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NGC 6826: A UNIFIED STUDY OF THE PLANETARY NEBULA AND ITS CENTRAL STARS

C. R. Fierro,[1] A. Peimbert,[1] L. Georgiev,[1] C. Morisset,[1] and A. Arrieta[2]

RESUMEN

Presentamos una metodología de trabajo para obtener un modelo estelar-nebular autoconsistente. Determinamos la distancia usando las trazas evolutivas teóricas de estrellas centrales de nebulosas planetarias. Se aplicó esta metodología a la nebulosa planetaria galáctica NGC 6826. El modelo unificado requiere más trabajo pero disminuye las incertidumbres debido al mayor número de restricciones observacionales.

ABSTRACT

We present a methodology to obtain a stellar-nebular self-consistent model. Distance is determined using theoretical evolutive tracks of central stars of planetary nebulae. This methodology is applied to study of the galactic planetary nebula NGC 6826. A unified model requieres more work, but its uncertainties are smaller due to their larger number of observational constraints.

Key Words: ISM: abundances — planetary nebulae: individual (NGC 6826) — stars: abundances — stars: atmospheres — stars: rotation — stars: winds, outflows

1. INTRODUCTION

Planetary nebulae (PNe) are the final stage of low and intermediate mass stars (0.8 to 8.0 $M_{\odot}$). They are shells of gas surrounding the nucleus of the progenitor star, the stellar remnant is hot enough to emit photons able to ionize the surrounding gas. Many detailed models of either PNe or central stars of planetary nebulae (CSPN) have been developed separately; however, there are few works that combine the study of the nebula with its central star. We present a methodology to obtain a self-consistent model of the planetary nebula and its central star.

2. NEED OF A UNIFIED MODEL

From the data published in the literature we note that, in the case of central stars (CSPN) of galactic planetary nebulae, more than one model can reproduce the observations of the same star. The biggest problem is the high uncertainty in the distance to these objects. Table 1 shows two examples of the stellar models from the literature with different parameters.

On the other hand, the ionization sources generally used in photoionization models are black bodies (BB) or atmosphere models. The criterion to fix the temperature of a BB is only the number of ionizing photons necessary to reproduce the state of ionization in the nebular gas. When an atmosphere model is used, some parameters are adopted from other sources, while $T_{\rm eff}$ and luminosity are changed to reproduce the state of ionization in the nebula. Stellar wind is not considered in these studies. The degeneration distance-luminosity allows several nebular models to reproduce the observations in the nebular spectrum. Table 1 shows two examples of nebular models from the literature with different parameters.

There are few studies that simultaneously fit the CS and PN parameters (Morisset & Georgiev 2009). One way to link the two objects (CS and PN) is to use the atmosphere model as input to the photoionization model. The CS model should reproduce the stellar spectrum, including P-Cygni profiles associated with the wind. The nebular model responds to changes in $T_{\rm eff}$ and luminosity of the star changing its ionization degree. A stellar-nebular model requires additional work over producing a stellar or nebular model separately; but the additional observational constraints imposed, reduce the number of possible models and the uncertainties in the parameters.

3. LUMINOSITY-DISTANCE DEGENERATION

The distances to the Galactic PNe are poorly known, making the determination of the absolute luminosity a difficult problem. The luminosity-distance degeneration produces degenerations in many others parameters; because of this problem,

[1]Instituto de Astronomía, Universidad Nacional Autónoma de México, Apdo. Postal 70-264, 04510, México, D.F., Mexico (crfierro@astroscu.unam.mx).

[2]Depto. de Física y Matemáticas, Universidad Iberoamericana, Prolongación Paseo de la Reforma 880, Lomas de Santa Fe, C.P 01210, México, D.F., Mexico.