DDX of ^{238}U

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Comparison of Double-differential Neutron Emission Cross Sections Calculated from Evaluated Nuclear Data Libraries with Experimental Data

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The energy-angle double differential cross sections of emitted neutrons (DDXs) from neutron induced reactions are fundamental data for fusion neutronics calculation. The third version of Japanese Evaluated Nuclear Data Library (JENDL-3) was produced aiming at the applications related to the fission neutronics as well as fusion reactors. In order to check the reliability of the evaluated data, the DDX data for 32 elements from lithium to uranium calculated from JENDL-3 were compared with experimental data and values calculated from other two major evaluated nuclear data libraries, ENDF/B-VI and JEF-2. The comparison was made at the neutron incident energies of 4.2, 5.4, 6.0, 14.1 and 18.0 MeV, and at the angles of 30°, 60°, 90°, 120° and 150°. It was found that the DDX data calculated from JENDL-3 could reproduce overall trend of experimentally observed values. However, some discrepancies were also recognized.

Keywords: Nuclear Data, JENDL-3, Evaluation, Experimental Data, Neutron, Data Review, Double Differential Cross Section, Fusion Neutronics

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3.32 Uranium

The DDXs calculated from the evaluated data of ^{238}U are compared with the experimental data /BABA+('90)/ of ^{nat}U at the emitted angles of 30°, 60°, 90°, 120° and 150° at the incident neutron energy of 1.20 (60° and 120° only), 2.03, 4.25, 6.10, 14.1 MeV in Figs.51-55. The DDXs calculated from JENDL-3 include contributions of fission neutrons, except for the 1.20 MeV incident energy data. For the other evaluated libraries, however, fission neutrons could not be added to DDXs calculations for a technical reason. For the other quantities, the JEF-2 data are equivalent to the JENDL-3 data. The JENDL-3 data almost reproduce the experimental data at 1.20 and 4.25 MeV. At the incident neutron energy of 14.1 MeV, the JENDL-3 data give small values in the energy region of 5 to 12 MeV, since the energy spectrum of the continuum inelastic scattering in JENDL-3 is adopted only the evaporation spectrum. In the discrete inelastic scattering energy region, JENDL-3 gives much higher values than the experimental data. The fission tail lying in the higher energy region above the elastic scattering peak is in good agreement with the experimental data.

DDX Experimental Data
BABA+('90)

Their final report : M. Baba et al., J.Nucl.Sci. Technol., 27, 601(1990)

Reference for the Experimental Data in Figures

BABA+('90): Baba M., Wakabayashi H., Itoh N., Maeda K. and Hirakawa N., JAERI-M 89-143 (1986) in Japanese.

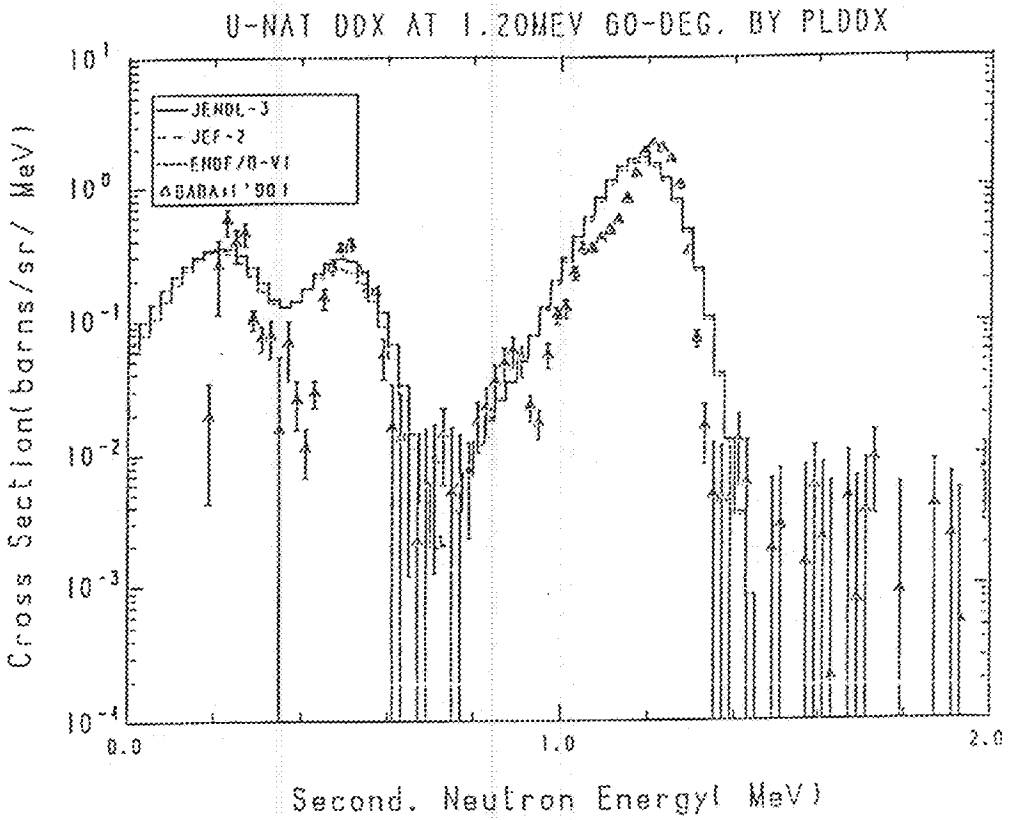

Fig. 51-1 The ^{nat}U Double Differential Cross Section at 1.20 MeV, Emitted Angle = 60° in Laboratory System

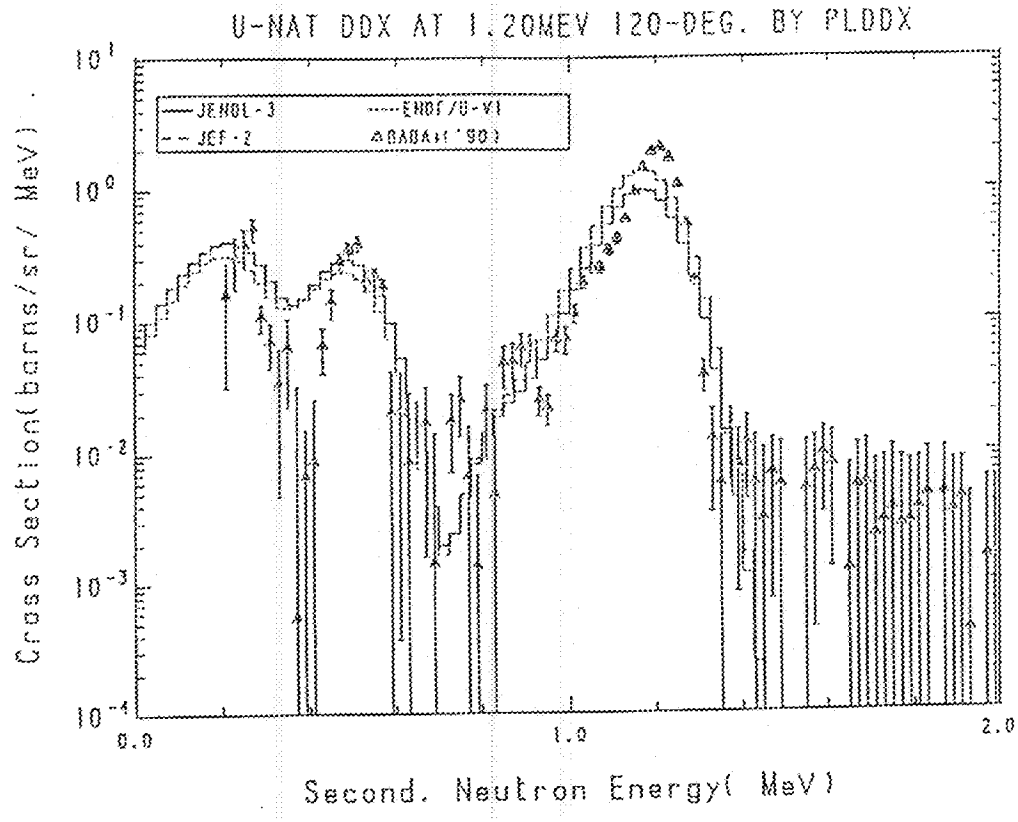

Fig. 51-2 The ^{nat}U Double Differential Cross Section at 1.20 MeV, Emitted Angle = 120° in Laboratory System

