Monitoring the Variability of Newly-discovered Symbiotic Stars

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Abstract. The IPHAS survey identified new symbiotic binary systems through observation of their Hα emissions and color spectrum. However, the survey made no attempt to determine whether the targets varied with time. Seven of the identified systems were photometrically observed at Manashtash Ridge Observatory (MRO) during the summer of 2013 with the intent of discovering which targets will display variability in their light curves.

1. Introduction

A symbiotic binary system (SS) consists of an interacting cool star (usually a red giant) and a white dwarf. Material being sloughed off of the cool star due to stellar winds or to gravitational attraction between the two stars can result in optical and x-ray outbursts, accretion disks, and jets. Some of these interacting binaries have outbursts at irregular intervals (usually months to years between). Typically these outbursts are about 1-3 magnitudes in the V band. Others will brighten by a magnitude or so over a period of months and stay bright for perhaps a year or two. A small sub-group called the recurrent symbiotic novae can brighten about 6 magnitudes in a few days and then fade over a month or two, repeating this behavior on timescales of decades. Other types of light variations seen in SS are pulsations of the cool stars and eclipses. Most symbiotic systems are stellar, but a few have interesting structures such as jets or bipolar nebulae. SS are also classified into S- and D-types (stellar and dusty), according to their infrared characteristics. SS are fairly rare objects, with only about 250 known, yet they are important for studies of several different aspects of stellar evolution. Their possible role in the production of Type Ia supernovae is particularly crucial (Munari & Renzini 1992; Hachisu & Kato 2001; Patat et al. 2011). The difficulty is that there appears to be a dearth of white dwarf binary systems, so other types of objects are needed to produce the observed numbers of SN Ia explosions. At least a few SS appear to be good candidates (RS Oph, T CrB and SN 2006X) according to Mikolajewska (2008), so finding more candidates would be highly desirable. Another matter that connects SS to the "bigger picture" of stellar evolution is their propensity to produce bipolar nebulae and jets, a behavior that is also seen in planetary nebulae (Corradi 2003; Mondez & Kastner 2011; Kastner et al. 2012). Understanding the mechanisms that shape the jets and nebulae and the influence of the hot star on the nebular/jet environment is aided by the rich spectra and variability exhibited by the SS. The goal of our project is to characterize the photometric variability of seven SS identified recently from spectroscopic studies (Corradi 2012) inspired by IPHAS candidates (Corradi et al. 2010). This paper reports the results of the first season of observations (summer 2013 with the 0.8-m telescope at Manastash Ridge Observatory (MRO).

2. Observations

The targets were observed on several nights during July, August and September of 2013 at MRO with a CCD camera. The filters used were Hα, r, and i. Five comparison stars were chosen from each target's field of view on the basis that they are of comparable magnitude to that specific target and are themselves nonvariable. See Table 1 for information on the target star characteristics.

Table .1: Target Designations and Details

Object	IPHAS Name	r [mag]	Type
SV1	J183501.83+014656.0	16.3	S
SV2	J184446.08+060703.5	14.7	S
SV3	J185323.58+084955.1	16.5	S
SV4	J190832.31+051226.6	16.2	-
SV5	J193501.31+135427.5	14.0	S
SV6	J202510.58+435233.0	15.3	S
SV7	J205836.43+503307.2	16.8	D

3. Analysis and Results

The observed comparison magnitudes were averaged to create the baseline measurement, the target magnitude was subtracted from the baseline, and the data point which came first chronologically was defined as the zero point for each data set.

4. Conclusions

From the derived light curves (see Figures 1 and 2), it is apparent that the targets designated as SV1, SV2, SV3, and SV7 all demonstrated r filter variability, with SV3 showing additional variability in the i and Hα filters. We are continuing the monitoring of the specified targets in this summer of 2014.

