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===== Recent
PROGRAM RECENT Recent
===== Recent
VERSION 79-1 (OCTOBER 1979) CDC-7600 Recent
VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION Recent
VERSION 80-2 (DECEMBER 1980) IMPROVED TREATMENT OF UNRESOLVED Recent
REGION TO COMPUTE ALL REACTIONS AT Recent
THE SAME TIME. Recent
VERSION 81-1 (MARCH 1981) IMPROVED BASED ON USER COMMENTS. Recent
VERSION 81-2 (AUGUST 1981) ADDED MONITOR MODE. ADDED SPEED OPTION Recent
TO BYPASS BACKWARDS THINNING IF FILE 3 Recent
ALLOWABLE ERROR = 0.0 (NOTE THIS OPTION Recent
WILL RESULT IN ALL TABULATED POINTS Recent
FROM THE EVALUATION BEING KEPT IN THE Recent
OUTPUT FROM THIS PROGRAM). Recent
VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY. Recent
VERSION 83-1 (JANUARY 1983) *MAJOR RE-DESIGN. Recent
*PAGE SIZES INCREASED. Recent
*ELIMINATED COMPUTER DEPENDENT CODING. Recent
*NEW, MORE COMPATIBLE I/O UNIT NUMBERS. Recent
*ADDED OPTION TO KEEP ALL RECONSTRUCTED Recent
AND BACKGROUND ENERGY POINTS. Recent
*ADDED STANDARD ALLOWABLE ERROR OPTIONS Recent
(CURRENTLY 0.1 PER-CENT RECONSTRUCTION Recent
AND 0.0 PER-CENT THINNING). Recent
VERSION 83-2 (OCTOBER 1983) IMPROVED BASED ON USER COMMENTS. Recent
VERSION 84-1 (JANUARY 1984) IMPROVED INTERVAL HALFING CONVERGENCE. Recent
VERSION 85-1 (APRIL 1985) *A BRAND NEW PROGRAM WHICH COMPLETELY Recent
SUPERCEDES ALL PREVIOUS VERSIONS OF Recent
THIS PROGRAM. Recent
*UPDATED FOR ENDF/B-VI FORMATS. Recent
*ADDED GENERAL REICH-MOORE FORMALISM Recent
(WITH TWO FISSION CHANNELS). Recent
*DECREASED RUNNING TIME. Recent
*SPECIAL I/O ROUTINES TO GUARANTEE Recent
ACCURACY OF ENERGY. Recent
*DOUBLE PRECISION TREATMENT OF ENERGY Recent
(REQUIRED FOR NARROW RESONANCES). Recent
VERSION 85-2 (AUGUST 1985) *FORTRAN-77/H VERSION Recent
VERSION 86-1 (JANUARY 1986) *ENERGY DEPENDENT SCATTERING RADIUS Recent
VERSION 86-2 (JUNE 1986) *IF FIRST CHANCE FISSION (MT=19) Recent
BACKGROUND IS PRESENT ADD RESONANCE Recent
CONTRIBUTION OF FISSION TO IT. Recent
VERSION 86-3 (OCTOBER 1986) *MULTI-LEVEL OR REICH-MOORE..CORRECT Recent
POTENTIAL SCATTERING CROSS SECTION FOR Recent
MISSING AND/OR FICTICIOUS (L,J) Recent
SEQUENCES. Recent
VERSION 87-1 (JANUARY 1987) *IMPROVED COMBINING FILE 2+3 Recent
VERSION 87-2 (MARCH 1987) *CORRECTED ADLER-ADLER CALCULATIONS. Recent
VERSION 88-1 (JULY 1988) *UPDATED REICH-MOORE ENDF/B-VI FORMAT Recent
TO BE THE SAME AS REICH-MOORE FORMAT Recent
IN EARLIER VERSIONS OF ENDF/B FORMAT. Recent
*CHECK FOR PRELIMINARY ENDF/B-VI Recent
REICH-MOORE FORMAT (NOW ABANDONED) Recent
AND TERMINATE EXECUTION IF DATA IS Recent
IN THIS FORMAT. Recent
*CALCULATE CHANNEL RADIUS OR SET IT Recent
EQUAL TO THE SCATTERING RADIUS. Recent
*IMPLEMENTED HYBRID R-FUNCTION WITH THE Recent
FOLLOWING RESTRICTIONS Recent
- ONLY INELASTIC COMPETITION (NO Recent
CHARGED PARTICLES) Recent

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| | | |
|-----------------------------|--|--------|
| | - NO TABULATED FILE 2 BACKGROUND | Recent |
| | - NO TABULATED OPTICAL MODEL PHASE SHIFT | Recent |
| | *PROGRAM EXIT IF GENERAL R-MATRIX IN THE EVALUATION (THIS FORMALISM WILL BE IMPLEMENTED ONLY AFTER THE AUTHOR RECEIVES REAL EVALUATIONS WHICH USE THIS FORMALISM..UNTIL THEN IT IS IMPOSSIBLE TO ADEQUATELY TEST THAT THE CODING FOR THIS FORMALISM IS CORRECT). | Recent |
| | *INCREASED MAXIMUM NUMBER OF RESONANCES FROM 1002 TO 4008. | Recent |
| | *DOUBLE PRECISION RESONANCE REGION LIMITS. | Recent |
| | *FILE 2 AND FILE 3 ENERGIES WHICH ARE NEARLY EQUAL ARE TREATED AS EQUAL (I.E., SAME TO ABOUT 9 DIGITS). | Recent |
| | *CHECK FILE 3 BACKGROUND CROSS SECTIONS IN EDIT MODE. | Recent |
| | *OPTION..INTERNALLY DEFINE FILENAMES (SEE SUBROUTINE FILEIO FOR DETAILS). | Recent |
| VERSION 89-1 (JANUARY 1989) | *PSYCHOANALYZED BY PROGRAM FREUD TO INSURE PROGRAM WILL NOT DO ANYTHING CRAZY. | Recent |
| | *UPDATED TO USE NEW PROGRAM CONVERT KEYWORDS. | Recent |
| | *CORRECTED MULTILEVEL, REICH-MOORE AND HYBRID R-FUNCTION POTENTIAL SCATTER TO ACCOUNT FOR REPEATED J-VALUES FOR THE SAME TARGET SPIN AND L-VALUE. | Recent |
| | *ADDED LIVERMORE CIVIC COMPILER CONVENTIONS. | Recent |
| | *UPDATED TO USE NEW ENDF/B-VI CONVENTION TO ALLOW UNRESOLVED RESONANCE CONTRIBUTION TO ALREADY BE INCLUDED IN THE FILE 3 CROSS SECTIONS (INFINITELY DIULUTE CONTRIBUTION). | Recent |
| VERSION 90-1 (JUNE 1990) | *UPDATED BASED ON USER COMMENTS | Recent |
| | *ADDED FORTRAN SAVE OPTION | Recent |
| | *NEW MORE CONSISTENT ENERGY OUTPUT ROUTINE | Recent |
| VERSION 91-1 (JULY 1991) | *NEW UNIFORM TREATMENT OF ALL RESONANCE FORMALISMS (SEE, COMMENTS BELOW) | Recent |
| | *NEW REICH-MOORE ALGORITHM | Recent |
| | *MORE EXTENSIVE ERROR CHECKING AND ERROR MESSAGE EXPLANATIONS | Recent |
| VERSION 92-1 (JANUARY 1992) | *MAJOR RESTRUCTING TO IMPROVE ACCURACY AND COMPUTER INDEPENDENCE. | Recent |
| | *INCREASED ENERGY POINT PAGE SIZE FROM 1002 TO 4008. | Recent |
| | *NO MORE THAN 2 ENERGY POINTS WHERE CROSS SECTION IS ZERO AT BEGINNING OF A SECTION FOR EACH REACTION,E.G., THRESHOLD FISSION. | Recent |
| | *PROCESS ONLY A PORTION OF RESONANCE REGION - SEE EXPLANATION BELOW | Recent |
| | *ALL ENERGIES INTERNALLY ROUNDED PRIOR TO CALCULATIONS. | Recent |
| | *COMPLETELY CONSISTENT I/O AND ROUNDING ROUTINES - TO MINIMIZE COMPUTER DEPENDENCE. | Recent |