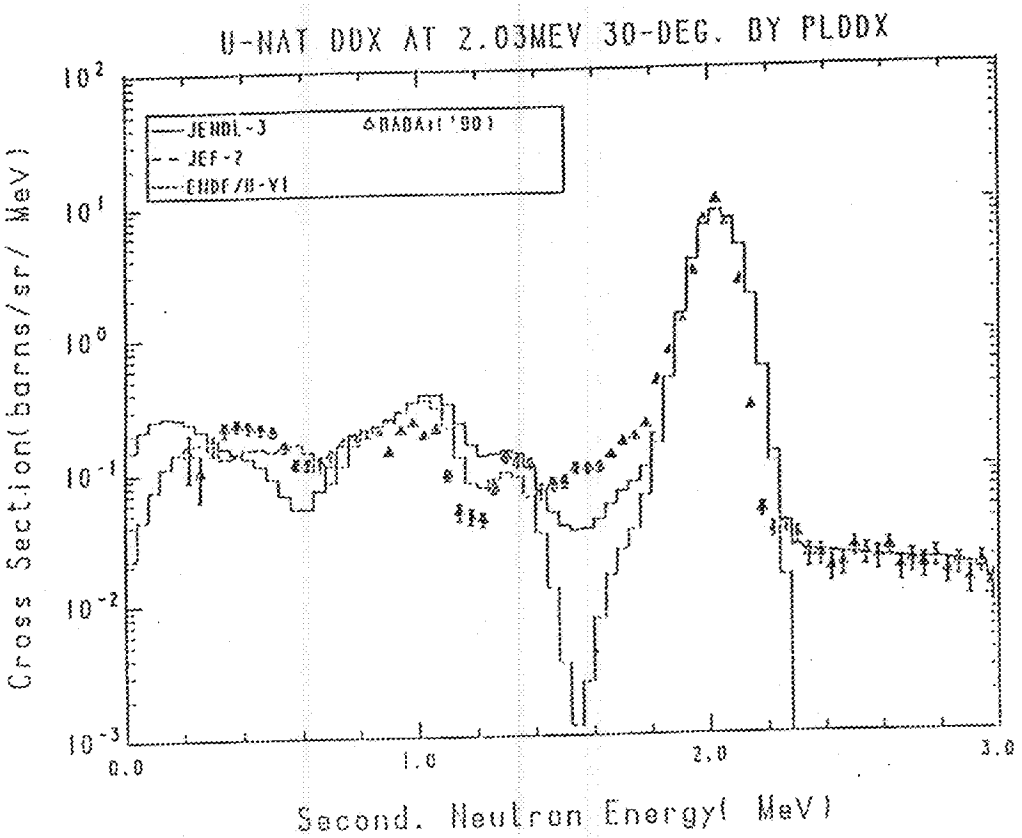

Fig. 52-1 The ^{nat}U Double Differential Cross Section at 2.03 MeV, Emitted Angle = 30° in Laboratory System

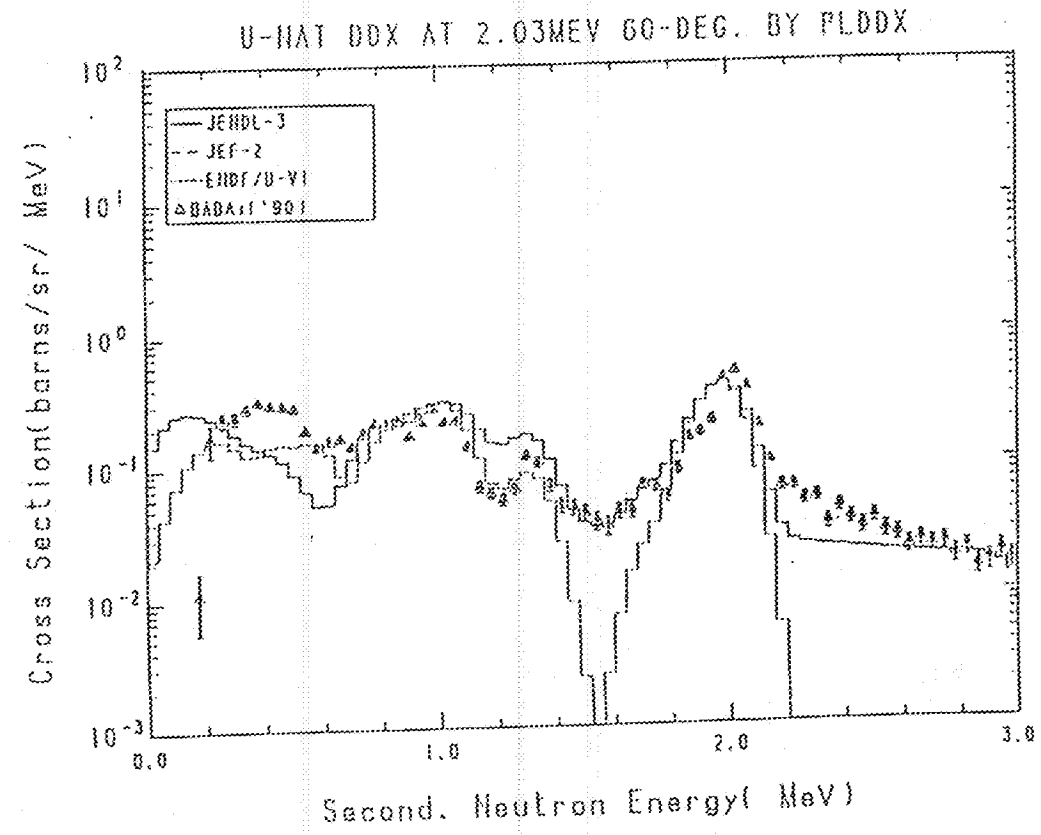

Fig. 52-2 The ^{nat}U Double Differential Cross Section at 2.03 MeV, Emitted Angle = 60° in Laboratory System

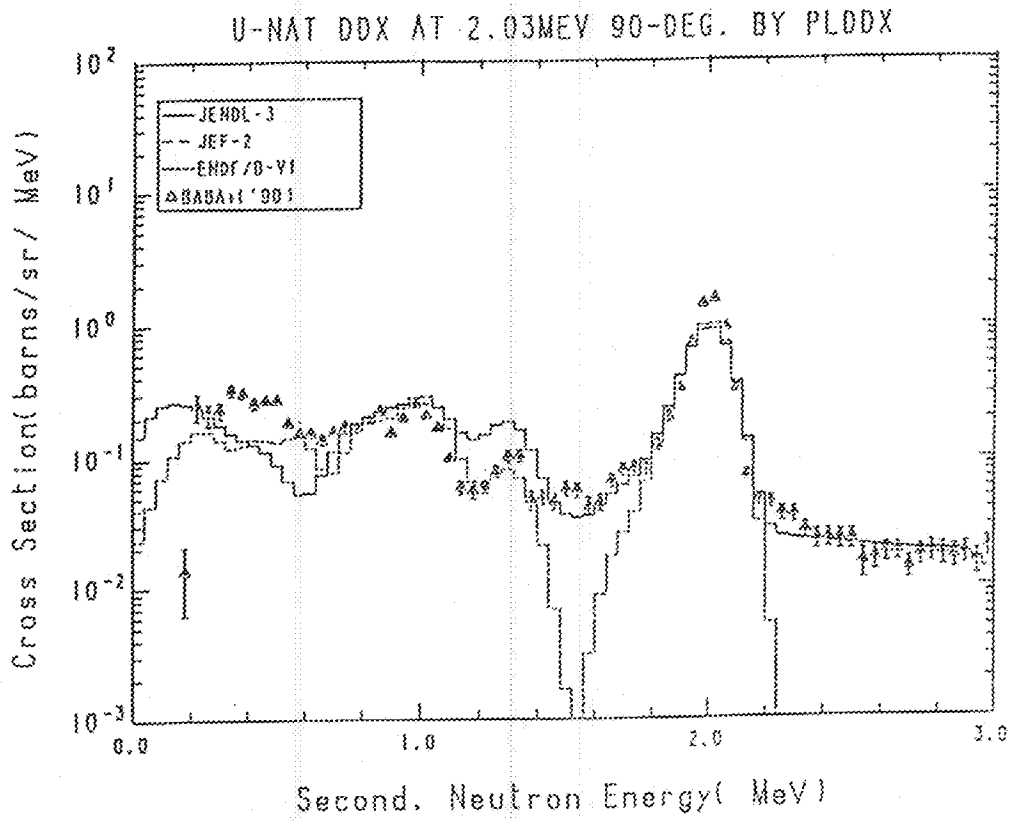

Fig. 52-3 The ^{nat}U Double Differential Cross Section at 2.03 MeV, Emitted Angle = 90° in Laboratory System

