THE EFFECTS OF MASS AND METALLICITY UPON PN FORMATION

K.A. Papp
University of Waterloo

C.R. Purton
Dominion Radio Astrophysical Observatory

S. Kwok
Herzberg Institute for Astrophysics

We construct a parameterized function which describes the possible dependence of planetary nebulae formation upon metal abundance and stellar mass. Data on galaxies in the local group compared with predictions made from the parameterized function indicate that heavy element abundance is the principal agent influencing the formation of planetary nebulae; stars which are rich in heavy elements are the progenitors of planetary nebulae. Our analysis, when compared with the observations, argues for a modest degree of pre-enrichment in a few of the sample galaxies. The heavy element dependence of planetary nebulae formation also accounts for the deficit of planetary nebulae in the nuclei of NGC 221 and NGC 224, and in the bulge of our galaxy.

WEHRSE: Model calculations for luminous M-star atmospheres show that the geometrical extensions and temperature distributions depend strongly on the metallicity. Do your computations show such correlations?

PAPP: No. Our model shows only a correlation of PN formation with metallicity - high metallicity stars are more likely to form PN.

SERRANO: You are probably overestimating the number of low mass stars, first, because the IMF flattens out at low masses, and, second, because a constant BRF would be more appropriate.

PAPP: Our IMF is well within the limits set by Miller and Scalo, but, even if one adopts an IMF which levels off at 1.5 $M_\odot$ or 2 $M_\odot$, the results will not change very much, as they are most sensitive to the form of the IMF between the turn-off mass and 1.2 $M_\odot$.

A constant BRF for the irregulars and spirals would reduce our problems. In particular, a constant BRF for the SMC would help to explain the very large number of PN without having to invoke an extended burst of star formation. There will be little or no change for spiral galaxies.

KWOK: A small value for the low-mass cut-off implies that the transition time from the AGB to PN is short, even for low mass stars.

https://doi.org/10.1017/S0074180900094006 Published online by Cambridge University Press

PAPP: Too high a value for the low-mass cut-off would mean that we could not explain the large numbers of PN in elliptical galaxies without invoking extreme conditions of star formation at the birth of the galaxy. However, a small value does imply that the transition time must be short, certainly very short compared with the AGB-lifetime, even for low-mass stars.

RENZINI: When comparing theoretical PN birthrates with PN counts, one has to make an assumption regarding the PN lifetimes. You have implicitly assumed that the PN lifetime is independent of the initial mass of the parent star - an assumption which is very probably incorrect. If this assumption is relaxed, the results of your analysis will change dramatically.

https://doi.org/10.1017/S0074180900094006 Published online by Cambridge University Press