230M echelle and G230L first-order spectra. The STIS acquisition would use the NUV CCD and F28x50OII. The coordinates in this Phase II proposal are from the 2MASS Catalog and are accurate to better than 0.1 arcseconds.

++++++++++++++++++++++

The total G130M exposure, using three (1291,1309,1327) grating settings, is 3.75 ksec and the total G160M exposure, predominantly using the 1577 grating, plus a small amount using the 1623 grating, is 3.5 ksec. The total Si IV exposure is 6.85 ksec, and the total for C IV is 3.5 ksec. The STIS orbit should provide 1.5 ksec of E230M exposure and good Mg II h&k emission line profiles.

No UV spectra exist for 11560431 Therefore, we have constructed our Phase II observing sequence to match successfully implemented COS/STIS observations for young active stars with similar spectral properties by Cycle 17 program 11616 --- in particular we have used the COS G130M/G160M spectrum of the young active star LkCa19 (K0, rotational period = 2.24 days). LkCa19 is old enough that it is no longer accreting and thus its UV continuum is typical. LkCa19 has V=11.3, i.e.1.5 magnitudes fainter than KIC11560431; we have thus multipled the flux density spectrum of LKCa19 by a factor of 4 before entering it into the ETC. (This factor is consistent with the roughly factor of 2 difference in the distances to these stars.) Both stars have fairly low interstellar H columns --- the best estimate for KIC11560431 is N_H ~ 8 x 10e19 cm-2.

Visit

Proposal 12745, Visit 01, implementation Tue Apr 17 01:12:56 GMT 2012

Diagnostic Status: Warning

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

Special Requirements: (none)

Diagnostics

(Visit 01) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.

(Visit 01) Warning (Form): If the target coordinates are not known to 0.4" (or better) an ACQ/SEARCH should precede the ACQ/IMAGE.

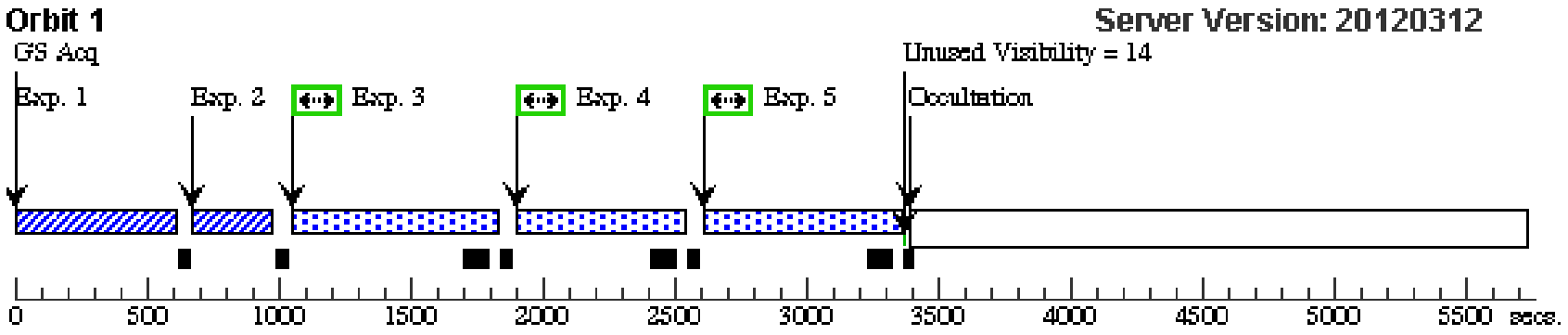
Fixed Targets

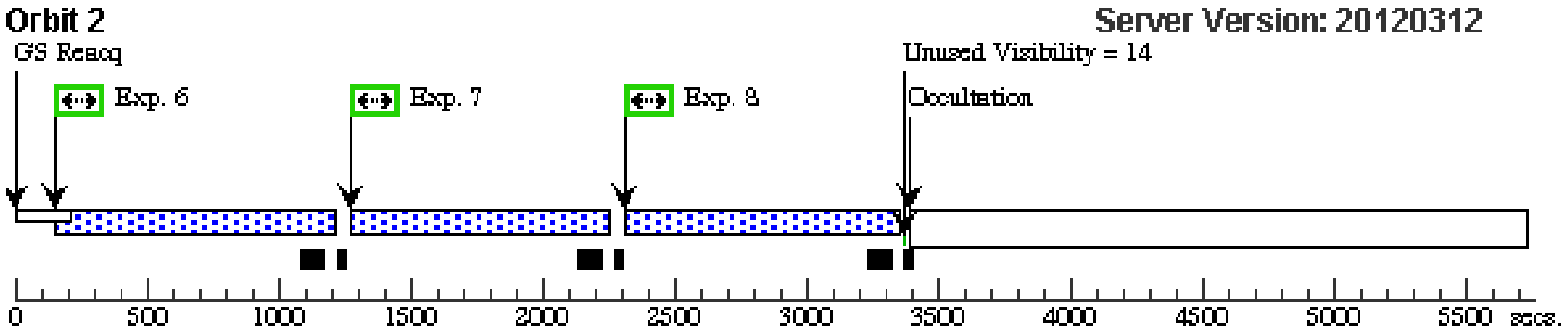
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	KIC11560431	RA: 19 30 15.8010 (292.5658375d) Dec: +49 32 8.61 (49.53572d) Equinox: J2000	Epoch of Position: 2000.0	V=9.8+/-0.01	Reference Frame: ICRS

