DISTRIBUTIONS AND MOTIONS OF NEARBY STARS DEFINED BY OBJECTIVE PRISM SURVEYS AND HIPPARCOS DATA

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ABSTRACT

Material from objective prism spectral classification work is used to determine the space density distribution of nearby common stars to the limits of objective prism spectral surveys and, more specifically, to extend the knowledge of the local densities of specific spectral types from a radius of 25 pc from the Sun, as limited in the Catalogue of Nearby Stars by Gliese, to 50 pc or more. Future plans for the application of these results to studies of the kinematic and dynamical properties of the stars in the solar neighbourhood as a function of their physical properties and ages are described.

Key words: nearby stars; objective prism surveys.

1. INTRODUCTION

Objective prism surveys have formed a reliable method for assuring the completeness of certain kinds of stars within a specified volume of space. Combined with Hipparcos data, they can provide information on several matters. In addition to identifying the location of the giant branch as a function of surface temperature (Upgren et al. 1997), we have made use of other stars in the surveys with spectral dispersions near 280 and 580 Å/mm at the H_γ line, and at all galactic latitudes. They are mostly of stars with absolute visual magnitudes, M_V, between 0 and +5 (e.g. A and F main sequence stars, normal giants and subgiants). These are the types of stars that dominate this range in M_V, the range most likely to be improved in the stellar luminosity function by the parallaxes and proper motions from Hipparcos. The precision of such surveys in the calibration of M_V and color identified by spectral class, and a recalibration of photometric systems are to be investigated as well as the space densities of some of these types of stars in the solar neighbourhood.

The goals of this project are twofold. The first goal is to determine the space density distribution of nearby common stars to the limits of objective prism spectral surveys, and, more specifically to extend the knowledge of the local densities of specific spectral types from a radius of 25 pc from the Sun, as limited in the Catalogue of Nearby Stars by Gliese, to 50 pc or more. A total of 23 fields covered by objective prism spectral classifications distributed throughout the northern celestial hemisphere and at all galactic latitudes, have been included in this study. The second goal is to derive the density distribution of the stars, specifically those with absolute magnitudes between 0 and +5 within 100 pc of the Sun to examine the reality of a local clustering of F stars indicated in a study by McCuskey & Rubin (1966). All stars with HD spectral types between A5 and G0 within 7 degrees of the galactic plane and in selected longitude regions in the northern hemisphere ($\sim$ 2000 stars) are included in the program. Of those stars, 612 were included in the Hipparcos program. Provisional results are inconclusive about local clustering pending detailed photometric calibration and analysis of the entire data sample.

Other goals are to extend the census of the brighter nearby stars in our fields beyond 25 pc to twice that distance or more, thus increasing the volume of space and the star counts for the more luminous stars to greater numbers. The number and distribution of stars in color-magnitude diagrams, and the percentages among them of magnetic and other stars of peculiarity will also be examined.

2. DATA ANALYSIS

The program has been more fully described by Upgren & Hemenway 1997 and Upgren et al. 1997. Four-color photometry on the Strömgren system, will be applied to the stars on the programme, to determine the stellar densities with greater precision.

In Figure 1, the color-magnitude diagrams are plotted with Upgren's Hipparcos stars in the upper plot and Hemenway's in the lower plot. Because the stellar samples in this program have not all been observed by the Hipparcos satellite, the determination of the distances and absolute magnitudes of these stars will require calibration of the spectroscopic and

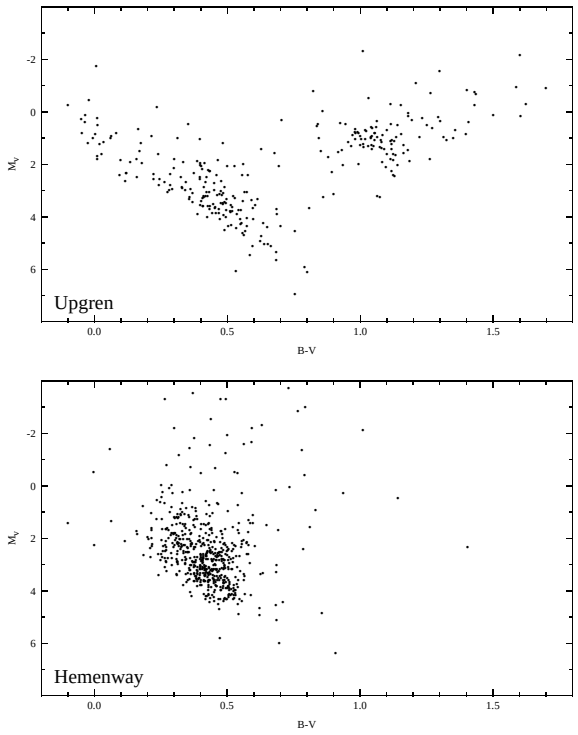

Figure 1. Colour–magnitude diagram.

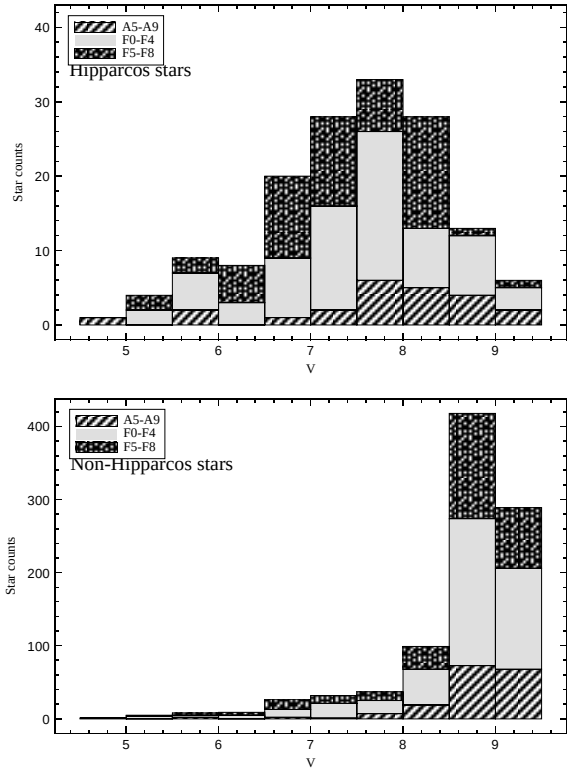

Figure 2. Distribution of A and F sample stars in the galactic plane as a function of spectral type and magnitude. This sample is the sample of stars with transcribed spectral type so far, and includes both Hipparcos and non-Hipparcos stars.

photometric parameters using the Hipparcos results (see, e.g. Perryman et al. 1995). Therefore, we need to compare the relationship between the stars with directly observed distances, magnitudes, and colors from the Hipparcos program, to those without such data. A bias toward an overabundance of brighter stars with the data is present and understandable (Figure 2), although no apparent bias correlated with spectral type is found. Preliminary plots of the four-color data for our stars show no striking deviations from the calibrations of the four-color system made by Crawford (1975, 1979) for the A and the F stars near the Sun.

3. FUTURE APPROACH

The highly accurate Hipparcos parallaxes and proper motions can be combined with good radial velocities to derive high-precision space motions. Then the kinematic and dynamical properties of the stars in the solar neighbourhood may be investigated in detail as a function of their physical properties and ages.

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