THERMAL DATA FOR FISSION REACTORS
ETA OF U-235

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In this paper, we studied the values of eta ($\nu.\sigma_f/(\sigma_c+\sigma_f)$) for U235 in the low energy range (below 1. eV). We calculated with NJOY91.38 the capture and fission cross sections and retrieved the nu values from the evaluations, for ENDF/B6, ENDF/B6 revision 1, JEF2.0 and JEF2.2. We compared the calculated values with the eta measurements from Geel (1987) [ref 1], Harwell (1988) [ref 2], Grenoble (1989) ref [3], Oak Ridge (1990) [ref 4]. The new alpha measurements (1991) [ref 5] and fission cross section measurements from Geel [ref 6] have been used too.

Present status of the 4 libraries :

ENDF/B6 :
The low energy range is entirely represented by the resonance parameters, there is no background in file 3. The resonance parameters had been evaluated by the standard comittee of CSEWG (L.C. Leal, G. De Saussure, R.B. Perez, N.M. Larson, M.S. Moore and R.Q. Wright), in the Reich and Moore formalism and in 10 separate energy regions. The first region is between 1.E-5 and 110. eV. The eta value was constant below 0.1 eV.

ENDF/B6 revision 1 :
The resolved resonance parameters have been changed. The neutron energy region below 4. eV has been made a separate group. Eta is now decreasing with decreasing neutron energy below 0.1 eV. The low energy range is still entirely represented by the resonance parameters, defined by the same comittee as above in 11 energy regions.

JEF2.0 :
In March 89, some resonance parameters from Oak Ridge have been inserted. They were replaced in September 89 by the first version of G. de Saussure's resonance parameters, between 0.15 eV and 110. eV. The low energy range, from 1.E-5 to 0.15 eV, is represented by a smooth background cross section, which has been adjusted to fit in the shape of the experimental data of eta (Geel and Grenoble) and of the fission cross

section measured in Geel [REF 6] and to avoid a discontinuity at the boundary with the resonance region.

JEF2.2 :
The JEF2.2 data were based on the ENDF/B6 evaluation. The resonance parameters have been taken from ENDF/B6, between 0.15 eV to 110. eV. The lowest energy region, from 1.E-5 to 0.15 eV, is still represented by the JEF2.0 smooth background. As no more adjustment has been made, there is a discontinuity at 0.15 eV between the smooth and the resonance parameter representations.

Comparisons between the 4 libraries, the corresponding eta values, the 4 eta measurements and the fission measurements

See figure 1 to 11 and 15, 16.

There is no big change in the fission cross section between JEF2.0 and JEF2.2 (figure 4) and between ENDF/B6 and B6 revision 1 (figure 2).

The main changes can be seen on the capture cross sections. We already mentionned the discontinuity at 150 meV for JEF2.2 (figure 3). This, of course, induces an important effect on eta (figure 8). For B6, the slope on eta (figure9) is due to the changes on the capture cross section (figure 1). The other discontinuities on eta for JEF2 are due to the shape of nu, which had been readjusted on the Gwin experiments [ref 7], (figure,7), with no smoothing of the values.

The comparison with the measured points (figure 10, 11) show that the best estimation for the smooth part (below 150 meV) seems to be JEF2.0, which had been adjusted on the fission measurement of Geel (figure 15, 16). We have the same conclusion for the minimum (about 260 meV), but as the resonance parameters come from B6, the difference is due to the renormalisation of nu.

Comparisons between the alpha values corresponding to the 4 libraries and the Geel alpha measurements

We compared the calculated alpha values (σ_c/σ_f) and eta values with the last Geel alpha measurements (figures 13, 14) and the corresponding eta values (figure 12).

General conclusion

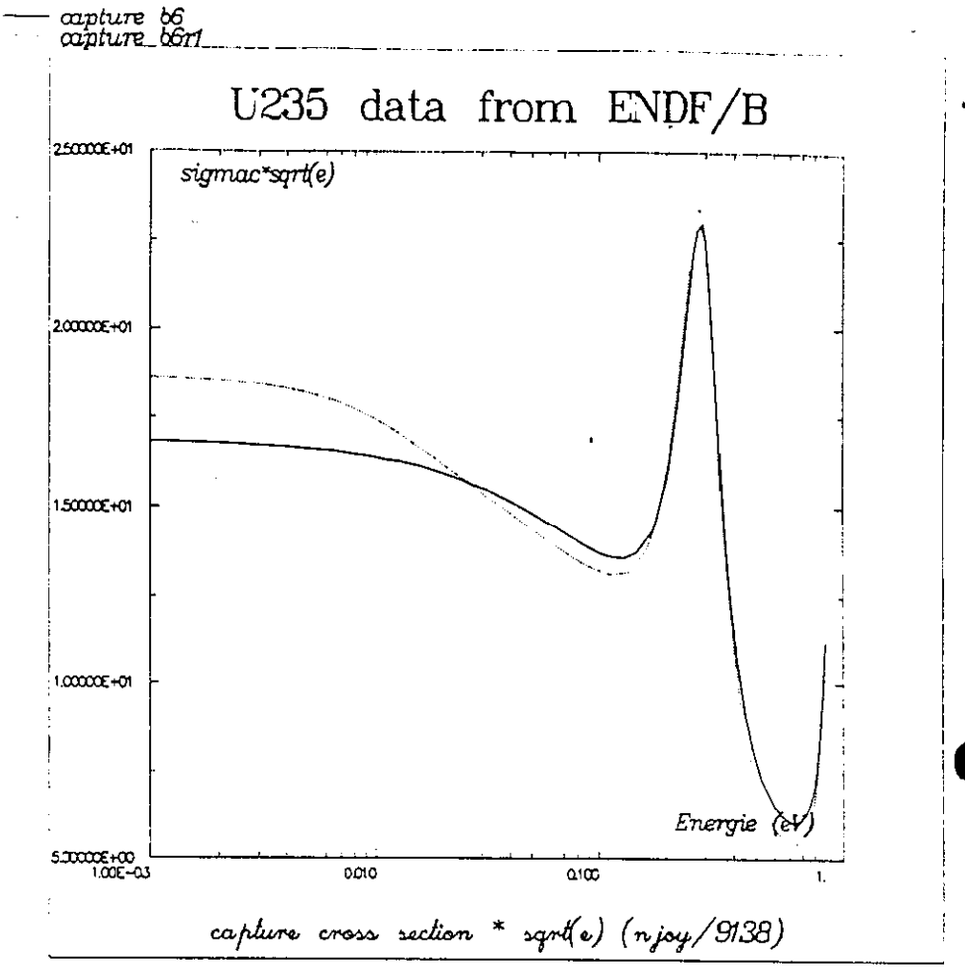
The JEF2.2 shows incoherent results at the discontinuity (150 meV), which were not present in JEF2.0, which seemed to be more satisfactory. The nu values should also be smoothed in the energy range below 150 meV, to avoid the discontinuities in that part.

