THE DYNAMICS OF PLANETARY NEBULAE IN THE GALAXY: EVIDENCE FOR A THIRD INTEGRAL

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Abstract. The dynamical modeling of various tracer populations in our galaxy is an important tool in the study of its formation and evolution. Planetary Nebulae (PNe) seem to be particularly useful for such a study. In this contribution we attempt to link the dynamics of PNe and OH/IR stars, and confirm on dynamical grounds that both classes are indeed related by stellar evolution. Moreover, we show that 2 integrals of motion are probably not sufficient to characterize the dynamical state of the PNe: the models produce a velocity dispersion which is too low, pointing at the likely presence of a third integral.

1. Introduction

Dynamical studies of the Galaxy as a whole need reasonably homogeneous samples over large volumes. At present, the OH/IR stars and the Planetary Nebulae are prime candidates for this.

We use in this work data compiled in the *Strasbourg-ESO Catalogue of Galactic PNe* [1] and recently calibrated thanks to 65 new radial velocities obtained at high resolution by Acker and Zijlstra (private communication). The radial velocities and galactic positions of about 650 PNe are now accurately known, but the selection biases of the surveys are still poorly understood. So we utilize as a projected star counts map the COBE brightness

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map of the full sky at 2.2 μm, which is commonly taken as representative for the stellar emission of Galactic populations (mainly K and M giants).

2. The modeling

The modeling consists in fitting a set of galactic orbits created by an axisymmetric Stäckel potential with a halo-disk structure [2], to the observed distribution of radial velocities, longitudes and latitudes of PNe. We use for this a Quadratic Programming method developed by H. Dejonghe [3]. The validity of the modeling is easily checked via a qualitative comparison between data and model.

3. The conclusions

- The COBE 2.2 μm map (corrected for interstellar extinction, using the method presented in [5]) is a very useful substitute for star counts in the presence of non-kinematic detection biases.
- The bulge-disk decomposition is very obvious in the density map (r,z) obtained via the 2-integral deprojection of the COBE map. Our deduced scalelengths are $h_r^B = 0.4$ Kpc for the bulge and $h_r^D = 5.8$ Kpc for the disk.
- Velocity dispersions of the OH/IR sample (about 700 stars) are globally lower that PNe ones, especially in the disk. This could indicate that the former may be indeed the progenitors of the latter. Bulge PNe on the other hand show nearly similar dispersions as the bulge OH/IR. This may be interpreted as evidence that the dynamics of bulge stars are dominated by mixing, while phase-space diffusion is more important for disk stars. Thus, the age of those disk PNe may be similar to the time-scale needed for phase-space diffusion.
- A 2-integral model does not fit the disc kinematics of the PNe well. This fact points to the presence of a third integral [6].

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