



Distributions of Stellar Systems Using Mathematica with Applications to Cataclysmic Variables and Planetary Nebulae

M.A.Sharaf¹, Z.A. Mominkhan²

¹Department of Astronomy, Faculty of Science, King Abdulaziz University, Jeddah, Saudi Arabia

²Department of Mathematics, College of Science for Girls King Abdulaziz University, Jeddah, Saudi Arabia

Abstract In this paper, Meisel's(2013) algorithm for the distribution of galaxies using *Mathematica* was used for the distributions of Cataclysmic Variables(CV) and Planetary Nebulae(PNe). Data manipulations are illustrated generally, through the Internet data sources and the implementation for *Mathematica* usage. The distributions are displayed in two dimensions (ℓ, b), the galactic longitude and galactic latitude. The distributions of both CVs and the PNe are symmetric about the galactic plane, with high condensation of PNe towards the plane which supports the known fact that PNe are young. On the other hand, the remarkable condensation at high galactic latitudes of CVs indicates that these objects are old.

Keywords: Stellar distributions; Cataclysmic Variables; Planetary Nebulae.



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1. Introduction

It is known long time ago that there are definite relations between kinematical and spatial (KS) properties of stellar systems. The first step for setting up relations between (KS) properties of stellar systems is to visualize the relations through the manner by which these systems are distributed. In fact the spatial distributions could used to except the age of the stellar system to which the distribution refer, the high the condensation towards the galactic plane the youngest age will be. On the other hand, the distribution determines the most suitable stellar systems for studying certain problem, for example, in the determination of the equatorial coordinates of the north galactic pole, we obviously shall except to get the best results choosing objects which exhibit the strongest concentration towards the galactic plane .Some useful objects for this application are, the young Population I and particularly the youngest among them as for examples: galactic cluster, the Wolf –Rayet stars, the O-type stars and classical Cepheid. While for problems of galactic rotation, the best objects are those far from galactic plane, for example globular clusters and other old galactic objects. How we know the degree of concentration towards the galactic plane without spatial distributions?

The importance of the stellar distributions as mentioned very briefly as in the above had motivated our work: to develop the distributions of two important stellar system, CVs (old) and the PNe (young).

2. Data manipulations

2.1 Data source(s)

Today there are tremendous astronomical and astrophysical data available at Internet sites for download including tables and images. Of these sites which we used is, CDS(Centre de Données astronomiques de Strasbourg) which is the main database portal for Simbad, VizieR, and Aladin :

Hyperlink ["IAU/CDS/ADS", "http://cds.u-strasbg.fr"]

2.2 Dataimplementation for *Mathematica* usage

Having obtained the data (in form of a table) from the database (e.g.VizieR), the implementation of the data for *Mathematica* usages could be performed as :

1-copythe data in "Excel" (of course after removing all the columns titles, since *Mathematica* can not work with combination of numbers and letters) . 2-Then copy the last table in "Notepad" by any name RA.txt (say), with the passD:\(say).3-Finally, write the command

```
data = ReadList["D:\RA.txt", Number, RecordLists = True];
```

in the *Mathematica* session that uses the data. (Note that you can use any name rather than "data"). Now the data are ready to be used for *Mathematica* program(s)

3. Two dimension distributions using *Mathematica* and its applications

3.1 Algorithm

Recently in 2013 Meisel David established a marvelous algorithm in the notebook "distribution of galaxies on the sky (2D)" from the book Astrophysics through Computation (Koberlein and Meisel 2013). The detailed structure of the algorithm could be found in the notebook.

3.2 Distribution of Cataclysmic Variables

Cataclysmic variable is a binary star system in which the primary is a white dwarf and the secondary is a late-type main sequence star. The white dwarf accretes hydrogen-rich material usually through an accretion disk from a Roche lobe filling secondary that is on or near the main sequence. The light from the accretion disk around the white dwarf would dominate such system. The CVs are characterized by long quiescent intervals punctuated by outbursts in which the brightness of the system increases dramatically; the outbursts are believed to be due a sudden increase in the rate at which mass flows down through the disk [Carroll and Ostlie 1996].The CVs consists of several classes such as classical novae, recurrent novae., nova-like, dwarf novae, helium CVs, and magnetic CVs.

What concerns us in the present paper is to demonstrate the distribution of CVs on the sky (2D). For this purpose we utilized the most recent data of the seven addition, catalogue for CVs, release 7.21, March 2014 of Ritter and Kolb All the tabular material contained in this catalogue are available at Vizier catalogue database:B\cb\cbdata. The number of data is 1166.

