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DT FUSION NEUTRON IRRADIATION OF LLL "TRITIUM-TRICKED" NIOBIUM, BNL-LASL SUPERCONDUCTOR WIRES, BPNL WIRE-FOIL PACKAGES

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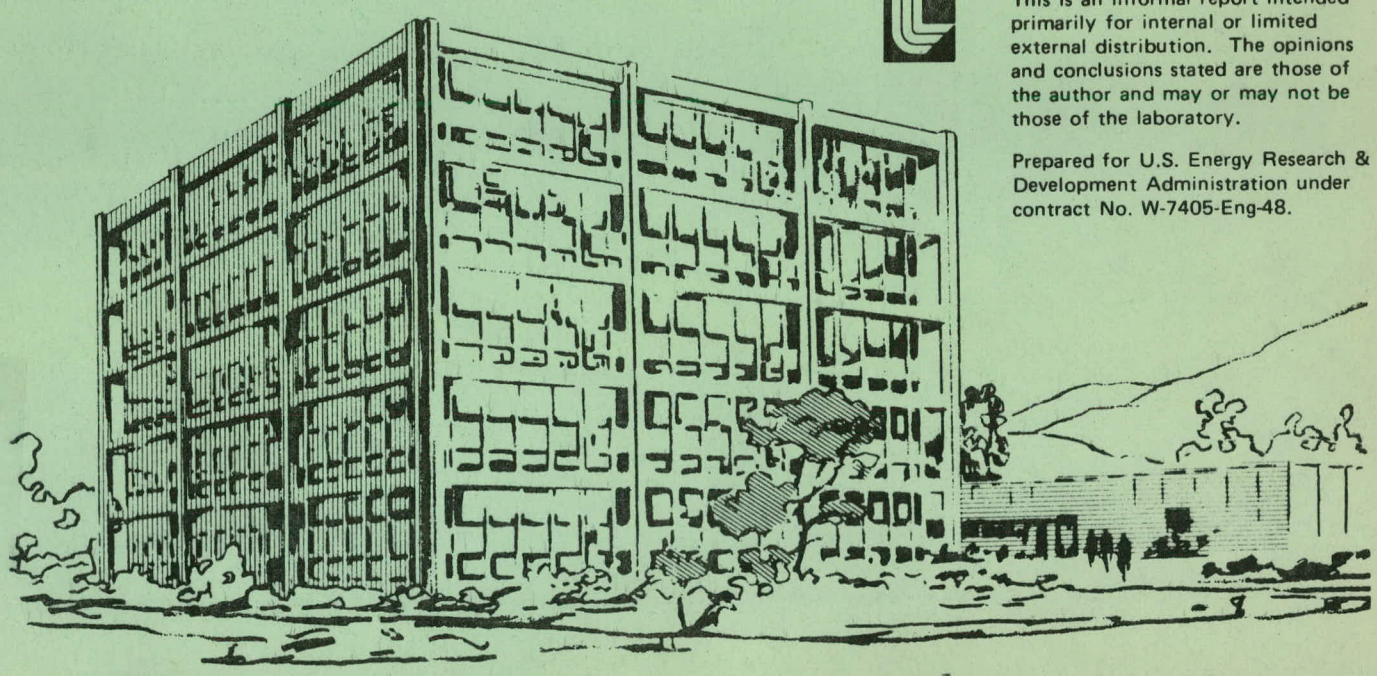
January 13, 1977



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DT FUSION NEUTRON IRRADIATION OF LLL "TRITIUM-TRICKED" NIOBIUM, BNL-LASL SUPERCONDUCTOR WIRES, BPNL WIRE-FOIL PACKAGES

ABSTRACT

The DT fusion neutron irradiation of eight LLL "tritium-tricked" niobium foils, eleven BNL-LASL superconductor wires, and two wire-foil packets from BPNL is described. The sample position, beam-on time, and neutron dose record are given. The maximum neutron fluence on any sample was 9.66×10^{16} neutrons/cm^2.

DT FUSION NEUTRON IRRADIATION OF LLL "TRITIUM-TRICKED" NIOBIUM.
BNL-LASL SUPERCONDUCTOR WIRES, BPNL WIRE-FOIL PACKAGES

During the week of September 27 to October 1, 1976, Drs. Robert C. Haight and Steven M. Grimes of LLL generously allowed samples from other experimenters to be put in front of their experimental apparatus during the irradiation at the LLL Rotating Target Neutron Source (RTNS).