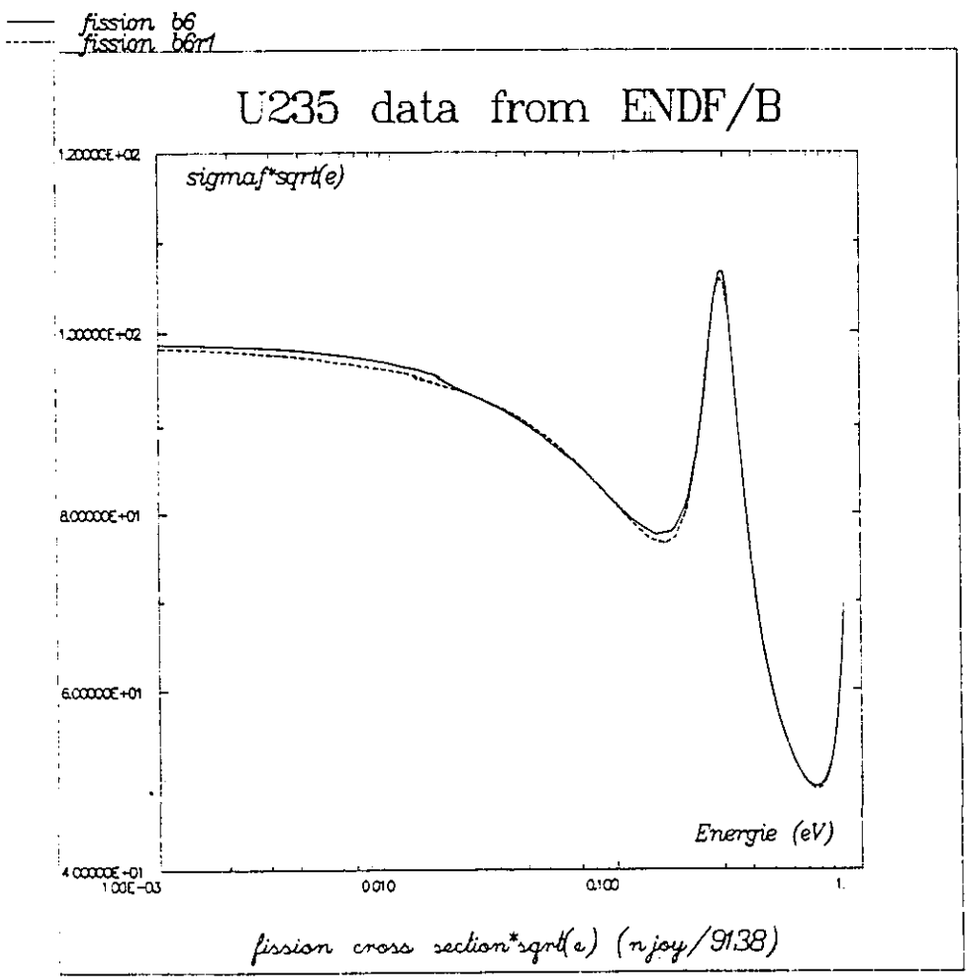
The ENDF/B6 and ENDF/B6 revision 1 do not represent correctly the minimum of eta given by the measurements.

References :

[1] J.A. Wartena et al. : Report IEAA. Tecdoc 491, 123 (1987)
[2] M.C. Moxon et al. : "Nuclear data for science and technology - Mito", 75 (1988)
[3] J.A. Wartena et al. : Report NEANDC (E) 312 III (1989)
[4] M.C. Moxon et al. : Private communication to the NEA data bank(1990)
[5] H. Weigmann : JEF 2 meeting (june 1992)
[6] R.A. Schrack : "Nuclear Data for Science and Technology - Mito",131 (1988)
[7] R. Gwin et al. : Nuclear Science and Engineering 87, 381 (1984)
[8] H. Tellier : Thermal and epithermal data assessment for fission reactors (Jülich 1991)

Figure 1





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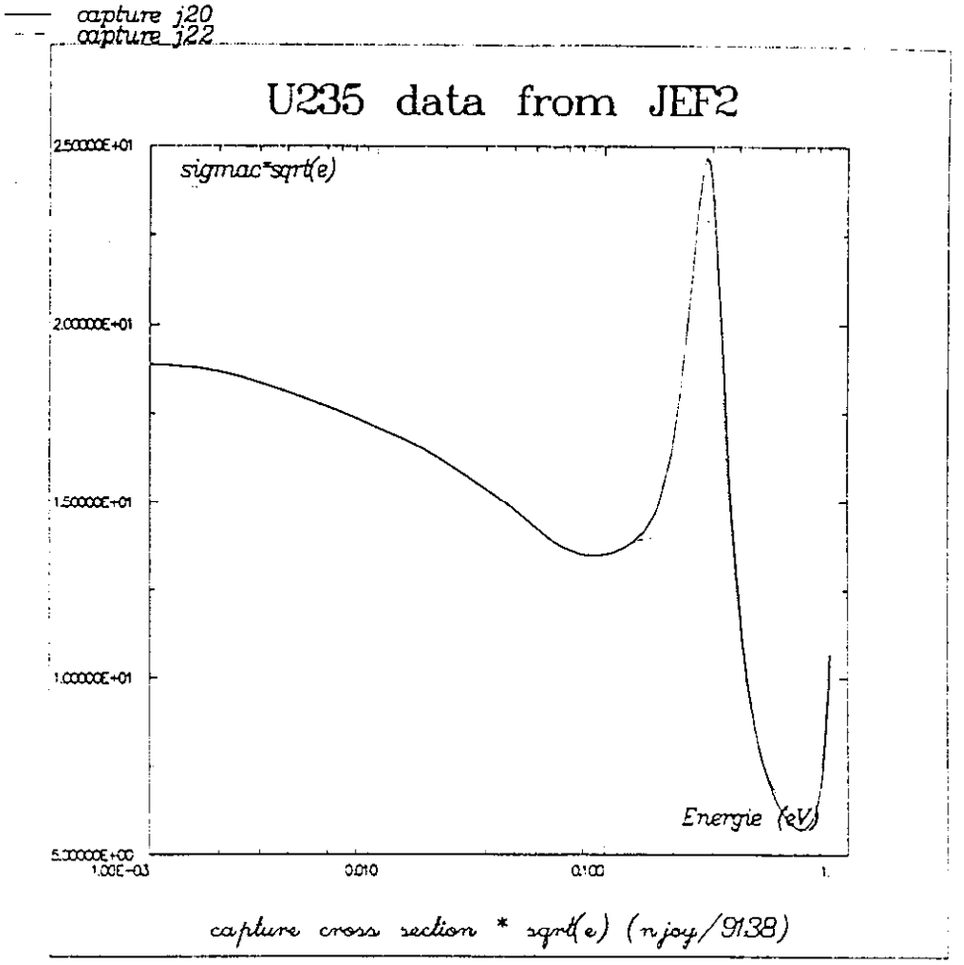

