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Lawrence Livermore Laboratory

DT FUSION NEUTRON IRRADIATION OF BNL-LASL SUPERCONDUCTOR WIRES, BPNL NICKEL AND MOLYBDENUM, ORNL MAGNESIUM OXIDE, UW-LLL METALLIC FOILS, AND LLL ALUMINUM TENSILE

Susan C. MacLean

November 24, 1975

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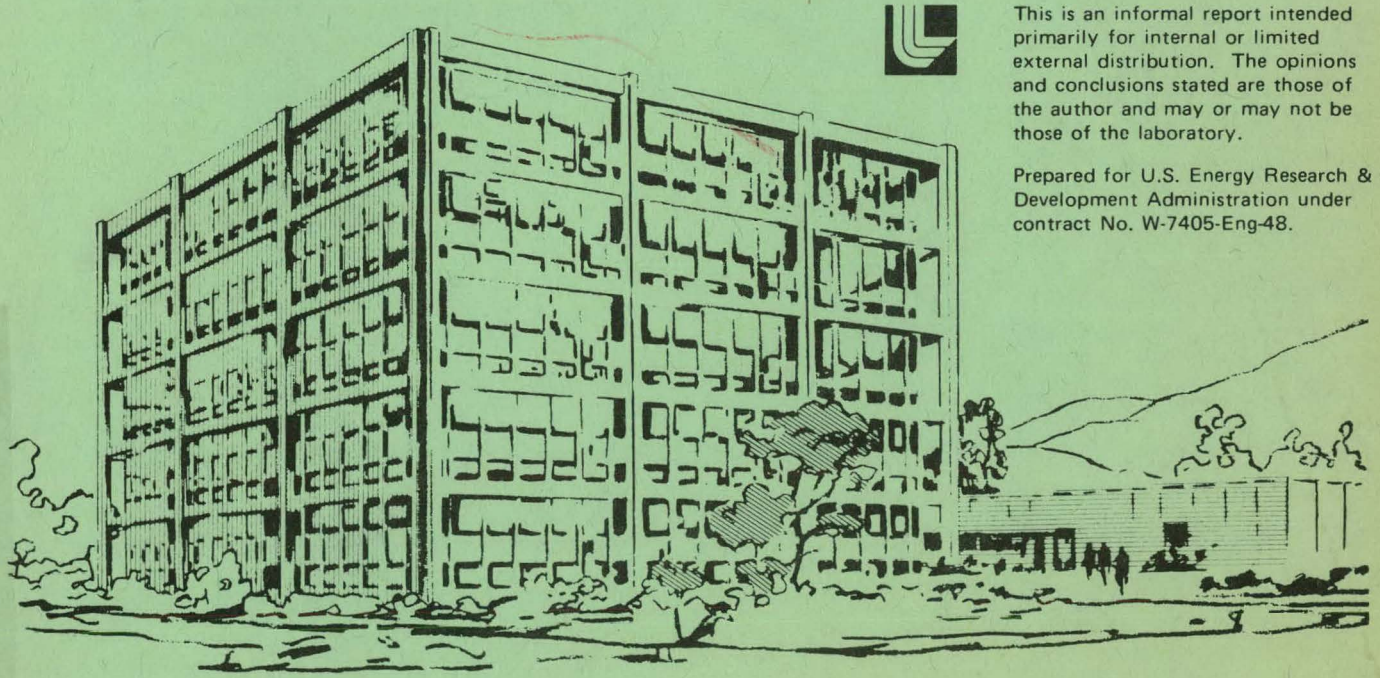
Unclassified



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Samples from several researchers were combined for the Rotating Target Neutron Source (RTNS) irradiation beginning October 3, 1975.

Dr. C. L. Snead, Jr. of Brookhaven National Laboratory (BNL) and Dr. Don M. Parkin of Los Alamos Scientific Laboratory (LASL) asked that a fluence of 1×10^{18} neutrons/cm^2 be accumulated on twelve superconductor wires. The wires had previously been irradiated July 31, 1975, August 18-22, 1975, August 26-29, 1975 and September 16-19, 1975.

Two of the superconductor wires, 19-core Nb_3Sn multifilament, had received approximately 10^{18} neutrons/cm^2 from prior RTNS irradiations. The remaining V_3Ga single core, two pieces NbTi Supercon 402, and two pieces NbTi cupronickel jacketed. The twelve wires measuring between 19 and 28 mm in length, were wrapped together in aluminum foil.