Eight samples were received from Dr. Willis L. Barmore of LLL. Five of the samples were niobium foils that had been "tritium-tricked" to different helium concentrations. One sample was "tritium-tricked" Nb-1 Zr and two were niobium as received. "Tritium-tricked" samples become brittle as the helium concentration increases. They cannot be scribed. Therefore, some of the samples had corners cut off to identify them. The samples were stacked and all wrapped together in aluminum foil in the following order from the front to the back:

Nb-660, as received, approx. 8.5 × 12.5 × 0.025 mm, two corners cut off.
Nb-B-6, 100 ppm, approx. 8.5 × 13 mm, one edge notched.
Nb-B-7, 25 ppm, approx. 8.5 × 12.5 mm, very wrinkled, one corner cut off.
Nb-B-8, 500 ppm, approx. 8.5 × 12.5 mm, curved wrinkle on one edge and bent corner.
Nb-B-9, 50 ppm, approx. 8.5 × 11.5 mm, straight fold line on an angle across sample.
Nb-B-10, 250 ppm, approx. 8.5 × 12 mm, smooth foil.
Nb-B-14, Nb-1 Zr, 25 ppm, approx. 9.5 × 11 × 0.152 mm.
Nb-661, as received, approx. 8.5 × 12.5 × 0.025 mm, three corners cut off.
An "F" was marked on the outside front of the aluminum foil package.

Dr. C. L. Snead, Jr. of Brookhaven National Laboratory (BNL) and Dr. Don M. Parkin of Los Alamos Scientific Laboratory (LASL) requested that a fluence of 10^{18} neutrons/cm^2 be accumulated on eleven superconductor wires. The wires were placed in a single layer and wrapped in aluminum foil. This package had been irradiated during the period July 26-29, 1976. Nine of the wires, 3 Nb_3Sn single core, 3 V_3Ga single core, 2 NbTi Supercon 402, and 1 NbTi cupronickel jacketed, had received 8×10^{17} neutrons/cm^2 from RTNS irradiations prior to the present accumulation. The remaining two wires, 19-core Nb_3Sn multifilament wires, had 1.8×10^{18} neutrons/cm^2 from previous RTNS irradiations.

Two wire-foil packets were received from Drs. Russell H. Jones and David L. Styris of Battelle Pacific Northwest Laboratories (BPNL). The wire-foil packets were to receive repeated irradiation in order to accumulate fluences of 10^{18} neutrons/cm^2 on packet No. 3 and 5×10^{17} neutrons/cm^2 on packet No. 4. The wires of each packet were closest to the target.

The samples were stacked with 12 mm diameter niobium dosimetry foils, all 0.14 mm thick except for the front foil, which was 0.030 mm thick. The order of stacking, beginning with the material nearest the neutron source, was as follows:

Order	Sample
1	Nb-666
2	Nb-660
3	Nb-B-6
4	Nb-B-7
5	Nb-B-8
6	Nb-B-9
7	Nb-B-10
8	Nb-B-14
9	Nb-661
10	Nb-662
11	Superconductor wires
12	Nb-663
13	Wire-foil packet No. 3
14	Nb-664
15	Wire-foil packet No. 4
16	Nb-665

The neutron irradiation was carried out by the LLL E Division Accelerator Staff during the period September 27 to October 1, 1976. Neutron production was monitored continuously with a proton recoil counter and recorded each hour. The dose record is attached.

Following the irradiation, the sample package was stored for several days to allow short-lived isotopes to decay. The superconductor wires and both wire-foil packets were retained for further irradiation. The niobium dosimetry foils and Barmorc's samples were delivered to Ruth Anderson in the LLL Radiochemistry Division. She carried out the gamma ray counting.

