MEAN CHEMICAL ABUNDANCE OF THE F STARS AS A FUNCTION OF DISTANCE FROM THE GALACTIC PLANE

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At the Tbilisi European Regional Meeting 1975, I reported on results of uvby, Hβ photometry of F-type stars in the north and south galactic polar caps (Blaauw and Garmany, 1976), based on stars in the McCormick proper motion fields between latitudes 60° and the poles. A relation was shown to exist between the quantity Δm_1 as determined in this photometric system, and the distance, z, from the galactic plane; Δm_1 being a measure of the metal abundance in these stars. The spectral range we deal with is defined by b-y = 0.25 to 0.40, corresponding with F0 to G2. It was found that, from the solar neighbourhood near z = 0, to z = 700 pc, the mean relative metal abundance M/H decreases by a factor of about one third.

This relation is understood in terms of the local chemical abundance distribution of the F stars and the distribution of their velocity components, W, perpendicular to the galactic plane, together with the field of force, K(z), in this direction. For K(z) I adopted the run with z as given by Oort (1965) for distances up to 1500 pc. For the distribution of the w velocity components, I made use of data for the bright stars generously made available to me by Dr. M. Mayor of the Geneva Observatory, forming the basis for his research on the local chemical evolution in the galactic disk and the radial metallicity gradient (Mayor, 1976). The distribution of the w velocity components was determined for six intervals of Δm_1. Two features of these distributions are relevant here: (a) The velocity dispersion, i.e. the r.m.s. value, σ_w, increases continuously with increasing Δm_1, from 10 to 31 km/sec. See the upper part of Table 1 where also the numbers of stars in these six groups are given; (b) It appears that these velocity distributions are gaussian to a sufficient degree of approximation to render it unnecessary for the present exploratory calculations to introduce more than one gaussian component.

We can then predict, for any subgroup of Δm_1, the density distribution in z according to the relation

$$D(z_1)/D(0) = e^{\sigma_w^{-2}\int_0^{z_1} K(z)dz}$$

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and subsequently, starting from the numbers of stars in the Δm_1 groups at z = 0, calculate the relative numbers at various distances z. From this, we obtain the average Δm_1 as a function of z, which we may compare with the observed relation. For the actual calculations the first three intervals of Δm_1 were combined so that we actually use the four subdivisions given in the lower part of Table 1.

Within z = 200 pc, the sample mainly consists of stars of subgroup I, whereas beyond 600 pc group IV dominates. At 1 kpc this latter represents about 90 percent of all stars. The resulting average values of Δm_1 give a good representation of the observed ones (except for a small zero point correction to be checked by further observations). This implies that the observed run with z can be entirely understood in terms of local dynamical considerations.

Table 1

Velocity Dispersion of Subgroups according to Δm_1 for Bright F0 to G2 Stars (b-y = 0.25 to 0.40)

Δm_1 (unit .001)	< 1	1-10	11-20	21-30	31-40	41-80	all
n	113	165	181	134	72	40	705
σ_w (km/sec)	9.8	10.4	11.2	15.4	20.0	30.6	
Subgroup		I		II	III	IV	
%		65		19	10	6	100
adopted σ_w (km/sec)		11		15	20	31	
$<\Delta m_1>$		+.006		+.026	+.035	+.050	

A more detailed report on this programme will be submitted in due course to Astronomy and Astrophysics.

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