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TITLE: THE FILE OF EVALUATED DECAY DATA IN ENDF/B

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The File of Evaluated Decay Data in ENDF/B

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One important application of nuclear decay data is the Evaluated Nuclear Data File/B, the base of evaluated nuclear data used in reactor research and technology activities within the U. S. The decay-data evaluation activities for ENDF/B were guided by the following considerations.

1) It was recognized[1] at the outset that the scope and content of the data should be much broader than that required simply for decay-heat prediction (the original motivation behind this effort). Conversely, it was not practical to include "everything". The decay-data types to be included thus had to be limited to those most widely applicable. Making these choices required much care and judgement.

2) At the very minimum, however, these data types had to be able to describe the evolution in time of the emitted energy, together with its form, magnitude and distribution.

3) It was not felt desirable to add to the proliferation of files of "evaluated" data--drawn from the same base of measurements--whose contents differed only trivially from each other. Consequently, the Evaluated Nuclear Structure Data File (ENSDF), the evaluated data base for the Nuclear Data Sheets, was used as a starting point for the latest version of ENDF/B.

Discussions of the organization and content of the decay data in Version-IV of ENDF/B (issued in 1974, and the first to contain such data in any appreciable quantity) and ENDF/B-V (issued in 1979) have been given previously[1,2,3]. Work on ENDF/B-VI has recently been completed. Some aspects of this information are as follows.

The decay data in the Activation File (158 nuclides) and the Actinide File (108 nuclides) excellently represent the current status of this information. In particular, the half-lives and gamma and alpha emission probabilities, quantities that are so important for many applications, of the actinide nuclides represent a significant improvement over those in ENDF/B-V, because of the inclusion of data produced by an IAEA Coordinated Research Program.[4]

The Fission-Product File contains experimental decay data on ~510 nuclides, which is essentially all for which a meaningful amount of data is available. For the first time, delayed-neutron spectra for the precursor nuclides are included. Descriptions of the types and quantities of fission-product-related data have been given by England et al. [5,6]

As shown in Fig. 1, the ENDF/B-VI fission-product data are able to fit decay-heat data quite well. However, there are still potential problems in this data base. Of the ~750 radioactive nuclides, ~230 have no measured spectral data, while the existing data for another ~120 are not (owing to the "pandemonium" problem[8]) useful for decay-heat calculations. This information must be obtained from nuclear-model calculations; and none of these models are currently able to provide accurate predictions for it. Uncertainties also exist in the fission-yield data, which are needed for the calculations.

Some hint of problems in the fission-product data base is provided by the gamma decay heat following a "burst" irradiation of ^{239}Pu, shown in Fig. 2. The data are fit quite well by ENDF/B-VI. However, the fit can be dramatically changed by changing the value of only one datum[9], $\langle E\gamma \rangle$ for ^{102}Tc. The ENDF/B-VI value for this is ~1.19 MeV[10], from a Gross Theory[11] calculation. However, from the currently accepted[12] ^{102}Tc decay scheme, the $\langle E\gamma \rangle$ value is only 81 keV. If

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this latter value is correct, the good agreement in Fig. 2 may not mean that the data base is correct, but simply that there are (a number of) errors in other input data that are masked by this "incorrect" one.

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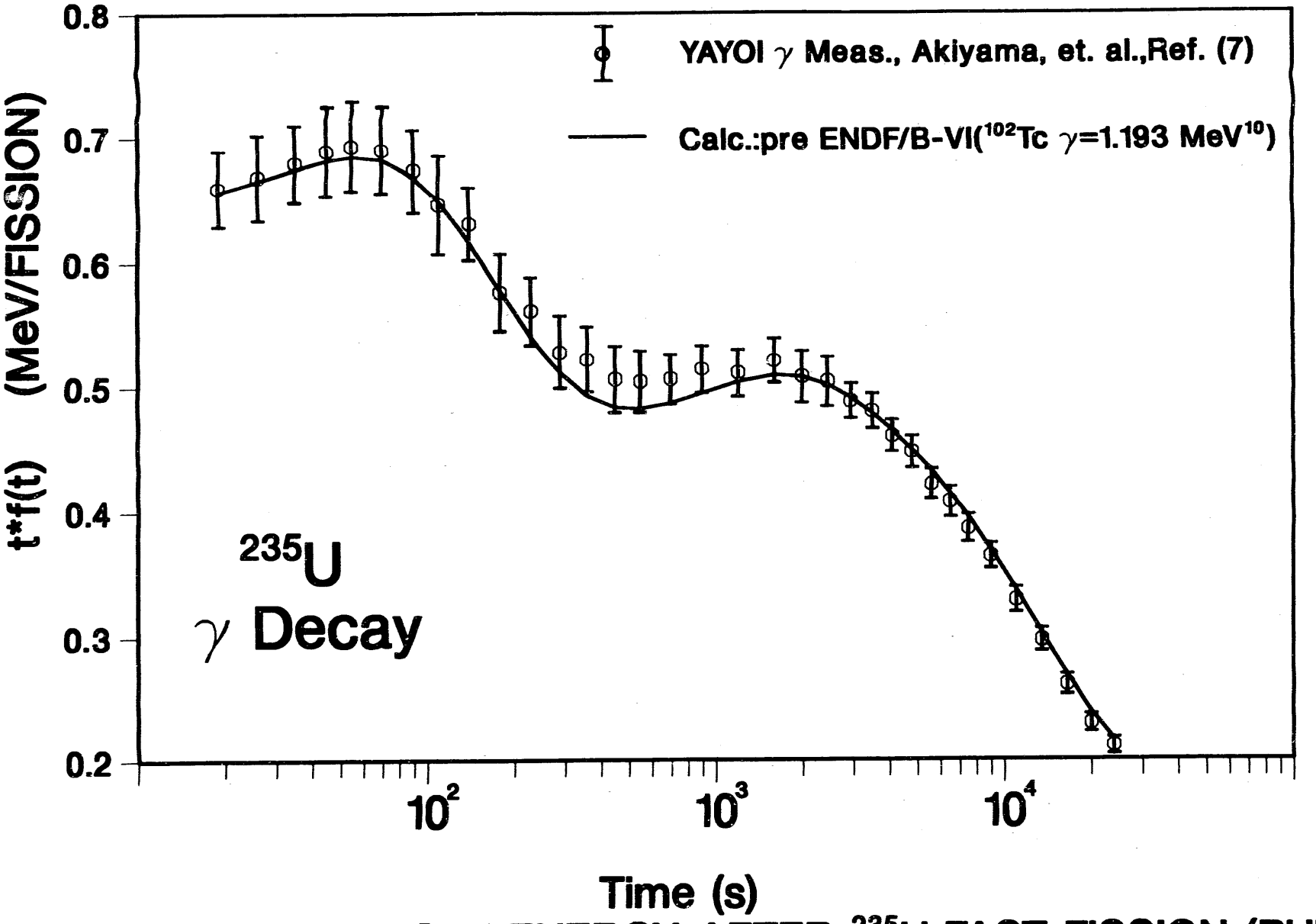

