

Preface

Active Galactic Nuclei (AGN) are a rapidly evolving and exciting field in modern astrophysics. Since the discovery of quasars, it has been suspected that the mechanism powering AGNs is mass accretion onto a supermassive black hole (BH). After the introduction of the so-called Unified Model, the numerous observed types of AGNs are believed to represent the same central engine but seen at different viewing angles. Recently, the discovery of supermassive black holes in nearby galaxy nuclei has shed new light on the importance of AGNs in galaxy evolution. The correlations between black hole mass and host galaxy structural parameters reveal a tight link between BH growth and galaxy evolution. Such link is probably the consequence of the feedback from the accreting BH, i.e. an AGN, on the host galaxy. Thus, AGNs are not just "exotic" objects, they represent an important phase in the life of all galaxies. Until very recently, imaging the inner engine of AGNs has been beyond reach at all wavelengths except for the radio band where interferometry has allowed to resolve sub-parsec scales.

Interferometry in the optical and near infrared has so far played a marginal role in Extragalactic Astronomy. AGNs are the brightest and most compact extragalactic sources, nonetheless only a very limited number could be studied with speckle interferometry and none with long baseline interferometry. The Very Large Telescope Interferometer (VLTI), which combine 8m-class telescopes with 100m-scale baselines, is starting to allow the study of moderately faint extragalactic objects with very high spatial resolution thus opening a new window on the universe. A flavour of what is to be expected in the future is provided by the first mid-infrared interferometric observations of nearby AGNs which have allowed to resolve the dusty torus invoked by the Unified Model.

This book compiles the lectures which were given during the Summer School on "Active Galactic Nuclei at the highest angular resolution: theory and observations", held from August 27th to September 7th 2007 in Toruń, Poland. Toruń, with its nicely preserved medieval Old Town (UNESCO World Heritage) is the birthplace of Nicolaus Copernicus (1473-1543) and hosts a university, named after him, nearest to the birthplace of Albert Abraham Michelson (1852-1931) – Strzelno. The school was opened by prof. Józef Szudy, the Dean of the Department of Physics, Astronomy and Applied Informatics of the Nicolaus Copernicus University in Toruń. It was organized within the frame of the ON THE FRINGE program¹ which is funded through the Marie Curie Action (conferences and training courses).

¹ <http://www.vlti.org>

The goal of the school was to present an overview of the field of Active Galactic Nuclei covering both the physical mechanisms, and high angular resolution observational techniques, such as adaptive optics, millimeter and optical interferometry. The main focus was on interferometry, given the importance of the VLTI and the future Atacama Large Millimeter Array (ALMA) for AGN studies. Practical sessions were centered on proposal preparation for the VLTI and data analysis.

The book contains the following lectures:

- "An introduction to active galactic nuclei: classification and unification", by Clive Tadhunter;
- "The Central Black Hole and Relationships with the Host Galaxy ", by Brad Peterson;
- "Disc Accretion in Active Galactic Nuclei", by Andrew King;
- "Ionized Gas in Active Galactic Nuclei", by Hagai Netzer;
- "The Toroidal Obscuration of Active Galactic Nuclei", by Moshe Elitzur;
- "AGN host galaxies", by Sylvain Veilleux;
- "Adaptive Optics: Observations and Prospects for Studies of Active Galactic Nuclei" by Ric Davies;
- "Studies of Active Galactic Nuclei with the VLT Interferometer" by Klaus Meisenheimer;
- "Prospects for AGN studies with ALMA" by Roberto Maiolino.

Lectures start with a general description of Active Galactic Nuclei, focussing on the different observational classes and the unified model (Lecture 1). Then they present in details all AGN components starting from the central supermassive black hole, its mass and relations with the host galaxy (Lecture 2). Lecture 3 describes the physics of the accretion disk surrounding the central BH, while Lecture 4 deals with the ionized gas clouds which provide the characteristic emission line signatures observed in all AGN spectra. Lecture 5 describes the physics and the existing models of the putative torus which is at the basis of the Unified Model while Lecture 6 focusses on the host galaxies of Active Galactic Nuclei and the connection with star formation. The three final lectures describe existing and future high spatial resolution observations with Adaptive Optics (Lecture 7), the VLTI (Lecture 8) and ALMA (Lecture 9). These lectures were given to about 60 students from all over the world. The students were also given lectures on interferometry and took active part in the practical sessions. We hope that this book will provide a valuable introduction on Active Galactic Nuclei for all newcomers in the field.

We wish to thank the lecturers for their very well-received presentations, for their many discussions with the students and for their contributions to this book. Special thanks go to the referees of each individual chapter. In particular we wish to thank the lecturers who presented the lectures on interfer-

ometry and the guided the students through the practical sessions: Françoise Delplancke, Gilles Duvert, Chris Haniff, Jean-Baptiste Le Bouquin, Florentine Millour, Markus Schoeller, Markus Wittkowski, John Young. Their contributions have not been included in this book since they were already presented in the book of the school held in Goutelas². Furthermore, we would like to thank the members of the Scientific Organizing Committee for their help in the preparation of the Summer School and the members of the local organizing committee for their efforts "behind the scene" to make this Summer School a success. We also wish to thank Julio Carreira, Manuel Monteiro and Elsa Silva from the Centro de Astrofísica da Universidade do Porto for their invaluable help in the organizing and running the school.

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Fig. 1. School participants