STELLAR POPULATION SYNTHESIS AND STAR COUNTS TO CONSTRAIN THE GALACTIC STRUCTURE

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ABSTRACT: Our model of stellar population synthesis allows to derive synthetic star counts and distribution of colors, ages, and spectral types of stars in any given direction of observations. Here we compare results of the model with the distribution of stars in space and in absolute magnitude of stars of Gilmore and Reid. We find a small disagreement between observations of GR and predictions of our model in the space density of stars of $4 < M_V < 5$. We show that this discrepancy can well be explained by a contamination of their sample of assumed main sequence stars by red giants and subgiants.

1 - DISTRIBUTION IN ABSOLUTE MAGNITUDE OF STARS AT THE SGP

Our approach of stellar populations in the Galaxy has been described in Creze and Robin, 1983, and Robin, 1983. We compare here the predictions of our model with the distribution of stars in space and in absolute magnitude obtained by Gilmore and Reid, 1983 (GR).

We present in figure 1 the distribution in absolute magnitude of stars with apparent magnitude $15 < V < 17$ in the direction of the South Galactic Pole. We compare the distribution obtained by Gilmore and Reid (1983) (broken line) with the one predicted by the model of Bahcall and Soneira (1980) (BS) (solid line) and with the distribution obtained by our model (dotted line).

The distribution of BS is sensibly different from our's: in our model, the halo luminosity function (fig. 2) results from the various halo disk ratios adopted in different parts of the HR diagram. Our halo includes both intermediate population II and extreme halo, with scale heights z(0.1) ranging between 2.1 kpc and 5.5 kpc. The density law of this component is thus much flatter than the BS one.

GR measured UK Schmidt plates in V and I bands. Then they used a M_V / V-I relation from unreddened main sequence stars to estimate absolute magnitudes assuming that all stars in their sample are on the

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Main Sequence. Then they deduce the distribution of stars in absolute magnitude. We are going to show that, using both the predicted distribution of stars in absolute magnitude and the space density, our model can be useful to determine the cause of the disagreement and that the assumption of GR leads to a non-negligible misclassification of the giants and subgiants.

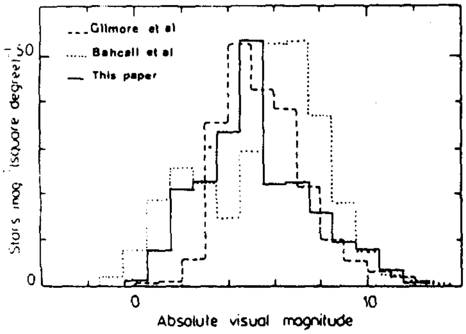

Figure 1: Distribution in M_V of stars with 15<mv<17 (SGP).

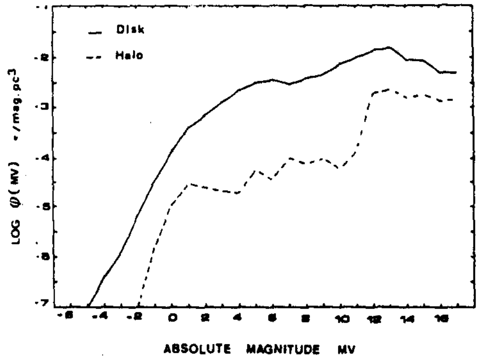

Figure 2: Luminosity function in the solar neighborhood adopted in our model.

2 - SPACE DENSITY OF STARS AT THE SOUTH GALACTIC POLE

From their observations, GR deduce the space density of stars of absolute magnitude M_V between 4 and 6 in the direction of the South Galactic Pole. The comparison between their space density and the one from our model is shown in fig. 3 a and b for stars of absolute magnitude $4 < M_V < 5$ and $5 < M_V < 6$ respectively. A very good agreement is found for this last range. But for stars with $4 < M_V < 5$, our model predicts much less stars than GR. Since both investigations use the same luminosity function for disk stars and since the agreement is good for stars of $M_V > 5$, the main sequence stars and their density law cannot be the cause of this discrepancy.

Through their M_V / V-I relation, stars with $4 < M_V < 5$ are in fact in the range V-I = 0.61 to 0.75 (see Reid and Gilmore, 1982, appendix B). In this range of colors one finds not only main sequence stars but also giants and subgiants. Contaminating stars are F5 to F8 giants with absolute visual magnitude ranging between 1.35 - 1.70 and F5 to G0 subgiants of absolute magnitude 2.5 - 3.0 (from calibrations of Deutchman et al, 1976, and our calibrations from photoelectric photometry catalogues). In the GR sample these misclassified giants slightly contaminate the counts in the range $4 < M_V < 5$ and a lack of such stars appears at $M_V = 1.5$. The misclassified subgiants of absolute magnitude $M_V = 3$ are seen by GR at $M_V = 6.5$. It thus induces an excess of stars at $4 < M_V < 5$ and at $M_V = 6.5$, and a lack at $M_V = 1.5$ and 3 in the GR sample (see figure 1).

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In the GR sample, the space density of stars with $4 < M_V < 5$ induces a density law composed of two exponentials. The first one has a scale height of 300 pc and the second one 1350 pc. Our model is consistent with a two exponential density law but the first exponential would have a scale height of 250 pc since our synthetic counts are not contaminated by giants. For the sample of stars with $5 < M_V < 6$ we find a space density very close to the GR one with the same scale heights.

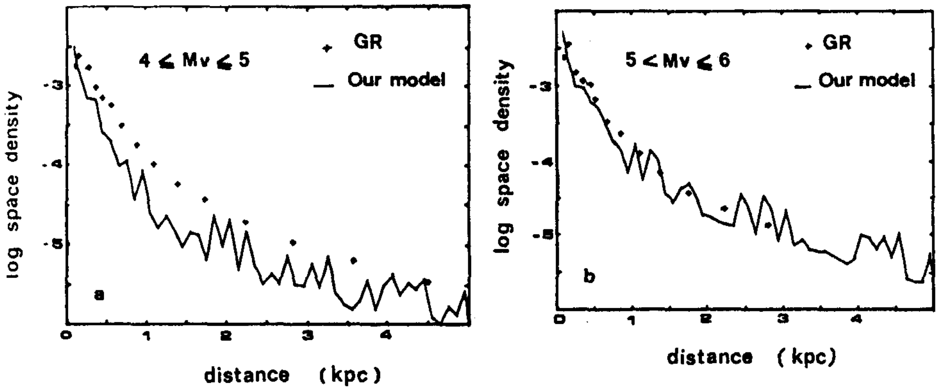

Figure 3: Density distribution of stars with distance from the Galactic Plane, in two ranges of absolute magnitude. Crosses are from Gilmore and Reid, 1983. The solid line is from our model.

3 - CONCLUSION

The analyse of Gilmore and Reid induces errors in the distribution of stars in absolute magnitude and in space. With our model we show that their assumption that all stars are on the main sequence in their sample is wrong since the number of giants and subgiants is not negligible. This misclassification of evolved stars induces an artificial increase in the scale height of disk main sequence stars from 250 pc to 300pc.

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