OAK RIDGE ELECTRON LINEAR ACCELERATOR (ORELA)

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ORELA is a high current electron accelerator that produces a pulsed neutron source used for basic research in nuclear astrophysics and other programs. In addition, ORELA hosts a pulsed, intense photon source and slow positron source. It is an ORNL User Facility and, as such, is available on a cost recovery basis for work requiring neutrons, photons, or positrons. ORELA now operates about 1400 hrs/year. Programs for nuclear astrophysics, the Defense Nuclear Facility Safety Board, the Spallation Neutron Source, and target development for radioactive-ion beams are the prime users of time.

Measurements of importance to nuclear astrophysics completed since October 1996 include total and capture cross sections on isotopic samples of ^{88}Sr, ^{137}Ba, and ^{194}Pt. Measurements published in 1997 on neodymium isotopes won two ORNL awards and a Lockheed Martin NOVA Award. The physics resulting from these measurements is discussed elsewhere in this Annual Report. This program provides about five weeks/year of funding for ORELA.

The Defense Nuclear Facility Safety Board (DNFSB), as a result of its Recommendations 93-2 and 97-2, has implemented a program to measure neutron-induced nuclear data of importance to Criticality Safety. This program provides funding to operate ORELA about 10 weeks/year, and has measured the fission cross section of ^{233}U, and capture and total cross sections of Al, Cl, and K. A long list of nuclear data measurement requests remains, and this program is expected to continue for several years.

Target development work for both the Spallation Neutron Source (SNS, to be built at ORNL), and the HRIBF requires a source of charged particles with a very high energy-density for testing target designs. The 150 MeV electron beam at ORELA has the necessary energy-density for target testing, and both the SNS and HRIBF have target development programs underway at ORELA. The SNS work involves investigating radiation damage effects induced by electrons at the boundary between a flowing sample of liquid mercury and the stainless steel container through which it flows. The HRIBF work involves design and development of a target to demonstrate that yields of radioactive fission product isotopes of interest to nuclear physics can be produced by electro- and photo-fission and extracted from the target in copious enough quantities to be useful for research.

The pulsed, intense photon source at ORELA was used by a group from the Indiana University Medical Center for research in energy deposition by electrons in hydrogenous materials. Two pulses each second are diverted from the electron beam, and strike a tantalum converter that produces an intense photon pulse. The associated neutrons are stopped in a water trap behind the converter, and the remaining electrons are bent away by a magnet in the water trap. The resulting beam has a photon/neutron ratio of 2500/1.

In addition to the intense neutron and photon sources, ORELA also hosts the most intense pulsed positron source in the US, funded through DOE/BES and at no cost to DOE/NP. It utilizes remaining beam passing through the neutron-producing

target to strike a tungsten radiator, in which positrons are produced and transported to an experimental area for use in studying positron and positronium interactions with atoms, molecules, and surfaces, and as a probe in materials research. A flux of 10^8 slow positrons/second is available. The positron buncher has been designed and tested for measurements of positron lifetimes in polymers and porous materials. Recent results include discovery of HeH^+ formation by positron impact of mixtures of gaseous H_2 and He. Positron ionization of halomethane molecules is found to resemble virtual photon ionization. A new direction is being undertaken to study positron chemistry on surfaces, interfaces, and films.

Safe and efficient operation of the accelerator and associated facility has also been addressed in this time frame. Numerous reviews of several aspects of facility operation have occurred, with positive findings from each review. Training required for work at ORELA has been put on the World Wide Web for easy access by staff and users. An engineering technician has been assigned to the ORELA to ensure proper accelerator maintenance and to assist a growing number of experimenters with facility-related aspects of their work.