A circular brass envelope, approximately 19 mm in diameter, containing molybdenum and nickel foils was being irradiated to a fluence of 4×10^{17} neutrons/cm^2 for Dr. John L. Brimhall of Battelle Pacific Northwest Laboratories (BPNL) Some of the molybdenum foils had been irradiated by the RTNS prior to the current fluence build up during the periods of August 18-22, 1975 and September 16-19, 1975.

Dr. Yok Chen of Oak Ridge National Laboratory (ORNL) requested a fluence of 2 X 10^{17} neutrons/cm^2 for one of his magnesuim oxide crystals. MgO-18, approximately 1.5 mm thick, was wrapped in aluminum foil. The MgO crystal, the superconductor wires, and the brass envelope were all stacked with 0.03 mm thick 12 mm diameter niobuim foil dosimetry discs.

Seven aluminum tensile specimens, measuring approximately 28.6 mm in length, 9.5 mm in width, and 0.5 mm in thickness, were supplied by Drs. Jack B. Mitchell and Richard A. VanKonynenburg of LLL. These samples had been irradiated May 2-7, 1975, July 18-25, 1975, August 18-22, 1975, and September 16-19, 1975. The tensile specimens were stacked in an epoxy-fiberglass-laminate sample holder with 0.127 mm thick niobium dosimeters of the same size and shape.

Thirteen high purity metallic foils are being repeatedly irradiated over a long period of time for Dr. Heinz Barschall, of the University of Wisconsin (UW) and LLL, so that he will be able to look for long lived isotopes. The sample foils, aluminum, iron, tantalum, nickel, niobium, copper, tungsten, molybdenum, zirconium, tin, titanium, vanadium and chromium, all about 12 mm in diameter, were sealed in an aluminum capsule with aluminum foil spacers between the samples. They had been irradiated November 7-13, 1974, December 2-6, 1974, January 6-14, 1975, January 21-February 4, 1975, May 2-7, 1975, May 16, 1975, August 26-29, 1975, and September 16-19, 1975. The capsule was sandwiched between 0.127 mm thick, 12 mm diameter niobium dosimetry foils.

The order of stacking, beginning with the material nearest the neutron source, was as follows:

Order	Sample
1	Nb-504

Order	Sample
2	Superconductor wires
3	Nb-509
4	BPNL Mo and Ni foils
5	Nb-510
6	MgO-18
7	Nb-511
8	Nb-512
9	Al-5384
10	Nb-513
11	Al-5386
12	Nb-514
13	Al-5387
14	Nb-515
15	Al-5388
16	Nb-516
17	Al-5389
18	Nb-517
19	Al-5391
20	Nb-518
21	Al-5392
22	Nb-519
23	mylar spacers
24	Nb-507
25	Barschall's foils
26	Nb-508

The irradiation was carried out by the LLL E Division Accelerator Staff during the period of October 3 to 13, 1975. Neutron production was monitored continuously with proton recoil counters and recorded each hour. The dose record is attached. Total beam-on time was 102.53 hours.

Autoradiographs of the front of the sample holder showed that the samples had been well centered with the neutron beam. The sample holder assembly was removed and stored for several days to allow for decay of short-lived isotopes.

The superconductor wires were retained for further RTNS irradiation, as were Barschall's foils and the aluminum tensile specimens. The magnesium oxide crystal was returned to Dr. Chen. The brass envelope containing molybdenum and nickel foils was shipped back to Dr. Brimhall.

The tensile specimen shaped dosimetry foils were cut so that only the portions corresponding to the tensile gauge sections were weighed. These along with the other niobium dosimetry foils were delivered to Ruth Anderson in the LLL Radiochemistry Division for gamma ray counting.

The average fluence of each dosimetry foil was calculated using the method described in UCRL-51393, Rev. 1. However, the value used for the cross section of the activation of the 10.16 day niobium isomer by 14.8 MeV neutrons was changed to 458 millibarns. The results were as follows:

Dosimetry Foil	Fluence (neutrons/cm^2)
Nb-504	3.02×10^{17}
Nb-509	2.41×10^{17}
Nb-510	1.80×10^{17}
Nb-511	1.16×10^{17}
Nb-512	1.24×10^{17}

Dosimetry Foil	Fluence (neutrons/cm^2)
Nb-513	1.08×10^{17}
Nb-514	9.37×10^{16}
Nb-515	8.22×10^{16}
Nb-516	7.39×10^{16}
Nb-517	6.61×10^{16}
Nb-518	5.86×10^{16}
Nb-519	5.28×10^{16}
Nb-507	3.85×10^{16}
Nb-508	2.49×10^{16}

The estimated overall uncertainty of these results is $\pm$7.5%. The relative uncertainty between any two values is about $\pm$2%. The values given here represent average fluences over the volume of each dosimetry foil.