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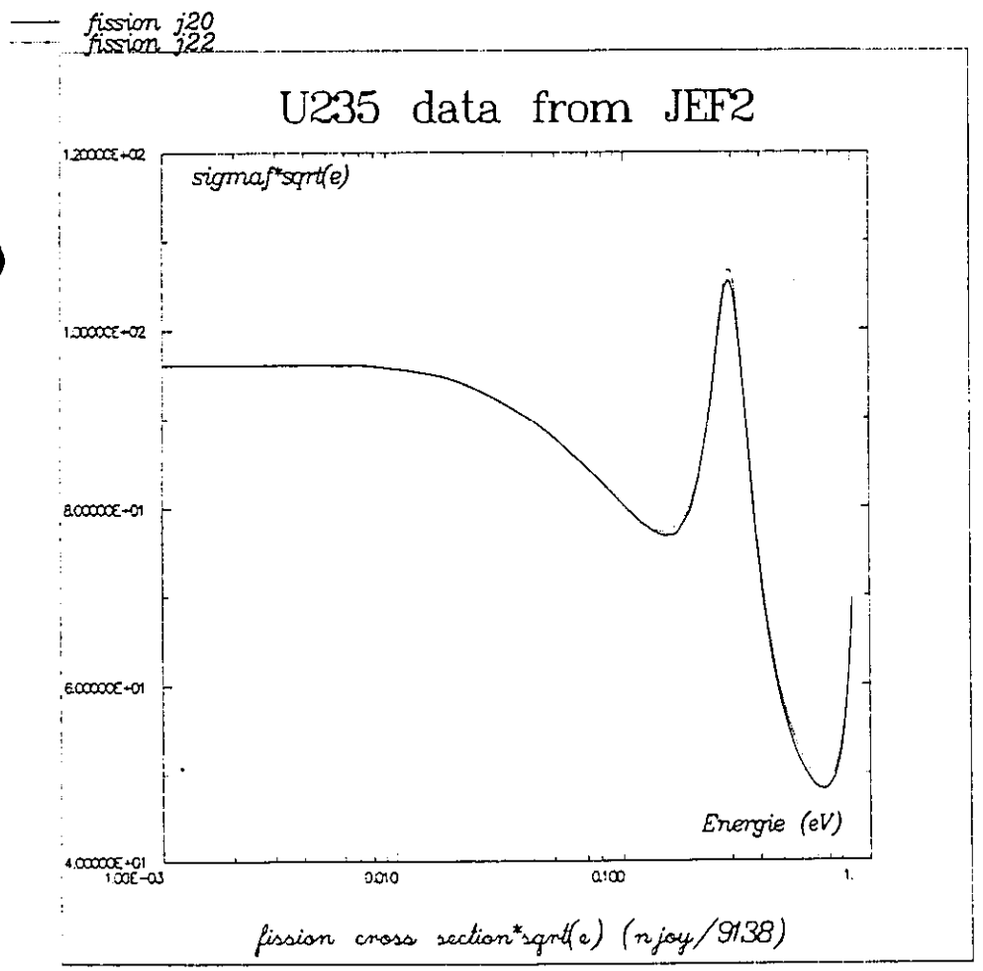

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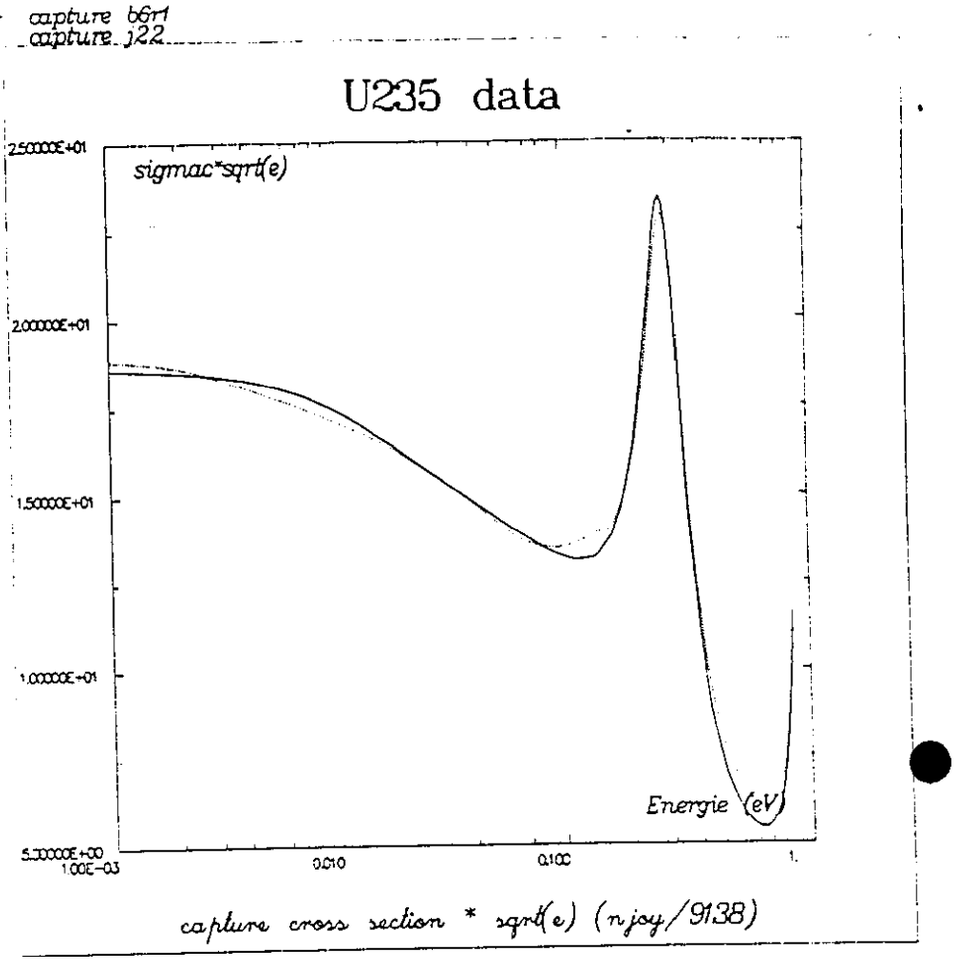

