LA-UR-21-27085
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Title: Y-89 Cross Sections for MCNP

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Intended for: Report

Issued: 2021-07-21

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memorandum

TO: Distribution

DATE: August 16, 1985

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SYMBOL: X-6:RCL-85-419

SUBJECT: Y-89 CROSS SECTIONS FOR MCNP

Two sets of continuous-energy cross sections for ^{89}Y have recently been made available for use with MCNP. One is from ENDF/B-V, the other is from ENDL85. Both are described in this memo.

1. ENDF/B-V

The ENDF/B-V ^{89}Y evaluation is found as MAT=9202 on Tape 542, the so-called Fission Product Tape. Evaluations contained on Tape 542 may be complete, but may not contain as much detail as evaluations found on the general-purpose files. As such, the characteristics of these evaluations should be well understood before calculations are performed using these data.

ENDF/B-V Tape 542 and a previously-processed PENDF tape (/PENDF/5/Y/89) were used as input to the NJOY/ACER code system to produce an ACE-format ^{89}Y cross-section table with ZAID=39089.50C. Cross sections are given for elastic scattering, six discrete inelastic levels, continuum inelastic scattering, and radiative capture. There are no photon-production data, no heating numbers, and no anisotropic angular distributions. There are 1877 points in the main energy grid.

2. ENDL85

The ^{89}Y evaluation found on the ND850424 version of ENDL85 was processed using MCPOINT. Our new post-processing code, ENDLGAM, was then used to incorporate expanded photon-production data into the ACE-format table. This data set may be used with confidence in coupled neutron-photon calculations. The ZAID is 39089.35C.

There is a surprising amount of detail provided in this evaluation. Cross sections are given for elastic scattering, seven discrete inelastic levels, continuum inelastic scattering, (n,2n), (n,p), (n,α), and radiative capture. As mentioned previously, photon-production data are included. There are 6154 points in the main energy grid.

Comparing Data Sets

The ENDL85 and ENDF/B-V evaluations of ^{89}Y are quite different. In addition to the contrasts cited in previous paragraphs, the total cross sections vary by as much as a factor of two below 1 keV (see Fig. 1). The low-energy ENDL85 total cross section appears more reasonable when comparing with experimental results from Ref. 1 (reproduced here as part of Fig. 1). The resolved resonance region is extended to a much higher energy (> 200 keV) in ENDL85 than in ENDF/B-V (< 20 keV).

There is also a large difference in the radiative capture cross sections of the two evaluations (see Fig. 2). There is a sudden rise in the ENDL85 cross section right at thermal. The ENDL85 capture cross section is then increasingly greater than the ENDF/B-V capture cross section, with an order-of-magnitude difference at 1 keV. The one experimental result in Ref. 1 for thermal capture (1.28 b) seems to support the ENDF/B-V curve.

The conclusion is that the data sets are different enough that both should probably be used in calculations to check for sensitivity and to define the cross-section uncertainty in results.

Using the Data in MCNP

To use either the ENDL85 or ENDF/B-V ^{89}Y cross sections in MCNP, it is necessary to fetch a special cross-section directory from CFS. The directory is available as /X6XS/LTSS/XSDIRXAL or /X6XS/CTSS/XSDIRXAL. Switch XSDIRXAL to XSDIR or set XSDIR=XSDIRXAL on the MCNP execution line. The ZAID is 39089.35C for ENDL85 and 39089.50C for ENDF/B-V.

Reference 1

D. I. Garber and R. R. Kinsey, "Neutron Cross Sections Volume II, Curves," Brookhaven National Laboratory report BNL-325, 3rd Ed., Vol. II (Jan. 1976).

