THE BULGE / HALO INTERFACE
ROTATIONAL KINEMATICS FROM [Fe/H] = –3.0 TO SOLAR

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Abstract. Kinematics and abundances have been determined for a large sample of K giants in a field at ~2 kpc from the center to study the relationship between the bulge and the halo. There are two different kinematic groups evident. The metal-poor stars have low rotation and high velocity dispersion, and so can be associated with the halo. The metal-richer stars have intermediate rotation. Our data suggest that the bulge and halo could be separate kinematical entities.

Key words: Kinematics - K giants - Halo

The term "spheroid" is used to describe an amalgam of properties of the halo and bulge of both our Galaxy and other spiral galaxies. However, if the halo and bulge are not related, attempting to combine their properties into one category may confuse rather than provide any coherent picture.

In order to determine if the halo and bulge can be considered as distinct populations towards the center of our Galaxy, we have surveyed a field at $l = 350, b = -10$, to examine the dependence of rotational kinematics on abundance. Along this line of sight velocities of stars close to the tangent point are dominated by rotation. The minimum distance is ~2 kpc from the Galactic center. Accurate colors and magnitudes using Washington photometry have been measured for ~250000 stars in the 2 square degree field. The reddening has also been measured to be both low (E(B–V) = 0.07) and uniform over the whole field. Washington photometry provides good estimates of abundance (our photometric errors translate to an error of 0.3 in [Fe/H]) and temperature for the ~5000 K giants in the field. Distances can then be estimated to an accuracy of 25 – 30% for the giants. The mean abundance of the whole sample is [Fe/H] = –0.8, and only 30% of stars have [Fe/H] < –1.

Radial velocities have been measured for a subset of the K giants sampled uniformly on abundance and chosen to be close to the tangent point. Figure 1 shows the plot of line of sight velocity versus abundance. These giants separate clearly into two kinematic groups. (Note that our [Fe/H] errors will make the transition seem more gradual than it really is). Stars with [Fe/H] < –1 have a mean line-of-sight velocity of –37 ±8 km/s and dispersion $\sigma_{los} = 107 \pm 6$ km/s. Those with [Fe/H] > –1 have a mean velocity of –82±8 km/s and $\sigma_{los} = 67 \pm 6$ km/s. (Mean velocities are negative because the field is at negative longitude.)

Our distance estimates for each star allow us to calculate rotational kinematics directly following the procedure of Morrison et al (1990). We solve for V_{rot} (the mean rotational velocity about the galactic center) and σ_ϕ (the velocity dispersion of the azimuthal component). The change in kinematics at [Fe/H] = –1 is still apparent. For the metal-poor group ([Fe/H]<–1.0) V_{rot} = 44 ±12 km/s and $\sigma_\phi = 107 \pm 11$ km/s. The errors quoted include the effect of distance errors. The abundance errors, which will cause the more numerous stars with [Fe/H] >–1.0 to spill over into this group, mean that this is probably an over-estimate by 10–20 km/s. The kinematics

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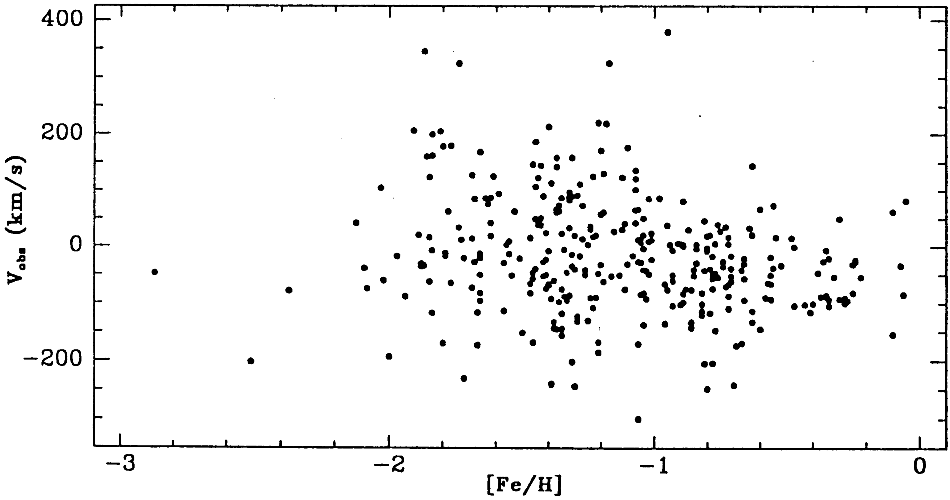

Fig. 1. The observed velocity with respect to the LSR, plotted against [Fe/H] from the Washington photometry. A change in the kinematics is seen at [Fe/H]=−1.0.

of this group are remarkably similar to those of the halo in the solar neighborhood and thus it seems appropriate to associate these stars with the halo.

The stars with [Fe/H] > -1 have V_{rot} = 112 ±12 km/s and σ_ϕ = 60 ±12 km/s. These measures are consistent with the kinematics of the Mira variables (Menzies 1990), planetary nebulae (Kinman et al 1988), and OH/IR stars (Dejonghe, this volume, te Lintel-Hekkert et al 1991) at similar l and b but show higher mean velocity than the sample of Minitti et al (1992).

Our data are consistent, within the errors, with an abrupt change in kinematics near [Fe/H] $= -1.0$, which would imply that the bulge and halo are different entities, possibly having completely different origins. We plan to measure more accurate abundances from the stellar spectra, and this will provide a stronger test of this hypothesis.

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