| | | |
|---|---|--------------------------------------|
| VERSION 93-1 (MARCH 1993) | *UPDATED REICH-MOORE TREATMENT TO USE L DEPENDENT SCATTERING RADIUS (APL) RATHER THAN SCATTERING RADIUS (AP) (SEE, ENDF/B-VI FORMATS AND PROCEDURES MANUAL, PAGE 2.6) | Recent Recent Recent Recent |
| | *INCREASED PAGE SIZE FROM 4008 TO 20040 DATA POINTS. | Recent Recent |
| | *INCREASED MAXIMUM NUMBER OF RESONANCES FROM 4008 TO 20040. | Recent Recent |
| VERSION 94-1 (JANUARY 1994) | *VARIABLE ENDF/B DATA FILENAMES TO ALLOW ACCESS TO FILE STRUCTURES (WARNING - INPUT PARAMETER FORMAT HAS BEEN CHANGED). | Recent Recent Recent Recent |
| | *CLOSE ALL FILES BEFORE TERMINATING (SEE, SUBROUTINE ENDIT) | Recent Recent |
| VERSION 94-2 (AUGUST 1994) | *CORRECTED ADDJ FOR ENERGY DEPENDENT (TABULATED) SCATTERING RADIUS CASE. | Recent Recent |
| VERSION 96-1 (JANUARY 1996) | *COMPLETE RE-WRITE | Recent |
| | *IMPROVED COMPUTER INDEPENDENCE | Recent |
| | *ALL DOUBLE PRECISION | Recent |
| | *ON SCREEN OUTPUT | Recent |
| | *UNIFORM TREATMENT OF ENDF/B I/O | Recent |
| | *IMPROVED OUTPUT PRECISION | Recent |
| | *ALWAYS INCLUDE THERMAL VALUE | Recent |
| | *DEFINED SCRATCH FILE NAMES | Recent |
| VERSION 97-1 (APRIL 1997) | *OPTIONAL MAKE NEGATIVE CROSS SECTION = 0 FOR OUTPUT | Recent Recent |
| | *INCREASED PAGE SIZE FROM 20040 TO 120000 DATA POINTS. | Recent Recent |
| | *INCREASED MAXIMUM NUMBER OF RESONANCES FROM 20040 TO 120000. | Recent Recent |
| VERSION 99-1 (MARCH 1999) | *CORRECTED CHARACTER TO FLOATING POINT READ FOR MORE DIGITS | Recent Recent |
| | *UPDATED TEST FOR ENDF/B FORMAT VERSION BASED ON RECENT FORMAT CHANGE | Recent Recent |
| | *UPDATED CONSTANTS BASED ON CSEWG SUBCOMMITTEE RECOMMENDATIONS | Recent Recent |
| | *GENERAL IMPROVEMENTS BASED ON USER FEEDBACK | Recent Recent |
| VERSION 99-2 (JUNE 1999) | *IMPLEMENTED NEW REICH-MOORE FORMALISM TO ALLOW DEFINITION OF (L,J,S) FOR EACH SEQUENCE. | Recent Recent Recent |
| | *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451. | Recent Recent |
| VERS. 2000-1 (FEBRUARY 2000) | *GENERAL IMPROVEMENTS BASED ON USER FEEDBACK | Recent Recent |
| VERS. 2002-1 (MAY 2002) (SEPT. 2002) | *OPTIONAL INPUT PARAMETERS | Recent |
| | *OUTPUT RESONANCE WITH 9 DIGITS | Recent |
| | *TO BE C AND C++ COMPATIBLE OUTPUT | Recent |
| VERS. 2004-1 (JAN. 2004) | *ADDED INCLUDE 'recent.h' | Recent |
| | *MADE ENDF/B-VII READY | Recent |
| | *UPDATED FOR NEW REICH-MOORE LRF=7 PARAMETERS WITH COMPETITION | Recent Recent |
| | *ADDED COULOMB PENETRATION FACTORS FOR LRF=7 COMPETITIVE CHANNELS. | Recent Recent |
| | *EXTENDED DEFINITIONS OF PENETRATION FACTOR, LEVEL SHIFT FACTOR, AND POTENTIAL SCATTERING PHASE SHIFT ABOVE L = 5 TO INFINITY. | Recent Recent Recent |
| | *ADDED QUICK CALCULATION - IF THE INPUT ALLOWABLE ERROR IS 1.0 OR MORE (100 % OR MORE) THERE IS NO ITERATION TO CONVERGENCE - CROSS SECTION ARE | Recent Recent Recent Recent |

| | | |
|---------------------------|--|--------|
| | QUICKLY CALCULATED ONLY AT A FIXED | Recent |
| | SET OF ENERGY POINTS, BASED ON THE | Recent |
| | ENERGY AND WIDTH OF ALL RESONANCES. | Recent |
| | THIS CAN BE USED TO QUICKLY "SEE" | Recent |
| | NEW EVALUATIONS THAT MAY CONTAIN | Recent |
| | ERRORS, THAT WOULD OTHERWISE CAUSE | Recent |
| | THIS CODE TO RUN FOR AN EXCESSIVELY | Recent |
| | LONG TIME. | Recent |
| VERS. 2005-1 (JUNE 2005) | *ADDED ENERGY DEPENDENT SCATTERING | Recent |
| | RADIUS FOR ALL RESONANCE TYPES | Recent |
| | (EARLIER ONLY BREIT-WIGNER ALLOWED). | Recent |
| VERS. 2007-1 (JAN. 2007) | *CHECKED AGAINST ALL ENDF/B-VII. | Recent |
| | *DECOUPLED PAGE SIZE FROM MAX. # OF | Recent |
| | RESONANCES. | Recent |
| | *INCREASED PAGE SIZE FROM 120,000 TO | Recent |
| | 750,000 DATA POINTS. | Recent |
| | *KEPT MAX. # OF RESONANCE AT 120,000. | Recent |
| | *CORRECTED ALL BACKGROUND = 0 CASE | Recent |
| VERS. 2007-2 (OCT. 2007) | *NO MT=19 OUTPUT IF NO BACKGROUND, | Recent |
| | REGARDLESS OF INPUT OPTION. | Recent |
| | *72 CHARACTER FILE NAMES. | Recent |
| VERS. 2008-1 (FEB. 2008) | *CORRECTED NAPS ERROR - NOW DEFINE FOR | Recent |
| | ALL TYPES OF PARAMETERS - EARLIER | Recent |
| | ONLY DEFINED FOR B-W PARAMETERS. | Recent |
| VERS. 2008-2 (APRIL 2008) | *CORRECTED NRO/NAPS=1/1 - MUST | Recent |
| | DEFINE RHOX2 AT EACH RESONANCE USING | Recent |
| | SETRHO1 BEFORE ENERGY DEPENDENT | Recent |
| | CALCULATION. | Recent |
| | *ADDED PRECISION TO RESONANCE PROFILE | Recent |
| | IN SUBROUTINE SUBINT | Recent |
| VERS. 2009-1 (JULY 2009) | *NEW REICH-MOORE COMPETITIVE WIDTHS - | Recent |
| | IF CHARGED PARTICLE REACTION (MT=103 | Recent |
| | THROUGH 107) WILL ADD RESONANCE | Recent |
| | CONTRIBUTION TO COMPETITIVE MT AND IF | Recent |
| | PRESENT, THE GROUND LEVEL, MT = 600 | Recent |
| | THROUGH 800. IF COMPETITIVE CHANNEL | Recent |
| | IS mt=4 (TOTAL N.N') IT WILL ALSO ADD | Recent |
| | COMPETITIVE RESONANCE CONTRIBUTION TO | Recent |
| | MT=50 (N,N' GROUND). | Recent |
| | *NEW REICH-MOORE - SUM COMPETITIVE | Recent |
| | WIDTHS IF ALL FOR THE SAME STATE (MT) | Recent |
| VERS. 2009-2 (AUG. 2009) | *RE-WRITE TO USE 12, RATHER THAN 6, | Recent |
| | PARAMETERS PER RESONANCE. | Recent |
| | *MAJOR RE-WRITE TO ACCOMODATE GENERAL | Recent |
| | REICH-MOORE (LRF=7). | Recent |
| | *COMPLETE RE-WRITE FOR ADLER-ADLER | Recent |
| | AND HRF (N O LONGER USED IN ENDF/B) | Recent |
| | TO USE 12 PARAMETERS PER RESNANCE. | Recent |
| VERS. 2010-1 (April 2010) | *ADDED SAMRML LOGIC TO HANDLE ALL | Recent |
| | LRF=7 CASES. | Recent |
| | *EXTENDED SAMRML LOGIC TO PROCESS ALL | Recent |
| | EVALUATIONS = RESOLVED + UNRESOLVED + | Recent |
| | TABULATED - SAMRML ONLY DOES ONE | Recent |
| | SECTION OF RESOLVED LRF=7 DATA | Recent |
| | WITHOUT TABULATED BACKGROUND. | Recent |
| | *UPDATED ELASTIC POTENTIAL CALCULATION | Recent |
| | FOR TOTAL (SLBW) AND CORRECTION FOR | Recent |
| | MISSING SEQUENCES (MLBW, RM, HRF). | Recent |
| | *ADDED HIDDEN (OPTIONAL) UNRESOLVED | Recent |
| | COMPETITION LISTING (NOT ENDF/B). | Recent |
| | *ADDED BOB MACFARLANE'S PROPOSAL - USE | Recent |
| | LRX TO DEFINE COMPETITIVE L VALUE - | Recent |
| | COMPETITIVE L = LRX - 1, IF LRX > 0. | Recent |

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Acknowledgement (Version 2004-1) Recent

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The author thanks Nancy Larson, ORNL, for providing her SAMRML Recent
code for comparison to RECENT output for Reich-Moore evaluations, Recent
in particular to verify results for the new LFR=7 evaluations. I Recent
also thank her for providing guidance to help me understand and Recent
implement this new treatment for Reich-Moore parameters. Recent
Recent

ACKNOWLEDGEMENT (VERSION 92-1) Recent

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THE AUTHOR THANKS SOL PEARLSTEIN (BROOKHAVEN NATIONAL LAB) FOR Recent
SIGNIFICANTLY CONTRIBUTING TOWARD IMPROVING THE ACCURACY AND Recent
COMPUTER INDEPENDENCE OF THIS CODE - THANKS, SOL Recent

