Galactic Structure Surveys and the Kinematic Properties of the Galaxy's Stellar Populations

1. Introduction

We describe a sample survey programme in stellar photometry and astrometry (Robin et al. 1993), with an aim to study the galactic structure and stellar evolution. In the framework of the current programme, new UBV and absolute proper motion surveys were carried out in three selected areas of the Galaxy. We have analyzed the large stellar samples, with reliable absolute proper motions and without biases of selection in kinematics or metallicity. The algorithm SEM (Stochastic-Estimation-Maximization; Celeux & Diebolt 1986) was used for the deconvolution of the stellar populations up to large distances above the plane, allowing us to study their statistical properties independently. New estimates of the kinematical parameters of the thin and thick disks have been deduced.

2. Sample Survey

The combination of the OCA, ESO, Tautenburg and Palomar Schmidt plates was used to derive the multicolour absolute proper motion for the following three fields at intermediate latitude:

- field in the direction of galactic anticentre (l = 167°, b = 47° [Ojha et al. 1994a]);
- field in the direction of galactic centre (l = 3°, b = 47° [Ojha et al. 1994b]);
- field in the direction of galactic antirotation (l = 278°, b = 47° [Bienaymé et al. 1994]).

All the Schmidt plates were measured with the MAMA machine at the Observatoire de Paris.

3. Results

The combinations of the new data sets with different statistical methods have given until now a number of results concerning the galactic structure and stellar evolution:

i) From the number ratio of the thin and thick disks stars in a pair of directions towards galactic centre and anticentre, we deduced the scale length h_R of the thin disk and thick disk, which is found to be 2.6 ± 0.1 and 3.6 ± 0.5 kpc, respectively (Ojha et al. 1994a, c).

ii) The thin disk population is found with (<U + W>, <V>) = (1 ± 4, -14 ± 2) km sec^{-1} and velocity dispersions (σ_{U+W}, σ_V) = 35 ± 2, 30 ± 1) km sec^{-1} (Ojha et al. 1994a, b).

iii) The thick disk population is found to have a rotational velocity of V_{rot} = 177 km sec^{-1} and velocity dispersions (σ_U, σ_V, σ_W) = (67, 51, 42) km sec^{-1} (Ojha et al. 1994a, b; Bienaymé et al. 1994). Our data are consistent with no dependence of the thick disk's asymmetric drift with distance (up to z ~ 3 kpc) above the galactic plane (Ojha et al. 1994b).

iv) The density laws for stars with 3.5 ≤ M_V ≤ 6 as a function of distance above the plane, follow a single exponential with scale height of ~ 260 pc for 150 ≤ z ≤ 1200 pc, and a second exponential with scale height of ~ 770 pc for z distances from ~ 1200 pc to at least 3000 pc. We identify the 260 pc scale height component as a thin disk, and the 770 pc scale height component as a thick disk (Ojha et al. 1994c).

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D.K. Ojha
Observatoire de Besançon
41 bis, BP 1615
F-25010, Besançon Cedex
France