A DETERMINATION OF KINEMATICS AND STRUCTURE OF THE INNER GALACTIC HALO USING BLUE FIELD STARS AS TRACERS OF LARGE-SCALE HALO PROPERTIES

by

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ABSTRACT

A DETERMINATION OF KINEMATICS AND STRUCTURE OF THE INNER GALACTIC HALO USING BLUE FIELD STARS AS TRACERS OF LARGE-SCALE HALO PROPERTIES

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The structure and kinematics of the inner galactic halo are explored by utilizing samples of blue field stars as tracers of large-scale halo properties. Using the catalogue of blue field horizontal-branch (FHB) stars of Beers, Preston and Schectman, it is demonstrated that the distribution of these stars is not uniform, and that structure exists in their distribution on scales of less than 100 parsecs. The extension of the HK Survey of Beers, Preston and Schectman to the northern galactic hemisphere is discussed, outlining the methodology of both the survey and the follow-up observations that are made on the blue halo stars identified therein. A sample of 592 stars for which spectroscopic measurements have been taken, drawn from the HK Survey in the southern galactic hemisphere, consisting of 353 FHB stars and 239 main sequence A-type stars, are applied to the kinematic models of Frenk and White to determine the rotational velocity of these field star systems. These stellar types are treated both independently and in combination for this analysis, and the results are compared with previous analyses which have been made for other systems in the halo.

This is dedicated to my family,
and to the memory of my grandfathers,
Steve Doinidis and Zachariah Kourous.

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KEY TO SYMBOLS, ABBREVIATIONS AND NOMENCLATURE

GCS – Globular Cluster System.
FW80 – Frenk and White (1980).
T89 – Thomas (1989).
BPS I – Beers, Preston and Schectman (1985).
BPS II – Beers, Preston and Schectman (1990).
FHB – Field Horizontal-Branch.
FHB I – Beers, Preston and Schectman (1988).
SLC – Sommer-Larsen and Christensen (1987).
PCF – Pairwise Correlation Function.
KPNO – Kitt Peak National Observatory.
CTIO – Cerro Tololo Interamerican Observatory.
KP – Line index based on K feature of CaII.
HP – Line index based on $H\gamma$ and $H\delta$.
$D_{0.2}$ – Width of $H\delta$ feature at 20% below the level of the local continuum.
R_C – Depth of $H\delta$ feature relative to continuum.

CHAPTER 1: INTRODUCTION

The study of the galactic halo offers clues to the formation and evolution of the galaxy. This is due to the unavoidable chemical and dynamical mixing that has occurred in the disk since its formation, virtually eliminating the record of the initial collapse and early stages of the protogalaxy that formed our present system. Because the halo is much less dense than the disk, there has been little opportunity for the individual components of the halo system to interact with each other, and it is uncertain even if the halo has dynamically relaxed since the collapse and formation of the disk system. If this is indeed the case, then objects in the halo can be utilized as tracers of the formation of the galaxy. The halo can also provide information on the kinematics and dynamics of the galaxy to large distances from the galactic center, free from the obscuration of the gas and dust in the disk. Objects in the halo can be used to empirically establish the form of the galactic potential to large galactocentric distances, which allows the testing of models for the kinematical behaviour of the galaxy and work towards refinements of these models. These observations can also provide information on more general problems in galactic astronomy, such as the large-scale structure of spirals and the dark matter hypothesis.

The globular cluster system (hereafter GCS) was the first and most obvious system of halo objects to be studied. Kinematic studies, such as those of Kinman (1959), Clube and Watson (1979) and Frenk and White (1980, hereafter FW80) have formed the basis of our understanding of the processes which govern the nature of the halo. Studies on the spatial distribution of the GCS (e.g., Woltjer, 1975, Thomas, 1989, hereafter T89) suggest that the form of the galactic potential is spherical, but it is inherently problematic to apply the GCS to these ends, as the number of clusters which can be observed number in the hundreds while the volume occupied by the system is on order $10^5 - 10^6$ kpc^3. This limits the conclusions that can be drawn from these studies to areas of large scales and meager detail. Another limit of the globular cluster system is the large uncertainty in distance estimates for many clusters, which have distance modulii accurate only to about 0.5 mag, a figure unlikely to improve in the near term.

It would be far more advantageous to employ halo stars in determinations of halo structure and kinematics, as they are far more numerous than the globulars. They are also distributed more uniformly throughout the halo, giving much more predictive power to the observations that can be made on them. This advantage is offset, to a degree, by their faintness, which makes it difficult to unambiguously identify field stars in large-scale surveys. The first attempts to collect samples of halo stars involved the identification of high velocity stars, as well as surveys for faint blue stars in the direction of the galactic poles.

The high velocity stars are so-called because they are close to the solar neighbourhood, yet have heliocentric radial velocities that are in excess of the circular velocity that a star would have at the sun's galactocentric distance, the inference being that their orbits are much more energetic than that of the sun, making them members of the halo population. Because the criterion used to select these stars introduces an obvious kinematic bias to any samples collected in this manner, their usefulness in applications to dynamic modelling is limited.

Surveys for faint blue stars have relied on two basic methods for collecting samples of stars. The first is simply to look for stars with blue colours and faint limiting magnitudes. Stars are identified either through wide-field photographic plates taken through broad-band filters, or by individual photometric measurements on selected stars. The colour of the objects is, however, a weak criterion from which to select field stars, and there are problems with contamination of these samples from subluminous stars in the stellar neighbourhood. The range of stellar types which can be found is also limited to the hottest of the field populations, which are also the least numerous. A similar method utilizes the colour differences of stars, $(B-V)$ and $(U-B)$, which can be used to place a star on a two-colour diagram (see Figure 1). This entails either measurements of photographic magnitudes of these stars on plates taken with broad-band filters, which are accurate only to ± 0.2 mag, or by individual photometric measurements, which are inefficient and time consuming.

Over the last ten years, two survey methods have been developed to more easily identify large numbers of halo stars by making use of the large areal coverage that

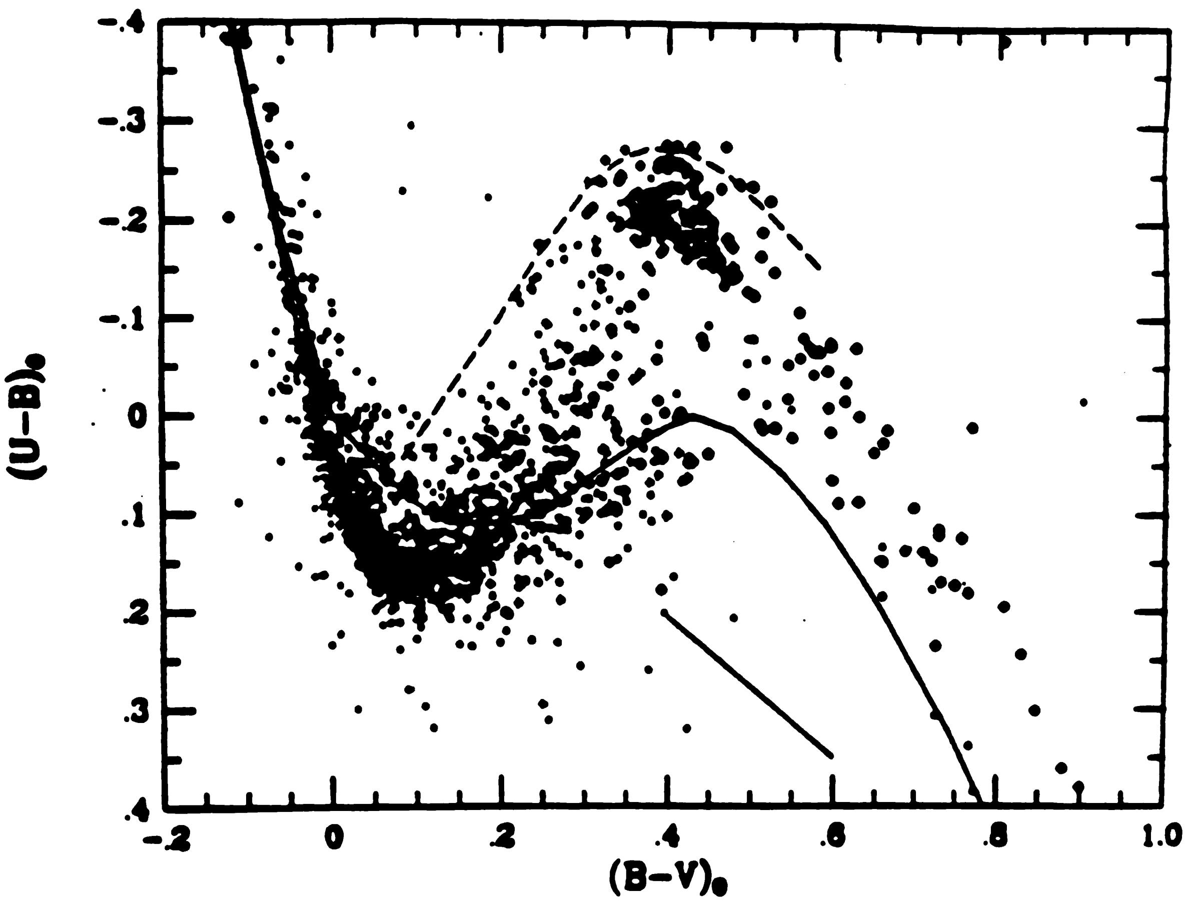

Figure 1. Unreddened two-colour diagram. The solid curve represents the main sequence relation, the dashed curve synthetic colours from Buser and Kurucz (1978) for log g = 4.5 and [Fe/H]= -2.5. The stellar types represented here are FHB stars (filled circles), candidate metal-poor halo stars (diamonds) and field stars of intermediate type (crosses). The lower line represents the reddening. Figure reproduced from Preston *et al.* (1990).

is possible with Schmidt telescopes. The first method is to search for stars with large ultraviolet excesses, and has been employed successfully in the the Palomar Green Survey (Green 1980), and in the Kiso Survey (Noguchi, Maehara and Kondo 1980). The methodology for these surveys is essentially the same as earlier surveys that sought to identify blue stars at high galactic latitudes, but better techniques have since been developed for colorimetric classification of these objects into the various stellar types which populate the halo (Kilkenny 1987). Spectroscopic and photometric follow-up observations are nevertheless required in order to confirm the candidate stars that are identified in these surveys, and so they are by nature long-term projects.

The second method is to search for candidate stars by analyzing their spectra on objective-prism plates taken on these telescopes. Earlier surveys, such as those of Slettebak and Stock (1959) and Slettebak and Brundage (1971) concentrated on identifying early-type stars in the vicinity of the galactic poles over the magnitude range $6 < B < 14 - 15$. Some difficulty is faced at the faint magnitudes in these surveys, owing to overlap between adjacent spectra. At the magnitude limits, this effect is very pronounced, making it difficult to accurately identify stellar types which are of interest. The HK Survey of Beers, Preston and Schectman (1985, 1991; hereafter BPS I and BPS II) utilizes an objective-prism coupled with an interference filter to identify blue halo stars, particularly halo stars of extremely low metal abundance. The filter has a narrow ($\approx$ 150 Å) bandpass centered in the region of the H and K lines of CaII, a wavelength range with features that are sufficient for the identification of these stars with a high degree of success.

By using such a narrow bandpass for the plates, the resultant spectra are themselves smaller (although they are widened for clarity), so that crowding of spectra is not as great a concern as for other methods, allowing for a fainter limiting magnitude, covering the range $11 < B < 16$. This work will be concerned primarily with those stars in the survey which were classed as type A and AB, for which the great majority ($\geq 85\%$) are expected to be blue field horizontal-branch (FHB) stars. Among the other types expected are A type stars, hot subdwarfs (sdO and sdB) and degenerates. These stars alone are numerous enough to allow for a comprehensive determination of all kinematical and dynamical parameters in the halo. Another major advantage of this survey method is the efficient use that it makes of observational facilities. This is due partly to the large areal coverage of Schmidt plates, but mostly due to the high percentage of the candidate stars which are identified correctly on these plates. This ensures that the majority of the follow-up spectroscopic and photometric observations can be put to use.

A catalogue of FHB candidate stars identified through the HK Survey in the southern galactic hemisphere has been presented by Beers, Preston and Schectman (1988, hereafter FHB I), containing some 4400 candidate stars. The data included for each star consists of coordinates accurate to 2 arcseconds, and rough magnitude estimates based on the brightness of the spectra, accurate to about ± 0.5 mag. Although the uncertainty in magnitude is roughly equal to that for the globulars, the prospects for improving these are limited only to the availability of observational facilities for photometric measurements of these stars. Distances for these stars are easily determined, owing to the well-defined intrinsic brightness of the horizontal-branch ($M_V = 0.6 \pm 0.2$ mag). Chapter 2 outlines the use of an estimator, the two-point correlation function, which can be used to probe the distribution of the FHB stars in the catalogue for deviations from that expected for a random distribution of stars. In Chapter 3, it is demonstrated that the FHB I sample indicates that there is structure in the distribution of the halo stars on scales of less than 100 parsecs, suggesting that models for the galaxy which assume dynamical relaxation in the halo may not be truly reflective of the actual conditions existent in the halo.

In Chapter 4, the extension of the HK Survey into the northern galactic hemisphere is discussed, as well as the determination of the stellar types of candidates based on follow-up spectroscopic and photometric observations is detailed. Because the scanning of the northern survey plates is carried out by Beers as opposed to Preston, who carried out the scanning in the south, it is important to establish that the methodology employed by both is consistent. It has therefore been important to initiate the follow-up observations of the northern hemisphere candidates in order to be able to address any possible differences. In Chapter 5, photometry for a sample of stars drawn from the northern survey is presented, and the issue of uniformity between the northern and southern samples is discussed.

In Chapter 6, a sample of 585 stars from the southern HK Survey for which spectroscopic measurements have been made are applied to the kinematic models of FW80 to determine the rotational velocity of the inner halo. The sample consists of 375 FHB stars and 210 stars with normal A type spectra. The stars are applied both as separate samples and a combined sample, and the results are compared against similar determinations made for other halo systems.

CHAPTER 2: STATISTICAL TESTS FOR SPATIAL STRUCTURE IN THE HALO

The spatial structure of the halo has for some time been a topic of great interest and a property of the galaxy which is poorly constrained. The interest in this facet of the halo comes from the link that the spatial distribution of objects could have with the overall mass distribution of the galaxy, so that knowledge of this distribution would in turn provide us with the form of the galactic potential. The result which is obtained using the GCS is consistently that of a spherical distribution, but over the large scales which are necessitated by using this sample. It is unclear as to whether the GCS can adequately constrain the geometry of the mass distribution on scales smaller than a few kpc (Woltjer, 1975). This is due in part to scale, but also to differences between individual globulars (*e.g.*, metal-poor halo clusters *vs.* metal-rich disk clusters) which make it difficult to draw any direct conclusions from the entire sample.

Studies have also been made using field star samples, and in general the results have depended on whether kinematics or star counts were used in making the determination. High-velocity, metal-poor subdwarfs in the solar neighbourhood exhibit a velocity dispersion tensor $\sigma_{rr} : \sigma_{\theta\theta} : \sigma_{zz} \approx 2 : 1 : 1$, suggesting that, if these stars are tracers of the mass distribution in the halo, the potential is flattened, at least to distances of a few kpc from the sun (Gilmore *et al.*, 1989), with an axial ratio of $c/a \approx 0.6$. Star count studies are more consistent with a distribution that is close to spherical. By comparing star counts in two fields at different latitudes along the $l = 90°, 270°$ plane selected by Koo and Kron (1982), Bahcall and Soneira (1984) derive an axial ratio of $c/a \approx 0.80^{+0.20}_{-0.05}$. In similar fields (but at fainter magnitudes), Koo *et al.*(1986) derive a value of $c/a \approx 1.3$, but this figure is not as well constrained.

In general, much of this work rests on the assumption that these objects are tracers of the halo mass, when in fact this is not clearly evident on small scales. Much, if not most of the halo mass is in the form of dark matter, and so care must be taken to utilize samples that cover a wide range of positions in the halo in order to properly account for this. The announcement of the discovery of a group of FHB stars which were clustered together and which had similar velocities (Sommer-Larsen and Christensen, 1987, hereafter SLC) raised the possibility that there could be gravitationally bound structures in the halo on small scales, independent of the GCS. This group exhibited a spread in distance modulus of $\sigma_{DM} = 0.16$ and a velocity dispersion of $\sigma_v \leq 20\text{km s}^{-1}$, so that if the FHB stars are tracing a larger group, then it would have a characteristic size and mass of a globular cluster with an extremely large ($\approx 500 : 1$) mass-to-light ratio. Recent work on the SLC group (Sommer-Larsen and Christensen, 1989) has shown that one of the five stars in the group is a main sequence gravity A star, and that a more accurate determination of the velocity dispersion gives $\sigma_v = 53 \pm 22\text{km s}^{-1}$, which severely weakens the possibility that the group is bound.

The original finding did, however, motivate a search through the data of Pier (1982, 1983) revealing a similar grouping of FHB stars (Beers and Doinidis, 1988), and this raised the possibility that there could be additional such groups present in the halo. As the data of Pier was drawn from candidate A and AB type stars identified in the HK Survey, it is possible that additional groups of this kind could be found in the FHB I catalogue. This catalogue contains positional data and rough estimates of apparent brightness (± 0.5 mag) for the FHB candidate stars contained within it, so it is possible to test, albeit tentatively, for groupings of these stars in space on scales similar to that found in the SLC and Pier groups. Confirmation of these groups as dynamically bound entities would require accurate photometry and radial velocity measurements.

Groups such as these, if they are prevalent, would seem to indicate that the distribution of halo stars is not uniform at some scale, and this could be determined given a large enough sample to test this hypothesis. A number of statistical methodologies are available to explore this possibility, and the choice of estimator is driven mainly by the nature of the sample to be studied. The FHB I catalogue consists of candidate FHB stars identified on individual Schmidt plates, which do *not* form a contiguous area on the sky (see Figure 1 of FHB I). The sample, therefore, cannot be treated as a whole. It is possible, however, to treat the plates individually and combine the results derived in this manner for the individual plates. An estimator which can be applied in this way is the pairwise correlation function (hereafter PCF), which has been previously used to explore clustering among galaxies.

A Monte Carlo PCF estimator, $\omega(\theta)$, can be defined by comparing the number of pairs of objects, $N_p(\theta)$, which have angular separations between $\theta - \Delta\theta/2$ and $\theta + \Delta\theta/2$ found in the FHB I fields to $N_r(\theta)$, the number expected from a random distribution, such that

$$\omega(\theta) = \frac{N_p(\theta)}{N_r(\theta)} - 1 \,, \tag{1}$$

Because this estimator requires no separate calculation for edge effects which are introduced by setting an upper limit to θ, it can be used with sample fields of any expedient size. This allows its appplication to the FHB I sample as a collection of individual plates. If one assumes a spherically symmetric, random distribution for these stars, then the PCF derived for each of the plates should be identically zero. Any statistically significant deviation from zerois then evidence that some structure exists. The test for this hypothesis consisted of a comparison of the plates against the expectation for a random distribution, which was determined by creating 100 random realisations of each of the survey plates. It was found that the PCF for the catalogue differed from that for the random realisations to a significant degree, implying that the halo contains structure that deviates from that expected for a random distribution. A summary of this work is given in the following chapter.

This alone would not imply that other clusters of FHB stars necessarily exist, or that these clusters can account for the observed PCF. A further test using a single-linkage clustering algorithm was applied to the FHB I data. This algorithm searches around a specific star for other stars that satisfy the linkage criterion, namely, that the other stars are within a specified distance. This criterion was set to the typical separation between stars in the SLC and Pier groups, and by this method, 23 candidate groups were found, compared to an average of 12 for the randomly generated catalogues. It was also determined that the candidate groups do not fully account for the observed strength of the PCF. Finally, it should also be noted that SLC explore the possibility of clustering in velocity space for their fields in the direction of the north and south galactic poles, finding no groups of stars with velocity dispersions less than 20 km s^{-1}. Because of the small numbers of FHB stars expected in such high latitude fields, it is uncertain as to whether this demonstrates a general trend for the halo.

CHAPTER 3: EVIDENCE FOR CLUSTERING OF FIELD HORIZONTAL-BRANCH STARS IN THE GALACTIC HALO

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EVIDENCE FOR CLUSTERING OF FIELD HORIZONTAL–BRANCH STARS IN THE GALACTIC HALO

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ABSTRACT

We report on an investigation of the clustering of field horizontal–branch stars in the Galactic halo. We examine this question using a catalog of over 4400 candidate field horizontal–branch stars distributed over roughly 2300 square degrees of sky, primarily in the southern Galactic hemisphere. A two–point correlation analysis indicates that the catalog contains an excess of stellar pairs with angular separations $\theta \leq 10$ arc minutes; at the approximate distances of these stars (5–8 kpc from the sun) the corresponding linear separations are $r \leq 10$ pc. We comment on the possible connection with loose groups of halo field horizontal–branch stars noted previously by Sommer–Larsen and Christensen, and Beers and Doinidis.

I. INTRODUCTION

This *Letter* reports on an initial investigation of the clustering properties of field horizontal–branch (hereafter FHB) stars in the Galactic halo. This study was motivated, in part, by the report of an apparent physical group of FHB stars discovered in a limited sample of blue objects on a single wide–field Schmidt plate (Sommer–Larsen and Christensen 1987; hereafter SLC). The proposed group consists of five stars with a spread in apparent magnitude $\sigma_V = 0.16$ mag, and a radial velocity dispersion $\sigma_r \leq 20$ km s^{-1}. The spatial extent of this group (roughly 100 pc at a distance of 4 kpc from the sun) prompted SLC to speculate that these stars are part of a high mass–to–light object with dimensions of a globular cluster, or remnants of a recently disrupted system. In a sub–sample of some 200 FHB stars with complete photometric and radial velocity measurements, Beers and Doinidis (1988) identify a similar group with at least five members, which suggested that other such groups might be found.

FHB stars serve as valuable probes of the Galactic halo. They are intrinsically luminous ($M_V \approx 0.8$), homogeneously distributed, and easily identified, either spectroscopically (Pier 1983) or photometrically (Schechter 1988). They are also numerous. Preliminary investigations of the number density of FHB stars in the region of the Galactic bulge indicate that they outnumber the RR Lyrae variables in the same field by roughly a factor of 5 to 10 (Preston 1988).

Large samples of FHB stars enable investigations of the kinematics and dynamics of the halo on much smaller scales than heretofore possible. Previous searches for faint blue objects, primarily in the direction of the Galactic poles, have identified several hundred early–type stars, some of which might be expected to be halo FHB stars (Chavira 1958; Haro and Luyten 1962; Philip and Sanduleak 1968; Slettebak and Brundage 1971). The catalog of Beers, Preston and Schectman (1988; hereafter FHB I) contains some 4,400 FHB candidates selected from an objective–prism survey of over 2300 square degrees in the south Galactic hemisphere. Spectroscopy of a limited sample of these candidates indicates that over 85% are bona–fide members of the halo horizontal–branch population (Pier 1983). Details of the objective–prism survey itself are given in FHB I.

As discussed in FHB I, apparent magnitudes estimated from the density of individual objective–prism spectra were assigned to each candidate, with an error on order 0.5 mag. The distance to each candidate is derived from its estimated apparent magnitude, assuming a horizontal–branch luminosity of $M_V = 0.8$. Color information is not available for most candidates, and no attempt is made to correct the inferred distance for the color dependence of the horizontal–branch luminosity. It is apparent from the available photometry (Pier 1983; Preston 1988) that the great majority of candidate stars in FHB I lie in the color range $-0.1 \leq B-V \leq 0.2$, where no appreciable color correction is expected. Small shifts in horizontal–branch luminosity might be expected if the helium abundance of the FHB population varies over a wide range (Sweigart 1985), but this effect is small compared to the random error in estimating apparent magnitudes. Because the plates are primarily located at high Galactic latitudes, interstellar reddening is not expected to be appreciable.

II. THE TWO–POINT CORRELATION ANALYSIS

We restrict our attention to the candidates occupying the three most populous brightness classifications (FHB I classes m, mf, and f); these classes correspond to median distances of 5, 6, and 7.5 kpc from the sun, respectively. It should be emphasized that the 92 plates available to date *do not* represent a contiguous sample; each plate is 5 degrees in diameter with little or no overlap even in well–surveyed portions of the sky. We simulate the FHB I catalog by replacing the coordinates of each candidate on a given plate with draws from a random distribution. This procedure retains the original brightness distributions of the candidates on each plate. One hundred random realizations of the FHB I catalog were created.

Significant small–scale clustering should be revealed by power in a two–point correlation plot of angular separations. Following the method of Hewett (1982) we obtain:

$$\omega(\theta) = \frac{N_p(\theta)}{N_r(\theta)} - 1 \,, \tag{1}$$

where $N_p(\theta)$ is the number of pairs in the FHB I sample with separations in the range $\theta \pm \Delta\theta$ and $N_r(\theta)$ is the corresponding number of pairs in each of the random catalogs. This procedure eliminates the need for explicit correction of edge effects, which might be expected to be severe due to the low areal density of stars on each plate. The faintest FHB candidates we consider are at least 1 magnitude above the plate limit, thus small variations in plate sensitivity should not affect the sample. We choose $\Delta\theta = 5$ arc minutes, and count pairs to separations of 90 arc minutes, without distinguishing between stars of different brightness classes.

A matter of concern in the correlation analysis was the possibility of bias due to the inclusion of FHB stars in the outskirts of globular clusters. The presence of a few such interlopers would increase the number of close pairs in our sample, and completely dominate the signal. We have checked the list of Harris and Racine (1979) for globulars within 3 degrees of the centers of the catalog plates. We found only four plates on which there was the possibility of contamination of our sample. In only one of the four cases (CS 22890) was the nearby globular cluster at a distance where its members might overlap in apparent brightness with stars in FHB I. Horizontal–branch stars in M5 have apparent magnitudes corresponding to FHB I brightness class f. We exclude the 14 likely members of M5 before making our calculations.

The final correlation we obtain is the mean of the correlation functions calculated by comparing the FHB I sample with each of 100 random catalogs. Errors bars are obtained from the one–sigma scatter about this mean. Making use of the approximate distances assigned to each discrete brightness class, we calculate the corresponding linear correlation function:

$$\xi(r) = \frac{N_p(r)}{N_r(r)} - 1\,. \tag{2}$$

We use bins of width 10 pc, to separations of 100 pc. Only stars of the same brightness class were counted as possible pairs in this case. Figure 1a shows the mean angular correlation function for stars in the FHB I catalog. The solid lines indicate the one–sigma variation about a purely random distribution. In the range $0 \leq \theta \leq 10$ arcminutes there is a weak, but significant, correlation (amplitude $\approx 0.40 \pm 0.08$). In this bin, 488 unique pairs in the FHB I catalog were identified compared to an expected 348 pairs from the simulations. A statistically significant correlation exists out to separations on order 60 arc–minutes.

The linear correlation is shown in Figure 1b. Again, the signal in the first bin is weak but significant (amplitude $\approx 0.40 \pm 0.12$), resulting from 186 pairs in FHB I compared to an expected 133 pairs. No significant correlation is observed at larger separation. The large scatter in the linear correlation is expected due to the coarseness of the brightness estimates.

We have considered the possibility that the observed correlation is due, in part, to potential selection biases in the original classification of the FHB candidates. The spectroscopic signature of the FHB stars on the objective–prism plates is unmistakable – a weak or absent CaII K line accompanied by a strong Hϵ absorption feature and a blue continuum. The only doubts concerning classification are for the very faintest stars (class vf), which are excluded from our correlation analysis. It *is* possible that the brightness classes which are assigned to each candidate star are influenced by the proximity of one star to another, which might potentially bias the linear correlation calculation, but of course should not affect the angular correlation.

III. A SEARCH FOR CANDIDATE GROUPS

The observation of a significant two–point correlation in the positions of the FHB stars is a necessary, but not sufficient condition for the existence of loose groups such as those identified by SLC and Beers and Doinidis (1988). For example, the correlation power could be dominated by isolated pairs or triplets rather than groups of five or more objects.

Given the rough magnitude estimates presently available for the stars in FHB I we are hesitant to present a definitive list of FHB groups. A strict evaluation of the significance of a group–finding procedure would require a model for the subjective process of assigning discrete brightness estimates for each star, which would be rather ad–hoc. We only comment that an application of a single–linkage clustering algorithm (based on the code of Huchra and Geller 1982) on the FHB I catalog detected 23 groups of 5 or more stars in identical brightness classes; the same algorithm identified, on average, 12 such groups in the simulated catalogs.

One group of FHB candidates identified by the group–finding algorithm, discussed by Beers and Doinidis (1988), is very similar to the SLC group. This group is identified on a plate at relatively low galactic latitude ($b = -15°$) in a direction toward the Galactic center. The list of potential members, along with available velocity and photometric information, is provided in Table 1. Column 1 is the star number from FHB I. Columns 2 and 3 list the 1950 equatorial coordinates. Columns 4–6 give the apparent magnitude and colors (if available) from Pier

(1982). The distance moduli for candidate members are calculated using the parameterization of horizontal–branch absolute magnitude from Sommer–Larsen and Christensen (1986), and are given in column 7. Heliocentric radial velocities (Pier 1983) are listed in column 8. Column 9 lists the equivalent width of the CaII K feature (also from Pier 1983).

Two stars are rejected from consideration on the basis of their large positive velocities. The group covers a total area of roughly 1 square degree of sky. The mean pairwise separation of candidate members is 33 arc–minutes, corresponding to roughly 45 pc at the median group distance of about 5 kpc from the sun. The proposed members with measured photometry have a dispersion in apparent magnitude $\sigma_V = 0.14$ mag. The corresponding spread in distance moduli is $\sigma_{DM} = 0.12$ mag. The radial velocity dispersion for the five stars judged to be members is $\sigma_r = 21$ km s^{-1}. We caution that the radial velocities have external errors no better than 10 km s^{-1}; the SLC measurements are even less accurate. It is therefore possible that the actual dispersions of the groups are substantially smaller than the reported 20 km s^{-1}. More accurate velocities are clearly required.

IV. DISCUSSION

The existence of structure in the halo FHB population, if confirmed by further analysis, is of great importance for constraining models of the formation and evolution of the Galaxy. For example, in the presence of a population of massive black holes, which have been suggested as a major component of the dark coronae of galaxies (Lacey and Ostriker 1985), loose clusters with masses and radii typical of the halo FHB groups would be rapidly disrupted (Wielen 1987). On the other extreme, it is even possible that the apparent high mass–to–light ratios of the FHB groups indicate that they, themselves, are harboring the proposed black holes.

The FHB groups are not the first suggested clusters of halo stars other than the globulars. Proper motion and radial velocity surveys of stars in the solar neighborhood suggest that at least some "moving groups" of stars exist (Eggen 1987;

Ratnatunga 1988). One such group, Groombridge 1830, has a measured space velocity large enough to preclude its membership in the disk population (Eggen and Sandage 1959).

We are still ignorant of many basic properties of FHB groups. It is not even known, for example, whether these groups have corresponding populations of other kinds of stars, such as red giants and main sequence stars. Freeman (1988) is investigating this question for the SLC group; a result should be shortly forthcoming. We plan on obtaining photometry and radial velocities for all pairs and members of the proposed groups in the FHB I catalog. With this information in hand, a more definitive evaluation of structure in the halo FHB population can be made.

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TABLE 1

A PROPOSED GROUP OF FHB STARS ON PLATE CS 22936[a]

Star	R.A. (1950)	Declination	V	B−V	U−B	DM	Velocity (km/s)	W(K) (Å)	Comments
279	18 58 09.4	−35 49 33	...	...	...	...	...	...	
281	18 56 33.4	−35 53 34	14.37	0.25	0.16	13.57	−111	1.8	
282	18 56 37.3	−36 03 14	14.87	0.02	−0.04	13.83	73	0.6	non−member
283	18 57 27.0	−36 06 18	14.50	0.11	0.14	13.62	−62	0.8	
284	18 57 43.0	−36 06 32	14.66	0.02	0.03	13.62	−67	0.9	
285	18 56 44.0	−36 10 51	14.58	0.11	0.15	13.70	201	0.6	non−member
286	18 57 44.6	−36 12 52	14.66	0.16	0.19	13.83	−98	0.7	
287	18 57 30.2	−36 21 36	14.72	0.09	0.04	13.81	−60	0.7	
290	18 59 11.9	−35 47 54	...	...	...	...	...	...	

[a]Photometry from Pier (1982b). Radial velocities and K–line equivalent widths from Pier (1983). Distance moduli assume the parameterization of Sommer–Larsen and Christensen (1986).

FIGURE CAPTIONS

Figure 1 – (a) Mean Monte Carlo estimator of the two–point angular correlation of the FHB I catalog. The error bars represent the one–sigma scatter about the mean. The solid lines represent the one–sigma spread in the correlation of the random catalogs against themselves.

Figure 1 – (b) Mean Monte Carlo estimator of the two–point linear correlation of the FHB I catalog, using coarse apparent magnitude bins to assign distances. The error bars represent the one–sigma scatter about the mean. The lines represent the one–sigma spread in the correlation of random catalogs against themselves.