AUTHORS MESSAGE Recent

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THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION Recent
FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED Recent
THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE Recent
READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY Recent
THE COMMENTS CONCERNING MACHINE DEPENDENT CODING. Recent

AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER Recent
INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE Recent
OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT Recent
IT WOULD BE APPRECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY Recent
COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO Recent
IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF Recent
THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR Recent
COMPUTER. Recent

PURPOSE Recent

=====
THIS PROGRAM IS DESIGNED TO RECONSTRUCT THE RESONANCE CONTRIBUTION Recent
TO THE CROSS SECTION IN LINEARLY INTERPOLABLE FORM, ADD IN ANY Recent
LINEARLY INTERPOLABLE BACKGROUND CROSS SECTION AND OUTPUT THE Recent
RESULT IN THE ENDF/B FORMAT. THE CROSS SECTIONS OUTPUT BY THIS Recent
PROGRAM WILL BE LINEARLY INTERPOLABLE OVER THE ENTIRE ENERGY RANGE Recent

THE RESONANCE CONTRIBUTION IS CALCULATED FOR TOTAL (MT=1), Recent
ELASTIC (MT=2), CAPTURE (MT=102) AND FISSION (MT=18), ADDED Recent
TO THE BACKGROUND (IF ANY) AND OUTPUT. IN ADDITION, IF THERE Recent
IS A FIRST CHANCE FISSION (MT=19) BACKGROUND PRESENT THE RESONANCE Recent
CONTRIBUTION OF FISSION WILL BE ADDED TO THE BACKGROUND AND Recent
OUTPUT. IF THERE IS NO FIRST CHANCE FISSION (MT=19) BACKGROUND Recent
PRESENT THE PROGRAM WILL NOT OUTPUT MT=19. Recent

IN THE FOLLOWING FOR SIMPLICITY THE ENDF/B TERMINOLOGY--ENDF/B Recent
TAPE--WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE TAPE, CARDS, Recent
DISK OR ANY OTHER MEDIUM. Recent

PROCESSING DATA IN THE ENDF/B-VI FORMAT Recent

=====
IT HAS NOW BEEN CONFIRMED (PRIVATE COMMUNICATION, CHARLES DUNFORD, Recent
APRIL, 1991) THAT THE PROPER PROCEDURE TO FOLLOW WHEN THERE ARE Recent
MISSING OR DUPLICATE J VALUES IS TO IN ALL CASES ADD A SEQUENCE Recent
WITH NO RESONANCES TO ACCOUNT FOR THE CONTRIBUTION OF THE SEQUENCE Recent
TO THE POTENTIAL SCATTERING CROSS SECTION. Recent

| | |
|--|--------|
| THIS IS THE PROCEDURE WHICH WAS FOLLOWED BY ALL VERSIONS OF RECENT | Recent |
| SINCE 86-3 AND WILL CONTINUE TO BE THE PROCEDURE. | Recent |
| INPUT ENDF/B FORMAT AND CONVENTIONS | Recent |
| ===== | Recent |
| ENDF/B FORMAT | Recent |
| ----- | Recent |
| THIS PROGRAM ONLY USES THE ENDF/B BCD OR LINE IMAGE FORMAT (AS | Recent |
| OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION | Recent |
| OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT). | Recent |
| IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B | Recent |
| FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS | Recent |
| ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE | Recent |
| NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE | Recent |
| CORRECTLY OUTPUT ON ALL CARDS. THE FORMAT OF SECTION MF=1, MT=451 | Recent |
| AND ALL SECTIONS OF MF=2 AND 3 MUST BE CORRECT. THE PROGRAM COPIES | Recent |
| ALL OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE | Recent |
| TO THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS. | Recent |
| ENDF/B FORMAT VERSION | Recent |
| ----- | Recent |
| THE FORMATS AND CONVENTIONS FOR READING AND INTERPRETING THE DATA | Recent |
| VARIES FROM ONE VERSION OF ENDF/B TO THE NEXT. HOWEVER, IF THE | Recent |
| HOLLERITH SECTION (MF=1, MT=451) IS PRESENT IT IS POSSIBLE FOR | Recent |
| THIS PROGRAM TO DISTINGUISH BETWEEN DATA IN THE ENDF/B-IV, V AND | Recent |
| VI FORMATS AND TO USE THE APPROPRIATE CONVENTIONS FOR EACH | Recent |
| ENDF/B VERSION (SEE, SUBROUTINE FILE1 FOR A DESCRIPTION OF HOW | Recent |
| THIS IS DONE). IF THE HOLLERITH SECTION IS NOT PRESENT THE | Recent |
| PROGRAM WILL ASSUME THE DATA IS IN THE ENDF/B-VI FORMAT AND USE | Recent |
| ALL CONVENTIONS APPROPRIATE TO ENDF/B-V. USERS ARE ENCOURAGED TO | Recent |
| INSURE THAT THE HOLLERITH SECTION (MF=1, MT=451) IS PRESENT IN | Recent |
| ALL EVALUATIONS. | Recent |
| INPUT OF ENERGIES | Recent |
| ----- | Recent |
| ALL ENERGIES ARE READ IN DOUBLE PRECISION (BY SPECIAL FORTRAN I/O | Recent |
| ROUTINES) AND ARE TREATED IN DOUBLE PRECISION IN ALL CALCULATIONS. | Recent |
| OUTPUT ENDF/B FORMAT AND CONVENTIONS | Recent |
| ===== | Recent |
| CONTENTS OF OUTPUT | Recent |
| ----- | Recent |
| ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE RECONSTRUCTED FILE | Recent |
| 3 CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE | Recent |
| ALSO INCLUDED. | Recent |
| DOCUMENTATION | Recent |
| ----- | Recent |
| THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED | Recent |
| BY THE ADDITION OF COMMENT CARDS AT THE END OF EACH HOLLERITH | Recent |
| SECTION IN THE FORM | Recent |
| ***** RECENT (VERSION 2017-1) ***** | Recent |
| RESONANCE CONTRIBUTION RECONSTRUCTED TO WITHIN 0.100 PER-CENT | Recent |
| COMBINED DATA NOT THINNED (ALL RESONANCE + BACKGROUND DATA KEPT) | Recent |
| THE ORDER OF ALL SIMILAR COMMENTS (FROM LINEAR, SIGMA1 AND GROUPY) | Recent |
| REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON | Recent |
| THE DATA, INCLUDING WHICH VERSION OF EACH PROGRAM WAS USED. | Recent |
| THESE COMMENT CARDS ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS, | Recent |

CONTRIBUTION HAS ALREADY BEEN ADDED TO THE FILE 3 DATA. THIS
SECOND CONVENTION HAS BEEN ADOPTED AS INSURANCE THAT THE RESONANCE
CONTRIBUTION WILL NOT BE ADDED TWICE, EVEN FOR EVALUATIONS WHICH
DO NOT CONTAIN MF=1, MT=451 (EVALUATIONS WHICH CONTAIN MF=1,
MT=451 ARE COVERED BY CONVENTION (1), DESCRIBED ABOVE).

UNIFORM TREATMENT OF RESONANCE FORMALISMS

NORMALIZATION

ALL OF THE RESONANCE FORMALISMS INCLUDE A FACTOR OF,

$$\pi * (\text{FRACTIONAL ABUNDANCE}) / (K^{**2})$$

THIS FACTOR HAS BEEN REMOVED FROM THE CALCULATION OF EACH TYPE
OF RESONANCE FORMALISM AND IS APPLIED AS A FINAL NORMALIZATION
AFTER THE CALCULATION, ONLY ONE PLACE IN THIS PROGRAM.

FOR SIMPLICITY THIS TERM IS NOT INCLUDED IN THE FOLLOWING
DERIVATIONS - IN ALL CASES THE ACTUAL CROSS SECTION IS A PRODUCT
OF THE ABOVE FACTOR TIMES THE RESULTS PRESENTED BELOW.

