SPECTROSCOPIC OBSERVATIONS OF NUCLEI OF PLANETARY NEBULAE

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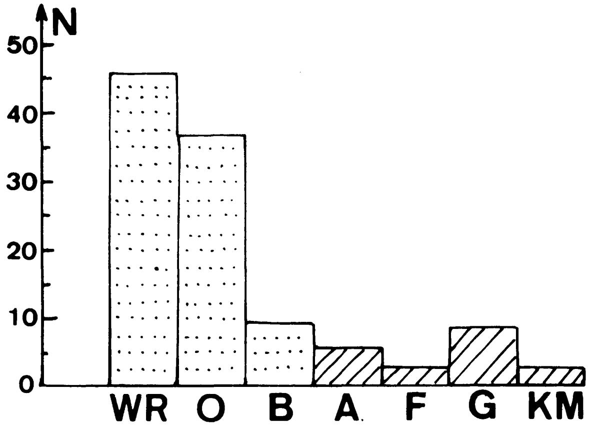
Up to date, 1518 true, possible, and probable planetary nebulae (PN) are known in our Galaxy ; 463 nuclei (NPN) were observed. For about 150 stars, a spectral study has been done ; only about 30 NPN have a well studied spectrum. (Acker, Gleizes et al, 1982 "Catalogue of the central stars of true and possible PN")

It must be remembered that this is a difficult study, as the PN are very distant objects (the nearest, Helix, is at about 120 pc), and that their central stars are very faint (the 35 brightest have a magnitude of from 9 to 12), are generally of a particular spectral type, and have a spectrum in which nebular lines interfere with stellar features.

SPECTRAL CLASSIFICATION



Number N of NPN for which a spectral type has been given in the "catalogue of the central stars of PN" (Acker, Gleizes et al, 1982).

*A spectral class is given for 127 NPN. 14 % have a spectrum classified as continuous, on the basis on observations made in the visible ;

35 % are of Wolf-Rayet type (18 % WC, 10 % WN)

29 % are O stars (9 % Of) ;

7 % are B stars ; in addition, the BQ [ ] type, i.e. early type stars with forbidden emission lines, is attributed to 5 stars called "proto-PN" ;

14 % of the nuclei have a cold type, which implies the presence of a warmer companion, or an instability of the star (case of FG Sge).

* New lines have been discovered in the U.V. (Heap, 1983). 39 NPN show strong P-Cygni type lines ; all WR-and Of-type NPN have high-velocity winds ; the mass loss rate does not exceed 10^{-6} $M_{\odot} \cdot yr^{-1}$ (Perinotto, 1983).

A. Maeder and A. Renzini (eds.), Observational Tests of the Stellar Evolution Theory, 213–214.

TEMPERATURES

The temperatures of the NPN have been calculated by classic methods, using photometric and spectral data of the nebulae and of the stars, in the visible and in the U.V. The different temperature values obtained vary greatly in height, because of the different magnitudes and distance scales used by the authors. The regrouping of NPN in the H - R diagram into one single evolutive sequence, or into various sequences according to mass, is not yet clearly defined.

TEMPERATURE SCALES OF NUCLEI OF PLANETARY NEBULAE

Extreme values of the Temperature			Authors (objects)
100 000	< T <	700 000	POTTASCH 1981 (29 very faint nuclei of brightest PN)
33 000		350 000	PREITE-MARTINEZ, POTTASCH 1982 (14 NPN)
70 000		200 000	KALER, FEIBELMAN 1982 (23 nuclei of large PN)
40 000		140 000	CLEGG, SEATON 1982 (20 NPN)
		120 000	KOHOUTEK, MARTIN 1982 (62 NPN)

SPECTROSCOPIC VARIATIONS ; BINARIES

For 13 NPN, spectroscopic variations are due to an instability of the star (FG Sge ; proto-PN such as HBV 475, V 1016 Cygni, ...). For other NPN, variations are due to a binarity ; 5 nuclei are single lined (SB1) spectroscopic binaries :nuclei of IC 418 (P≃0.2 d.), NGC 1360 (30d.?), NGC 2346 (16.2 d.), NGC 6826 (0,238 d.), and A 36 (several d.); the nucleus of NGC 1514 has a composite (Ao+sd 0) spectrum.

Other NPN are known to be binaries : 9 astrometric, 4 eclipsing. In addition, about 20 objects with an advanced spectral type, and about 10 % of the WR-nuclei (4 to 5 objects) are possible binaries. On the other hand, Peimbert's type I PN with bipolar structure seem to have binary nuclei (Acker, 1983).

The occurence of binary and peculiar stars must be considered in working out the evolutionary study for PN.

NEW OBSERVATIONS

A new spectroscopic study is made by F. GLEIZES, for about 60 NPN, using a spectrograph with image-tube (dispersion ≃ 90 Å /mm). A new spectral classification is given, and new values of the temperature were calculated ; the results were published in 1984.

REFERENCES

ACKER A., 1983, 5e Journée de Strasbourg : Les étoiles binaires dans le diagramme H.R., p. 103
HEAP S.R., 1983, IAU Sympos. 103 (London), Reidel, p. 375
PERINOTTO M., 1983, IAU Sympos. 103 (London), Reidel, p. 323

Other references in ACKER et al (1982) Catalogue of the Central Stars of PN (Strasbourg).

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