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Metallicity estimates of Galactic Cepheids in the Inner Disk

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Abstract. We collected a sample of high-resolution UVES@VLT (R$\sim$40000) optical spectra (3700-9500 Å) to provide new metallicity estimates for 77 Galactic Cepheids using the method of equivalent width (EW) abundance analysis. Our program is to estimate the metallicity for a total of 23 Galactic Cepheids. In order to constrain the occurrence of a Galactic abundance gradient, we used the NIR photometry together with reddening-free Period-Wesenheit relations to estimate the Galactocentric distances.

Key words. Stars: abundances – atmospheres – Cepheids – Galaxy: metallicity gradient

1. Introduction

The use of Cepheids to trace the Galactic chemical enrichment presents several observational advantages such as high luminosity, spectra rich in iron and alpha-elements lines (e.g. Romaniello et al. 2008), and the possibility to derive their distance (e.g. Bono et al. 2010). Cepheids, as tipical stellar tracers of the Galactic Disk, provide firm constraints on the radial abundance gradient of the Disk (see, e.g., Luck & Lambert 2011, Pedicelli et al. 2009, Lemasle et al. 2008).

2. Distances determination

We estimated Galactocentric distances (R_G) for a large and homogeneous sample of 433 Cepheids. This was based on the reddening-free Period-Wesenheit relations provided by Inno et al. (2013, in print) and on the NIR photometry in J, H, K_s bands (Monson & Pierce 2011, Laney priv. comm., Laney & Stobie 1993). Our sample was complemented using the 2MASS single-epoch photometry after having applied the light-curve template presented in Soszynski et al. (2005).

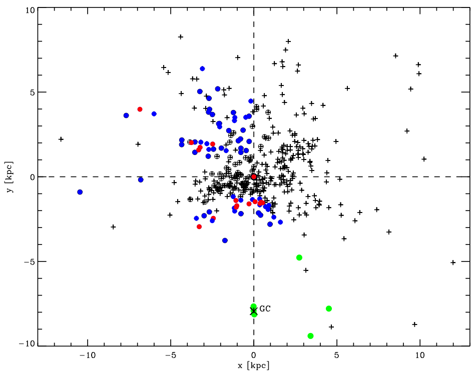

Fig. 1. Distribution of Cepheids on the Galactic Plane. Sun is located at the center of the axis, the black cross indicates the Galactic Center (GC). Our new (red and blue filled circles) optical sample will integrate the metallicity estimates currently available for Cepheids (black crosses: Luck & Lambert 2011; open circles: Pedicelli et al. 2009, 2010; Lemasle et al. 2007, 2008; Romaniello et al. 2008); thanks to new 6 Cepheids (green filled circles) observed in K_s band we will provide new information about the Cepheid metallicity also in the Galactic Bulge and in the GC.

3. Metallicity estimates

In order to provide new metallicity estimates for Galactic Cepheids through the method of equivalent width (EW) abundances analysis, we collected a sample of high-resolution UVES (R∼40000) and CRIRES (R∼50000) spectra. We implemented a semi-automatic procedure, to automatically determine the continuum and fit the line profile. This allowed us to measure the EWs of about 350 selected Fe I and Fe II lines (Romaniello et al. 2008) for 168 UVES spectra. The $T_{\rm eff}$ was independently estimated by using the line depth ratios method (Kovtyukh & Gorlova 2000). The final aim is to provide the metallicity of 77 Galactic Cepheids. The metallicity distribution in the inner disk is confirmed to be super-solar, and it ranges from ∼ 0.2 dex ($R_G \approx 6.5$ kpc) to ∼ 0.4 dex ($R_G \approx 5.5$ kpc). Current finding supports previous results (Pedicelli et al. 2009; Luck & Lambert 2011) concerning a steady increase in the mean metallicity when moving toward the innermost disk regions.

4. Conclusions

We plan to provide the metallicity estimates for a total of 23 Galactic Cepheids (colored symbols in Fig. 1). The new estimates will allow to constrain the abundance gradient, especially in the inner Disk, increasing by ∼20% the number of Cepheids located at $R_G < 6.9$ kpc. Our new data constitute an homogeneous sample of metallicity estimates for the ∼60% of the inner Disk Cepheids. Thanks to 3 new Cepheids located at $R_G < 4.6$ kpc and 3 Cepheids in the Galactic Center, we will obtain hints on the behaviour of the Cepheids' metallicity in the innermost region of the Milky Way.

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