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PROBING GALACTIC STRUCTURE WITH MUSYC

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RESUMEN

Presentamos resultados preliminares del programa galáctico como parte de la colaboración MUSYC. Utilizando la fotometría multicolor de MUSYC, podemos clasificar objetos y seleccionar muestras de un tipo dado. Aplicamos la selección de color para establecer una muestra de estrellas M en el campo de MUSYC CDFS-E, que fue utilizado para estudiar la distribución a lo largo del rayo de haz. La distribución muestra tres componentes para los cuales hemos derivado alturas de escala que indican que estos componentes son el disco delgado, el disco grueso y el halo.

ABSTRACT

We present some preliminary results of the Galactic program within the MUSYC collaboration. Using the multi-colour photometry of MUSYC we are able to classify objects and select samples of a given type. We apply colour selection to establish a sample of M-stars in the MUSYC field CDFS-E which was then used to study the distribution along the pencil beam. The distribution shows three components for which we derived scale heights indicating that these components are the Thin and Thick Disk and the Halo.

Key Words: **GALAXY: DISK — GALAXY: STELLAR CONTENT — GALAXY: STRUCTURE — STARS: LATE TYPE — STARS: STATISTICS**

The **MU**ltiwavelength **S**urvey **Y**ale **C**hile (Gawiser et al. 2005, see also: `http://www.astro.yale.edu/MUSYC`) is a one square degrees deep multi-passband survey. Like most, MUSYC's main aim is extragalactic research. However MUSYC was designed from the beginning with Galactic research in mind - it is one of the very few which has a proper motion program[3].

The Galactic program mainly aims at the detection of faint objects, such as white and brown dwarfs (see Altmann et al. 2005) but also aims at studies of stellar statistics. The colour selection routines developed to select these dwarfs can also be used to harvest samples of more common objects which can then be used to study the Galaxy and it's substructures. Here we show some preliminary results of such a study in one of the fields (CDFS-E); the full results on all 4 fields will be published in a later stage.

To select the point sources from the catalog we used the CLASS parameter of SEXTRACTOR (which was used to extract sources from the images). For our purposes a limiting value of 0.85 was sufficient. Note however that CLASS becomes increasingly less reliable for objects fainter than 25 mag.

However a large fraction of these selected sources will still be extragalactic. To separate these from the stars and also to classify the objects in the sample we developed a SED fitting routine which compares integrated template fluxes, which were convolved with the filter transmission, detector function and atmospheric throughput, with the optical data. The comparison is done using the minimisation of chi^2. Hatziminaoglou et al. (2002) and Groenewegen et al. (2002) used a similar approach on the same field. As templates we currently use various extragalactic and stellar model spectra. To accomodate redshift, the extragalactic model spectra were redshifted in steps of 0.1 within reasonable redshift ranges.

While this routine allows a relatively precise classification of objects, there are some object types which are ambiguous, such as QSOs and A- stars. Another contaminant are elliptical galaxies. It was found that K and M stars are quite free of contamination, which is also supported by the spectroscopy.Another reason for using K and M stars as a probe in this analysis is that they are the most numerous stars and their absolute magnitude range fits perfectly to MUSYC's magnitude range., i.e. the MUSYC M stars cover the whole Galactic extent.

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[3] Unfortunately due to persistent adverse weather condition or technical problems the data acquisition for the second epoch has been delayed for most fields. Moreover the MUSYC proper motion program extends to fields of a previous effort, the CYDER (Calan Yale Deep Extragalactic Research) survey, extending the total area for this part to three square degrees.

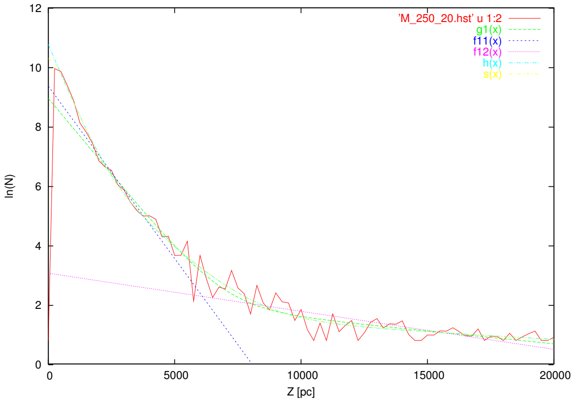

Fig. 1. The z distribution of M stars in the MUSYC field CDFS and various functions fitted to represent the scaleheights of different components. Two components can be clearly seen, the third can be glimpsed at the left.

Distances of the objects were determined by first deriving a quadratic relation between $R - I$ (this colour was used to ensure maximum accuracy in the colours even for the faintest stars) and the absolute V magnitude, based on data taken from Cox (2000). From this the absolute V magnitude for each star was computed. The distribution of the stars with distance was then transformed into a histogram which was then normalised by the volume covered by each bin to give the volume density. Finally, assuming an exponential distribution we took the natural logarithm of the volume densities. Finally the distribution was corrected for Galactic latitude.

The resulting logarithmic distribution does not show a uniform slope, as would be expected if there was only one population of stars (Figure 1); there are most likely two to three components with a very steep one at small z values, a somewhat less steep component dominating at z between 2 and 7 kpc and finally a very shallow distribution predominantly at large values of z. The inner steep slope is not very prominently seen in the z-distribution of M stars. The reason for this is that the actual volume of the innermost bins are small, so we are dealing with small number statistics here. Moreover the closest stars are bright enough to be partly saturated, so they will be underrepresented. Curiously the K star sample (which consists of intrinsically much brighter objects and should thus be more affected by the upper cutoff) has a more prominent inner "spike".

In order to get a more quantitative measure, we fitted various equations to the distribution (Figure 1). The most crude approximation is to use linear equations, each representing one exponential falloff. A better method is to use two or three component fits (see Altmann et al. 2004) and the whole z-distribution for the fit[4]. The resulting scale height values for the 2-component fits are for both samples 800 pc for the middle component and 9300 pc for the shallow part, while the 3-component fit delivers 400 pc, 1060 pc and 16000 pc for our M-starsample, and 150 pc , 780 pc and 9300 pc for the K-sample. The discrepancy in the latter fit is due to the issues concerning the bins closest to us. We therefore consider the 2-component fits to be more reliable, and come to the conclusion that the middle component, representing the Galactic Thick Disk has a scale height of about 800 pc. The Halo (the shallow distribution), which does not have an exponential distribution - therefore the fit can only be a crude approximation - has a value of 9000 pc. The steep component, featuring the Thin Disk has a value of 150-400 pc, clearly the issues concerning this part need to be resolved. Compared with the results of other work, we find that Altmann et al. (2004) arrive at 900 pc for the Thick Disk and 7500 pc for the Halo. Especially the Thick Disk value is very close to ours - which is striking, since that study used both completely different stars and methods. Another study concerning the scale height of M stars (Phleps et al. 2000), leads to a somewhat larger result of about 1200-1300 pc.

Given that these are preliminary results, they further constrain the scale height of the Thick Disk to be ≤ 1 kpc. This analysis is currently being done for all 4 fields and we will then be able to draw further conclusions about the structure of our Galaxy.

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[4] in the case of a 2 component fit, the part where the third component has significant influence is left out.