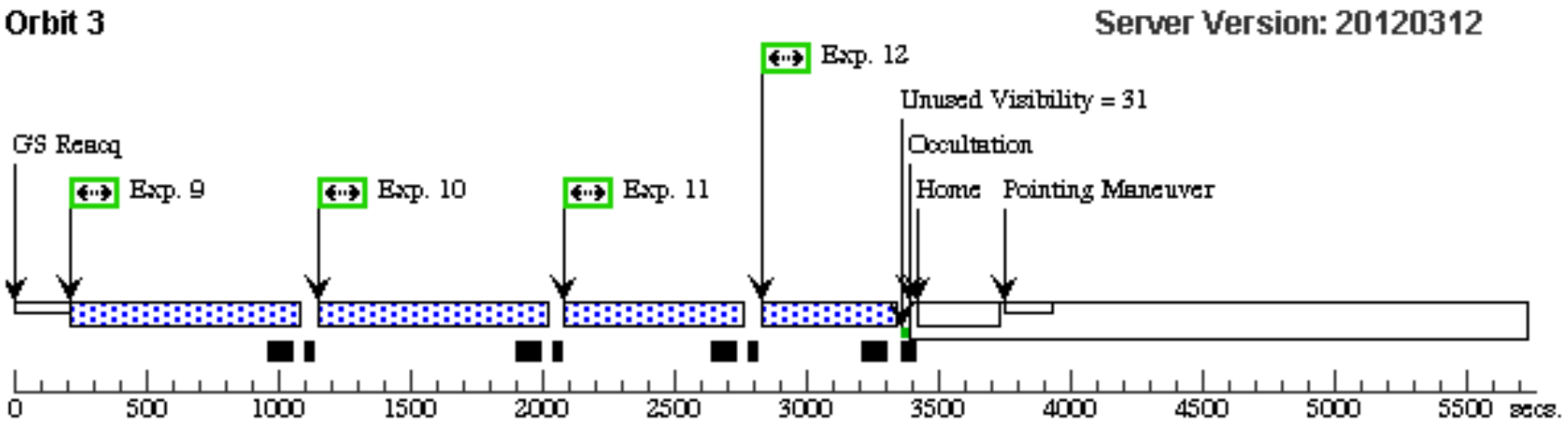
Exposures

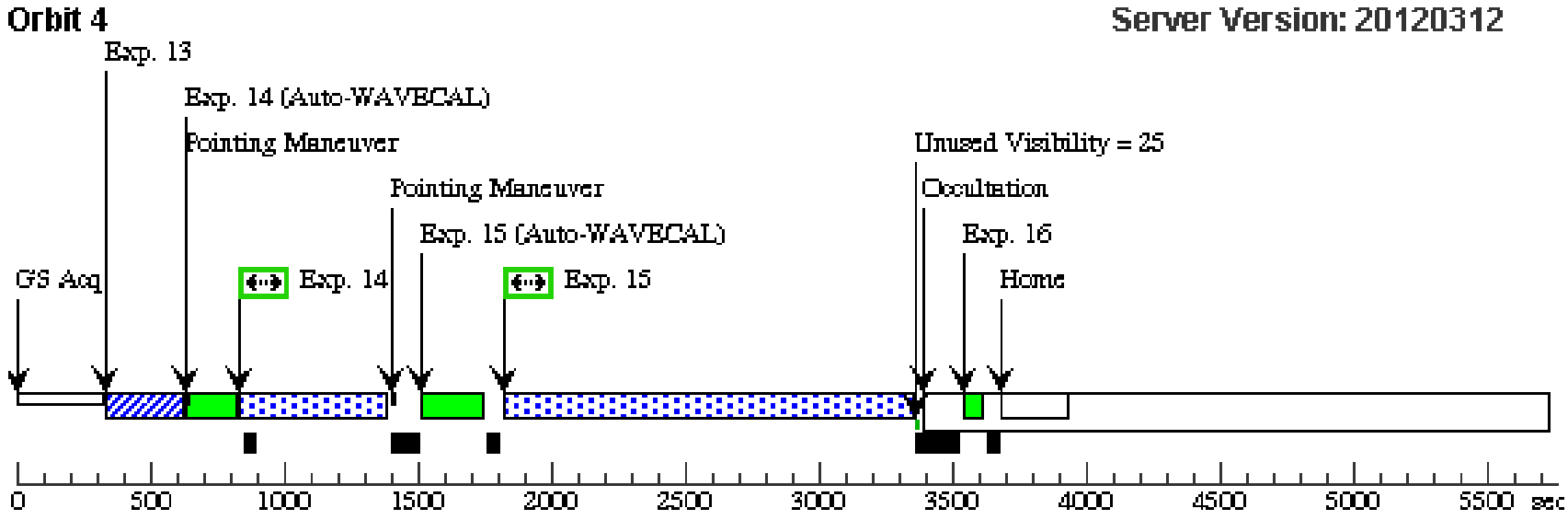
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	(COS.ta.397 311)	(1) KIC11560431	COS/NUV, ACQ/IMAGE, BOA	MIRRORA				100 Secs *[==>]*	 ***[1]***
2	(COS.ta.397 311)	(1) KIC11560431	COS/NUV, ACQ/IMAGE, BOA	MIRRORA				100 Secs *[==>]*	 ***[1]***
3	(COS.sp.241 900)	(1) KIC11560431	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=480; FP-POS=3			590 Secs *[==>]*	 ***[1]***
4	(COS.sp.241 900)	(1) KIC11560431	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=480; FP-POS=4			590 Secs *[==>]*	 ***[1]***
5	(COS.sp.241 901)	(1) KIC11560431	COS/FUV, TIME-TAG, PSA	G130M 1309 A	BUFFER-TIME=515; FP-POS=3			625 Secs *[==>]*	 ***[1]***
6	(COS.sp.241 902)	(1) KIC11560431	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=830; FP-POS=3			940 Secs *[==>]*	 ***[2]***
7	(COS.sp.241 902)	(1) KIC11560431	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=820; FP-POS=4			930 Secs *[==>]*	 ***[2]***
8	(COS.sp.241 905)	(1) KIC11560431	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=750; FP-POS=1			860 Secs *[==>]*	 ***[2]***
9	(COS.sp.241 905)	(1) KIC11560431	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=710; FP-POS=2			820 Secs *[==>]*	 ***[3]***