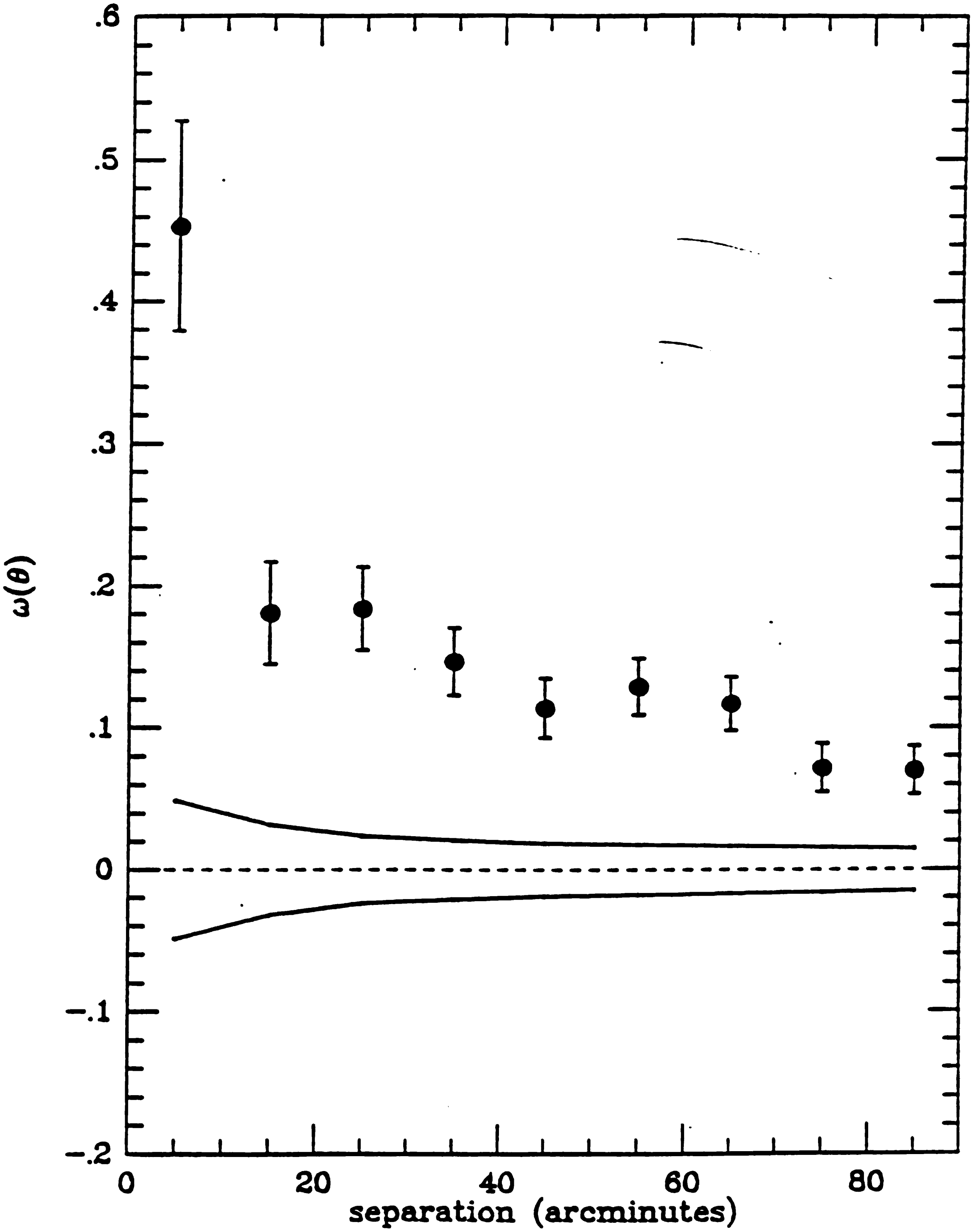

Figure 1 (a) - Doinidis and Beers (1989)

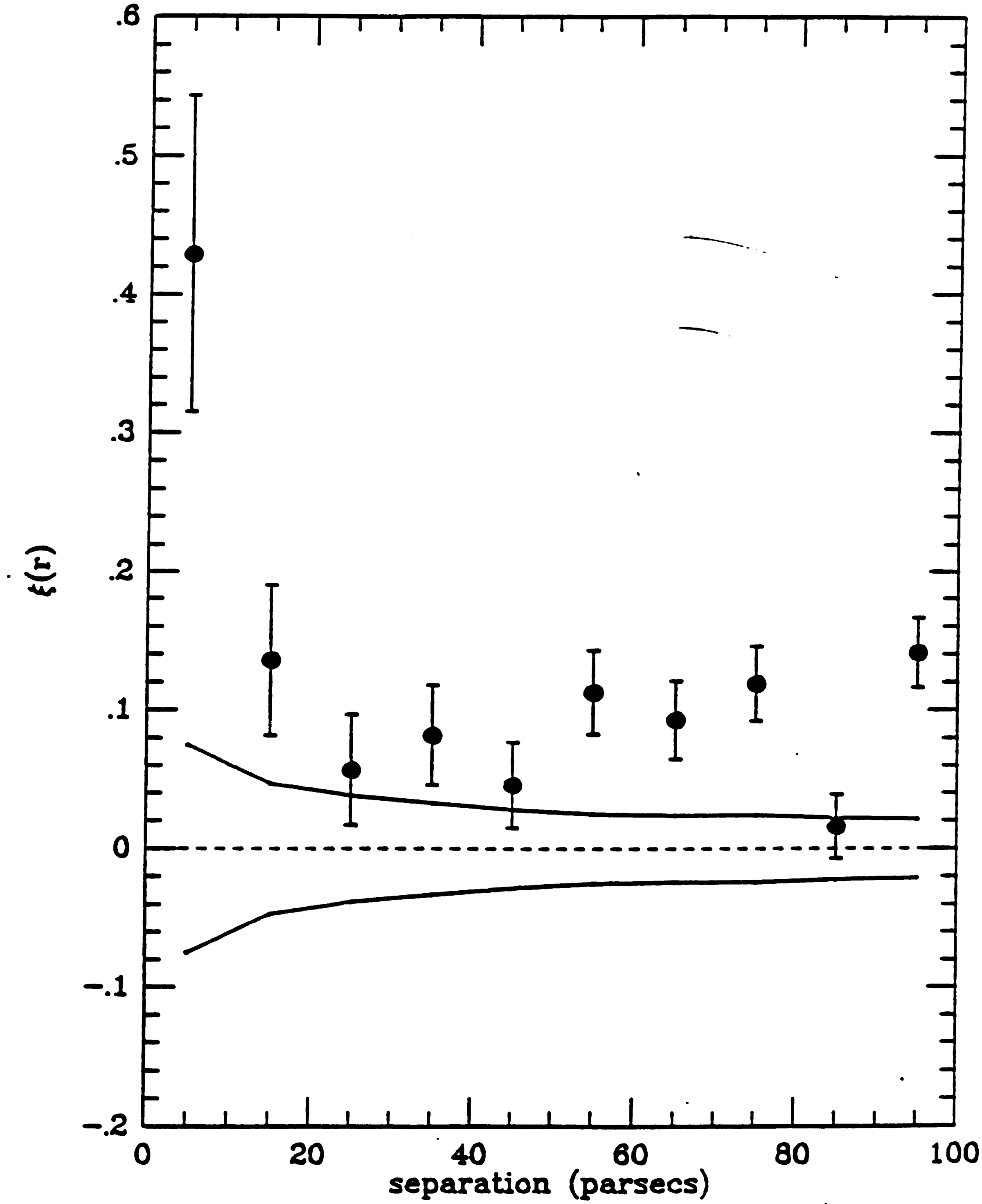

Figure 1 (b) - Doinidis and Beers (1989)

CHAPTER 4: THE EXTENSION OF THE HK SURVEY TO THE NORTHERN GALACTIC HEMISPHERE

The extension of the HK Survey to include the northern galactic hemisphere began in 1986 utilizing the Burrell Schmidt telescope at KPNO, the sister telescope to the Curtis Schmidt at CTIO, and an obvious choice for the continuation of the survey. Plates are acquired in the same manner as in the southern hemisphere, namely, a 4° prism is used together with the HK filter, and the exposures are taken on Kodak IIao plates which have been hypersensitized. The exposure time is nominally 90 minutes, but the images are widened, meaning that nine successive offsets are made in right ascension, each occurring after ten minutes. The resultant spectra have a dispersion of 180 Å/mm at Ca II H and K. The purpose of widening the exposures is to gain clarity for the spectral features by enlarging the spectral image.

The survey plates are scanned visually for candidates, and the criteria for the different candidate classes is summarized in Table 1. Of the candidates which are identified, roughly 35% are metal-poor candidates (type MP, although a number of those classed as type B and C are expected to be metal-poor as well), 50% are

TABLE 1. HK Survey Stellar Classifications.

CODE	Spectral Criteria
C	Continuous spectrum; no lines present
D	Degenerate spectrum; extremely broad $H\epsilon$
B	B-type spectrum; very blue continuum, weak $H\epsilon$
AB	AB-type spectrum; blue continuum, strong $H\epsilon$, no CaII K visible
A	A-type spectrum; strong $H\epsilon$, weak Ca II K visible
MP	Metal-poor F- or G-type spectrum; extremely weak CaII H and K
AF	Intermediate between A- and F-type spectrum; moderate $H\epsilon$/CaII H, weak to moderate CaII K
L	Late-type spectrum; red continuum
E	Emission noticed in spectrum
P	Peculiarities noticed in spectrum

FHB candiates (types AB and A), and the remaining 15% are stars whose spectral features were indicative of other interesting types, such as degenerates. Positions for the candidate stars are measured using the XY measuring engine at Case Western Reserve University. SAO positional standard stars are identified for each plate, and 20 to 25 are used for the plate solution. The typical accuracy which results in the estimated positions is roughly 2 arcseconds, based on the residuals of the calculated positions of the standard stars against their true positions.

As the intention of the survey is to identify candidate stars with dispatch, the relatively poor resolution of the spectra make follow-up measurements to provide confirmation of the candidate classes and to provide detailed information for those which are successfully identified. Central to this work are those stars which are FHB, A type, and so the resulting discussion will be devoted to the process of confirming candidates of this type and the characterisation of the physical properties of these stars based on the follow-up observations.

To date, spectroscopic observations have only been made for those stars in the southern HK Survey. Spectra for the candidate stars are taken over the wavelength range 3700 Å to 4500 Å, and a detailed discussion of the observation and reduction procedures are given in BPS I and BPS II. Roughly equal numbers of the spectra were taken with the reticon spectrograph (≈ 0.7 Å FWHM resolution) and the 2D-Frutti (≈ 1.2 Å FWHM resolution) at the DuPont 2.5m telescope at Las Campanas. The candidate classes MP, C and B are assigned the highest priority for spectra, and so most of the FHB and A type stars which have been measured spectroscopically are misidentified metal-poor candidates. Radial velocities are obtained from measures of line center for prominent absorption features, typically 4 to 6 for each star, with an external error in the determination of roughly 10 km s^{-1}.

Equivalent widths for prominent features (Hγ, Hδ and HeI) are obtained over a fixed bandwidth of 12 Å. The width of the CaII K feature, KP, is measured over bandwidths of 6, 12 and 18 Å, and the equivalent width which is determined is as follows: If the measured width is less than 2 Å, then the width from the 6 Å bandpass is adopted, if the width is between 2 and 6 Å, then the 12 Å bandpass measure is used, and if the width is greater than 6 Å, then the 18 Å measure is adopted. The wavelength bands employed for calculating these widths are given in Table 2.

A generalized index, HP, is calculated from Hδ and Hγ according to

$$HP = 0.5H\delta + 0.588H\gamma - 0.276$$

This comes from a linear fit of Hγ *vs.* Hδ, which is given in Figure 2 and follows the relation

$$H\gamma = 0.468 + 0.850H\delta$$

For each star, the breadth of the Hδ feature at 20% below the level of the local continuum, $D_{0.2}$, and its depth relative to the continuum, R_C is also measured, with errors of order 10% and 15% respectively. As many of the spectra that have

TABLE 2. Line Index Wavelength Bands (Å).

Line	Line Band	Blue Sideband	Red Sideband
CaII K6	3930.7-3936.7	3903.0-3923.0	4000.0-4020.0
CaII K12	3927.7-3939.7	3903.0-3923.0	4000.0-4020.0
CaII K18	3924.7-3942.7	3903.0-3923.0	4000.0-4020.0
$H\delta$	4095.8-4107.8	4000.0-4020.0	4144.0-4164.0
$H\gamma$	4334.5-4346.5	4247.0-4267.0	4357.0-4377.0
HeI λ4026	4020.2-4032.2	4000.0-4020.0	4144.0-4164.0
HeI λ4388	4381.9-4393.9	4350.0-4370.0	4405.0-4425.0
HeI λ4472	4465.5-4477.5	4435.0-4455.0	4490.0-4510.0

been obtained have relatively low signal-to-noise ratios ($5 \leq S/N \leq 10$), an equivalent width of ≤ 0.5 Å was considered to be the minimum which could be reliably measured. Stars which are either FHB or A type can be separated from other hot star types on a diagram of $D_{0.2}$ *vs.* R_C, as shown in Figure 3.

FHB stars, typically, exhibit broad, deep Balmer lines ($R_C \geq 0.5$ and $D_{0.2} \leq 30$ Å), although they may sometimes have shallower lines that give an appearance of a high luminosity or sdB type star. In general, KP must be less than 3 Å, by noting that as members of the halo population they will have [Fe/H] ≤ -1. Figure 4 shows that, for this limit, the probability of spuriously including stars of solar abundance is negligible. Type A stars are characterized by strong, narrow Balmer lines ($R_C \geq 0.5$ and $D_{0.2} \leq 20$ Å) and the presence of metallic lines. If KP is greater than 4 Å, then a star is automatically assigned to this type, as Figure 4 indicates that this star almost certainly has a solar metal abundance. This figure also shows, however, that for $3 \leq KP \leq 4$, there is a great deal of ambiguity in assigning a star as FHB or A type on the basis of its metallicity. The estimated uncertainty in a metallicity derived in this manner is on order 0.3 dex, large enough to require determinations of additional parameters in order to correctly classify these stars.

When colours are not available, it is possible to estimate them using the synthetic colours and line profiles of Kurucz (1979) and Buser and Kurucz (1978). Figure 5 shows the theoretical unreddened $(B-V)$ colours for stars with FHB and A type gravities as a function of HP. The size of KP is temperature dependent for A type stars, and for FHB stars, it can be seen from Figure 4 that a KP greater

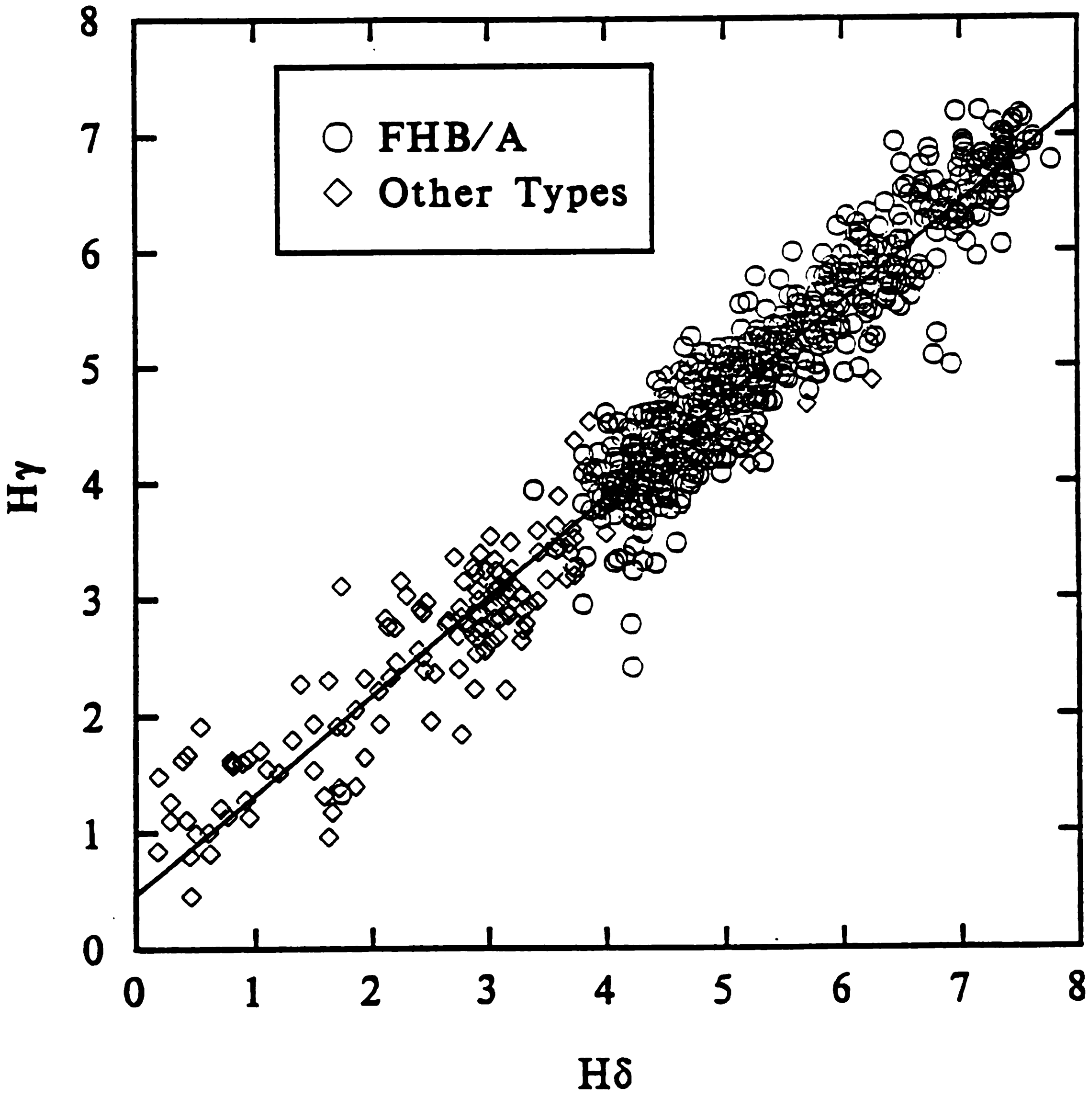

Figure 2. A plot of $H\gamma$ *vs.* $H\delta$ for hot blue field stars. Reproduced from Beers *et al.* (1991).

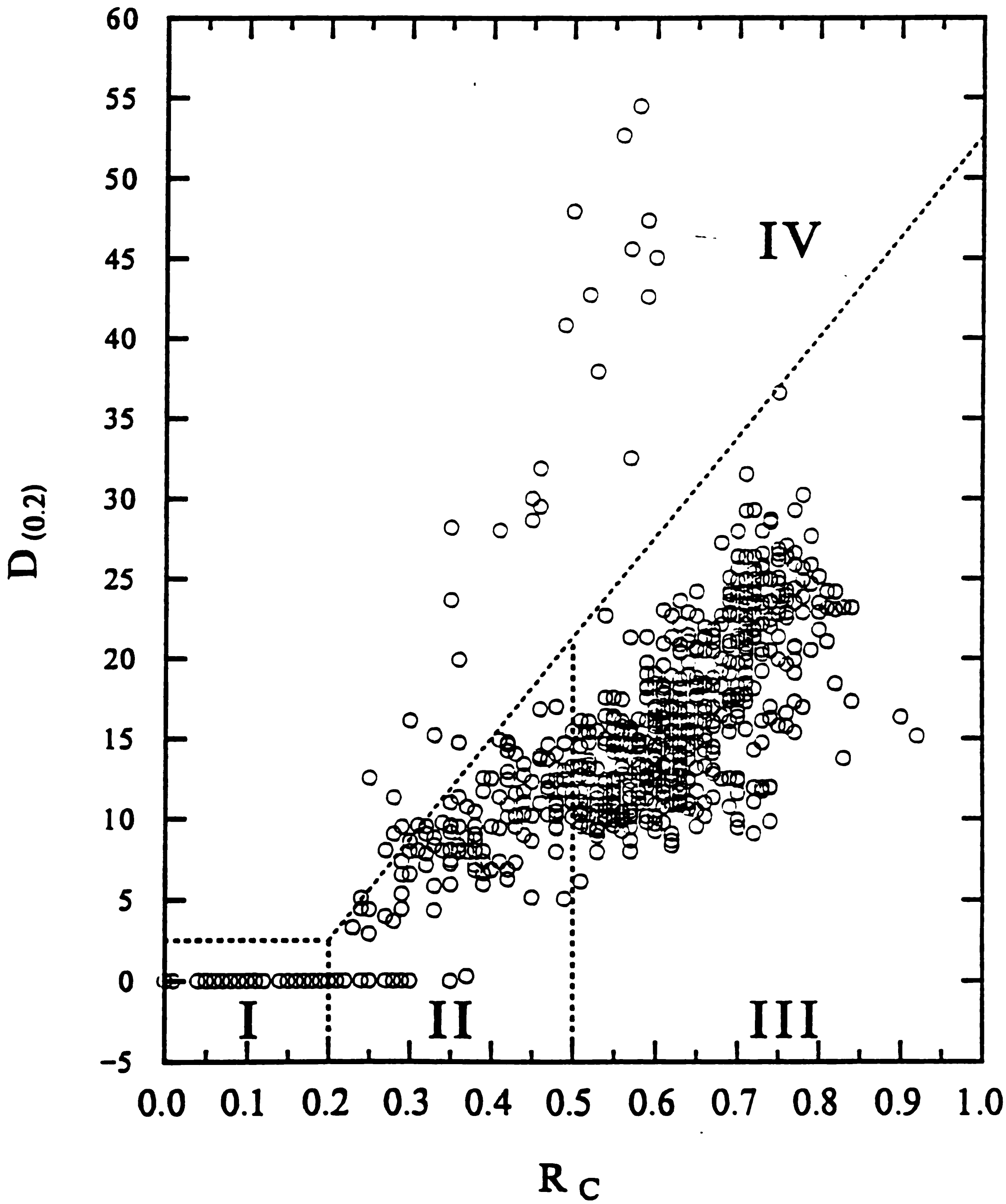

Figure 3. A plot of $D_{0.2}$ *vs.* R_C for a variety of hot stars in the halo. Region (I) is occupied by white dwarfs, sdO and sdB stars, region (II) by sdO, sdB and high luminosity stars, region (III) by FHB and A type stars, and region (IV) by white dwarfs. Figure reproduced from Beers *et al.* (1991).

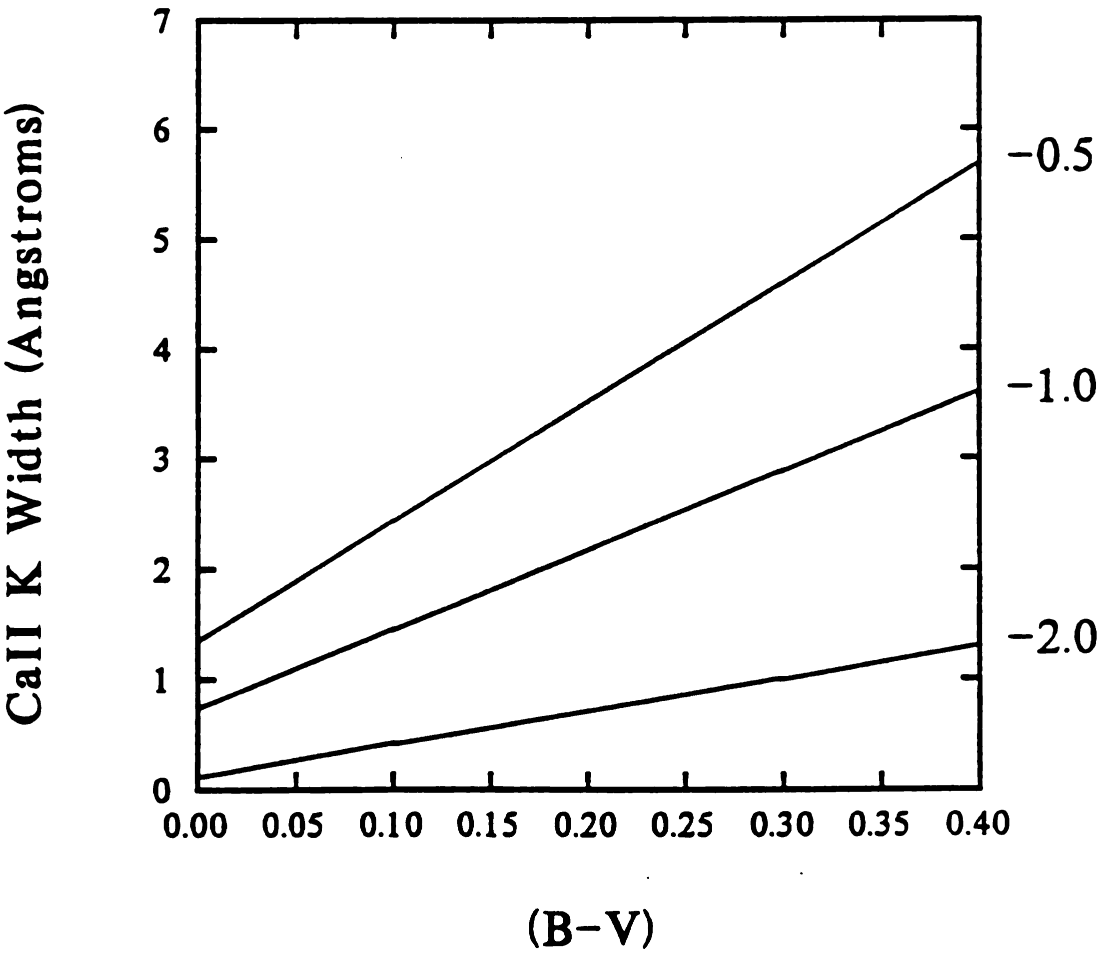

Figure 4. Theoretical relation for KP *vs.* unreddened $(B - V)$, showing loci of [Fe/H]= -0.5 (upper line), [Fe/H]= -1 (middle line) and [Fe/H]= -2 (lower line).

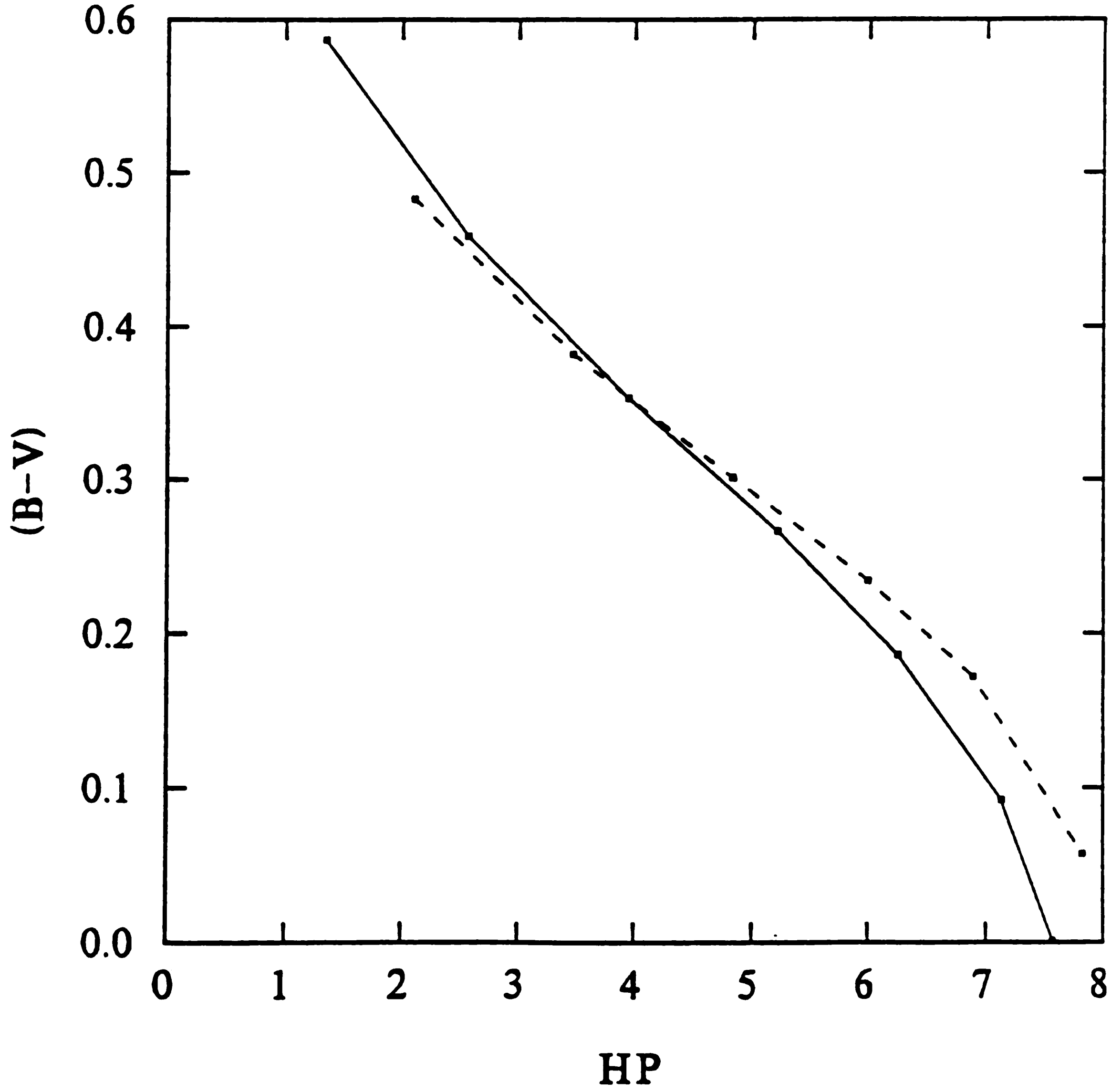

Figure 5. Theoretical relation for $(B-V)$ *vs.* HP for [Fe/H]=-1. The solid line represents the relation for log g = 3 and the dashed line, log g = 4.

than 3 Å is indicative of a $(B-V)$ colour redward of zero. Thus, only the region of the $(B-V)$ *vs.* HP relation redward of zero needs to be considered, avoiding the problem of the turnover that the function has at this colour. This mean relation is used to determine an approximate $(B-V)$ colour for these stars, by averaging the derived colour for each of the gravities, which can aid in deciding its type.

Surface gravity can also be used to discriminate between the two types, as FHB stars have gravities that are lower than those of main sequence stars. This can be determined if colours are available for the stars in question. So-called "Kiel Diagrams" can be constructed using the synthetic colours and linewidths. In essence, given values of $(B-V)_0$, $(U-B)_0$ and HP define loci on a graph of log g *vs.* θ_{eff}, where $\theta_{eff} = 5040/T_{eff}$ and T_{eff} is in Kelvin. The intersection of these three loci define a unique value of (log g,θ_{eff}) for the star, with an accuracy of roughly ± 0.03 in θ_{eff} and ± 0.3 dex in log g. In general, log g ≈ 3 is typical for FHB stars and log g ≈ 4 is typical for A stars. Even these methods sometimes fail to resolve the ambiguity for these stars, and high resolution spectroscopy is required for a clear determination of their type.

CHAPTER 5: PHOTOMETRY OF A SAMPLE OF STARS FROM THE NORTHERN HK SURVEY

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ABSTRACT

Photoelectric photometry is presented for a sample of 139 halo stars drawn from an extension of the HK objective-prism survey of Beers, Preston and Schectman to the northern galactic hemisphere. The candidates for which photometry is reported here were selected to span a wide range of types, but are dominated by stars classified as type AB, A, or metal-poor (MP) .

1. Introduction

The HK objective-prism/interference-filter survey of Beers, Preston and Schectman has been underway for over a decade from the southern hemisphere; a total of 193 usable plates have been obtained with the Curtis Schmidt telescope at the Cerro Tololo Inter-American Observatory. Recently, this survey has been extended to the northern hemisphere, where plates are obtained with the Burrell Schmidt telescope at Kitt Peak National Observatory. To date this effort has yielded 92 usable plates, primarily in the direction of the north galactic pole. As described in detail elsewhere (Beers, Preston, and Shectman 1985), each plate is visually scanned to identify candidate halo stars (in the range of apparent magnitude $11 \leq B \leq 16$) which exhibit a weak or absent CaII K line. Roughly thirty five percent of the candidates are classified as likely metal-deficient stars with effective temperatures typical of halo main-sequence turnoff stars or cooler giants. On order fifty five percent of the candidates exhibit an Hϵ Balmer line which is considerably broader than that of a turnoff star, and are classified as type AB (no Ca II K line visible) or A (weak CaII K line visible). The remaining 10 percent of the candidates selected include likely subdwarf B stars, degenerate stars, and stars exhibiting a wide variety of peculiarities in their spectra.

Follow-up photometry and spectroscopy of this sample demonstrates that the HK survey technique is successful in identifying large numbers of the most metal-deficient stars known in the Galaxy (Beers, Preston, and Shectman 1990, hereafter referred to as BPS II). Photometry of the candidate AB- and A-type stars indicates that the vast majority of these objects are members of the field blue horizontal-branch (hereafter referred to as BHB) population (Pier 1982; Preston, Shectman, and Beers 1990a, hereafter referred to as FHB II). The catalog of field horizontal-branch candidate stars is already very large, and promises to expand rapidly as the survey continues. Beers, Preston, and Shectman (1988) presents a list of some 4400 AB- and A-type candidate stars. Preston, Shectman, and Beers (1990b, hereafter referred to as FHB III) employ UBV photometry for a subset of this catalog to infer the existence of a small, but significant, gradient in the mean color of BHB stars as a function of distance from the galactic center. Additional data for BHB stars in the north galactic hemisphere would clearly be very useful.

