THE USES OF A VLT FOR COMPLEMENTING OBSERVATIONS WITH RADIO AND SPACE TELESCOPES

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It is now evident that major advances in observational sensitivity in other regions of the electromagnetic spectrum invariably lead to heavy demand for complementary observations with existing large (3- to 5-meter) optical/infrared (O/IR) telescopes, and that such observations are often essential to the interpretation and understanding of phenomena revealed by the former. The Einstein X-ray mission, the International Ultraviolet Explorer (IUE), the Very Large Array (VLA) and the recent Infrared Astronomical Satellite (IRAS) are all clear demonstrations of this effect.

Plans now exist for a number of new astronomical observing facilities which, together with planned improvements in existing facilities, will provide several orders of magnitude increase in sensitivity. In all cases, one can identify many areas where essential complementary O/IR observations are only possible if a VLT-class telescope is available.

At optical and near-IR wavelengths, the Space Telescope, scheduled for a 1986 launch, will provide detailed images (resolution 0.1 arc sec) with a limiting magnitude for point sources of $m_V \gtrsim 28$. The VLT will provide essential complementary capability such as better sensitivity for extended sources, higher signal-to-noise ratio for observations, particularly spectroscopy, of objects brighter than the sky background and, through speckle techniques, higher angular resolution.

In the thermal IR, the success of the IRAS survey has accelerated plans for more sensitive cryogenic telescopes in space (GIRL, ISO and SIRTF). A VLT is essential for optical/near infrared confirmation and study of sources observed by these missions and for moderate to very high resolution spectroscopy in atmospheric windows.

At radio frequencies, results from the VLA are already driving many O/IR observing programs. This pressure is expected to increase substantially as the VLA matures, particularly in the area of spectral line observations, and as dedicated Very Long Baseline Interferometry (VLBI) facilities begin operation. VLT-type telescopes are essential for observations such as O/IR imaging of optical counterparts to radio sources and spectroscopic line mapping.

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In the ultraviolet, Space Telescope will provide more than a tenfold increase over IUE in spectroscopic capability together with high-resolution imaging. Similarly, in the X-ray region the planned AXAF facilities class mission will provide 1 to 2 orders of magnitude improvement in sensitivity over missions such as Einstein, EXOSAT, and ROSAT. The planned γ-ray observation will provide a major observational capability at even higher energies.

In summary, in the same time frame as the VLT, there are plans to orbit a number of space observing facilities which will each provide 1 to 3 orders of magnitude in sensitivity over missions flown to date. Together with enhancements and new facilities operating at radio frequencies, these can each be expected to obtain observations for which a VLT is absolutely essential if complementary O/IR observations critical to the understanding of the new sources are to be feasible.

This predictable synergism between observations with a VLT and those with other facilities raises a number of operational issues. Procedures need to be developed for allocation of observing time to programs which require observations from multiple facilities and to ensure convenience of access to archival data from individual facilities. There is a further question of planning for long-term programs which would require very substantial amounts of time on these major facilities and which can only be carried out if this observing time is available.

DISCUSSION

H. Smith to D. Hall: Important as Space Telescope will be, it's also necessary to point out that large ground-based telescopes are two orders of magnitude more cost-effective per photon gathered! This is true both in their construction costs and in their annual operating costs. Specifically, the 2-meter-class ST costs more than 1000 million dollars, whereas a 10-meter-class ground-based telescope - collecting more than 10 times the number of photons per year - costs 100 million dollars. Likewise, the annual operating cost of ST will exceed 100 million dollars per year, whereas the large ground-based telescopes should operate at under 10 million per year, giving again their two orders of magnitude superiority in cost/photon.

In other words, it will be absolutely urgent to use ST only for such observations as it can uniquely carry out, leaving vast areas of astronomy as best done from the ground for reasons of cost alone (not to mention that VLT's are also intrinsically superior in some areas).

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