Kinematic determination of the luminosity function in the neighborhood

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AIMS

The luminosity function is crucial to know the structure of the galaxy as well as allowing the determination of the stellar mass function, two functions essential to know the star formation and evolution of the galaxy.

At present, all studies of the local luminosity function, the distance limit studied is given by the limiting magnitude of stars with accurate proper motions and distances.

In this work we have determined the luminosity function in the solar neighborhood up to 200 pc, whereas the proper motions as estimates of distances, using the method of mean absolute magnitudes.

SAMPLE TO STUDY

The sample chosen to determine the LF is out from the galactic plane and is complete (Fig. 1):

- spatially ($260^\circ < l < 340^\circ$, $45^\circ < b < 60^\circ$)
- photometrically ($K_s < 12$, less sensitive to extinction)
- kinematically ($\mu > 0.03$ km year$^{-1}$)

Kinematic database: CdC-SF catalogue (Vicente et al. 2007, 2010), with precise proper motions similar to that of Hipparcos up to $V = 16$ and uniformity of data.

Photometric database: CdC-SF includes JHKs photometry from 2MASS catalogue (Cutri et al. 2003)

The determination of the H-M regression to calibrate, we use the Hipparcos catalogue (ESA 1997) which includes trigonometric parallax up to $V = 8$.

MEAN ABSOLUTE MAGNITUDES

METHOD

The parameter $H$, reduced proper motion (Luyten 1938), defined similarly to the absolute magnitude $M$, is used as a statistical estimator $M$:

$$M = m + 5 \log d$$

$$H = m + 5 \log \mu$$

$$\mu = \frac{V}{2.74}$$

Proper motion is directly related to the absolute magnitude $M$, if $Vt$ is independent of $M$. So, with a sample of stars with the same distribution we have $Vt = a + b \cdot M$.

Determined the relationship $\sim M = a + b \cdot H$ with calibration stars, we can obtain absolute magnitudes for all stars in our sample.

RESULTS

We obtained the calibration equations to relate the proper motion reduced with the absolute magnitude (Fig. 3), and are as follows:

**Dwarfs**

$$M_v = -2.91 \pm 0.45 + 0.74 \pm 0.06 H_k, \sigma_M = 0.97$$

**Giants**

$$M_v = -5.27 \pm 0.67 + 1.33 \pm 0.20 H_k, \sigma_M = 0.67$$

Malmquist bias and Lutz-Kelker corrections were found to be negligibles.

We have determined the Luminosity Function up to 200 pc (Fig. 4). It agrees perfectly with the transformation, in the K band, calculated by Mamon & Soneira (1982) from the semi-empirical Luminosity Function of Bahcall & Soneira (1980).

In case of dwarfs stars (Fig. 4a), there is a deficit of faint and near stars that are not included in our catalogue CdC-SF due to its construction itself (Fig. 5). In the future, we will add high proper motion catalogs to solve this problem.

For giant stars (Fig. 4b), not just our data agree very well, but extending to the current observations.

REFERENCES

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