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The Carina Spiral Feature: Strömgren–*Hβ* photometry approach

I. The photometric data-base⋆,⋆⋆

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Abstract. A data-base collating all *uvbyβ* photometry available at present for O-B9 stars brighter than 10th visual magnitude in the field of the Carina Spiral Feature is presented. The completeness and homogeneity of the data-base are discussed.

Key words. stars: early-type

1. Introduction

When talking about the Galactic spiral structure, star formation fields, their distance, location and history, the large star forming region seen toward the constellation Carina is the first one to be mentioned. It is probably the most complex single optical spiral feature known in the Galaxy, and obtaining a reliable and consistent picture of the structure of this field has always been a high priority task.

While study star-forming regions, because of their large distance from the Sun and structural complexity, the quantity, quality and completeness of the observational data and their interpretation play a critical role in gaining a satisfactory degree of understanding. So far, no overall study of the Carina Spiral Feature has been performed in the *uvbyβ* system. This photometry is capable of classifying large samples of stars in the presence of non-uniform and heavy interstellar absorption and offers reliable calibrations in terms of stellar parameters. The distance calibrations in the *uvbyβ* system have been compared to the *Hipparcos* distance estimates (see Kaltcheva & Knude 1998; Torra et al. 2000) and shown to be reliable.

In this context, maintaining the effort to improve the completeness of the *uvbyβ* data for Galactic star-forming fields and for the Carina Spiral Feature in particular is worthwhile. This would lead to the establishment of a homogeneous photometric distance scale to the most prominent Galactic young structures. The distribution of the visual extinction can also be precisely analyzed and uniform procedures to infer various photometry-derived stellar parameters may be applied to a large set of data.

2. The data-base

The present paper has the purpose to collate all *uvbyβ* observations for the Carina Spiral Feature into one data-base. This will give an idea about the completeness of the *uvbyβ* photometric data for the field at present and should encourage and facilitate future observational efforts. This data-base will also be a starting point for a thorough and, to a large extent, a homogeneous photometric investigation of the field.

To organize the data-base, all stars brighter than 10th magnitude and younger than spectral type B9 in the Simbad data-base that appear in the HD, CPD, PPM and LS catalogues are selected using CDS. In this aspect, the completeness of our sample is restricted by the completeness of these four catalogues. In very few cases a star appears only in one of the catalogues – in the vast majority the stars can be found in all four catalogues. The approximate magnitude limit for the PPM catalogue for example is 10.5 mag. For our selection the magnitude limit should be set moreover by the existing spectral classification, than by the limits of the catalogues. The overall impression after browsing the Simbad data-base is that most of the stars from the four mentioned catalogues have spectral classification coming from different sources, and a precise estimate is difficult to be made. The most widely adopted Michigan Spectral Classification should be complete to the limits set by the HD catalogue, which is about 10th magnitude. The compilation of Hauck & Mermilliod (1998) (HM hereafter) was searched for *uvbyβ* data for these stars and the observations performed by Kaltcheva et al. (2000) (KOC hereafter) (not implemented to that point in the HM) are also considered.

2.1. The data-base homogeneity.

Good agreement between photometric data coming from different observers has always been an essential issue when

⋆ Based on CDS data.
⋆⋆ Table 1 is only available in electronic form at the CDS via anonymous ftp to `cdsarc.u-strasbg.fr (130.79.128.5)` or via `http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/410/523`
⋆⋆⋆ e-mail: `kaltchev@uwosh.edu`

