THE 150-METER TIME-OF-FLIGHT FACILITY AT ORELA¹

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Flight Path 6, an underground neutron time-of-flight facility located normal to the electron beam in the Oak Ridge Electron Linear Accelerator (ORELA),² has recently been extended from 40 meter length to 150 meters. This extension of the underground flight path required the construction of an additional collimating station at 80 meters from the neutron source, and an underground experiment station at 150 meters. Figure 1 shows the general features of the extended flight path.

In April 1972, this facility was completed, and the ORELAST,³ the 800-gallon liquid scintillator gamma-detector was disassembled, moved to the 150 Meter Station, and reassembled there.

This 3.9-fold increase in the length of the flight path was undertaken mainly to permit extension of the capture and fission cross section measurements, previously carried out at the 40 Meter Station, to higher energy. At the 40 Meter Station the upper limit of measurable neutron energy was about 200 keV, due to a gamma-flash-induced overloading of the photomultipliers, preamplifiers, and linear amplifiers, as a result of which the system was inactivated for about 8 μ sec. Even after the amplifiers recover a gain-shift persists, which limits the useful range to less than 100 keV. This shift occurs in the photomultipliers, and is due to increased electron multiplication immediately following intense light bursts. This gain change is particularly important when both high-bias and low-bias measurements are made simultaneously, since the effective threshold bias thus changes with neutron energy, i.e., time-of-flight.

At the 150-meter distance, not only is the dead-time cut-off above 1.5 MeV, but the 15-fold reduction in gamma intensity almost completely eliminates the gain-shift problem encountered at 40 meters.

Additional advantages are the improved time-of-flight resolution, and the almost complete elimination of the induced-rf noise in the signal circuits which had existed at the 40 Meter Station. The benefits are offset, of course, by reduced intensity.

Two additional collimators have been added to the system, at 80 meters in a separate cubicle, and at the entrance to the 150 Meter Station.

The collimator system is so designed that neutrons from the target cannot scatter in a single collision off the flight tube walls into the sample area.

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The collimator design allows relatively easy beam-diameter changes up to 6-in. diameter beam size. A special set of collimator inserts was made to allow use of the existing high-isotopic-purity 4.375-in.-diameter ^{238}U transmission samples at the 40 Meter Station for total cross section and self-indication measurements. The entire collimator system was aligned by use of a focussed He-Ne laser beam, with evacuated light path.

A 5-in.-thick shield of low-activity steel surrounds the ORELAST in its new location. This shield reduced the tank-halves coincidence background counting rate by a factor of 12 relative to the rate observed in the 40 Meter Station without local shielding.

At the time the move from the 40 Meter Station to the 150 Meter Station was made, the water-filled aluminum container which surrounded the LINAC target and served as the source of moderated neutrons was replaced with a similar target can made of beryllium. This change smoothes out the neutron spectrum, which had been noticeably perturbed at 6, 35, and 87 keV due to the aluminum resonances, since in beryllium the lowest resonance is above 600 keV.

The first experiments at the 150 Meter Station are in progress, and include measurements of $^{238}\text{U}(n,\gamma)$, $^{235}\text{U}(n,f)$, and $^{235}\text{U}(n,\gamma)$.

REFERENCES

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150-Meter Facility -- ORELA

Figure 1