

IV. OPPORTUNITIES AND NEEDS IN EDUCATION AND TRAINING

An NSF program should play an important role in strengthening education in computational physics. We see two primary objectives: (1) to train the next generation of computational physicists, and (2) to integrate computation into the standard physics curriculum.

The growing use of computation in basic and applied research has created an increasing demand for computational physicists. Computational scientists find employment in universities, national laboratories, the computer industry, and a host of industries, ranging from aerospace to Wall Street, for which numerical modeling has become an important tool. Computational scientists require backgrounds in applied mathematics, computer architectures, and software engineering, as well as in their own disciplines. A number of universities have established interdisciplinary programs in computational science and engineering. However, the design of such programs and of the individual courses that make them up is time consuming, and often not valued as highly as it should be within the university. The creation of course software is particularly labor intensive, and often requires staff support and infrastructure. Seed funding for such endeavors would be very valuable, as would funding for workshops that would help to identify and draw attention to approaches that work well.

Graduate and postdoctoral fellowship programs that attract outstanding young people to computational physics would be particularly valuable investments. As already indicated, large computational projects often involve interdisciplinary collaborations and/or geographically distributed groups. Fellowship programs that maximize the opportunities of students to work with the diverse senior members of such groups would be particularly valuable. If properly designed, fellowship programs can help to foster the broad education that computational physicists need. For example, the highly successful Department of Energy Computational Science Graduate Fellowship Program requires that fellows take courses in applied mathematics and computer science, as well as in their own disciplines. It also provides opportunities for summer internships at national laboratories, and for the presentation of research results at meetings attended by fellows from throughout the country.

Greater integration of computation into the core curriculum could have a dramatic impact on undergraduate education in physics. It would enable faculty to go beyond the relatively small number of exactly solvable problems usually presented in the classroom. It would allow students to watch the development of complex systems and obtain hands-on experience regarding the effects of changing parameters, initial conditions, or even the laws of physics. We believe that the sense of excitement that would be generated would help to attract more young people to physics and give them a better understanding of it. The major impediments to progress are the human and financial resources needed to produce course software, and the physical infrastructure needed to make use of the software. Of course, much work is being done in this area. Additional support from the NSF would accelerate and enhance it.