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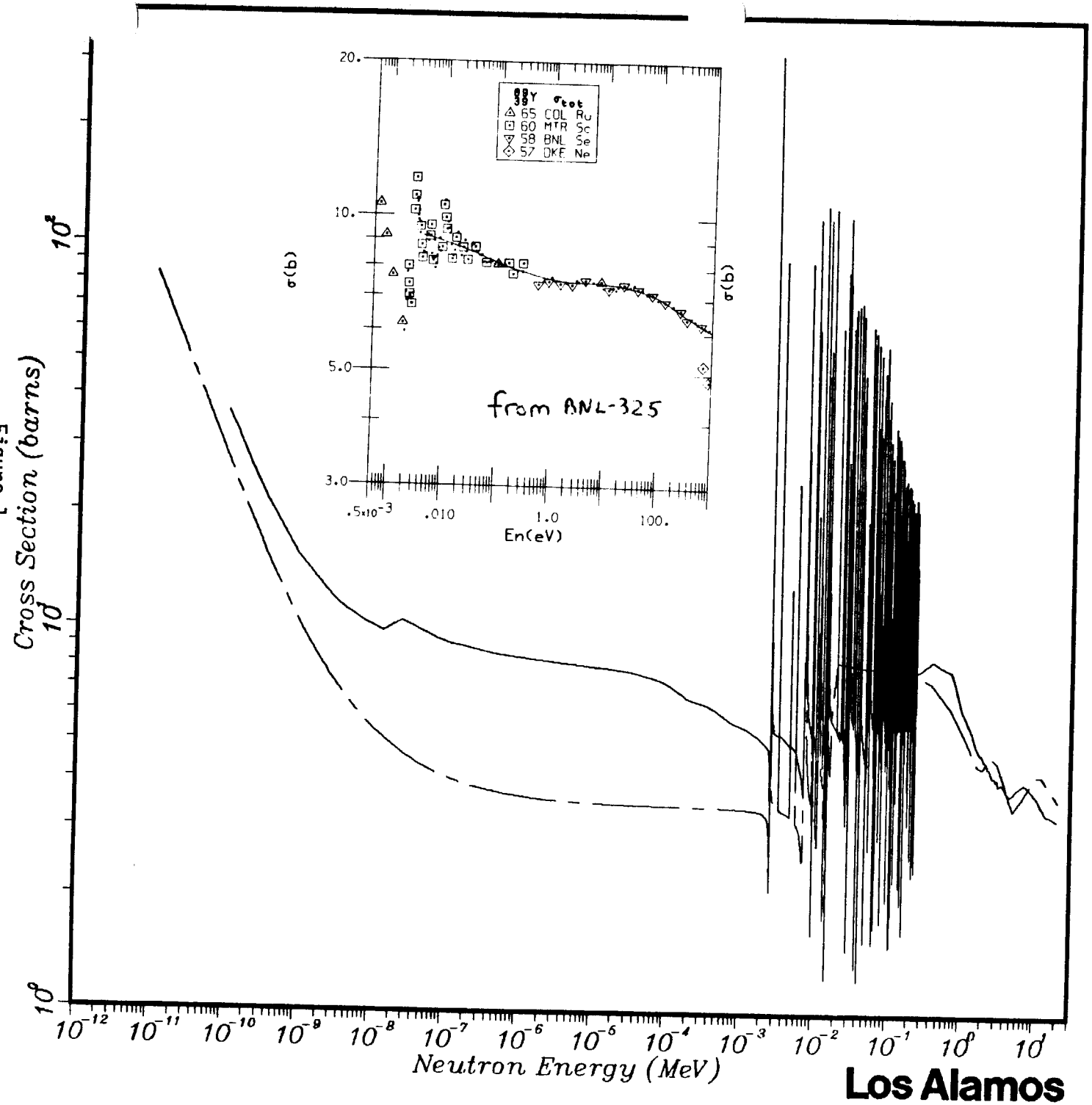
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From File ND85Y893
ZAID = 39089.50C
From File Y89E53
Cross Section (barns)
Neutron Energy (MeV)
from ANL-325
En(eV)
σ(b)
