# letters

## Masters in instrumentation

In response to your October news article (page 85) on future prospects for jobs in physics, we in the physics department at the University of California, Santa Barbara would like to describe our successful six-year-old experiment in graduate education at Santa Barbara: the Master of Science in Instrumentation program. We

**GUEST COMMENT**

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wish to suggest to other departments that such a program stands to benefit from recent developments in technology as well as changing attitudes about the purpose of graduate education.

The motivation for creation of the MSI program by Vincent Jaccarino and Virgil Elings in 1972 was to provide intermediate-level graduate training for the sort of person research laboratories seemed to be crying out for: namely, a "master of instrumentation," who is able independently to translate ideas relating to a scientific measurement into the design *and* construction of a professional-quality electronic instrument.

The MSI program is popular at UCSB; its yearly average of ten entering students accounts for roughly half of the total entering physics graduate-student population. The opportunity to receive "hands-on" training in a vital applied area with a commitment of only two years appeals to an increasing number of capable students who have rejected the alternative of seeking a PhD degree—which is several years down the road and too ambiguously linked to future goals given present-day employment trends.

These MSI students become active participants in the revolution that is microelectronics. Ironically, such a program can return some of the excitement and "action" of solid-state electronics back to a physics department where, of course, it all began two and three decades ago. The revolution in large-scale integrated electronics is notable not only because it provides such astounding tools at exceedingly low cost but especially because

it has made this technology more accessible to *non-specialists*.

The admissions policy of UCSB regarding MSI applicants has been to determine, primarily from grades, whether in the past a given student has applied himself and done well with whatever he has attempted. Prior knowledge of electronics is not a requirement. An extreme emphasis is placed on individual work in the laboratory. It is where projects are discussed, designed and constructed. It is in the laboratory alone that there occurs that moment of truth for every MSI student: can he make something *work*? For most students this is the first time that such a demand has been made of them, and for some it clearly provides a rude awakening from the spoon-feeding of most undergraduate experiences.

The first year of the program is devoted to work on a series of projects of typical duration two to three months. The students are largely responsible for finding these ideas from within the department or from other science faculty on campus. The projects must have real "clients"—those who have a vested interest in the timely and successful completion of the project.

The second year is devoted mainly to a single large-scale project. It must be original and challenging and be fully documented upon completion. One exciting aspect of microelectronics is that the resulting "intelligent" instruments may be easily redesigned to meet altered specifications, often by simple software changes. The emphasis, again, is on the conceptual design rather than the tedious details of hardware and circuitry, from which the "new" electronics has largely liberated us. Some past instruments include ultrasound cardiac dimensioning, light scattering immunoassay, a sensitive gravimeter, speech display for deaf children and a thermal-dilution cardiac output computer.

Perhaps not surprisingly, the graduates of MSI and UCSB are finding a variety of attractive employment opportunities. A number of them have accepted offers from university research groups, mainly in physics, biology and medicine. Others have taken positions in industrial research labs, often in the semiconductor area. These include Stanford Research Institute, Hewlett-Packard, TRW, IBM and National Semiconductor. Indeed, for a good student the MSI degree may produce a wider spectrum of employment options than would a PhD in applied physics.

Obviously, instrumentation expertise is vital for any serious experimental research effort. Hence, it can be argued that a physics department can itself benefit from such an in-house degree program in instrumentation.

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## Index to astronomy articles

The huge breadth of topics encompassed by modern astronomy and astrophysics makes it almost impossible for the instructor of an introductory astronomy course to be sufficiently knowledgeable about every topic he must cover to be able to field every question his brighter students may raise or to discuss current problems in the light of the most recent results. This problem is also encountered in many other fields of physics. The series of "Resource Letters"[1] published by