Originally, we had only intended to obtain broadband photometry and derive metal abundance estimates for those stars whose CaII K line strength available from digital spectroscopy was consistent with a metal abundance [Fe/H] ≤ -2.0. However, Beers *et al.* (1990) show that the correlation between CaII K line strength and [Fe/H] is sufficiently tight to allow metal abundance estimation up to [Fe/H] $= -1.0$. As eighty percent of the low metallicity candidate stars picked out in the HK survey meet this abundance criterion, we can profitably use photometric measurements for virtually all of the MP candidates. A two-color $(U-B)_o$ versus $(B-V)_o$ diagram provides a useful gravity discriminant between metal-poor stars at the main-sequence turnoff and stars with similar temperature but lower surface gravity. The division between hot metal-poor stars and BHB or asymptotic giant-branch stars is difficult to draw from moderate signal-to-noise spectroscopic observations alone, but is trivial to determine with UBV photometry (see BPS II).

In this paper we present broadband UBV observations for 139 stars identified from the northern extension of the HK survey. In Section 2 we describe the observation and reduction procedures that we employed. Section 3 presents our results.

2. Observations and Reductions

2.1 *Sample Selection*

The program stars were selected from the six northern hemisphere HK survey fields listed in Table 1. For each plate we list approximate equatorial coordinates of the plate center, galactic coordinates, and the number of stars observed in each field. Positions for each star, accurate to two arcseconds, were obtained using the XY machine at Case Western Reserve University. Enlargements of the objective-prism plates served as finding charts.

2.2 *Photometric Observations*

All observations were obtained during a six night run in February 1990 with the #2-0.9m telescope at Kitt Peak National Observatory. The data were acquired using the AFP2 pulse-counting aperture photometer system, incorporating a 1P21 photomultiplier tube and standard Johnson UBV filters. A solid $CuSO_4$ blocking filter was included for observations with the U filter. Each observation consisted of five integrations on the star and two integrations of the background sky in each filter. The sky region was obtained by a 30 arcsecond offset in right ascension to an area covered in the field of view of the guider camera. Care was taken to ensure that faint stars were absent from this area. Integration times were adjusted for each star such that a S/N ratio of 100 was achieved, based on Poisson statistics. Individual integrations were no longer than 30 seconds. The longest total integrations were 400 seconds (U passband) for the faintest of the program stars. Offset guiding was not deemed necessary, as repeated checks with the TV guider system indicated that the star being measured stayed well within the 15 arcsecond aperture at all times. The data acquisition software incorporated into the AFP2 system was used to provide a first-order reduction of the colors obtained, along with their approximate errors; this allowed for an assessment of the photometric quality of the observations as they were made.

Standards were chosen from the celestial equatorial list of Landolt (1983). In

Table 2 we list apparent magnitudes and colors (according to Landolt) for 28 standard stars with $8.08 \leq V \leq 11.80$ and $-0.24 \leq (B-V) \leq 1.36$. Over the course of each night, 20 to 30 measurements of stars from this list were made. Several measurements were carried out each night at large airmasses ($X \geq 1.5$) to give weight to the extinction solutions. Program stars were observed exclusively in the vicinity of the meridian ($X \leq 1.3$). In all, 151 observations were made of 139 program stars.

2.3 *Reductions*

Photometric reductions were obtained by use of the method described by Harris, Fitzgerald and Reed (1981). At our request, C. Reed kindly provided the FORTRAN code which performs the reductions outlined in that paper. The transformation coefficients to the standard UBV system were solved for using the full set of standard star measurements, with nightly determinations of the zero points and first-order extinction terms. These proved consistent with expected values. Second-order terms were determined for the entire run, and in general represented a small correction to the derived colours. In Table 2 we list our determinations of computed residuals from fits to the standard stars. Internal rms errors in the reduction are 0.011 mag in V, 0.009 mag in $B-V$ and 0.015 mag in $U-B$, based on the residuals of the standards used for the solution. Figure 1 is a plot of the differences in computed and standard values of $B-V$ and $U-B$ colors for the standard stars as a function of the the standard $B-V$ color.

External errors may be estimated from the small number of repeat observations (obtained on different nights) available for ten of the program stars. Absolute differences in measured magnitudes and colors for repeat observations are presented in Figure 2. The solid lines are locally weighted regression lines (*lowess*, Cleveland and Devlin 1988) fit to the absolute differences in apparent magnitude and color as a function of the mean apparent magnitude. If the residuals in our measurements are consistent with draws from a normal distribution, then the range between successive measurements of individual stars is directly related to the standard deviation of the parent distribution (Pearson and Stephens 1964). The dashed lines are *lowess* lines for the implied standard deviations. The mean range in measured V, $B-V$, and $U-B$ colors for these ten stars are 0.036 mag, 0.021 mag and 0.027 mag, respectively. Based on the calculations of Pearson and Stephens, these imply equivalent standard deviations of $\sigma_V = 0.018$ mag, $\sigma_{B-V} = 0.011$ mag, and $\sigma_{U-B} = 0.014$ mag. It is difficult to be certain of any trends in the data from batches this small. Nevertheless, the range in repeat measurements in the V band does seem to increase for fainter stars, an effect that may be unavoidable with limited integration times on an 0.9m telescope. The ranges in colors appear roughly stable over the available span of apparent magnitude.

Seven of the stars which are reported here have also been measured by others, and a comparison of the derived colours is given in Table 3. These data were acquired from the SIMBAD database operated by CDS, and are largely consistent with the measurements of this paper. One exception is the V magnitude reported by Mermilliod and Mermilliod (1990) for BS16027-061, which differs also from that reported by Dahn *et al.*(1982).

3. Results

Data for the program stars are summarized in Table 4. Column (1) lists the star. Equatorial and galactic coordinates are listed in columns (2)–(5). The derived magnitude and colors for each program star are listed in columns (6)–(8). An approximate reddening for the direction of the plate centers, taken from Burstein and Heiles (1982), is listed in column (9). The original classification of each program star, based on the appearance of its objective-prism spectrum, is listed in column (10). A colon next to the classification code indicates that some doubt exists in the classification. A de-reddened two-color diagram for the program stars is given in Figure 3. Four stars with $(B-V)_o > 1.0$, all of which were classified in the survey as peculiar, have been excluded from this diagram. Plot symbols are coded to represent the original prism survey classifications. Their size is roughly representative of the external 2σ errors. Included in this plot are polynomial fits for luminosity classes Iab and III (Fitzgerald 1970), and class V (Johnson 1966 and Fitzgerald 1970). The blackbody line is a fit to the data of Arp (1961) and Mathews and Sandage (1963). From the work of Pier (1982) and FHB II, we expect the majority of the stars with $(B - V)_o < 0.35$ to be members of the field blue horizontal-branch population. Those stars redward of $(B - V)_o = 0.35$ are expected to be predominantly low metallicity stars.

Much work remains to be done. A comparison of Figure 3 with Figure 8 of FHB II establishes that a photometrically similar set of candidate stars is isolated by visual scans (by Beers) of HK objective-prism plates obtained with the Burrell Schmidt telescope to candidates selected (by Preston) from HK survey plates obtained from the Curtis Schmidt. A dedicated program of *UBV* photometry of additional candidates would be extremely useful for detailed analysis of the properties of the galactic field horizontal-branch component along the lines of FHB III, as well as for estimation of metal abundance as described in Beers *et al.* (1990). Philip (1987) outlines an ambitious program of spectrophotometric observations of A-type field horizontal-branch stars. Several of the AB- and A-type stars listed in Table 3 are as bright as $V = 11$–12, and thus might prove useful for such an application.

We would like to acknowledge the assistance of Bret Goodrich of the KPNO staff for helpful guidance at the telescope, and P. Pesch of Case Western Reserve University for providing access to the Case measuring engine. S.P.D. would like to commend the KPNO "First Response Medical Unit" for doughty late night assistance during the run. This work received partial support from the National Science Foundation via grants AST 86-17265 and AST 90-01376 to Michigan State University.

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FIGURE CAPTIONS

Figure 1 – Mean differences, computer minus standard values, for observations of standard stars for (a) $B-V$ and (b) $U-B$ are plotted versus standard values of $B-V$.

Figure 2 – Absolute differences in observed magnitudes and colors for program stars with repeat measurements, plotted against their mean V magnitude (a)–(c), and against their mean (B-V) color for (d)–(f).

Figure 3 – De-reddened two-color $(U-B)_o vs.(B-V)_o$ diagram for the program stars listed in Table 3. Polynomial fits to stars of luminosity classes Iab, III, and V are indicated, as is a blackbody curve. The diameters of the symbols are roughly equivalent to the external 2σ errors in the measurements.

TABLE 1

Summary of Plate Fields for Program Stars

PLATE	RA (1950)	DEC (1950)	l (°)	b (°)	Stars Observed
BS 15621	10 17.9	+25 10	208.0	+56.2	57
BS 15622	12 52.2	+25 11	321.3	+87.7	1
BS 15623	13 58.3	+25 10	83.8	+64.8	1
BS 15625	11 46.1	+25 12	218.3	+75.7	8
BS 16026	12 26.1	+30 12	182.4	+84.3	55
BS 16027	13 12.2	+30 11	63.2	+84.2	17

TABLE 2

Summary of Standard Star Data

		Standard Values			Computed − Standard		
STAR	N	V	$B-V$	$U-B$	ΔV	$\Delta(B-V)$	$\Delta(U-B)$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BD+2 2711	1	10.367	−0.162	−0.708	+0.001	−0.008	+0.024
BD+5 2468	4	9.348	−0.116	−0.560	+0.019	+0.013	+0.011
HD 84971	5	8.636	−0.159	−0.770	+0.007	−0.008	+0.000
HD 100340	4	10.117	−0.242	−0.975	+0.001	−0.004	+0.001
HD 118246	1	8.089	−0.141	−0.636	−0.015	−0.027	−0.008
SA 99−296	3	8.454	+1.187	+1.265	−0.003	−0.004	−0.002
SA 99−358	12	9.605	+0.776	+0.509	−0.008	+0.006	−0.007
SA 99−367	9	11.149	+1.005	+0.829	−0.001	−0.001	+0.004
SA 99−408	5	9.807	+0.407	+0.043	−0.011	+0.001	+0.003
SA 99−438	8	9.399	−0.155	−0.719	−0.006	−0.005	−0.010
SA 99−447	9	9.415	−0.071	−0.217	+0.001	+0.005	+0.008
SA 100−95	5	8.915	+0.814	+0.391	+0.006	+0.004	−0.019
SA 100−241	5	10.140	+0.156	+0.102	+0.001	−0.000	+0.006
SA 100−280	5	11.802	+0.496	+0.009	−0.002	−0.012	+0.012
SA 100−606	7	8.641	+0.052	+0.125	−0.004	+0.006	−0.036
SA 101−281	5	11.579	+0.814	+0.435	+0.006	−0.003	+0.014
SA 101−363	6	9.871	+0.262	+0.121	−0.003	+0.007	+0.007
SA 102−58	6	9.380	+0.060	+0.021	−0.004	+0.008	−0.008
SA 102−620	5	10.067	+1.087	+1.013	−0.006	+0.010	+0.008
SA 102−625	6	8.890	+0.552	+0.035	+0.009	−0.007	−0.004
SA 103−302	4	9.862	+0.369	−0.058	+0.002	−0.005	+0.009
SA 103−462	5	10.111	+0.564	+0.089	+0.015	−0.008	+0.011
SA 103−526	8	10.903	+1.089	+0.941	+0.005	−0.002	−0.003
SA 104−337	6	11.207	+0.768	+0.336	+0.001	−0.000	+0.015
SA 105−448	5	9.176	+0.249	+0.037	+0.007	−0.006	−0.004
SA 106−485	1	9.484	+0.380	−0.039	−0.015	+0.004	−0.004
SA 106−834	1	9.088	+0.701	+0.292	−0.012	−0.003	+0.018
SA 106−1024	1	11.594	+0.332	+0.085	+0.015	+0.020	+0.009

TABLE 3

Comparison with Previous Photometric Measurements of Program Stars

	This Paper			Other Work			
STAR (1)	V (2)	$B-V$ (3)	$U-B$ (4)	V (5)	$(B-V)$ (6)	$(U-B)$ (7)	Source (8)
15625-002	10.68	+1.51	+1.19	10.68	+1.52	+1.23	6
027	11.54	+0.30	+0.06	11.60	+0.26	+0.06	2
16026-010	10.10	+0.33	−0.03	10.08	+0.36	...	3
017	10.65	+1.44	+1.24	10.63	+1.46	+1.25	4
				10.62	+1.42	+1.27	6
056	11.00	+0.17	+0.11	11.04	+0.19	...	3
				11.05	+0.16	+0.09	2
				11.00	+0.17	+0.07	1
16027-061	12.66	−0.14	−1.20	12.68	−0.12	−1.17	5
				12.86	−0.10	−1.14	6
070	13.75	+0.04	+0.02	13.79	+0.07	+0.02	6

1. Slettebak *et.al.*(1961).
2. Klemola (1962).
3. Ljunggren (1965).
4. Upgren and Kerridge (1973).
5. Dahn *et.al.*(1982).
6. Mermilliod and Mermilliod (1990).

TABLE 4

Summary of Photometric Data for Program Stars

STAR (1)		RA (1950) (2)	DEC (1950) (3)	l (°) (4)	b (°) (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	CLASS (10)
15621–	1	10 27 29.8	+26 16 09	206.8	+58.5	12.38	0.66	0.22	0.00	P
	2	10 26 24.4	+26 14 18	206.8	+58.3	11.82	0.16	0.11		AB
	7	10 25 10.3	+28 03 26	203.3	+58.3	12.13	0.70	0.23		MP:
	8	10 24 50.4	+28 03 26	203.3	+58.2	11.24	-0.03	-0.05		AB
	9	10 25 13.4	+27 47 58	203.8	+58.3	13.59	0.25	0.07		A/MP
	10	10 25 19.1	+26 48 11	205.6	+58.1	13.75	0.65	0.21		MP/A
	11	10 23 52.8	+25 59 38	207.0	+57.7	13.98	0.65	0.11		MP
	12	10 24 30.4	+25 37 33	207.8	+57.7	12.27	0.22	0.09		MP/A
	14	10 23 43.7	+24 06 04	210.5	+57.2	13.70	0.68	0.16		P
	15	10 23 33.6	+23 45 53	211.0	+57.1	12.26	0.14	0.16		AB/A
	16	10 23 30.5	+28 02 43	203.2	+57.9	13.36	0.65	0.02		MP
	17	10 22 10.0	+27 55 06	203.4	+57.6	11.09	0.09	0.10		A
	18	10 21 31.8	+26 37 46	205.7	+57.3	14.19	0.67	0.18		MP:
	19	10 23 07.7	+26 16 11	206.5	+57.6	11.93	0.16	0.11		A
	20	10 21 32.1	+24 23 05	209.7	+56.8	10.96	-0.05	-0.06		AB
	21	10 22 22.0	+23 56 09	210.6	+56.9	12.49	0.19	0.12		A/MP
	22	10 19 07.1	+24 06 06	210.0	+56.2	12.85	0.30	0.00		MP/A
	23	10 19 08.0	+24 31 20	209.3	+56.3	13.30	0.48	-0.05		MP
	24	10 19 21.2	+25 42 08	207.2	+56.6	14.78	0.38	-0.27		C
	26	10 17 14.7	+24 11 51	209.6	+55.8	13.65	0.62	0.02		MP
	27	10 18 19.7	+23 14 33	211.4	+55.8	12.70	-0.26	-1.05		AB
	28	10 15 38.9	+24 37 07	208.8	+55.6	13.89	0.61	-0.02		A:
	29	10 15 11.9	+25 15 47	207.6	+55.6	13.94	0.65	0.01		MP:
	30	10 15 50.7	+26 00 48	206.4	+55.9	13.41	0.69	0.22		MP:
	31	10 16 50.7	+26 38 11	205.3	+56.2	14.60	0.31	0.10		MP/A
	32	10 16 27.7	+26 42 31	205.2	+56.2	14.83	0.04	0.17		AB
	33	10 13 20.4	+26 10 29	205.9	+55.4	13.73	0.61	-0.08		MP
	34	10 13 21.5	+26 04 27	206.1	+55.4	13.65	0.77	0.43		P
	36	10 12 51.9	+25 20 54	207.3	+55.1	11.67	1.31	1.26		P
	37	10 13 17.5	+24 59 15	207.9	+55.1	11.64	0.23	0.02		A
	38	10 11 30.9	+23 49 12	209.7	+54.5	13.39	0.49	-0.09		MP:
	39	10 11 02.6	+25 33 18	206.8	+54.8	13.60	0.06	0.13		AB
	40	10 09 42.1	+27 32 30	203.3	+54.8	13.81	0.20	-0.03		A
	41	10 08 39.5	+23 13 56	210.4	+53.7	12.60	0.22	0.05		A
	42	10 07 03.7	+24 12 59	208.7	+53.6	13.70	0.56	0.01		MP
	43	10 06 38.9	+25 04 50	207.2	+53.7	14.41	0.05	0.07		A:

TABLE 4 (Continued)

STAR (1)		RA (1950) (2)	DEC (1950) (3)	l (°) (4)	b (°) (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	CLASS (10)
15621–	45	10 06 27.5	+26 16 26	205.2	+53.9	14.00	0.62	0.07		MP
	47	10 06 46.6	+26 14 17	205.3	+53.9	13.63	0.87	0.37		C:
	48	10 14 18.0	+24 30 50	208.8	+55.2	12.20	0.26	0.08		MP/A
	49	10 06 39.0	+25 37 02	206.3	+53.8	13.22	0.25	0.13		AB
	50	10 10 04.4	+23 38 02	209.9	+54.1	13.92	0.58	0.01		MP:
	51	10 14 32.8	+23 18 16	210.9	+55.0	13.97	0.45	0.09		A
	52	10 14 47.1	+23 13 33	211.1	+55.0	13.42	0.44	-0.10		MP
	53	10 17 15.9	+23 09 05	211.4	+55.6	13.59	0.25	0.04		A
	54	10 21 04.3	+24 10 40	210.1	+56.7	14.13	0.46	-0.26		A/MP
	55	10 23 04.5	+24 11 01	210.2	+57.1	13.30	0.41	-0.14		MP
	58	10 26 50.6	+23 40 02	211.6	+57.8	14.38	0.35	-0.07		MP
	63	10 27 26.7	+26 37 21	206.1	+58.6	11.08	0.99	0.82		P
	68	10 21 25.3	+23 05 13	212.0	+56.5	10.32	0.39	-0.01		MP
	69	10 19 06.4	+26 22 05	206.0	+56.7	13.61	0.63	0.11		MP
	70	10 19 07.9	+27 26 28	204.1	+56.9	12.61	0.37	-0.07		MP
	71	10 12 44.2	+27 15 19	204.0	+55.4	13.02	0.42	-0.03		MP
	72	10 14 29.2	+26 05 13	206.1	+55.6	12.80	0.30	0.10		MP:/A:
	73	10 10 30.5	+24 19 59	208.8	+54.4	13.53	0.42	-0.21	0.00	MP
	74	10 10 05.6	+27 27 30	203.5	+54.9	13.69	0.62	0.21		MP:
	76	10 08 02.9	+26 28 26	205.0	+54.3	12.92	0.44	-0.02		MP
	77	10 10 11.7	+25 04 42	207.5	+54.5	13.87	0.43	-0.17		MP
15622–	36	13 03 49.7	+28 20 21	49.9	+86.6	11.97	0.96	0.80	0.01	A:
15623–	1	14 06 11.8	+23 35 02	24.9	+72.2	13.75	0.14	0.19	0.00	AB
15625–	2	11 39 33.5	+26 59 11	210.5	+74.6	10.68	1.51	1.19	0.01	MP:
	15	11 54 27.0	+25 43 03	217.8	+77.7	13.30	0.52	-0.08		MP
	17	11 53 50.0	+24 44 53	222.0	+77.3	12.86	0.67	0.00		MP:
	18	11 57 11.4	+25 22 46	219.9	+78.2	13.77	0.50	-0.15		MP
	23	11 47 59.7	+28 01 07	206.8	+76.5	13.13	0.49	-0.04		MP
	24	11 50 00.8	+23 36 41	225.6	+76.2	11.81	0.48	-0.06		MP
	26	11 49 14.9	+26 38 37	212.8	+76.7	11.07	0.30	0.08		MP
	27	11 53 07.6	+23 16 39	228.0	+76.7	11.54	0.30	0.06		MP
16026–	2	12 14 52.1	+32 06 50	178.5	+81.2	13.67	0.67	0.06	0.01	MP:

TABLE 4 (Continued)

STAR (1)		RA (1950) (2)	DEC (1950) (3)	l (°) (4)	b (°) (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	CLASS (10)
16026–	3	12 14 40.4	+31 45 51	180.6	+81.4	13.94	0.63	0.04		MP
	4	12 15 12.8	+31 34 36	181.4	+81.5	13.66	0.66	0.06		MP:
	5	12 14 34.6	+31 02 25	185.1	+81.7	14.15	0.70	0.18		MP
	6	12 14 26.5	+30 59 24	185.5	+81.7	14.35	0.35	-0.19		MP
	7	12 14 21.5	+30 37 54	187.8	+81.8	13.89	0.68	0.14		MP
	8	12 15 35.0	+30 34 04	187.6	+82.0	14.80	0.08	0.18		AB
	9	12 15 16.8	+30 31 47	188.0	+82.0	14.15	0.60	0.03		MP:
	10	12 14 15.4	+29 51 49	193.0	+82.0	10.10	0.33	-0.03		MP
	11	12 14 18.8	+29 12 43	197.6	+82.2	13.56	0.07	0.13		AB
	12	12 15 04.0	+28 42 37	201.1	+82.4	13.94	0.58	0.02		MP:
	14	12 13 55.6	+28 07 19	205.6	+82.2	14.72	0.21	0.13		MP/A
	15	12 17 26.9	+27 54 06	207.1	+83.0	13.41	0.62	0.07		MP
	16	12 15 50.8	+28 17 56	204.1	+82.6	14.17	0.61	-0.05		AB:
	17	12 16 54.0	+28 39 31	201.1	+82.8	10.65	1.44	1.24		P
	18	12 17 38.6	+29 01 06	198.0	+82.9	13.86	0.47	-0.21		MP
	19	12 15 46.9	+30 09 39	190.3	+82.2	14.20	0.52	-0.19		MP
	20	12 16 36.1	+32 07 20	177.2	+81.5	12.34	1.49	1.19		MP:
	21	12 20 03.0	+32 16 05	173.5	+82.1	13.91	0.75	0.40		MP
	23	12 19 27.4	+31 23 19	179.4	+82.4	12.80	0.17	0.05		A
	24	12 19 51.5	+31 04 12	181.3	+82.7	14.84	0.42	-0.01		C
	26	12 19 32.9	+28 20 36	203.0	+83.4	13.95	0.08	-0.04		AB
	27	12 19 21.4	+28 02 11	205.7	+83.4	13.66	0.76	0.36		MP
	28	12 20 32.4	+27 43 53	208.3	+83.7	13.68	0.01	0.08		AB
	29	12 21 22.2	+31 43 53	175.5	+82.6	14.13	0.55	-0.03		MP:
	30	12 23 36.2	+31 38 31	174.0	+83.0	14.33	0.51	-0.06		MP
	32	12 23 35.4	+31 16 48	176.5	+83.2	13.57	0.77	0.38		MP:
	33	12 24 33.5	+29 38 17	188.9	+84.2	14.46	0.55	-0.02		MP
	35	12 24 55.9	+28 01 30	204.9	+84.6	13.76	0.38	-0.12		A/MP
	36	12 26 14.2	+28 37 11	198.0	+84.8	13.91	-0.12	-0.28		AB
	38	12 27 04.2	+29 50 17	184.8	+84.6	12.94	0.36	-0.05		MP
	40	12 27 56.6	+31 11 22	172.2	+84.0	13.35	0.40	-0.19		MP
	41	12 28 42.4	+31 08 01	171.6	+84.2	14.05	0.11	0.13		AB
	42	12 28 49.8	+30 50 25	173.8	+84.4	13.82	0.58	0.02		MP
	43	12 28 32.5	+30 41 15	175.5	+84.5	14.22	0.47	0.02		MP
	47	12 29 13.3	+28 28 46	198.0	+85.5	14.08	0.67	0.16		MP:
	48	12 30 17.0	+28 27 33	197.5	+85.7	13.33	0.90	0.54	0.01	MP:

TABLE 4 (Continued)

STAR (1)	RA (1950) (2)	DEC (1950) (3)	l (°) (4)	b (°) (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	CLASS (10)
16026– 49	12 30 06.7	+28 32 28	196.6	+85.7	12.30	1.27	1.10		MP:
50	12 31 25.2	+28 33 03	195.5	+86.0	13.62	0.59	0.00		MP
54	12 30 35.9	+29 54 00	180.1	+85.3	14.34	0.54	-0.09		MP
55	12 29 53.6	+30 06 46	178.9	+85.0	14.48	0.59	-0.01		MP
56	12 31 45.1	+30 56 21	168.7	+84.8	11.00	0.17	0.11		A
57	12 30 24.5	+31 18 35	167.9	+84.4	14.40	0.43	-0.14		A/MP
58	12 29 55.8	+32 09 52	162.8	+83.7	13.46	0.66	0.12		A
59	12 34 05.7	+32 20 02	155.3	+84.1	14.48	0.22	-0.02		AB
61	12 32 54.2	+31 34 39	162.0	+84.5	14.25	0.15	0.07		AB
62	12 32 06.1	+31 01 09	167.5	+84.8	13.53	0.60	0.04		MP:
63	12 32 02.6	+30 52 52	168.8	+84.9	12.81	1.17	1.00		MP:
64	12 32 17.3	+30 40 16	170.2	+85.1	13.80	0.54	0.01		MP
65	12 32 30.3	+30 32 07	171.0	+85.2	13.42	0.66	0.11		MP:
66	12 33 37.9	+27 56 49	203.0	+86.6	14.12	0.37	-0.10		MP
67	12 33 53.4	+27 33 04	209.5	+86.6	13.39	-0.01	0.04		AB
72	12 35 10.4	+30 49 35	163.6	+85.4	13.54	0.62	0.08		MP
73	12 36 31.8	+30 59 14	159.4	+85.5	13.38	0.33	-0.08		A/MP
74	12 34 52.0	+32 01 50	155.7	+84.4	14.45	0.56	-0.11		MP
16027– 1	13 03 52.2	+32 58 21	93.9	+83.6	12.82	0.33	0.01	0.00	A/MP
3	13 04 53.5	+32 33 26	90.3	+83.8	13.77	0.43	-0.16		MP
9	13 03 05.2	+31 13 24	85.1	+85.1	14.11	0.65	0.15		E
15	13 03 38.8	+30 31 39	78.2	+85.5	14.06	0.53	-0.05		MP
28	13 06 44.3	+29 15 48	59.6	+85.7	12.80	0.60	0.12		A/MP
35	13 06 21.0	+33 08 08	90.9	+83.2	11.69	-0.01	0.06		AB
38	13 08 28.2	+32 44 11	85.9	+83.2	11.73	-0.01	0.06		AB
39	13 08 56.0	+32 16 53	82.7	+83.5	13.79	0.64	0.12		MP:
49	13 10 05.2	+30 37 10	69.2	+84.4	13.26	0.39	0.04		A
53	13 10 52.5	+31 37 51	76.0	+83.6	14.60	-0.13	-0.55		AB
56	13 10 38.1	+32 53 56	83.9	+82.8	13.92	0.46	-0.19		MP
57	13 13 53.3	+32 12 41	76.2	+82.8	14.59	0.00	0.05		A
59	13 12 22.1	+31 47 00	75.2	+83.3	13.94	0.06	0.03		AB
61	13 14 00.3	+29 21 44	54.1	+84.2	12.66	-0.14	-1.20		C
63	13 12 21.4	+28 38 59	48.0	+84.7	15.00	0.36	-0.20		MP
70	13 17 21.9	+29 39 28	54.6	+83.4	13.75	0.04	0.02		AB
84	13 22 42.7	+30 01 57	54.6	+82.2	14.12	-0.04	0.11		AB

CLASS CODES: AB– type AB; A– type A; MP– metal poor candidate; C– continuous; P– peculiar; E– emission