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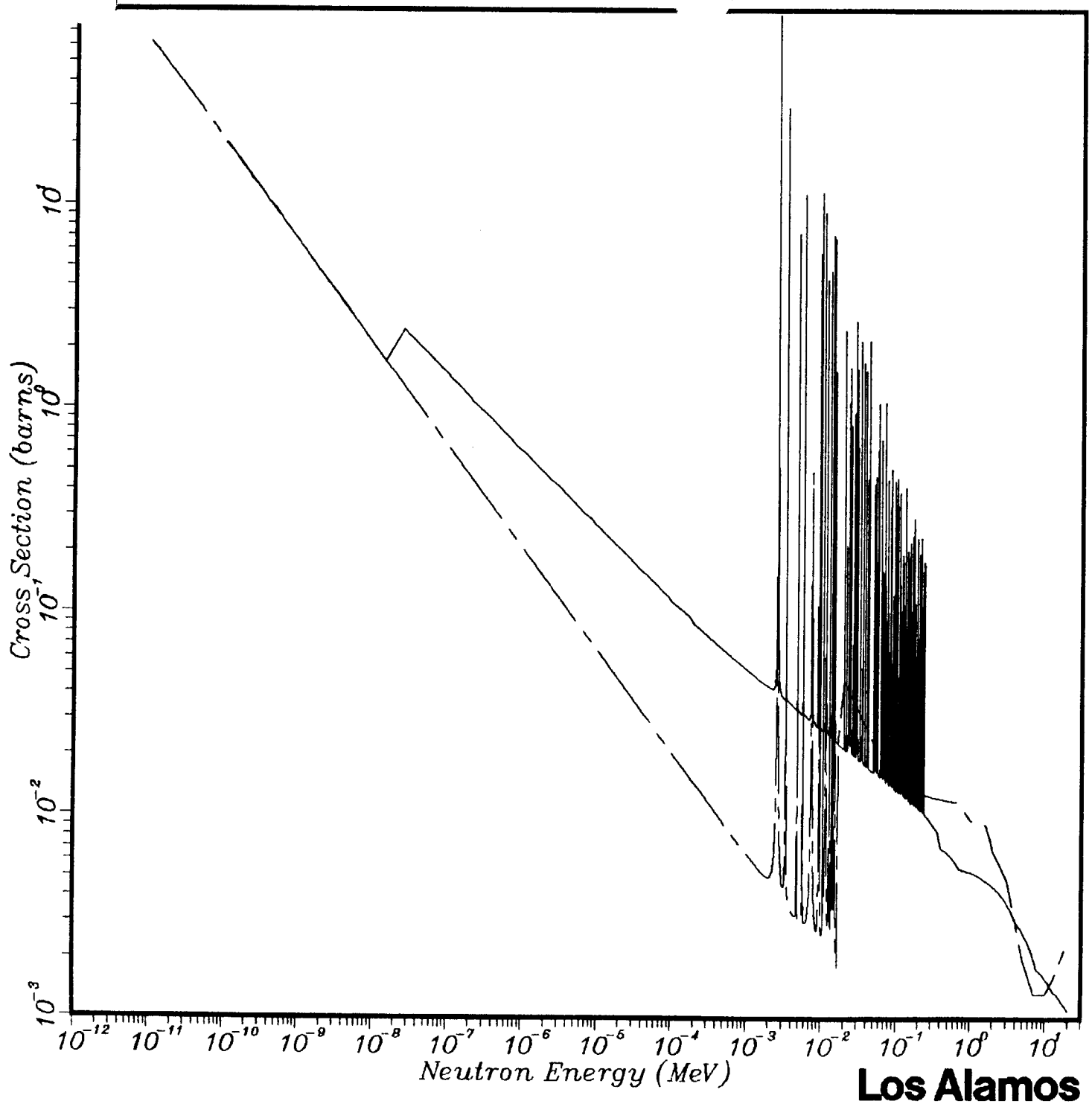
Figure 1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MT=102
N,GAMMA
ZAID = 39089.35C
From File ND85Y893
ZAID = 39089.50C
From File Y89E53
Cross Section (barns)
Neutron Energy (MeV)
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Figure 2