THE COLOUR EXCESS SCALF AND INTRINSIC COLOUR PROPERTIES OF THE LONGER PERIOD CEPHEIDS

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Abstract. Following a discussion of two recent papers by Schmidt (1973, 1975), we conclude that for the large amplitude, longer period Cepheids (log P greater than about 1.1), the small colour excesses derived from the six-colour photometry (traditional method or Parsons method) are to be preferred to the large colour excesses derived from the Γ-index photometry (Kraft's scale).

Some papers by E. G. Schmidt were an incitement to clarify the question of the colour excess scale and intrinsic colour properties of the longer period Cepheids (periods longer than about ten days).

We first draw attention to the two following facts:

(1) For these Cepheids, since about 1960, the choice has been between the colour excesses derived from the six-colour photometry (the Lick system), and those derived from Kraft's Γ-photometry – the second ones being larger than the first ones by 0.15 or 0,20 m.

(2) The colour excesses of the six-colour photometry (traditional method or Parsons method) are meant to ensure (on the whole) uniformity and continuity of intrinsic colour properties for all colours (other than colour U), over the entire period range of the long period Cepheids. It follows that Kraft's scale necessarily implies colour discrepancies when going from the shorter to the longer period Cepheids.

Hence the colour and temperature discrepancies that were encountered by Schmidt (1973), when assuming Kraft's scale.

Now, against Kraft's results concerning the longer period Cepheids, three kinds of arguments can be advanced:

– *Arguments against Kraft's method.* There are indications in the work of Nikolov and of Tsarevsky and Yakimova that the Γ spectral type system may not be well defined for the later spectral types.

– *Arguments in favour of the six-colour method.* The basic principle of the method must be recalled (opposite curvatures of the interstellar and temperature reddening laws on either side of colour G).

With this in mind, it is difficult to accept as real the large colour discrepancies between

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shorter and longer period Cepheids which result from Kraft's scale, as they bear all the characteristic features of differential interstellar reddening.

– *Schmidt's argument* – A third argument was recently provided by Schmidt himself (1975).

Having measured on the *uvbyβ* system the interstellar reddening of field stars in the direction of two longer period Cepheids, Schmidt found that the colour excesses that he formerly assumed for these stars had been largely overestimated.

This last (extrinsic) argument will probably be felt as the more convincing and the one that settles the question: for large amplitude, longer period Cepheids, the small colour excesses of the six-colour photometry are to be preferred to the larger colour excesses of Kraft's scale.

Concerning the intrinsic colour properties of these stars, however, Schmidt's position, in his communication of 1975, is not entirely clarified: He does not seem to realize that to give up Kraft's large colour excesses also means giving up the large colour discrepancies (and line blanketing discrepancies) previously suggested by him.

References

Schmidt, E. G.: 1973, *Monthly Notices Roy. Astron. Soc.* **163**, 67.
Schmidt, E. G.: 1975, *Monthly Notices Roy. Astron. Soc.* **170**, 39P.

DISCUSSION

Cayrel: You said that an overestimated colour-excess 'simulates' a line-blanketing excess in the blue colours. What amount of metal overabundance would be necessary to account for this line-blanketing excess?

Canavaggia: What I meant is that an overestimated de-reddening simulates a line-blanketing excess for E. G. Schmidt, who uses Johnson's system, because it results in associating an $R-I$ index that is 'too blue' with a $B-V$ index that is 'too red'. But when the *IRGBV* colours of the Lick system are considered, things are different: the over-de-reddening results in a deficiency of I and of V with respect to the median R, G, B colours, and this cannot be accounted for by any metal overabundance.

Spinrad: Will the new colour excesses change the Cepheid distances and then propagate into uncertainties in the extra-galactic distance scale?

Canavaggia: The Period-luminosity and Period-colour-luminosity relations for Cepheids are mainly calibrated through using shorter period cluster Cepheids, and nothing is changed for these stars. Only the extension of the laws towards cooler, more luminous stars depends on longer period Cepheids, and especially on RS Puppis, which Westerlund showed to be an association Cepheid. Sandage and Tammann used this star, assuming the colour excess of the two nearer stars in the association. This excess is about midway between the colour excesses implied by Kraft's scale and the six-colour scale – so half of the change suggested here was already applied by Sandage.