

MILLIMETER-WAVE OBSERVATIONS OF PLANETARY NEBULAE

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Observations of the integrated continuum flux density of several stellar planetary nebulae have been made at 90 GHz. These are reported, with some remarks on their significance for objects with positive radio-frequency spectral index, and to display graphically their relation to published microwave and near-infrared data. The 90-GHz data have been obtained with the 11-m dish of the National Radio Astronomy Observatory* on Kitt Peak, under the Lockheed Independent Research Program. Three of the objects have been included among a dozen stellar planetary nebulae observed with the Fabry-Perrot interferometer at the Cerro Tololo Inter-American Observatory† so as to provide kinematical information with the microwave spectral data, since they are related in the theories of the positive spectral index that appeared in 1975. The Fabry-Perrot observations are reported in Astrophys. J. 1977 September 15. No other journal article is yet in press.

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†Visiting Astronomer, Cerro Tololo Inter-American Observatory, which is operated by the Association of Universities for Research in Astronomy, Inc., under contract with the National Science Foundation.

THE "BUTTERFLY" NEBULA M2-9: ITS POSSIBLE RELATION TO B[e] STARS AND PROTO-PLANETARIES

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M2-9 is not a bona fide planetary, nor simply a star: it most probably is a planetary nebula in the formative stages. High densities, the presence of [OI], FeII and [FeII] emission lines, and prominent infrared continua are characteristic of such objects. There is a striking progression of their spectra from B[e] stars such as HD45677 to

M2-9 itself; Merrill's class of objects intermediate between Be stars and planetary nebulae is represented e.g. by MWC 645, HD 51585, V 1016 Cygni, HM Sagittae, and MWC 349. Remarkable similarities exist between the spectra of the latter objects and that of M2-9, especially in the recently covered region between 8000 and 11000 Å which is rich in emission lines of the Paschen series, of HeI, OI, [SIII], FeII and [FeII] (Andrillat and Swings, 1977, in preparation).

DISCUSSION

Cohen: The central core of M2-9 is optically polarized at a level of about 10% from 4300 to 6700 Å. But the position angle of this polarization is 65° which does not relate to any obvious photographic structure in the nebula.

Feldman: Purton and I have found that the core of M2-9 is similar to MWC349 not only in its emission-line spectrum, but also in that it possesses an optically thick, highly compact radio source.