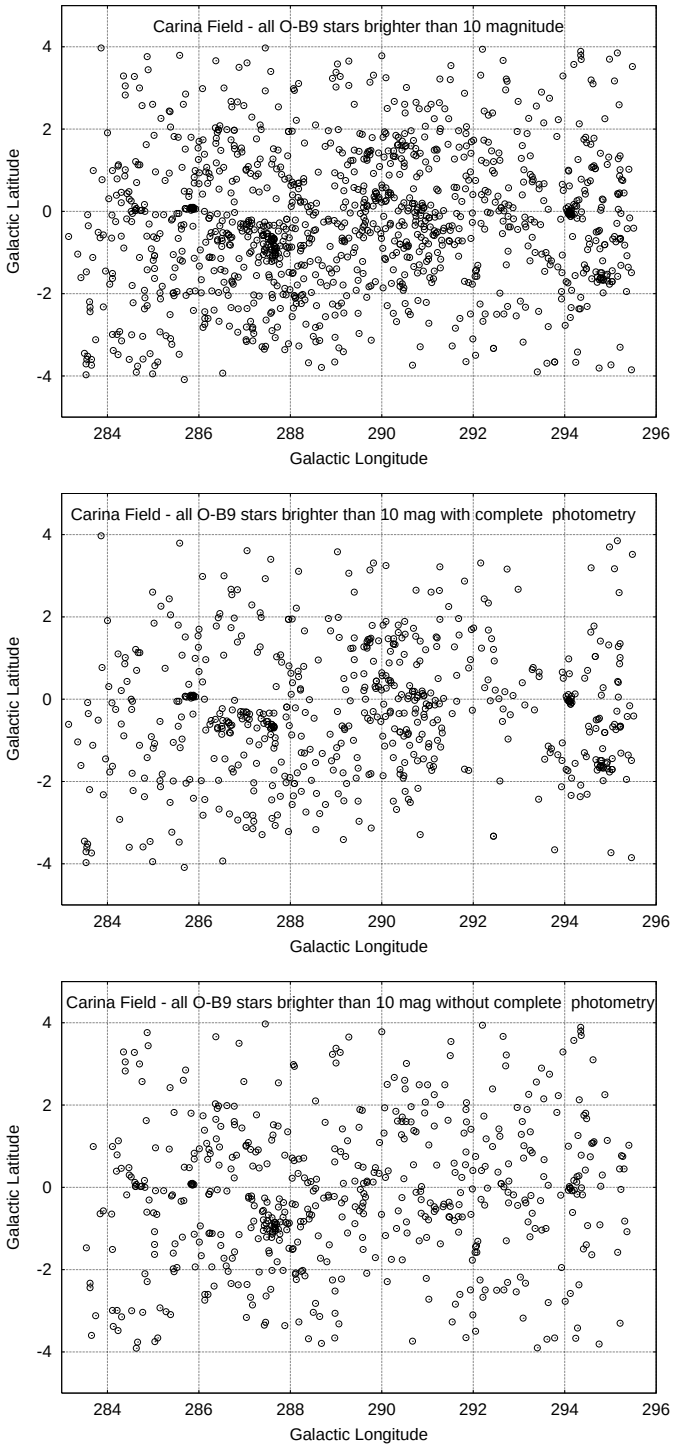

Fig. 1. The distribution of the stars from the data-base in Galactic coordinates. Top: all stars, middle: only stars with complete photometry, bottom: stars without or with partial photometry.

discussing both the photometric diagrams or photometry-derived physical stellar parameters. At present, the largest *uvbyβ* data set for the Carina Field, obtained with a single telescope during a single observational run is presented by KOC. These observations are part of an ongoing study of selected star-forming regions of the Milky Way and were carried out as complementary to the already existing data from the *uvbyβ* compilation of HM. For the Carina Field, a comparison of

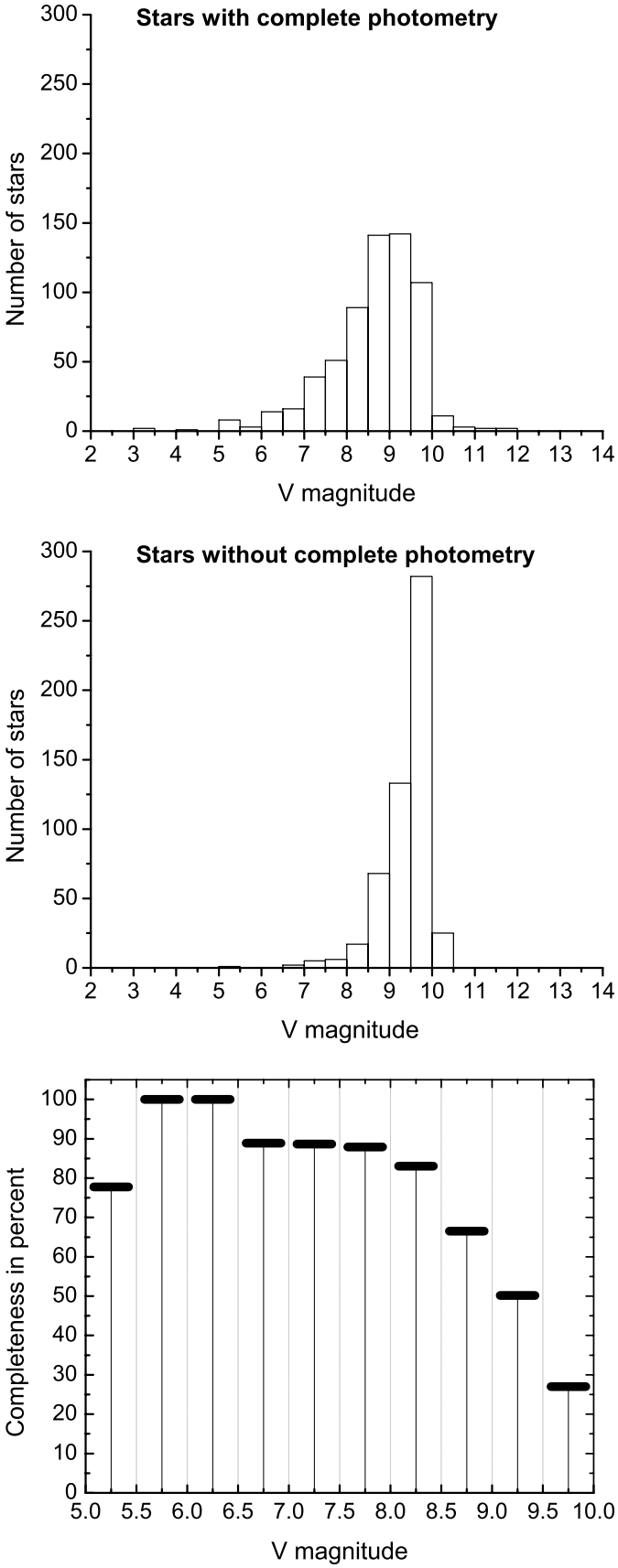

Fig. 2. First two panels: the distribution of the stars with complete photometry and stars without or with partial photometry over the *V*-magnitude range. Bottom: the completeness of the data-base in percent for successive *V*-magnitude intervals.

uvbyβ observations coming from different authors is presented by KOC and suggests small differences in the precision and accuracy of different data sets, more significant for the c_1 and m_1 photometric quantities. Although the comparisons give a good impression about the agreement between different authors, in most of the cases not enough common data between KOC and other sources are available to do a safe transformation between different data sets. The procedure adopted in collating the present data-base was the following. For each star the photometry from all sources included in the HM compilation was inspected. Where possible, data from sets showing the largest disagreements with other works (like those of Hill & Perry 1969 and Eggen 1983, see KOC) were eliminated. The rest of the measurements were averaged, assigning to the sets that show high consistency with each other (like KOC; Crawford et al. 1971; Schneider & Weiss 1988; Kaltcheva & Georgiev 1994) a slightly larger weight. Experiments were performed to estimate whether this procedure leads to results different from the photometry in the HM compilation. The difference was insignificant. Again, it should be emphasized that with the present data the systematic underestimation up to –0.02 in m_1 and systematic overestimation up to 0.02 mag in c_1 in some data sets, noticed by different authors can not be eliminated. No such systematic difference is noticed for V, $b-y$ and $H\beta$ photometric quantities (see KOC for details).

In Table 1, available only electronically at the CDS, the collated data-base is presented. An identification (HD or CPD) is given in the first column. Columns 2, 3, 4, 5, and 6 give V, $b-y$, m_1, c_1 and $H\beta$. The Galactic coordinates, cross-identifications and the spectral type follow. The stars without photometry or with partial photometry only are left in the data base as future program stars.

2.2. The data-base completeness

The data-base stars plotted in Galactic coordinates are shown in Fig. 1. The top plot presents all stars in the data-base, regardless of whether they do have *uvbyβ* photometry or not. The middle plot shows the stars with complete photometry, followed by the sample without or only with partial photometry.

The first two panels of Fig. 2 give more thorough understanding of how the stars with complete and incomplete or without photometry are distributed over the apparent magnitude range. The bottom plot presents the completeness of the sample in percent in the V-magnitude intervals 5–5.5 mag, 5.5–6 mag, 6–6.5 mag and etc. The completeness is quite satisfactory for stars brighter than 8.5 mag, dropping rapidly toward the fainter stars to less than 30% for the 9.5–10 magnitude range. Please note, that for most of the stars without *uvbyβ* photometry at all (most of them do not also have UBV data), the V magnitudes are not of high precision. The overall impression is that in these cases the apparent magnitude is most of the time underestimated. This means that part of the stars without *uvbyβ* photometry could be fainter than listed in the catalogues. Considering the correct magnitude will possibly increase the calculated completeness of the data-base for stars fainter than 8.5–9 and 9–9.5 mag intervals and will lower the completeness for the 9.5–10 mag interval. For the same reason, the data-base, originally restricted to the 10th magnitude contains few stars slightly fainter. Note that the counts in the 9.5–10.5 mag intervals in Fig. 2 should be considered approximate, due to the approximate limiting magnitude of the catalogues, and also to the completeness of the spectral classification for this magnitude range.

As far as the existing photometric data are concerned, the overall completeness of the collected data-base to about 9.1 mag is about 80%. The structure of the Carina Spiral Feature field based on the photometric *uvbyβ* data-base will be presented in a forthcoming paper.

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