10	(COS.sp.241 905)	(1) KIC11560431	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=710; FP-POS=3; SEGMENT=BOTH			820 Secs *[==>]*	 ***[3]***
11	(COS.sp.241 905)	(1) KIC11560431	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=520; FP-POS=4; SEGMENT=BOTH			630 Secs *[==>]*	 ***[3]***
12	(COS.sp.241 904)	(1) KIC11560431	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=280; FP-POS=4; SEGMENT=BOTH			390 Secs *[==>]*	 ***[3]***
13	(STIS.ta.241 916)	(1) KIC11560431	STIS/CCD, ACQ, F28X50OII	MIRROR				8 Secs *[==>]*	 ***[4]***
14	(STIS.sp.24 1911)	(1) KIC11560431	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				540 Secs *[==>]*	 ***[4]***
15	(STIS.sp.24 1912)	(1) KIC11560431	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230M 2561 A	BUFFER-TIME=1605			1515 Secs *[==>]*	 ***[4]***
16		WAVE	STIS/NUV-MAMA, ACCUM, 0.2X0.2	E230M 2561 A				25 Secs *[==>]*	 ***[4]***

Orbit Structure






Orbit 3
Server Version: 20120312
Exp. 12
Unused Visibility = 31
GS Reacq
Occultation
Exp. 9
Exp. 10
Exp. 11
Home
Pointing Maneuver
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 4
Server Version: 20120312
Exp. 13
Exp. 14 (Auto-WAVECAL)
Pointing Maneuver
Unused Visibility = 25
Pointing Maneuver
Occultation
Exp. 15 (Auto-WAVECAL)
Exp. 16
GS Acq
Exp. 14
Exp. 15
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec