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BF CYG DURING ITS CURRENT OUTBURST

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Abstract. We are intensively monitoring the current outburst on BF Cyg, both spectroscopically (high and low resolution modes) and photometrically (so far 450 $BVR_{\rm C}I_{\rm C}$ measurements have been collected). The outburst is photometrically reminiscent of the major event BF Cyg experienced in 1890 when it rose by 4 mag in the blue. In this contribution we present the data and describe the plans to investigate this object.

Key words: stars: symbiotic binaries – individual (BF Cyg)

1. INTRODUCTION

BF Cyg is a S-type symbiotic star and one of the most studied objects of its class. The system consists of a M5 III late-type cool component (Belczyński et al. 2000) and a hot luminous white dwarf, revolving with an orbital period of 757.2 d (Fekel et al. 2001). The system underwent a major outburst in 1890 (Leibowitz & Formiggini 2006, hereafter LF06), that required almost a century to decline to quiescence, and a second one occurred in 2006, with BF Cyg still at maximum brightness after 5 years. On top of this remarkable light-curve, different types of variability and recurrence scales have been observed (Figure 1). BF Cyg has been the subject of many intensive investigations over the years. In particular Fekel et al. (2001) obtained a spectroscopic orbit from IR data. Yudin et al. (2005) discovered that the cool component fills its Roche lobe causing the infrared light-curve being modulated by ellipticity variability. LF06 detected a periodic recurrence of the enhanced luminosity of 6376 d (which they ascribed to some magnetic activity driven by a magnetic dynamo taking place on the external layer of the giant component, similar to the $\sim$22 year solar magnetic cycle). In their time-series analysis, LF06 found also the presence in the light-curve of a further period of 798.8 d, that they ascribed to the rotation period of the cool star. In addition, Formiggini & Leibowitz (2009) reported the discovery of a $\simeq$7 mmag amplitude variation in the B passband that they interpreted as the spin period of

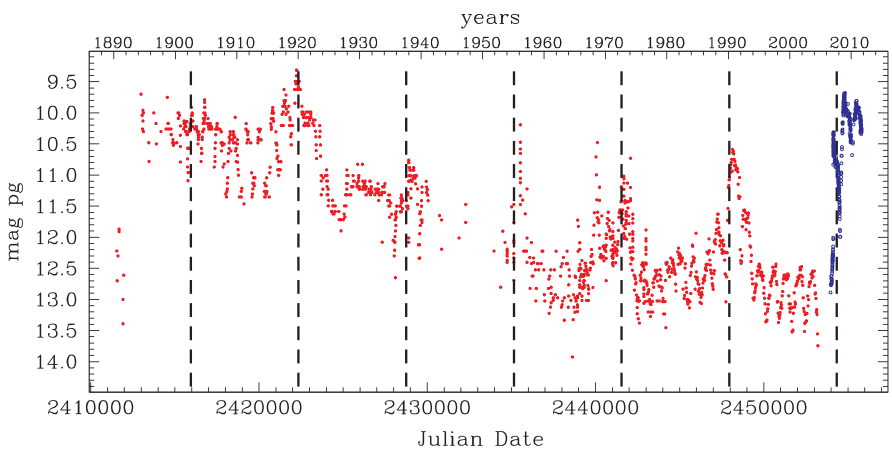

Fig. 1. Historical light curve of BF Cyg. Data prior to 2006 are from Jacchia 1941, Skopal et al. 1995 and AAVSO. The vertical dashed lines mark the 6376 d periodic variability found by Leibowitz & Formiggini (2006). Blue open circles are ANS Collaboration data.

the WD. Finally, a complete census of the emission and absorption lines visible in high resolution spectra ($R \sim 35\,000$) of BF Cyg obtained at the beginning of the current outburst has been presented by McKeever et al. (2011).

