VLT Working Group for Scientific Priorities – Status of the Work

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In its May 1993 session, the ESO Scientific and Technical Committee formed a working group to propose a set of main scientific priorities to serve as guidelines for future discussions on the VLT and its instrumentation. A number of working groups on this matter existed during the early definition phase of the VLT. Their reports are included in the proceedings of the 2nd VLT Workshop, held 1986 in Venice. On that basis, ESO worked out the VLT Instrumentation Plan which was widely circulated in the community in June 1989 and discussed by ESO committees. Between the preparation of the Blue Book and the commissioning of the first unit telescope, about 12 years will elapse – even more for the other unit telescopes. Being roughly half-way between these two events, the STC thought it timely to reassess these scientific priorities for the VLT and the instrumentation plan, taking into account recent scientific and technical developments. Another goal of this exercise is to provide scientific priorities which can later be used as guidelines in prevision of future problems, technical trade-off or descoping.

After some changes during the summer, the group is now composed of STC members K. de Boer, B. Marano and L. Vigroux (chairman), ESO representatives J. Wampler, J. Walsh and S. D'Odorico and two external experts, B. Fort and R. Kudritzki.

To involve the ESO community in this activity, we circulated during the summer a questionnaire about the scientific programmes to be done with the VLT. The real work of the group started in September 1993. The main line of our reflection is organized around several steps:

- review the capabilities of other observatories in the VLT era, both on ground and in space. Scientific programmes for the VLT have to be examined in the context of what will be done at the other observatories,
- assess the uniqueness of the VLT, both as single 8-m telescope or with the four telescopes,
- define a set of scientific domains in which the VLT with an appropriate instrumentation will have the capabilities to create a unique breakthrough,
- make recommendations in several areas of the VLT: telescopes, detectors, instruments and operations.

The first part of this work is now completed. Preliminary versions of the other points have been presented and discussed during the November 1993 STC meeting. We do not yet have a detailed new instrumentation plan, but we are almost getting there. I will indicate here only the general directions to get a flavour of our work.

To define the scientific priorities, we have not tried to make an extensive survey of all the astrophysical problems which can be tackled with the VLT, but rather to focus on a few scientific domains in which we expect that the VLT will provide a significant gain over existing capabilities. For the time being, we have selected four domains, star formation and young stellar objects, starburst galaxies and active nuclei, formation and evolution of galaxies, and formation and abundances of the elements. For each of these themes, we have identified programmes which can be done with the planned instruments, and those which require new instruments. This part of the work must be followed in two directions, elaborate on these themes, and incorporate one or two additional themes.

For the telescopes and the instruments, we have agreed on two main directions: emphasize the importance of the infrared, and the need for very large detectors.

Arguments for supporting infrared work on the VLT are overwhelming. Infrared astrophysics deals with crucial areas such as star-forming regions which are generally embedded in dusty clouds and accessible only in infrared, or detection of very distant galaxies which are about 5 to 10 times brighter in the infrared than in the visible. The largest gain provided by large telescopes is for infrared wavelengths where observations are limited by the background. In this case, the sensitivity increases as D^4, D being the telescope diameter. In addition, a revolution in IR detectors is now taking place. We should expect a boost of IR observations similar to the dramatic developments of optical observations coincident with the use of 2D electronic detectors 25 years ago. New techniques of imaging at the diffraction limit with adaptive optics or interferometry are already operational in the infrared, but might not become available in the visible in the next few years. Together with the detector revolution and the increase of telescope size, they will provide an enormous gain in sensitivity for point source observations. Last but not least, the VLT will become operational after the ISO mission which is expected to create a scientific breakthrough with its sensitivity improved by a factor of 50 to 100 over IRAS. New scientific problems will be uncovered and will require new sets of infrared observations.

The present VLT instrument package is designed around CCDs that are about state-of-the-art at the present day. Recent developments in the CCD mosaic techniques and progress of the IR arrays will allow a new instrument design, with a good image sampling on a large field. The VLT has been optimized for image quality, and the pixel sampling must be optimized accordingly. However, further analysis is needed to assess these instrument concepts.

During the last STC meeting, it was decided to continue this work along the line defined in the preliminary report. ESO will strengthen its participation, both in scientific priorities definition, and in the assessment of the new instrument concepts. A final version of the report will be presented at the next STC meeting in May 1994 and discussed more widely in a workshop which will be organized by ESO before the summer.