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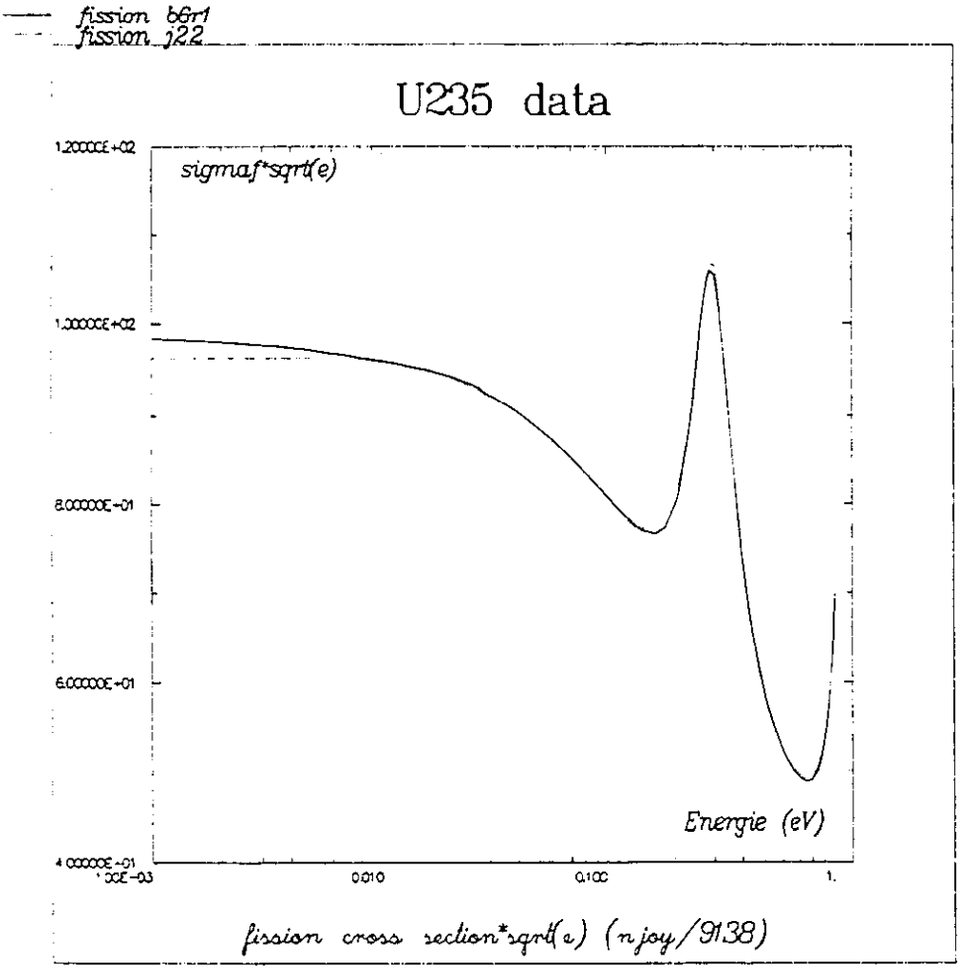