2. THE 2006 OUTBURST

In July 2006, Munari et al. (2006) discovered BF Cyg beginning a major outburst, so far evolving as a close replica of the 1890 event, when the star rose by 4 mag in a couple of years and remained at maximum brightness an additional ~ 30 years, fully qualifying BF Cyg as a member of the very exclusive club of symbiotic novae, whose outbursts last for decades to centuries. A catalog and discussion of the symbiotic novae has been presented by Munari (1997), who lists less than 30 known symbiotic novae, half of them still close to maximum brightness after ≥ 50 years since their discovery. At the time of the 2006 outburst discovery, BF Cyg was under intensive monitoring by the ANS Collaboration (Munari et al. 2012) because an increase in brightness was predicted in 2007 by LF06 following the ~ 6400 d periodicity. The 2006 outburst was enormously brighter and occurred a whole year earlier than the predicted 2007 maximum (Figure 2), indicating the two as unrelated events.

3. THE PHOTOMETRIC AND SPECTROSCOPIC OBSERVING CAMPAIGN

ANS Collaboration has so far collected 450 $BVR_{\rm C}I_{\rm C}$ measurements of the BF Cyg outburst (Figure 2), and a tight spectroscopic monitoring program is underway with the following telescopes: (i) the 1.82 m telescope operated in Asiago by INAF – Astronomical Observatory of Padova and equipped with a multi-mode AFOSC spectrograph/imager and a high resolution Echelle spectrograph; (ii) the 1.22 m telescope operated in Asiago by the Departement of Astronomy of the University of Padova and equipped with a B&C long-slit spectrograph; and (iii) 0.6

