

## **ASTR3002 – Galaxies in the Universe – 2008 – Assignment\_Carollo**

*Note: this assignment is due 19 September. It has to be presented in time and in a neat way to the lecturer or marks will be deducted. You can also send a pdf version by email to [carollo@mso.anu.edu.au](mailto:carollo@mso.anu.edu.au)*

### **The structures and star populations in the Milky Way [12 points]**

*Daniela Carollo – 09/09/08 – 12/09/08*

## **ASSIGNMENTS**

### **Problem N. 1**

a. (1 point) Using the formula of the propagation errors demonstrate the following relation (Lecture N. 1):  $\sigma_d/d = \sigma_\pi/\pi$ .

b. (2 points) Also, given the following spectral type:

Main Sequence:

Giants:

F5

K5

G0

M0

M0

for a given limit magnitude of the telescope  $m_V = 20$ , evaluate the parallaxes for each spectral type, and give an indication of the galactic structure at which the star could belong.

Which space mission of the modern era could potentially measure these values of parallax?

Note that:

- ✚ The absolute magnitudes are available at page 107 of Binney and Merrifield.
- ✚ The parallax must be expressed in  $\mu\text{as}$ .

### Problem N. 2

c. (2 points) Given the following distances:  $d = 1 \text{ kpc}$ ,  $2 \text{ kpc}$ ,  $4 \text{ kpc}$ , evaluate the error on the tangential velocity of a star, assuming a 15% of relative error on the distance, and an error on the proper motions of  $4 \text{ mas/yr}$ . Repeat the same evaluation for a distance of  $8 \text{ kpc}$ , and asses if the error obtained is acceptable to use the derived velocity in galactic studies.

### Problem N. 3

The table below lists four stars of the Sloan Digital Sky Survey (Lecture 2)

Star name	$\alpha$ (deg)	$\delta$ (deg)	$\pi$ (mas)	$\mu_\alpha \cos(\delta)$ (mas/yr)	$\mu_\delta$ (mas/yr)	$V_r$ km/s	$d$ (kpc)
SDSS_449	0.038	-8.796	0.364	-6.016	-15.694	-97.6	2.7
SDSS_314	0.090	14.747	0.257	-4.486	-3.772	-11.5	3.9
SDSS_165	0.125	-10.406	0.298	2.251	-22.786	-91.0	3.4
SDSS_509	0.128	1.218	0.340	0.928	-6.766	-88.8	2.9

d. (2 points) For each star evaluate the  $U, V, W$  velocities in the local standard of rest. Use the relation and matrix transformation reported in the Lecture N. 1. The correction for the solar motion is that of *Mihalas & Binney 1981*.

In the table:

- ✚ right ascension and declination are in degree
- ✚ parallax is in mas
- ✚ proper motion is in mas/yr
- ✚ radial velocity is in km/s
- ✚ distance in kpc

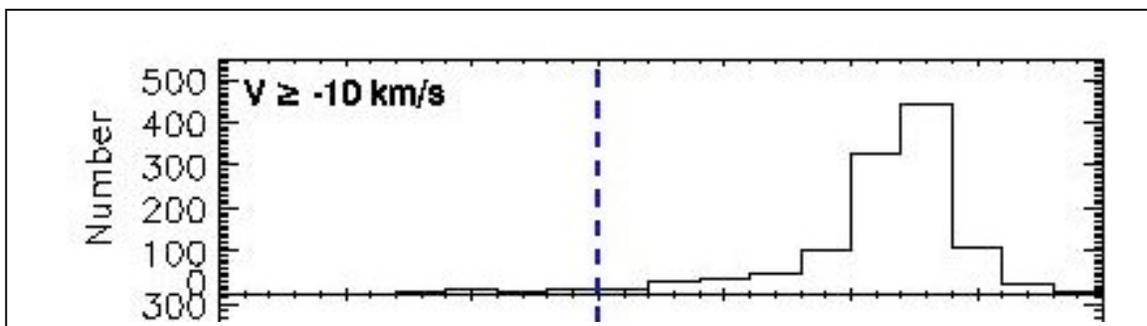
e. (2 points) Evaluate also the rotational velocity in the Galactocentric Reference Frame, and basing on the value obtained place the star in one of the following galactic structures: thick disk, inner or outer halo.

#### Problem N. 4:

f. (1 point) A star with metallicity  $[Fe/H] = -2$  belong to a Population I or Population II?

g. (2 points) The plots below shows two different metallicity distribution for stars in the Milky Way. At which structure of the Galaxy they could be associated?

#### Plot 1.



**Plot 2.**

