Il Colle di Galileo

International Conference on Adaptive Optics for Extremely Large Telescopes III

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Abstract. The third edition of the International Conference on Adaptive Optics systems for extremely large telescopes took place in Florence on May 2013. These systems make it possible to obtain astronomical images with ground-based telescopes of similar, or in some cases even higher, spatial resolution than that achieved by space-borne telescopes in orbit beyond the Earth's atmosphere. Among the highlights of the Conference: discussion on the status of the systems to be mounted on next-generation telescopes with diameters greater than 30-40 meters.

Keywords. Large Telescopes, Adaptive Optics Systems, High Spatial Resolution

The design and development of the instruments for the largest astronomical telescopes (with mirrors of 4-10 meter diameter) is a rapidly developing field that is absorbing a large quantity of human and financial resources. Due to the complexity of the new instruments, it is no longer possible to design and build them in a single laboratory, but requires international collaboration by groups with different expertise and facilities. This is the case for a variety of instruments, including the Integral Field Spectrographs, the Large Field Cameras, and the High Resolution Cameras. A remarkable example of the need for coordination is represented by the design of new instruments for the next generation of optical telescopes with diameters larger than 20 meters, the so-called *Extremely Large Telescopes* (ELTs). Here, the consortia consist of more than 10 institutes distributed around the world. Once used at maximum capacity, these huge telescopes will help to answer fundamental questions such as "*What are the properties of the first stars and galaxies that formed in the Universe?*", "*Are there other planets similar to Earth"?* and "*Are we alone in the Universe?*".

In order to achieve their specifications, it is recognized that the large telescopes have to be equipped with adaptive optics (AO) systems, that is devices that reduce or even eliminate the disturbances on the images caused by the passage of radiation through the earth's atmosphere. The AO field involves a large international

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community that is working hard on the design of the apparatus for the ELTs. The need for a coordinated effort was the main reason for promoting the organization of a bi-annual meeting on "Adaptive Optics for ELTs". The first edition took place in 2009 in Paris and it was followed in 2011 by the second meeting in Victoria, Canada. The third edition (http://ao4elt3.sciencesconf.org) was organized by the Arcetri Astrophysical Observatory with the support of the headquarters of the National Institute for Astrophysics (INAF) from 26 to 31 May, 2013 at the Palazzo degli Affari of Florence, Italy. In spite of the current economic restrictions, in particular from NASA, it turned out to be the conference with the largest number of participants of the series (about 250). During the six days of the meeting, there were more than 250 contributions, including 20 *invited talks*, 65 *oral contributions* and 165 *posters* (the proceedings are available at http://ao4elt3.astro.it/proceedings). A significant feature of the programme was the presence of several industries and companies that are actively involved in the high-level technology of the AO systems.

The organization of the third meeting came in the wake of recognition of the excellent work performed by INAF and the Arcetri Observatory in the field of AO, in particular for the FLAO (First Light Adaptive Optics) mounted on the Large Binocular Telscope (LBT) and in use since 2010 on Mt. Graham in Arizona (USA). The exceptionally high-resolution images obtained with FLAO-LBT represent an outstanding improvement for ground-based optical telescopes. These images are of similar, or in some cases even higher, angular resolution than those obtained in space by the Hubble Space Telescope. This has been made possible through the development, led by INAF, of the two key features of the FLAO system: the secondary adaptive mirrors and the pyramid wavefront sensors.

In summary, the scientific programme focussed on: the design and scientific goals of the adaptive ELTs, the pathfinder projects developed for the 4-10 meter class telescopes, and new ideas for future ELTs. Several sessions were devoted to discussions of the scientific motivations for the three current ELT projects: the Thirty Meter Telescope, the Giant Magellan Telescope, and the European-ELT. The session attracting the largest turnout was that presenting the results of the AO systems currently operating in telescopes of the 4-10 meter class. These include: "GEMS" the multi-conjugate system with artificial laser stars mounted on Gemini South (USA); "MagAO" the first optical system that will shortly be operating on the Magellan telescope, derived from the FLAO system on LBT; "GPI" and "Sphere" the two planet finders for Gemini South and the Very Large Telescope (ESO).

It is now clear how the development of the secondary adaptive mirrors and the wavefront sensors has dictated the design choice for the AO systems of the current 4-10 meter telescopes and the future ELTs. In conclusion, the investments made by INAF and the industrial partners have allowed the Italian astronomical community to achieve a leadership in the field of AO that guarantees it a prominent role in the development of the instruments for future telescopes of larger dimensions.

Fig. 1. Group picture of the participants at the AO4ELT3 Conference. Palazzo degli Affari, May 30, 2013.

Dr Simone Esposito is the leader of the Adaptive Optics Group of the Arcetri Observatory. The group has developed adaptive secondary mirrors and high order correction pyramid sensors for several international projects and telescopes, such as LBT, VLT, Magellan, GMT and E-ELT. He is currently the PI of the LBT First Light AO system (FLAO) and led the commissioning campaign of the First Light AO systems for LBT in 2010-2013.

The engineer Luca Fini is the coordinator of software development in the Adaptive Optics Group of the Arcetri Observatory. His interests include: software engineering, computer networks, high performance computing, data analysis, control and real-time systems for astronomical applications.