Symbiotic Stars in the Campaign 9 field
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Symbiotic stars are interacting binary systems containing a red giant star and a hotter component, which can be a white dwarf, a main sequence star or even a neutron star (see Mikolajewska 2007 Balt Astron 16 1 for a review). A relatively small fraction of these binaries show evidence for accretion onto the hot component via a disc, while the remainder show evidence of accretion via the wind from the giant star and, in some systems, nuclear burning occurs on the surface of the hot component (see Kenyon & Webbink 1984 ApJ 279 252). Some systems such as CH Cyg, have produced jets (eg Taylor, Seaquist & Mattei 1986 Nat 319 38) and large variations (∼5 mag) in optical brightness over year long timescales (eg Mikolajewski, Mikolajewska & Khudiakova 1990 A&A 235 219). More recently, evidence has been presented which suggests that symbiotic stars could be progenitors of a fraction of supernovae 1a explosions (eg Dilday et al 2012 Sci 337 942).

Symbiotic binaries can show photometric variability on a number of different time scales. A small fraction show evidence of variability on short timescales which has been taken to imply accretion onto the compact object via an accretion disk or wind (see Sokoloski et al 2001 MNRAS 326 553) and in one case (Z And) periodic variations have been used to infer the presence of a significant magnetic field on the white dwarf. Periods on the time scale of weeks or months are expected from pulsations from the red giant star, whilst the orbital period is expected to be a year or more.

Kepler was therefore perfectly suited to be used to study symbiotic stars. However, there were only two stars classed as symbiotics in the *Kepler* field – CH Cyg was observed but the data were compromised, at least to some extent, by it being saturated, and the little known system StHa 169 was also observed. The *Kepler* observations of StHa 169 showed a quasi-period of 34 days (see Figure 1) and UV observations made using *Swift* indicate the system is a red giant plus late B/early A type main sequence star, making it an unusual type of binary (Ramsay, Hakala & Howell 2014 MNRAS 442 489).

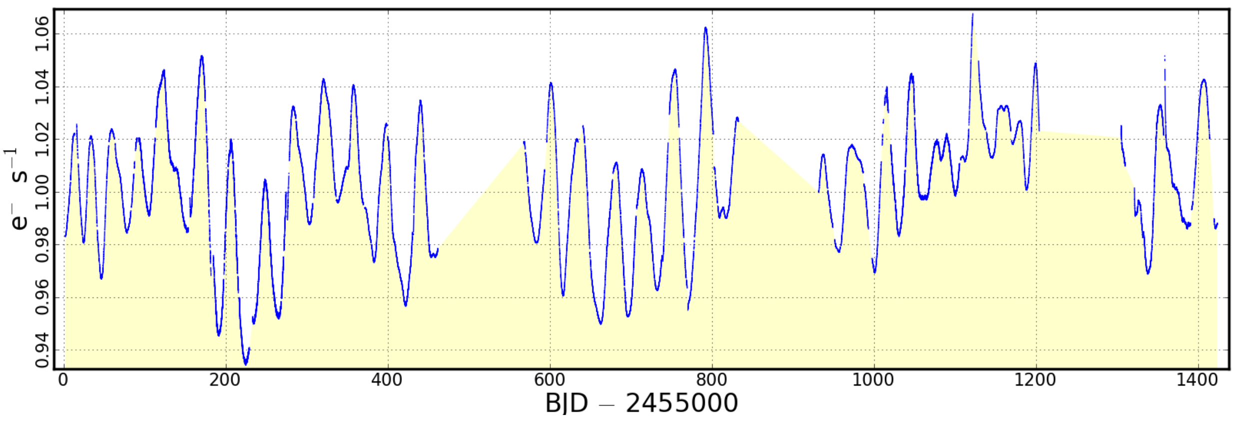

Figure 1: The *Kepler* light curve of the system StHa 169 which had been classified as a symbiotic binary. These observations show variability on a quasi-period of 34 days which is due to pulsation of a red giant. Based on additional *Swift* data we show that the second stellar component is likely to be a late B or early A type main sequence star (Ramsay, Hakala & Howell 2014).