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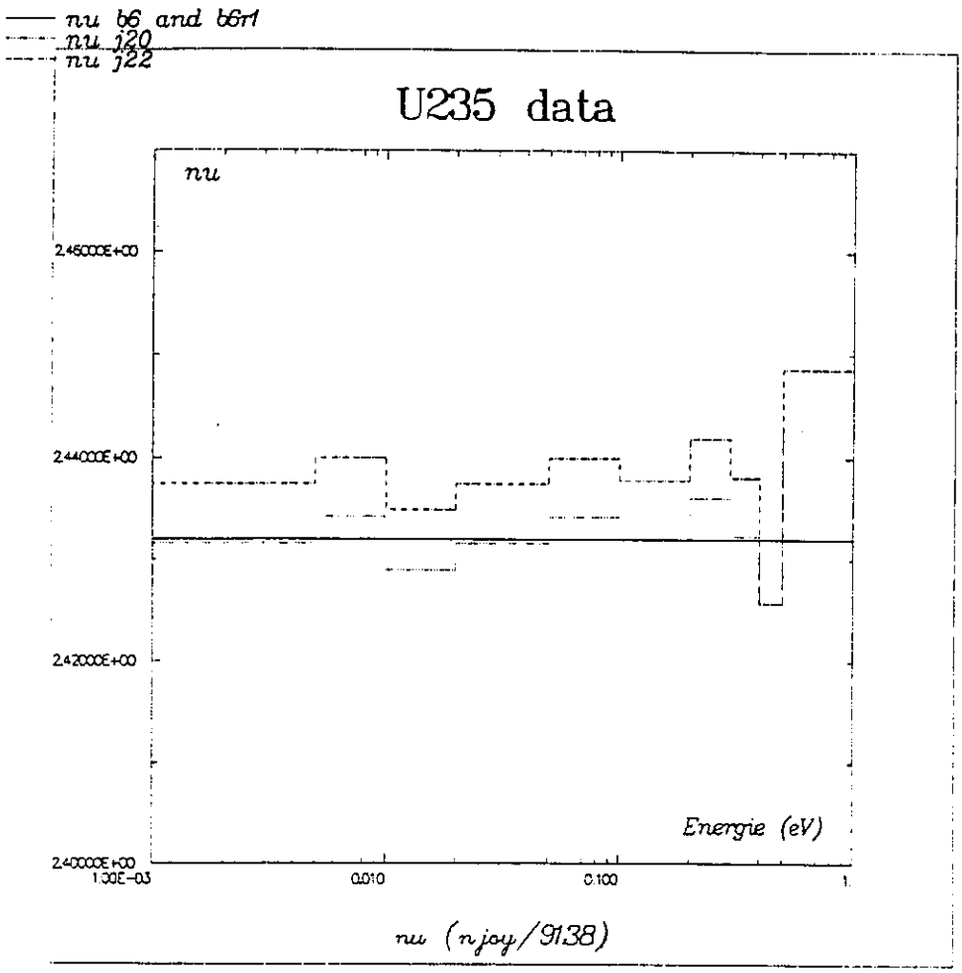
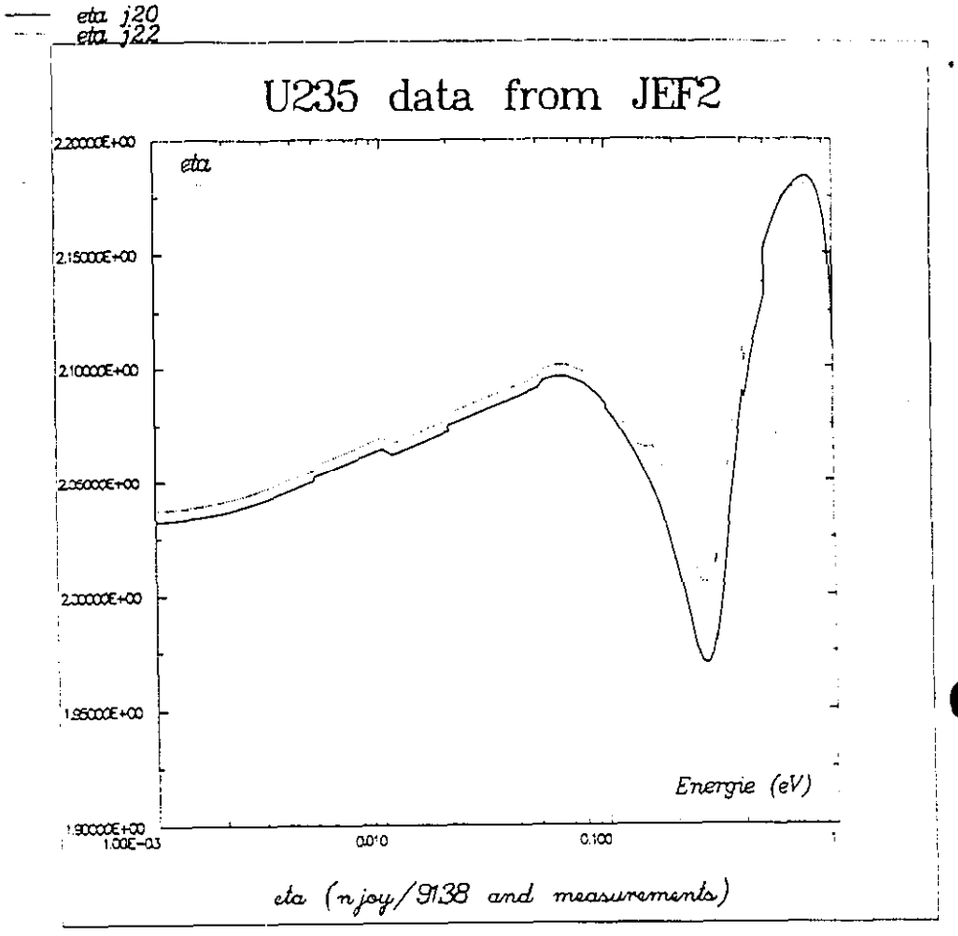
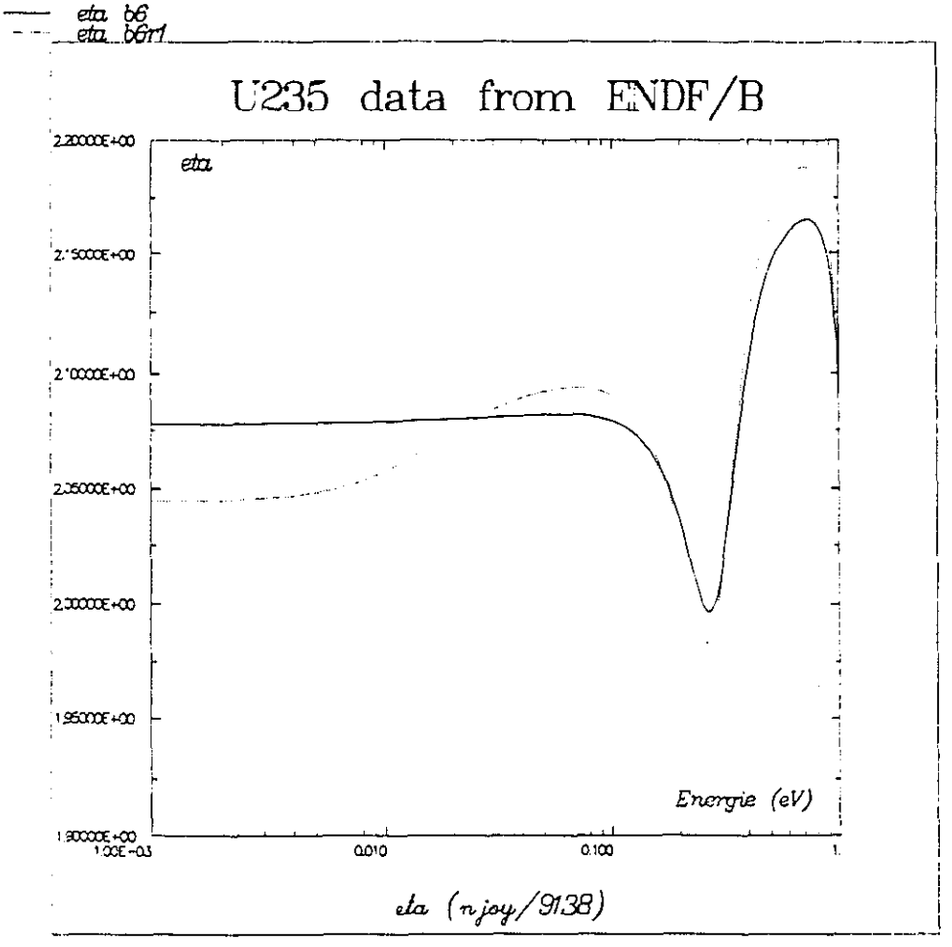


