Nuclear Science Program at the Oak Ridge National Laboratory

Research

Funding	FY 2000: $6714K	FY 2001: $6738K			
Staffing	Regular Ph.D.	Tech/Admin	Postdocs	G.S.	Undergrad.
FY 2000	24.5	4.5	2	16	2

Facility Operations

Funding	FY 2000: $7191K	FY 2001 $7002K			
Staffing	Regular Ph.D.	Tech/Admin	Postdocs	G.S.	Undergrad.
FY 2000	5.8	19	0	2	0

Users:	Total	Ph.D.	G.S.	Undergrad.	DOE/NSF/Other/Foreign
FY 2000	107	61%	34%	5%	61%/5%/3%/31%

Staff numbers include direct charges only. For FY 2001 reduce research staff by 2 Ph.D. and 1 technical, and reduce facility staff by 1 Ph.D. and 3 technical.

Main Research Initiatives

The construction of the SNS at ORNL by the Basic Energy Sciences Office of DOE presents an extraordinary opportunity for nuclear science research. The ORNL Physics Division is leading a group that will propose to construct an underground neutrino research facility near the neutron production target of the SNS. Neutrons are produced at the SNS by bombardment of a mercury target with a 2-milliamp, 1-GeV proton beam. The combination of SNS beam energy, beam power, beam pulse structure, and the ability to design an underground facility suited to neutrino research will provide the world's most powerful medium energy neutrino research program. The Oak Ridge Laboratory for Neutrino Detectors (ORLaND) will be a user facility for a broad range of neutrino science experiments. The facility is designed to accommodate a large tank capable of housing a 2000-ton experiment, and several smaller experiments of 100- to 200-ton size. Preliminary engineering estimates indicate a cost of approximately $62 million including the fully instrumented large detector and two smaller detectors. It is estimated that the operating cost of the facility will be between 2 and 3 million dollars. Since no cost for construction or operation of the SNS will be incurred, ORLaND will be extremely cost-effective to the Nuclear Physics community. The underground facility must be built during the construction of the SNS, mandating a construction start for ORLaND in FY 2004 or early FY 2005. A preliminary decision has been made on a site for ORLaND that is acceptable to both the SNS and ORLaND.

Facility Upgrades

The Holifield Radioactive Ion Beam Facility (HRIBF) is the only ISOL facility in the United States that can provide both neutron and proton rich beams at energies needed for nuclear structure and nuclear astrophysics research. The HRIBF is fully operational and can provide over 100 different species of exotic beams with intensity greater than 1000

particles/second. The proposed RIA facility will provide a major advance in the production of radioactive ions and would be by far, the best facility in the world for RIB research. However, RIA, should it be constructed, will not be available for research for at least a decade. It is critical to the success of RIA that the United States maintain an infrastructure in RIB research that produces the students and faculty needed to carry out research at RIA. A plan to do this should be created now. The HRIBF should form a major part of that plan. It is also important to fully provide the funds necessary to operate the HRIBF and to provide upgrades that will allow the U.S. RIB Program to remain competitive prior to the startup of RIA. The HRIBF currently requires a budget of $7600K to provide ~1200 hours of RIB beam on target per year. The facility is capable of providing 2000 hours of RIB beam on target in its current configuration. Operation at this level would require about $9000K for operation in FY 2001 dollars. Furthermore, a series of upgrades costing between 3 and 25 million dollars each could increase the intensity of the HRIBF radioactive ion beams by over three orders of magnitude as well as provide a much larger variety of beams. Obviously these upgrades would lead to a much broader research program than is possible with the existing facility. The research already carried out at the HRIBF has been received with considerable interest and has indicated the excellent potential for future work in this field. However, it is necessary to invest in the current infrastructure if the full potential of RIA is to be realized a decade from now.

Budgets

The nuclear physics programs at ORNL, and similar programs at other national laboratories, are in a crisis with regard to their operating budgets. At ORNL the operating budgets for both nuclear physics research and facility operation have been flat for the past four fiscal years. In the same time period costs have risen in excess of 30%. These two facts have led to a staffing crisis in our programs. Over the past several years we have eliminated nearly all temporary positions including postdocs. Since the beginning of FY 2000 we have had to eliminate eight staff positions. If our operating budgets are flat again in FY 2002 we will lose as many as five additional positions. In March 1996, DOE convened an Operating Budget Review for the HRIBF. The conclusion of this review was that a budget of $7500K was required to operate HRIBF in FY 1997. Our current budget is $7002K (~6200K FY97$). To operate the HRIBF at a level of 1200 hours of radioactive beam on target in FY 2001 requires $7600K. With our present configuration we are capable of providing in excess of 2000 hours of radioactive beam on target, while carrying out the vigorous beam development program required to sustain the health of the facility. Operation at this level would require an operating budget of about $9000K per year. The HRIBF is currently oversubscribed by a factor of between 3 and 5 relative to what we can afford to run. The 1996 long-range plan documented the position of RIB physics as one of the leading new fields of nuclear science. Furthermore, a major new construction initiative at the level of $800 million is being proposed for this field. Without investment of more funding into both research and operation of the existing RIB facilities, the research promise of the RIA will not be realized.

In summary, in order to maintain **status quo only in FY 2002**, the research budgets at ORNL need to be $7900K and the HRIBF budget needs to be $7900K. Without this increase staff losses will occur in all programs and facility operation will be curtailed.

Inside /Outside Research

Currently the ratio between inside and outside research for the two experimental programs at ORNL is approximately (inside/outside): low-energy-80/20, and relativistic heavy-ions-0/100. The figure for the relativistic heavy-ion program will continue to be 100% outside due to facility location. In the case of the low energy research program the fraction of inside research has increased as the HRIBF has become operational. It is expected that the low energy program will maintain about 15% outside research in the future.

Graduate Students

ORNL is not a teaching institution and as such does not directly attract graduate students. However, we do host a number of students (19 in FY 2000) due to the existence of the HRIBF. It is anticipated that the number will grow as the popularity of RIB physics increases.

Unique or Noteworthy Features

The nuclear physics program at ORNL has an outstanding staff. In particular the number and quality of young staff is higher than at any time in the recent past. This is evidenced by the fact that an ORNL Physics Division staff member has been a winner of the Presidential Early Career Award for Scientists and Engineers in each of the past three years, and that three of the Wigner Fellowships awarded by ORNL are held by scientists working in the Physics Division.

A unique and noteworthy opportunity centers on the construction of the SNS at ORNL. Nuclear physics has the opportunity to take advantage of neutrinos produced by the SNS by building a user facility that can carry out a broad research program in neutrino science. This investment of $60 million provides an excellent way to leverage the $1.5 billion investment DOE is making in the SNS to the advantage of nuclear physics.

The HRIBF is a RIB facility that is unique in the world. The community has the opportunity to expand the research at the HRIBF through modest investments in upgrades and increases in operating budgets. These investments will insure the needed research infrastructure is available between now and the time RIA is operational to train the next generation of scientists who will use RIA. While the community has charted a plan to bring RIA to reality there is no plan to bridge the gap between now and RIA operation.