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ABSTRACT

EJECTION OF PLANETARY NEBULAE BY HELIUM SHELL FLASHES AND THE PLANETARY DISTANCE SCALE

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We investigate a consequence of the hypothesis that planetary nebulae are ejected in the nuclear runaway shell flashes which take place in intermediate-mass stars when both hydrogen and helium are burning in thin shells. During this evolutionary phase, the star's luminosity and the time between shell flashes are both (almost) uniquely determined by the star's core mass. Thus, if planetary nebulae with two or more shells are products of ejection at the same velocity by two or more successive flashes, it should be possible to correlate the separation of the shells with the brightnesses of the central stars. Because linear separation and absolute luminosity are related to angular separation and apparent luminosity by distance to the first and second powers, respectively, this correlation provides a constraint on distances to the object.

Using data from the literature, we find that the hypothesis is tenable only if the larger of the two distance scales which have been suggested is correct. In this case, the carbon-oxygen cores of the stars apparently have masses of $0.8 \pm 0.15 M_{\odot}$, which is interesting in connection with measured white-dwarf masses. It should be possible in principle to calibrate a new, independent distance scale for the planetary nebulae based upon this hypothesis.

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