Figure 7

Figure 8





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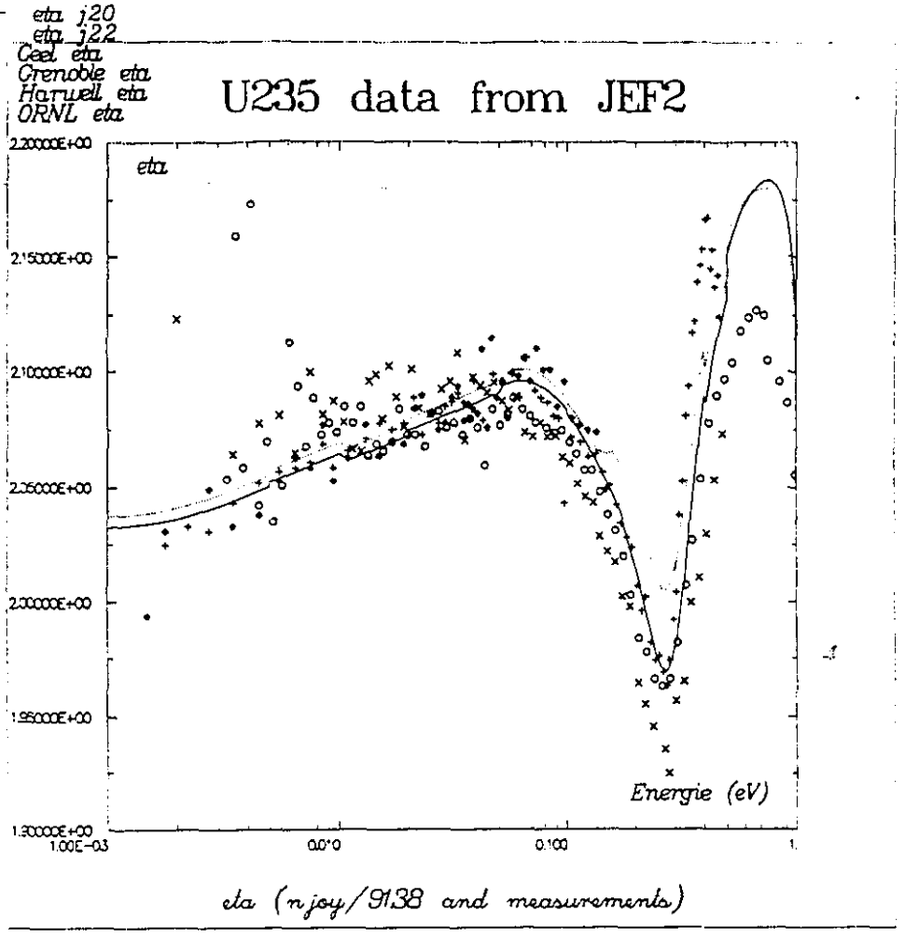

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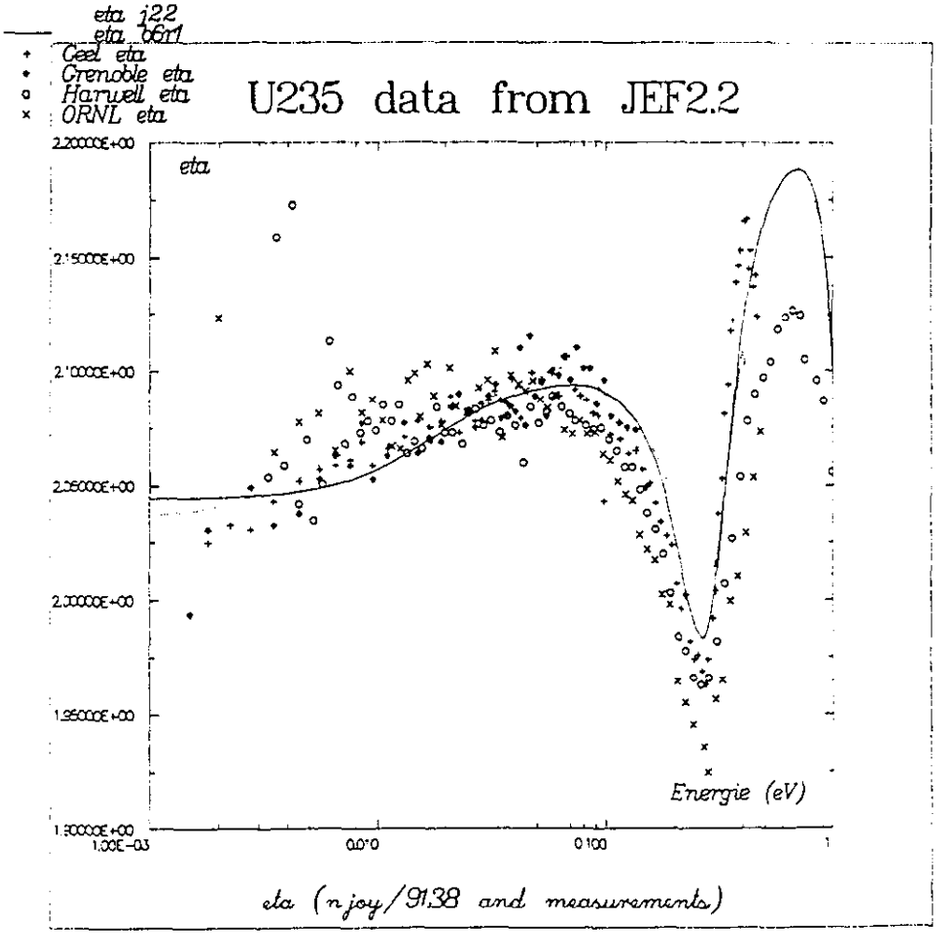

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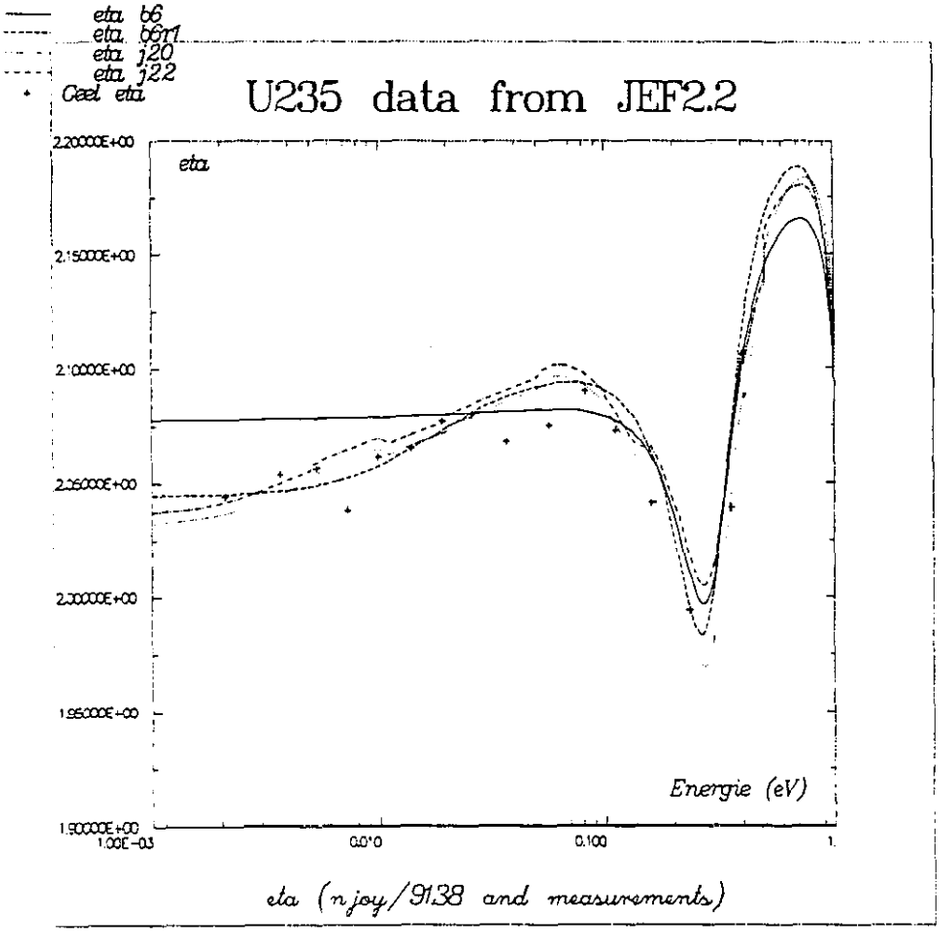