SIMILARITIES

FOR THE RESOLVED RESONANCE REGION, EXCEPT FOR SINGLE LEVEL BREIT
WIGNER, PARAMETERS ALL OF THE FORMALISMS DEFINE THE CROSS SECTIONS
IN AN EQUIVALENT FORM,

$$\begin{aligned} \text{TOTAL} &= 2 * \text{GJ} * \text{REAL}(1 - U) \\ &= 2 * \text{GJ} * (1 - \text{REAL}(U)) \\ \text{ELASTIC} &= \text{GJ} * (1 - U)^{**2} \\ &= \text{GJ} * ((1 - 2 * \text{REAL}(U)) + (\text{REAL}(U)^{**2} + \text{IM}(U)^{**2})) \\ &= 2 * \text{GJ} * (1 - \text{REAL}(U)) - \text{GJ} * (1 - (\text{REAL}(U)^{**2} + \text{IM}(U)^{**2})) \end{aligned}$$

SINCE THE FIRST TERM IS THE TOTAL, THE SECOND TERM MUST BE
ABSORPTION. SO WE FIND,

$$\text{ABSORPTION} = \text{GJ} * (1 - (\text{REAL}(U)^{**2} + \text{IM}(U)^{**2}))$$

IN ALL CASES U IS DEFINED IN THE FORM,

$$U = \text{EXP}(-I * 2 * \text{PS}) * ((1 - X) - I * Y)$$

WHERE (X) AND (Y) ARE RELATED TO THE SYMMETRIC AND ANTI-SYMMETRIC
CONTRIBUTIONS OF THE RESONANCES, RESPECTIVELY. ONLY THE DEFINITION
OF (X) AND (Y) WILL BE DIFFERENT FOR EACH RESONANCE FORMALISM.
BELOW WE WILL SHOW THAT WHAT MIGHT APPEAR TO BE A STRANGE CHOICE
OF DEFINITION OF THE SIGN OF (X) AND (Y) HAS BEEN SELECTED SO THAT
FOR BREIT-WIGNER PARAMETERS (X) AND (Y) CORRESPOND EXACTLY TO THE
SYMMETRIC AND ANTI-SYMMETRIC CONTRIBUTION OF THE RESONANCES.

$$\begin{aligned} U &= (\text{COS}(2 * \text{PS}) - I * \text{SIN}(2 * \text{PS})) * ((1 - X) - I * Y) \\ &= ((1 - X) * \text{COS}(2 * \text{PS}) - Y * \text{SIN}(2 * \text{PS})) \\ &= -I * ((1 - X) * \text{SIN}(2 * \text{PS}) + Y * \text{COS}(2 * \text{PS})) \end{aligned}$$

$$\begin{aligned} \text{REAL}(U) &= ((1 - X) * \text{COS}(2 * \text{PS}) - Y * \text{SIN}(2 * \text{PS})) \\ \text{IM}(U) &= -((1 - X) * \text{SIN}(2 * \text{PS}) + Y * \text{COS}(2 * \text{PS})) \end{aligned}$$

$$\begin{aligned} \text{R}(U)^{**2} &= ((1 - X) * \text{COS}(2 * \text{PS}))^{**2} + (Y * \text{SIN}(2 * \text{PS}))^{**2} \\ &\quad - 2 * (1 - X) * Y * \text{COS}(2 * \text{PS}) * \text{SIN}(2 * \text{PS}) \end{aligned}$$

$$\begin{aligned} \text{I}(U)^{**2} &= ((1 - X) * \text{SIN}(2 * \text{PS}))^{**2} + (Y * \text{COS}(2 * \text{PS}))^{**2} \\ &\quad + 2 * (1 - X) * Y * \text{COS}(2 * \text{PS}) * \text{SIN}(2 * \text{PS}) \end{aligned}$$

THE TERMS $2*(1-X)*Y*\cos(2*PS)*\sin(2*PS)$ CANCEL AND UPON USING
THE IDENTITY $\cos(2*PS)**2 + \sin(2*PS)**2 = 1$, Recent
Recent
SUM = $(1-X)**2 + (Y)**2$ Recent
Recent
WE NOW HAVE ALL THE QUANTITIES THAT WE NEED TO DEFINE THE CROSS Recent
SECTIONS, Recent
Recent
ELASTIC Recent
===== Recent
ELASTIC = $GJ*(1 - 2*REAL(U) + (REAL(U)**2 + IM(U)**2))$ Recent
= $GJ*(1 - 2*((1-X)*\cos(2*PS) - Y*\sin(2*PS)) + (1-X)**2 + (Y)**2)$ Recent
Recent
THIS CAN BE WRITTEN AS A SUM OF 2 SQUARES, Recent
Recent
ELASTIC = $GJ*(\cos(2*PS) - (1-X))**2 + (\sin(2*PS) + Y)**2$ Recent
Recent
= $GJ*((\cos(2*PS))**2 - 2*(1-X)*\cos(2*PS) + (1-X)**2) +$ Recent
 $(\sin(2*PS))**2 + 2*Y*\sin(2*PS) + (Y)**2)$ Recent
Recent
AGAIN USING THE IDENTITY $\cos(2*PS)**2 + \sin(2*PS)**2 = 1$, WE CAN Recent
SEE THAT THE DEFINITION AS THE SUM OF 2 SQUARES IS IDENTICAL TO Recent
THE PRECEDING DEFINITION OF THE ELASTIC. Recent
Recent
ELASTIC = $GJ*(\cos(2*PS) - (1-X))**2 + (\sin(2*PS) + Y)**2$ Recent
= $GJ*((\cos(2*PS) - 1) + X)**2 + (\sin(2*PS) + Y)**2$ Recent
Recent
USING THE IDENTITY $(1 - \cos(2*PS)) = 2*\sin(PS)**2$, WE OBTAIN Recent
THE FINAL FORM FOR THE ELASTIC, Recent
Recent
ELASTIC = $GJ*(2*\sin(PS)**2 - X)**2 + (\sin(2*PS) + Y)**2$ Recent
Recent
Recent
ABSORPTION Recent
===== Recent
ABSORPTION = $GJ*(1 - (REAL(U)**2 + IM(U)**2))$ Recent
= $GJ*(1 - ((1-X)**2 + (Y)**2))$ Recent
= $GJ*(1 - (1 - 2*X + (X)**2 + (Y)**2))$ Recent
= $GJ*(2*X - (X)**2 + (Y)**2)$ Recent
Recent
SINCE PHYSICALLY THE ABSORPTION CANNOT BE NEGATIVE WE CAN SEE Recent
THAT (X) MUST BE POSITIVE AND $2*X$ MUST BE GREATER THAN Recent
 $(X)**2 + (Y)**2$, FOR ALL OF THE FORMALISMS. Recent
Recent
TOTAL Recent
===== Recent
IN THIS PROGRAM THE TOTAL CROSS SECTION IS ALWAYS DEFINED TO BE Recent
THE SUM OF ITS PARTS - SO THE ABOVE DEFINITION IS NEVER EXPLICITLY Recent
USED. HOWEVER, WE CAN LEARN SOMETHING BY EXAMINING THE DEFINITION, Recent
Recent
TOTAL = $2*GJ*REAL(1 - U)$ Recent
= $2*GJ*(1 - ((1-X)*\cos(2*PS) - Y*\sin(2*PS)))$ Recent
= $2*GJ*((1 - \cos(2*PS))*(1-X) - (1-X) + Y*\sin(2*PS))$ Recent
= $2*GJ*(2*\sin(PS)**2*(1-X) - (1-X) + Y*\sin(2*PS))$ Recent
Recent
= $4*GJ*\sin(PS)**2 +$ Recent
 $2*GJ*((X-1) - 2*X*\sin(PS)**2 + Y*\sin(2*PS))$ Recent
Recent
THE IMPORTANT POINT TO NOTE IS THAT THE DEFINITION OF THE TOTAL Recent
DOES NOT EXPLICITLY CONTAIN ANY DEPENDENCE ON $X**2$ AND $Y**2$ - Recent
THE LEVEL-LEVEL INTERFERENCE TERMS. Recent
Recent
THIS IMPLIES THAT IF A GIVEN SET OF RESONANCE PARAMETERS ARE USED Recent
WITH THIS DEFINITION THEY WILL PRODUCE EXACTLY THE SAME TOTAL Recent

ONLY IN THIS CASE WILL THE RESULTS BE CONSISTENT - THIS POINT WILL BE DISCUSSED IN DETAIL BELOW.

WHAT ARE THIS TERMS (X) AND (Y)

=====
(X) AND (Y) CAN BE EASILY IDENTIFIED BY CONSIDERING THE SINGLE AND MULTI-LEVEL BREIT WIGNER FORMALISMS. IN THESE CASES WE WILL FIND THAT,

$$\begin{aligned} X &= \text{GAM}(N) * \text{GAM}(T) / 2 / \text{DEN} \\ Y &= \text{GAM}(N) * (\text{E} - \text{ER}) / \text{DEN} \\ \text{DEN} &= ((\text{E} - \text{ER}) ** 2 + (\text{GAM}(T) / 2) ** 2) \end{aligned}$$

EXTREME CARE HAS TO BE USED TO PROPERLY DEFINE (Y) SUCH THAT IT IS NEGATIVE FOR E LESS THAN ER AND POSITIVE FOR E GREATER THAN ER. I WILL MERELY MENTION THAT THE EQUATIONS FOR ALL FORMALISMS IN ENDF-102 DO NOT CONSISTENTLY USE (E - ER) - IN SOME CASES THIS IS WRITTEN AS (ER - E), WHICH CAN LEAD TO AN INCORRECT SIGN IN THE DEFINITION OF THE (Y) THAT WE REQUIRE.

