DIAGNOSTIC POSSIBILITIES OF THE WALRAWEN PHOTOMETRIC SYSTEM

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ABSTRACT. Diagnostic possibilities of the Walraven photometric system to analyze the UV Cet type flare stars have been studied. It was shown that the Walrawen system marks out the hydrogen spectrum features better than the standard UBV system. Observations of the UV Cet flare of 1985 December 23,carried out in the Walraven system were analyzed with computed two-colour diagrams, temperature and gaseous density at the maximum of brightness were estimated.

1.1 Introduction

Resently some statements on necessity to use non-traditional photometric systems for the observations of flare stars have been published. Some authores suggested the Walrawen system. Thus, diagnostic possibilities of the Walrawen photometry are to be considered.

1.2 Walrawen middle-band photometric system

The main information about Walrawen system see in [1]. The positions of the passbands have been specially chosen to measure the hydrogen spectrum features. This circumstance is important for observations of flare stars since strong hydrogen emission is observed during flares.

1.3 Two-colour diagrams computations

For two-colour diagram computations two kinds of the hydrogen emission spectra were considered. These spectra correspond to two different models of the flare radiative region.

The first model was computed by using the computer program taken from [2]. The program permits us to calculate the continuum and line emission formed in the non-LTE moving gas. The computations were made for gaseous temperatures T_e=10000–20000K, gaseous densities $n_e = 10^{12} - 10^{14}$ cm^{-3},the star's temperature T_*=3000K, dilution factors W=0.1–0.5. The Lα quantum escape probability β_{12} was varied from 10^{-7} to 1.

The second model of a flare radiative region advanced by Grinin and Sobolev [3] for the explanation of the flare continuum emission at the

L. V. Mirzoyan et al. (eds.), Flare Stars in Star Clusters, Associations and the Solar Vicinity, 37–39.

maximum of brightness was also considered .The gas was adopted to be denser - the atomic concentrations $n_H=10^{15}-10^{17}cm^{-3}$. Under the temperatures 10000 - 20000K such gas becomes partly non-transparent for radiation, and when the thickness of the region increases,the gaseous radiation approaches to the black body one.

For this two emission models colour indexes in the Walrawen system were computed. For determination the scale coefficients which are need to reduce calculated indexes to observational ones, we used the results of the spectrophotometry of α Lyr [4].

1.4 Two-colour diagrams' features

Among different possible kinds of two-colour diagrams, two of them - (V-U,U-W) and (V-L,L-W) are the most interesting. The passbands V,U and W are more sensible for the continuum emission while the passbands B and L are more sensible for the emission of lines. Therefore, the (V-U,U-W) diagram must mark out better the continuum behaviour, but the (V-L,L-W) mark out better the behaviour of lines. These diagrams are given on figure 1 where black body radiation are given by thick line. The curves for first kind of spectra were drawn by narrow solid lines and marked by numbers 1 and 2.The curves for second kind were drawn by dash lines and marked by numbers 3 and 4. The radiation of a hydrogen gas is seen to be separated from the black body radiation on both diagrams.

To illustrate the possibilities of Walraven system to mark out the flare behaviour , position of the real UV Ceti flare observed at 1985, 23 December by De Jager et al [5] was marked on both diagrams. The colour indexes of this flare were corrected for the contribution of the star's radiation. On the figure 1 the full circle designates the first moment of flare, open circle - the moment of the maximum of brightness. The next five minutes of flare development was marked also by crosses.

The flare colours at the maximum of brightness are seen close to coloures of the black body radiation with a temperature near 15000K. In the second model this position corresponds to the gaseous density which can be appreciated as $10^{16}cm^{-3}$.

The displacement of the flare position during its development on the diagrams is seen to be real and this displacement really marks out the changes occurring in the flare spectrum. Such changes in the broad-band UBV system can be smoothed and not displayed,see for example [6].

The continuum of this flare was short-lived and at once after maximum of brightness the line emission given the main contribution to the flare radiation. As it may be seen from behaviour of V-L, during the flare,the strong line emission in the L-band was present.

There is no conformity beetwen computed and observed coloures on both diagrams. Therefore, more detailed computations of the emission spectrum is needed (taking into account non-homogenious structure of the radiative region.) It should be noted that L-band can be influenced by H and K emission of Ca II. If we take this circumstance into account,the curves 1 and 2 on the (V-L,L-W) diagram move leftward and the disagreement between computed and observed coloures increases.

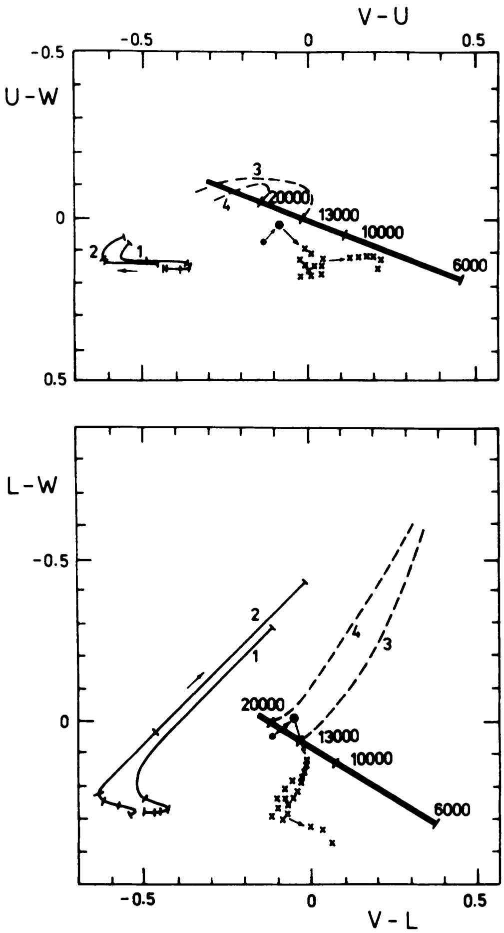

Figure 1. The (V-U,U-W) and (V-L,L-W) diagrams. The thick line is a black body radiation. The curves for the first kind of hydrogen spectrum are marked by 1 and 2. 1 - for $n_e=10^{12}cm^{-3}$,2 - for $n_e=10^{14}cm^{-3}$. Both curves were calculated for temperature T_e=10000K. The decreasing of β_{12} was shown along both curves. The curves for the second kind of spectrum are marked by 3 and 4. 3 - for T_e=13000K, 4 - for T_e=20000K. Both curves were calculated for $n_H=10^{16}cm^{-3}$. The position of the UV Cet flare of 1985, 23 December was marked on diagrams, too.

1.5 Conclusions

In general, the Walrawen system is more preferable for separation different radiative sources and for marking features of the flares than the traditional UBV. The (V-U,U-W) and (V-L,L-W) diagrams are more useful for diagnostics.

I wish to thank Drs. Gershberg and Grinin for their interest to my work and valuable recommendations.

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