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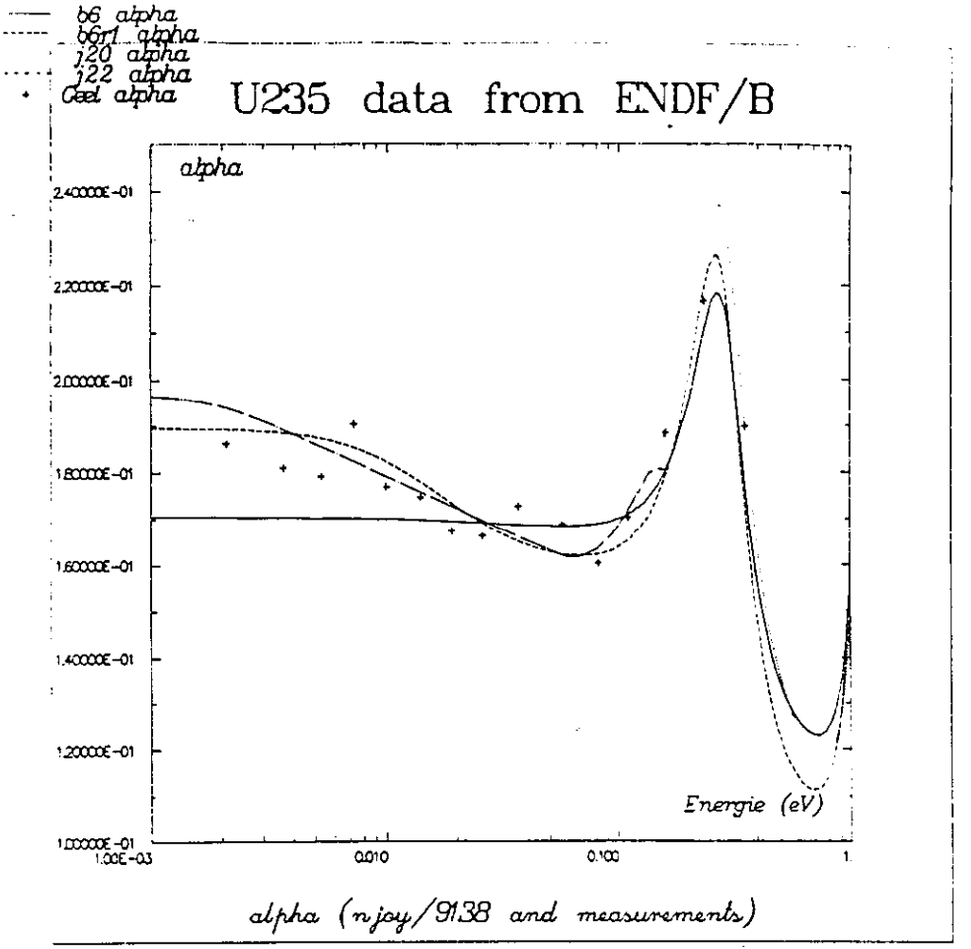

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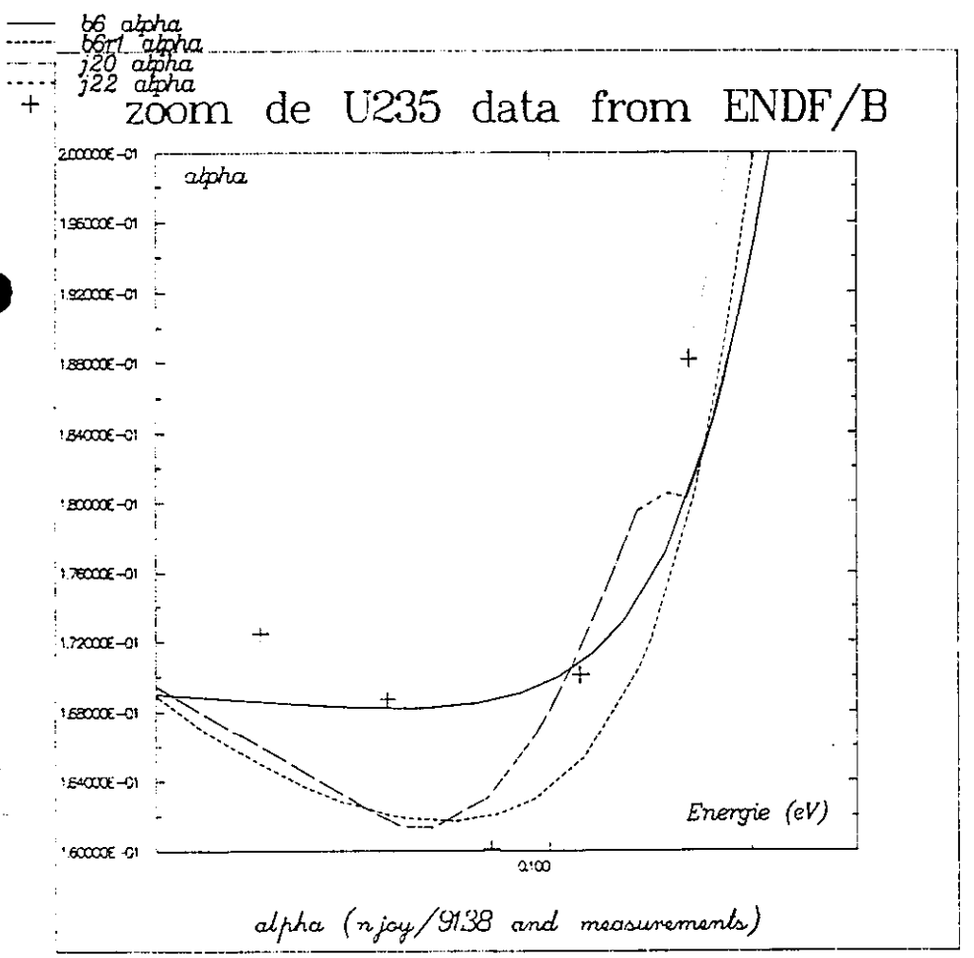