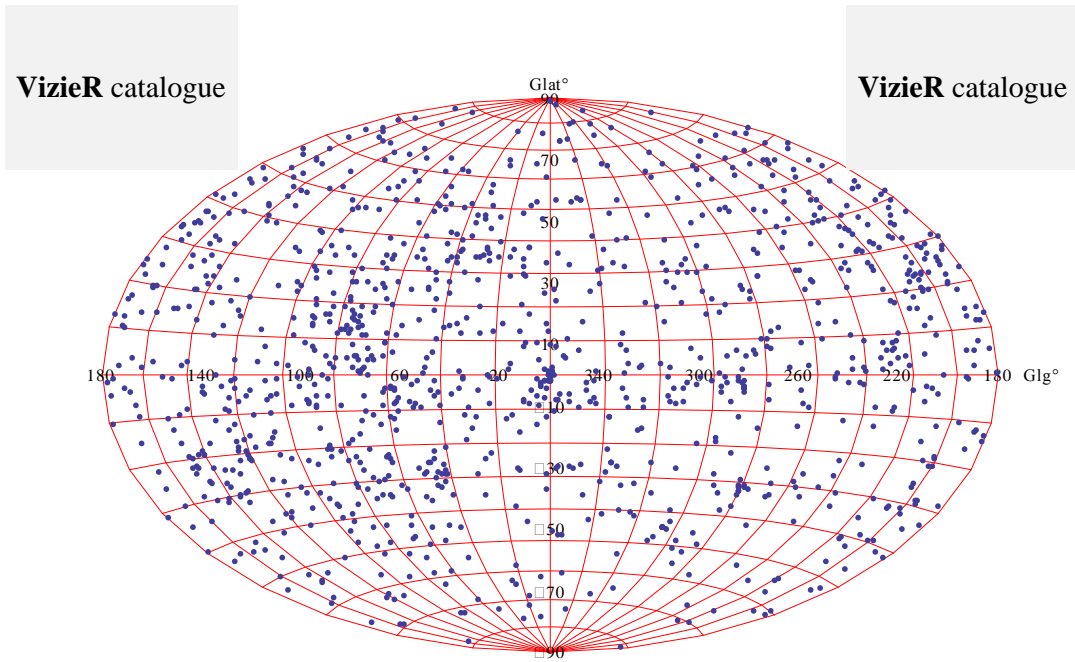


Fig.1: Two dimension on distribution of Cataclysmic variables

3.3 Distribution of Planetary nebulae

Planetary nebulae are glowing clouds of gas excited by a very hot central star. in PNe, collisions between electrons, atoms, and ions occur more frequently Co

Collisional excitation and de- excitation are therefore significant, and the emission occurs from forbidden lines. In PNe a large shell (or shell) is visible, and the emission lines show velocities of expansion of some tens of kilometers per second.

A substantial fraction of all stars probably go through the planetary-nebula stag after their asymptotic giant branch and before they become white dwarfs. The estimated ages of PNe are on the order of 10,000 years. After only about 50,000 years a PN will dissipate into interstellar medium.

Some main catalogue of PNe are listed in [Allen 2000]. Recent catalogue which we used in the present paper is the MASH Catalog of Planetary Nebulae(Parker et al. 2006)available at Vizier catalogue database: V/127A/mash1. The number of data is 903.

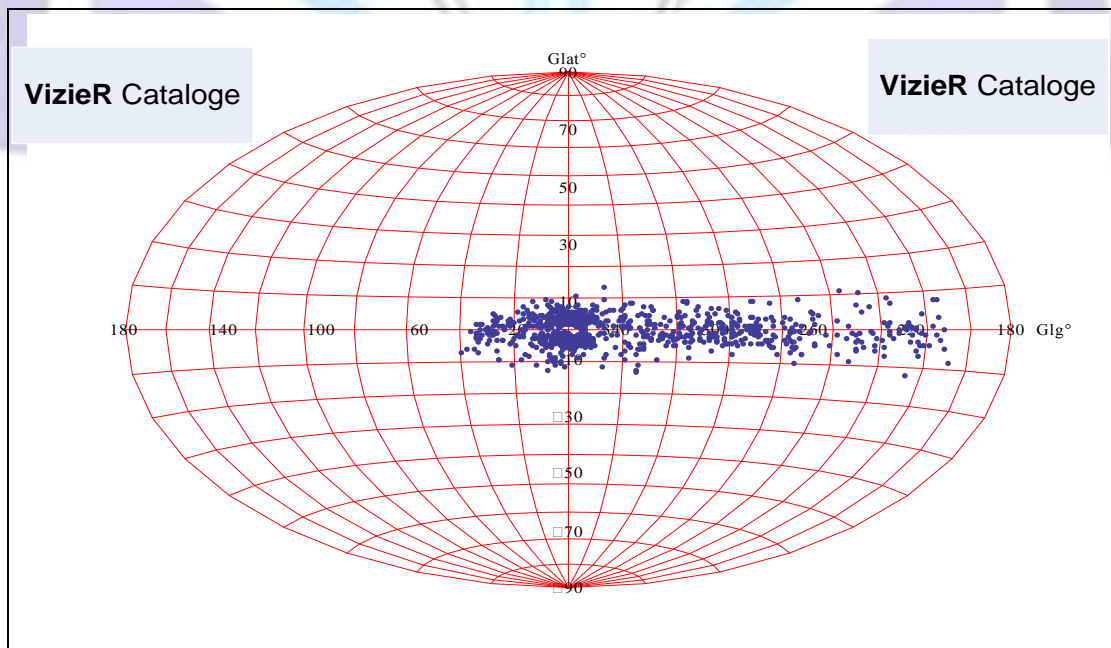


Fig. 2: Two dimension on distribution of Planetary nebulae



In concluding the present paper, Meisel's (2013) algorithm for the distribution of galaxies using *Mathematica* was used for the distributions of Cataclysmic Variables (CV) and Planetary Nebulae (PNe). Data manipulations are illustrated generally, through the Internet data sources and the implementation for *Mathematica* usage. The distributions are displayed in two dimensions (ℓ, b) , the galactic longitude and galactic latitude. The distributions of both CVs and the PNe are symmetric about the galactic plane, with high condensation of PNe towards the plane which supports the known fact that PNe are young. On the other hand, the remarkable condensation at high galactic latitudes of CVs indicates that these objects are old.

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