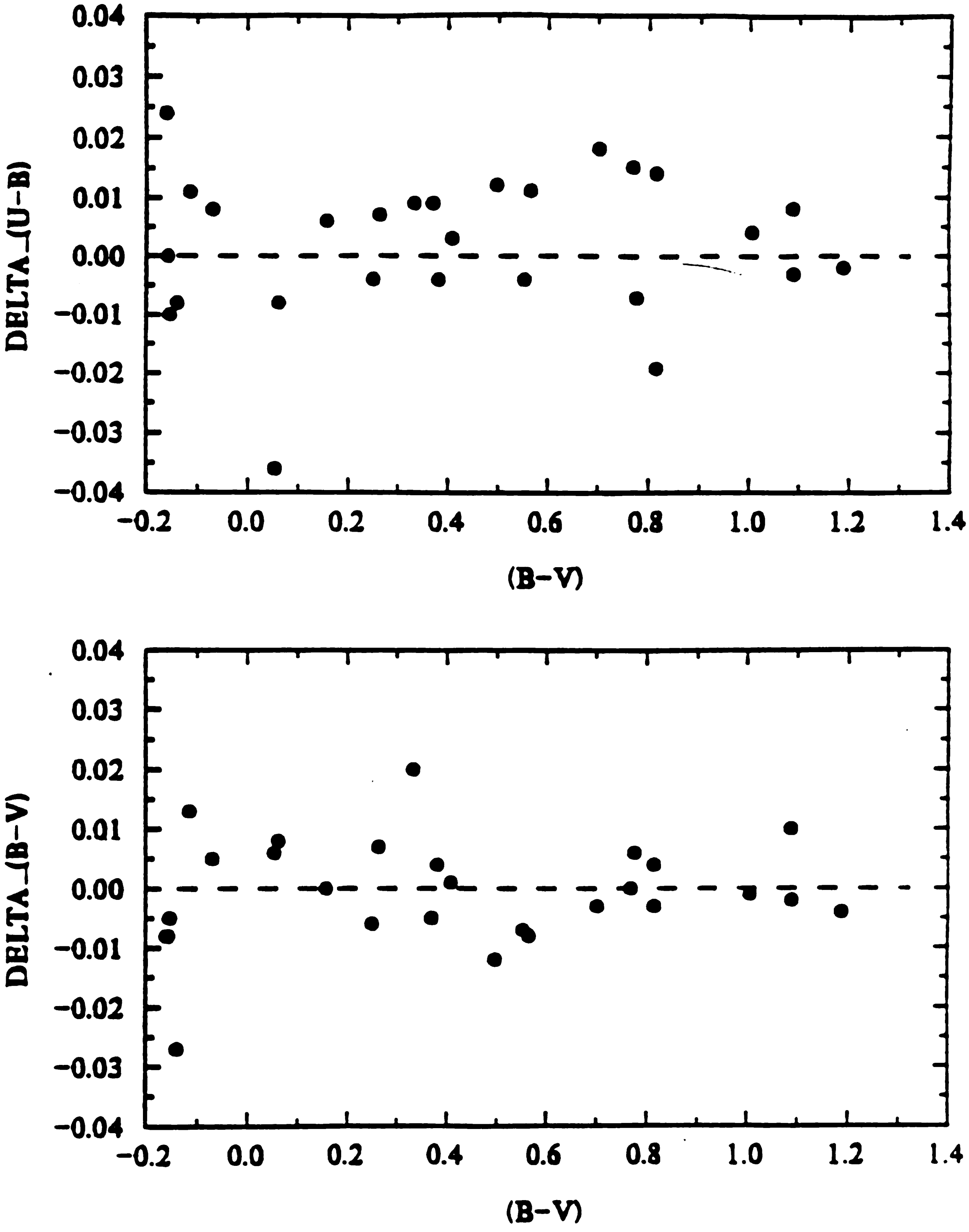

Figure 1 (a) and (b) - Doinidis and Beers 1990

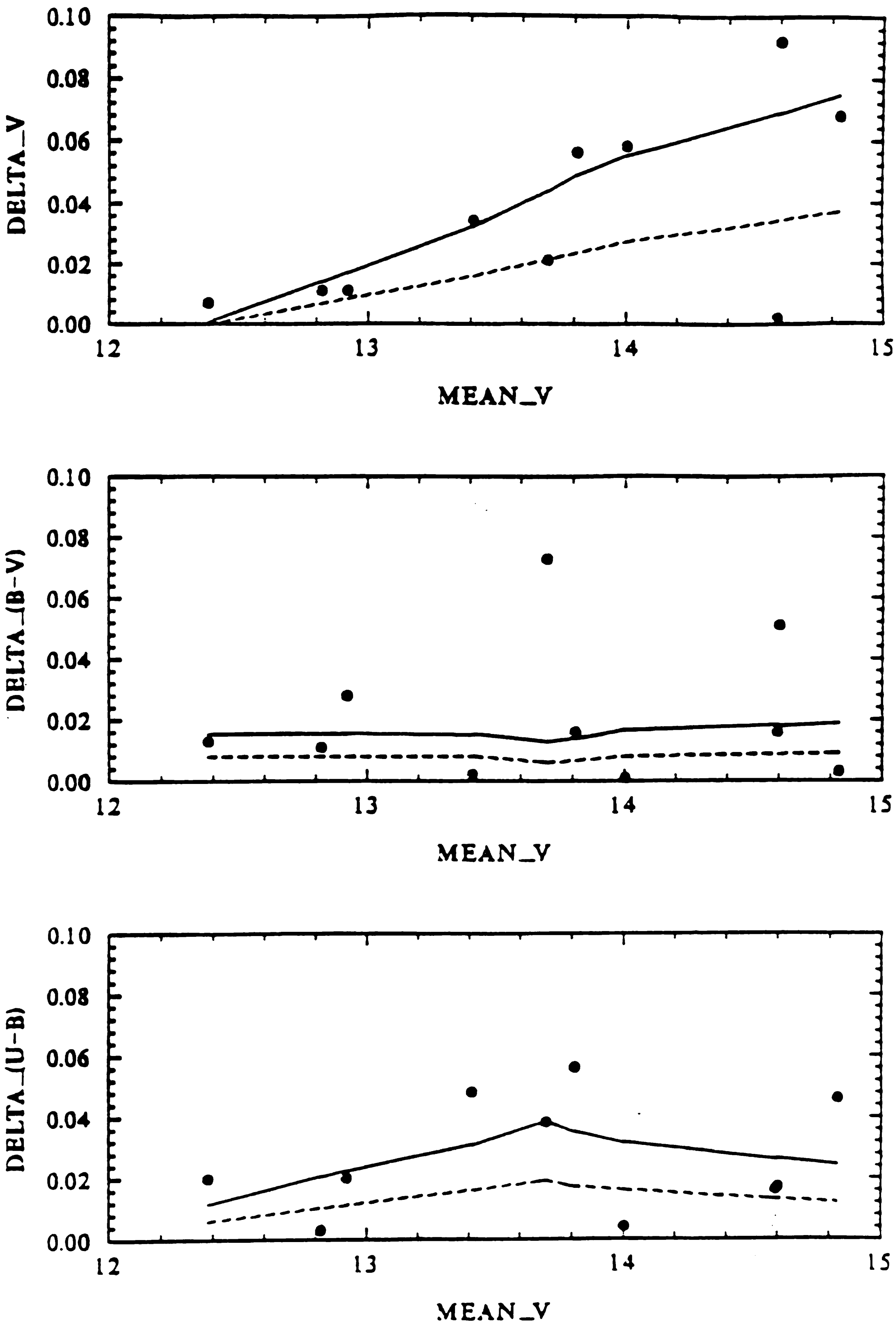

Figure 2 (a), (b) and (c) - Doinidis and Beers 1990

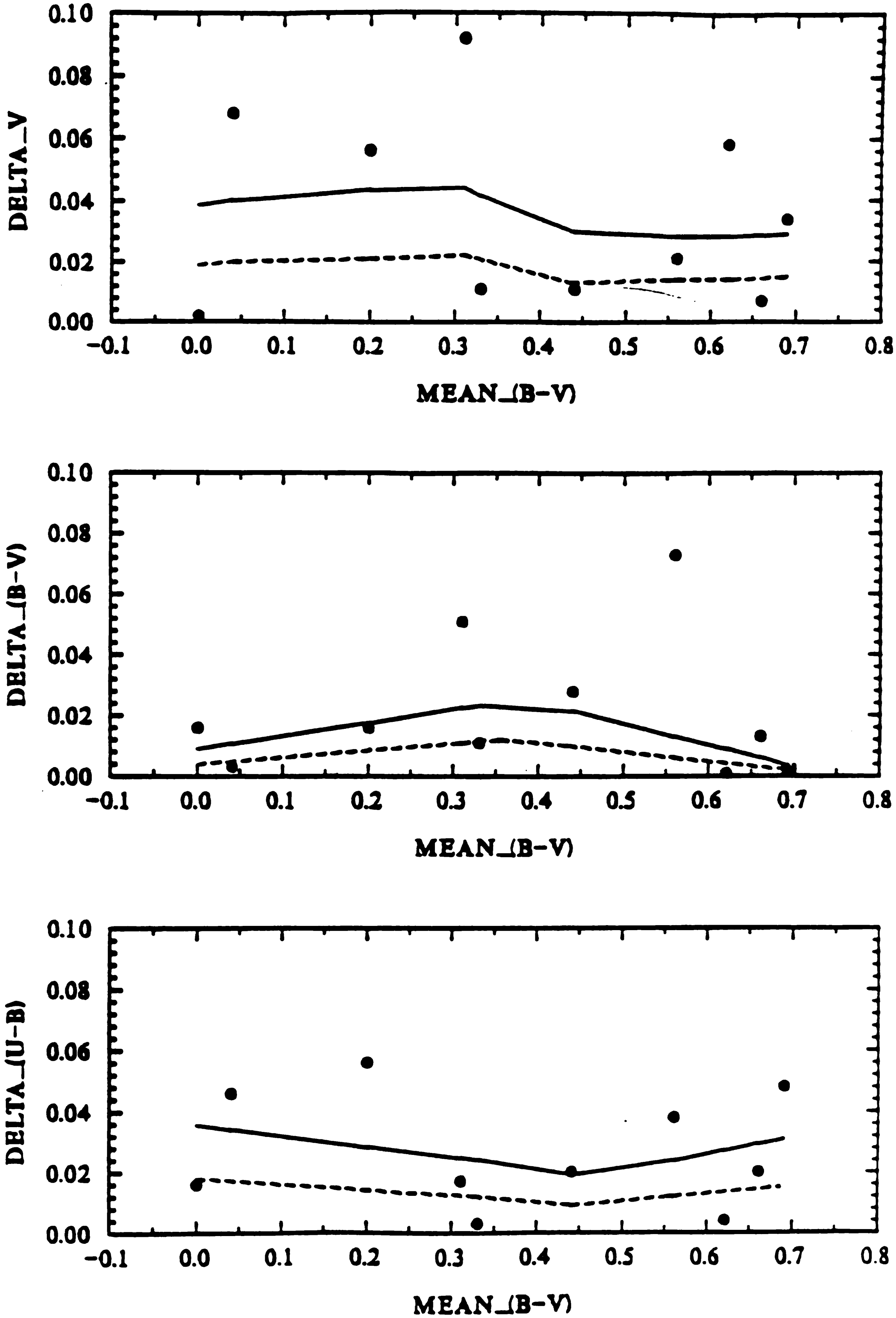

Figure 2 (d), (e) and (f) – Doinidis and Beers 1990

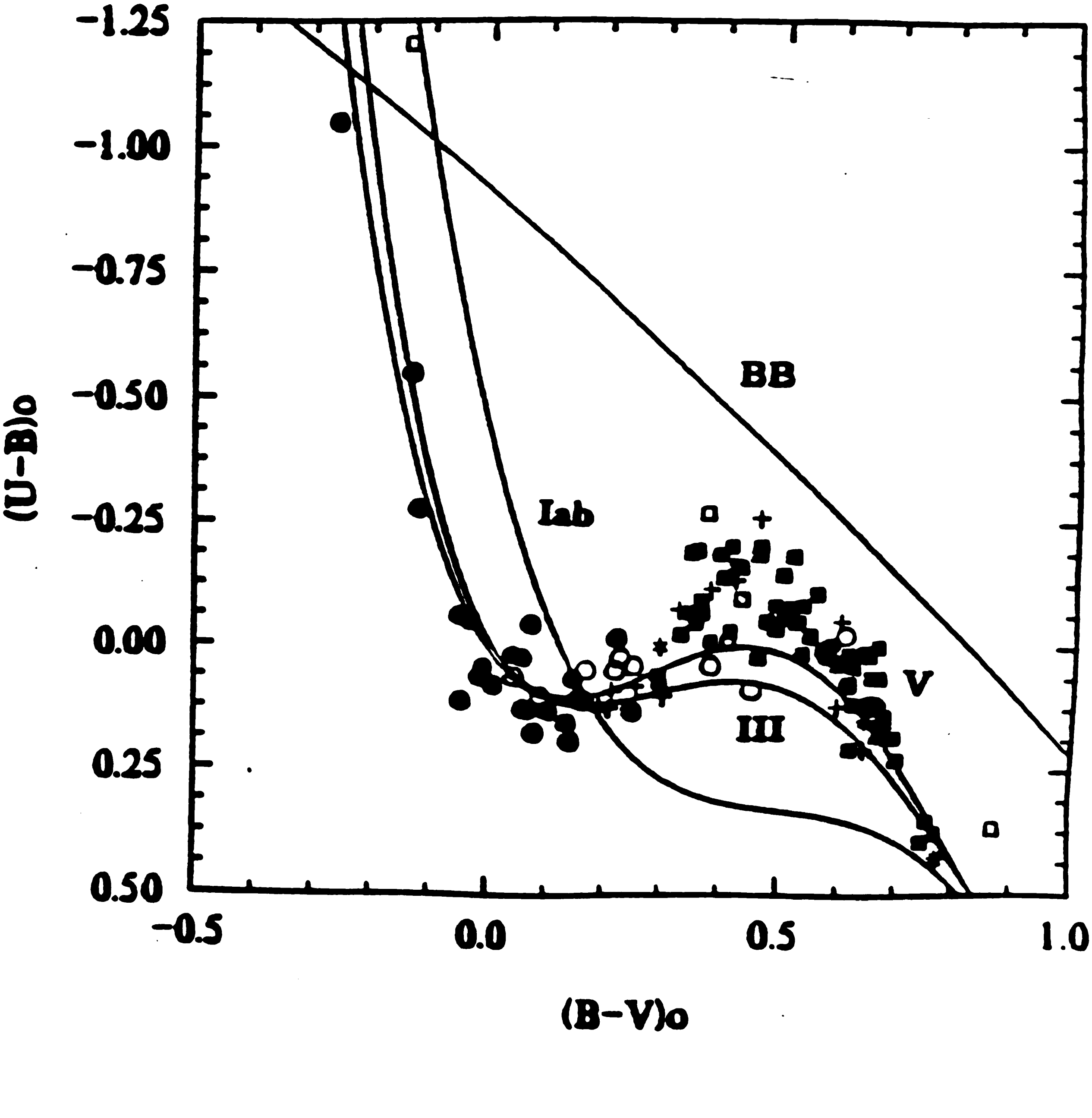

Figure 3 - Doinidis and Beers 1990

CHAPTER 6: A DETERMINATION OF THE ROTATIONAL VELOCITY OF A SYSTEM OF FIELD STARS

The application of halo samples to kinematic models for the galaxy requires a knowledge of seven things for each object in the sample: the three components of both its position and velocity, and the form of the potential through which it moves. Of these, only four can be directly observed, namely, position and heliocentric radial velocity. If the number of objects in the sample is small, then simplifying assumptions can be made with regard to the symmetry of the potential or the distributions of position and velocity, in order to constrain the rest. With larger samples, these constraints can be made statistically. It is also preferable, in any case, to use samples which are uniform in general properties (*e.g.*, stellar type and metallicity). This ensures that the objects comprising the sample share other physical properties and the same evolutionary history. It is a relatively straightforward exercise to determine the rotational velocity of a system of stars, and this determination can be applied to important problems in galactic structure and evolution. The interface between the disk Population I and the halo Population II must exist at some point, for example, but it is not completely clear as to where one may draw a distinction between the two, or even whether they are truly discrete. Eggen, Lyndon-Bell and

Sandage (1962), based on a correlation of rotational velocity with abundance, argue that the galaxy underwent a rapid collapse to its present form, with progressive enrichment of the material in the disk from young halo stars.

Also using metal abundance and kinematics as a guide, Gilmore *et al.* (1989) review the evidence for a third component of the galactic system, the so-called "thick" or "extended" disk, which has high rotational velocity (but less than that of the disk) and intermediate metal abundance, peaking at [Fe/H] ≈ -0.6 and a characteristic scale height $z \approx 1.4$ kpc, and which presumably formed during one or more intermediate dissipative stages of the galaxy's collapse. Norris (1986), however, using a large non-kinematic sample of stars in the solar neighbourhood, finds a sharp transition between halo and disk kinematics at roughly $-1.2 \leq$ [Fe/H] ≤ -1.6, suggesting therefore that the disk system is decoupled from the halo, and moreover, that for [Fe/H] ≥ -1.2, there is a marked increase in rotation that is smooth over the region occupied by the "extended disk." It should also be noted that Norris differs in his definition of the "extended" disk, maintaining that it should be considered a part of the disk rather than a separate component of the galaxy.

A sample of 592 stars, drawn from the southern hemisphere HK Survey, is used to calculate the rotational velocity of the halo. From this sample, some 507 have metallicities which can be determined from the relations in Figure 4, and the analysis which follows will include only these stars. There are two stellar types in the sample: 269 FHB stars, and 238 stars with spectra similar to those of normal A type main sequence stars. The stars have been separated according to the criteria outlined in Chapter 4, with the additional criterion that stars with [Fe/H] ≥ -0.75 are considered A stars, and those with [Fe/H] ≤ -0.75 are FHB, in order to clearly separate these two sub-samples. While this division is arbitrary, it serves to divide the sample into halo and disk components, where the disk component (the A type stars) is so named because of their assumed young age.

Lance (1988) found no systematic motion for a polar sample of these apparently normal A type stars, and suggests that their young ages require that they had been formed in situ, rather than had been ejected from the disk. She therefore postulates that they were formed due to a collision or merger between the galaxy and a satellite. It should be possible to test this hypothesis with this sample, as the A type stars here should show no evidence of systemic rotation, or, at the very least, rotation which is markedly different than that of the disk, "extended disk" or halo populations.

For a Cartesian coordinate frame centered on the sun, where the galactic center is along the negative X-direction, the galactic rotation in the positive Y-direction, and the NGP in the positive Z-direction, the distributions of this sample in the Z-X and Y-X planes are given in Figure 6. The distributions of these stars in the Z-direction over the range in their metallicities are given in Figure 7. It can be seen that, over this metallicity range, both components of the sample are distributed uniformly.

The pertinent data for the sample are presented in Table 3. The star identifications (Column (1)) are composed of the plate number from the Curtis Schmidt

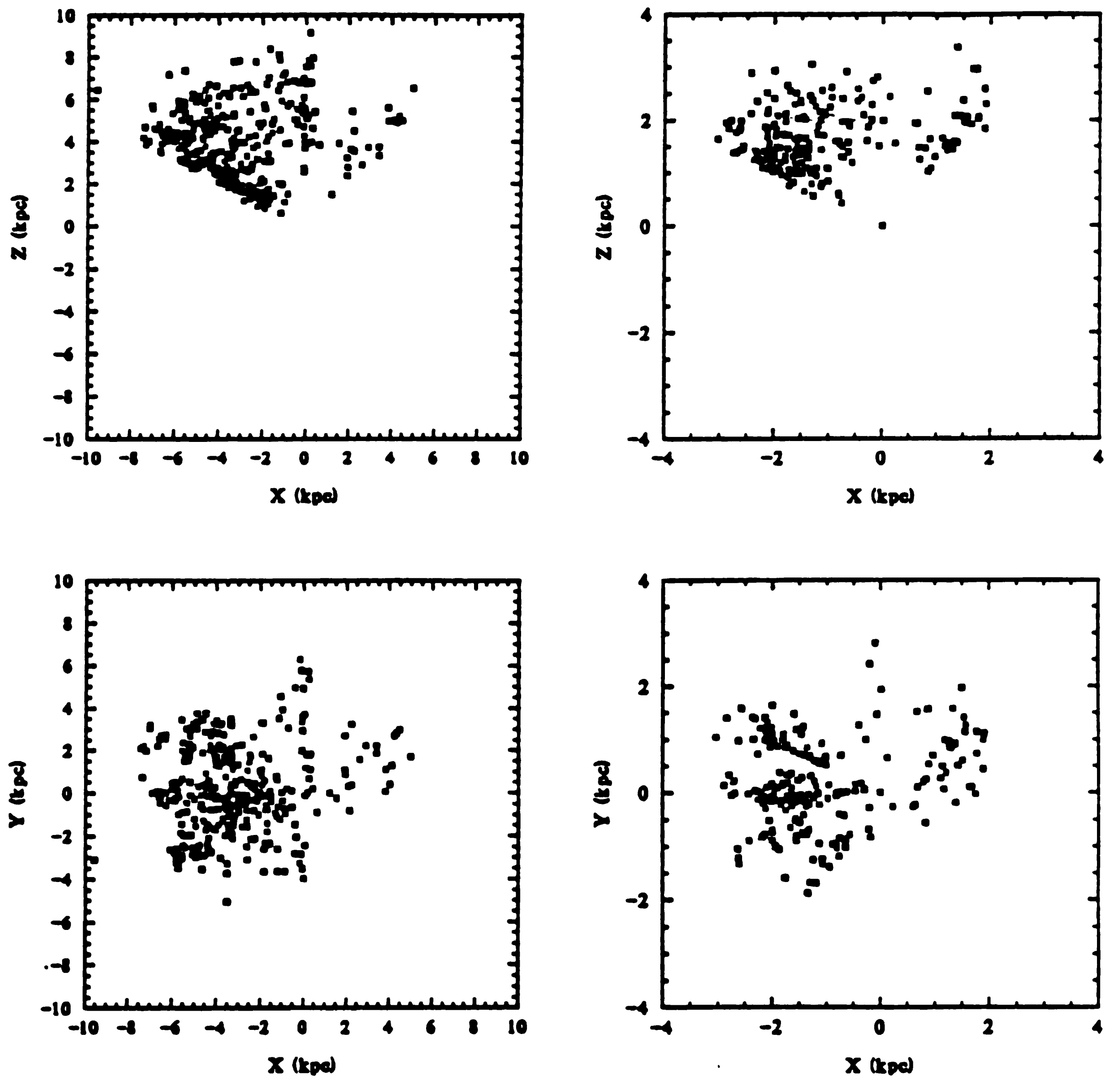

Figure 6. Distributions in position of FHB stars (left side) and A type stars (right side) in the Z-X and Y-X planes.

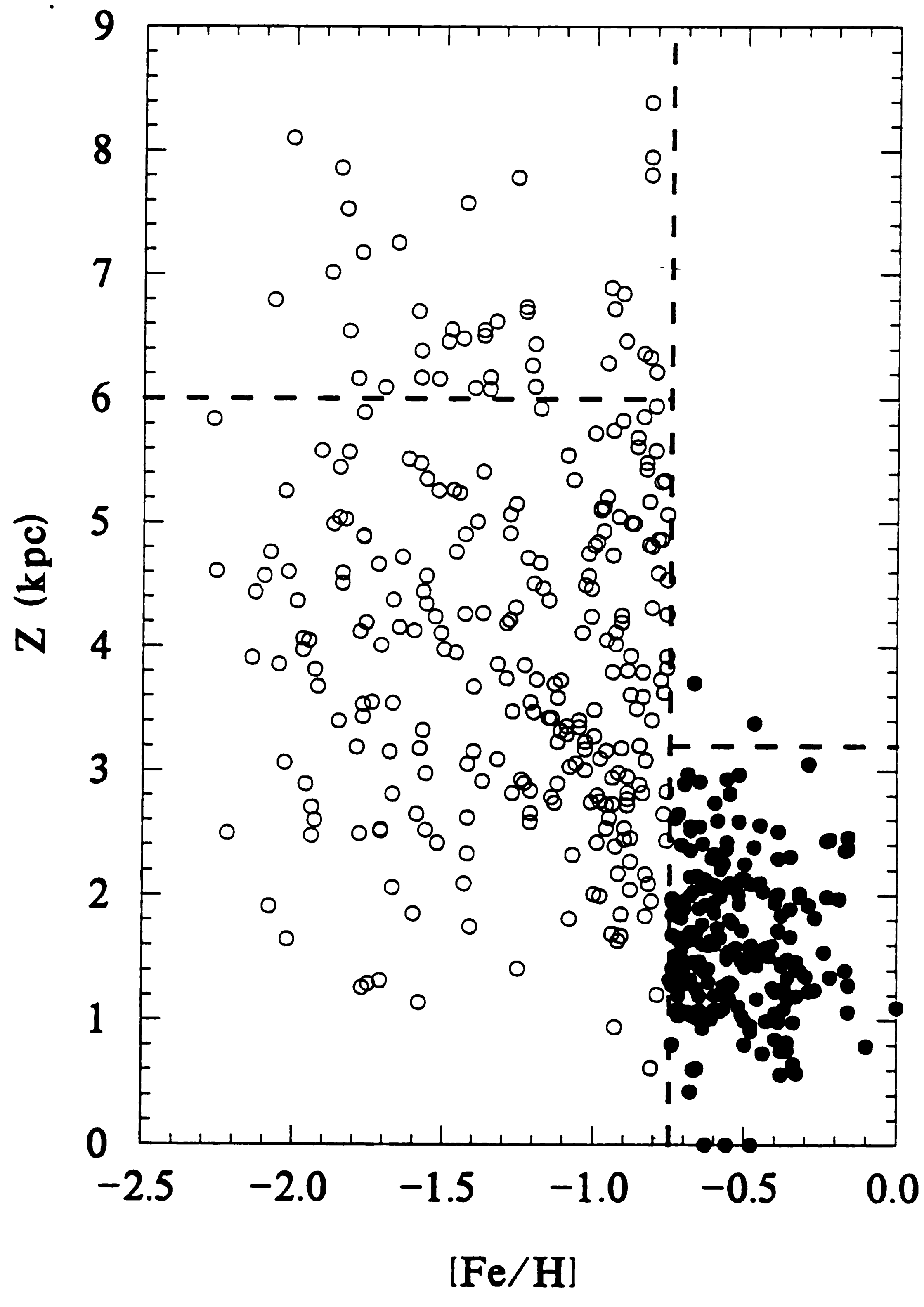

Figure 7. Distance above the galactic plane, Z, *vs.* abundance for the FHB stars (open circles) and A type stars (filled circles). The dashed lines represent a typical distance for each of these types near the magnitude limit of the HK Survey.

plate log and an individual number for that star. Columns (2) through (5) give the 1950.0 coordinates for each star, and Columns (6) through (8) give the measured UBV colours (where available). Column (9) gives the reddening for the direction of each plate center, which was taken from Burstein and Heiles (1982), or from Preston (1990) when available. In Column (10), $(B - V)$ estimates from synthetic colours are given for those stars without photometry. Column (11) gives the measured heliocentric radial velocity for the star, Column (12) gives the detector used for the spectrum (F = 2D-Frutti, R = Reticon), and Columns (13) through (16) give the spectral parameters discussed in Chapter 4. Column (16) lists the type given to that star from its spectral appearance of the plate (see Table 1), and Column (17) give the final type which was assigned to the star. Columns (19) and (20) give the absolute magnitude and heliocentric distance (in parsecs) for each star, and Column (21) the derived metal abundance, again following the method outlined in Chapter 4. Stars which are marked with an asterisk are those for which KP was below the measurable threshold, and so were not included in the abundance determination. A number of stars are given a metallicity of "< -2.00," and these stars are those whose measured values of KP put them considerably below the [Fe/H] $= -2$ line of Figure 4. It is assumed that they are of lower metal abundance, but this cannot be confirmed without higher resolution spectra.

Table 3. Spectroscopy and Photometry of FHB and A Stars.

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22166–	6	00 50 46.5	-11 31 55	124.6	-74.1	...	...	...	0.00	0.30	11	F	4.80	14.00	0.63	3.78	A	A	2.50	1660	-0.74
	17	00 56 44.0	-15 09 14	131.7	-77.6	...	...	...	0.00	0.38	0	F	4.25	12.46	0.49	5.73	A/MP	A	2.50	1600	-0.43
22169–	25	04 13 47.5	-14 41 26	208.9	-40.9	14.15	0.32	0.08	0.00	...	10	R	4.58	10.61	0.64	2.86	MP	FHB	0.60	5129	-1.09
	31	04 12 55.1	-13 46 09	207.7	-40.7	...	...	...	0.00	0.35	48	R	4.59	9.50	0.53	5.65	MP:	A	2.50	2818	-0.36
22171–	5	01 54 11.6	-11 48 21	170.6	-68.2	13.76	0.28	0.03	0.01	...	-21	R	5.65	16.60	0.61	3.44	A/P	FHB	0.60	4223	-0.76
	15	01 58 15.6	-11 47 20	172.5	-67.5	...	...	...	0.01	0.34	48	R	4.63	10.84	0.63	5.17	MP:	A	2.50	3661	-0.46
22172–	14	03 18 59.1	-11 26 16	196.1	-51.4	14.66	0.35	0.01	0.01	...	17	R	5.11	14.29	0.64	3.65	C	FHB	0.60	6391	-0.87
	26	03 27 40.4	-11 23 26	197.6	-49.5	14.74	0.34	0.10	0.01	...	-14	R	6.00	16.81	0.60	1.39	C	FHB	0.60	6631	-1.85
	27	03 26 51.8	-10 59 33	197.0	-49.5	13.19	0.37	-0.03	0.01	...	16	R	4.69	11.28	0.58	4.61	MP:	A	2.53	1354	-0.67
	28	03 27 41.6	-10 48 23	196.9	-49.2	13.95	0.30	0.05	0.01	...	-1	R	5.37	15.68	0.57	4.48	A	A	2.48	1939	-0.51
22173–	1	03 58 08.4	-21 46 56	216.3	-46.9	...	...	...	0.00	0.35	-14	F	4.44	11.71	0.65	4.89	A/MP	A	2.50	2818	-0.56
	9	03 56 08.3	-18 08 35	211.1	-46.1	13.39	0.34	-0.06	0.00	...	108	R	4.41	10.99	0.55	4.68	MP	A	2.53	1507	-0.60
	17	04 06 11.7	-17 09 40	211.0	-43.5	...	...	...	0.00	0.17	44	F	6.13	17.68	0.65	1.87	A	FHB	0.63	4169	-1.05
	24	04 04 06.2	-19 35 49	214.0	-44.9	...	...	...	0.00	0.27	34	F	5.37	16.94	0.67	4.39	A	A	2.43	2291	-0.45
	36	04 11 42.6	-18 06 11	212.9	-42.7	...	...	...	0.00	0.15	7	F	6.33	23.45	0.72	1.53	AB	FHB	0.65	5495	-1.23
22174–	17	01 14 47.6	-07 52 02	141.6	-69.5	...	...	...	0.01	0.31	10	R	4.89	11.29	0.57	4.87	MP	A	2.50	...	-0.46
	31	01 24 46.1	-11 19 18	152.3	-71.9	...	...	...	0.01	0.34	82	R	4.44	10.86	0.53	4.63	MP	A	2.50	...	-0.62
	38	01 22 23.9	-07 23 04	146.1	-68.5	...	...	...	0.01	0.37	28	R	4.09	9.47	0.52	4.68	MP:	A	2.50	2739	-0.68
22177–	5	04 05 54.9	-22 59 54	218.8	-45.5	...	...	...	0.00	0.30	-34	R	4.95	14.54	0.60	4.16	MP	A	2.49	2897	-0.62
	18	04 12 25.3	-25 28 13	222.7	-44.7	...	...	...	0.00	0.33	69	R	4.61	12.76	0.56	4.47	MP	A	2.50	...	-0.62
	30	04 18 16.0	-22 47 41	219.6	-42.7	...	...	...	0.00	0.39	56	R	4.11	10.09	0.54	5.56	MP	A	2.50	2099	-0.49
	33	04 19 30.5	-24 54 28	222.5	-43.0	...	...	...	0.00	0.32	-7	R	4.68	16.05	0.52	4.55	MP:	A	2.50	2858	-0.59
22180–	12	01 31 08.0	-11 30 30	156.9	-71.3	...	...	...	0.02	0.36	3	R	4.43	12.01	0.61	5.71	MP:	A	2.50	2047	-0.39
	19	01 37 06.9	-11 33 49	160.8	-70.6	...	...	...	0.02	0.35	1	R	4.33	10.63	0.51	4.32	MP:	A	2.50	2057	-0.71
	40	01 43 22.4	-08 20 01	159.5	-67.0	14.52	0.33	-0.17	0.02	...	-135	R	4.39	9.47	0.57	3.77	MP:	FHB	0.60	5905	-0.83
22181–	16	03 02 14.5	-12 14 54	193.7	-55.4	...	...	...	0.03	0.35	69	R	4.40	10.84	0.55	4.92	MP:	A	2.50	2017	-0.56
	26	03 09 08.5	-10 48 19	193.1	-53.2	...	...	...	0.03	0.32	21	R	4.73	11.28	0.57	4.56	A	A	2.50	3242	-0.57

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22182–	18	04 14 36.9	-30 26 10	229.7	-45.3	...	...	...	0.00	0.28	26	R	5.22	14.84	0.55	4.55	MP	A	2.46	2965	-0.45
	26	04 22 46.3	-32 23 45	232.8	-43.9	...	...	...	0.00	0.32	43	R	4.85	10.69	0.57	4.96	MP	A	2.50	3436	-0.45
22184–	5	02 29 54.4	-08 18 27	179.1	-59.5	...	...	...	0.02	0.27	64	R	5.19	14.76	0.65	3.73	MP	A	2.44	3477	-0.67
	11	02 32 24.1	-10 34 31	183.3	-60.4	...	...	...	0.02	0.28	-9	R	5.23	13.17	0.56	4.40	MP	A	2.45	3445	-0.49
	33	02 40 56.9	-12 18 04	188.6	-59.8	13.78	0.32	0.00	0.02	...	3	R	5.03	13.63	0.52	3.67	MP:	FHB	0.60	4200	-0.77
22185–	3 *	03 24 14.3	-16 15 49	204.0	-52.5	15.10	-0.28	-1.02	0.05	...	60	R	3.62	9.51	0.48	...	B	FHB	2.22	3499	...
	10	03 14 25.8	-14 31 35	199.7	-53.9	...	...	...	0.05	0.33	25	R	4.58	11.29	0.53	4.65	MP	A	2.50	2582	-0.59
	17	03 23 11.5	-12 56 00	198.9	-51.2	...	...	...	0.05	0.05	34	R	7.58	25.82	0.73	0.47	C	FHB	0.85	8279	-1.78
	29	03 32 10.5	-14 39 14	202.9	-50.1	...	...	...	0.05	0.34	-28	R	4.42	11.30	0.55	4.28	A	A	2.50	1950	-0.70
	32	03 29 33.0	-14 14 28	201.9	-50.5	...	...	...	0.05	0.35	36	R	4.24	10.41	0.51	4.30	MP	A	2.50	2559	-0.73
22186–	34	04 21 56.6	-33 34 19	234.4	-44.2	13.93	0.37	-0.04	0.00	...	97	R	4.77	13.09	0.52	3.13	MP	FHB	0.60	4634	-1.12
	43	04 32 26.1	-33 59 27	235.4	-42.1	14.22	0.28	0.04	0.00	...	84	R	5.53	17.55	0.55	2.36	MP	FHB	0.60	5297	-1.21
22189–	5	02 30 06.2	-14 45 00	189.9	-63.3	14.18	0.31	0.08	0.02	...	-120	R	5.84	17.29	0.77	2.45	A	FHB	0.60	5049	-1.20
	8	02 37 01.1	-12 48 37	188.4	-60.9	13.30	0.30	0.00	0.02	...	-21	R	5.07	15.76	0.56	3.86	MP	A	2.46	1430	-0.66
	25	02 43 42.3	-15 25 00	194.7	-60.8	...	...	...	0.02	0.26	38	R	5.56	15.93	0.60	4.78	MP:	A	2.40	1703	-0.30
22190–	4 *	03 50 30.6	-17 19 42	209.3	-47.1	...	...	...	0.00	-0.14	-112	R	4.49	13.11	0.52	...	AB	FHB	2.08	3251	...
	32	03 44 31.6	-12 50 08	202.4	-46.6	...	...	...	0.00	0.37	87	R	4.17	10.11	0.50	4.70	A/P	A	2.53	2793	-0.66
22191–	10	04 32 52.9	-38 00 00	240.8	-42.4	...	...	...	0.00	0.23	71	R	5.69	15.76	0.60	3.42	MP	A	2.29	2489	-0.63
	20	04 37 50.8	-41 57 46	246.2	-41.7	...	...	...	0.00	0.28	-2	R	5.24	15.73	0.60	4.58	MP	A	2.46	2249	-0.44
22871–	1	14 29 26.0	-21 02 33	332.2	+35.8	...	...	...	0.08	0.08	5	F	7.32	36.58	0.75	...	AB	FHB	0.78	7258	< -2.0
	2	14 30 37.9	-20 59 10	332.6	+35.7	...	...	...	0.08	0.28	-113	F	4.96	15.37	0.56	3.09	C	FHB	0.60	7191	-0.89
	7	14 32 49.1	-20 28 05	333.4	+35.9	...	...	...	0.08	0.37	-57	F	4.51	12.43	0.54	6.77	MP:	A	2.50	1815	-0.15
	10	14 31 26.0	-19 57 42	333.4	+36.5	...	...	...	0.08	0.30	-20	F	5.11	14.55	0.55	5.00	MP:	A	2.49	1428	-0.37
	12	14 32 01.2	-19 29 10	333.8	+36.9	...	...	...	0.08	0.35	363	F	3.98	10.98	0.66	2.69	MP	FHB	0.60	5792	-1.26
	29	14 34 44.0	-18 20 09	335.2	+37.6	...	...	...	0.08	0.31	-51	F	4.86	13.91	0.60	4.62	AB	A	2.51	2957	-0.53
	36	14 33 53.4	-19 50 43	334.1	+36.4	...	...	...	0.08	0.31	-2	F	4.68	11.70	0.54	3.46	A/P	FHB	0.60	5899	-0.85
	38	14 36 21.5	-20 23 04	334.4	+35.6	...	...	...	0.08	0.24	-72	F	5.59	17.55	0.59	3.58	A/P	A	2.33	2084	-0.61
	44	14 35 31.1	-21 22 34	333.6	+34.8	...	...	...	0.08	0.15	-97	F	6.82	23.40	0.71	4.34	MP:	A	1.88	2027	+0.12

