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MODIFICATION AND TESTING OF THE CODE POLLA*

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Abstract

We discuss our implementation and testing of the code POLLA which translates Reich-Moore multilevel resonance parameters into the equivalent Adler-Adler ones. We suggest that the Adler-Adler parameters obtained from POLLA be subjected to a further fine adjustment in order to remove the discrepancies observed in the low energy reconstructed cross sections.

1. INTRODUCTION

Due to its theoretical content, the Reich-Moore formalism[1] is generally, preferred by nuclear data evaluators as a means of parametrizing low energy neutron resolved resonance cross sections. Doppler broadening effects due to finite temperature are relatively difficult to introduce into this formalism however. Thus, for use in nuclear physics applications, the Adler-Adler formalism[1] has generally been preferred for parametrization of the resolved resonance cross sections.

To bridge this gap between evaluation and application, the Centro de Dados Nucleares of the Instituto de Estudos Avançados has as part of its program the responsibility of translating Reich-Moore parametrizations of actinide resonance data to the equivalent Adler-Adler ones. This translation is performed by the code POLLA[2], the implementation and testing of which we will discuss here.

To fully test the code POLLA, we found it desirable to also be able to reconstruct cross sections using the original Reich-Moore parameters. The introduction into the code RECENT[3]of a routine permitting such a reconstruction has been described in a previous note[4]. Here, we will limit our discussion to the code POLLA itself.

2. IMPLEMENTATION

In order to simplify the use of the code POLLA, it was transformed into a subroutine of a more general data handling program. The new code, called POLLA1, is capable of reading any library written in the ENDF/B format[5], transforming, as desired, any Reich-Moore resolved resonance parameters into the equivalent Adler-Adler ones and rewriting the entire library. All changes and input instructions are documented in the new program.

In order to make the program consistent with the current representation of Reich-Moore parameters, it was also necessary to make several small changes in POLLA itself. These changes transform the Reich-Moore neutron partial widths at the resonance energies, given in the data sets, into the reduced neutron partial widths expected by the code POLLA. Again, the changes are documented in the new program.

3. DISCUSSION AND CONCLUSION

To test our implementation of the code POLLA, we compared the curves generated by the code RECENT using the Adler-Adler parameters obtained from POLLA to those generated by our implementation of the Reich-Moore parametrization in RECENT[4] (RECENT1), using the original Reich-Moore parameters.

Our results for the total and elastic cross sections of the system n+ ^{243}Cm are shown in Figures 1 and 2, respectively. The Adler-Adler result is represented by the triangles while the Reiche-Moore result is represented by the solid line. We find the two to agree well for energies above about 2 eV. Below this value, the elastic cross section curves differ substantially.

We attribute the discrepancy in the elastic cross sections to the difference in the low energy resonance sum of the two parametrizations. As pointed out by Saussure and Perez[2], this is due to the fact that the translation from Reich-Moore to Adler-Adler parameters takes into account only half of the resonance poles contained in the original Reich-Moore parametrization. Were we to include all of them, we would find that the Adler-Adler poles occur in almost equal pairs differing only in the choice of sign of the square root of the energy used in the neutron penetrability. The usual prescription for translation of Reich-Moore parameters to Adler-Adler ones evaluates the neutron penetrability at the positive squaare root of the complex resonance energy. This is sufficient for reproducing the cross sections in the resonance region. It cannot reproduce the resonance sum at lower energies however.

Although we were convinced that, at low energies, the differences observed in the two parametrizations were to be expected, the fact that these comparisons also served as tests of our implementation of the Reich-Moore parametrization forced us to test further our implementation of POLLA. To do this we wrote a small program which produces an Adler-Adler type parameter set containing all of the resonance poles. The curve generated by RECENT using this set of parameters cannot be distinguished from those obtained with the original Reich-Moore parametrization. We also found those pole and residue parameters corresponding to the positive square root of the energy to agree with the Adler-Adler parameters obtained from POLLA.

The same comparisions were also made for the system n+ ^{243}Cm and similar results were obtained. We thus conclude that we have successfully implemented the code POLLA. We suggest, however, that before being used in other calculations,

the Adler-Adler parameters obtained from POLLA should be subjected to a further fine tuning in order to remove the discrepancies observed at low energies.

FIGURE CAPTIONS

Figure 1: ^{243}Cm total cross section as reconstructed by RECENT1 using the original Reich-Moore parameters (solid line) and the Adler-Adler parameters obtained from POLLA (triangles).

