

FOREWORD

The working group on Planetary Nebulae as subgroup of the IAU Commission 34 selected the Highlands of Europe for hosting the IAU symposium 155 devoted to the most beautiful and the most interesting – though small and unsubstantial – objects in our universe.

The Institute of Astronomy of the Innsbruck University spent a lot of time organizing the meeting with an exemplary rigour and boundless generosity, with a lot of refinements, and with particular effort for our colleagues from Eastern Europe, whose borders have recently been opened. The scientific organisation was built through many oral and written discussions with the members of the *Scientific Organizing Committee*, with whom I had the unique opportunity to work.

During the last years, an impressive number of papers were devoted to the planetary nebulae, the record being held in Europe by Pottasch and his collaborators: 75 papers appeared between 1986 and 1990, followed by Jacoby (36), Kwok (35), Clegg (31), Kaler (30). Thanks to all these works, and to those of all other specialists throughout the world, extensive surveys of planetary nebulae (PN) in our Galaxy and in the Local Group have been performed, both in the optical and in the radio domains. A number of new objects were discovered, mainly proto-planetary nebulae, through their IRAS colors. These studies allow, first, to give a better **classification** in Hydrogen-rich, Helium-rich, etc, PN and in better defined types of central stars.

Second, due to their intense emission lines, the PN are traceable throughout large distances, and should be characterized as “**stellar populations**” having specific (chemical, spatial, kinematical) properties: disc objects, halo objects, bulge objects,... , related to models of dynamical and chemical evolution of galaxies.

On the other hand, a large set of observations and theoretical work was devoted to the **evolution** of PN: OH/IR stars, Mira variables, carbon stars as proto-PN, and with white dwarfs as nuclei of old PN. The understanding of the formation of PN requires multi-wavelength observations. Large infrared molecular CO emissions and continuum excesses have been observed in PN, especially in young PN. Optical CCD imaging of PN revealed faint outer haloes which are probably remnants of the AGB winds. From the comparison of observed HR diagrams and the theoretical tracks, a mass distribution of the stars is deduced, depending strongly on the adopted theoretical tracks. A controversial comparison of these theories is needed.

First, the field of research usually referred to as “Planetary Nebulae” is not isolated from other fields; on the contrary, it represents one of the most interesting intersections between different areas, subjects, methodologies in the astrophysical world (e.g.: stellar evolution, stellar atmospheres, stellar winds, asteroseismology and thermal evolution, binaries; galactic populations and evolution,...). In addition, PN are *per se*, unrivalled “physical laboratories” (physical processes in nebular gas,

magnetohydrodynamics, photoionisation models, atomic and molecular data, dust, etc...).

A second, equally important theme will be the PN “evolutionary connection”. Still open problems remain like those concerning evolutionary scenarios from the Asymptotic Giant Branch (timescales, dredge-ups, link to OH/IR stars, physics and dynamics of envelopes,...) down to white dwarfs (composition, instabilities, birth-rates,...), and like those concerning the mechanism of PN formation, including the evolution of the central star, the interaction of an aspherical superwind with a spherical AGB wind, and interactions with the interstellar medium.

During the symposium, we brought advances on those uncleared paths, and found, on our way, new unsolved riddles, such as PG1159-pulsators, or proto-PN shells with water, Polycyclic Aromatic Hydrocarbons, and other exotic constituents.

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