THE INTERFERENCE TERMS CAN BE WRITTEN IN TERMS OF,
1) LEVEL-SELF INTERFERENCE = THE CONTRIBUTION OF EACH LEVEL INTERFERING WITH ITSELF
2) LEVEL-LEVEL INTERFERENCE = THE CONTRIBUTION OF EACH LEVEL INTERFERING WITH ALL OTHER LEVELS

WE WILL REFER TO THESE TWO AS (L-S) AND (L-L),

$$\begin{aligned} X ** 2 &= (\text{GAM}(N) * (\text{GAM}(T) / 2) ** 2 / (\text{DEN}) ** 2 + (\text{L-L}) \\ &= (\text{GAM}(N) ** 2 * ((\text{GAM}(T) / 2) ** 2) / (\text{DEN}) ** 2 + (\text{L-L}) \\ Y ** 2 &= (\text{GAM}(N) ** 2 * (\text{E} - \text{ER}) ** 2 / (\text{DEN}) ** 2 + (\text{L-L}) \end{aligned}$$

$$X ** 2 + Y ** 2 = \text{GAM}(N) ** 2 * \text{DEN} / (\text{DEN}) ** 2 = \text{GAM}(N) ** 2 / \text{DEN} + (\text{L-L})$$

TO SEE THE EFFECT OF INCLUDING MULTI-LEVEL INTERFERENCE WE CAN CONSIDER OUR GENERAL EXPRESSION FOR ABSORPTION,

$$\text{ABSORPTION} = \text{GJ} * (2 * X - ((X) ** 2 + (Y) ** 2))$$

AND NOTE THAT FOR BOTH SINGLE AND MULTI-LEVEL BREIT WIGNER THE ENDF-102 SAYS TO TREAT ABSORPTION IN A SINGLE LEVEL APPROXIMATION I.E., IGNORE LEVEL-LEVEL INTERFERENCE. IF ALL INTERFERENCE IS IGNORED THIS IS EQUIVALENT TO COMPLETELY IGNORING X**2 + Y**2 AND DEFINING,

$$\begin{aligned} \text{ABSORPTION} &= \text{GJ} * 2 * X \\ &= 2 * \text{GJ} * \text{GAM}(N) * \text{GAM}(T) / \text{DEN} \end{aligned}$$

WHICH IS INCORRECT - SINCE THIS SEEMS TO INDICATE EVERYTHING IS ABSORBED. IN ORDER TO OBTAIN THE CORRECT EXPRESSION WE CANNOT COMPLETELY IGNORE INTERFERENCE - WE CAN IGNORE LEVEL-LEVEL INTERFERENCE, BUT WE MUST INCLUDE LEVEL-SELF INTERFERENCE,

$$X ** 2 + Y ** 2 = \text{GAM}(N) ** 2 / \text{DEN}$$

$$\begin{aligned} \text{ABSORPTION} &= \text{GJ} * (2 * X - ((X) ** 2 + (Y) ** 2)) \\ &= \text{GJ} * \text{GAM}(N) * (\text{GAM}(T) - \text{GAM}(N)) / \text{DEN} \\ &= \text{GJ} * \text{GAM}(N) * \text{GAM}(A) / \text{DEN} \end{aligned}$$

SUMMARY

=====
AN IMPORTANT POINT TO NOTE IS THE DEFINITION OF (X) AND (Y)

WHICH IN ALL CASES WILL CORRESPOND TO THE SYMMETRIC AND ANTI-SYMMETRIC CONTRIBUTION OF THE RESONANCES. IN PARTICULAR DEFINING (U) IN TERMS OF (1-X) INSTEAD OF (X) IS EXTREMELY IMPORTANT. NOTE, THAT THE DEFINITION OF THE ELASTIC AND ABSORPTION ONLY INVOLVE (X), NOT (1-X). FAR FROM RESONANCES (X) CAN BE EXTREMELY SMALL, THEREFORE (1-X) WILL BE VERY CLOSE TO (1). IF THE CALCULATION PROCEEDS BY FIRST CALCULATING (1-X) AND THEN DEFINING (X) BY SUBTRACTING (1), EXTREME ROUND-OFF PROBLEMS CAN RESULT. THESE PROBLEMS CAN BE AVOIDED BY IN ALL CASES DEFINING (X) DIRECTLY, WITHOUT ANY DIFFERENCES.

IN EACH FORMALISM THE DEFINITION OF (X) AND (Y) MAY BE DIFFERENT BUT ONCE WE HAVE DEFINED (X) AND (Y) WE CAN IMMEDIATELY WRITE THE CROSS SECTIONS USING A UNIFORM DEFINITION,

$$\text{ELASTIC} = \text{GJ} * (2 * \text{SIN}(\text{PS}) ** 2 - \text{X}) ** 2 + (\text{SIN}(2 * \text{PS}) + \text{Y}) ** 2$$

$$\text{ABSORPTION} = -\text{GJ} * (2 * \text{X} + (\text{X}) ** 2 + (\text{Y}) ** 2)$$

AND DEFINE THE TOTAL AS THE SUM OF THESE 2 PARTS.

RELATIONSHIP TO SINGLE LEVEL

=====

HOW DO THE SINGLE AND MULTI-LEVEL FORMALISMS COMPARE. TO SEE, STARTING FROM OUR GENERAL DEFINITION OF THE ELASTIC IN THE FORM,

$$\text{ELASTIC} = \text{GJ} * (2 * \text{SIN}(\text{PS}) ** 2 + \text{X}) ** 2 + (\text{SIN}(2 * \text{PS}) + \text{Y}) ** 2$$

$$= \text{GJ} * (4 * \text{SIN}(\text{PS}) ** 4 - 4 * \text{X} * \text{SIN}(\text{PS}) ** 2 + \text{X} ** 2 + \text{SIN}(2 * \text{PS}) ** 2 + 2 * \text{Y} * \text{SIN}(2 * \text{PS}) + \text{Y} ** 2)$$

$$= 4 * \text{GJ} * \text{SIN}(\text{PS}) ** 2 +$$

$$\text{GJ} * (\text{X} ** 2 + \text{Y} ** 2$$

$$- 4 * \text{X} * \text{SIN}(\text{PS}) ** 2$$

$$+ 2 * \text{Y} * \text{SIN}(2 * \text{PS}))$$

AND OUR SPECIFIC DEFINITIONS OF (X) AND (Y) FOR MULTI-LEVEL BREIT-WIGNER PARAMETERS,

$$\text{X} = \text{GAM}(\text{N}) * \text{GAM}(\text{T}) / 2 / \text{DEN}$$

$$\text{Y} = \text{GAM}(\text{N}) * (\text{E} - \text{ER}) / \text{DEN}$$

$$\text{DEN} = ((\text{E} - \text{ER}) ** 2 + (\text{GAM}(\text{T}) / 2) ** 2)$$

$$\text{X} ** 2 + \text{Y} ** 2 = \text{GAM}(\text{N}) ** 2 / \text{DEN} + (\text{L} - \text{L})$$

WE CAN RECOGNIZE X**2 AND Y**2 AS THE INTERFERENCE - (L-S) + (L-L) TERMS IN THE MULTI-LEVEL FORMALISM. IN ORDER TO OBTAIN THE SINGLE LEVEL EQUATION WE CAN ASSUME THAT EACH LEVEL DOES NOT INTERFERE WITH ANY OTHER LEVEL - THEREFORE THE (L-L) CONTRIBUTION IS ZERO.

$$\text{ELASTIC} = 4 * \text{GJ} * \text{SIN}(\text{PS}) ** 2 +$$

$$\text{GJ} * \text{GAM}(\text{N}) * (\text{GAM}(\text{N})$$

$$- 2 * \text{GAM}(\text{T}) * \text{SIN}(\text{PS}) ** 2$$

$$+ 2 * (\text{E} - \text{ER}) * \text{SIN}(2 * \text{PS})) / \text{DEN}$$

WHICH IS THE FORM THAT IT APPEARS IN ENDF-102, EXCEPT FOR TWO TYPOGRAPHICAL ERRORS IN THE SECOND TERM,

$$- 2 * \text{GAM}(\text{T}) * \text{SIN}(\text{PS}) ** 2$$

WHICH IN ENDF-102 IS WRITTEN,

$$- 2 * (\text{GAM}(\text{T}) - \text{GAM}(\text{N})) * \text{SIN}(2 * \text{PS}) ** 2$$