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22871-	47	14 33 39.5	-21 48 36	332.9	+34.7	...	...	...	0.08	0.32	144	F	4.51	12.42	0.55	3.41	MP	FHB	0.60	4455	-0.89
	55	14 39 31.7	-21 20 07	334.6	+34.4	...	...	...	0.08	0.21	-83	F	5.93	20.49	0.65	3.30	MP:	A	2.21	1694	-0.60
	65	14 40 12.5	-20 14 00	335.4	+35.3	14.79	0.40	0.02	0.08	...	-69	R	5.27	14.02	0.62	4.27	MP	A	2.50	2552	-0.65
	68	14 38 45.4	-19 44 56	335.4	+35.9	15.75	0.45	0.18	0.08	...	278	R	6.40	15.42	0.69	1.41	P	FHB	0.60	9524	-1.91
	71	14 40 14.1	-18 24 10	336.6	+36.9	...	...	...	0.08	0.06	-108	F	7.64	24.88	0.78	...	AB	FHB	0.84	7125	< -2.0
	82	14 42 22.9	-17 32 28	337.7	+37.3	...	...	...	0.08	0.16	39	F	6.23	22.68	0.71	2.15	AB	FHB	0.63	6234	-0.90
	84 *	14 44 13.7	-17 51 12	338.0	+36.8	...	...	...	0.08	-0.15	-39	F	4.11	16.83	0.46	0.25	AB	FHB	2.22	2623	...
	86	14 41 20.2	-18 37 31	336.7	+36.5	...	...	...	0.08	0.20	-109	F	5.73	17.56	0.69	0.53	AB	FHB	0.59	7495	-2.12
	100	14 47 12.9	-21 10 26	336.5	+33.6	...	...	...	0.08	0.15	-74	F	6.41	22.67	0.70	2.02	MP	FHB	0.66	4686	-0.90
	102	14 49 39.2	-20 48 32	337.3	+33.6	...	...	...	0.08	0.36	38	F	3.95	12.43	0.49	3.35	MP	FHB	0.60	4373	-0.99
	108	14 46 05.1	-19 55 24	337.1	+34.8	...	...	...	0.08	0.23	-27	F	5.55	19.75	0.59	3.16	MP:	A	2.32	2103	-0.74
22872-	5	16 13 33.6	-04 55 29	7.9	+31.0	13.33	0.47	0.14	0.17	...	55	R	5.55	15.91	0.60	2.41	AB	FHB	0.60	2737	-1.25
	9	16 15 03.1	-04 40 50	8.4	+30.9	13.75	0.30	0.29	0.17	...	117	F	5.17	14.62	0.63	2.92	MP	A	1.77	1934	-0.43
	19	16 13 54.8	-02 46 42	10.0	+32.2	13.63	0.40	0.12	0.17	...	34	F	5.67	18.27	0.68	2.66	MP	FHB	0.60	3142	-0.91
	21	16 16 37.3	-02 50 26	10.4	+31.6	15.02	0.19	0.27	0.17	...	-13	F	7.08	25.58	0.72	0.47	AB	FHB	0.96	5053	-1.59
	45	16 20 37.4	-03 40 49	10.2	+30.3	15.09	0.16	0.03	0.17	...	41	R	6.82	17.30	0.84	0.43	A	FHB	1.09	4920	...
	49	16 17 59.3	-04 11 31	9.3	+30.6	...	...	...	0.17	0.33	-25	R	4.98	12.01	0.59	6.47	A	A	2.50	1553	-0.08
	107	16 29 03.5	-04 21 36	11.0	+28.2	13.82	0.37	0.30	0.17	...	16	R	6.97	26.33	0.71	2.40	A	FHB	0.58	3462	-0.92
	112	16 27 38.4	-05 31 42	9.7	+27.8	13.15	0.31	0.26	0.17	...	4	R	7.53	23.99	0.72	1.04	AB	FHB	0.67	2438	-1.58
	117	16 32 15.3	-05 09 23	10.7	+27.1	...	...	...	0.17	0.38	-50	R	4.21	9.24	0.56	5.54	MP	A	2.50	2001	-0.48
	118	16 30 29.1	-05 07 22	10.5	+27.5	14.39	0.42	0.30	0.17	...	-4	F	6.43	23.98	0.69	1.41	AB	FHB	0.60	4459	-1.67
	128	16 32 21.6	-02 16 48	13.5	+28.7	14.98	0.40	0.40	0.17	...	-106	R	6.83	18.42	0.82	1.32	AB	FHB	0.60	5851	-1.67
	138	16 31 13.4	-01 26 47	14.1	+29.4	...	...	...	0.17	0.35	-68	R	4.33	9.68	0.60	4.31	AB	A	2.50	2439	-0.71
22873-	36	19 49 21.9	-57 56 35	339.6	-30.8	...	...	...	0.03	0.23	131	R	5.75	17.00	0.60	3.73	A/P	A	2.29	...	-0.52
	47	19 50 39.4	-58 46 04	338.7	-31.1	...	...	...	0.03	0.08	27	R	7.26	24.06	0.72	...	AB	FHB	0.77	5068	< -2.0
	49	19 48 02.3	-59 25 22	337.9	-30.7	...	...	...	0.03	0.06	-73	R	7.52	20.51	0.74	0.35	AB	FHB	0.83	7885	-1.95
	50	19 47 20.9	-59 27 11	337.9	-30.7	...	...	...	0.03	0.07	99	R	7.33	23.18	0.75	0.58	AB	FHB	0.80	7958	-1.74
	54	19 50 19.5	-59 47 59	337.5	-31.1	...	...	...	0.03	0.15	202	R	6.32	15.15	0.92	1.35	AB	FHB	0.65	8219	-1.38
	56 *	19 47 14.0	-59 48 01	337.5	-30.7	14.10	-0.04	-0.29	0.03	...	9	R	5.12	13.35	0.61	0.44	AB	FHB	1.45	3244	...
	59	19 51 43.8	-60 11 36	337.0	-31.2	...	...	...	0.03	0.09	215	R	7.17	19.90	0.77	...	AB	FHB	0.75	5091	< -2.0
	61	19 50 11.2	-60 16 45	336.9	-31.0	...	...	...	0.03	0.07	91	R	7.42	23.47	0.77	0.41	AB	FHB	0.81	4998	-1.91
	62	19 51 19.4	-60 31 24	336.6	-31.2	...	...	...	0.03	0.07	5	R	7.44	22.84	0.76	...	AB	FHB	0.80	5021	< -2.0
	64	19 53 34.7	-60 38 37	336.5	-31.5	...	...	...	0.03	0.10	14	R	7.10	20.80	0.69	...	AB	FHB	0.75	8032	< -2.0

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22873–	66	19 49 29.9	-60 50 23	336.3	-31.0	14.81	0.30	0.07	0.03	...	-92	R	5.94	23.19	0.73	2.41	AB	FHB	0.60	6650	-1.15
	165	20 15 32.0	-61 50 09	335.0	-34.1	14.80	0.32	0.01	0.03	...	138	R	5.37	15.47	0.62	3.78	MP	A	2.48	2785	-0.71
22874–	28	14 28 16.9	-23 29 01	330.6	+33.8	...	...	...	0.09	0.19	80	F	5.87	16.08	0.66	1.29	AB	FHB	0.60	7352	-1.57
	31	14 30 14.5	-23 37 08	331.0	+33.4	...	...	...	0.09	0.22	-28	F	5.53	20.46	0.63	1.47	A	FHB	0.60	4575	-1.53
	33	14 34 17.8	-22 43 19	332.5	+33.8	13.95	0.35	0.03	0.09	...	17	R	5.19	13.02	0.60	4.17	MP	A	2.41	1781	-0.50
	40	14 36 23.5	-24 26 15	332.0	+32.1	...	...	...	0.09	0.34	12	F	4.16	10.96	0.64	3.02	MP	FHB	0.60	5707	-1.07
	48	14 35 12.5	-25 38 02	331.1	+31.1	...	...	...	0.09	0.32	-50	R	4.97	11.59	0.70	5.70	MP	A	2.50	2401	-0.25
	60	14 37 55.4	-26 42 00	331.1	+29.9	14.08	0.43	0.14	0.09	...	51	R	4.03	7.95	0.53	3.80	MP	FHB	0.60	4349	-0.83
	72	14 38 18.9	-24 01 42	332.7	+32.2	14.31	0.21	0.12	0.09	...	-81	R	7.05	25.36	0.72	1.86	A	FHB	0.70	4611	-0.88
	74	14 37 17.0	-23 48 35	332.6	+32.5	...	...	...	0.09	0.25	-41	F	5.39	17.46	0.63	3.39	MP:	A	2.38	1508	-0.72
	81	14 41 27.3	-22 37 51	334.3	+33.1	14.38	0.36	0.00	0.09	...	-58	R	4.70	10.39	0.56	4.12	MP	A	2.44	2144	-0.55
	109	14 42 49.6	-27 22 46	331.9	+28.8	...	...	...	0.09	0.12	-45	F	6.86	24.01	0.69	2.42	A	A	1.69	2900	-0.60
	112	14 46 58.1	-26 55 20	333.0	+28.7	...	...	...	0.09	0.19	-3	F	6.06	20.46	0.67	3.19	A	A	2.15	2272	-0.60
	118	14 45 25.7	-25 24 59	333.6	+30.2	...	...	...	0.09	0.18	9	F	6.21	18.91	0.64	2.77	A	A	2.05	3788	-0.69
	120	14 48 58.5	-24 55 12	334.6	+30.2	...	...	...	0.09	0.26	-28	R	5.46	14.47	0.58	4.47	MP	A	2.41	1481	-0.41
	121 *	14 46 17.9	-24 39 59	334.2	+30.8	...	...	...	0.09	-0.16	-53	F	3.88	11.67	0.50	...	AB	FHB	2.22	2585	...
	135	14 41 28.5	-26 04 36	332.3	+30.1	12.98	0.48	0.24	0.09	...	-90	R	5.10	9.90	0.54	1.93	MP:	FHB	0.60	2621	-1.71
22875–	10	22 20 34.5	-38 43 21	3.2	-57.2	...	...	...	0.00	0.35	-75	R	4.45	12.84	0.57	4.93	MP	A	2.50	2818	-0.55
	39	22 36 48.0	-39 40 03	0.3	-60.1	...	...	...	0.00	0.26	8	R	5.47	16.38	0.55	4.16	MP	A	2.39	2344	-0.49
22877-	4	13 10 17.7	-11 26 47	311.3	+50.8	...	...	...	0.00	0.19	-9	F	5.91	19.75	0.64	1.77	MP	FHB	0.60	5521	-1.22
	26	13 18 18.1	-08 23 06	315.2	+53.5	13.53	0.21	0.11	0.00	...	161	R	4.24	11.76	0.47	2.31	AB	FHB	0.60	3855	-0.98
	28	13 14 27.2	-08 42 20	313.6	+53.4	15.16	0.28	0.13	0.00	...	29	R	6.03	18.71	0.63	1.88	AB	FHB	0.60	8166	-1.48
22878–	1	16 31 08.5	+07 53 34	23.5	+34.1	...	...	...	0.05	0.17	-96	R	6.15	23.02	0.61	1.79	AB	FHB	0.63	7907	-1.10
	6	16 30 21.0	+08 23 40	24.0	+34.5	...	...	...	0.05	0.07	-58	R	7.35	23.79	0.71	0.68	AB	FHB	0.80	7656	-1.62
	8	16 32 25.0	+08 40 31	24.6	+34.2	...	...	...	0.05	0.11	-158	R	6.87	21.84	0.72	...	AB	FHB	0.71	7834	< -2.0
	10	16 32 10.3	+08 49 28	24.7	+34.3	...	...	...	0.05	0.27	-65	R	5.15	13.27	0.56	3.33	MP	FHB	0.60	7656	-0.79
	12	16 32 19.8	+09 04 10	25.0	+34.4	...	...	...	0.05	0.11	-106	R	6.77	21.46	0.64	1.66	MP	FHB	0.71	7834	-0.95
	28	16 35 38.3	+10 31 04	27.0	+34.3	...	...	...	0.05	0.29	-14	R	5.11	14.51	0.57	4.59	MP:	A	2.48	2655	-0.47
	29	16 36 09.2	+10 25 35	26.9	+34.2	...	...	...	0.05	0.22	12	R	5.98	18.92	0.62	4.70	MP	A	2.28	3614	-0.17
	31 *	16 33 01.0	+09 53 53	26.0	+34.6	...	...	...	0.05	-0.16	-27	R	3.99	11.06	0.44	...	AB	FHB	2.22	2793	...
	37	16 36 45.1	+08 51 25	25.3	+33.3	...	...	...	0.05	0.24	-17	R	5.51	16.36	0.60	3.23	MP	A	2.34	3483	-0.73

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22878–	50	16 38 08.9	+08 13 08	24.9	+32.7	...	...	...	0.05	0.24	19	R	5.62	15.90	0.61	3.71	MP	A	2.33	3499	-0.57
	80	16 41 00.3	+11 51 27	29.1	+33.7	...	...	...	0.05	0.11	-179	R	6.88	23.04	0.82	0.96	MP	FHB	0.73	7762	-1.51
	108	16 46 44.1	+09 05 50	26.9	+31.2	...	...	...	0.05	0.11	10	R	6.82	24.19	0.69	1.58	MP:	FHB	0.72	6486	-0.97
22879–	37	20 39 58.2	-37 43 53	4.9	-37.5	...	...	...	0.02	0.27	96	R	4.82	12.19	0.63	1.83	MP	FHB	0.60	6748	-1.49
	63	20 41 50.2	-41 24 56	0.3	-38.3	...	...	...	0.02	0.30	9	R	4.90	12.78	0.56	4.27	MP	A	2.50	2105	-0.60
	101	20 43 32.8	-38 29 31	4.1	-38.3	...	...	...	0.02	0.35	62	R	4.31	12.78	0.67	4.26	MP	A	2.50	2711	-0.73
	142	20 58 08.6	-39 34 16	3.0	-41.2	...	...	...	0.02	0.27	-52	R	5.16	14.27	0.72	3.47	MP	A	2.43	3493	-0.75
	146	20 56 00.6	-39 07 37	3.6	-40.8	...	...	...	0.02	0.36	1	R	4.50	12.48	0.68	5.82	MP	A	2.50	2048	-0.35
	149 *	20 54 03.4	-38 23 28	4.5	-40.3	14.28	-0.23	-0.94	0.02	...	120	R	4.22	12.48	0.49	...	B	FHB	2.22	2507	...
	153	20 55 57.7	-37 46 44	5.3	-40.6	...	...	...	0.02	0.27	18	R	5.21	13.37	0.60	3.59	MP	A	2.43	2905	-0.70
22880–	48	20 41 30.6	-20 13 21	25.9	-33.5	...	...	...	0.09	0.11	-31	R	6.89	18.12	0.72	0.79	AB	FHB	0.72	4554	-1.67
	50	20 40 48.7	-20 41 33	25.3	-33.5	...	...	...	0.09	0.10	-136	R	7.01	27.64	0.79	0.35	AB	FHB	0.74	3439	-2.07
	53	20 40 26.0	-20 54 53	25.0	-33.5	...	...	...	0.09	0.08	-295	R	7.30	23.19	0.83	...	AB	FHB	0.77	7152	< -2.0
	54	20 41 37.8	-20 59 47	25.0	-33.8	...	...	...	0.09	0.07	-31	R	7.35	26.15	0.75	0.64	AB	FHB	0.80	4471	-1.67
	57	20 39 38.6	-21 38 54	24.1	-33.6	...	...	...	0.09	0.07	-113	R	7.32	24.93	0.72	0.59	AB	FHB	0.69	2251	-1.73
	59	20 41 17.0	-21 48 10	24.1	-34.0	...	...	...	0.09	0.04	37	R	7.70	22.89	0.76	0.47	AB	FHB	0.88	4369	-1.73
	60	20 40 01.4	-21 56 18	23.8	-33.7	...	...	...	0.09	0.11	-290	R	6.94	19.08	0.77	...	MP	FHB	0.72	7218	< -2.0
	61	20 38 34.6	-21 57 57	23.6	-33.4	...	...	...	0.09	0.06	-134	R	7.50	19.62	0.76	0.38	AB	FHB	0.82	4450	-1.92
	64	20 42 14.9	-22 28 07	23.4	-34.4	...	...	...	0.09	0.07	118	R	7.49	23.47	0.80	...	AB	FHB	0.81	4450	< -2.0
	66	20 45 58.1	-22 14 32	24.0	-35.1	...	...	...	0.09	0.08	-86	R	7.21	24.08	0.71	0.98	AB	FHB	0.79	4471	-1.34
	68	20 46 26.1	-21 43 25	24.6	-35.1	...	...	...	0.09	0.05	31	R	7.60	23.18	0.84	0.53	AB	FHB	0.85	2210	-1.70
	73	20 45 17.9	-21 10 30	25.2	-34.6	14.05	0.32	0.04	0.09	...	-51	R	5.25	15.75	0.67	3.08	MP	FHB	0.60	4289	-0.76
	89	20 45 27.4	-18 41 21	28.0	-33.8	14.77	0.32	0.06	0.09	...	-48	R	5.64	14.86	0.66	1.48	MP	FHB	0.60	5976	-1.57
	114	20 49 22.0	-19 43 45	27.2	-35.1	...	...	...	0.09	0.31	-10	R	4.73	12.32	0.64	4.12	MP	A	2.50	1830	-0.68
	120	20 47 45.2	-21 09 04	25.4	-35.2	...	...	...	0.09	0.06	25	R	7.55	20.53	0.73	0.45	B	FHB	0.84	5813	-1.82
22882–	23	00 33 36.5	-30 32 42	349.0	-85.4	...	...	...	0.01	0.26	-132	R	5.17	12.51	0.64	2.79	MP:	FHB	0.60	6912	-0.93
22883–	50	14 26 41.3	+10 15 28	1.0	+61.3	14.30	0.24	0.08	0.00	...	-61	R	5.65	18.12	0.61	3.49	MP	A	2.35	2459	-0.66
22884–	13	15 30 36.7	-09 34 51	355.3	+36.2	14.33	0.33	0.13	0.14	...	-58	F	6.27	22.64	0.65	2.75	A	A	2.11	2237	-0.75
	20	15 31 40.6	-08 23 41	356.6	+36.8	14.95	0.46	-0.14	0.14	...	19	F	3.53	10.18	0.45	3.46	MP	FHB	0.60	6031	-0.88
	55	15 38 47.6	-09 34 30	357.1	+34.7	...	...	...	0.14	0.37	-54	F	4.08	11.69	0.51	4.59	AB	A	2.50	2561	-0.70

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22885–	48	20 16 35.4	-39 06 05	2.3	-33.2	14.27	0.34	-0.07	0.03	...	-60	R	4.44	12.53	0.55	2.55	MP:	FHB	0.60	5186	-1.21
	89	20 17 44.2	-41 09 29	360.0	-33.7	...	...	...	0.03	0.18	92	R	5.94	22.67	0.62	0.65	C	FHB	0.61	8257	-2.01
	92	20 22 41.9	-40 54 24	0.4	-34.6	14.42	0.30	0.13	0.03	...	36	R	5.15	15.78	0.75	1.97	MP	FHB	0.60	5556	-1.40
	99	20 18 33.0	-39 36 47	1.8	-33.6	...	...	...	0.03	0.05	9	R	7.65	24.17	0.82	...	AB	FHB	0.85	7849	< -2.0
	116	20 16 44.2	-37 41 49	4.0	-32.9	...	...	...	0.03	0.31	-22	R	4.48	13.11	0.53	3.00	MP	FHB	0.60	7813	-0.99
	125	20 23 37.7	-38 07 31	3.8	-34.4	14.15	0.27	0.12	0.03	...	-175	R	4.97	14.63	0.64	2.79	MP	FHB	0.60	4907	-0.89
	145	20 23 19.9	-39 45 02	1.8	-34.6	...	...	...	0.03	0.28	8	R	4.87	12.51	0.70	2.72	MP	FHB	0.60	7921	-1.00
	161	20 27 55.2	-42 00 03	359.3	-35.7	...	...	...	0.03	0.15	84	R	6.40	19.69	0.70	1.89	AB	FHB	0.60	8181	-0.96
	162	20 32 08.7	-41 57 46	359.4	-36.5	...	...	...	0.03	0.31	-86	R	4.81	12.83	0.60	4.19	MP	A	2.50	1030	-0.64
	164	20 30 36.2	-41 35 28	359.8	-36.2	...	...	...	0.03	0.32	-10	R	4.59	10.44	0.56	3.82	MP	FHB	0.60	7777	-0.78
	174	20 30 41.2	-39 22 27	2.5	-35.9	...	...	...	0.03	0.32	-9	R	4.67	11.62	0.61	4.28	MP	A	2.50	1026	-0.65
	179	20 30 25.1	-38 52 43	3.1	-35.8	14.64	0.32	0.04	0.03	...	-28	R	5.11	11.94	0.72	3.34	MP	FHB	0.60	6149	-0.84
	188	20 31 45.3	-38 23 42	3.8	-36.0	...	...	...	0.03	0.40	-2	R	4.04	9.23	0.60	6.33	MP	A	2.50	1972	-0.36
	190	20 27 58.3	-38 21 03	3.7	-35.2	...	...	...	0.03	0.41	-31	R	3.99	9.25	0.53	6.56	MP:	A	2.50	984	-0.32
22886–	15	22 10 45.3	-08 36 01	52.1	-48.2	...	...	...	0.03	0.36	-76	R	4.66	10.84	0.62	6.61	MP	A	2.50	3183	-0.14
	32 *	22 13 47.2	-11 45 36	48.5	-50.5	13.79	-0.14	-0.73	0.03	...	-95	F	4.83	15.47	0.50	...	AB	FHB	2.22	1972	...
	41	22 19 43.3	-10 53 24	50.8	-51.3	...	...	...	0.03	0.32	-41	R	4.72	12.48	0.59	4.43	MP	A	2.50	2046	-0.60
	50	22 17 24.3	-09 01 15	52.9	-49.8	...	...	...	0.03	0.37	-21	F	4.05	9.57	0.55	4.45	MP:	A	2.50	3162	-0.73
	73	22 26 06.8	-09 45 08	53.7	-52.0	...	...	...	0.03	0.22	-40	F	5.97	18.32	0.67	4.39	A/MP	A	2.26	1815	-0.26
22887–	12	22 33 41.5	-08 08 12	57.6	-52.7	...	...	...	0.03	0.38	-3	F	4.18	10.27	0.52	5.34	A	A	2.50	1990	-0.52
	27	22 37 19.8	-11 03 59	54.4	-55.1	...	...	...	0.03	0.11	-124	F	6.86	30.21	0.78	1.84	AB/P	FHB	0.72	5114	-0.85
	32	22 40 09.1	-10 40 28	55.6	-55.4	...	...	...	0.03	0.24	-35	F	5.79	18.32	0.67	4.90	A/P	A	2.35	2998	-0.18
	53	22 48 41.9	-11 37 50	56.3	-57.7	...	...	...	0.03	0.18	-67	F	5.96	23.46	0.73	1.30	A	FHB	0.60	5210	-1.54
22888–	28	23 14 21.9	-36 38 23	2.2	-68.0	...	...	...	0.00	0.31	19	R	4.32	10.14	0.56	1.88	MP	FHB	0.60	6887	-1.57
22889–	1	13 31 59.6	-11 35 14	319.4	+49.6	...	...	...	0.03	0.07	160	F	7.25	22.53	0.76	1.04	AB	FHB	0.80	7958	-1.25
	7	13 29 21.2	-09 37 38	319.2	+51.7	...	...	...	0.03	0.24	214	F	5.45	20.35	0.63	3.08	AB	FHB	0.60	8069	-0.79
	18	13 35 34.8	-09 18 56	321.7	+51.6	...	...	...	0.03	0.34	58	F	4.07	17.54	0.54	2.51	AB	FHB	0.60	8449	-1.32
22890–	1	15 10 49.6	-01 11 04	358.9	+45.5	...	...	...	0.02	0.20	-10	R	6.27	17.38	0.70	4.53	A/P	A	2.16	3398	-0.10
	32	15 16 41.0	-00 18 53	1.2	+45.0	14.09	0.36	0.11	0.02	...	-10	R	5.06	12.94	0.60	2.88	MP	FHB	0.60	4844	-1.14
	36	15 18 15.2	-00 05 27	1.8	+44.9	14.62	0.21	0.14	0.02	...	15	F	6.61	24.85	0.70	1.89	A	FHB	0.60	6197	-1.15

Table 3. (continued)

STAR (1)	RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22890- 38	15 17 22.4	+00 27 04	2.2	+45.4	15.26	0.21	0.19	0.02	...	-55	F	6.10	20.47	0.74	1.84	AB	FHB	0.60	8322	-1.18
41	15 18 24.9	+00 59 03	3.0	+45.5	12.61	0.35	0.16	0.02	...	-47	R	5.29	14.26	0.66	2.28	A	FHB	0.60	2450	-1.41
74 *	15 21 30.7	+01 44 54	4.5	+45.4	...	...	...	0.02	-0.14	-26	F	4.30	14.63	0.47	0.60	AB	FHB	2.16	3014	...
78	15 20 17.6	-00 55 14	1.4	+43.9	...	...	...	0.02	0.36	-11	F	3.88	10.97	0.46	2.88	MP:	FHB	0.60	3726	-1.20
79 *	15 22 03.2	-01 17 55	1.4	+43.4	...	...	...	0.02	-0.16	-38	F	4.01	13.09	0.48	...	AB	FHB	2.22	3901	...
82	15 23 58.2	+00 22 13	3.6	+44.1	14.13	0.28	0.18	0.02	...	-11	F	5.14	16.08	0.65	1.29	A	FHB	0.60	4934	-1.77
86	15 25 18.5	+00 58 26	4.5	+44.2	14.11	0.31	-0.02	0.02	...	-31	F	5.25	16.82	0.61	3.44	A	FHB	0.60	4889	-0.81
22891- 119	19 17 50.8	-59 52 50	337.0	-27.0	...	...	...	0.05	0.34	-63	R	4.20	11.04	0.72	3.21	MP	FHB	0.60	6166	-0.98
139 *	19 19 23.3	-57 58 36	339.1	-26.9	...	...	...	0.05	-0.15	-10	R	4.26	15.49	0.53	...	C	FHB	2.18	4487	...
141	19 14 16.4	-58 03 52	338.9	-26.2	...	...	...	0.05	0.11	123	R	6.81	20.85	0.71	1.64	MP:	FHB	0.72	7798	-0.95
151	19 21 35.7	-57 45 25	339.4	-27.2	...	...	...	0.05	0.30	-55	R	5.05	14.91	0.58	4.80	MP	A	2.50	3148	-0.44
161	19 22 08.5	-58 36 19	338.5	-27.4	14.87	0.16	0.17	0.05	...	59	R	7.17	26.52	0.75	0.49	A	FHB	0.72	6279	-1.96
175	19 23 45.0	-60 02 33	336.9	-27.8	...	...	...	0.05	0.39	-5	R	4.11	10.44	0.57	5.76	MP	A	2.50	2512	-0.45
211	19 36 19.4	-60 53 35	336.1	-29.4	13.64	0.27	0.14	0.05	...	-104	R	5.34	16.42	0.68	1.39	MP	FHB	0.60	3767	-1.60
216	19 33 52.9	-60 14 08	336.8	-29.0	14.71	0.26	0.16	0.05	...	150	R	4.69	14.91	0.61	3.24	MP	A	2.23	2913	-0.64
217	19 29 57.5	-60 08 24	336.9	-28.5	14.28	0.47	0.10	0.05	...	3	R	4.94	11.34	0.61	2.50	MP	FHB	0.60	5058	-1.52
219	19 34 45.8	-59 50 12	337.3	-29.1	...	...	...	0.05	0.38	121	R	4.20	10.14	0.54	5.97	MP:	A	2.50	2524	-0.39
22892- 11	22 00 19.9	-15 16 13	41.4	-49.1	14.13	0.36	0.11	0.02	...	-65	R	5.42	14.29	0.60	2.95	MP:	FHB	0.60	4934	-1.11
13	21 57 09.5	-14 26 23	42.0	-48.1	...	...	...	0.02	0.25	-134	R	5.36	12.68	0.63	3.49	A	A	2.39	3591	-0.70
20	22 04 40.4	-14 19 16	43.4	-49.7	14.39	0.32	-0.23	0.02	0.34	-188	R	4.28	10.14	0.59	1.90	MP	FHB	0.60	5562	-1.53
27	22 05 21.9	-15 50 11	41.3	-50.5	12.74	0.32	-0.04	0.02	...	-6	R	5.34	15.22	0.61	2.90	MP	FHB	0.60	2601	-1.00
48	22 11 14.4	-15 01 47	43.4	-51.4	14.13	0.35	0.01	0.02	...	-166	R	4.19	9.91	0.70	0.99	AB	FHB	0.60	4934	-2.05
58	22 14 17.9	-15 35 04	43.1	-52.3	...	...	...	0.02	0.34	-27	R	4.33	9.91	0.56	3.97	MP:	FHB	0.60	7856	-0.79
59	22 14 29.2	-14 14 23	45.1	-51.8	...	...	...	0.02	0.27	31	R	5.24	14.98	0.54	4.16	MP:	A	2.44	2892	-0.55
63	22 12 52.9	-12 59 40	46.6	-50.8	...	...	...	0.02	0.27	22	R	5.03	14.52	0.51	2.83	MP	FHB	0.60	8113	-0.94
22893- 29	23 01 27.9	-07 53 43	65.4	-57.9	...	...	...	0.00	0.24	-30	R	5.29	15.47	0.57	1.56	MP	FHB	0.60	5395	-1.54
38 *	23 01 31.2	-09 12 35	63.5	-58.8	16.18	-0.10	-0.37	0.00	...	-279	R	4.50	9.45	0.70	0.28	MP	FHB	1.70	7887	...
22894- 29	23 39 40.7	-01 08 12	87.8	-58.9	14.37	0.29	-0.06	0.02	...	11	R	5.31	16.60	0.63	2.28	AB	FHB	0.60	5511	-1.22
30	23 37 24.6	-01 05 13	86.9	-58.6	14.65	0.41	0.07	0.02	...	-71	R	4.46	11.74	0.55	3.38	MP	FHB	0.60	6269	-1.07
36	23 39 33.6	+00 16 14	89.1	-57.7	14.76	0.28	0.07	0.02	...	-240	R	4.53	13.71	0.47	1.19	C	FHB	0.60	6595	-1.82
43	23 44 43.9	+00 27 56	91.4	-58.1	13.99	0.34	-0.05	0.02	...	-51	R	4.91	13.38	0.52	3.47	MP	FHB	0.60	4626	-0.88

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22896–	12 *	19 18 19.8	-55 57 47	341.3	-26.4	...	...	...	0.04	-0.14	55	R	4.38	13.73	0.46	...	AB	FHB	2.15	3841	...
	52	19 23 04.4	-54 13 50	343.3	-26.8	15.39	0.29	-0.06	0.04	...	51	F	4.77	13.17	0.61	2.00	AB	FHB	0.60	8559	-1.32
	56	19 26 43.4	-54 14 56	343.4	-27.3	14.66	0.24	0.12	0.04	...	-26	F	6.07	21.22	0.70	2.82	MP	FHB	0.58	6174	-0.76
	69 *	19 21 20.9	-55 31 46	341.9	-26.7	...	...	...	0.04	-0.17	-25	F	3.71	14.63	0.42	...	AB	FHB	2.22	4533	...
	74	19 23 23.5	-55 54 11	341.5	-27.1	...	...	...	0.04	0.06	60	F	7.41	24.14	0.72	1.18	AB	FHB	0.84	7698	-0.98
	75	19 23 03.4	-56 23 52	341.0	-27.1	14.94	0.21	0.12	0.04	...	-52	F	6.93	24.87	0.71	2.66	AB	A	2.03	3607	-0.72
	77	19 25 06.6	-56 45 44	340.6	-27.5	14.74	0.26	0.17	0.04	...	27	F	6.55	22.67	0.68	1.94	MP	FHB	0.60	6345	-1.24
	82	19 22 02.5	-57 07 47	340.1	-27.1	14.85	0.21	0.14	0.04	...	-82	F	6.87	24.14	0.71	1.92	A	FHB	0.63	6597	-1.03
	90	19 30 47.9	-56 38 34	340.9	-28.2	14.73	0.35	-0.03	0.04	...	-56	F	5.01	15.36	0.57	3.24	MP	FHB	0.30	6315	-0.92
	92	19 32 38.6	-56 12 11	341.4	-28.4	14.71	0.44	0.13	0.04	...	-14	F	6.29	18.29	0.70	2.31	AB	FHB	0.60	6257	-1.56
	100	19 30 06.2	-55 20 35	342.3	-27.9	...	...	...	0.04	0.29	-24	F	5.18	15.36	0.63	4.88	A/MP	A	2.48	2706	-0.38
	105	19 28 01.1	-54 32 31	343.1	-27.5	14.75	0.31	0.01	0.04	...	21	R	5.45	17.28	0.71	2.88	AB	FHB	0.60	6374	-0.94
	123	19 34 27.3	-53 17 33	344.7	-28.3	15.37	0.27	0.16	0.04	...	95	R	5.48	17.00	0.62	2.59	A	FHB	0.60	8480	-0.93
	133	19 35 32.1	-53 47 45	344.2	-28.5	15.44	0.23	0.10	0.04	...	-89	F	7.03	27.05	0.76	1.69	AB	FHB	0.60	8778	-1.29
	147	19 36 57.7	-55 48 45	341.9	-29.0	14.80	0.31	0.08	0.04	...	-4	R	5.78	20.86	0.63	2.82	A	FHB	0.60	6522	-0.96
	171 *	19 44 41.2	-56 03 11	341.8	-30.1	14.04	-0.23	-1.07	0.04	...	64	R	2.86	6.86	0.40	...	B	FHB	2.22	2180	...
	173	19 49 03.1	-55 51 48	342.1	-30.7	14.13	0.35	-0.09	0.04	...	80	R	4.59	11.04	0.63	3.32	MP	FHB	0.60	4791	-0.90
	175 *	19 43 25.7	-55 38 33	342.2	-29.9	15.47	-0.08	-0.55	0.04	...	-17	R	4.82	12.83	0.58	...	B	FHB	1.89	4907	...
	194 *	19 44 11.5	-53 31 00	344.7	-29.7	15.89	-0.06	-0.35	0.04	...	44	F	4.06	12.43	0.42	0.11	AB	FHB	1.69	6506	...
	200	19 43 13.0	-52 42 28	345.6	-29.5	...	...	...	0.04	0.35	-87	R	4.38	15.20	0.64	4.50	MP	A	2.50	3136	-0.66
22897–	7	20 59 46.6	-65 27 22	329.4	-38.2	14.39	0.43	0.07	0.00	...	15	R	6.15	15.75	0.76	2.19	MP	FHB	0.60	5728	-1.67
	96	21 24 32.7	-65 31 35	328.1	-40.5	14.99	0.19	0.17	0.00	...	-61	R	6.37	21.79	0.67	1.71	MP:	FHB	0.60	7568	-1.28
	105	21 24 40.1	-67 03 47	326.3	-39.9	...	...	...	0.00	0.39	60	R	4.05	8.95	0.53	5.56	MP	A	2.50	3327	-0.50
	111	21 35 16.8	-66 09 41	326.7	-41.2	...	...	...	0.00	0.33	-74	R	4.54	10.75	0.55	4.46	MP	A	2.50	1637	-0.64
	116	21 36 09.9	-65 41 55	327.2	-41.5	...	...	...	0.00	0.35	21	R	4.37	9.83	0.74	4.91	MP	A	2.50	1622	-0.57
	117	21 32 58.7	-65 43 37	327.4	-41.2	14.85	0.32	-0.16	0.00	...	-55	R	4.58	12.83	0.62	1.62	C	FHB	0.60	7079	-1.72
	119	21 33 58.9	-64 52 54	328.3	-41.7	...	...	...	0.00	0.34	-2	R	4.51	10.13	0.57	4.54	MP	A	2.50	2148	-0.63
	120	21 35 12.3	-64 55 19	328.2	-41.8	15.32	0.34	-0.02	0.00	...	16	R	4.99	16.11	0.60	3.79	C	FHB	0.60	8790	-0.84
22898–	26	21 03 16.4	-18 45 10	29.8	-37.8	13.43	0.23	-0.51	0.03	...	-9	R	4.13	9.91	0.55	2.91	MP	A	2.18	1700	-0.73
22937–	17	20 59 05.9	-38 55 48	3.9	-41.3	13.65	0.33	-0.04	0.02	...	-40	R	4.93	12.51	0.59	3.96	MP:	A	2.50	1649	-0.72
	43	21 06 01.5	-41 48 30	0.1	-42.8	...	...	...	0.02	0.42	-13	R	3.99	8.65	0.62	6.88	MP:	A	2.50	2625	-0.26
	50	21 09 37.9	-41 06 08	1.1	-43.5	14.91	0.36	-0.06	0.02	...	-51	R	4.61	15.22	0.57	3.98	MP	FHB	0.60	7066	-0.78

