SMALL TELESCOPES AND RESEARCH FROM SPACE

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The number of artificial satellites dedicated to astrophysical research is increasing rapidly. Nearly 30 satellites currently under development or in the early planning stages will be in orbit within 10-12 years and will have more sensitive detectors and better data-processing technology as a result of current research. Many of the galactic and extragalactic objects discovered by the new technology are variable on surprisingly short time scales ranging from sub-seconds to many months. The new variable objects include but are not confined to: neutron and binary stars; quasars (and associated active centers of galaxies); newborn infrared stars and associated clouds; the coronal activity of main sequence stars; cataclysmic variables (white dwarfs in binaries); and novae, supernovae and remnants. We now realize that the short time-scale variations of many unusual stars and active galactic nuclei demand that ground and space data be taken as close in time as possible and that they be carefully planned and coordinated.

Astronomers face a situation where precise and simultaneous observations are necessary in order to make further progress and to decide between competing models. Present worldwide astronomical research plans call for billions to be spent on space-based technology, but neglect the coordinated ground-based optical support program needed. This haphazard situation will continue indefinitely unless telescopes can be built that are dedicated to space astronomy. An important step forward in ground-based support of astronomy satellites would be to build six new telescopes of the 2.5 meter class (e.g., Michigan, Dartmouth, MIT or angle design) which would be located to provide time-continuous support of any satellite and cosmic source in either hemisphere.

The total 20-year budget is shown in Table I and may be compared with the worldwide astronomical satellite effort during the same period. This table shows that the total cost of building and maintaining the ground-based support program is less than 1% of the cost of astrophysical space research, less than a recent expenditure for repairing the solar maximum mission satellite or less than the cost of putting one of the large space observatories into orbit. If the ground-based support program is not provided for, then much significant science on the spectral energy variations of many cosmic sources will be lost. In some

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cases astronomers would not be able to distinguish between competing models of the most exciting sources.

The question is what we can do now to alleviate the situation. I think that we can proceed in two steps:

1. By creating a clearing house for all observatories' schedules worldwide. Satellite observers in need of ground-based support could contact a clearing house in the hope that somewhere there is someone observing with the right instrument who is willing to cooperate.

2. With the advent of new detectors like the CCD and expected array detectors for the IR region 1.5 μm to 5 μm and 10 μm to 20 μm, the small telescope of near 1-meter class can play an important role in providing ground-based support and follow-up observations for astronomical satellites. It has been shown that a 20 mag star can be easily observed with a 0.9-meter telescope.

If some observatories would agree to dedicate their near 1-meter class telescopes to the project and maintain them, then through international effort those telescopes could be equipped with sets of identical instruments. These instruments could also be used for follow-up observations in support of surveys done by satellites. One is immediately reminded of an exciting program of the astrometric satellite HIPPARCOS. This satellite will gather very high precision astrometric data on 100,000 stars brighter than 12 mag. Additional, somewhat coarser accuracy observations will be generated by satellite auxiliary sensors on more than 400,000 stars. This data, if followed up by observations from the ground, will increase our knowledge of stellar distances, absolute magnitudes of stars, and the structure of HR diagram by the order of several magnitudes. What a perfect project for small telescopes!

This international organization, if formed, could also provide data for other observing programs requiring coordinated multi-site observations such as asteroids and comet nuclei rotation, or observations of oscillating astronomical phenomena as suggested by Sterken and Christensen-Dalsgaard (February 1985, "New IAU Commission?" IAU Bulletin 53, pp. 22-23). For logistical reasons, all of the involved observatories should be tied together and with a disposition center by telex.

Table I

Budget for Groundbased Support of Satellites

Items required over 20 years	Cost (millions 1985)
Six 2.5 meter angle telescopes	12
Six telescope domes	6
Instrumentation (exchanged every 5 years 6 X 500K X 4 computers)	12
Personnel (30K/yr X 20 yr X 6)	
Three observers (professional astronomers)	11
Three night assistants	11
Two engineers (BS degree)	8
Two technicians	8
Two data processors	8
Miscellaneous supplies (100K X 6 X 20)	12
Disposition center (100K X 20)	2
	90/20 years

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