Figure 2: ^{243}Cm elastic cross section as reconstructed by RECENT1 using the original Reich-Moore parameters (solid line) and the Adler-Adler parameters obtained from POLLA (triangles).

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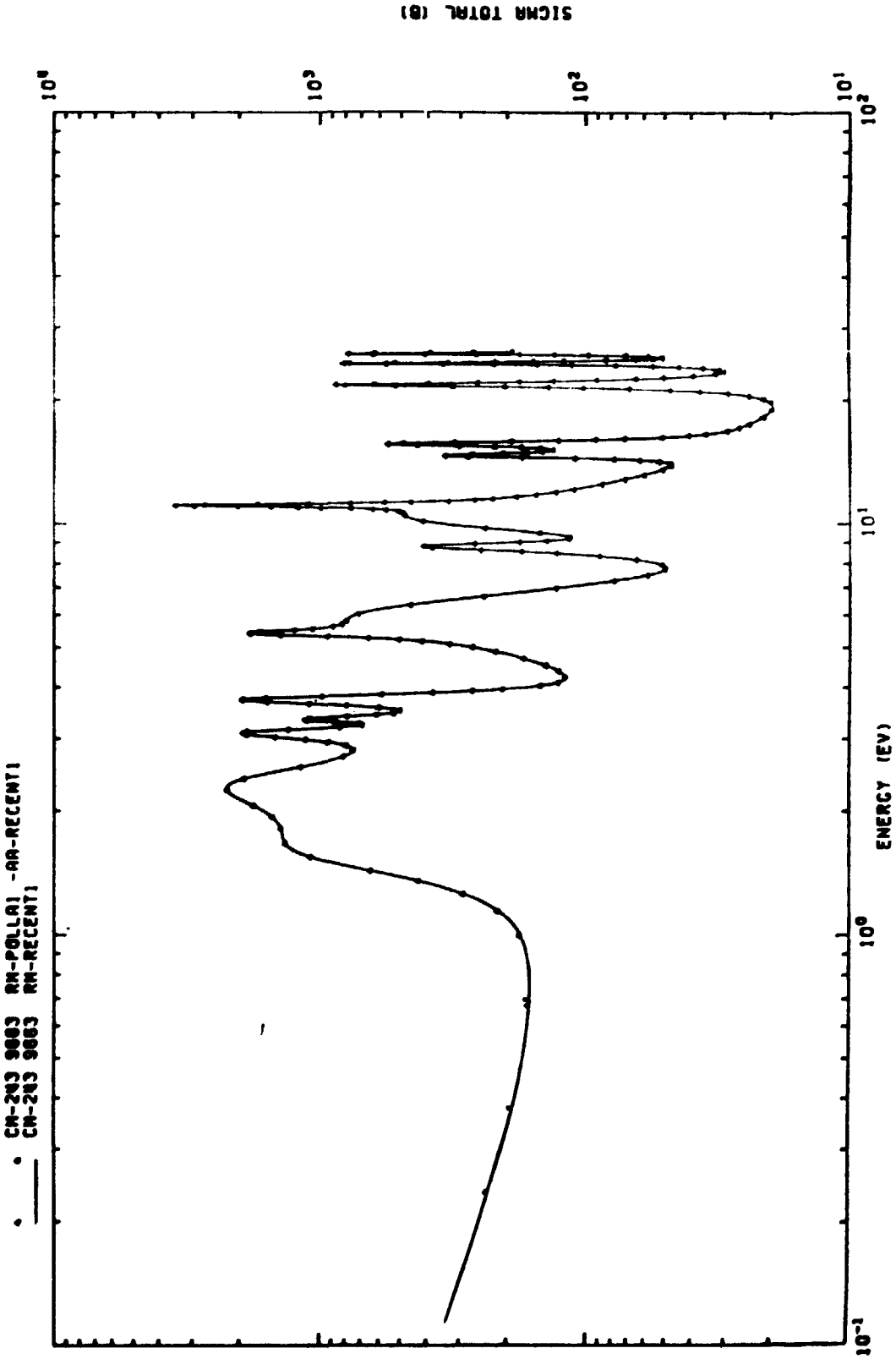
SIGMA TOTAL (B)
10^{3}
10^{2}
10^{1}
10^{2}
10^{1}
10^{0}
10^{-1}
ENERGY (EV)
CN-243 9803 RN-POLLAI -AA-RECENTI
CN-243 9803 RN-RECENTI

FIGURE 1.

