AGN Variability Studies with Kepler K2 Campaigns 2 and 3

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Abstract: Continued AGN monitoring throughout the K2 mission will result in hundreds of Kepler AGN light curves, greatly improving the statistical leverage for charactering their optical variability. In addition Campaign 3 provides a unique opportunity to obtain SC monitoring of 3C446, the first highly variable superluminal blazar that will also have simultaneous optical color and VLBI monitoring.

Kepler's initial optical light curves of active galactic nuclei (AGN) established that AGN power spectral density functions (PSDs) have steep power-law slopes $\alpha \sim -3$, much steeper than seen in the X-rays or predicted by theory (Mushotzky et al. 2011, ApJ, 743, L12; Edelson et al. 2014, in prep.); possible evidence of a turnover at long timescales (e.g., Carini & Ryle 2012, ApJ, 749, 70); the clearest measure to date of optical variations lagging behind the X-rays (Horne et al. 2014, in prep.); and unprecedented time resolution on a single highly variable blazar (W2R1926+42: Edelson et al. 2013, ApJ, 751, 52; Figure 1). K2 should be even better for AGN as its increased, more favorable sky coverage yields a much larger sample than the ~30 our group discovered and observed in the original low Galactic latitude Kepler field.

3C446 SC monitoring: The highlight this round is 3C446, the first known superluminal blazar to fall on Kepler silicon (Field 3). We request SC data to assure adequate sampling (see Figure 1). We will test if 3C446 exhibits strong rms/flux correlation and lognormal flux distribution as seen in W2R1926+42 (Edelson et al. 2013). Our > 6-month advance warning allows us to arrange multi-wavelength support such as daily LCOGT *r*-band monitoring until the start of Campaign 3, increasing to *ugriz* once it begins. This historically intensively-studied source has continuing 15 GHz monitoring with the OVRO 30m and AMI array and monthly VLBA mapping (see the BU and MOJAVE webpages). This could increase the time resolution for matching radio ejections to optical outbursts.

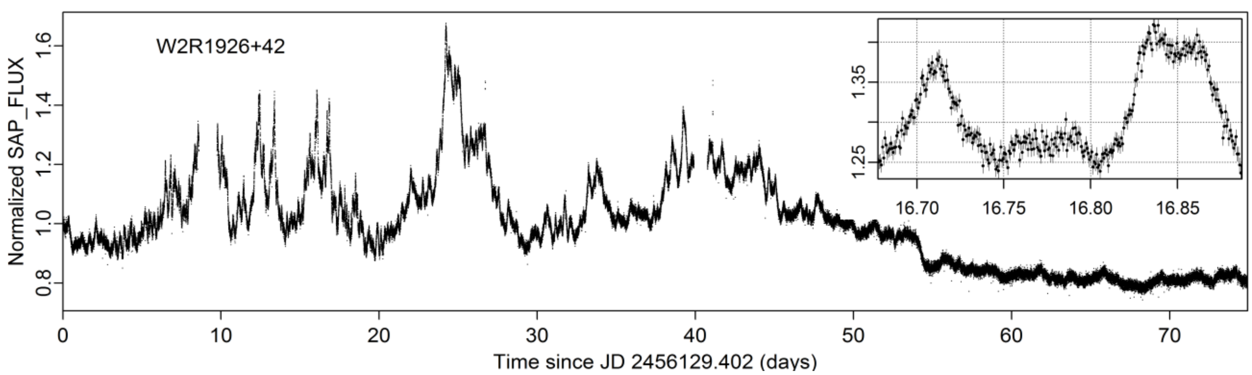

Figure 1: Q14 SC light curve of the only rapidly-variable blazar observed by Kepler to date. The inset shows that SC data is necessary and sufficient to resolve flares separated by a few hours. 3C446 will be Kepler's second SC-monitored blazar, and the first with simultaneous (lower time resolution) optical color and radio VLBI monitoring.

LC monitoring of 74 AGN / AGN candidates: Our remaining request is for LC monitoring of these samples: 1) 52 confirmed AGN from the Veron-Cetty & Veron (2010, A&A, 518, 10) catalog; 2) eight blazars from BZCAT (Massaro et al. A&A, 209, 681); 3) 14 highly-likely AGN candidates with power-law IR spectra and X-ray emission (Edelson & Malkan 2012, ApJ, 751, 52). All are relatively bright (Kp < 18) and lie on Kepler silicon, with 57 targets in Field 3 and 17 in Field 2. Galaxy extent/confusion was estimated from DSS2 images. We will obtain Lick 3m spectra for all currently unconfirmed candidates. K2 will eventually collect hundreds of AGN light curves, an order of magnitude improvement on the ~30 observed in the original Kepler field. This much larger, deeper sample of shorter light curves is an ideal complement to the original small, long-duration sample. For instance this will extend the AGN luminosity/variability amplitude relation (e.g., McLeod et al. 2010 ApJ, 721, 1014) to shorter timescales and higher redshift and luminosity than currently accessible. Higher luminosity also means less fractional dilution by the underlying galaxy, increasing the sensitivity to smaller intrinsic variations.