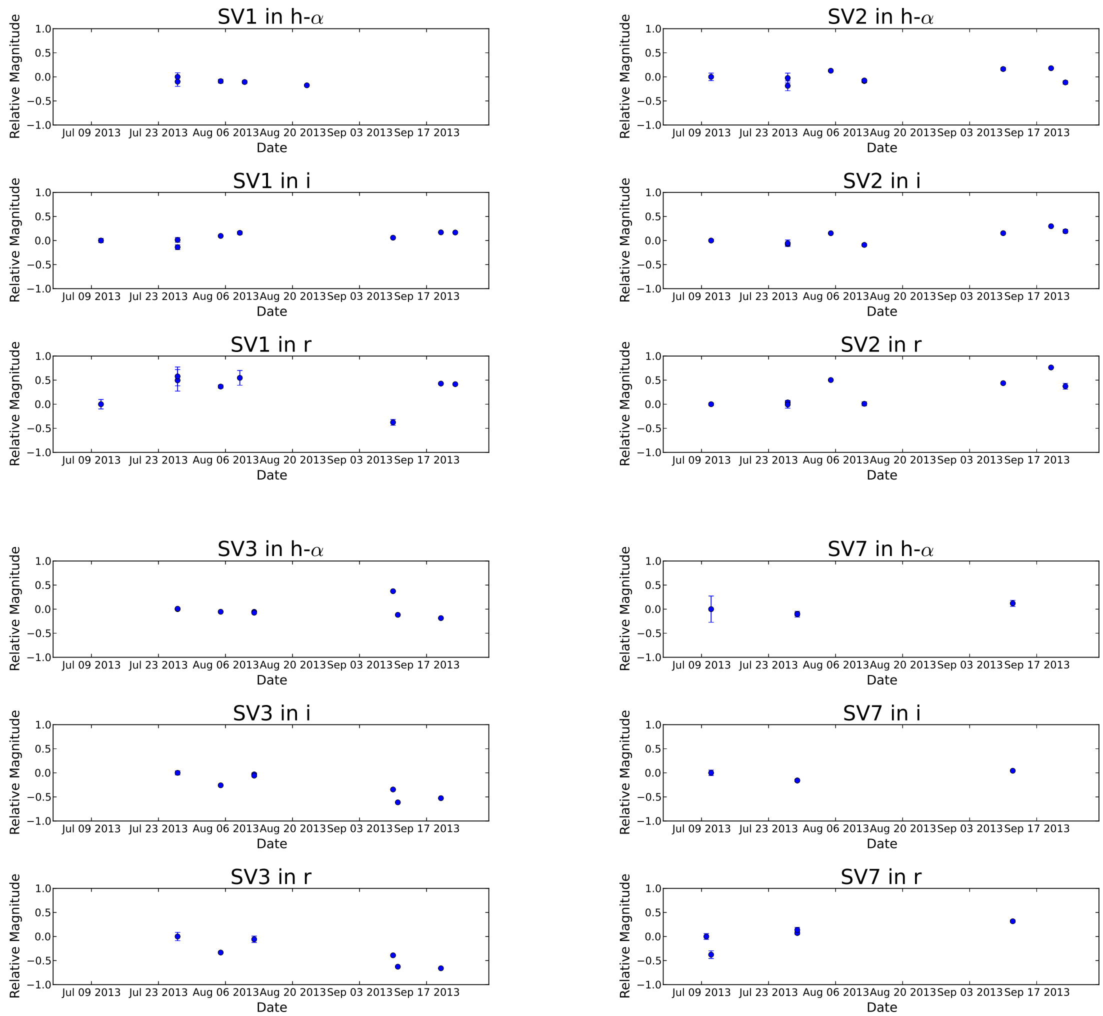

Figure .1: The data for each target which showed variability. SV1, SV2, and SV7 all show changes in r filter magnitude over the course of observations, and SV3 shows changes in all filter magnitudes.

Acknowledgments. Thanks go to the Kenilworth Fund of the New York Community Trust for support of this research. We also thank Dr. Chris Laws and his Astronomy 481 students for assistance with obtaining the observations.

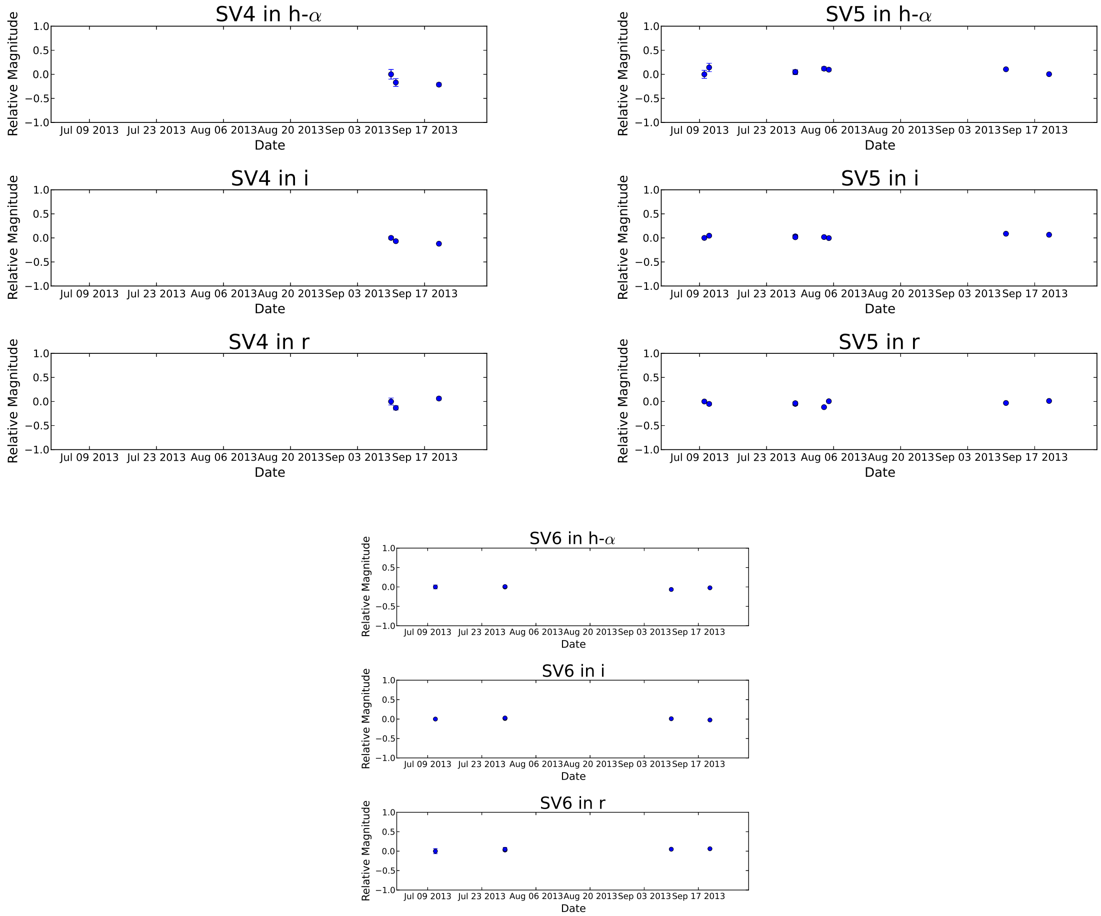

Figure .2: The data for the targets which showed little to no variability, whether due to lack of actual change or too few data points.

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