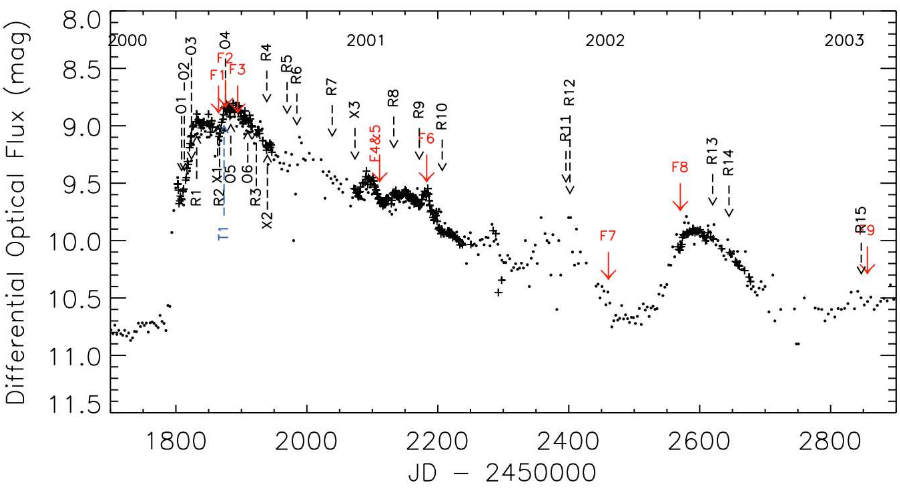

Figure 2: The optical light curve of the symbiotic binary Z And made using KAIT and AAVSO observations showing a prominent outburst (taken from Sokoloski et al 2006 ApJ 636 1002).

Name	EPIC	RA	Dec	KepMag	SpTy	Orbital Period	Priority
Hen 2-247	227028693	17:34:17.2	-19:09:23.0	10.4	M6III	900 d	5
2MASSJ1746	224389634	17:46:33.1	-24:19:55.8	11.6	M4/5III		10
Hen 2-312	225884422	17:57:16.0	-21:41:29.1	8.1	M5/6III		1
PN H 2-34	221730704	17:58:28.0	-28:33:42.0	11.1	M5III		8
SS73 122	222672261	18:04:41.2	-27:09:12.4	10.0	M7.5III+Be	>1500 d	7
Haro 3-38	221907528	18:06:01.2	-28:17:04.2	10.0	M8.5III	400 d	4
Hen 2-357	222119868	18:10:43.9	-27:57:50.1	10.0	M4/6III		2
Hen 2-374	225936180	18:15:31.1	-21:35:22.8	14.0	M5/7III	820 d	6
SS73 153	223186907	18:20:19.1	-26:22:46.5	13.8	M5III	1000 d	9
V3929 Sgr	222907137	18:20:58.9	-26:48:25.6	13.1	M1/2III		3

Table 1: The symbiotic binaries which are the targets of this proposal. The spectral type refers in the main to the red giant component. In the last column we give the relative priority of our targets. (We appreciate that our highest priority target is relatively bright (mag∼8) which could be an issue).

We have identified ten symbiotic binaries in the `SIMBAD` database which are 'on-silicon' in the K2 Campaign 9 field (Table 1). They are bright (KepMag∼8–14) and half have known (or approximate) orbital periods. Given the sharp drop in the K2 response at ∼4200Å, we do not expect to detect evidence of flickering or short periods since this is only visible at U and B bands. We therefore bid for long cadence observations of our ten targets. Based on the targets current knowledge and giving higher priority for sources detected in X-rays, we rank the priority of our targets in Table 1.

What do we expect to obtain from these observations? Detecting evidence for the pulsation period of the red giant star in symbiotics is notoriously difficult. With a base line of ∼70 days with K2 we will search for a approximately week or month long variability in the light curves which could provide evidence for a pulsation period in the red giant star. Outbursts have also been seen in a number symbiotics (eg Z And, Sokoloski et al 2006 ApJ 636 1002 and Figure 2, AG Dra Munari et al 2009 PASP 121 1070) as have eclipses (eg BF Cyg Skopal et al 1997 MNRAS 292 703) which would give excellent means to determine the binary parameters. Although the likelihood of detecting either an outburst or an eclipse is fairly small, K2 observations of either event in the ten targets would provide an excellent opportunity to explore outbursts in symbiotic stars and accreting binary systems in general.