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All sky photometric zero-points from stellar effective temperatures

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Abstract. I use SkyMapper DR1.1 to explore the quality of its *uvgriz* photometry, and zero-points. I introduce a formalism to derive photometric zero-points across the sky by benchmarking against stars with well known effective temperatures, bypassing the need for absolute spectrophotometry.

Keywords. surveys; techniques: photometric; stars: fundamental parameters, late-type; Galaxy: stellar content

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Photometric zero-points in SkyMapper DR1.1 are not tied to spectrophotometric standard stars, but are obtained by predicting SkyMapper magnitudes of an ensemble of stars with photometry from other surveys (Wolf *et al.* 2018). If we wish to use SkyMapper photometry to study stellar populations across the Galaxy, and derive their parameters (most importantly metallicities), it is imperative to make sure that stellar parameters are not affected by variations of photometric zero-points.

With this goal in mind, we have conducted a thorough study of SkyMapper DR1.1 photometry. Since absolute flux standards are not available for SkyMapper, we have checked its standardisation by devising a new method based on the effective temperatures of a sample of reference stars (from Casagrande *et al.* 2010, 2011) to determine photometric zero-points across the sky. With our method we have recovered an offset of the *uv* zero-points that varies as a function of Galactic latitude. This variation is interpreted as a consequence of the reddening corrections currently employed to predict SkyMapper *uv* magnitudes from external photometry at longer wavelengths.

With a good control over photometric zero-points, we have then applied the InfraRed Flux Method (Casagrande *et al.* 2014) to compute effective temperatures for all stars in the GALAH spectroscopic survey, and provide empirical colour$-T_{\rm eff}$ relations. We have also used the GALAH spectroscopic metallicities to derive a calibration between them and SkyMapper v, g, and 2MASS K_S magnitudes. Our calibrations is validated down to approximately [Fe/H]$=-2$, and applies to late-type giants and dwarfs with $M_g < 7$. The reliability of our photometric metallicities is further checked against other spectroscopic surveys, confirming an overall precision of 0.2 dex. Finally, using ~ 9 million stars with Gaia parallaxes, we have produced a metallicity map in which we can clearly trace the mean metallicity decreasing as we move from the thin disc to the thick disc and then on into the halo, in agreement with what is expected from our knowledge of the Milky Way's structure.

References

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