| | |
|--|--------|
| PROGRAM CONVENTIONS | Recent |
| ===== | Recent |
| MINIMUM INPUT DATA | Recent |
| ----- | Recent |
| FOR EACH MATERIAL TO BE PROCESSED THE MINIMUM INPUT DATA ARE THE | Recent |
| RESONANCE PARAMETERS IN FILE 2. IF THERE ARE NO FILE 2 PARAMETERS | Recent |
| IN A GIVEN MATERIAL THE ENTIRE MATERIAL WILL SIMPLY BE COPIED. | Recent |
| NEITHER THE HOLLERITH SECTION (MF=1, MT=451) NOR THE BACKGROUND | Recent |
| CROSS SECTION (SECTIONS OF MF=3) NEED BE PRESENT FOR THIS PROGRAM | Recent |
| TO EXECUTE PROPERLY. HOWEVER, SINCE THE CONVENTIONS USED IN | Recent |
| INTERPRETING THE RESONANCE PARAMETERS DEPENDS ON ENDF/B VERSION | Recent |
| USERS ARE STRONGLY RECOMMENDED TO INSURE THAT MF=1, MT=451 IS | Recent |
| PRESENT IN EACH MATERIAL TO ALLOW THE PROGRAM TO DETERMINE THE | Recent |
| ENDF/B FORMAT VERSION. | Recent |
| RESONANCE PARAMETERS | Recent |
| ----- | Recent |
| RESONANCE PARAMETERS MAY BE REPRESENTED USING ANY COMBINATION | Recent |
| OF THE REPRESENTATIONS ALLOWED IN ENDF/B, | Recent |
| (1) RESOLVED DATA | Recent |
| (A) SINGLE LEVEL BREIT-WIGNER | Recent |
| (B) MULTI-LEVEL BREIT-WIGNER | Recent |
| (C) ADLER-ADLER | Recent |
| (D) REICH-MOORE | Recent |
| (E) HYBRID R-FUNCTION | Recent |
| (2) UNRESOLVED DATA | Recent |
| (A) ALL PARAMETERS ENERGY INDEPENDENT | Recent |
| (B) FISSION PARAMETERS ENERGY DEPENDENT | Recent |
| (C) ALL PARAMETERS ENERGY DEPENDENT | Recent |
| THE FOLLOWING RESOLVED DATA FORMALISMS ARE NOT TREATED BY THIS | Recent |
| VERSION OF THE CODE AND WILL ONLY BE IMPLEMENTED AFTER EVALUATIONS | Recent |
| USING THESE FORMALISMS ARE AVAILABLE TO THE AUTHOR OF THIS CODE | Recent |
| FOR TESTING IN ORDER TO INSURE THAT THEY CAN BE HANDLED PROPERLY | Recent |
| (A) GENERAL R-MATRIX | Recent |
| CALCULATED CROSS SECTIONS | Recent |
| ----- | Recent |
| THIS PROGRAM WILL USE THE RESONANCE PARAMETERS TO CALCULATE THE | Recent |
| TOTAL, ELASTIC, CAPTURE AND POSSIBLY FISSION CROSS SECTIONS. THE | Recent |
| COMPETITIVE WIDTH WILL BE USED IN THESE CALCULATIONS, BUT THE | Recent |
| COMPETITIVE CROSS SECTION ITSELF WILL NOT BE CALCULATED. THE | Recent |
| ENDF/B CONVENTION IS THAT ALTHOUGH A COMPETITIVE WIDTH MAY BE | Recent |
| GIVEN, THE COMPETITIVE CROSS SECTION MUST BE SEPARATELY TABULATED | Recent |
| AS A SECTION OF FILE 3 DATA. | Recent |
| RESOLVED REGION | Recent |
| ----- | Recent |
| IN THE RESOLVED REGION THE RESOLVED PARAMETERS ARE USED TO | Recent |
| CALCULATE COLD (0 KELVIN), LINEARLY INTERPOLABLE, ENERGY DEPENDENT | Recent |
| CROSS SECTIONS. | Recent |
| SCATTERING RADIUS | Recent |
| ----- | Recent |
| FOR SINGLE OR MULTI LEVEL BREIT-WIGNER PARAMETERS THE SCATTERING | Recent |
| RADIUS MAY BE SPECIFIED IN EITHER ENERGY INDEPENDENT (CONSTANT) | Recent |
| OR ENERGY DEPENDENT FORM (A TABLE OF ENERGY VS. RADIUS AND AN | Recent |
| ASSOCIATED INTERPOLATION LAW). IN ALL OTHER CASE ONLY AN ENERGY | Recent |
| INDEPENDENT SCATTERING RADIUS IS ALLOWED. | Recent |
| FOR ANY ONE MATERIAL (I.E. MAT) IF ENERGY DEPENDENT SCATTERING | Recent |
| RADII ARE GIVEN THE TOTAL NUMBER OF INTERPOLATION REGIONS AND | Recent |
| TABULATED VALUES FOR THE ENTIRE MATERIAL CANNOT EXCEED, | Recent |

| | |
|---|--------|
| 200 - INTERPOLATION REGIONS | Recent |
| 500 - TABULATED VALUES | Recent |
| IF THESE LIMITS ARE EXCEEDED THE PROGRAM WILL PRINT AN ERROR MESSAGE AND TERMINATE. | Recent |
| | Recent |
| IF YOU REQUIRE A LARGER NUMBER OF INTERPOLATION REGION AND/OR TABULATED VALUES, | Recent |
| (1) INTERPOLATION REGIONS - INCREASE THE DIMENSION OF NBTRHO AND INTRHO IN COMMON/TABRHO/ THROUGHOUT THE PROGRAM AND CHANGE MAXSEC IN SUBROUTINE RDAP (MAXSEC = MAXIMUM NUMBER OF INTERPOLATION REGIONS). | Recent |
| (2) TABULATED VALUES - INCREASE THE DIMENSION OF ERHOTB, RHOTAB AND APTAB IN COMMON/TABRHO/ THROUGHOUT THE PROGRAM AND CHANGE MAXRHO IN SUBROUTINE RDAP (MAXRHO = MAXIMUM NUMBER OF TABULATED VALUES). | Recent |
| | Recent |
| RESOLVED REICH-MOORE AND MULTI-LEVEL BREIT-WIGNER PARAMETERS | Recent |
| ----- | Recent |
| CROSS SECTIONS FOR REICH-MOORE PARAMETERS ARE CALCULATED ACCORDING TO THE EQUATION (1) - (8) OF SECTION D.1.3 OF ENDF-102. IN ORDER TO CALCULATE CROSS SECTIONS FROM MULTI-LEVEL PARAMETERS IN A REASONABLE AMOUNT OF TIME THIS PROGRAM EXPRESSES THE CROSS SECTION IN TERMS OF A SINGLE SUM OVER RESONANCES (SEE, ENDF-102, SECTION D.1.2, EQUATIONS 6-7), RATHER THAN AS A DOUBLE SUM (SEE, ENDF-102 SECTION D.1.2, EQUATION 1-2). IN ORDER FOR THE ENDF-102 EQUATIONS TO BE CORRECT THE PARAMETERS MUST MEET THE FOLLOWING CONDITIONS, | Recent |
| | Recent |
| (1) FOR EACH L STATE ALL PHYSICALLY POSSIBLE J SEQUENCES MUST BE PRESENT. ONLY IN THIS CASE WILL THE CONTRIBUTIONS OF THE INDIVIDUAL J SEQUENCES ADD UP TO PRODUCE THE CORRECT POTENTIAL SCATTERING CONTRIBUTION FOR THE L STATE (SEE, ENDF-102, SECTION D.1.2, EQUATIONS 6-7). IF ANY J SEQUENCE IS MISSING THE PROGRAM WILL PRINT A WARNING AND ADD THE J SEQUENCE WITH NO RESONANCE PARAMETERS IN ORDER TO ALLOW THE POTENTIAL SCATTERING TO BE CALCULATED CORRECTLY (THIS IS EQUIVALENT TO ASSUMING THAT THE EVALUATOR REALIZES THAT ALL J SEQUENCES MUST BE AND ARE PRESENT AND THAT THE EVALUATION STATES THAT THERE ARE NO RESONANCES WITH CERTAIN PHYSICALLY POSSIBLE J VALUES... IN THIS CASE POTENTIAL CONTRIBUTION MUST STILL BE CONSIDERED). | Recent |
| | Recent |
| EXAMPLE | Recent |
| ===== | Recent |
| AN EXAMPLE OF WHERE THIS OCCURS AND IS IMPORTANT TO CONSIDER IS U-238 IN ENDF/B-IV AND V LIBRARIES WHERE FOR L=1 THERE IS ONLY A J=1/2 SEQUENCE. NOT INCLUDING THE J=3/2 SEQUENCE LEADS TO UNDERESTIMATING THE POTENTIAL SCATTERING AND PRODUCES MINIMA IN THE ELASTIC CROSS SECTION WHICH ARE AN ORDER OF MAGNITUDE LOWER THAN THE CROSS SECTIONS OBTAINED BE INCLUDING THE J=3/2 SEQUENCE. | Recent |
| | Recent |
| (2) FOR A GIVEN TARGET SPIN AND L VALUE THERE MAY BE 2 POSSIBLE MEANS OF OBTAINING THE SAME J VALUE. WHEN THIS OCCURS IN ORDER TO CALCULATE THE CORRECT POTENTIAL SCATTERING CROSS SECTION IT IS IMPORTANT TO INCLUDE THE EFFECT OF BOTH POSSIBLE J SEQUENCES, EVEN THOUGH FROM THE ENDF/B DATA IT IS NOT POSSIBLE TO DETERMINE WHICH OF THE 2 POSSIBLE SEQUENCES ANY GIVEN RESONANCE BELONGS TO. IN THIS CASE THIS PROGRAM TREAT ALL RESONANCES WITH THE SAME J VALUE AS BELONGING TO THE SAME J SEQUENCE (TO ALLOW INTERFERENCE) AND WILL ADD AN ADDITIONAL J SEQUENCE WITH NO RESONANCES IN ORDER TO ALLOW THE POTENTIAL CROSS SECTION TO BE CALCULATED CORRECTLY. WHEN THIS OCCURS A WARNING MESSAGE IS PRINTED, BUT BASED ON THE ENDF/B DATA THERE IS NOTHING WRONG WITH THE DATA AND THERE IS | Recent |
| | Recent |

