

UNDERSTANDING BLAZAR VARIABILITY THROUGH KEPLER, PART 3

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We propose to increase by 50% the time baseline of our approved Cycles 2+3 programs to search for variability in four flat spectrum radio quasars (blazars) and one powerful radio galaxy, Cygnus A, on timescales comparable to the light crossing time of the accretion disk (AD) around the central supermassive black hole (SMBH) or the base of the relativistic jet. When the quasars are quiescent, a quasi-periodic light curve indicates an AD origin, and provides a way to estimate the mass of the SMBH. When the quasars are active, long-lived quasi-periodic oscillations (QPOs) are very probably from helical features in the jets; if several different short-lived QPOs are seen in one quasar, then the emission is probably coming from turbulence behind a shock. When we instead see aperiodic variations during a faint state, any high and low frequency breaks in the power spectral density (PSD) yield the inner and outer edges of ADs, hence the BH mass. Breaks in the PSD also could yield physical scales in the relativistic jet. Kepler is ideally suited to the necessary measurements by delivering highly stable photometry continuously on timescales from minutes to days. By adding a third year of data, we will: see more of the quasars' faint quiescent states, thus measuring the duration and occurrence rate of QPO-emitting blobs in the AD; use the better SNR in the PSD to improve our ability to detect the inner and outer edges of the AD; and reduce the error on any SMBH mass estimates by 20% compared to Cycles 2+3. For bright states, we will observe: long-timescale QPO-producing helical features in the jet; short-timescale QPO-emitting blobs near shocks; for aperiodic signals, we could detect twice as large physical scales in the jet, and use the better SNR to reduce error bars on the smallest strong structures in the jet by 20% compared to Cycles 2+3. We have fitted PSDs to our Cycle 2 long-cadence data on radio-loud quasars, and find a power-law slope $\alpha \sim -2.0$, consistent with the variability originating in turbulence behind a shock. These preliminary values are flatter than those in four low-redshift X-ray selected AGN reported by Mushotzky et al. (2011); the intriguing differences in PSDs may be a result of the differences in AGN luminosity or type.