SNAPSHOTS OF CCD FIELDS IN A STUDY OF THE VERTICAL DISTRIBUTION OF STARS

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ABSTRACT. Snapshots of eight SA and standard fields from low to high galactic latitudes were made using the KPNO 0.9 m 2k x 2k CCD with a limiting magnitude from 19 to 22.5. The purpose of this study is to determine the vertical distribution of stars with respect to galactic latitude and z-distance in comparison with the model simulation between intermediate population to the “thick disk” component of scale height of a few kpc. Comparison of the preliminary results between observed and model simulation for three of the eight fields shows good agreement both in V-mag and B-V color distributions. A bimodal distribution in B-V at high galactic latitude seems to be represented by a halo and “thick disk” dwarf in blue and a normal disk dwarf population in the red.

Key Words: Galaxy: structure, areas – techniques: photometry
1. INTRODUCTION

The luminosity profiles of spiral galaxies are usually described by a standard model suggested by Bahcall and Soneira (1980) which consisted a Galactic Bulge, Disk and spheroid or halo. The structure of a spiral galaxy, including the Milky Way Galaxy, has been satisfactorily explained by two independent components, an exponential disk and a spheroid component which follows the $r^{1/4}$ law (van der Kruit and Searle 1981). Based on the recent photometric surveys, several groups have suggested the existence of a “thick disk” component (Gilmore and Reid 1983, Robin et al. 1989, von Hippel and Bothun, 1993, Robin et al. 1996). In general, the thick disk has a scale height of more than 1 kpc, several times that of the normal disk and a density of a only few percent of the disk.

The use of star counts to model the global structure of the Galaxy have been shown to be both useful and effective to investigate metallicity, kinematics and stellar population properties. As pointed out by Robin and Oblak (1987), Ratnatunga et al. (1989), Gould et al. (1993) and Mendez and van Altena (1996) that most of the proposed model have little ability to predict star counts and kinematics simultaneously. This study is part of an on-going program to investigate the kinematics, metallicity, structure and mass density of the Galaxy toward the South Galactic Pole at Cerro Tololo Inter-American Observatory (Lu 1990, 1991, Lu et al. 1992). Photometric surveys using CCD photometry for galactocentric distances beyond the solar neighborhood have been studied by various groups. In this study, our observed star counts complete to a certain limiting magnitude and color are compared with a theoretic model simulation. Details of this model have been described by Mendez and van Altena (1996). The basic model uses the fundamental equation of stellar statistics in galactic astronomy, for example (Mihalas and Binney 1981) by calculating luminosity and density functions. The parameters used in the simulation depends largely on field of view, limiting magnitude, interstellar reddening, photometric error and positions in galactic longitude and latitude.

2. OBSERVATION AND ANALYSIS

Eight fields of Selected Areas and standard fields from low to high galactic latitudes were made in April 1994 using the KPNO 0.9 m with a 2k x 2k CCD (see Table 1). The limiting magnitude is about 22 in V mag for our primary targets of Lp 543-32/33 and SA 57. The other six fields are Landolt (1992) standard fields which are generally integrated with shorter exposure time, thus, these fields reach to a limiting magnitude to about 19. Distributions in V mag error, V mag and B-V color for the eight observed fields have been created. The distributions of magnitudes and their shapes are determined by their limiting
Snapshots of CCD Fields magnitudes and galactic positions and generally show no major differences. However, the histograms of B-V color exhibit considerable difference particularly at high latitude fields. For low latitude fields, the color distributions are generally skewed to blue which are expected, except for SA 98 and 107, which both have a rather normal distributions with the similar color.

Table 1. Positions of the observed fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>R.A.</th>
<th>Dec</th>
<th>Epoch</th>
<th>l</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA 98</td>
<td>06h 51m 34s</td>
<td>-0°18'54&quot;</td>
<td>1994.3</td>
<td>213.3</td>
<td>-0.1</td>
</tr>
<tr>
<td>LP 543-32/33</td>
<td>07 49 58</td>
<td>7 14 13</td>
<td>1994.3</td>
<td>213.1</td>
<td>16.4</td>
</tr>
<tr>
<td>PG 0918+029</td>
<td>09 21 14</td>
<td>2 48 29</td>
<td>1994.3</td>
<td>229.4</td>
<td>34.3</td>
</tr>
<tr>
<td>PG 1633+099</td>
<td>16 35 17</td>
<td>9 47 03</td>
<td>1994.3</td>
<td>25.9</td>
<td>34.6</td>
</tr>
<tr>
<td>SA 107</td>
<td>15 39 33</td>
<td>-0 13 57</td>
<td>1994.3</td>
<td>5.9</td>
<td>41.2</td>
</tr>
<tr>
<td>SA 104</td>
<td>12 41 42</td>
<td>-0 31 17</td>
<td>1994.3</td>
<td>297.9</td>
<td>62.2</td>
</tr>
<tr>
<td>G 12-43</td>
<td>12 33 02</td>
<td>9 03 02</td>
<td>1994.3</td>
<td>288.8</td>
<td>71.4</td>
</tr>
<tr>
<td>SA 57</td>
<td>13 10 05</td>
<td>30 15 51</td>
<td>1994.3</td>
<td>70.9</td>
<td>84.8</td>
</tr>
</tbody>
</table>

For the high latitude fields of SA 104, G 12-43 and SA 57, the observed distributions all show a bimodal distribution with a blue peak B-V = 0.6 and red peak at about B-V = 1.5. Since there are enough number of stars in the SA 57 field (near the NGP), the comparison between model and observed star counts show a remarkable agreement in distribution (Fig. 1). The model simulation for other fields have not yet analyzed. The simulation was normalized for 1 sq. deg, while the observed CCD field of 2k x 2k chips on KPNO #1 0.9 m yields a field of 0.396' x 0.396', therefore, the predicted star count of 1 sq-deg is scaled down to match with the chip size of 0.157 sq. deg. This simulation is consistent with the best S/N scenario.

3. SUMMARY

Using the SA57 field, the mean peak color of B-V = 0.8, a typical late F to early G stars, with an absolute magnitude of about 4 and an apparent magnitude of 22. This would yield an up limit distance modulus of about 10 kpc, consists probably by halo stars near the turnoff. The red peak of B-V = 1.5 is likely representing a typical late K and early M stars, thus, yield a distance of about few kpc for dwarf main sequence stars and about 20 kpc for the giants.

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Fig. 1. Star counts in SA 57

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