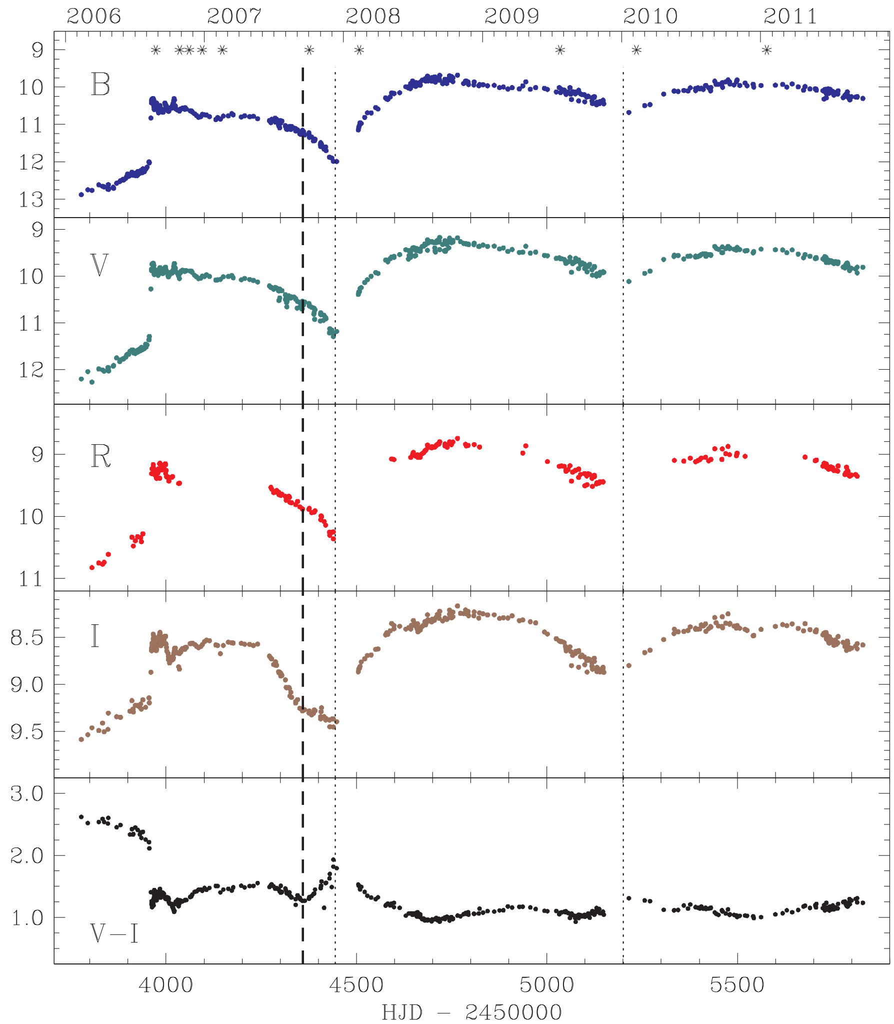

Fig. 2. The ANS Collaboration photometric observing campaign of BF Cyg. Dashed line marks the date of the 6376 d periodicity. Dotted lines mark the orbital periodicity according to the $JD_{\rm min} = 2415065 + 757.3 \times E$ given by Pučinskas (1970). The asterisks on the top panel mark the time when the spectra displayed in Figure 3 were obtained.

m telescope of the Schiaparelli Observatory in Varese equipped with a multi-mode spectrograph providing both low resolution and Echelle high resolution spectra. A sample of the low resolution spectra we have collected is presented in Figure 3 to highlight the spectral evolution of the current outburst.

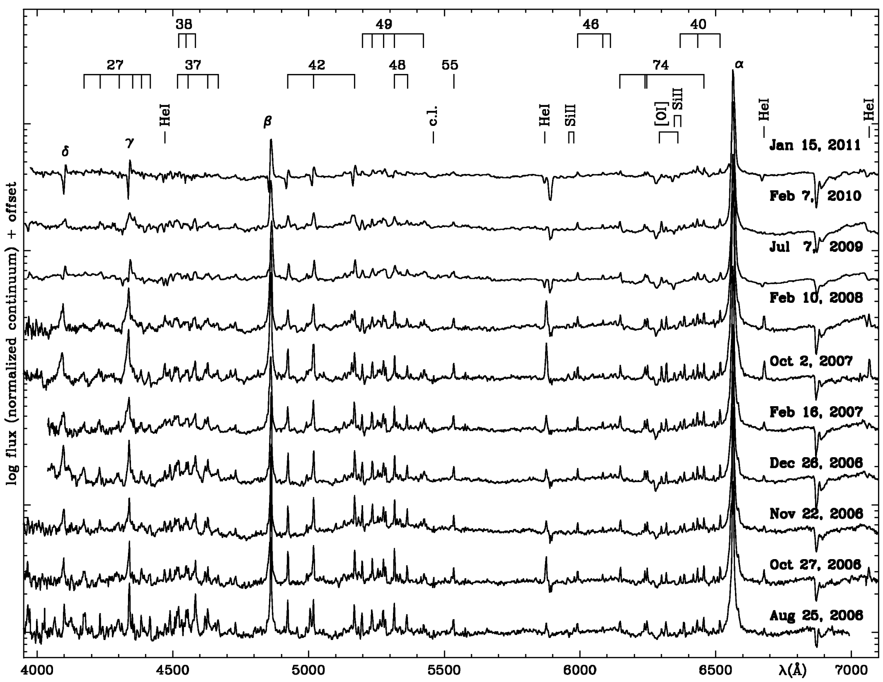

Fig. 3. Spectroscopic monitoring in low resolution of BF Cyg since the onset of the outburst. Spectra are continuum normalized and plotted on a logarithm flux scale. Principal emission lines are identified.

4. CONCLUSION

The aim of this poster was to present the large and densely mapped set of photometric and spectroscopic data the ANS Collaboration project carried out on BF Cyg during its current outburst. The regularity and frequency of the monitoring make the data perfectly suitable for a detailed study (for the first time in such objects) of the outburst evolution in terms of physical conditions of the outbursting component, like $T_{\rm eff}$ of the expanded photosphere, radius and luminosity, and nebular parameters like electronic temperature and density, radius and chemical composition of the emission region.

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