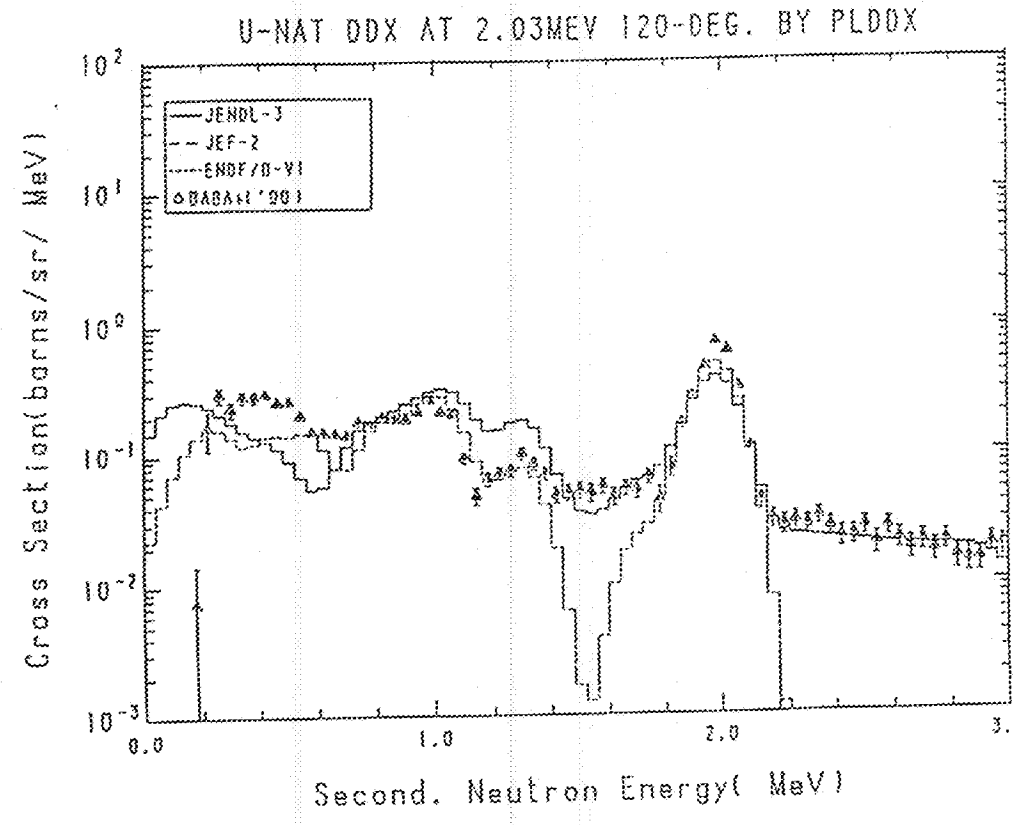

Fig. 52-4 The ^{nat}U Double Differential Cross Section at 2.03 MeV, Emitted Angle = 120° in Laboratory System

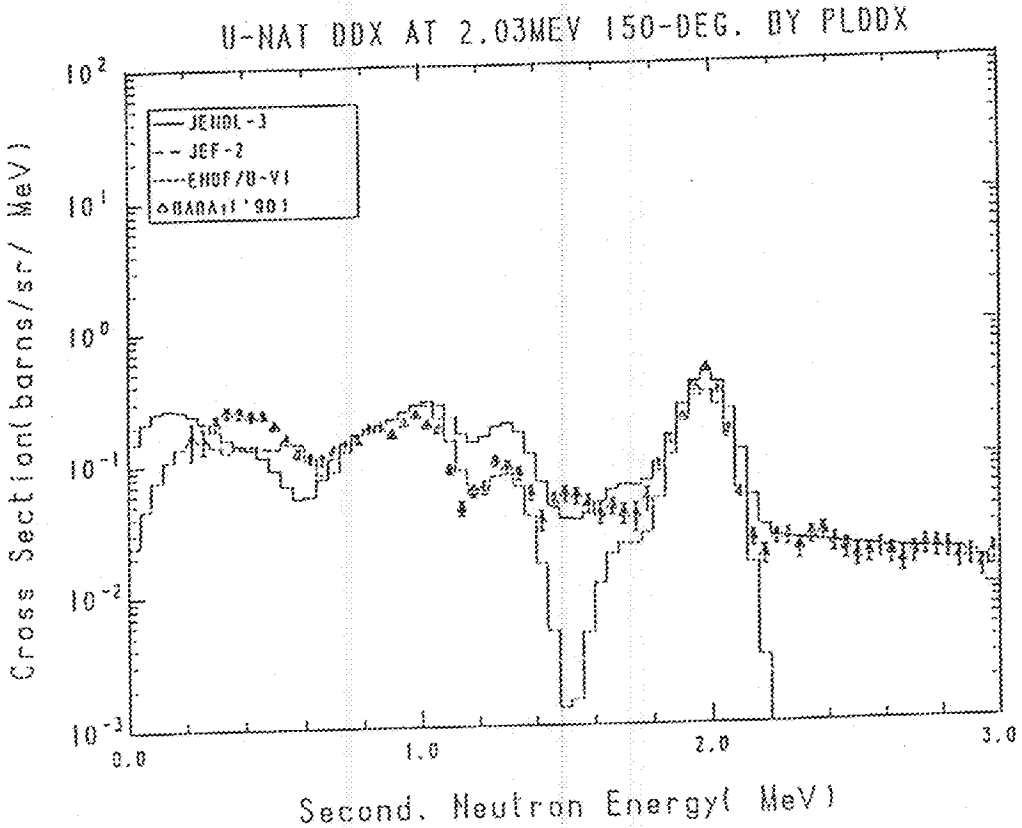

Fig. 52-5 The ^{nat}U Double Differential Cross Section at 2.03 MeV, Emitted Angle = 150° in Laboratory System

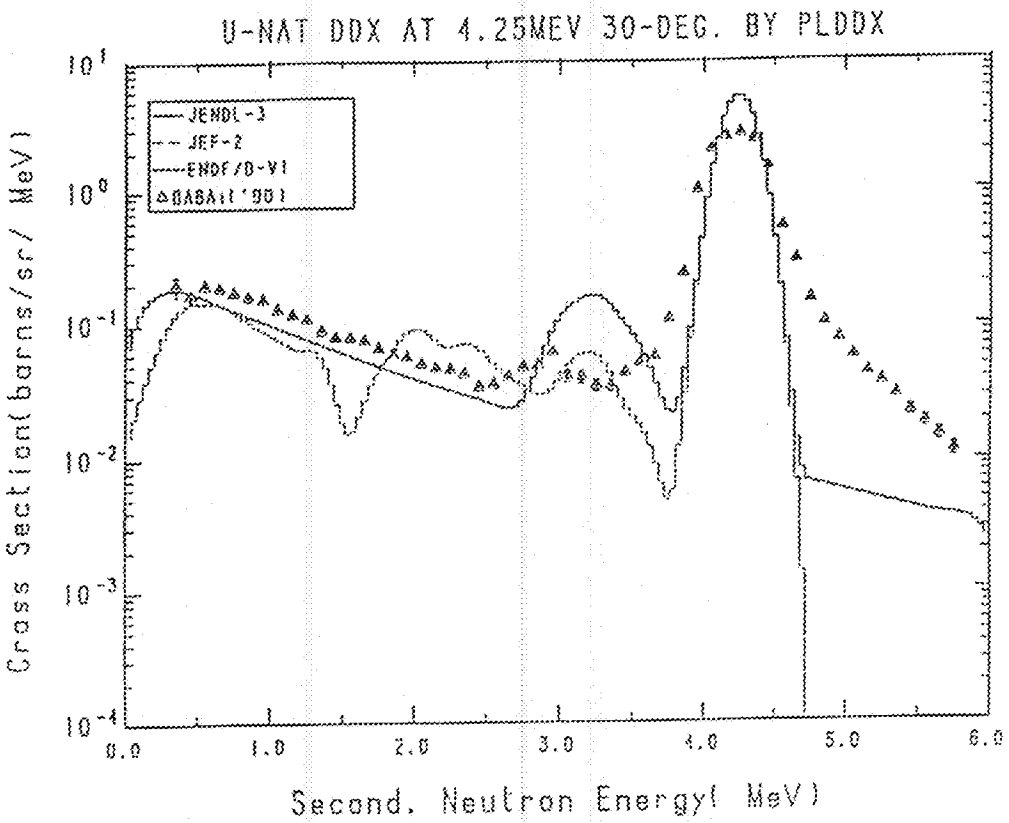

Fig. 53-1 The ^{nat}U Double Differential Cross Section at 4.25 MeV, Emitted Angle = 30° in Laboratory System

