THE EFFECT OF CROSSING TIMES THROUGH THE SOLAR NEIGHBOURHOOD ON THE OBSERVED STELLAR AGE AND METALLICITY DISTRIBUTIONS

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The effect of crossing times through the solar neighbourhood on the observed stellar age and metallicity distributions due to the oscillations perpendicular to the galactic plane is well known. Stars with high z-velocity are under-represented since they stay much longer far from the galactic plane than near the sun. Since the age and metallicity distributions of these high velocity stars are quite different from the age and metallicity distributions of all the stars moving at a mean distance $\overline{\varpi} = 10$ kpc from the galactic centre, a weighting procedure has to be adopted. The weight to be assigned to each star should be proportional to the ratio of the oscillation period in z, i.e. T_z, to the time spent within a sphere centered on the sun, i.e. τ_z. An approximate formula has been given by Woolley (1970): $T_z/\tau_z \sim 2.5|w| + 0.045|w|^2$. The effect of such a weighting procedure is very important : the ratio T_z/τ_z varies from 1 to more than 4 between young and old stellar populations. It has to be noted that the quadratic term of weighting (often neglected) is equal to the linear term for a $|w|$ velocity of about 55 km/s.

The same kind of bias is to be expected due to the motions parallel to the galactic plane. There is no reason why the stars presently at a distance $\varpi = 10$ kpc should be representative of all stars moving at a mean distance $\overline{\varpi} = 10$ kpc from the galactic centre. The problem is very complex here because of the density and metallicity variation with the distance from the galactic centre. Therefore, it is not a-priori evident whether the old stars are under-or over-represented. In fact what we would hope to get is the distribution (in ages or in metallicities) of the stars born at a distance $\varpi = 10$ kpc from the galactic centre. It is not evident that the relation between the brithplace and ϖ is unique. It has been shown that the bias due to the motions parallel to the galactic plane on the age distribution is smaller than 10 %. It depends on the run of the distribution of epicentres for galactic orbits and

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of the excentricity distribution of stars with given age and mean distance from the galactic centre. It depends also on the relation between stellar birthrate and ϖ. The present knowledge of these three functions is too poor to attempt any correction of this bias.

It has also been verified that the effect of crossing times due to the motions parallel to the galactic plane does not greatly modify the cumulative distribution of metallicities. This is shown in Fig. 1. The full line shows the distribution obtained with the simple one-zone model of chemical evolution, the dotted and dashed lines give the distributions obtained in correcting the crossing time effect. The correction is very small and should not be larger for any other model. Therefore, it can be concluded that the comparison between the local mixture of stars which come from very different regions and the prediction of a local model for the chemical evolution seems to be justified. This last statement is by no means a justification of one-zone models for chemical evolution, as mechanisms other than the crossing time effect may allow an interaction between different radial rings.

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REFERENCE

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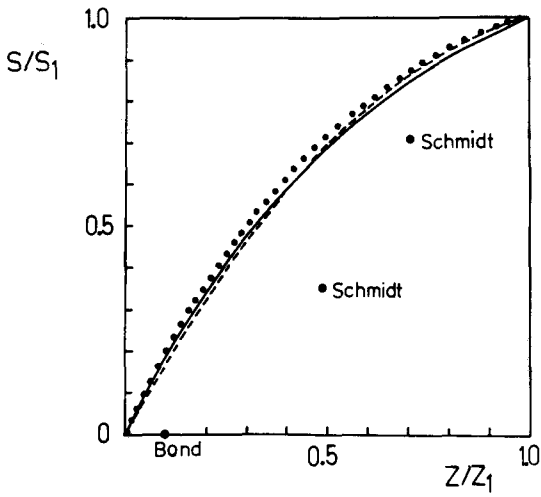

Fig. 1 Cumulative number of stars as a function of the heavy elements abundance Z
—— simple model
--- e_o (Z) same law as for the F-dwarf stars
··· e_o = 0.15 for all Z

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