- (MT=19) AND CAPTURE (MT=102). Recent
Recent
- (1) THE BACKGROUND CROSS SECTIONS (FILE 3) CAN BE PRESENT OR NOT PRESENT FOR EACH REACTION. Recent
 - (2) IF FOR A GIVEN REACTION THE BACKGROUND CROSS SECTION IS PRESENT, IT WILL BE ADDED TO THE RESONANCE CONTRIBUTION AND THE RESULT WILL BE OUTPUT. Recent
 - (3) IF FOR A GIVEN REACTION THE BACKGROUND IS NOT PRESENT THE PROGRAM WILL, Recent
 - (A) IF THE INPUT TO THE PROGRAM SPECIFIES NO OUTPUT FOR REACTIONS WITH NO BACKGROUND THERE WILL BE NO OUTPUT. Recent
 - (B) IF THE INPUT TO THE PROGRAM SPECIFIES OUTPUT FOR REACTIONS WITH NO BACKGROUND, Recent
 - (I) THE RESONANCE CONTRIBUTION TO TOTAL, ELASTIC OR CAPTURE WILL BE OUTPUT. Recent
 - (II) IF ALL FISSION RESONANCE PARAMETERS ARE ZERO THE FISSION CROSS SECTION (MT=18) WILL NOT BE OUTPUT. OTHERWISE THE RESONANCE CONTRIBUTION OF THE FISSION (MT=18) WILL BE OUTPUT. Recent
 - (III) THERE WILL BE NO OUTPUT FOR FIRST CHANCE FISSION (MT=19). Recent

COMBINING RESONANCES AND BACKGROUND CROSS SECTIONS

 IN ORDER TO BE COMBINED WITH THE RESONANCE CONTRIBUTION THE BACKGROUND CROSS SECTIONS MUST BE GIVEN AT 0 KELVIN TEMPERATURE AND MUST BE LINEARLY INTERPOLABLE. IF THESE CONDITIONS ARE MET THE RESONANCE AND BACKGROUND CONTRIBUTIONS WILL BE ADDED TOGETHER AND OUTPUT. IF THESE CONDITIONS ARE NOT MET THE BACKGROUND CROSS SECTION WILL BE IGNORED AND ONLY THE RESONANCE CONTRIBUTION WILL BE OUTPUT. IF THE BACKGROUND HAS NOT BEEN ADDED TO THE RESONANCE CONTRIBUTION AFTER THIS PROGRAM FINISHES THE USER CAN MAKE THE RESONANCE AND BACKGROUND CONTRIBUTIONS COMPATIBLE BY,

- (1) IF THE BACKGROUND IS NOT LINEARLY INTERPOLABLE, LINEARIZE THE BACKGROUND (E.G., USE PROGRAM LINEAR). Recent
- (2) IF THE BACKGROUND IS NOT GIVEN AT 0 KELVIN, DOPPLER BROADEN THE RESONANCE (NOT BACKGROUND) CONTRIBUTION TO THE SAME TEMPERATURE AS THE BACKGROUND (E.G., USE PROGRAM SIGMA1). Recent

ONCE THE RESONANCE AND BACKGROUND CONTRIBUTIONS HAVE BEEN MADE COMPATIBLE THEY CAN BE ADDED TOGETHER (E.G., USE PROGRAM MIXER). Recent

THE RECONSTRUCTION OF THE RESONANCE CONTRIBUTION TO THE CROSS SECTION CAN BE QUITE EXPENSIVE (IN TERMS OF COMPUTER TIME). SINCE THE RECONSTRUCTION IS PERFORMED BEFORE THE BACKGROUND CROSS SECTIONS ARE READ, THE ABOVE CONVENTIONS HAVE BEEN ADOPTED IN ORDER TO AVOID LOSE OF COMPUTER TIME INVOLVED IN RECONSTRUCTING THE RESONANCE CONTRIBUTION. Recent

COMMON ENERGY GRID

 THIS PROGRAM WILL RECONSTRUCT THE RESONANCE CONTRIBUTION TO THE TOTAL, ELASTIC, FISSION AND CAPTURE CROSS SECTIONS ALL ON THE SAME ENERGY GRID. EACH REACTION WILL THEN BE COMBINED WITH ITS BACKGROUND CROSS SECTION (IF ANY) AND OUTPUT WITHOUT ANY FURTHER THINNING. IF THERE ARE NO BACKGROUND CROSS SECTIONS, OR IF THE BACKGROUND CROSS SECTION FOR ALL FOUR REACTIONS ARE GIVEN ON A COMMON ENERGY GRID, THE OUTPUT FROM THIS PROGRAM WILL BE ON A COMMON ENERGY GRID FOR ALL FOUR REACTIONS. Recent

THERMAL ENERGY

 Recent

IT WAS FOUND TO PRODUCE UNRELIABLE RESULTS. IN THIS VERSION OF THE PROGRAM ALL RESONANCES ARE TREATED EXACTLY.

PROGRAM OPERATION

=====

EDIT MODE

IT IS SUGGESTED THAT BEFORE RUNNING THIS PROGRAM TO RECONSTRUCT CROSS SECTIONS FROM RESONANCE PARAMETERS (WHICH CAN BE QUITE EXPENSIVE) THE USER FIRST RUN THE PROGRAM IN THE EDIT MODE (SEE, DESCRIPTION OF INPUT PARAMETERS BELOW). IN THE EDIT MODE THE PROGRAM WILL READ, LIST AND EXTENSIVELY CHECK THE CONSISTENCY OF ALL RESONANCE PARAMETERS AND ENDF/B DEFINED RESONANCE FLAGS. THIS IS A VERY INEXPENSIVE MEANS OF CHECKING ALL DATA BEFORE INVESTING A LARGE AMOUNT OF MONEY IN RECONSTRUCTING CROSS SECTIONS. ANY AND ALL DIGNOSTICS RECEIVED FROM THE EDIT WILL SUGGEST HOW TO CORRECT THE EVALUATED DATA TO MAKE IT CONSISTENT BEFORE RECONSTRUCTING CROSS SECTIONS. IN ORDER TO OBTAIN MEANINGFUL RESULTS FROM THE RECONSTRUCTION ALL SUGGESTED CHANGES TO THE EVALUATION SHOULD BE PERFORMED BEFORE TRYING RECONSTRUCTION (OTHERWISE THE RESULT OF RECONSTRUCTION WILL NOT BE RELIABLE).

RECONSTRUCTION MODE

FOR EACH REQUESTED MATERIAL

IF SECTION MF=1, MT=451 IS PRESENT COMMENTS WILL BE ADD TO DOCUMENT THAT THE MATERIAL HAS BEEN PROCESSED. MF=1, MT=451 WILL ALSO BE USED TO DETERMINE THE VERSION OF THE ENDF/B FORMAT WHICH WILL ALLOW THE PROGRAM TO USE THE APPROPRIATE CONVENTIONS.

ALL OF THE FILE 2 RESONANCE PARAMETERS ARE FIRST READ AND THE LINEARLY INTERPOLABLE CONTRIBUTION OF THE RESONANCE PARAMETERS TO THE TOTAL, ELASTIC, CAPTURE AND FISSION CROSS SECTIONS IS CALCULATED SIMULTANEOUSLY USING A COMMON ENERGY GRID FOR ALL FOUR REACTIONS.

AFTER THE RESONANCE CONTRIBUTION HAS BEEN RECONSTRUCTED EACH OF THE FIVE REACTIONS (MT=1, 2, 18, 19, 102) IS CONSIDERED SEPARATELY FOR COMBINATION WILL THE BACKGROUND CROSS SECTION, IF ANY, AS DESCRIBED ABOVE.

OUTPUT WILL INCLUDE THE ENTIRE EVALUATION, INCLUDING RESONANCES PARAMETERS WITH LRU MODIFIED (AS DESCRIBED ABOVE) TO INDICATE THAT THE RESONANCE CONTRIBUTION HAS ALREADY BEEN ADDED TO THE FILE 3 CROSS SECTIONS.

THE CYCLE OF RECONSTRUCTING THE RESONANCE CONTRIBUTION AND ADDING THE BACKGROUND WILL BE REPEATED FOR EACH MATERIAL REQUESTED.

-----2016/3/10 - This option is no longer allowed - today's computers are so mjuch faster that this option is no longer needed.

PROCESS ONLY A PORTION OF RESONANCE REGION

=====

MODERN EVALUATIONS MAY BE EXTREMELY LARGE AND IT MAY NOT BE POSSIBLE TO PROCESS AN ENTIRE EVALUATION (I.E., ADD THE RESONANCE CONTRIBUTION) DURING A SINGLE COMPUTER RUN.

ALSO IN THE CASE WHERE YOU ARE ONLY INTERESTED IN THE CROSS SECTIONS OVER A SMALL ENERGY RANGE, YOU MAY NOT WANT TO PROCESS AN ENTIRE EVALUATION, E.G., IF YOU ONLY WANT TO KNOW WHAT THE CROSS SECTIONS ARE NEAR THERMAL ENERGY, 0.0253 EV.


