

# PHYSICS OF ACTIVE GALACTIC NUCLEI AT ALL SCALES

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ON BEHALF OF THE ORGANIZERS

**T**HIS WORKSHOP was held at ESO/Vitacura on December 3-6, 2003, and organised by Danielle Alloin, Poshak Gandhi, Rachel Johnson, Paulina Lira, Sebastian Lopez, Jose Maza, with support from the European Southern Observatory, FONDAF/Conycit, and the Universidad Chile.

The study of the physical processes at work in Active Galactic Nuclei has kept a large number of astronomers busy since the discovery of the first radio galaxies in the sixties... There is now a clear consensus about the source of energy in AGN, namely gravitational energy released through matter accretion onto a massive black-hole. Moreover, tremendous progress has been made in unveiling, analyzing and modeling the different components in AGN: the accretion disc, the jets of relativistic particles, the X-ray absorber very close to the central engine, the so-called “torus” which funnels the ionizing radiation, the surrounding clouds of dense material (in the broad-line region and in the narrow-line region), the jet-induced effects on larger scales, etc...

One of the goals of the Workshop being to train young researchers in the field, we started with a tutorial. As an introduction to the topic, Dr. Hagai Netzer gave a very comprehensive and overall picture of AGN physics. He pointed out that, in spite of today’s remarkable insights into the AGN phenomenon, some key questions remain open. One of them is the “energy budget problem”, that is the large discrepancy between the energy output required from the observed line emission (under dominant photoionization processes) and that extrapolated from the observed continuum energy distribution. Another key point is related to the detailed understanding of the physical processes hidden in the “alpha” parameter used to parametrize the viscosity of the accretion disc.

Following the tutorial, reviews and dis-

cussion about most of the AGN sub-systems were given by specialists in the field. Physical processes in jets were discussed through a multi-wavelength approach by Dr. Diana Worrall. The status of dense material in the form of clouds from the broad-line region and the narrow-line region, was successively reviewed by Dr. Bradley Peterson and Dr. Bob Fosbury. They presented our current knowledge about the structure, size and kinematics of these regions, as well as their links and relationship with other AGN sub-structures. The use of the variability of the central engine to probe material at distance from it (reverberation mapping) was reviewed in an exhaustive manner.

The mere survival and the physical conditions of cold material in the harsh -in terms of radiation- environment of an AGN were discussed by Dr. Jack Gallimore and Dr. Moshe Elitzur, including the dust component, the neutral and the molecular gas. Excitation of the molecular gas and heating of the dust particles are topics which were particularly discussed at the Workshop. The origin and the physical parameters of winds, in the context of AGN, were presented by Dr. Martin Elvis.

Another key question in AGN is that of their fueling mechanism: how is accreted matter carried inwards? Dr. Sharda Jogee discussed the interplay between an AGN and its environment, as well as various mechanisms to transport gas from tens of kiloparsecs to tens of parsecs. The role played by non-axisymmetries and transient nuclear bars was highlighted. The discussion on triggering of AGN at early epochs (redshifts 1 to 3) took us to a very new aspect in AGN studies: their role as cosmological probes.

Indeed, the formation epoch and formation mechanisms of massive black-holes is one of the most interesting problems in today’s astrophysics. At which stage in the evolution of the cosmic web did massive black-holes form? The problem can be addressed through the study of AGN populations at different redshifts, their location

with respect to large scale structures and the connections between galaxies and massive black-holes. Such new developments in AGN physics were presented in a complementary fashion by two reviewers, Dr. Omar Almaini and Dr. Niel Brandt.

Although it was generally felt that AGN studies had developed so well over the last three decades that a “plateau” in their understanding had been reached, they are again on the stage thanks to two factors: firstly, there is a wealth of new observational constraints (especially in the X-rays and in the IR/mm) to rejuvenate their physical modeling, and secondly, their role as cosmological probes make them of prime interest in the study of the early ages of the Universe.

Finally, two reviews were presented about the outstanding facilities available at observatories based in Chile for studying the physics of AGN, one by Dr. Chris Lidman and the other by Dr. Malcolm Smith.

The Workshop was attended by around 70 researchers, with a strong participation from South America, 53% including Chile. In addition to the reviews, a set of oral contributions and a large number of posters provided some recent and exciting results. The Workshop turned out to have a perfect format and size for boosting discussions and exchanges. The pleasant environment of the ESO grounds in Vitacura/Santiago also played its role in the success of the Workshop. And of course, we shall all remember the closing Chilean “asado” which took place on a sunny afternoon in the peaceful garden of Cerro Calan Observatory.

Pictures taken during the Workshop as well as the presentations made available so far (to be updated as more of them are received), can be found at: <http://www.sc.eso.org/santiago/science/sympcl2003.html>

A volume in the Springer series Lecture Notes in Physics is in preparation: it will contain the tutorial and the main reviews given at the Workshop.