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WORKSHOP SUMMARY

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RESUMEN

Se presenta un breve sumario de la primera conferencia sobre "Ciencia con el GTC", poniendo un énfasis especial en los aspectos relativos al estado actual de la instrumentación y los objetivos científicos que se han diseñado para aprovechar las posibilidades observacionales que ofrecerán los nuevos instrumentos del GTC. Se incluye una visión global sobre el estado de la Astronomía en los paises del consorcio y un resumen de conclusiones de la discusión sobre nuevas ideas e iniciativas para futura instrumentacón.

ABSTRACT

A brief summary of the first workshop on *Science with the GTC* is presented, with emphasis on those aspects related to the present stage of development of the instrumentation and the science drivers designed to reap the benefit of the new observing capabilities offered by the future GTC instruments. A concise overview of astronomical activity in the partner countries is included, as well as a report on the conclusions of the panel discussion for new scientific ideas and initiatives for future instrumentation.

Key Words: **ASTRONOMICAL INSTRUMENTATION: TELESCOPES**

Science with the GTC 10-m Telescope (Granada, España, 5-8 febrero 2002)
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1. A WORKSHOP FOR THE FUTURE

This is the first of a series of workshops devoted to the preparations for the science to be achieved with the GTC. Let us start by congratulating the organizers since this meeting has been a great success. First of all, the participation was high: over 170 astronomers were registered, and 64 talks and 48 poster papers were presented, testifying to the high quality of the science discussed. In addition, the presence of technological firms involved in the GTC and the real impact of the workshop on society and the media give us an idea of the magnitude of this scientific event.

We have learned that the GTC will be fully operational by the year 2004 with at least three instruments for Day One—CanariCam, OSIRIS, and ELMER—to be followed by EMIR two years later. It has been emphasized by the instrument teams at this meeting that this instrumentation has many innovative aspects that will make GTC a competitve astronomical machine in the years to come. CanariCam wil be a multimode mid-IR camera for the GTC, working in the thermal infrared between $\sim$7.5 and 25 μm and providing spectroscopic, polarimetric, and coronographic options. OSIRIS will be a tunable imaging system and a low resolution, long slit, and multiobject spectrograph of the GTC working in the optical range. This is a new generation instrument using original observing techniques including tunable filters and charge shuffling in the CCD detectors. ELMER is the backup Day One instrument of the GTC for imaging and intermediate resolution long slit spectroscopy over the whole optical range. Finally, EMIR will be a wide field multiobject spectrograph and camera working in the near infrared; it will allow observers to obtain hundreds of intermediate resolution spectra. The project team has revealed the current stage of the project and the remaining milestones to be achieved until the final completion of the GTC.

All the instrument teams have given abundant information to the user community throughout the conference on many relevant aspects, ranging from the current stage of development and future operation of the instrumental projects to the science drivers behind the instrument programs. This exchange of updated information and rapid access to members of the teams has, in my opinion, been one of the keys to the success of this meeting, not only because the user community has taken advantage of this close contact with the instrument teams and the Project Office but also because of the fresh input that the teams have received from the future user community of the GTC. This kind of feedback is always very useful, allowing the identification of real people with specific tasks.

2. "BIG" PROJECTS AND SCIENCE DRIVERS

During this meeting we have had the opportunity to learn about the stage of development of other

TABLE 1

NUMBER OF CONTRIBUTIONS PRESENTED ON THE TELESCOPE AND/OR INSTRUMENTATION

	#
GTC	6
All Instruments:	65
CanariCam	14
ELMER	4
OSIRIS	24
EMIR	18
LIRIS & calibrations	5

"big" astronomical projects, either planned for the future or already operational, and several talks were delivered on this and related subjects such as:

1. A comprehensive overview of the European VLT in Chile
2. The current stage of development of the *Hubble Space Telescope* Advanced Camera for Surveys
3. The GTM (Gran Telescopio Milimétrico) project and its scientific potential—especially for cosmology—combining the GTC and GTM/LMT
4. X-ray surveys with *XMM–Newton* and *Chandra*
5. Future follow-up science of the *SIRTF* GTO Cosmological Survey Program

A significant step forward for the construction of astronomical instrumentation in Spain has been the completion at the IAC of LIRIS, a near-infrared low–intermediate resolution spectrograph for the 4.2 m William Herschel Telescope (WHT), to be commissioned on the WHT in 2003 January. Table 1 shows an approximate overview of the number of contributions presented directly related with the GTC and/or with a given instrument. The total number of papers devoted to instruments (including LIRIS and calibrations) is 65 and another six contributions were devoted specifically to the GTC.