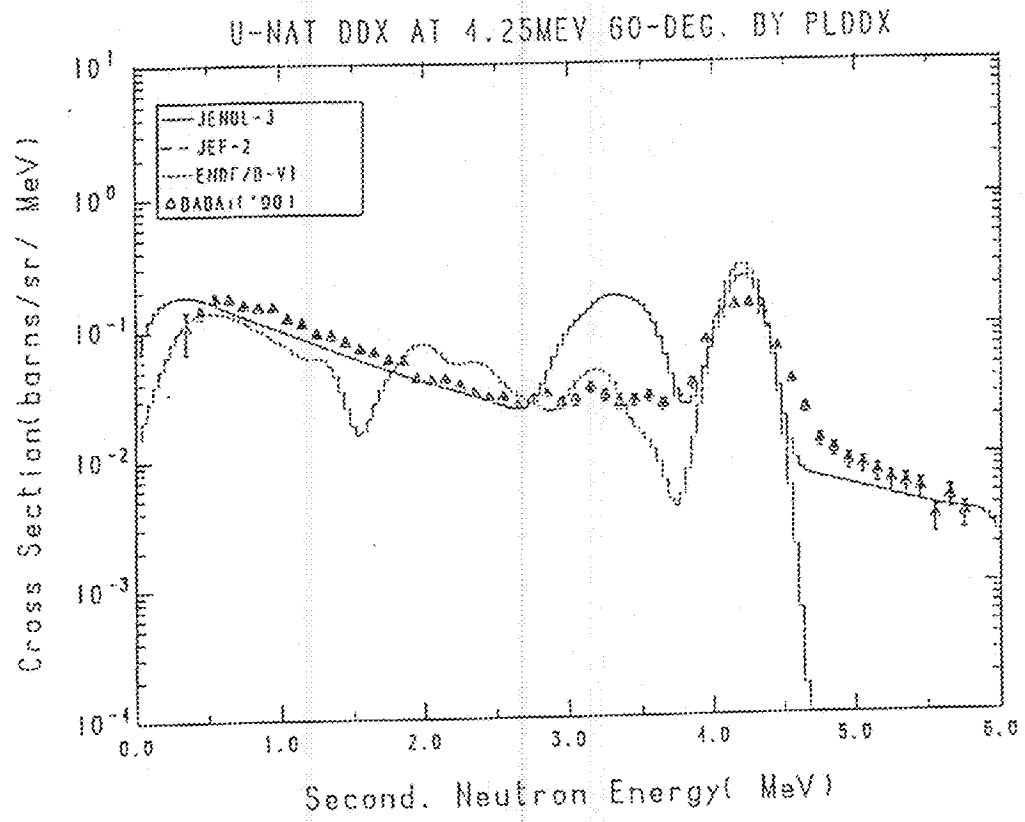

Fig. 53-2 The ^{nat}U Double Differential Cross Section at 4.25 MeV, Emitted Angle = 60° in Laboratory System

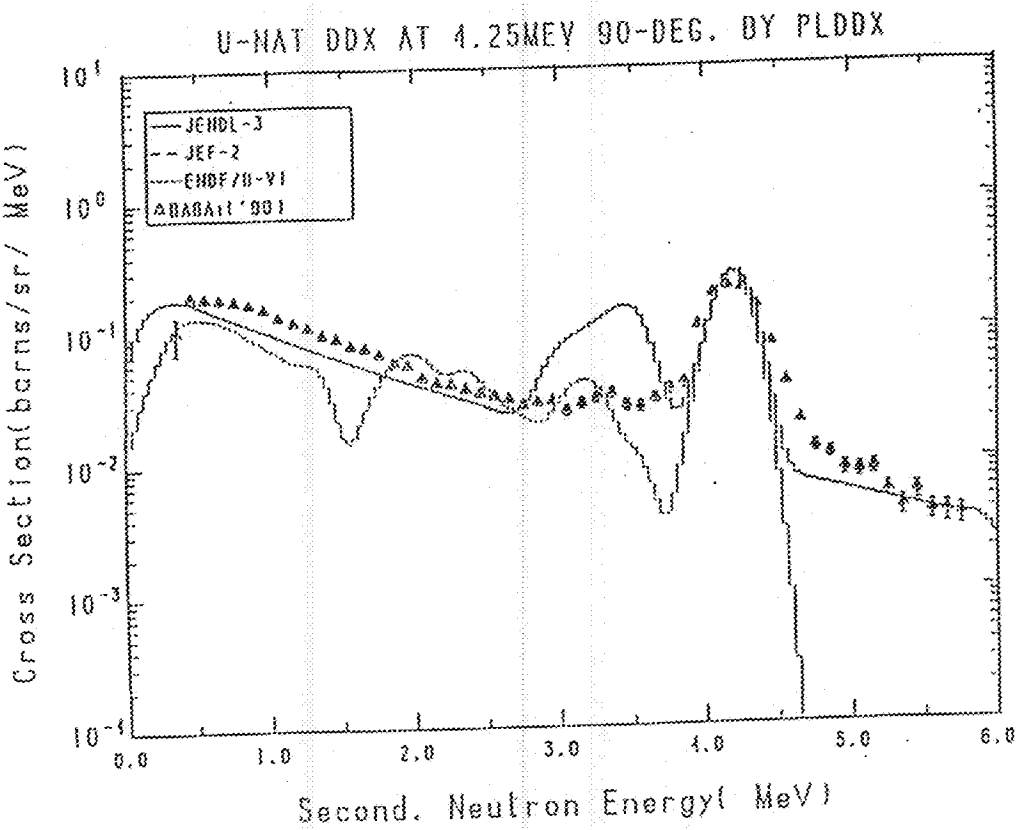

Fig. 53-3 The ^{nat}U Double Differential Cross Section at 4.25 MeV, Emitted Angle = 90° in Laboratory System

