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3-D structure of the Galaxy from star-counts

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Abstract. In the framework of a large project aimed to derive the Galactic structure from star-counts and kinematic information we present preliminary results concerning 6 fields in the direction of the Carina arm and one field in the bulge. Assuming a logarithmic spiral structure, we derive a pitch angle of $12.73^\circ \pm 0.2^\circ$ in the case of a four-armed spiral and a pitch angle of $6.53^\circ \pm 0.20$ using a two-armed spiral. We cannot distinguish between a four- and a two- armed structure. However, the scale height of the Carina arm is found to be 0.05-0.1 kpc, definitely smaller than the value of 0.30 kpc suggested by Taylor & Cordes (1993) as a mean value for the spiral arms. This is in agreement with the dynamical model of the Galaxy by Amaral & Lepine (1997) where even if four arms are present, only two are dominant. The analysis of the bulge field suggests an age spread from 12 to 9 Gyr and a flat IMF.

Key words. Galaxy: stellar content – Galaxy: structure

1. Introduction

To study the structure of the Galaxy a program has been underkaten by means of deep photometry of stellar populations. Since the 1995, several fields have been analyzed with the aim of studying the Galactic bulge (Bertelli et al. 1995; Vallenari et al. 1999); deriving the stellar extinction along the line of sight; obtaining information about the age and the metallicity of the stars in the disk (Bertelli & Nasi 2001; Vallenari et al. 2000); couple kinematical and chemical information of the populations (Vallenari et al. 2002). In this paper we report preliminary results concerning 6 stellar fields in the direction of the Sag-Carina arm and a field in the direction of the Baade Window.

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2. The Carina arm

Many attempts have been made in the recent past to derive the characteristics of the Milky Way spiral structure. The vaste majority of these works fit a four-arm logarithmic spiral to our own Galaxy with a mean pitch angle of about 12°. However suggestions can be found in literature that the structure can be by far more complicate: two arm pattern has been derived as well. Drimmel & Spergel (2001) on the ba-

sis of COBE/DIRBE infrared K data while optical tracers and the 240 μm emission are consistent with a four armed pattern. Theoretical arguments in favor of a superposition of a 2- and 4- armed patterns are advanced by Amaral & Lepine (1997) and Lepine et al. (2001) and by Puerari & Dottori (1992) looking at external galaxies. Here we analyze observational colour-magnitude diagrams (CMDs) and luminosity functions of six stellar fields in the direction of the Sagittarius-Carina spiral arm with the aim of discussing the location and the basic parameters of the inner arm. We find evidence of a population younger than 10^8 yr distributed in a spiral arm in the directions $l \sim 286°, 287°, 288°, 292°$, and 305°. Adopting a logarithmic four-armed spiral model, we derive a pitch angle of $12.73° \pm 0.2°$ and a value of $r_0 = 2.27 \pm 0.7$ kpc. A two-armed spiral is as well compatible with the data, the pitch angle being of about $6.53° \pm 0.20°$ and $r_0 = 2.3 \pm 0.1$ kpc. In both representation however, the most convincing fit is obtained when the scale height of the arm perpendicularly to the plane σ_z is of the order of $0.05 - 0.1$ kpc, smaller than the σ of 0.30 kpc suggested by Taylor & Cordes (1993) as a mean value for the spiral arms, but in substantial agreement with the findings by Drimmel & Spergel (2001) and with the dynamical model of the Galaxy by Amaral & Lepine (1997) where even if four arms are present, only two are dominant.

3. The Galactic bulge

From an observational point of view, there is no general agreement on the age and on the age spread of the stars of the Galactic bulge. While all determinations of ages agree on the presence of an old component, they diverge on whether a substantially younger population is required. Recently suggestions have been advanced than the bulge might present an intermediate age component: OH/IR stars (Sevenster et al. 1997), infrared carbon stars (Cole & Weinberg 2002) are found. In this work we present a study of the central part of the Baade Window 8 from archive HST-WFPC2 data in the F555W and F814W pass-bands. About 18000 stars are measured down to F555W$\sim$25. To properly derive the age of the bulge it is of fundamental importance to account for the metallicity spread (Vallenari & Ortolani 2001). We find a dependence of the turnoff magnitude on the spatial distribution of the stars. Varying the spatial distributions as described in Vallenari & Ortolani (2001), the termination point of the main sequence is found to change of $0.3-0.4$ mag. Discussing the luminosity function and the CMD by means of a χ^2 procedure deriving automatically the best fit parameters, we find that the most convincing solution is obtained including an age spread from 12 to 9 Gyr, a flat IMF ($x = 1.35$ when the Salpeter slope is 2.35) and the G2 distribution having axial ratios 1:0.22:0.16.

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