Deep Imaging of Type I PN

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Progress in developing theories concerning the evolution of the central star and the surrounding planetary nebula requires a large, uniform set of data (monochromatic images, isophotes) which CCD imaging of PN can supply at present (Kaler, 1985; Balick 1987). One of the unknown parameters remains the mass budget of the (PN + central star) system. As a matter of fact, existing inventories of the measured ionised mass in PN reveal a shortfall as compared with theory. Nonetheless, since the major portion of the total mass loss occurs in the earlier ejection phases, a main objective was to detect the faint brightness peripheral nebular emissions and to provide quantitative measurement when possible of the global ionised mass.

Our goal in this study was to obtain deep exposures of some type I PN in specific wavelengths using narrow bandpass interference filters centred at Hα, HeIIλ4686, [NII]λ6583, [OIII]λ5007 in order to investigate their "bipolar" morphologies, and especially to search for the so-called secondary structures, if any, around the bright main nebula, and which could be relics of primary ejections by the evolving central star in the AGB phase. In addition, the absolute flux was also calibrated in the above-mentioned emission lines (including the outer structures) for all the PN observed. We have focused our attention on large diameter type I PN which are reputed helium and nitrogen-rich (Peimbert 1981, Peimbert & Torres-Peimbert 1983). The observations were performed using the Siding Spring Observatory *Advanced Technology* 2.3-m telescope and the LGEC-CCD/E2 detector having 22.5 μm pixel-size, providing the image-scale of 0.558 arcsec pixel^{-1}.

We have obtained monochromatic images, computed ionised masses, and measured absolute fluxes for : A 70 (50x45″), DS2 (185), IC 4406 (109x37), IC 5148-50 (130), K 1-3 (150x120), K 2-7 (150), NGC 6302 (285x90), NGC 6751 (145), NGC 6818 (36x34), SaWe3 (150x90). The PN overall dimensions (in parentheses above) are generally much larger than usually quoted in the literature. These faint extensions give them linear diameters greater than one parsec, and the related ionised masses are often larger than 1 solar mass. All give the appearance of bipolar outflow in a circumstellar medium with a strong polar density gradient, and clear evidence of developed Rayleigh-Taylor and Kelvin-Helmholtz instabilities is found. In the case of NGC 6302 we have also been able to derive the two-dimensional density structure from imaging separately in the two [SII] lines. A more complete description of this work will be shortly submitted to A&A for publication.

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