Table 3. (continued)

STAR (1)			RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22937–	56		21 11 45.3	-40 25 20	2.0	-43.8	...	...	...	0.02	0.29	29	R	5.06	13.72	0.60	4.55	MP	A	2.49	2800	-0.50
	58		21 11 47.1	-40 13 46	2.3	-43.8	...	...	...	0.02	0.26	-7	R	5.37	15.49	0.62	4.08	MP:	A	2.41	2235	-0.54
	65		21 11 25.0	-38 34 24	4.6	-43.7	...	...	...	0.02	0.29	-9	R	5.08	13.71	0.63	4.69	AB	A	2.49	2124	-0.46
	68		21 11 48.7	-38 22 04	4.9	-43.8	15.01	0.35	-0.11	0.02	...	-43	R	4.76	11.34	0.57	3.17	AB	FHB	0.60	7399	-0.98
	74		21 15 58.6	-37 32 39	6.1	-44.6	14.75	0.51	-0.13	0.02	...	-3	R	6.84	22.63	0.72	0.87	MP	FHB	0.60	6564	-2.26
	82	*	21 18 29.3	-40 26 27	2.0	-45.1	...	...	...	0.02	-0.17	26	R	3.52	9.53	0.40	...	AB	FHB	2.22	2973	...
	84		21 16 18.5	-40 43 49	1.6	-44.7	14.80	-0.07	-0.37	0.02	...	134	R	5.79	13.70	0.64	0.27	B	FHB	1.61	4223	...
	86		21 17 55.8	-40 50 13	1.4	-45.0	...	...	...	0.02	0.33	-76	R	4.59	10.73	0.69	4.33	MP:	A	2.50	2076	-0.66
22938–	4		22 30 11.6	-65 43 44	322.7	-46.0	...	...	...	0.00	0.35	74	R	4.49	10.74	0.61	5.44	MP:	A	2.50	2818	-0.43
	15		22 43 39.8	-63 44 12	323.3	-48.4	...	...	...	0.00	0.39	18	R	3.99	9.25	0.53	5.19	MP:	A	2.50	2767	-0.59
	16		22 43 04.3	-63 45 47	323.3	-48.4	...	...	...	0.00	0.30	61	R	4.74	11.94	0.55	3.59	MP:	FHB	0.60	6918	-0.80
	17		22 43 58.5	-64 06 16	322.9	-48.2	...	...	...	0.00	0.21	-39	R	5.74	18.17	0.65	2.58	MP	FHB	0.60	8670	-0.87
	19		22 46 30.5	-65 15 24	321.4	-47.5	14.26	0.40	0.05	0.00	...	50	R	4.35	12.24	0.54	2.45	P	FHB	0.60	5395	-1.50
	21		22 45 53.2	-66 46 37	320.0	-46.4	...	...	...	0.00	0.15	79	R	6.39	16.09	0.73	1.27	MP	FHB	0.66	7211	-1.42
	22		22 45 06.0	-66 54 14	320.0	-46.2	...	...	...	0.00	0.27	160	R	4.91	16.41	0.54	2.00	MP	FHB	0.60	8433	-1.38
	29		22 52 46.9	-66 56 17	319.1	-46.7	...	...	...	0.00	0.41	-12	R	4.02	8.66	0.57	6.55	MP	A	2.50	2742	-0.32
	38		22 56 50.9	-64 49 25	320.6	-48.6	...	...	...	0.00	0.22	29	R	5.79	17.31	0.69	3.72	MP	A	2.28	3981	-0.52
	64		23 14 58.7	-65 48 08	317.4	-48.9	...	...	...	0.00	0.39	42	R	4.11	11.02	0.62	6.10	C	A	2.50	3327	-0.38
	71		23 09 34.7	-64 06 38	319.6	-50.0	...	...	...	0.00	0.28	56	R	5.07	14.03	0.63	3.91	MP	A	2.47	2239	-0.65
22940–	3		20 24 57.3	-61 45 37	334.9	-35.2	...	...	...	0.06	0.20	6	R	5.86	18.47	0.65	2.72	MP	FHB	0.60	4893	-0.80
	63		20 38 51.5	-62 11 43	334.1	-36.7	14.62	0.39	0.08	0.06	...	-130	R	4.24	11.59	0.63	4.13	MP	A	2.50	2430	-0.72
	75		20 36 13.2	-60 17 29	336.5	-36.7	...	...	...	0.06	0.14	-113	R	7.18	24.38	0.77	1.13	MP	FHB	0.67		
	105		20 48 24.4	-62 23 25	333.6	-37.8	...	...	...	0.06	0.24	-51	R	5.50	16.05	0.67	3.61	MP	A	2.36	2816	-0.63
22941–	30		23 37 51.2	-36 56 17	356.1	-72.2	...	...	...	0.03	0.24	1	R	5.33	16.05	0.69	2.56	MP	FHB	0.60	5091	-0.96
	32		23 34 34.0	-36 27 18	358.4	-71.8	...	...	...	0.03	0.38	-3	R	4.32	10.10	0.53	6.07	MP	A	2.50	1990	-0.34
	35		23 35 29.1	-36 09 33	359.1	-72.1	...	...	...	0.03	0.31	-1	R	4.72	12.18	0.63	4.10	MP	A	2.50	2055	-0.68
	38		23 36 59.7	-35 22 15	1.1	-72.7	...	...	...	0.03	0.19	-41	R	6.08	20.51	0.79	2.95	MP	A	2.12	2587	-0.67
22942–	12		00 48 38.7	-25 47 57	120.1	-88.4	14.14	0.29	-0.06	0.00	...	-46	R	5.15	14.33	0.61	2.88	MP	FHB	0.60	5105	-0.98
	17	*	00 53 53.7	-26 53 26	188.2	-88.8	15.94	-0.02	-0.14	0.00	...	-56	R	7.01	19.09	0.71	...	C	FHB	1.14	9138	...
22943–	27		20 06 11.7	-45 40 57	354.3	-32.3	...	...	...	0.00	0.15	-39	F	6.35	19.77	0.71	1.67	AB	FHB	0.66	8670	-1.11

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22943–	34	20 06 56.5	-44 55 42	355.2	-32.3	...	...	...	0.00	0.24	-151	F	5.63	18.30	0.66	3.80	MP:	A	2.33	2432	-0.54
	38	20 11 31.9	-44 51 29	355.4	-33.1	...	...	...	0.00	0.12	-38	F	6.82	26.35	0.72	2.54	MP	A	1.72	3404	-0.56
	45	20 10 05.5	-43 58 27	356.4	-32.7	...	...	...	0.00	0.24	10	F	5.59	16.84	0.62	3.88	A	A	2.35	2410	-0.53
	58	20 17 24.3	-43 27 31	357.2	-34.0	...	...	...	0.00	0.19	22	F	6.04	18.30	0.66	2.91	A	A	2.14	3581	-0.69
	68	20 15 39.6	-44 46 15	355.6	-33.8	...	...	...	0.00	0.15	29	F	6.41	19.06	0.69	...	AB	FHB	0.66	7211	$<$ -2.0
	70	20 13 05.7	-45 03 10	355.2	-33.4	...	...	...	0.00	0.17	-120	F	6.11	18.30	0.65	1.45	D	FHB	0.63	5495	-1.38
	75	20 16 27.4	-45 16 53	355.0	-34.0	...	...	...	0.00	0.31	-39	F	4.48	15.37	0.65	2.54	MP	FHB	0.60	6887	-1.21
	96	20 23 32.2	-46 51 18	353.2	-35.4	...	...	...	0.00	0.31	-55	F	4.81	14.02	0.56	4.11	AB	A	2.50	3451	-0.66
	108	20 19 04.6	-46 03 37	354.1	-34.6	...	...	...	0.00	0.22	-38	F	5.50	21.36	0.71	1.87	A	FHB	0.60	5445	-1.29
	113	20 22 04.0	-45 23 30	355.0	-35.0	...	...	...	0.00	0.11	165	F	6.79	25.62	0.70	0.89	A/P	FHB	0.71	7178	-1.61
	133	20 20 13.9	-42 50 40	358.0	-34.4	...	...	...	0.00	0.15	5	F	6.40	27.96	0.73	1.84	AB	FHB	0.66	7211	-0.98
	150	20 25 04.9	-44 11 55	356.5	-35.4	...	...	...	0.00	0.15	59	F	6.40	19.77	0.69	1.51	AB	FHB	0.66	7211	-1.22
	171	20 26 17.9	-47 40 03	352.3	-35.9	...	...	...	0.00	0.09	100	F	7.18	21.24	0.71	...	AB	FHB	0.76	5370	$<$ -2.0
	172	20 29 13.6	-47 17 23	352.8	-36.4	...	...	...	0.00	0.24	9	F	5.42	21.34	0.59	3.00	A	FHB	0.60	5395	-0.82
	174	20 33 57.1	-47 07 00	353.0	-37.2	...	...	...	0.00	0.08	257	F	7.43	25.63	0.73	...	AB	FHB	0.79	7015	$<$ -2.0
	177 *	20 32 20.4	-46 48 19	353.4	-36.9	...	...	...	0.00	-0.16	-25	F	3.88	11.72	0.44	...	B	FHB	2.22	3076	...
	198 *	20 28 56.0	-44 15 44	356.5	-36.1	...	...	...	0.00	-0.15	27	F	4.30	16.12	0.51	...	C	FHB	2.16	4150	...
	202	20 34 03.8	-43 56 23	357.0	-37.0	...	...	...	0.00	0.07	58	F	7.47	23.56	0.72	...	AB	FHB	0.80	5321	$<$ -2.0
22944–	8	21 39 55.4	-16 11 39	37.2	-45.0	...	...	...	0.03	0.16	-106	R	6.18	16.34	0.70	0.26	MP	FHB	0.63	8257	-2.26
	13	21 38 00.1	-15 10 38	38.3	-44.2	...	...	...	0.03	0.10	-148	R	7.01	24.93	0.74	0.83	AB	FHB	0.75	6680	-1.59
	18	21 39 14.3	-14 15 33	39.6	-44.1	...	...	...	0.03	0.30	24	R	5.05	10.96	0.58	5.13	MP	A	2.50	2064	-0.36
22945–	1	23 27 38.0	-67 49 47	314.3	-47.8	...	...	...	0.00	0.25	164	R	5.11	17.89	0.61	1.83	MP:	FHB	0.60	7079	-1.42
	9	23 24 09.1	-65 57 02	316.1	-49.2	...	...	...	0.00	0.26	78	R	5.20	13.12	0.63	3.39	MP	FHB	0.60	7047	-0.76
	20	23 33 38.0	-63 26 59	316.5	-51.9	...	...	...	0.00	0.32	67	F	4.62	12.45	0.62	4.19	A/MP	A	2.50	1644	-0.68
	23 *	23 27 49.4	-65 57 24	315.5	-49.4	...	...	...	0.00	-0.16	-86	F	3.84	12.44	0.49	...	AB	FHB	2.22	4055	...
22947–	15	19 02 50.1	-50 51 25	346.2	-23.0	...	...	...	0.06	0.35	-7	F	4.55	11.69	0.51	5.67	MP:	A	2.50	1444	-0.37
	36	19 00 05.0	-49 47 10	347.2	-22.3	13.30	0.32	0.07	0.06	...	-38	F	5.59	16.81	0.64	3.27	A/MP	FHB	0.60	3174	-0.79
	47	19 03 26.3	-48 52 39	348.3	-22.5	12.75	0.31	0.16	0.06	...	-58	F	6.36	21.07	0.64	2.74	A/MP	FHB	0.60	2464	-0.93
	79	19 08 27.8	-47 58 30	349.5	-23.1	...	...	...	0.06	0.33	-62	F	4.81	12.35	0.59	5.40	MP:	A	2.50	1921	-0.36
	84	19 10 05.5	-48 14 59	349.3	-23.4	...	...	...	0.06	0.34	-29	F	4.71	12.42	0.58	5.59	A	A	2.50	1912	-0.35
	99 *	19 07 27.1	-48 54 31	348.5	-23.2	14.03	-0.09	-0.69	0.06	...	-25	F	4.43	10.23	0.51	0.54	AB	FHB	2.22	2107	...
	100	19 10 18.2	-48 45 10	348.8	-23.6	13.14	0.21	0.20	0.06	...	134	F	4.82	13.17	0.56	3.35	MP:	A	1.91	1616	-0.34

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22947– 206		19 19 22.1	-48 30 06	349.4	-25.0	...	...	...	0.06	0.35	137	F	4.51	14.62	0.58	5.15	MP	A	2.50	1904	-0.49
236		19 23 03.0	-50 07 12	347.8	-25.9	...	...	...	0.06	0.38	42	F	4.26	13.18	0.58	6.10	MP	A	2.50	1878	-0.35
287		19 27 18.4	-50 20 45	347.8	-26.7	13.87	0.23	0.10	0.06	...	-9	F	6.21	26.37	0.70	2.38	E	FHB	0.63	4079	-0.83
299	*	19 28 53.9	-49 33 33	348.7	-26.7	14.52	-0.07	-0.41	0.06	...	134	F	5.40	16.84	0.63	0.53	MP	FHB	1.99	2930	...
301		19 28 10.7	-49 31 22	348.7	-26.6	...	...	...	0.06	0.24	-28	F	5.70	18.30	0.67	4.08	MP	A	2.33	2166	-0.44
22948– 2		21 30 41.5	-41 06 59	1.0	-47.4	14.83	0.16	0.18	0.00	...	-56	R	6.93	23.84	0.78	1.53	MP	FHB	0.64	6886	-1.28
8		21 27 37.3	-39 07 55	3.9	-46.9	...	...	...	0.00	0.33	-37	R	4.67	11.32	0.67	4.88	MP	A	2.50	2844	-0.51
25		21 32 13.2	-39 32 26	3.3	-47.8	13.03	0.29	0.06	0.00	...	-78	R	5.32	13.14	0.65	3.22	MP	FHB	0.60	3062	-0.88
62		21 37 01.7	-38 14 36	5.2	-48.7	...	...	...	0.00	0.13	-93	R	6.56	23.85	0.70	0.81	C	FHB	0.68	9506	-1.75
68		21 46 05.0	-37 41 52	6.0	-50.5	13.77	0.32	-0.14	0.00	...	79	R	4.68	13.13	0.52	2.82	MP:	FHB	0.60	4305	-1.11
101		21 51 46.9	-39 10 14	3.6	-51.6	14.43	0.29	0.00	0.00	...	-5	R	5.23	16.09	0.63	2.78	MP	FHB	0.60	5834	-1.02
22949– 11		23 15 21.7	-02 34 56	76.9	-56.6	14.80	0.29	0.06	0.01	...	-125	R	5.49	16.07	0.56	3.22	MP	FHB	0.60	6817	-0.86
20		23 17 03.3	-07 03 57	71.8	-60.2	15.07	0.44	0.05	0.01	...	-3	R	5.04	12.62	0.59	3.27	MP	FHB	0.60	7720	-1.23
22950– 1	*	20 17 42.5	-16 47 33	27.2	-27.0	...	...	...	0.07	-0.17	103	R	3.74	14.23	0.42	...	MP	FHB	2.22	4278	...
3		20 17 50.6	-16 30 21	27.5	-26.9	15.06	0.30	0.18	0.07	...	208	R	4.51	9.34	0.53	2.65	MP	FHB	0.60	7034	-0.91
8		20 15 35.8	-16 10 41	27.6	-26.3	...	...	...	0.07	0.29	-6	R	4.96	15.59	0.55	3.99	A/MP	A	2.48	971	-0.66
14		20 13 52.8	-15 53 10	27.7	-25.8	...	...	...	0.07	0.38	-19	R	4.21	10.49	0.53	5.97	MP	A	2.50	2428	-0.39
23		20 13 32.5	-14 42 55	28.9	-25.2	...	...	...	0.07	0.31	-13	R	4.70	14.45	0.67	3.65	B	FHB	0.60	1443	-0.79
24		20 13 38.5	-14 12 26	29.4	-25.1	...	...	...	0.07	0.18	-22	R	6.08	20.76	0.77	2.40	MP:	FHB	0.61	6356	-0.85
36		20 17 14.7	-12 40 54	31.3	-25.2	...	...	...	0.07	0.05	-98	R	7.55	22.87	0.73	0.61	MP	FHB	0.85	7264	-1.62
38		20 20 29.9	-13 06 41	31.3	-26.1	...	...	...	0.07	0.17	15	R	6.13	17.50	0.65	2.37	MP	FHB	0.62	6356	-0.85
61	*	20 19 10.3	-14 51 36	29.3	-26.6	...	...	...	0.07	-0.18	75	R	3.36	10.27	0.44	...	MP	FHB	2.22	3574	...
64		20 18 08.6	-15 19 50	28.7	-26.5	...	...	...	0.07	0.30	-52	R	4.73	13.74	0.60	3.34	MP:	FHB	0.60	4584	-0.87
136		20 26 41.3	-13 35 17	31.5	-27.7	...	...	...	0.07	0.22	-188	R	5.53	16.10	0.63	1.78	MP	FHB	0.60	6269	-1.34
151		20 29 09.4	-15 47 14	29.4	-29.1	...	...	...	0.07	0.35	16	R	4.42	11.66	0.53	4.80	MP	A	2.50	2462	-0.59
152		20 27 44.7	-15 52 30	29.2	-28.9	...	...	...	0.07	0.20	-40	R	5.71	20.93	0.61	1.65	MP	FHB	0.60	7607	-1.37
175		20 32 06.1	-15 45 18	29.8	-29.8	...	...	...	0.07	0.16	-107	R	6.19	21.00	0.67	1.96	MP:	FHB	0.63	6356	-0.98
22951– 31	*	21 41 45.2	-43 04 44	357.8	-49.3	...	...	...	0.01	-0.15	34	R	4.16	14.03	0.43	...	C	FHB	2.22	1505	...
39		21 40 39.0	-44 44 07	355.3	-48.9	...	...	...	0.01	0.34	-66	R	4.28	12.81	0.60	3.61	MP	FHB	0.60	5054	-0.88
43		21 45 42.2	-45 27 31	354.0	-49.6	...	...	...	0.01	0.33	58	F	4.63	12.53	0.55	4.45	MP	A	2.50	2790	-0.62
51		21 48 30.1	-46 39 46	352.0	-49.9	...	...	...	0.01	0.27	4	F	4.80	16.22	0.55	1.81	MP	FHB	0.60	6880	-1.51

Table 3. (continued)

STAR (1)	RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22951– 58	21 48 30.0	-45 05 39	354.4	-50.2	...	...	...	0.01	0.30	173	F	4.53	13.26	0.63	2.54	MP	FHB	0.60	8158	-1.20
78	21 51 12.1	-43 33 26	356.6	-50.9	...	...	...	0.01	0.21	45	F	5.73	22.89	0.80	2.84	MP	FHB	0.60	7072	-0.80
95	21 56 46.5	-45 51 55	352.7	-51.4	...	...	...	0.01	0.21	15	R	5.56	18.79	0.67	1.13	AB	FHB	0.60	5365	-1.75
22952– 17	23 38 52.4	-05 49 08	82.1	-62.7	14.63	0.27	0.13	0.02	...	-81	R	6.33	16.58	0.76	1.50	MP:	FHB	0.60	6212	-1.62
22953– 6	01 04 35.0	-61 37 15	299.7	-55.7	...	...	...	0.00	0.35	7	R	4.25	9.53	0.65	4.02	MP:	FHB	0.60	6761	-0.79
8	01 00 56.2	-61 06 58	300.4	-56.2	...	...	...	0.00	0.32	80	R	4.70	11.94	0.74	3.10	MP:	FHB	0.60	6918	-0.93
22954– 9	02 43 59.0	-06 44 26	181.2	-55.8	...	...	...	0.00	0.34	54	F	4.29	12.44	0.60	3.72	MP	FHB	0.60	6793	-0.85
22955– 12	20 21 28.9	-26 40 00	16.9	-31.2	13.96	0.21	0.17	0.06	...	-135	F	6.18	21.38	0.66	2.00	AB	FHB	0.66	4194	-0.92
15	20 21 15.7	-26 26 05	17.2	-31.1	14.05	0.25	0.14	0.06	...	-101	F	5.01	15.38	0.61	2.00	AB	FHB	0.60	4494	-1.07
18	20 19 56.9	-26 10 20	17.3	-30.7	14.84	0.15	0.17	0.06	...	-142	F	6.93	24.16	0.81	1.33	AB	FHB	0.76	5994	-1.06
23	20 21 27.3	-25 25 32	18.3	-30.8	14.50	0.21	0.22	0.06	...	-80	F	6.80	22.80	0.72	1.87	AB	FHB	0.66	5377	-0.98
25	20 19 20.5	-25 23 24	18.2	-30.4	...	...	...	0.06	0.31	32	F	5.03	15.37	0.57	5.36	MP:	A	2.50	1939	-0.31
27	20 19 45.4	-25 03 17	18.6	-30.3	13.73	0.30	0.14	0.06	...	42	F	6.46	26.35	0.76	3.02	A/MP	FHB	0.60	3869	-0.81
28 *	20 19 37.1	-24 57 15	18.7	-30.3	14.05	-0.16	-0.89	0.06	...	-30	F	4.89	15.36	0.60	...	AB	FHB	2.22	2126	...
39	20 20 42.2	-23 19 24	20.5	-30.0	14.19	0.38	0.09	0.06	...	-57	F	5.76	18.29	0.59	3.27	MP	FHB	0.60	4782	-0.93
40	20 21 28.3	-22 43 27	21.3	-30.0	14.23	0.34	0.06	0.06	...	8	F	5.39	22.68	0.54	3.67	MP:	A	2.46	2069	-0.72
50	20 25 51.5	-23 38 52	20.6	-31.2	...	...	...	0.06	0.25	-3	F	5.60	18.30	0.61	4.75	AB	A	2.39	2764	-0.29
60	20 23 47.6	-24 22 04	19.7	-31.0	14.69	0.12	0.10	0.06	...	127	F	7.35	29.27	0.72	3.30	MP:	A	1.21	4547	+0.28
61	20 24 44.5	-24 20 40	19.8	-31.2	14.96	0.47	0.08	0.06	...	-106	F	6.45	18.30	0.65	1.87	MP	FHB	0.60	6817	-1.77
83	20 24 08.8	-26 44 35	17.0	-31.8	...	...	...	0.06	0.32	-76	F	4.73	14.65	0.56	4.26	MP:	A	2.50	1930	-0.64
89 *	20 24 42.0	-27 10 35	16.6	-32.0	...	...	...	0.06	-0.17	61	F	3.74	11.72	0.39	0.61	AB	FHB	2.22	3627	...
99	20 29 47.0	-26 43 38	17.5	-33.0	...	...	...	0.06	0.31	-101	F	4.50	12.45	0.68	3.16	MP	FHB	0.60	4652	-0.95
103	20 28 54.6	-26 17 03	17.9	-32.7	16.18	0.40	0.06	0.06	...	-148	F	3.88	12.51	0.52	2.18	C	FHB	0.60	11956	-1.49
104	20 28 35.6	-26 01 32	18.2	-32.5	15.37	0.08	0.13	0.06	...	-122	F	7.36	25.04	0.75	0.87	C	FHB	0.96	6981	$<$ -2.0
110	20 29 27.6	-25 18 38	19.1	-32.5	...	...	...	0.06	0.32	-5	F	4.63	14.65	0.55	4.10	MP	A	2.50	1930	-0.70
115	20 30 29.0	-24 35 17	20.0	-32.5	14.55	0.30	0.01	0.06	...	-76	F	5.28	19.04	0.59	3.37	MP:	A	2.35	2526	-0.70
118	20 27 54.7	-24 14 00	20.2	-31.8	...	...	...	0.06	0.39	22	F	4.20	10.26	0.47	6.02	D	A	2.50	1869	-0.38
124	20 31 06.9	-23 51 32	20.8	-32.4	14.85	0.27	0.07	0.06	...	-9	F	6.46	22.70	0.69	1.94	D	FHB	0.60	6480	-1.20
129	20 27 35.4	-23 07 30	21.4	-31.4	13.81	0.35	0.11	0.06	...	-15	F	5.09	16.11	0.59	3.41	MP	FHB	0.60	4014	-0.82
132	20 30 32.3	-22 45 57	22.0	-31.9	14.37	0.44	0.11	0.06	...	39	F	5.40	15.37	0.77	3.43	MP	FHB	0.60	5195	-1.01
136	20 33 05.4	-23 12 39	21.7	-32.6	...	...	...	0.06	0.31	96	F	4.76	11.72	0.73	4.04	C	A	2.50	3370	-0.69

Table 3. (continued)

STAR (1)	RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22955– 146	20 35 48.3	-25 32 37	19.3	-33.9	...	...	...	0.06	0.31	-31	F	4.80	10.99	0.64	4.26	MP	A	2.50	2556	-0.63
147	20 35 36.8	-25 58 40	18.8	-34.0	14.23	0.21	0.19	0.06	...	10	F	6.54	21.97	0.74	1.55	MP:	FHB	0.66	4749	-1.21
155	20 32 41.5	-27 12 14	17.2	-33.8	13.38	0.23	0.12	0.06	...	-33	F	7.00	26.38	0.70	1.85	MP	FHB	0.63	3255	-1.08
163	20 37 35.2	-25 51 10	19.1	-34.4	13.11	0.39	0.08	0.06	...	-180	F	7.00	16.94	0.78	1.06	MP	FHB	0.60	2908	-2.02
176 *	20 37 06.7	-24 12 10	21.0	-33.8	15.18	0.03	-0.04	0.06	...	-100	F	7.14	25.64	0.78	...	AB	FHB	1.19	5750	...
22956– 2	21 45 07.8	-66 54 35	325.2	-41.7	...	...	...	0.00	0.33	111	R	4.45	11.57	0.55	4.05	MP	A	2.50	2844	-0.75
22	21 45 50.2	-64 07 14	328.4	-43.2	...	...	...	0.00	0.30	-27	R	4.88	15.19	0.66	3.79	MP	A	2.49	2897	-0.72
28	21 40 59.6	-63 35 56	329.4	-43.0	...	...	...	0.00	0.31	14	R	4.20	10.48	0.57	1.19	MP	FHB	0.60	3963	-1.93
32 *	21 41 49.4	-62 51 30	330.2	-43.4	...	...	...	0.00	-0.16	-36	R	3.88	13.02	0.49	...	B	FHB	2.22	3076	...
33	21 47 45.4	-62 23 39	330.4	-44.2	...	...	...	0.00	0.13	110	R	6.68	20.25	0.73	0.59	A	FHB	0.69	5445	-1.91
39	21 51 00.8	-63 46 54	328.4	-43.8	..	...	...	0.00	0.24	-81	R	5.23	14.10	0.67	2.23	A	FHB	0.60	5395	-1.16
43	21 49 08.8	-64 23 37	327.8	-43.4	...	...	...	0.00	0.30	103	R	4.66	11.57	0.58	2.87	MP	FHB	0.60	6918	-1.00
44	21 47 57.8	-64 32 55	327.7	-43.2	...	...	...	0.00	0.25	377	R	5.00	11.56	0.62	1.03	MP	FHB	0.60	5370	-1.90
58	22 03 15.1	-67 04 07	323.7	-43.1	...	...	...	0.00	0.18	-15	R	6.05	17.33	0.68	2.55	P/E	FHB	0.61	4207	-0.81
79	22 00 52.0	-64 11 34	327.1	-44.5	...	...	...	0.00	0.06	381	R	7.62	23.15	0.81	...	C	FHB	0.82	8395	< -2.0
83	22 03 15.5	-62 24 18	329.1	-45.7	...	...	...	0.00	0.25	124	R	5.11	11.97	0.74	1.37	P	FHB	0.60	8511	-1.69
95	22 12 07.9	-65 00 47	325.2	-45.0	...	...	...	0.00	0.08	148	R	7.26	27.94	0.70	0.55	AB	FHB	0.78	7047	-1.80
98	22 08 42.0	-65 20 52	325.1	-44.6	...	...	...	0.00	0.15	30	R	6.36	22.41	0.74	2.21	A	FHB	0.65	4169	-0.84
104	22 11 48.2	-65 54 20	324.2	-44.5	...	...	...	0.00	0.35	-25	R	4.08	9.07	0.62	3.49	C	FHB	0.60	6761	-0.94
111	22 17 53.4	-67 02 25	322.5	-44.2	...	...	...	0.00	0.11	65	R	6.96	23.59	0.76	...	AB	FHB	0.73	8551	< -2.0
120	22 23 56.9	-65 04 09	324.0	-46.0	...	...	...	0.00	0.16	230	R	6.20	24.18	0.65	0.66	AB	FHB	0.64	5495	-1.95
124	22 19 29.7	-64 15 50	325.4	-46.1	...	...	...	0.00	0.07	62	R	7.33	21.78	0.80	0.57	AB	FHB	0.80	8433	-1.75
22957– 7	23 50 08.2	-03 22 38	90.1	-62.2	...	...	...	0.00	0.25	-242	R	5.02	12.38	0.70	1.17	MP	FHB	0.60	8511	-1.82
22958– 1	01 49 01.7	-57 37 46	287.8	-58.0	...	...	...	0.01	0.23	55	R	5.55	12.68	0.62	3.07	MP	FHB	0.60	7009	-0.77
13	01 39 45.2	-54 40 39	287.7	-61.2	...	...	...	0.01	0.35	15	R	4.38	12.71	0.44	5.00	MP:	A	2.50	2764	-0.55
16	01 52 09.1	-53 23 32	283.1	-61.5	...	...	...	0.01	0.35	188	R	4.11	7.98	0.48	3.62	C	FHB	0.60	6631	-0.90
18	01 51 41.6	-54 12 06	284.1	-60.8	...	...	...	0.01	0.06	105	R	7.49	22.43	0.71	0.64	AB	FHB	0.83	8196	-1.60
22	01 47 15.6	-54 07 23	285.2	-61.2	...	...	...	0.01	0.31	-20	R	4.68	14.15	0.55	4.02	MP	A	2.50	2136	-0.71
50	02 10 00.3	-57 23 50	283.1	-56.8	...	...	...	0.01	0.16	76	R	6.23	27.22	0.68	...	D/P	FHB	0.64	8543	< -2.0
22959– 10	18 39 38.4	-67 16 49	328.0	-24.2	...	...	...	0.05	0.27	93	F	5.30	18.13	0.59	4.30	AB	A	2.44	2729	-0.50
14	18 41 44.3	-66 29 58	328.9	-24.3	...	...	...	0.05	0.38	-74	R	4.32	10.86	0.52	5.97	C	A	2.50	3034	-0.36