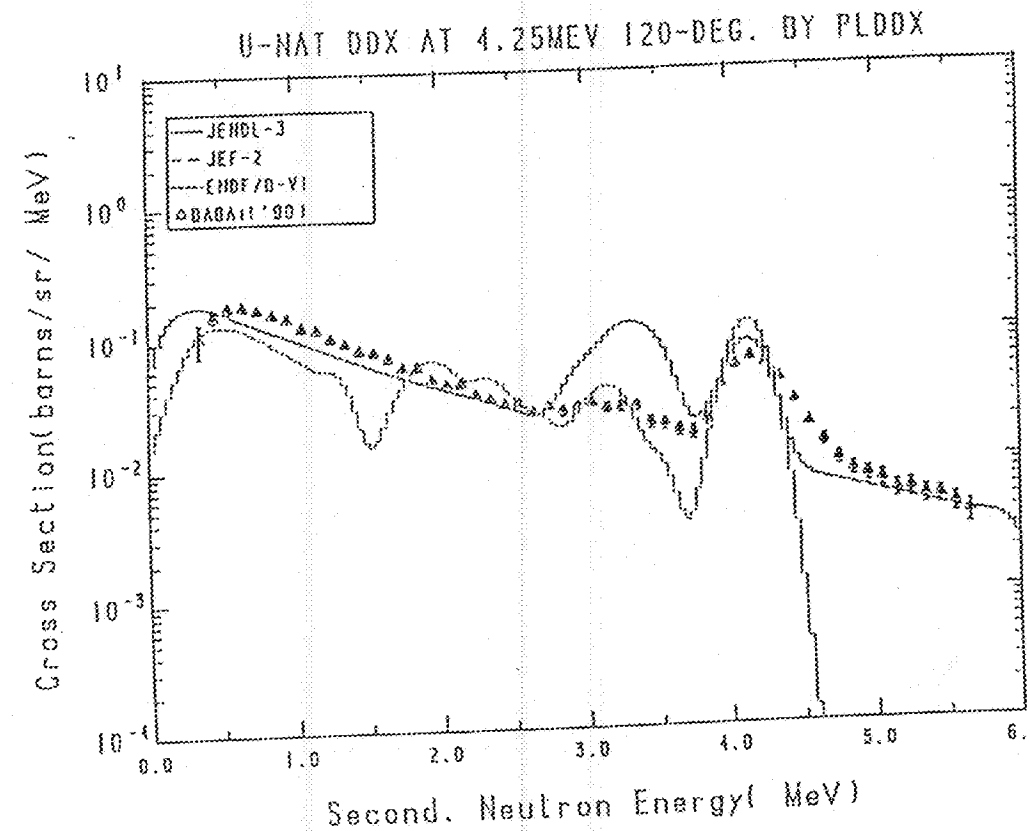

Fig. 53-4 The ^{nat}U Double Differential Cross Section at 4.25 MeV, Emitted Angle = 120° in Laboratory System

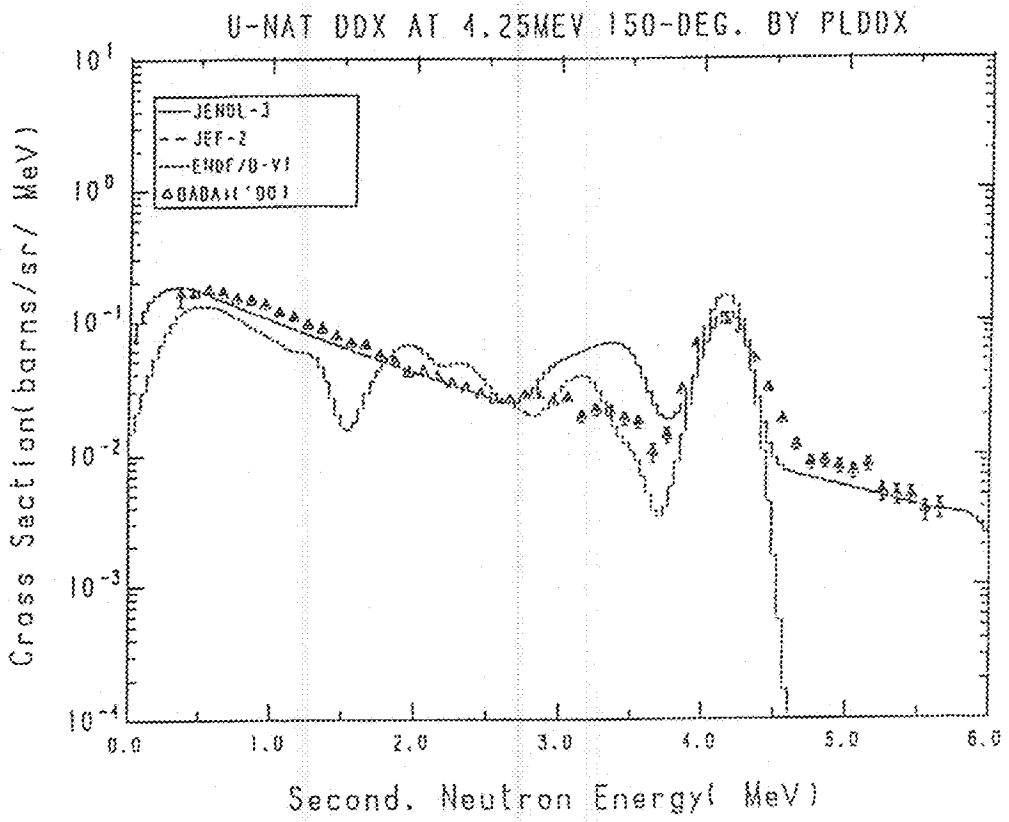

Fig. 53-5 The ^{nat}U Double Differential Cross Section at 4.25 MeV, Emitted Angle = 150° in Laboratory System

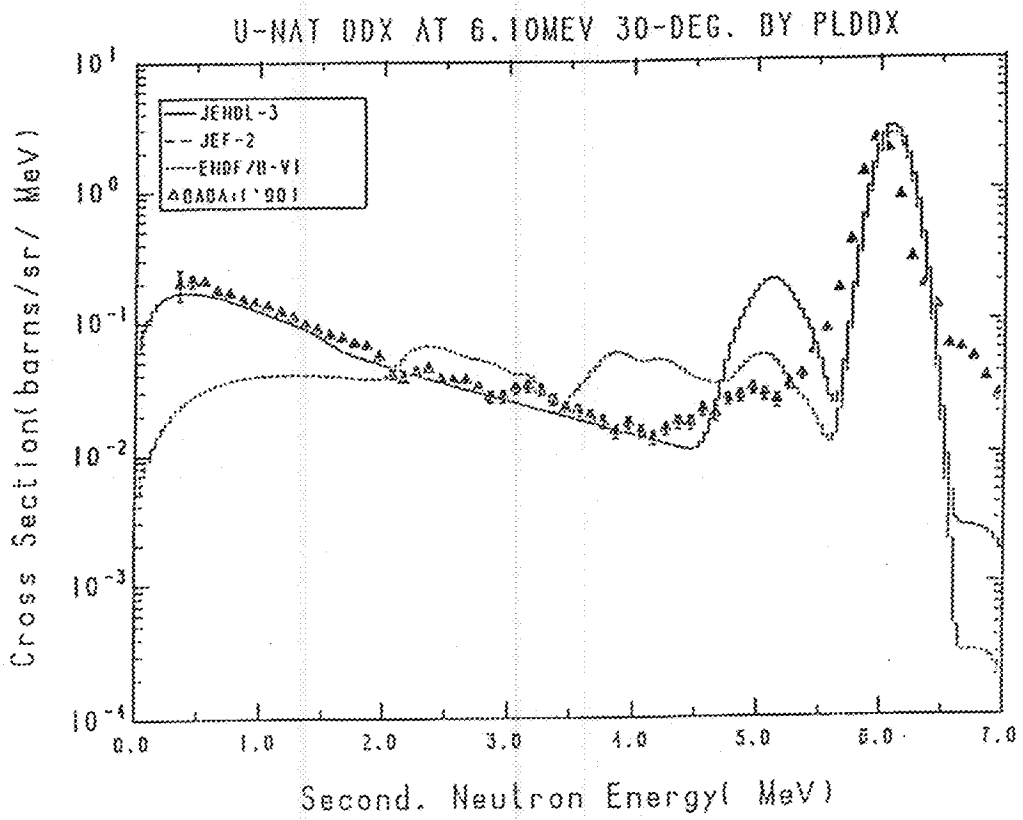

Fig. 54-1 The ^{nat}U Double Differential Cross Section at 6.10 MeV, Emitted Angle = 30° in Laboratory System

