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The stellar populations of the Milky Way in CFHTLS fields

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Abstract. We investigate the characteristics of the thick disk in the Canada – France – Hawaii – Telescope Legacy Survey (CFHTLS) fields, complemented at bright magnitudes with Sloan Digital Sky Survey (SDSS) data. The ([Fe/H], Z) distributions are derived in the W1 and W3 fields, and compared with simulated maps produced using the Besançon model. It is shown that the thick disk, represented in star-count models by a distinct component, is not an adequate description of the observed ([Fe/H], Z) distributions in these fields.

1. INTRODUCTION

Our knowledge of the characteristics of the thick disk remains limited in practically every aspects. Its structure on large scales (>kpc) is not well defined, and its connections with the collapsed part of the halo or the old thin disk are essentially not understood. The spectrum of possible scenarios proposed to explain its formation is still very large and really discriminant constraints are rare. The SDSS photometric survey has provided a wealth of new informations on the thick disk, see in particular [1], [2] and [3]. However, the data have barely been directly confronted to star-count models, and little insights have been given on how the thick disk in these models really represent the survey data. In the present work, we initiate such comparisons by comparing the Besançon model with metallicity and distance informations in the W1 and W3 CFHTLS fields, and provide a brief discussion of our results.

2. W1 AND W3 CFHTLS DATA

We selected W1 and W3 Wide CFHTLS fields (72 and 49 square degrees) which are at a latitude of -61°, 58° respectively, implying less interstellar extinction than the fields W2 and W4 (at $b = 26.3^\circ$ and -42.5° respectively). The CFHTLS photometry has been completed at bright magnitudes with SDSS data in order to sample the thick disk closer to the galactic plane. The metallicity [Fe/H] is calculated using the calibration of [2] which depends on u–g and g–r. The Z-heights above the galactic plane are derived from the photometric distances of [1]. The metallicity-Z distributions for W3 is shown on Fig. 1 (left). These maps are compared with the Besançon model ([4], [5], [6]) (plot on the right).

[a] Based on observations obtained with MegaPrime/MegaCam, a joint project of CFHT and CEA/DAPNIA, at the Canada-France-Hawaii Telescope (CFHT) which is operated by the National Research Council (NRC) of Canada, the Institut National des Science de l'Univers of the Centre National de la Recherche Scientifique (CNRS) of France, and the University of Hawaii. This work is based in part on data products produced at TERAPIX and the Canadian Astronomy Data Centre as part of the Canada-France-Hawaii Telescope Legacy Survey, a collaborative project of NRC and CNRS.

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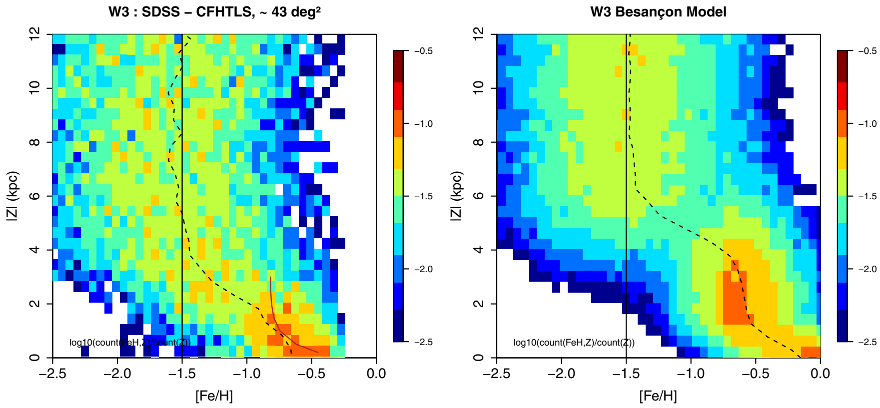

Figure 1. Metallicity distributions of W3 and the Besançon model. The thick disc metallicity of the model is set at –0.6 dex and the one of the halo to –1.5 dex. The continuous line on the left plot shows the median metallicity formula (A2) derived by [2]. The dotted line is the median metallicity per 500 pc bin.

3. RESULTS

The observed distribution is compatible with similar distribution presented in [2], which shows a halo dominating the counts above 3 kpc at mean metallicity near −1.5 dex, and a thick disk component dominating the distribution below this limit. The slight decrease in metallicity with Z observed in the W3 field (and equivalently in W1) is qualitatively compatible with the one found by Bond et al. and illustrated on the plot by the continuous line. The lack of resolution and the validity of the Bond et al. metallicity calibration ([Fe/H]< -0.2 dex) prevents any firm conclusion on the metal-rich side of the distribution. It is in particular difficult to assess if the increase of the median metallicity towards the galactic plane is intrinsic to the thick disk (a metallicity gradient) or due to the increasing presence of thin disk objects in the selection.

The counts generated with the Besançon model in the W3 field illustrates how a discrete thick disk component translates in the ([Fe/H], Z) distribution, showing a distinct large density of stars well separated from the halo and the thin disk. In present models, the thick disk is represented as a separate, distinct component from the thin disk and halo. This has been justified by the fact that the vertical density is well fitted by two exponentials with different scale heights (see, e.g. [7]), and that, (both locally and in in situ samples), the thick disk is identified by stars that are significantly hotter kinematically and enriched in α elements compared to the thin disk. What comes out clearly from the comparison of the observed and simulated distributions however is the absence of a discrete component at metallicities and heights expected for such component, according to accepted models.

4. CONCLUSION

Investigation of the ([Fe/H], Z) distribution in the CFHTLS Wide fields does not seem to show a thick disc component as prominent and distinct as predicted by standard star-count models. The behavior of models must be studied on more extensive data sets in order to assess the necessary adjustments and to better characterise the thick disk.

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