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STRÖMGREN PHOTOMETRY OF THE Be STAR θ CrB: 1996–1999

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Fabregat & Adelman (1998) presented differential Strömrgren *uvby* photometry from the Four College Automated Photoelectric Telescope (FCAPT) of the Be star θ Coronae Borealis (= HR 5778 = HD 138749) obtained during February and March 1994 and during March through July 1995. No short term periodic variability with an amplitude greater than 0^m005 nor long term variations greater than 0^m01 were seen. A review of the literature shows that θ CrB has had periods of both activity and inactivity (see, e.g., Percy et al. 1988 and Percy & Attard 1992). Thus the photometric observations with the FCAPT were continued to see how long the period of inactivity would last.

The FCAPT operated on Mt. Hopkins, AZ for six years until July 1996 and since then at nearby Washington Camp, AZ. During the 1995–96, 1996–97, 1997–98, and 1998–99 observing seasons an additional 26, 26, 45, and 44 high quality observations, respectively, were made with the FCAPT. Table 1 summarizes the photometry (the values are not identical with those of Fabregat & Adelman (1998) as a few values were deleted). After the dark count, the telescope measures the sky – *ch* – *c* – *v* – *c* – *v* – *c* – *v* – *c* – *ch* – sky in each filter with sky being a reading of the sky, *ch* of the check star, *c* of the comparison star, and *v* of the variable star. Table 2 contains group (a variable along with two supposedly non-variable stars, the comparison and check, against which the brightness of the variable is compared) information (Hoffleit 1982, ESA 1997). The comparison and check stars were chosen from supposedly non-variable stars in the vicinity of the variable on the sky that had similar *V* magnitudes and *B* – *V* colors. Their stability was checked using Hipparcos photometry (ESA 1997) by Adelman (1998). The Hipparcos photometry standard errors and amplitudes of θ CrB are the same as those of the comparison and check stars, which are considered to be non-variable. It is usually difficult to find stars of a given type with smaller standard errors and amplitudes especially close to a given position in the sky.

The consensus of the users of the FCAPT is that its differential photometry has an accuracy of order 0^m005 for properly exposed stars. Thus apparent systematic differences of this magnitude must be regarded with caution. Further one must be careful of any changes occurring at the time the telescope was moved as they might be due to small errors in the extinction such as those in *u*. The *y* photometry of θ CrB is the most stable. The largest changes were in *b* where the *v* – *c* values brightened by about 0^m008 between 1997 and 1998, but this might be due to the comparison star.

The study of Be stars, which are not always variable, should be able to yield important information about this class. The formation and dispersion of the equatorial disk is the

Table 1: Summary of photometry for θ CrB.

Heliocentric Julian Date	<i>u</i>		<i>v</i>		<i>b</i>		<i>y</i>	
	<i>v - c</i>	<i>c - ch</i>	<i>v - c</i>	<i>c - ch</i>	<i>v - c</i>	<i>c - ch</i>	<i>v - c</i>	<i>c - ch</i>
1993–94, 66 observations								
average	-1.741	-0.348	-1.309	-0.044	-1.260	0.051	-1.242	0.101
std. dev.	0.008	0.009	0.004	0.004	0.004	0.004	0.004	0.004
1994–95, 148 observations								
average	-1.738	-0.347	-1.306	-0.044	-1.259	0.051	-1.240	0.101
std. dev.	0.008	0.005	0.006	0.003	0.006	0.003	0.006	0.003
1995–96, 26 observations								
average	-1.741	-0.348	-1.308	-0.046	-1.261	0.049	-1.242	0.101
std. dev.	0.005	0.005	0.003	0.004	0.003	0.003	0.003	0.003
1996–97, 26 observations								
average	-1.746	-0.344	-1.308	-0.044	-1.261	0.046	-1.242	0.099
std. dev.	0.005	0.003	0.005	0.004	0.004	0.003	0.005	0.003
1997–98, 45 observations								
average	-1.742	-0.341	-1.304	-0.042	-1.268	0.044	-1.242	0.099
std. dev.	0.006	0.004	0.008	0.005	0.004	0.003	0.004	0.003
1998–99, 44 observations								
average	-1.742	-0.342	-1.302	-0.043	-1.269	0.043	-1.241	0.099
std. dev.	0.006	0.006	0.005	0.005	0.005	0.003	0.004	0.004
all observations								
average	-1.740	-0.346	-1.306	-0.044	-1.262	0.048	-1.241	0.100
std. dev.	0.008	0.006	0.006	0.004	0.006	0.005	0.005	0.004

Table 2: Main data for the stars involved.

	Star	<i>V</i>	Spectral Type	Hipparcos std. error	amplitude	
Var.	HD 138749	θ CrB	4.14	B6Vnne	0.0005	0.02
Comp.	HD 136849	50 Boo	5.37	B9Vn	0.0005	0.02
Check	HD 135502	χ Boo	5.26	A2V	0.0005	0.02

source of the variability on various time scales. By obtaining long term photometric data one can derive information on the nature of the variability and its relationship to variability at other wavelengths. Since observations of how a variability episode begins in θ CrB should be most enlightening, this series of observations will be continued. As this star has been inactive since about 1990 (Percy & Attard 1992) it might become variable in the next few years. But the FCAPT photometry has not yielded any information about changes in its current non-variable state as the standard deviations of the means so far have reflected mainly the observing conditions under which the data was taken.

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