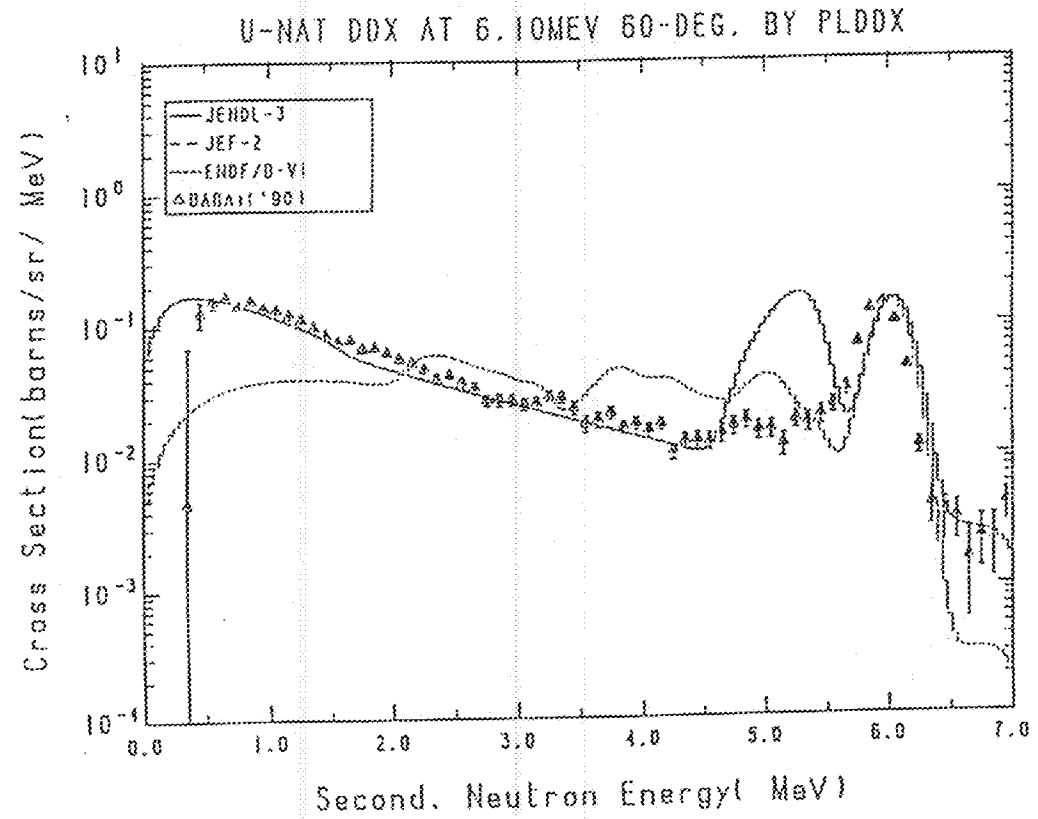

Fig. 54-2 The ^{nat}U Double Differential Cross Section at 6.10 MeV, Emitted Angle = 60° in Laboratory System

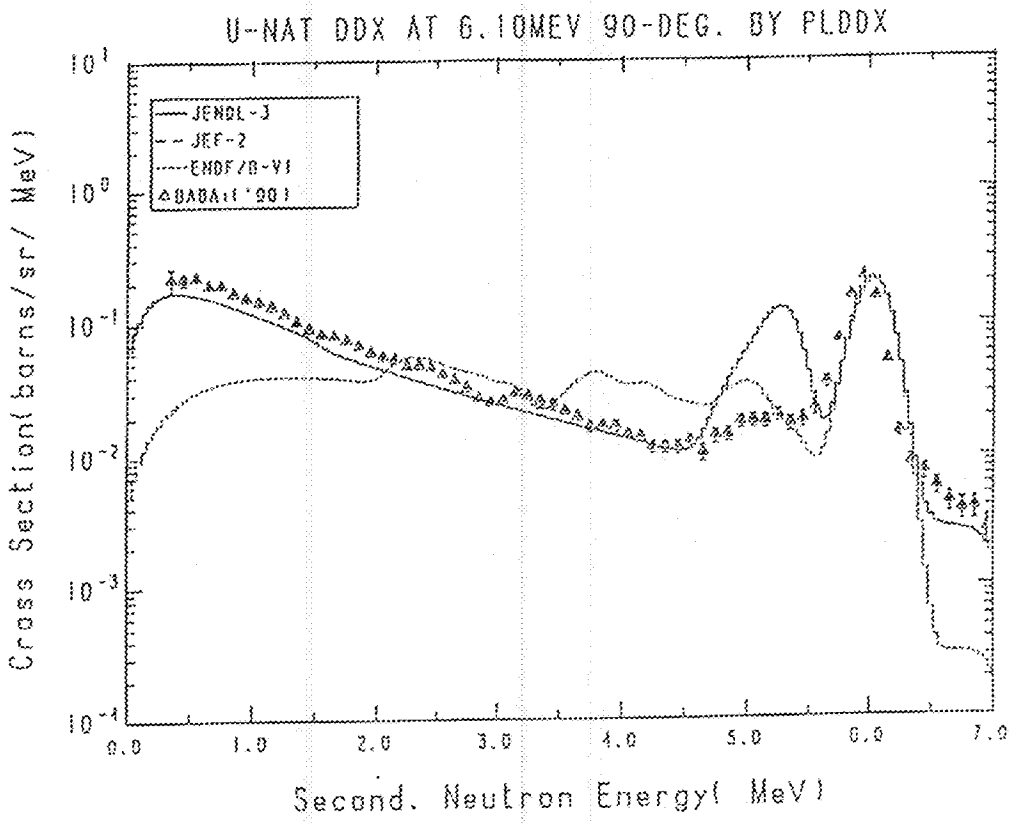

Fig. 54-3 The ^{nat}U Double Differential Cross Section at 6.10 MeV, Emitted Angle = 90° in Laboratory System

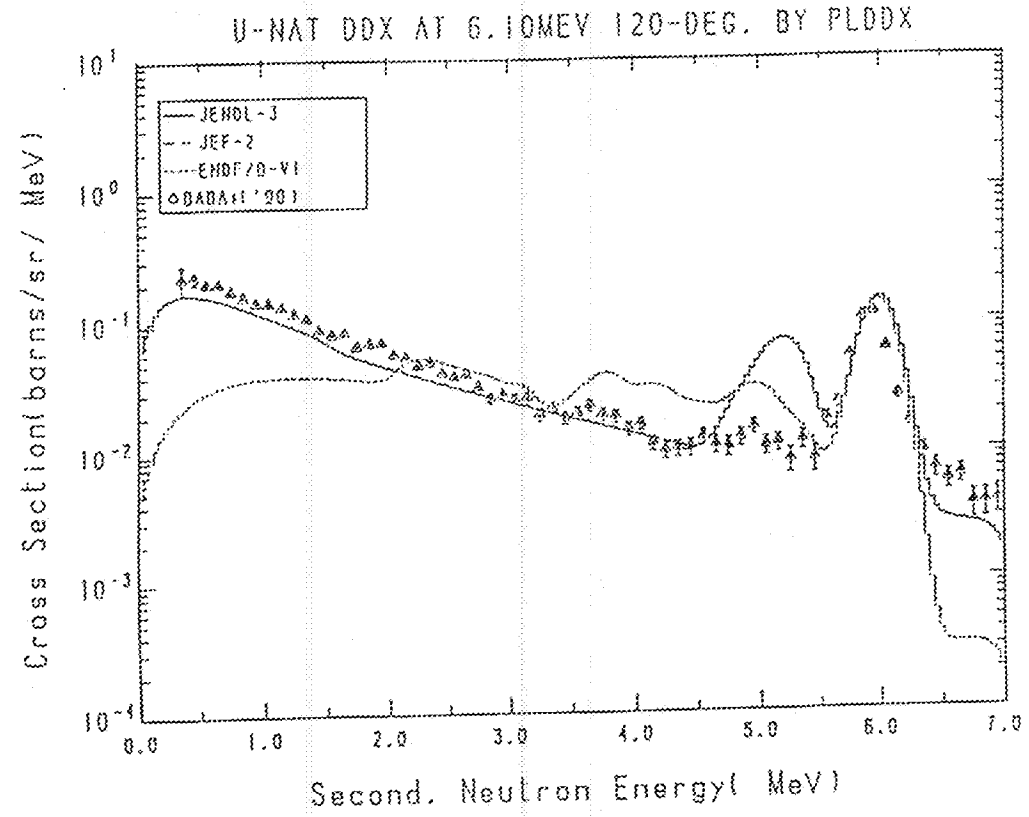

Fig. 54-4 The ^{nat}U Double Differential Cross Section at 6.10 MeV, Emitted Angle = 120° in Laboratory System

