PLANETARY NEBULAE: THEIR EVOLUTION AND ROLE IN THE UNIVERSE
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Studies of Extragalactic Planetary Nebulae with VLT+FORS: Detection, Photometry and Slitless Radial Velocities of 535 PNs in the Flattened Elliptical Galaxy NGC 4697

R. H. Méndez (1,2), A. Riffeser(1), R. P. Kudritzki(2), M. Matthias(1), K. C. Freeman(3), M. Arnaboldi(4), M. Capaccioli(4), O. Gerhard(5)

(1) Munich University Observatory, Germany. (2) Institute for Astronomy, Univ. of Hawaii, 2680 Woodlawn Drive, Honolulu, HI 96822, U.S.A. (3) Mt. Stromlo and Siding Spring Observatories, Australia. (4) Osservatorio Astronomico di Capodimonte, Italy. (5) Astronomisches Institut, Univ. Basel, Switzerland.

We describe a procedure for the efficient measurement of large quantities of PN radial velocities (RVs) in early-type galaxies, using the Focal Reducer and Spectrograph (FORS) at the Cassegrain foci of the ESO Very Large Telescope. The PNs are detected using the classic on-band/off-band filter technique. The radial velocity is obtained by measuring and calibrating the displacement of a PN image on the CCD produced by the insertion of a grism in the light path. Since no slits are used, it is possible to measure RVs for all the detected PNs, irrespective of their number and distribution in the field. All the images needed to find the PNs and measure their brightness and RVs can be collected in just one observing run, without the complicated preparation procedures typical of multi-object slit spectroscopy. The RVs have errors of about 40 km/s.

In the first large-scale application of this method, we have detected 535 planetary nebulae (PNs) in the flattened elliptical galaxy NGC 4697. From our photometry we have built the [O III] 5007 planetary nebula luminosity function (PNLF) of NGC 4697. It indicates a distance of 10.5 Mpc to this galaxy, in good agreement with the distance obtained from surface brightness fluctuations and substantially smaller than a previous estimate of 24 Mpc used in earlier dynamical studies. The PNLF also provides an estimate of the specific PN formation rate: 6×10^{-12} PNs per year per solar luminosity.

Combining the information from on-band images with PN positions on dispersed, slitless grism images, we have obtained RVs for 531 of the 535 PNs. The slitless RVs provide kinematic information up to a distance of almost three effective radii from the nucleus. Some rotation is detected in the outer regions, but the rotation curve of this galaxy appears to drop beyond one effective radius. Assuming an isotropic velocity distribution, the velocity dispersion profile is consistent with no dark matter within three effective radii of the nucleus (however, some dark matter can be present if the velocity distribution is anisotropic). We obtain a blue mass-to-light ratio of 11. Earlier M/L ratios for NGC 4697 were too small, because of the too large distance used for their derivation.

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