Fortunately, the science drivers demonstrated at the workshop have been many and varied (low mass objects, stellar astronomy, galaxy evolution, chemical abundances, star formation, starbursts, AGN, and cosmology) and have generated discussion of many science cases and projects. This wide range of scientific interests, in my view, shows the great potential of our user community, which in many cases appears to be driven by the clear determination of the younger researchers. Table 2 shows an approximate overview (a sort of "top 40") of the number of papers presented in the workshop, roughly grouped according to astronomical subject. From a total of 85 papers devoted to the six broad areas, the main science drivers are evenly populated (more or less, depending of your favorite subject grouping). This again clearly demonstrates the wide range of interests indicated above.

TABLE 2

NUMBER OF CONTRIBUTIONS PRESENTED ON THE MAIN SCIENCE DRIVERS

	#
Planets & low mass objects	12
Stellar astronomy	12
Galaxy evol. & chem. abundances	16
Star formation, starbursts, & AGN	19
Cosmology	14
Surveys	12

It is important to emphasize here that a large fraction of the projects appear especially designed to take advantage of the innovative aspects of the new instrumentation. Several important items for the future operation of the GTC have also been presented, including the study of the infrared quality of the sky of the Observatory and GPS water vapor monitoring at the site, new approaches in data reduction, the commissioning policy of the GTC, the design of observing mode strategies, and astronomy support.

3. ASTRONOMY IN THE GTC PARTNER COUNTRIES

Historically, astronomy was a major discipline in the world of *al-Andalus*, (i.e., the territory under Islamic rule in the Middle Ages that comprises a large part of present-day Spain), which flourished especially during the last Naṣrid Kingdom of Granada. The development of astronomy during this period reached an extraordinary level, which later had a decisive influence on the development of modern astronomy in Europe. From this perspective, this first workshop on *Science with the GTC*, held in Granada can be seen to form a bridge between a rich history and the promising future of astronomy in our countries.

The intention of this workshop was to familiarize the future user community of GTC with the scientific capabilities of the telescope and its instrumentation and, more importantly, to promote the exchange of ideas and scientific collaboration among the astronomers of the three communities involved in the GTC. It has been a real tool for developing the necessary synergies among research groups of the GTC partner countries.

Modern Astronomy in Spain started only very recently. Twenty-five years ago, astrophysics was a rather exotic discipline in most Spanish universities. In recent years, however, the impact of the new observatories based in the Canary Islands and in Andalusia, as well as our increasing technological involvements in the space sciences, have promoted astronomy and its related technological applications. We have learned from the head of the Spanish National Plan for Astronomy and Astrophysics that the Scientific production in astronomy and astrophysics in Spain has now reached over 5% of the world total, and the relative impact normalized to the world has increased from 2.1% (1993–7) up to $\sim$9.5% (1996–2000). The GTC project helped to develop astronomy and astrophysics in Spain into "big" science and, more importantly, has enormously increased the technological return to society.

We all know how Mexican astronomy stems from a marvelous and impressive ancient tradition. Modern astronomy in Mexico has a renowned tradition, notably since the Guillermo Haro era. Several important technological projects have been developed, and others are under way, notably the GTM consortium. We have learned how many well-established groups in Mexico DF, Puebla, Ensenada, and many other places throughout the country are now actively working in astronomy. Some of these groups are deeply involved in the GTC.

The case of the Department of Astronomy at the University of Florida has perhaps previously been less familiar to many of the participants of this first workshop; at the same time (and possibly also for this reason) it is truly impressive. We have learned about the enormous technological capacity of this department, which is associated with a small and select group of faculty, postdocs, and students. In my view, this department may be considered as an example to all of us of how the development of front-line instrumentation may provide precious "added value" to academic endeavor. I find it a real privilege for the Spanish astronomical community to share a scientific partnership with these two communities, and we all look forward to a productive parnership with many scientific successes and flourishing human interrelations.

4. PANEL DISCUSSION: THE NEW INSTRUMENTATION FOR THE GTC

An important aspect of the Workshop has also been to explore new scientific ideas and initiatives regarding future instrumentation for the GTC. Several working and interest groups have met during this meeting in order to explore possible collaborations and/or initiatives. With this idea in mind, a panel discussion was organized in order to explore possible new initiatives for the future of the GTC. Among other suggestions, it was clear that the construction of an optical intermediate-to-high resolution spectrograph is the next step forward, which indeed appears to be greatly in demand by the community. Last but not least, there must, of course, be a full development of all the technical aspects of adaptive optics needs for the future of GTC.

I am very grateful to the Local Organizing Committee for arranging this magnificent conference in Granada. I would like to thank the Project Office, the GTC Project Scientist, and all the members of the instrument teams for their continuous efforts.

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