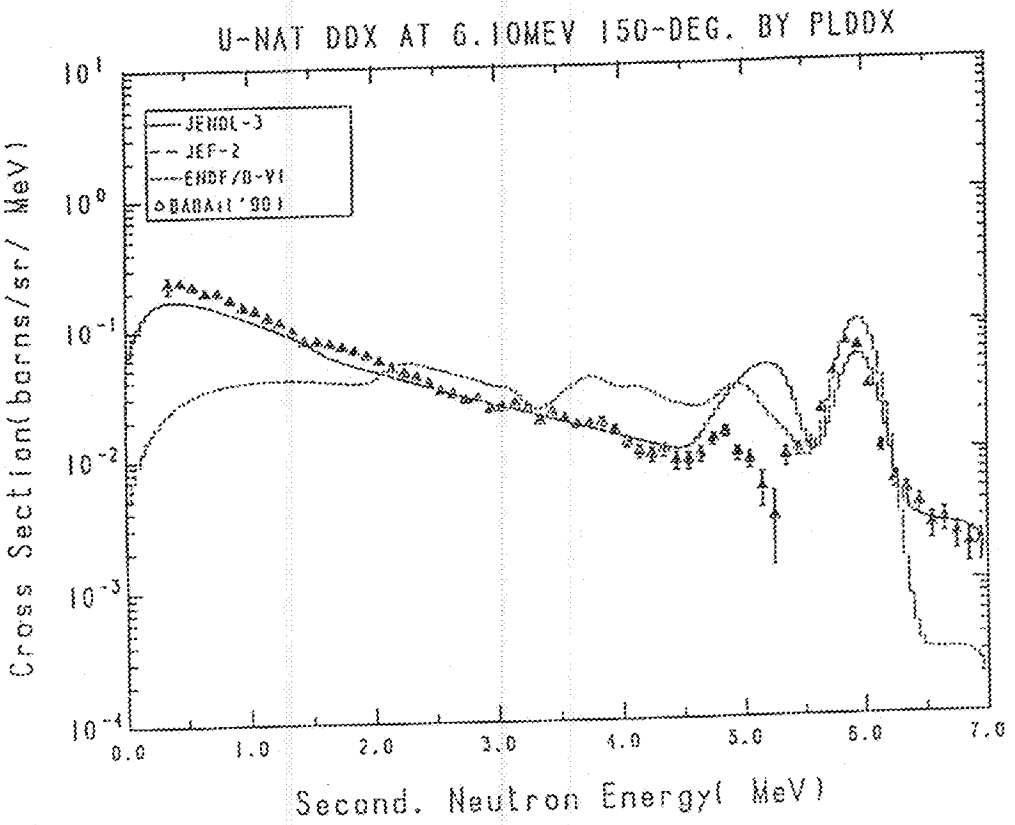

Fig. 54-5 The ^{nat}U Double Differential Cross Section at 6.10 MeV, Emitted Angle = 150° in Laboratory System

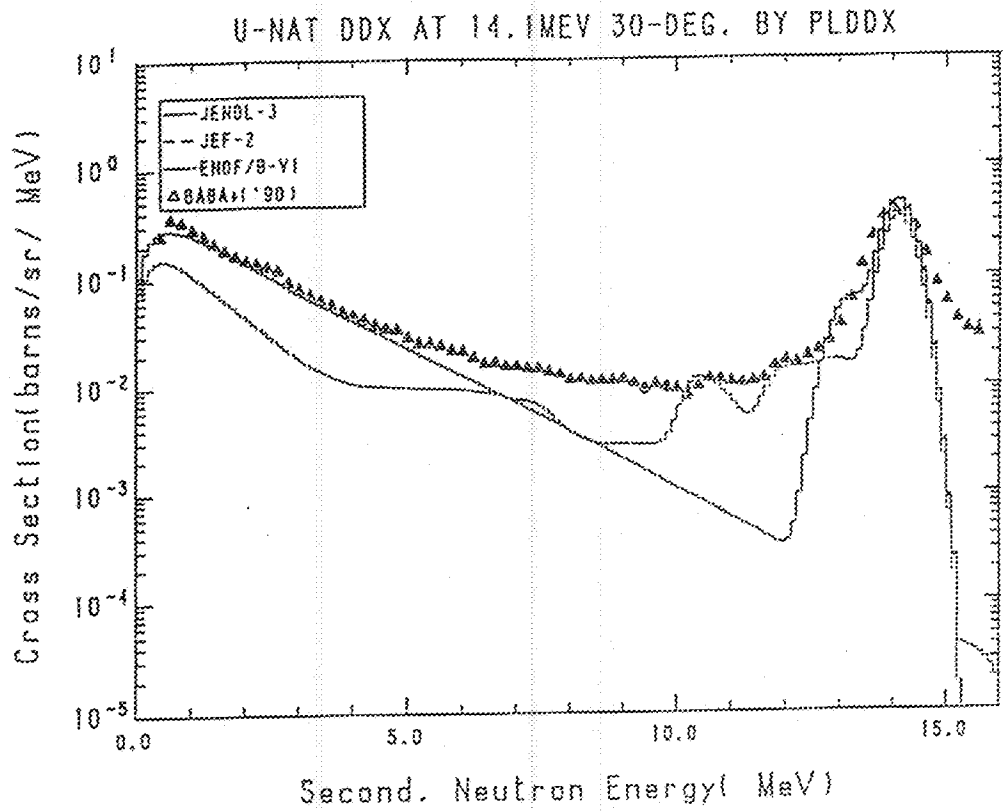

Fig. 55-1 The ^{nat}U Double Differential Cross Section at 14.1 MeV, Emitted Angle = 30° in Laboratory System

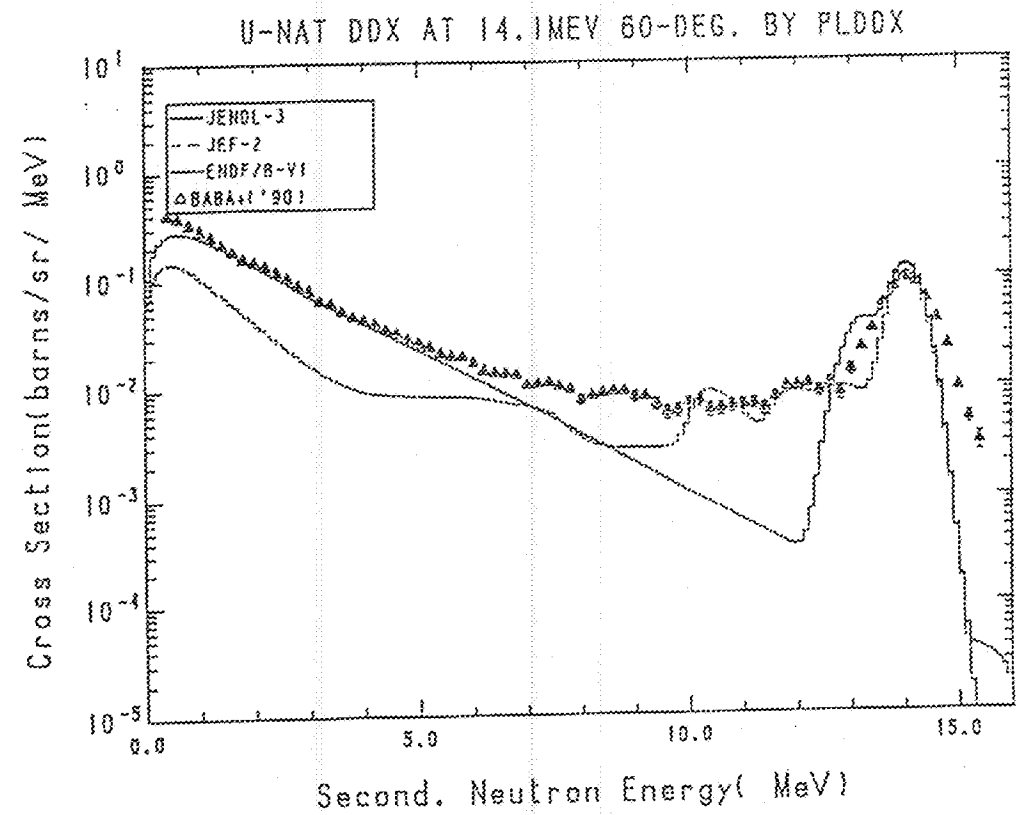

Fig. 55-2 The ^{nat}U Double Differential Cross Section at 14.1 MeV, Emitted Angle = 60° in Laboratory System

