Limb-darkening coefficients for the purpose of pulsation mode identification for A-F stars.

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Abstract. Limb-darkening coefficients are computed from a set of model atmospheres with: a solar chemical composition, 6000 K \( \leq T_{\text{eff}} \leq 8500 \) K (\( \Delta T_{\text{eff}}=250 \) K), 2.5 \( \leq \log g \leq 4.5 \) (\( \Delta \log g=0.1 \)) and a microturbulent velocity of 2 km/s. Convection is included assuming either the turbulent convection approach of Canuto et al. (1996) or the classical mixing length prescription with \( \alpha = 0.5 \) and 1.25. Four limb-darkening laws have been used: quadratic, cubic, square root and the one of Claret (2000). We compare the ATLAS 9 intensities and the ones computed from these laws. We find that Claret’s law is the best law for almost all the models, independently of the convection prescription used.

Key words. Stars: atmospheres – Stars: oscillations

1. Introduction

Multicolor photometry is used for oscillation mode identification in variable main sequence stars such as Delta Scuti stars (e.g. [Garrido 2000]). These methods involve precise computation of oscillation amplitudes and phases which imply accurate computation of colors and limb-darkening coefficients (LDC) and their partial derivatives with respect to \( \log T_{\text{eff}} \) and \( \log g \). We present in this paper LDC computed from up-to-date model atmospheres (see [Heiter et al. 2002]) using the nonlinear law suggested by Claret (2000) for the Strömgren and Geneva photometric systems. For the Strömgren system, we compare these LDC with the ones using simpler laws presented in Barban et al. (2003) (hereafter B03).

2. Limb-darkening coefficients

LDC have been computed as in B03 from model atmospheres with a solar chemical co-
2.1. Limb-darkening coefficients for the Strömgren photometric system

For the u and y bands and for CGM models, Claret’s law is found to be the best law, same for the v and b bands except for a few models around 7250 K. For any band, the best law yields a $\sigma$ smaller than 0.0009 compared to 0.004 found in B03 using simpler limb-darkening laws.

For any band with the adopted best law and for CGM models, the flux computed with the limb-darkening laws fits the ATLAS9 flux to better than 0.1% and the intensity variation over the disk computed from the limb-darkening laws to better than 0.6% from B03.

Again, the effect of the convection treatment in the model atmosphere on the choice of the best law is more important between CGM and MLT $\alpha = 1.25$ than between CGM and MLT $\alpha = 0.5$ ($\Delta \sigma = 5-126$% for CGM models vs MLT $\alpha = 0.5$ models, $\Delta \sigma = 0.2-397$% for CGM models vs MLT $\alpha = 1.25$ models).

3. Conclusions and future plans

For almost all the models considered in this work, we found that the intensity variations over the stellar surface are better recovered with a multi-parametric non-linear law than with simpler laws, independently of the convection prescription used. The effect of these new LDC on the multicolor photometry method for mode identification is a work in progress.

Acknowledgements.

CB is supported by the Research Fund K.U.Leuven under grant GOA/2003/04.

References