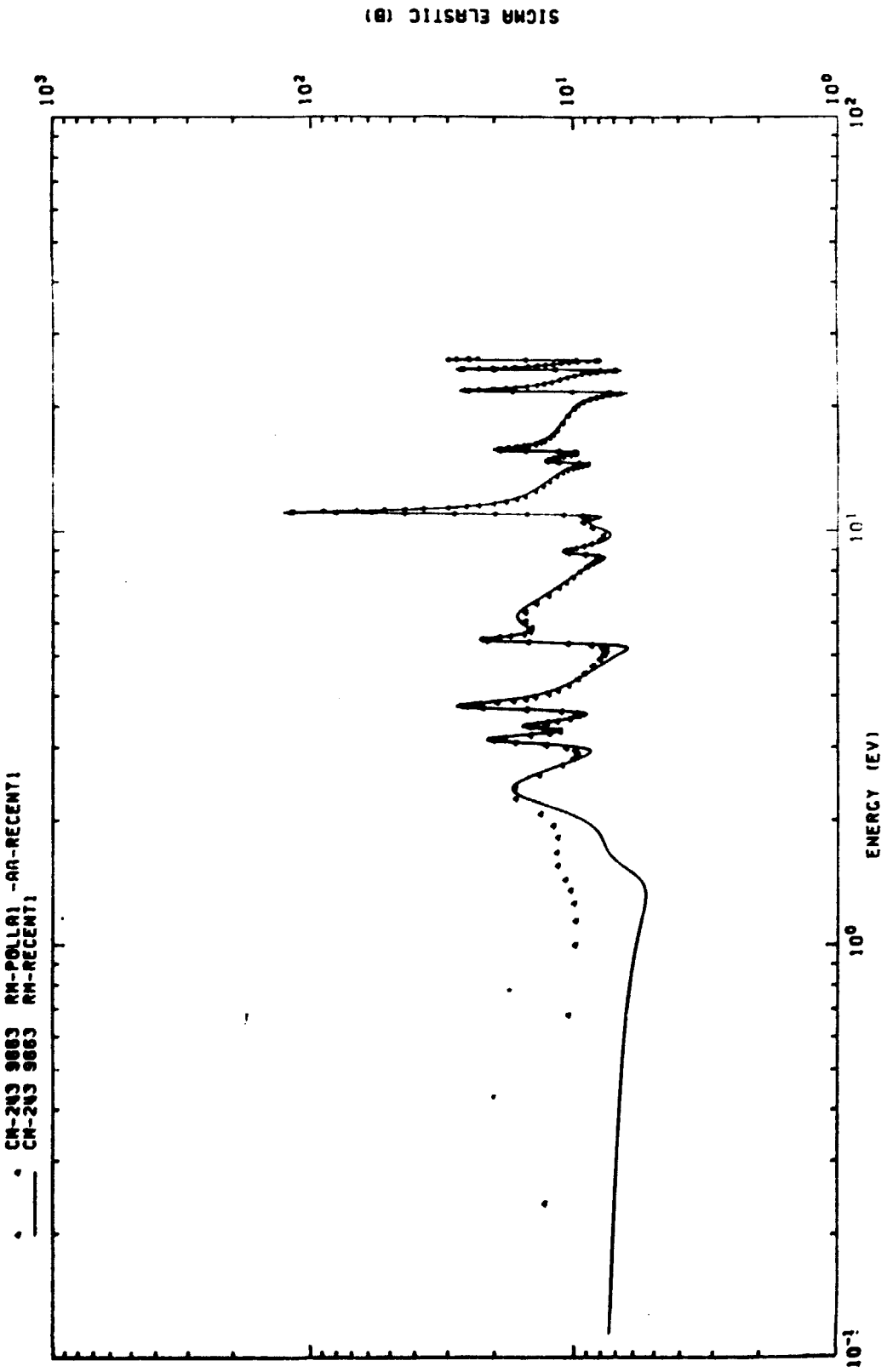
SIGMA ELASTIC (B)
10^3
10^2
10^1
10^0
10^{-1}
ENERGY (EV)
CM-243 9883 RM-POLLAI -AA-RECENTI
CM-243 9883 RM-RECENTI

FIGURE 2.