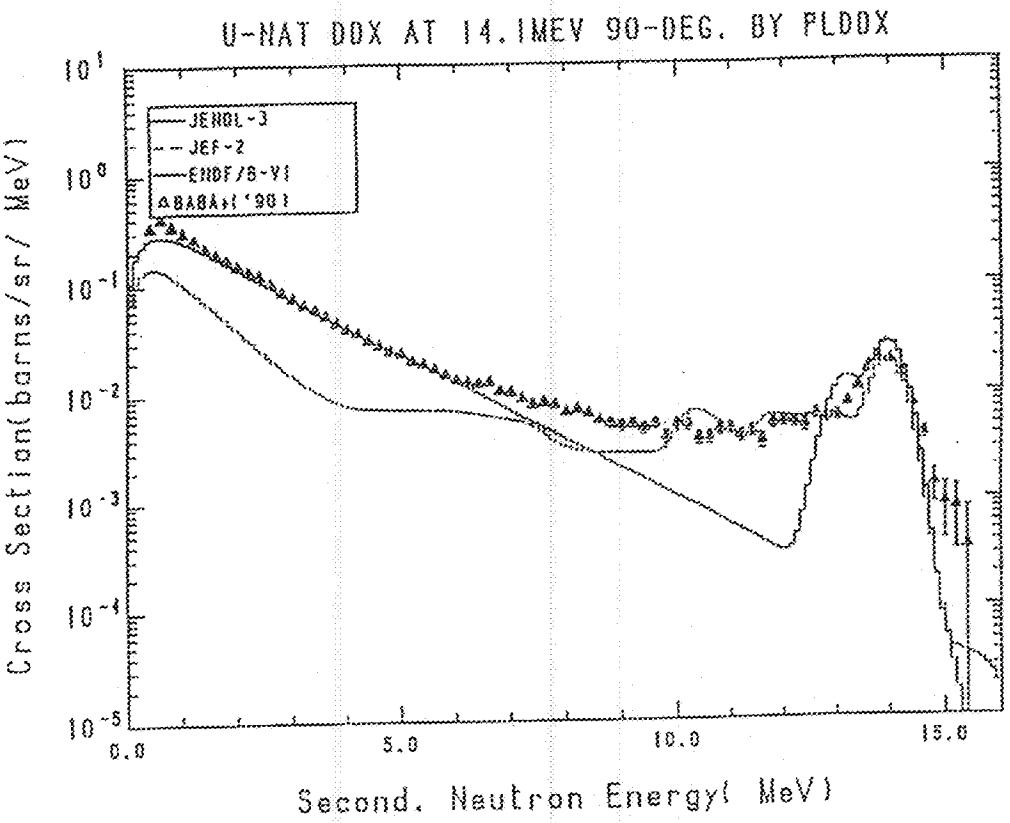

Fig. 55-3 The ^{nat}U Double Differential Cross Section at 14.1 MeV, Emitted Angle = 90° in Laboratory System

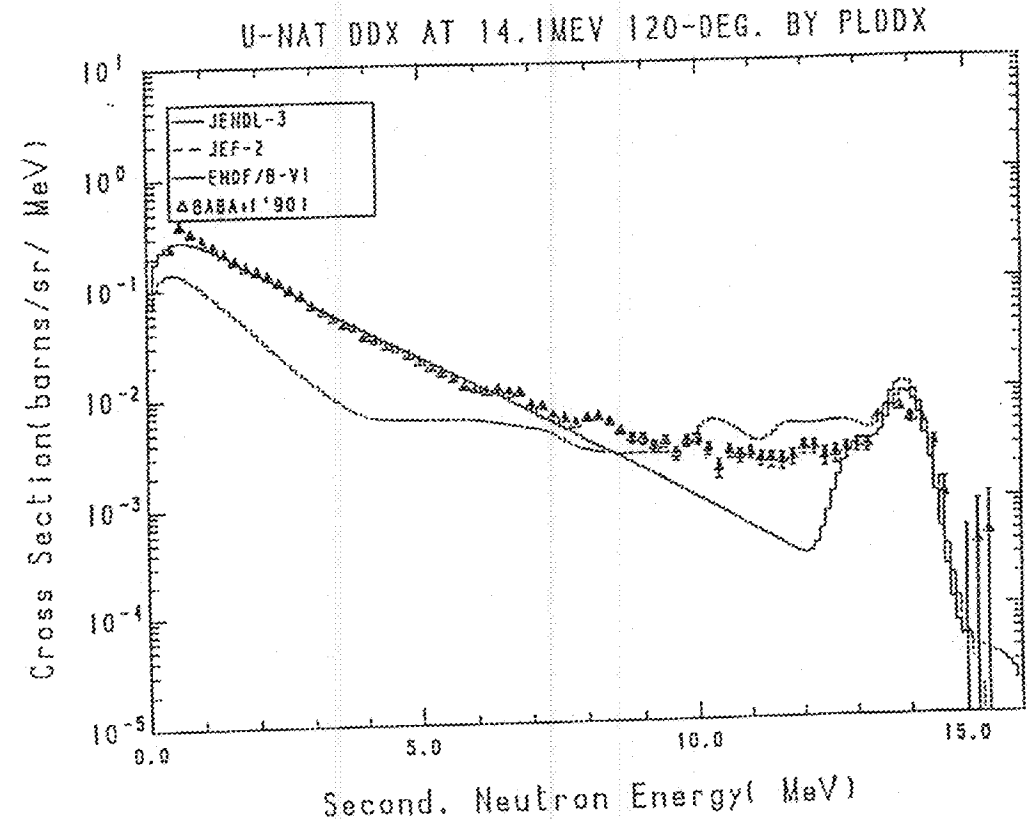

Fig. 55-4 The ^{nat}U Double Differential Cross Section at 14.1 MeV, Emitted Angle = 120° in Laboratory System

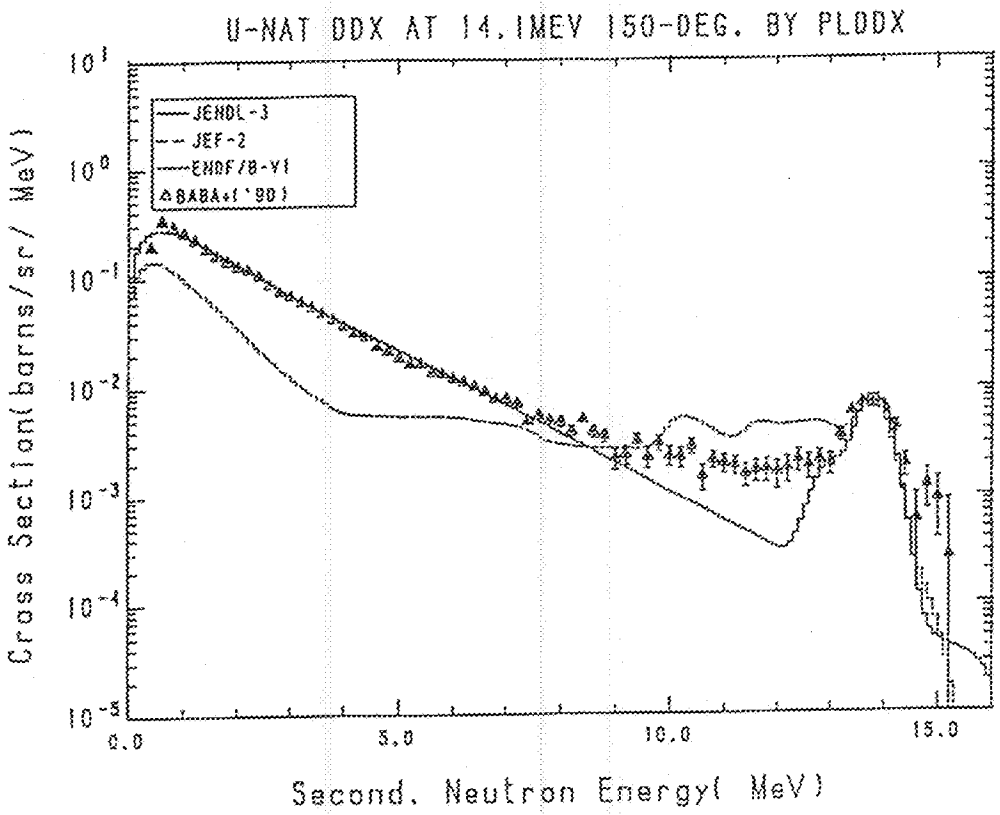

Fig. 55-5 The ^{nat}U Double Differential Cross Section at 14.1 MeV, Emitted Angle ≈ 150° in Laboratory System