RTNS IRRADIATION OF OCTOBER 3 TO 13, 1975

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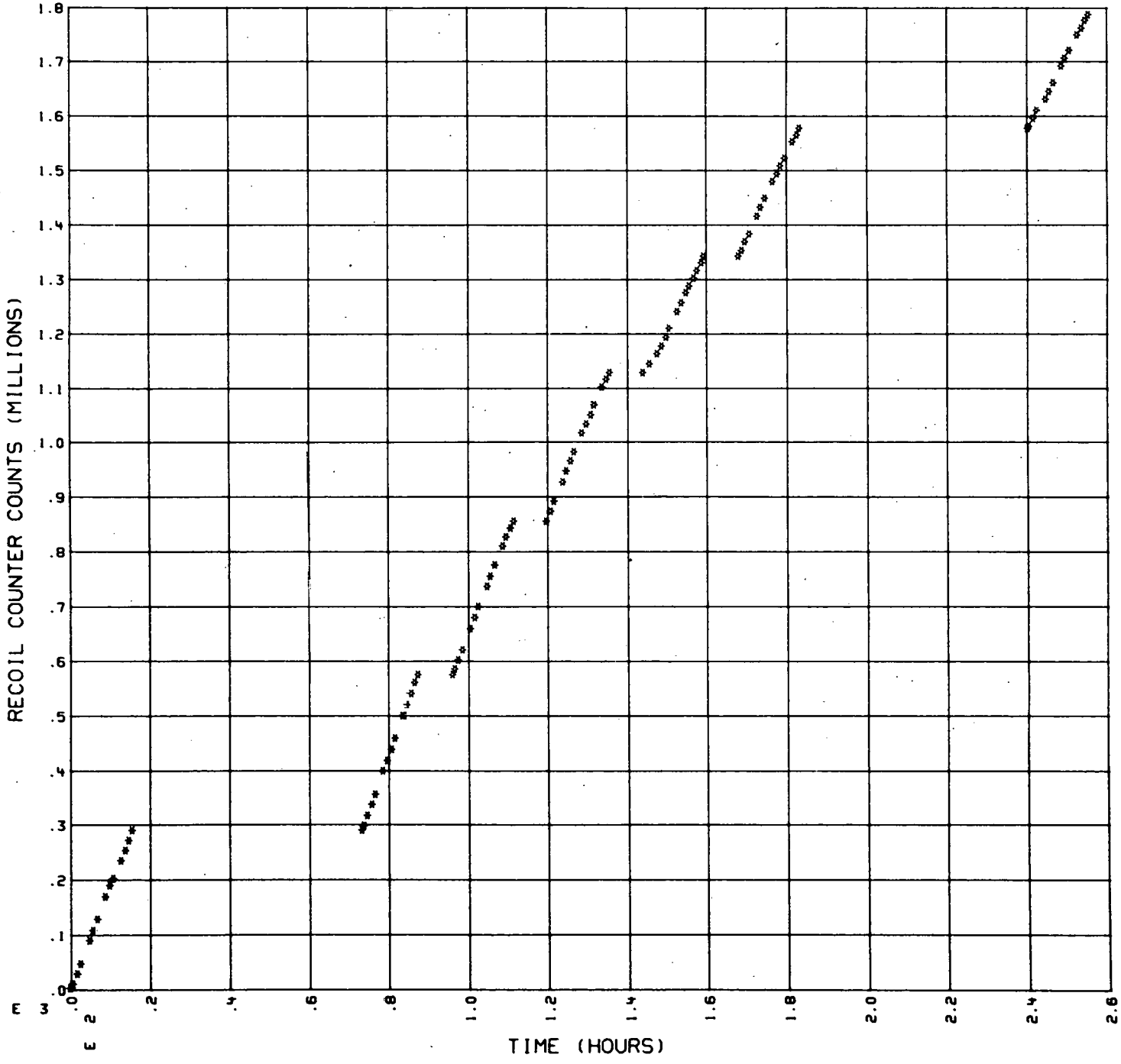

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