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22959–	51	18 38 23.1	-64 17 53	331.2	-23.4	...	...	...	0.05	0.26	-21	R	5.54	15.56	0.71	4.67	MP	A	2.40	2793	-0.33
	66	18 48 33.7	-63 04 49	332.8	-24.2	...	...	...	0.05	0.32	-31	R	4.68	12.30	0.62	4.17	MP	A	2.50	2594	-0.68
	89	18 47 09.1	-66 11 44	329.4	-24.7	...	...	...	0.05	0.18	43	R	6.01	21.06	0.81	1.91	MP	FHB	0.60	6607	-1.08
	103	18 53 14.8	-67 31 12	328.1	-25.6	...	...	...	0.05	0.08	-24	R	7.28	23.51	0.74	2.52	AB	A	1.42	3614	-0.36
	124	18 57 27.4	-64 54 24	331.0	-25.5	...	...	...	0.05	0.37	72	R	4.22	10.85	0.54	5.13	MP	A	2.50	2535	-0.56
	125	18 57 48.2	-64 47 37	331.1	-25.5	...	...	...	0.05	0.10	245	R	6.90	24.21	0.81	1.28	AB	FHB	0.73	6486	-1.19
	126	18 53 58.1	-64 49 48	331.0	-25.1	...	...	...	0.05	0.33	-101	R	4.33	12.30	0.55	3.18	AB	FHB	0.60	4699	-0.97
	133	18 53 30.4	-63 44 53	332.2	-24.9	...	...	...	0.05	0.10	58	R	6.95	23.87	0.70	1.08	AB	FHB	0.74	4898	-1.36
	134	18 53 22.4	-63 45 32	332.2	-24.9	...	...	...	0.05	0.17	-30	R	6.14	13.74	0.83	...	AB	FHB	0.63	4989	< -2.0
	142	18 54 22.8	-63 19 04	332.7	-24.9	...	...	...	0.05	0.23	0	R	5.49	17.74	0.71	2.61	MP	FHB	0.60	6486	-0.92
	165	19 05 33.5	-64 20 30	331.8	-26.3	...	...	...	0.05	0.10	-20	R	6.91	23.59	0.69	1.33	MP	FHB	0.74	6457	-1.13
	191	19 04 10.7	-66 53 13	329.0	-26.5	...	...	...	0.05	0.41	4	R	4.06	9.41	0.48	6.60	MP	A	2.50	2992	-0.30
	198	19 05 47.6	-67 27 15	328.4	-26.7	...	...	...	0.05	0.17	35	R	6.30	21.40	0.67	2.72	A	A	2.01	3484	-0.68
	210	19 17 17.2	-66 07 44	330.0	-27.7	...	...	...	0.05	0.16	-129	R	6.27	20.62	0.71	1.39	MP	FHB	0.65	4966	-1.37
	215	19 14 54.9	-65 57 56	330.1	-27.5	...	...	...	0.05	0.25	-187	R	4.89	13.75	0.57	...	AB	FHB	0.60	4875	< -2.0
	216	19 17 22.0	-65 48 23	330.3	-27.7	...	...	...	0.05	0.14	110	R	6.82	21.35	0.72	3.86	MP:	A	1.84	2897	-0.06
	218	19 11 09.9	-66 11 10	329.8	-27.1	...	...	...	0.05	0.06	129	R	7.62	24.96	0.73	...	AB	FHB	0.82	4808	< -2.0
	236	18 30 48.9	-66 20 12	328.8	-23.2	...	...	...	0.05	0.34	78	R	4.49	9.79	0.51	4.68	MP	A	2.50	2570	-0.60
22960–	21	22 10 15.1	-42 32 08	357.2	-54.5	...	...	...	0.00	0.35	61	R	4.37	10.17	0.57	4.77	MP:	A	2.50	2818	-0.60
	22	22 11 43.5	-43 06 06	356.2	-54.7	...	...	...	0.00	0.07	-356	R	7.45	24.65	0.79	...	B	FHB	0.81	6982	< -2.0
	43	22 18 50.9	-46 12 09	350.4	-55.0	...	...	...	0.00	0.32	-1	R	4.81	13.42	0.58	4.71	MP	A	2.50	2168	-0.52
	50	22 15 33.7	-45 04 04	352.6	-54.8	...	...	...	0.00	0.16	-35	R	6.26	22.87	0.69	0.82	B	FHB	0.64	5495	-1.82
	54	22 14 38.9	-43 56 48	354.5	-55.0	...	...	...	0.00	0.39	-12	R	4.13	12.34	0.47	6.07	MP	A	2.50	2099	-0.39
	58	22 13 04.7	-42 41 43	356.7	-55.0	...	...	...	0.00	0.35	86	R	3.75	10.16	0.48	1.61	MP	FHB	0.60	3890	-1.79
	70	22 19 50.1	-44 02 06	353.9	-55.9	...	...	...	0.00	0.25	-68	R	5.45	13.02	0.63	3.70	MP	A	2.38	3119	-0.62
	84	22 22 24.1	-46 25 47	349.6	-55.5	...	...	...	0.00	0.17	13	R	6.03	19.98	0.68	0.52	B	FHB	0.62	5521	-2.09
	90	22 25 32.3	-47 02 14	348.3	-55.8	...	...	...	0.00	0.35	15	R	4.09	10.49	0.48	3.50	MP	FHB	0.60	8128	-0.93
	98	22 25 34.0	-45 03 11	351.6	-56.5	...	...	...	0.00	0.17	88	R	6.34	21.06	0.69	3.09	MP	A	2.02	2897	-0.54
22963–	10	02 55 12.0	-05 57 22	183.2	-53.2	...	...	...	0.06	0.29	-21	F	5.16	16.13	0.60	4.84	A	A	2.48	1975	-0.40
	20	03 05 27.0	-05 50 06	185.6	-51.1	...	...	...	0.06	0.21	-161	F	5.79	24.15	0.71	2.63	A	FHB	0.60	6421	-0.85
	27	03 07 24.3	-03 48 51	183.6	-49.4	...	...	...	0.06	0.33	47	F	4.55	13.17	0.56	4.54	MP	A	2.50	2533	-0.62
	36 *	02 58 44.3	-02 52 06	180.3	-50.5	13.84	-0.18	-0.88	0.06	...	12	F	4.14	13.93	0.46	...	AB	FHB	2.22	1930	...

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
22964–	18	19 45 07.5	-39 56 27	359.9	-27.4	...	...	...	0.05	0.42	-65	R	4.08	9.54	0.51	7.30	MP	A	2.50	2979	-0.16
	28	19 42 31.8	-38 56 09	0.9	-26.7	...	...	...	0.05	0.35	-43	R	4.37	11.93	0.73	4.72	C	A	2.50	3076	-0.62
	79	19 48 12.2	-40 31 41	359.4	-28.1	...	...	...	0.05	0.34	-33	F	4.56	11.70	0.58	4.76	MP	A	2.50	2570	-0.56
	89	19 51 10.5	-41 21 07	358.7	-28.9	...	...	...	0.05	0.14	42	F	6.53	20.47	0.66	1.07	AB	FHB	0.68	6516	-1.54
	96	19 47 52.3	-42 29 36	357.2	-28.5	...	...	...	0.05	0.24	10	F	5.66	19.00	0.64	4.02	A/MP	A	2.34	2198	-0.47
	117	19 55 07.2	-40 01 12	0.3	-29.3	...	...	...	0.05	0.38	47	F	4.38	10.18	0.48	6.28	MP	A	2.50	2523	-0.28
	128	19 51 08.6	-38 45 55	1.5	-28.3	...	...	...	0.05	0.09	-66	F	7.17	24.72	0.75	0.37	A/MP	FHB	0.76	6427	-2.02
	151	19 54 43.8	-37 24 36	3.2	-28.6	...	...	...	0.05	0.33	19	F	4.62	13.17	0.59	4.81	MP	A	2.50	2582	-0.54
	170	19 56 31.6	-39 43 32	0.7	-29.5	...	...	...	0.05	0.09	-27	F	7.13	24.13	0.75	1.65	A/MP	FHB	0.77	3681	-0.84
	185	20 01 27.0	-41 00 24	359.5	-30.7	...	...	...	0.05	0.06	-42	F	7.54	28.52	0.74	0.19	A	FHB	0.82	7621	-2.13
	198	20 02 17.1	-41 34 30	358.9	-30.9	...	...	...	0.05	0.36	-7	R	4.46	10.15	0.60	5.55	MP	A	2.50	1932	-0.42
	209	20 02 51.2	-40 20 53	0.3	-30.8	...	...	...	0.05	0.25	-33	R	4.93	15.49	0.56	...	AB	FHB	0.60	4875	< -2.0
	219	20 03 09.2	-39 12 20	1.6	-30.6	...	...	...	0.05	0.29	19	F	5.21	15.37	0.62	4.93	MP:	A	2.48	2014	-0.36
	221	20 03 13.1	-39 03 54	1.8	-30.6	...	...	...	0.05	0.09	82	F	7.16	20.48	0.74	0.18	AB	FHB	0.75	4898	-2.21
22965–	30	21 55 25.2	-04 02 20	54.6	-42.5	...	...	...	0.00	0.36	-90	F	4.22	11.07	0.51	4.49	MP	A	2.50	2805	-0.69
	53	21 59 50.0	-02 38 04	57.0	-42.6	...	...	...	0.00	0.21	21	F	5.86	22.88	0.64	3.07	MP	A	2.22	1968	-0.69
	69	22 04 36.5	-05 03 44	55.2	-45.0	...	...	...	0.00	0.12	161	F	6.67	24.24	0.76	1.09	D	FHB	0.70	8630	-1.47
	77	22 09 43.7	-06 37 56	54.3	-46.9	...	...	...	0.00	0.36	-40	F	4.60	16.24	0.61	6.69	D	A	2.50	3373	-0.14
22968–	3	02 56 00.1	-55 04 56	272.1	-54.0	13.30	0.29	0.12	0.02	...	7	F	5.32	16.10	0.60	2.81	MP:	FHB	0.60	3367	-0.96
	11	03 01 47.7	-53 42 57	269.4	-54.2	14.68	0.23	0.13	0.02	...	325	R	4.65	14.69	0.62	1.85	MP	FHB	0.60	6356	-1.26
	12	03 01 52.1	-54 12 01	270.1	-53.9	15.27	0.33	-0.06	0.02	...	112	F	5.19	15.46	0.57	2.51	MP:	FHB	0.60	8341	-1.23
	15	03 02 29.4	-54 57 19	271.0	-53.4	14.18	0.17	0.10	0.02	...	125	F	6.95	29.26	0.77	1.24	A	FHB	0.66	4922	-1.46
	17	03 11 07.1	-56 00 28	271.3	-51.8	14.34	0.23	0.03	0.02	...	4	F	6.46	24.14	0.71	1.69	A	FHB	0.60	5435	-1.37
	23	03 20 16.0	-56 31 50	271.0	-50.4	15.46	0.24	0.19	0.02	...	318	R	5.83	16.33	0.90	0.96	AB	FHB	0.60	9103	-1.88
	35	03 19 54.6	-54 04 27	267.6	-51.7	15.51	0.11	0.19	0.02	...	-41	F	7.14	26.34	0.70	0.32	A	FHB	0.76	8655	-2.07
	42	03 11 49.0	-53 29 51	267.8	-53.0	15.59	0.18	0.12	0.02	...	0	F	7.09	29.22	0.71	1.33	A	FHB	0.64	9488	-1.43
29493–	9	21 36 46.1	-31 07 16	15.9	-48.2	...	...	...	0.00	0.28	1	F	5.07	13.28	0.66	3.77	MP	A	2.46	2249	-0.69
	12	21 38 24.1	-30 07 19	17.5	-48.4	...	...	...	0.00	0.23	-175	F	5.42	15.42	0.62	2.61	MP	FHB	0.60	5420	-0.93
	19	21 37 22.7	-28 22 22	20.0	-47.9	...	...	...	0.00	0.35	-128	F	4.39	10.28	0.51	4.47	MP	A	2.50	3388	-0.67
	33	21 41 07.9	-31 14 09	15.9	-49.2	...	...	...	0.00	0.15	38	F	6.39	21.28	0.66	1.12	B	FHB	0.60	7211	-1.54
	41	21 40 47.2	-32 34 02	13.9	-49.2	...	...	...	0.00	0.04	-98	F	7.70	26.59	0.77	0.53	B	FHB	0.88	5200	-1.65
	86	21 54 18.8	-32 26 22	14.5	-52.1	...	...	...	0.00	0.08	-79	F	7.33	24.38	0.72	...	AB	FHB	0.78	9290	< -2.0

Table 3. (continued)

STAR (1)	RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
29495– 1	21 30 54.3	-28 26 36	19.5	-46.5	...	...	...	0.03	0.08	48	F	7.31	23.59	0.74	...	AB	FHB	0.77	6680	< -2.0
39	21 35 12.7	-27 53 58	20.6	-47.4	...	...	...	0.03	0.16	-16	F	6.24	22.12	0.68	1.49	AB	FHB	0.64	8219	-1.30
43	21 38 42.0	-28 15 44	20.3	-48.2	...	...	...	0.03	0.24	45	F	5.47	18.43	0.60	3.48	AB	A	2.36	3934	-0.67
55	21 38 52.1	-25 38 32	24.1	-47.7	...	...	...	0.03	0.31	14	F	4.78	13.28	0.61	4.28	MP	A	2.50	3257	-0.63
81	21 46 01.6	-26 52 52	22.8	-49.5	...	...	...	0.03	0.07	-11	F	7.27	21.39	0.72	1.43	AB	FHB	0.80	6619	-0.90
29496– 6	23 29 20.8	-30 03 32	19.6	-72.4	...	...	...	0.00	0.34	-44	F	4.13	12.48	0.55	2.65	B	FHB	0.60	8165	-1.24
20	23 33 53.0	-31 43 26	13.6	-73.1	...	...	...	0.00	0.28	61	F	5.03	16.99	0.60	3.61	MP	A	2.46	2249	-0.74
25	23 44 30.1	-30 19 29	17.5	-75.6	...	...	...	0.00	0.15	6	F	6.37	22.16	0.71	...	B	FHB	0.65	7244	< -2.0
27 *	23 43 41.5	-29 44 31	19.9	-75.5	...	...	...	0.00	-0.15	12	F	4.15	16.99	0.48	...	MP	FHB	2.22	4036	...
29499– 31	23 40 03.5	-26 31 30	32.3	-74.6	...	...	...	0.00	0.26	-8	F	5.28	16.96	0.74	3.82	MP	A	2.42	3048	-0.63
43	23 45 11.5	-24 45 16	39.9	-75.4	...	...	...	0.00	0.21	-24	F	5.79	19.19	0.68	2.83	MP	FHB	0.60	8670	-0.78
29501– 10	20 58 48.2	-36 23 47	7.2	-41.0	...	...	...	0.06	0.26	80	F	5.17	18.44	0.66	2.87	MP	FHB	0.60	6275	-0.91
11	21 01 04.3	-36 16 28	7.5	-41.5	...	...	...	0.06	0.10	-41	F	7.11	20.66	0.77	...	AB	FHB	0.75	6304	< -2.0
16	20 59 53.4	-34 31 46	9.7	-41.0	...	...	...	0.06	0.10	-256	F	7.00	25.10	0.80	...	AB	FHB	0.73	7649	< -2.0
20 *	21 00 45.2	-33 34 58	11.0	-41.1	...	...	...	0.06	-0.21	65	F	2.66	7.37	0.41	...	B	FHB	2.22	2803	...
23	21 05 05.9	-32 56 50	12.0	-41.8	...	...	...	0.06	0.22	-30	F	5.53	17.62	0.62	2.35	A	FHB	0.60	4848	-0.99
26	21 06 43.8	-33 55 38	10.8	-42.3	...	...	...	0.06	0.35	108	F	4.31	11.80	0.60	4.25	MP	A	2.50	1904	-0.73
36	21 04 08.4	-36 18 51	7.5	-42.1	...	...	...	0.06	0.11	-151	F	6.75	21.40	0.72	1.58	MP:	FHB	0.71	4848	-0.99
54 *	21 12 55.1	-37 26 52	6.2	-43.9	...	...	...	0.06	-0.16	-71	F	4.01	13.27	0.50	...	B	FHB	2.22	2078	...
57	21 13 08.4	-35 21 43	9.0	-43.8	...	...	...	0.06	0.27	-98	F	5.00	15.40	0.64	2.72	MP	FHB	0.60	4738	-0.98
58	21 12 37.4	-35 23 49	9.0	-43.7	...	...	...	0.06	0.13	-260	F	6.58	21.28	0.72	1.08	AB	FHB	0.68	7720	-1.51
60	21 09 56.7	-35 03 34	9.4	-43.1	...	...	...	0.06	0.12	-31	F	6.82	25.06	0.69	0.49	D	FHB	0.71	6362	-1.97
102	21 22 55.2	-36 22 49	7.8	-45.9	...	...	...	0.06	0.19	-37	F	6.08	23.61	0.63	3.38	MP	A	2.16	3159	-0.53
29503– 24	00 07 36.0	-25 50 22	40.2	-80.6	...	...	...	0.02	0.21	143	F	5.71	17.72	0.70	2.57	MP	FHB	0.60	6937	-0.88
33	00 09 41.6	-24 10 22	50.8	-80.6	...	...	...	0.02	0.27	-27	F	5.02	17.73	0.61	3.01	MP	FHB	0.60	5119	-0.90
34	00 08 29.7	-23 34 55	53.4	-80.1	...	...	...	0.02	0.37	50	F	4.38	11.81	0.57	5.83	MP	A	2.50	2038	-0.38
29504– 3	01 28 04.3	-37 16 49	265.7	-77.1	...	...	...	0.01	0.34	27	F	4.35	13.29	0.51	3.88	C	FHB	0.60	8009	-0.81
4	01 28 47.5	-36 54 00	264.0	-77.3	...	...	...	0.01	0.14	49	F	6.49	20.69	0.71	0.51	AB	FHB	0.67	5365	-2.02
17	01 29 19.0	-33 08 44	248.9	-79.6	...	...	...	0.01	0.22	-72	F	5.43	17.67	0.69	...	A	FHB	0.60	4051	< -2.0
25	01 32 56.4	-36 28 36	260.0	-77.0	...	...	...	0.01	0.30	81	F	4.81	14.75	0.63	3.54	MP	FHB	0.60	8158	-0.80

Table 3. (continued)

STAR (1)			RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
29504–	37	*	01 40 06.8	-35 55 32	254.3	-76.2	...	...	...	0.01	-0.15	119	F	4.04	14.68	0.49	...	D	FHB	2.22	4760	...
	39		01 42 31.6	-37 40 08	258.8	-74.8	...	...	...	0.01	0.20	24	F	6.21	20.65	0.65	4.44	MP	A	2.18	2604	-0.15
29506–	25		21 21 25.0	-18 07 55	32.5	-41.6	...	...	...	0.00	0.08	-119	F	7.15	25.84	0.79	0.97	AB	FHB	0.77	7079	-1.38
	31	*	21 21 07.6	-19 13 46	31.1	-41.9	...	...	...	0.00	-0.15	-191	F	4.16	14.77	0.42	...	AB	FHB	2.22	4036	...
	37		21 21 28.5	-20 24 49	29.6	-42.4	...	...	...	0.00	0.23	-23	F	5.70	19.20	0.73	3.62	MP	A	2.30	2477	-0.57
	39		21 18 37.1	-20 50 40	28.8	-41.9	...	...	...	0.00	0.30	5	F	4.89	14.76	0.55	4.05	MP	A	2.50	2188	-0.66
	40		21 19 41.0	-21 08 56	28.5	-42.2	...	...	...	0.00	0.08	-191	F	7.30	25.84	0.77	...	D	FHB	0.78	8472	< -2.0
	45		21 18 54.5	-21 59 16	27.4	-42.3	...	...	...	0.00	0.30	12	F	4.89	15.42	0.51	3.91	MP	A	2.49	2198	-0.69
	46		21 17 48.6	-22 04 58	27.1	-42.1	...	...	...	0.00	0.19	-12	F	5.89	17.71	0.70	1.02	AB	FHB	0.60	8750	-1.75
	47		21 18 59.7	-22 18 42	26.9	-42.4	...	...	...	0.00	0.15	-186	F	6.40	22.15	0.73	0.87	B	FHB	0.66	7211	-1.74
	50		21 23 24.1	-22 31 33	27.1	-43.5	...	...	...	0.00	0.23	-71	F	5.82	21.41	0.70	4.42	MP	A	2.31	2466	-0.30
	73		21 27 30.7	-19 06 26	32.0	-43.3	...	...	...	0.00	0.27	-74	F	5.14	14.73	0.73	3.33	MP	FHB	0.60	7015	-0.79
	78		21 28 41.2	-20 02 20	30.9	-43.9	...	...	...	0.00	0.27	-20	F	5.08	16.20	0.58	3.46	MP:	FHB	0.60	7015	-0.77
	85		21 26 00.1	-21 19 13	28.9	-43.7	...	...	...	0.00	0.33	-25	F	4.69	14.73	0.56	4.74	MP:	A	2.50	2158	-0.54
	100		21 31 04.2	-21 07 34	29.7	-44.7	...	...	...	0.00	0.29	-61	F	5.06	14.65	0.57	4.41	MP	A	2.48	2218	-0.53
	102		21 32 30.4	-21 11 43	29.7	-45.1	...	...	...	0.00	0.08	-5	F	7.34	24.92	0.74	...	AB	FHB	0.79	5321	< -2.0
	112		21 34 30.3	-18 55 26	33.0	-44.8	...	...	...	0.00	0.08	-166	F	7.32	26.55	0.73	0.50	AB	FHB	0.79	7015	-1.84
	114		21 32 19.1	-18 40 13	33.1	-44.2	...	...	...	0.00	0.07	-155	F	7.27	31.51	0.71	1.72	AB	FHB	0.79	5346	-0.75
29512–	20		22 15 11.8	-09 13 22	52.2	-49.5	...	...	...	0.02	0.41	46	F	4.06	13.27	0.59	6.95	MP:	A	2.50	2001	-0.23
	35		22 13 10.5	-12 13 52	47.7	-50.6	...	...	...	0.02	0.34	13	F	4.62	11.07	0.64	5.47	MP:	A	2.50	2066	-0.39
	38	*	22 14 00.6	-13 03 22	46.7	-51.1	...	...	...	0.02	-0.16	53	F	3.84	14.75	0.49	...	D	FHB	2.22	3901	...
	44	*	22 13 47.1	-11 45 37	48.5	-50.5	...	...	...	0.02	-0.12	-99	F	4.96	15.41	0.52	...	AB	FHB	1.89	2566	...
	49		22 17 33.8	-12 33 05	48.1	-51.6	...	...	...	0.02	0.36	-20	F	4.30	12.53	0.52	4.73	MP	A	2.50	2047	-0.63
	55	*	22 17 20.2	-08 53 25	53.0	-49.7	...	...	...	0.02	-0.12	7	F	5.01	14.67	0.54	...	MP	FHB	1.87	4500	...
	60		22 22 52.8	-09 19 34	53.6	-51.1	...	...	...	0.02	0.39	-4	F	4.20	13.20	0.51	6.29	MP	A	2.50	1532	-0.33
	64		22 20 30.7	-10 52 56	51.0	-51.4	...	...	...	0.02	0.32	-134	F	4.63	11.81	0.63	4.24	MP	A	2.50	2749	-0.67
	68		22 19 43.3	-12 15 51	48.9	-52.0	...	...	...	0.02	0.39	-32	F	4.13	11.07	0.50	5.77	MP	A	2.50	2662	-0.45
	71		22 22 00.9	-13 12 58	48.0	-52.9	...	...	...	0.02	0.20	-33	F	6.09	22.13	0.63	3.77	MP:	A	2.18	1937	-0.40
	74		22 26 28.0	-12 31 35	49.9	-53.5	...	...	...	0.02	0.07	-100	F	7.40	24.96	0.71	0.49	MP	FHB	0.81	6717	-1.82
	82		22 27 02.0	-09 12 15	54.7	-51.9	...	...	...	0.02	0.07	-143	F	7.44	22.76	0.75	0.39	B	FHB	0.81	5096	-1.92
29513–	17		23 16 33.7	-37 57 13	358.6	-68.0	...	...	...	0.01	0.24	94	F	5.29	15.49	0.63	1.79	A	FHB	0.60	5292	-1.40
	44		23 25 28.5	-40 47 35	349.7	-68.2	...	...	...	0.01	0.08	142	F	7.16	22.87	0.78	1.05	AB	FHB	0.78	6912	-1.28

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
29513-	55	23 30 31.0	-39 26 59	351.5	-69.7	...	...	...	0.01	0.33	-7	F	4.51	14.75	0.52	4.12	MP	A	2.50	2790	-0.72
	58	23 27 42.0	-38 37 16	354.4	-69.7	...	...	...	0.01	0.30	68	F	4.74	14.68	0.57	3.48	AB	FHB	0.60	6786	-0.83
29514-	21	01 11 35.6	-26 41 04	206.2	-84.9	...	...	...	0.01	0.17	69	F	6.08	22.13	0.63	1.54	A	FHB	0.62	5415	-1.32
29517-	11	23 46 29.8	-13 52 49	72.7	-70.1	...	...	...	0.01	0.33	-29	F	4.87	14.74	0.59	5.59	MP	A	2.50	2116	-0.30
	21	23 55 35.0	-15 08 28	74.9	-72.6	...	...	...	0.01	0.34	-81	F	4.35	12.48	0.52	3.87	MP	FHB	0.60	5054	-0.81
	32	23 58 37.1	-14 48 09	77.5	-72.8	...	...	...	0.01	0.15	-57	F	6.50	19.93	0.75	2.93	A/P	A	1.93	2990	-0.54
	46	00 02 13.0	-14 19 20	80.9	-73.0	...	...	...	0.01	0.16	-132	F	6.23	16.16	0.64	...	B	FHB	0.64	7106	< -2.0
29529-	9	03 44 45.4	-61 11 55	274.6	-45.3	...	...	...	0.00	0.09	235	F	7.23	24.12	0.70	...	D	FHB	0.76	7079	< -2.0
	19	03 46 40.0	-59 51 58	272.8	-45.8	...	...	...	0.00	0.38	92	F	4.22	10.96	0.50	5.81	MP:	A	2.50	2109	-0.42
	27	03 45 13.2	-58 23 37	271.0	-46.6	...	...	...	0.00	0.28	243	F	4.84	16.10	0.60	2.42	MP	FHB	0.60	8395	-1.17
	29	03 50 05.7	-58 31 13	270.8	-45.9	...	...	...	0.00	0.34	135	F	4.06	11.69	0.53	2.96	MP:	FHB	0.60	5152	-1.12
	31	03 54 09.1	-57 57 27	269.7	-45.7	...	...	...	0.00	0.38	110	F	4.08	10.98	0.54	5.19	MP	A	2.50	2780	-0.57
	37	03 54 04.5	-59 46 14	272.1	-45.0	...	...	...	0.00	0.14	-6	F	6.65	21.95	0.66	2.95	MP	A	1.86	4169	-0.48
	55	03 59 00.2	-62 19 47	274.9	-43.3	...	...	...	0.00	0.38	93	F	4.29	12.42	0.48	5.91	AB	A	2.50	3342	-0.38
	112	04 14 49.0	-60 27 02	271.6	-42.3	...	...	...	0.00	0.25	111	F	5.19	19.03	0.60	2.60	C	FHB	0.60	8511	-0.98
30312-	1	15 30 02.6	-02 31 43	1.9	+41.0	...	...	...	0.06	0.23	-14	F	5.61	19.56	0.61	3.26	MP	A	2.31	2895	-0.70
	17	15 28 14.6	+00 18 37	4.4	+43.2	...	...	...	0.06	0.42	49	R	3.80	10.12	0.54	6.45	MP	A	2.50	2430	-0.39
	18	15 27 17.4	+00 36 17	4.5	+43.6	...	...	...	0.06	0.20	-2	R	5.81	16.99	0.62	2.42	A/MP	FHB	0.60	2452	-0.92
	20	15 30 29.8	+00 39 25	5.3	+43.0	...	...	...	0.06	0.14	-59	R	6.50	21.69	0.71	1.77	A	FHB	0.68	4848	-0.98
	32	15 32 40.2	+01 54 50	7.1	+43.3	...	...	...	0.06	0.33	-51	R	4.57	11.93	0.59	4.71	MP	A	2.50	2533	-0.57
	36	15 34 18.7	+01 25 37	6.9	+42.7	...	...	...	0.06	0.36	-7	R	4.36	12.29	0.60	5.12	MP	A	2.50	1895	-0.53
	38	15 31 59.3	+01 17 23	6.3	+43.1	...	...	...	0.06	0.29	-21	R	5.30	14.46	0.62	5.53	A/MP	A	2.48	1975	-0.19
	45	15 34 56.3	+00 38 05	6.2	+42.1	...	...	...	0.06	0.24	-58	R	5.52	16.99	0.66	3.75	A/MP	A	2.36	2136	-0.58
	70	15 38 09.7	-02 25 56	3.7	+39.5	...	...	...	0.06	0.22	-22	R	5.69	15.54	0.64	2.85	A/MP	FHB	0.60	4848	-0.80
	96	15 38 30.0	+02 27 26	8.9	+42.5	...	...	...	0.06	0.33	110	R	4.28	9.76	0.61	3.25	MP	FHB	0.60	7305	-0.96
30339-	6	00 11 59.4	-36 21 51	341.9	-78.1	...	...	...	0.00	0.23	-48	R	5.60	13.42	0.61	3.44	A/MP	A	2.32	2455	-0.65
	8 *	00 11 11.0	-35 43 41	344.7	-78.4	...	...	...	0.00	-0.15	-86	R	4.11	10.84	0.48	...	B	FHB	2.22	4036	...
	13	00 12 28.5	-34 29 19	348.6	-79.4	...	...	...	0.00	0.33	-16	R	4.63	13.01	0.67	4.59	MP	A	2.50	1637	-0.59
	16	00 10 19.5	-33 17 02	355.4	-79.8	...	...	...	0.00	0.19	-11	R	6.14	18.14	0.63	3.52	MP	A	2.14	2716	-0.47
	47	00 21 12.0	-36 32 11	334.0	-79.1	...	...	...	0.00	0.35	131	R	4.48	12.67	0.62	4.94	MP	A	2.50	2138	-0.54

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
30339–	49	00 24 24.3	-35 50 40	333.2	-80.1	...	...	...	0.00	0.39	36	R	3.26	8.35	0.62	1.63	MP	FHB	0.60	7980	-1.84
	72	00 27 05.7	-36 47 43	327.9	-79.5	...	...	...	0.00	0.32	-185	R	4.06	9.08	0.72	1.06	AB/P	FHB	0.60	8241	-2.01
30492–	11	21 00 22.0	-41 06 15	1.0	-41.7	...	...	...	0.02	0.10	-8	F	7.01	21.02	0.70	0.61	B	FHB	0.74	6842	-1.81
	15	21 00 28.9	-40 35 24	1.7	-41.7	...	...	...	0.02	0.16	-39	F	6.19	20.30	0.71	0.97	B	FHB	0.64	5287	-1.72
	29	20 59 05.6	-38 55 50	3.9	-41.3	...	...	...	0.02	0.28	-45	F	5.03	15.95	0.63	3.76	MP	A	2.47	2154	-0.70
	33	20 57 35.3	-41 29 48	0.4	-41.2	...	...	...	0.02	0.37	-3	F	4.25	10.15	0.66	5.40	C	A	2.50	3230	-0.50
	53	21 05 19.9	-39 48 07	2.8	-42.6	...	...	...	0.02	0.14	23	F	6.42	21.74	0.72	1.70	A	FHB	0.67	3992	-1.05
	59	21 07 51.5	-40 28 22	1.9	-43.1	...	...	...	0.02	0.34	-61	F	4.37	12.33	0.57	4.22	MP	A	2.50	2066	-0.73
	63	21 05 19.7	-40 59 38	1.2	-42.6	...	...	...	0.02	0.19	15	R	5.84	16.27	0.74	0.58	C	FHB	0.60	7002	-2.07
	89	21 12 23.4	-39 31 37	3.3	-43.9	...	...	...	0.02	0.35	-2	R	4.38	9.77	0.59	4.62	MP	A	2.50	2057	-0.63
	91	21 09 41.3	-39 28 11	3.3	-43.4	...	...	...	0.02	0.28	-83	R	4.84	14.11	0.63	2.62	C	FHB	0.60	8076	-1.07
	92	21 09 19.0	-39 12 07	3.7	-43.3	...	...	...	0.02	0.31	-108	R	4.80	11.24	0.63	4.25	MP	A	2.50	2762	-0.63
	98	21 11 25.1	-38 34 23	4.6	-43.7	...	...	...	0.02	0.30	-8	R	5.13	13.38	0.60	5.46	MP	A	2.50	2775	-0.26
	112	21 16 31.0	-38 48 51	4.3	-44.7	...	...	...	0.02	0.21	-25	R	5.97	18.44	0.71	3.70	A	A	2.22	2496	-0.47
	117	21 17 01.2	-40 17 48	2.2	-44.8	...	...	...	0.02	0.23	-50	R	5.59	21.34	0.62	3.42	MP	A	2.32	2362	-0.66
	125 *	21 13 59.6	-41 34 48	0.4	-44.3	...	...	...	0.02	-0.15	133	R	4.04	12.70	0.51	0.34	B	FHB	2.22	2946	...
30493–	5	22 57 52.0	-36 56 12	3.8	-64.7	...	...	...	0.00	0.33	81	F	4.06	10.87	0.54	1.97	MP	FHB	0.60	6823	-1.57
	8	22 59 35.8	-36 05 09	5.6	-65.3	...	...	...	0.00	0.09	52	F	7.02	26.82	0.75	1.12	D	FHB	0.75	7112	-1.28
	9 *	23 01 15.3	-36 03 32	5.5	-65.6	...	...	...	0.00	-0.09	37	F	5.72	17.39	0.69	...	B	FHB	1.63	5152	...
	12	23 00 48.8	-35 16 11	7.4	-65.7	...	...	...	0.00	0.08	-207	F	7.28	23.93	0.76	0.61	AB	FHB	0.79	5321	-1.73
	22	23 00 17.2	-33 49 48	10.9	-65.8	...	...	...	0.00	0.36	-25	F	4.43	14.50	0.67	5.45	MP	A	2.50	2805	-0.44
	34	23 04 04.6	-35 31 32	6.4	-66.3	...	...	...	0.00	0.22	46	R	5.80	18.08	0.63	3.90	MP	A	2.29	2500	-0.46
	45	23 10 04.0	-37 33 59	0.7	-66.9	...	...	...	0.00	0.08	49	R	7.36	23.86	0.75	...	AB	FHB	0.78	8472	< -2.0
	48	23 08 06.5	-37 27 11	1.2	-66.6	...	...	...	0.00	0.21	55	R	6.07	16.69	0.66	4.36	MP	A	2.23	3404	-0.23
	57	23 09 16.3	-33 42 44	10.4	-67.7	...	...	...	0.00	0.14	-132	R	6.51	28.68	0.74	1.07	AB	FHB	0.67	7211	-1.55
	59	23 12 00.8	-33 44 10	10.1	-68.2	...	...	...	0.00	0.07	-94	R	7.50	21.34	0.75	...	AB	FHB	0.80	8433	< -2.0
	66	23 13 17.3	-35 04 39	6.4	-68.2	...	...	...	0.00	0.28	83	R	4.81	13.38	0.63	1.96	MP	FHB	0.60	6982	-1.42
	76	23 20 56.6	-37 20 50	359.2	-69.0	...	...	...	0.00	0.38	11	R	4.39	10.89	0.60	6.81	MP	A	2.50	2108	-0.18
30494–	1	03 58 08.5	-21 46 55	216.3	-46.9	...	...	...	0.00	0.34	-15	R	4.60	10.17	0.55	4.85	MP:	A	2.50	2831	-0.54
	2	03 54 35.6	-21 34 01	215.7	-47.6	...	...	...	0.00	0.25	4	R	5.48	14.89	0.62	4.05	MP:	A	2.39	1786	-0.51
	10	03 54 44.7	-17 37 25	210.2	-46.3	...	...	...	0.00	0.23	45	R	5.84	17.43	0.56	4.42	MP:	A	2.31	3251	-0.30
	22	04 01 53.4	-19 08 12	213.1	-45.2	...	...	...	0.00	0.18	48	R	6.05	18.79	0.65	2.22	D	FHB	0.61	7278	-0.92

