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KINEMATIC AGES OF THE CENTRAL STARS OF PLANETARY NEBULAE

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RESUMEN

Se determina la distribución de edades de las estrellas centrales de nebulosas planetarias (CSPN) utilizando dos métodos basados en sus propiedades cinemáticas. En primer lugar, se comparan las velocidades de rotación de las nebulosas esperadas a partir de sus distancias galactocéntricas con los valores predichos por la curva de rotación, y las diferencias encontradas se atribuyen a las distintas edades de las estrellas evolucionadas. Se usa la relación entre las edades y la dispersión de velocidades del relevamiento Geneva-Copenhagen para obtener la distribución de edades. En segundo lugar, se determinan las componentes U, V, W de las velocidades de las estrellas, y se usan las relaciones edad-dispersión de velocidades para inferir la distribución de edades. Hemos aplicado estos métodos a dos muestras de nebulosas planetarias en nuestra galaxia. Los resultados son similares para ambas, y muestran que la distribución de edades de las CSPN está concentrada en edades menores que 5 giga-años, y que tiene un pico entre 1 y 3 giga-años.

ABSTRACT

The age distribution of the central stars of planetary nebulae (CSPN) is estimated using two methods based on their kinematic properties. First, the expected rotation velocities of the nebulae at their Galactocentric distances are compared with the predicted values from the rotation curve, and the differences are attributed to the different ages of the evolved stars. Adopting the relation between the ages and the velocity dispersions determined by the Geneva-Copenhagen survey, the age distribution can be derived. Second, the U, V, W, velocity components of the stars are determined, and the corresponding age-velocity dispersion relations are used to infer the age distribution. These methods have been applied to two samples of PN in the Galaxy. The results are similar for both samples, and show that the age distribution of the PN central stars concentrates at ages lower than 5 Gyr, peaking at about 1 to 3 Gyr.

Key Words: planetary nebulae: general — stars: AGB and Post-AGB — stars: fundamental parameters — stars: general

1. INTRODUCTION

Planetary nebulae (PN) are evolved objects ejected by stars with main sequence masses in the range of 0.8 and 8 $M_{\odot}$, so that the expected ages of their central stars are of the order of, or greater than, about 1 Gyr. However, the relatively large mass bracket of their progenitor stars implies that an age distribution is to be expected, which has some consequences for the interpretation of the PN data in the Galaxy and other stellar systems. The determination of ages of the central stars is a difficult problem, and most usual methods have large uncertainties when applied to intermediate and old age objects. We have recently developed three different methods to estimate the age distribution of the CSPN (Maciel, Costa, & Idiart 2010, see also Maciel, Costa, & Uchida 2003; Maciel, Lago, & Costa 2005, 2006), and have applied these methods to a sample of PN in the disk of the Galaxy, most of which are located in the solar neighborhood, within