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

Dosimetry Foil	Fluence (neutrons/cm^2)
Nb-666	9.66×10^{16}
Nb-660	9.19×10^{16}
Nb-B-6	8.38×10^{16}
Nb-B-7	8.79×10^{16}
Nb-B-8	8.64×10^{16}
Nb-B-9	8.30×10^{16}
Nb-B-10	8.50×10^{16}
Nb-B-14	8.19×10^{16}
Nb-661	7.93×10^{16}
Nb-662	7.77×10^{16}
Nb-663	6.55×10^{16}
Nb-664	5.42×10^{16}
Nb-665	5.39×10^{16}

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

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RTNS IRRADIATION OF SEPTEMBER 27 TO OCTOBER 1, 1976

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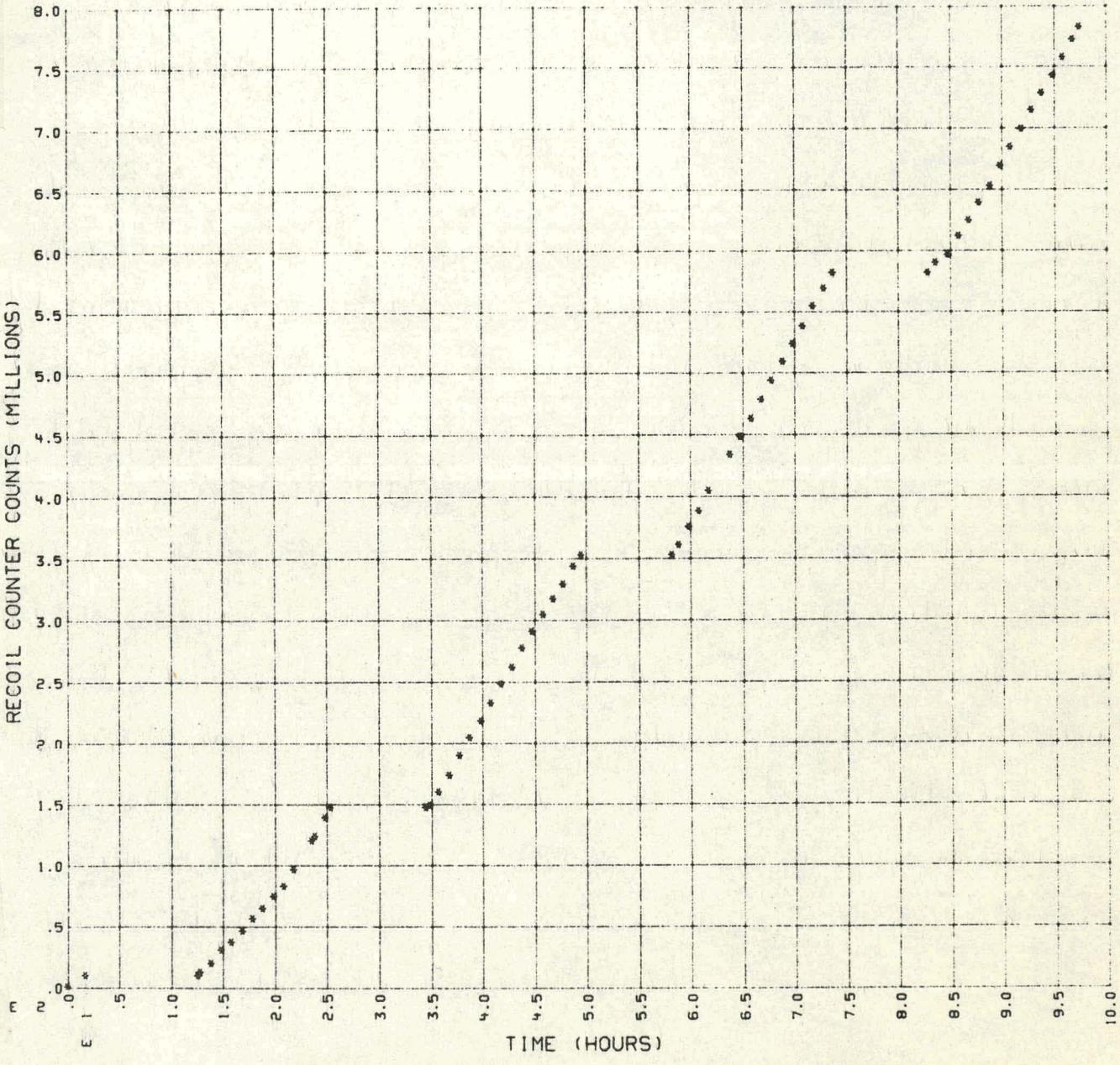

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