Table 3. (continued)

STAR (1)		RA (1950) (2)	DEC (3)	l (4)	b (5)	V (6)	$B-V$ (7)	$U-B$ (8)	E_{B-V} (9)	BV (10)	VEL (11)	DET (12)	HP (13)	$D_{0.2}$ (14)	R_C (15)	KP (16)	CLASS (16)	TYPE (18)	M_V (19)	DIST (20)	[Fe/H] (21)
30494-	29	04 04 33.5	-22 09 31	217.5	-45.6	...	...	...	0.00	0.31	-41	R	4.67	10.49	0.65	3.80	MP:	FHB	0.60	5224	-0.76
	31	04 05 40.4	-20 29 01	215.3	-44.8	...	...	...	0.00	0.29	-25	R	5.04	12.67	0.59	4.43	A/MP	A	2.49	2208	-0.53
	32	04 04 06.2	-19 35 49	214.0	-44.9	...	...	...	0.00	0.28	18	R	5.18	11.25	0.59	4.60	MP:	A	2.47	2239	-0.45
	34	04 05 14.5	-18 32 09	212.7	-44.3	...	...	...	0.00	0.28	52	R	5.14	14.82	0.58	3.97	MP	A	2.46	2965	-0.62
	36	04 03 58.6	-18 23 20	212.4	-44.5	...	...	...	0.00	0.08	106	R	7.40	23.49	0.77	...	AB	FHB	0.79	7015	< -2.0
	44	04 09 15.4	-18 21 06	212.9	-43.3	...	...	...	0.00	0.37	-11	R	4.36	10.15	0.55	5.87	MP:	A	2.50	2118	-0.37
	46	04 11 09.0	-18 49 14	213.7	-43.0	...	...	...	0.00	0.19	5	R	5.87	16.69	0.70	1.60	MP:	FHB	0.60	7278	-1.35
	47	04 08 26.8	-18 58 36	213.6	-43.7	...	...	...	0.00	0.26	-3	R	5.43	14.11	0.58	4.55	MP:	A	2.42	2312	-0.40
	48	04 07 16.7	-19 31 45	214.2	-44.1	...	...	...	0.00	0.35	27	R	4.61	10.49	0.54	5.70	MP:	A	2.50	2138	-0.35
	55	04 15 35.2	-21 23 05	217.5	-42.9	...	...	...	0.00	0.32	64	R	4.80	12.29	0.55	4.85	MP:	A	2.50	2168	-0.49

Absolute magnitudes for these stars are determined according to the relations given in Figure 7 of Preston (1990). For the FHB stars, absolute magnitudes are assigned according to

$$
\begin{aligned}
(B-V) \leq 0.02 &: M_V = 2.22 \\
0.02 < (B-V) < 0.20 &: M_V = 1.04 - 4.423(B-V)^2 + 17.74(B-V)^3 \\
(B-V) \geq 0.20 &: M_V = 0.60
\end{aligned}
\tag{2}
$$

and the A stars according to

$$M_V = 0.602 + 11.07(B-V) - 15.843(B-V)^2. \tag{3}$$

The method followed to determine the rotational velocity of the halo is that given in FW80, and will be outlined here. In a galactocentric frame, let $v_\odot$ be the velocity of the local standard of rest (in the direction of the galactic rotation), $v_{exp,i}$ the expansion velocity of the ith star, and v_{rot} the systemic rotational velocity. Using the quantities defined in Figure 8, then the observed heliocentric radial velocity of the ith star, $v_{o,i}$ is given by

$$v_{o,i} = v_{rot} \cos \psi_i + v_{exp,i} \cos \phi_i + v_{pec,i} - v_\odot \cos \lambda_i \tag{4}$$

so that the first two terms arise due to the systemic rotation and expansion of the stellar system, the third from the peculiar heliocentric velocity of the ith star

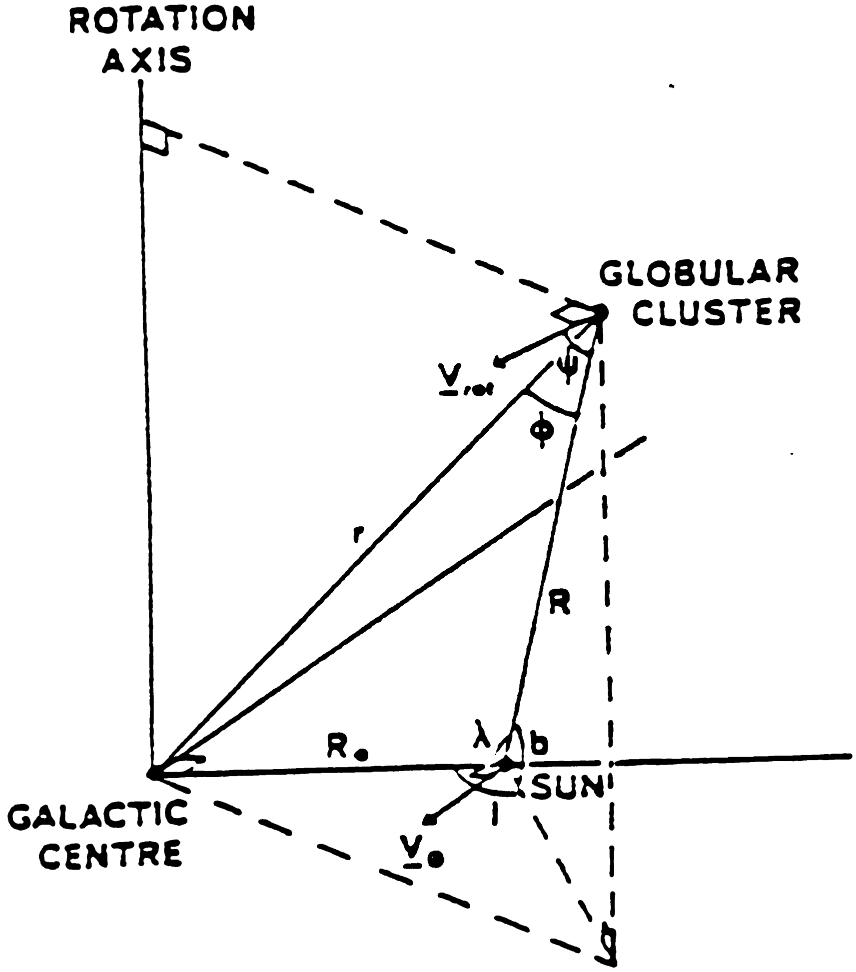

Figure 8. Definitions of the geometric and physical parameters used in the FW80 method (Figure reproduced from FW80).

with respect to this system, and the last from the sun's motion around the galactic center. The projection factors $\cos\psi_i$, $\cos\phi_i$ and $\cos\lambda_i$ can be related to the measured heliocentric latitude and longditude by

$$\cos\lambda_i = \cos b_i \sin l_i \tag{5}$$

$$\cos\psi_i = R_\odot \cos b_i \sin l_i [R_i^2 \cos^2 b_i \sin^2 l_i + (R_\odot - R_i \cos b_i \cos l_i)^2]^{-1/2} \tag{6}$$

$$\cos\phi_i = R_i - R_\odot \cos b_i \sin l_i [R_i^2 + R_\odot^2 - 2R_i R_\odot \cos l_i \cos b_i]^{-1/2} \tag{7}$$

where $R_\odot$ is the distance from the sun to the galactic center (assumed here to be 8 kpc) and R_i is the derived heliocentric distance to the ith star.

In the simplest case, the expansion velocity can be considered either a constant, or decreasing at a uniform rate $\epsilon = v_{exp,i}/r_i$, where r_i is the galactocentric distance to the ith star. For this calculation, a constant value for $v_{exp,i}$ is assumed, and moreover, it is assumed that it is small enough to be neglected. Even with this assumption, one is faced with the problem of constraining both v_{rot} and $v_{pec,i}$ in equation (2). To first order, this can be accomplished by solving for v_{rot} while neglecting $v_{pec,i}$, and then using this result to determine an rms estimate of $v_{pec,i}$.

If equation (2) is multiplied by $\cos\psi_i$ and summed over all stars, then one gets, to first approximation,

$$v_{rot,*} = \frac{\Sigma \cos\psi_i (v_{o,i} + v_\odot \cos\lambda_i)}{\Sigma \cos^2\psi_i} \tag{8}$$

where $v_{rot,*}$ is the rotational velocity assuming no expansion or peculiar velocities, and, finally,

$$v_{rot} = \frac{\Sigma \cos\psi_i (v_{o,i} + v_\odot \cos\lambda_i)}{\Sigma \cos^2\psi_i} \pm \frac{\sigma_{los}}{[\Sigma \cos^2\psi_i]^{1/2}} \tag{9}$$

where σ_{los} is the rms observed value of $v_{pec,i}$ obtained from

$$\sigma_{los} = \left[\frac{\Sigma (v_{o,i} + v_\odot \cos\lambda_i - v_{rot,*}\cos\psi_i)^2}{N-1}\right]^{1/2} \tag{10}$$

where N is the number of stars in the sample, and with an assumed error for σ_{los} of $(\sigma_{los}/2N)^{1/2}$.

The sample is divided into metallicity bins for the calculation. The results of the calculations for two such sets of bins are given in Tables 4 and 5. Figure 9 gives the results for the first set of bins (from Table 4), and the transition from halo to disk rotation can be seen in roughly the same area ([Fe/H] ≈ -1.2) found by Norris (1986) and Norris and Ryan (1989). For larger bin sizes, this transition is not as sharp, as can be seen in Figure 10 for the bins of Table 5, although Norris and Ryan maintain that their result does not differ when the number of bins that they use is reduced by a factor of up to two. Clearly, the results presented here have a noticable dependence on bin number, and this dependence comes from the range in [Fe/H] covered by the bin more than the number of objects per bin. It would

TABLE 4. FW80 Analysis Results.

$\langle[Fe/H]\rangle$ (1)	$\sigma_{[Fe/H]}$ (2)	N (3)	v_{rot} (km s^{-1}) (4)	σ_v (km s^{-1}) (5)	σ_{los} (km s^{-1}) (6)	$(disp)_{los}$ (km s^{-1}) (7)	$\mid v_{rot}/\sigma_{los} \mid$ (8)
-1.98	0.17	40	-29	34	106	12	0.27
-1.65	0.08	40	49	24	80	9	0.61
-1.40	0.08	40	53	29	103	11	0.51
-1.17	0.06	42	38	30	98	11	0.38
-0.97	0.03	43	68	22	76	8	0.90
-0.88	0.03	42	122	25	82	9	1.49
-0.77	0.03	43	90	21	58	6	1.55
-0.69	0.02	47	160	24	59	6	2.71
-0.62	0.02	40	180	26	57	6	3.15
-0.54	0.02	42	156	23	52	6	2.99
-0.44	0.03	40	180	21	48	5	3.74
-0.28	0.11	52	183	15	43	4	4.22

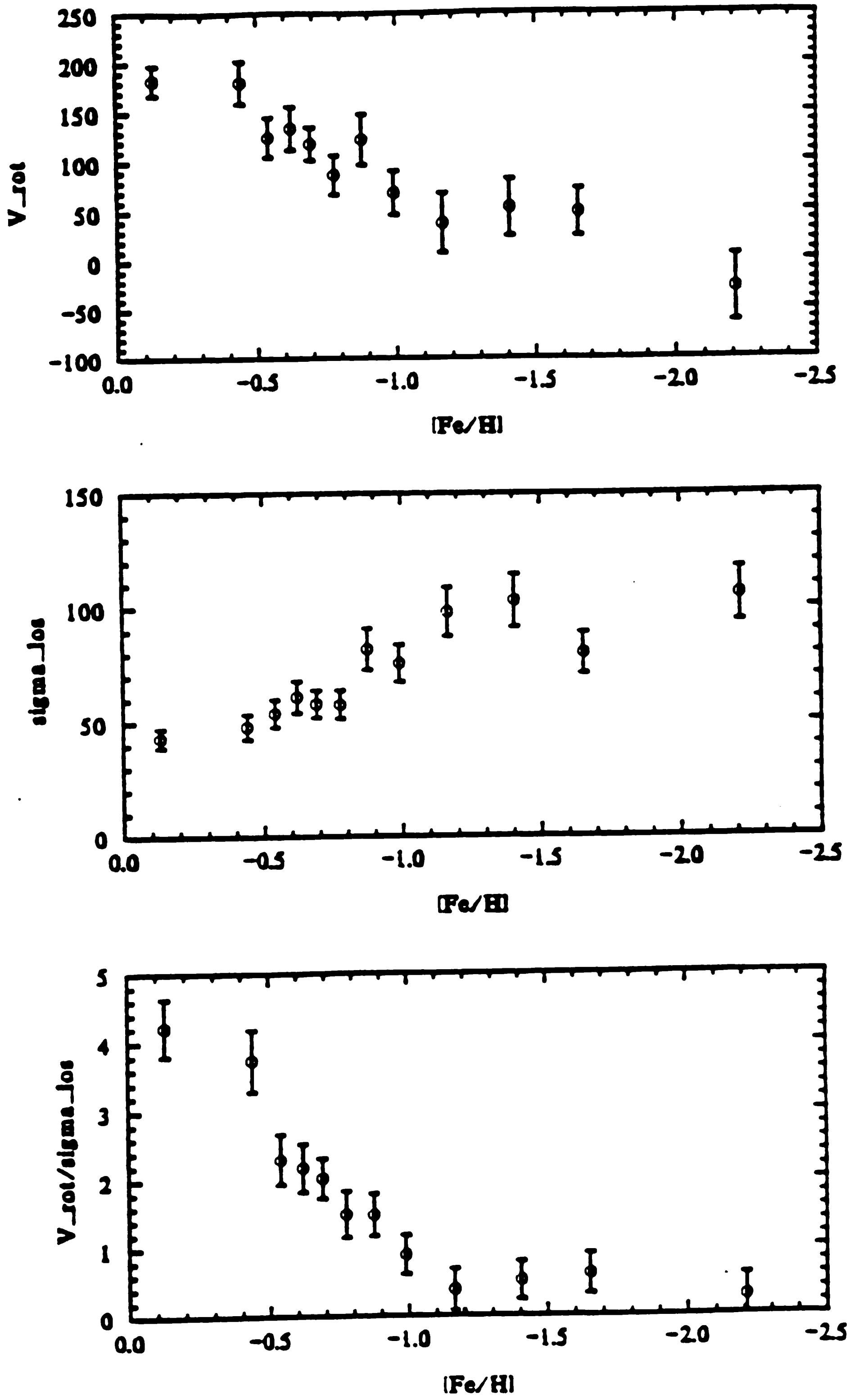

Figure 9. Solution for v_{rot}, σ_{los}, and their ratio as a function of abundance, using the method of FW80 and the data of Table 4.

TABLE 5. FW80 Analysis Results.

$\langle[Fe/H]\rangle$ (1)	$\sigma_{[Fe/H]}$ (2)	N (3)	v_{rot} (km s^{-1}) (4)	σ_v (km s^{-1}) (5)	σ_{los} (km s^{-1}) (6)	$(disp)_{los}$ (km s^{-1}) (7)	$\mid v_{rot}/\sigma_{los} \mid$ (8)
-1.82	0.21	80	13	21	95	8	0.14
-1.28	0.13	82	46	21	100	8	0.46
-0.93	0.06	85	93	17	80	6	1.17
-0.73	0.05	90	121	16	60	4	2.02
-0.56	0.05	82	168	17	54	4	3.08
-0.35	0.12	92	182	12	45	3	4.02

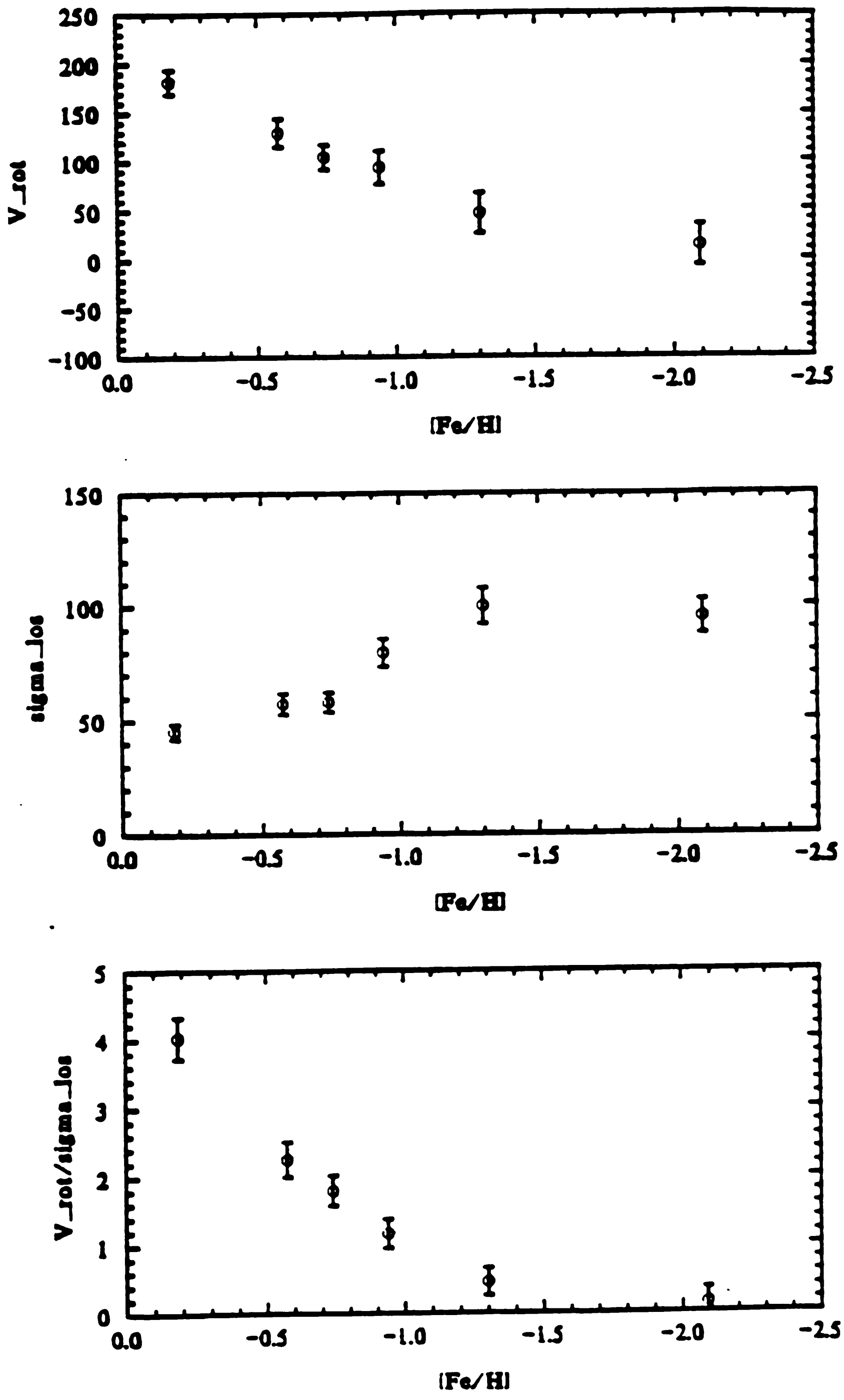

Figure 10. Solution for v_{rot}, σ_{los}, and their ratio as a function of abundance, using the method of FW80 and the data of Table 6.

seem that at least 40 objects per bin is sufficient to obtain a value for v_{rot} with an uncertainty that is close to the external errors in the velocities for the stars.

A potential weakness in the result presented here is the division in metallicty that is used to separate the FHB and A stars. To explore the effect that this cutoff has in the response of the rotation determination, the calculation was repeated twice, using a division of [Fe/H] $= -0.50$ and [Fe/H] $= -1.00$ to separate the FHB and A stars. A comparison of the results obtained is given in Figure 11, and it can be seen that the effect on v_{rot} is to increase the range in [Fe/H] over which the transition from halo to disk kinematics occurs. It is therefore difficult to assess the sharpness of the transition, as it depends heavily on the division between the two sub-samples. A better knowledge of the metallicity distribution of the A type stars would establish this upper limit in metallicity for which the kinematics become those of the "extended disk." The lower limit, *i.e.*, the point at which the transition begins, is clearer, as it is very unlikely that the A type stars are numerous at metallicities this low. In general, it can be seen that, for the results in Figure 9, the transition occurs over the range $-1.20 \leq$ [Fe/H] ≤ -0.6, which is consistent with the determinations of others.

As well, the values of v_{rot} over the range of metallicities in this determination are consistent with those derived by others. For the bins which approach solar metallicity, the result is consistent with "normal" properties of the "extended disk." This is noteworthy, as the stars which populate these high-metallicity bins are those which are classified as A type. They seem to participate in the same systematic

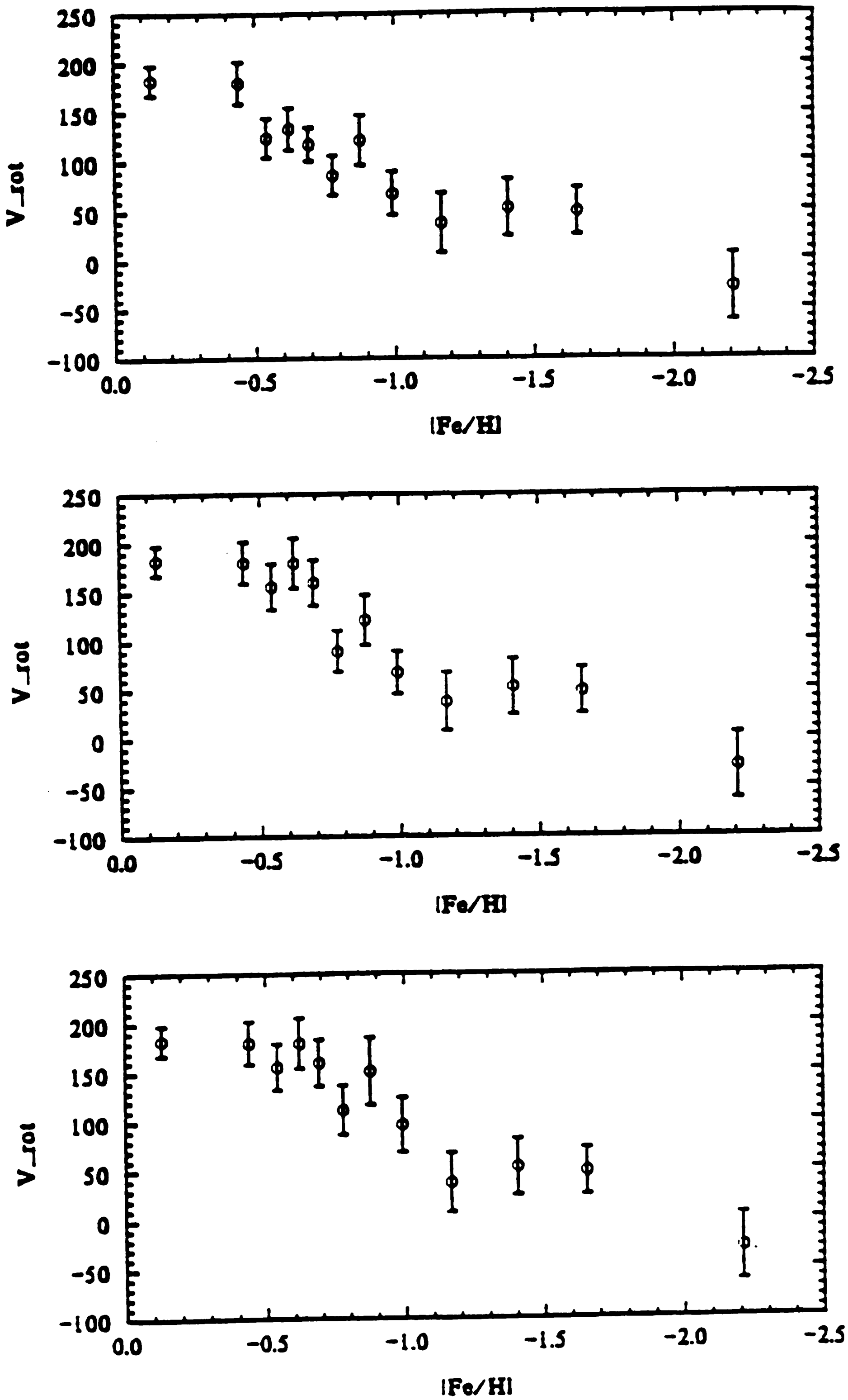

Figure 11. A comparison of derived values for v_{rot} for three different divisions between the FHB and A type star samples: [Fe/H] = −0.5 (top), [Fe/H] = −0.75 (middle) and [Fe/H] = −1.00 (bottom).

rotation that other stars have in this range of metallicity, which suggests that they are normal constituents of this region of the galaxy. The implication of this is that the "extended disk" is a site of star formation, and is therefore not a fossil remnant of the galaxy's collapse. Recent findings on the density of gas within a few kpc of the galactic plane would seem to allow for this conjecture (Robertson *et al.*, 1990). High velocity gas clouds with metallicities of up to [Fe/H] = -0.5 have been detected, using quasars and other extragalactic objects as probes.

Another worry in drawing conclusions from this sample is the question of whether the sky is adequately covered over each of the metallicity bins. Figure 12 is a stripe histogram of the values of $\cos\psi_i$ for the bins of Table 4 (each stripe on the histogram represents one star). Since this is the angle which projects the line of sight velocity along the radial direction, it is also a measure of how much weight to assign each bin in the determination of v_{rot}. It can be seen that there is sufficient coverage in each of the bins to consider the derived rotational velocities valid, although the general decrease in the coverage at higher metallicities stems from the relative proximity of the A type stars to the sun.

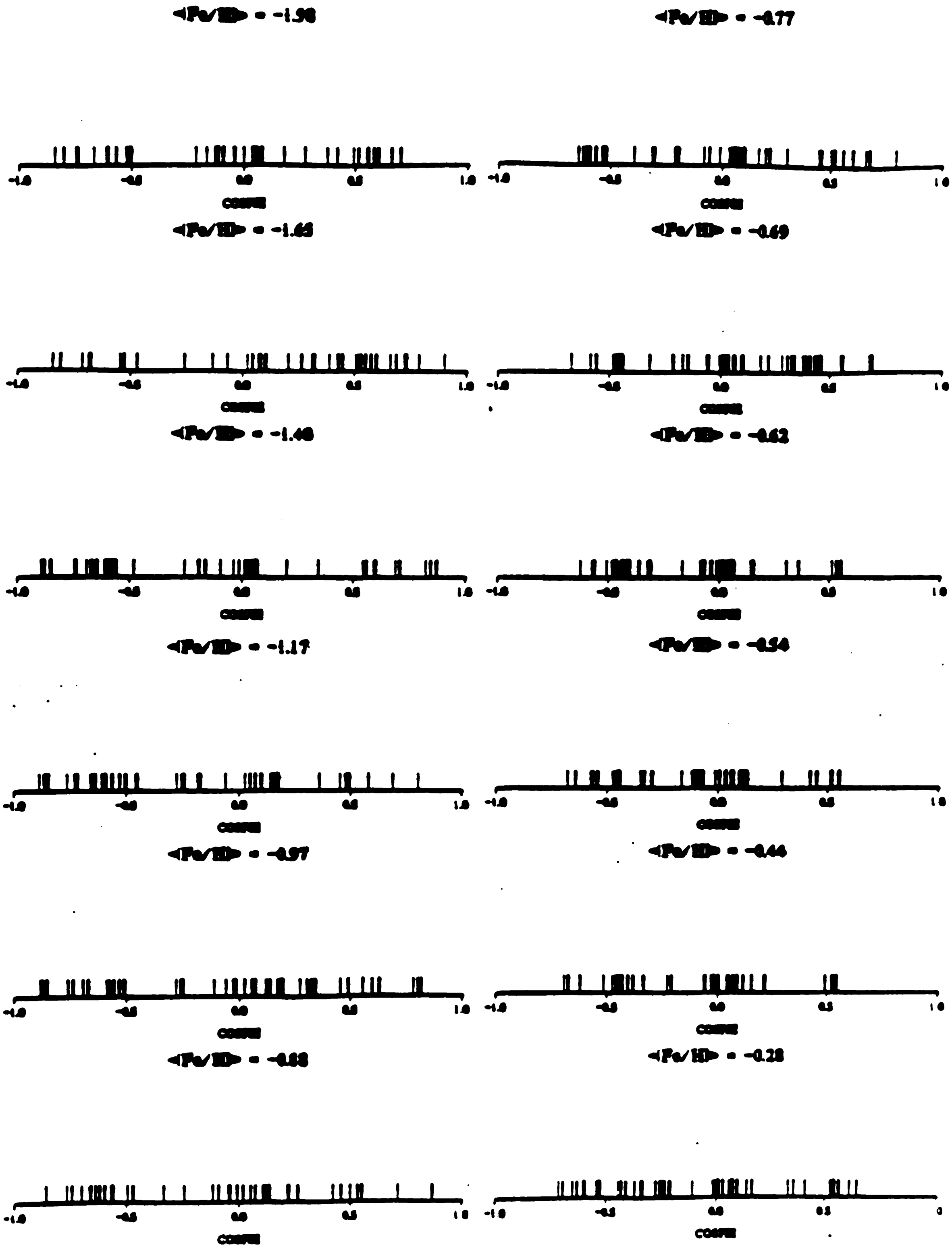

Figure 12. Stripe histograms showing the range in $\cos\psi_i$ for each of the bins in Table 4.

CHAPTER 7: SUMMARY AND CONCLUSIONS

It has been demonstrated that the spatial structure of the inner halo likely departs from a random distribution of stars to distances of ≈ 8 kpc. This conclusion stems from probing the structure of the halo with the FHB I catalogue, although it is unclear if the departure seen is a result of clumping of matter on small scales ($\leq$ 100pc), or perhaps the existence of remnants of disrupted groupings. The uncertainty here lies in the coarse brightness (and therefore distance) determinations for these stars at present, which would be remedied by an observing programme aimed at acquiring photometry for these stars. The extension of the HK Survey to the northern galactic hemisphere will prove beneficial in attacking this and other problems in galactic studies.

The rotation of the halo system as traced by the FHB stars is consistent with determinations which have been made for other populations of stars with the halo. The A type stars which are identified in the HK Survey appear to be normal members of the extended disk population, sharing the kinematics, distribution of metallicity and location of other stars which have been identified as part of this component of the galaxy. The transition in the halo from halo to extended disk kinematics occurs from [Fe/H] ≈ -1.2, and appears to extend to $-0.80 \leq$ [Fe/H] ≤ -0.6, and is smooth. This appears to confirm that the disk is decoupled from the halo, so that the evolutionary picture of Eggen, Lyndon-Bell and Sandage would seem to be at odds with this result.

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