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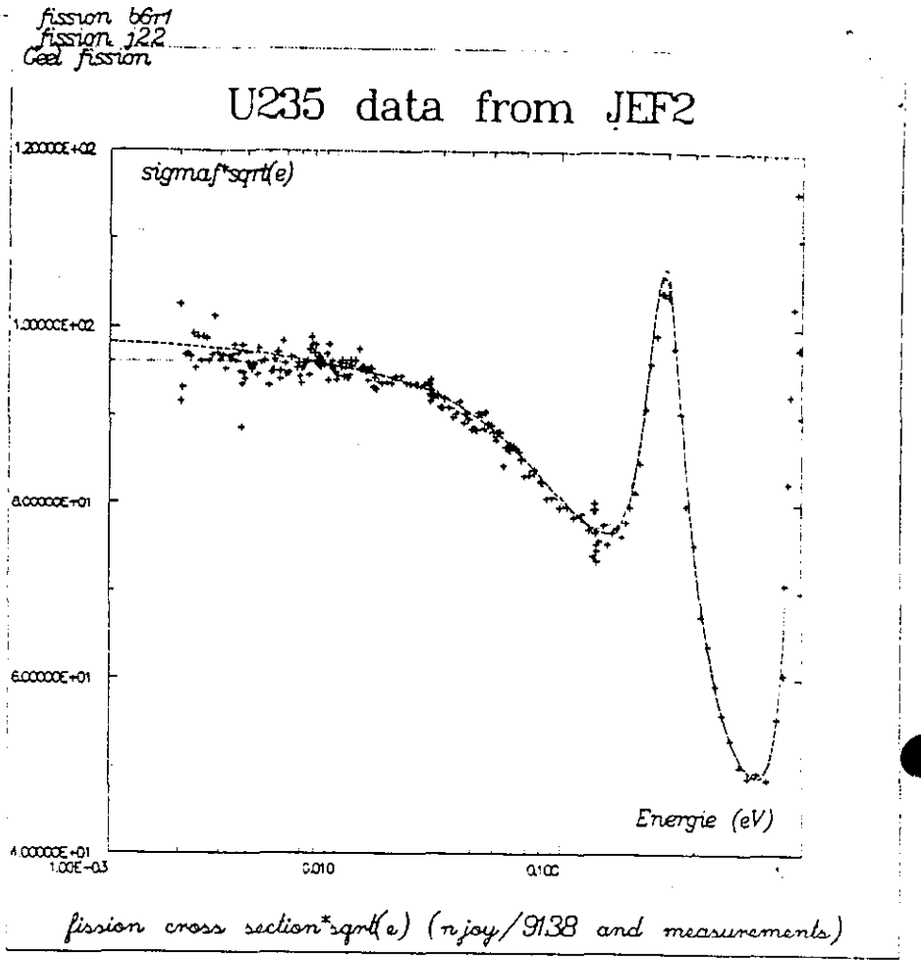

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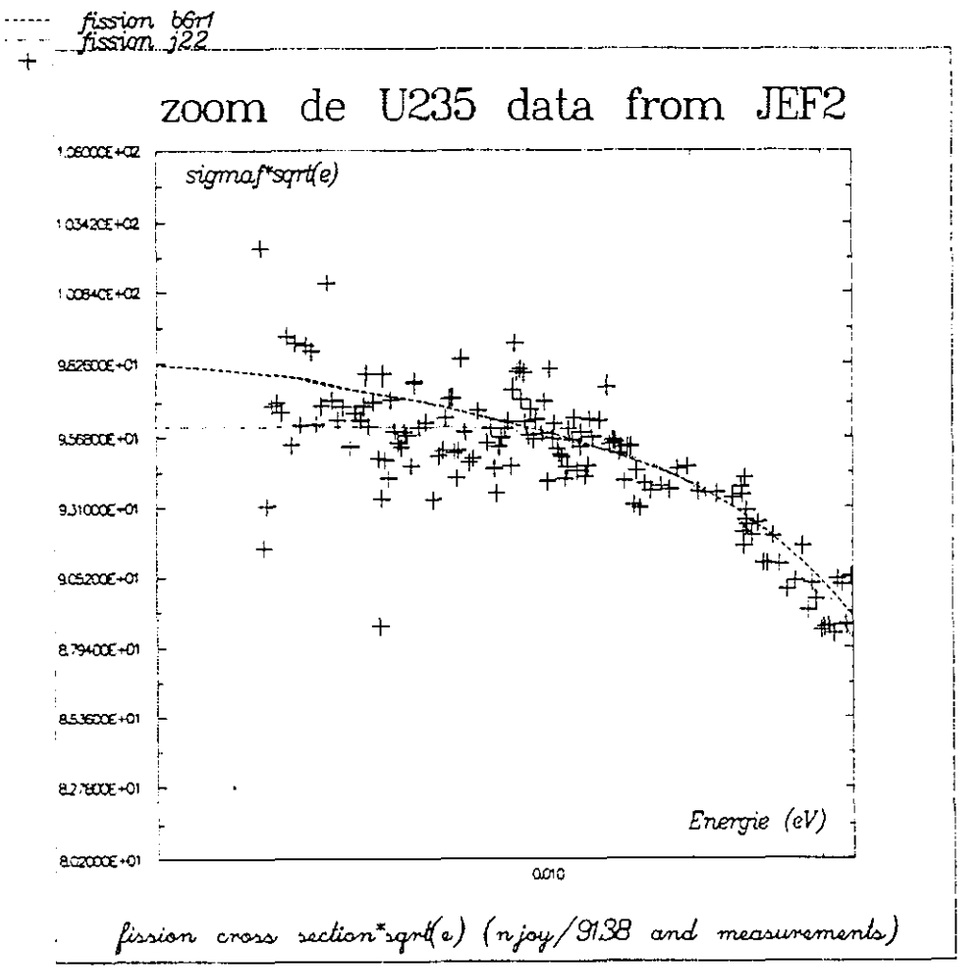

Figure 16