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# MID- AND FAR-INFRARED PHOTOMETRY OF GALACTIC PLANETARY NEBULAE WITH THE AKARI ALL-SKY SURVEY

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RESUMEN

Presentamos fotometría en el medio y lejano infrarrojo de 857 nebulosas planetarias (NPs) galácticas utilizando datos provenientes del AKARI All-Sky Survey. Se incluyen flujos a 9 y 18 $\mu$m obtenidos con la Infrared Camera (IRC), y a 65, 90, 140 y 160 $\mu$m producto de la far-Infrared Surveyor (FIS). Se nota que la luminosidad IR de las NPs más jóvenes es comparable a la luminosidad total la estrella central y que posteriormente decrece hasta $\sim 5\times10^2$ $L_\odot$ cuando $D > 0.08$ pc, lo cual es congruente con la evolución de la opacidad del polvo de las NPs y la apreciable absorción en las NPs jóvenes y en las proto NPs. Además notamos que hay poca evidencia de la evolución en los cocientes de los flujos IR/radio sugerida por autores previos. También hacemos notar que la disminución de la temperatura del polvo al aumentar el diámetro nebular es similar a la obtenida en estudios previos, mientras que los niveles de calentamiento por fotones de Ly$\alpha$ son <0.5 de la energía disponible para los granos. Parece haber una evolución del exceso infrarrojo (IRE) con la expansión de las nebulosas, el cual adquiere sus valores máximos cuando las NPs son más compactas.

ABSTRACT

We provide mid- and far-infrared photometry of 857 Galactic planetary nebulae (PNe) using data derived from the AKARI All-Sky Survey. These include fluxes at 9 and 18 $\mu$m obtained with the Infrared Camera (IRC), and at 65, 90, 140 and 160 $\mu$m using the far-Infrared Surveyor (FIS). It is noted that the IR luminosities of the youngest PNe are comparable to the total luminosities of the central stars, and subsequently decline to $\sim 5\times10^2$ $L_\odot$ where $D > 0.08$ pc. This is consistent with an evolution of PNe dust opacities, and appreciable absorption in young and proto-PNe. We also note that there is little evidence for the evolution in IR/radio flux ratios suggested by previous authors. The fall-off of dust temperatures with increasing nebular diameter is similar to that determined in previous studies, whilst levels of Ly$\alpha$ heating are <0.5 of the total energy budget of the grains. There appears to be an evolution in the infrared excess (IRE) as nebulae expand, with the largest values occurring in the most compact PNe.

*Key Words:* dust, extinction — infrared: ISM — ISM: jets and outflows — planetary nebulae: general

## 1. INTRODUCTION

Several large-scale surveys at infrared wavelengths have been undertaken in the last thirty or so years, permitting a clearer understanding of the properties of dust in planetary nebulae (PNe). Thus for instance, Pottasch et al. (1984) investigated the thermal and physical characteristics of grains using photometry taken with the *Infrared Astronomical Satellite* (*IRAS*; Neugebauer et al. 1984). They found that dust temperatures decline with increasing nebular radius $R$, and that dust/gas mass ratios decrease with expansion of the shells. A further analysis by Lenzuni, Natta, & Panagia (1989) found that grain radii also decreased with radius,