Fig. 1 GAMMA DECAY ENERGY AFTER ^{235}U FAST FISSION (PULSE)

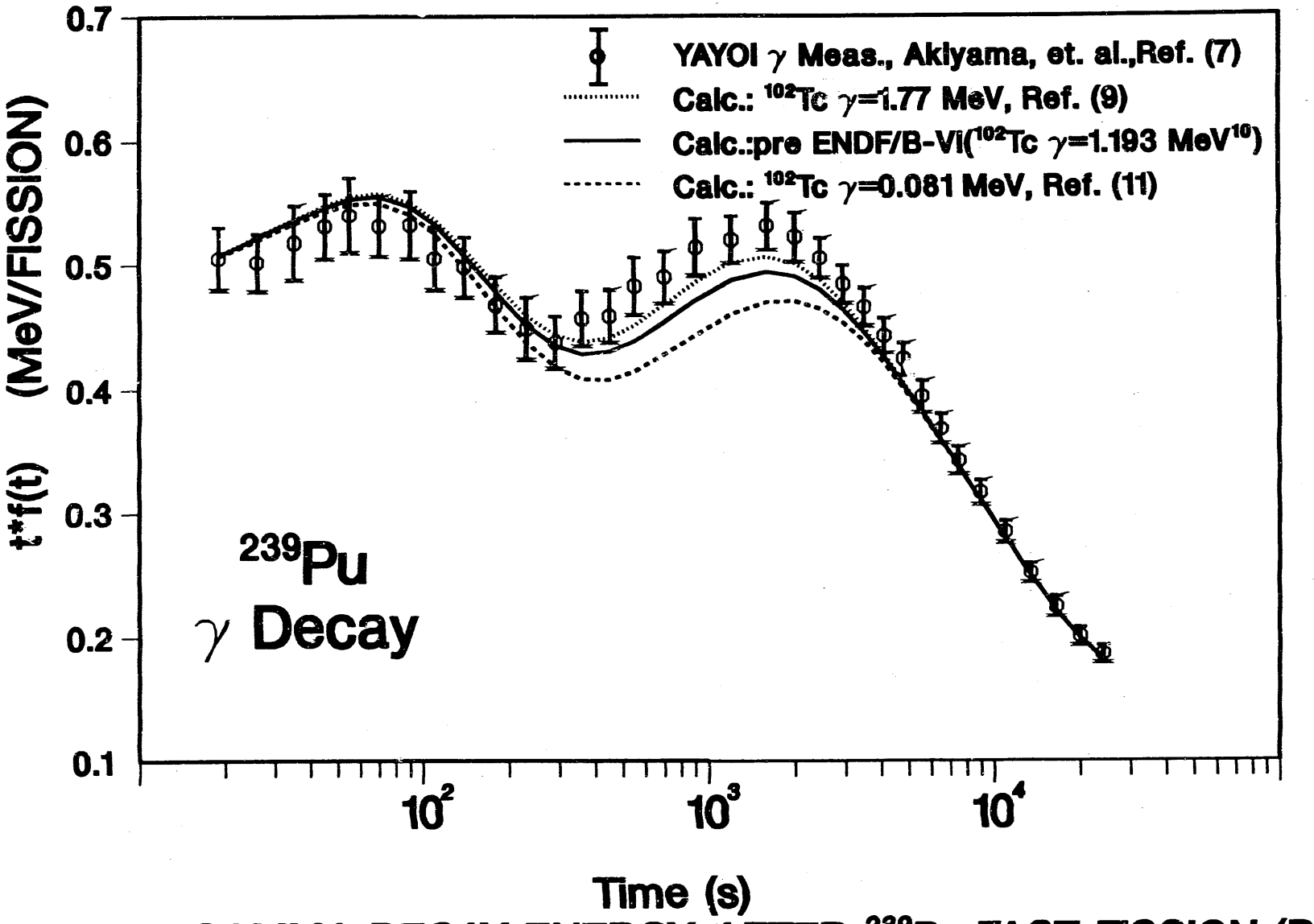

Fig. 2 GAMMA DECAY ENERGY AFTER ^{239}Pu FAST FISSION (PULSE)

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