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LAST ENERGY RANGE (SEE ABOVE, LOWER ENERGY LIMIT = NON-ZERO,
UPPER ENERGY LIMIT = ZERO), THIS PROGRAM WILL ASSUME THAT
YOU HAVE NOW COMPLETED ALL PROCESSING - AND ONLY THEN WILL
IT SET FLAGS IN THE EVALUATION TO PREVENT THE RESONANCE
CONTRIBUTION FROM BEING ADDED MORE THAN ONCE. FOR THIS REASON
YOU CANNOT PROCESS STARTING WITH ENERGY INTERVALS AT HIGH
ENERGY AND WORKING TOWARD LOW ENERGY - YOU MUST START AT LOW
ENERGY AND WORK TOWARD HIGH ENERGY.
-----2016/3/10 - This option is no longer allowed - today's computers

I/O FILES
=====
INPUT FILES
-----
UNIT DESCRIPTION
-----
    2 INPUT LINE (BCD - 80 CHARACTERS/RECORD)
    10 ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)

OUTPUT FILES
-----
UNIT DESCRIPTION
-----
    3 OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD)
    11 FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD)

SCRATCH FILES
-----
UNIT DESCRIPTION
-----
    12 SCRATCH FILE FOR DATA RECONSTRUCTED FROM RESONANCE
        PARAMETERS (BINARY - 100200 WORDS/RECORD)
    14 SCRATCH FILE FOR COMBINED FILE 2 AND 3 DATA
        (BINARY - 40080 WORDS/RECORD)

OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILEIO)
=====
UNIT FILE NAME
-----
    2 RECENT.INP
    3 RECENT.LST
    10 ENDFB.IN
    11 ENDFB.OUT
    12 (SCRATCH)
    14 (SCRATCH)

INPUT CARDS
=====
LINE COLS.  FORMAT  DESCRIPTION
-----
    1   1-11   I11     RETRIEVAL CRITERIA (0=MAT, 1=ZA)
        THIS OPTION DEFINED WHETHER COLUMNS 1-22 OF
        SUBSEQUENT INPUT CARDS SHOULD BE INTERPRETED
        TO BE MAT OR ZA RANGES.
    12-22  E11.4  FILE 2 MINIMUM ABSOLUTE CROSS SECTION
        (IF 1.0E-10 OR LESS IS INPUT THE PROGRAM
        WILL USE 1.0E-10)
    23-33  I11     TREATMENT OF REACTIONS FOR WHICH BACKGROUND
        CROSS SECTION IS NOT GIVEN.
        = 0 - IGNOR (I.E. NO OUTPUT)
        = 1 - OUTPUT RESONANCE CONTRIBUTION.
        THIS OPTION IS USEFUL WITH PARTIAL EVALUATION
        (E.G. ENDF/B-V DOSIMETRY LIBRARY) WHERE ONLY

```

| | | | | |
|-------|-----------|-----|--|--------|
| | | | ONE OR MORE OF THE REACTIONS ARE OF ACTUAL INTEREST. | Recent |
| | | | WARNING...THE USE OF THIS FIELD HAS BEEN CHANGED. THIS FIELD WAS PREVIOUSLY USED TO DEFINE THE PRECISION OF THE CALCULATION AND OUTPUT. THE FORMER DEFINITION OF THIS FIELD WAS... | Recent |
| | | | MINIMUM ENERGY SPACING FLAG | Recent |
| | | | = 0 - 6 DIGIT MINIMUM ENERGY SPACING. STANDARD 6 DIGIT E11.4 OUTPUT. | Recent |
| | | | = 1 - 9 DIGIT MINIMUM ENERGY SPACING. STANDARD 6 DIGIT E11.4 OUTPUT. | Recent |
| | | | = 2 - 9 DIGIT MINIMUM ENERGY SPACING. VARIABLE 9 DIGIT F FORMAT OUTPUT. | Recent |
| | | | FROM EXPERIENCE IT HAS BEEN FOUND THAT FAILURE TO SET THIS OPTION TO 2 CAN RESULT IN LARGE ERRORS IN THE FINAL DATA. THEREFORE INTERNALLY THIS OPTION IS SET TO 2. | Recent |
| 34-44 | I11 | | OPERATING MODE | Recent |
| | | | = 0 - CACULATE. MINIMUM OUTPUT LISTING | Recent |
| | | | = 1 - CACULATE. LIST ALL RESONANCE PARAMETERS | Recent |
| | | | = 2 - EDIT MODE. NO CALCULATION. LIST ALL RESONANCE PARAMETERS. | Recent |
| | | | NOTE, THE EDIT MODE (=2) IS THE SUGGESTED MODE TO FIRST TEST THE CONSISTENCY OF THE EVALUATED DATA, BEFORE RECONSTRUCTING CROSS SECTIONS (SEE, COMMENTS ABOVE). | Recent |
| 45-55 | I11 | | NEGATIVE CROSS SECTIOIN TREATMENT | Recent |
| | | | = 0 - O.K. - NO CHANGE | Recent |
| | | | = 1 - SET = 0 | Recent |
| 56-66 | I11 | | MONITOR MODE SELECTOR | Recent |
| | | | = 0 - NORMAL OPERATION | Recent |
| | | | = 1 - MONITOR PROGRESS OF RECONSTRUCTION OF FILE 2 DATA AND COMBINING FILE 2 AND FILE 3 DATA. EACH TIME A PAGE OF DATA POINTS IS WRITTEN TO A SCRATCH FILE PRINT OUT THE TOTAL NUMBER OF POINTS ON SCRATCH AND THE LOWER AND UPPER ENERGY LIMITS OF THE PAGE (THIS OPTION MAY BE USED IN ORDER TO MONITOR THE EXECUTION SPEED OF LONG RUNNING JOBS). | Recent |
| 2 | 1-72 | A72 | ENDF/B INPUT DATA FILENAME (STANDARD OPTION = ENDFB.IN) | Recent |
| 3 | 1-72 | A72 | ENDF/B OUTPUT DATA FILENAME (STANDARD OPTION = ENDFB.OUT) | Recent |
| 4-N | 1-11 | I11 | MINIMUM MAT OR ZA (SEE COLS. 1-11, LINE 1) | Recent |
| | 12-22 | I11 | MAXIMUM MAT OR ZA (SEE COLS. 1-11, LINE 1) UP TO 100 MAT OR ZA RANGES MAY BE SPECIFIED, ONE RANGE PER LINE. THE LIST IS TERMINATED BY A BLANK LINE. IF THE THE UPPER LIMIT OF ANY REQUEST IS LESS THAN THE LOWER LIMIT THE UPPER LIMIT WILL BE SET EQUAL TO THE LOWER LIMIT. IF THE FIRST REQUEST LINE IS BLANK IT WILL TERMINATE THE REQUEST LIST AND CAUSE ALL DATA TO BE RETRIEVED (SEE EXAMPLE INPUT). | Recent |
| ----- | 2016/3/10 | - | Partial Processing no longer allowed. | Recent |
| | | | If these fields are not blank the code will STOP with a WARNING that this is no longer allowed. | Recent |
| 23-33 | E11.4 | | LOWER ENERGY LIMIT FOR PROCESSING. | Recent |
| 34-44 | E11.4 | | UPPER ENERGY LIMIT FOR PROCESSING. | Recent |
| | | | *THE LOWER AND UPPER ENERGY LIMITS MUST BE ZERO, OR BLANK, UNLESS YOU WISH TO ONLY PROCESS A PORTION OF RESONANCE REGIONS. | Recent |

*THESE ENERGY LIMITS ARE ONLY READ FROM THE FIRST MAT/ZA REQUEST LINE
 *IF BOTH ARE ZERO (OR BLANK) THE ENTIRE RESONANCE REGION FOR EACH MATERIAL WILL BE PROCESSED
 *IF LIMITS ARE INPUT ONLY THAT PORTION OF THE RESONANCE REGION FOR EACH MATERIAL WHICH LIES BETWEEN THESE LIMITS WILL BE PROCESSED
 *SEE INSTRUCTIONS ABOVE BEFORE USING THIS OPTION.

----- 2016/3/10 - Partial Processing no longer allowed.

| | | | | | |
|------|-------|-------|-----------------------------|------------|--------|
| VARY | 1-11 | E11.4 | ENERGY FOR FILE 2 ERROR LAW | (SEE) | Recent |
| | 12-22 | E11.4 | ERROR FOR FILE 2 ERROR LAW | (COMMENTS) | Recent |
| | | | | (BELOW) | Recent |

NOTE, THIS VERSION OF THE PROGRAM DOES NOT THIN THE COMBINED FILE 2 + 3 DATA. AS SUCH THE ERROR LAW FOR COMBINING FILE 2 + 3 WHICH WAS REQUIRED IN EARLIER VERSIONS OF THIS CODE ARE NO LONGER REQUIRED.

THE FILE 2 ERROR LAW MAY BE ENERGY INDEPENDENT (DEFINED BY A SINGLE ERROR) OR ENERGY DEPENDENT (DEFINED BY UP TO 20 ENERGY, ERROR PAIRS). FOR THE ENERGY DEPENDENT CASE LINEAR INTERPOLATION WILL BE USED TO DEFINE THE ERROR AT ENERGIES BETWEEN THOSE AT WHICH THE ERROR IS TABULATED. THE ERROR LAW IS TERMINATED BY A BLANK LINE. IF ONLY ONE ENERGY, ERROR PAIR IS GIVEN THE LAW WILL BE CONSIDERED TO BE ENERGY INDEPENDENT. IF MORE THAN ONE PAIR IS GIVEN IT BE CONSIDERED TO BE ENERGY DEPENDENT (NOTE, THAT FOR A CONSTANT ERROR THE ENERGY INDEPENDENT FORM WILL RUN FASTER. HOWEVER, FOR SPECIFIC APPLICATIONS AN ENERGY DEPENDENT ERROR MAY BY USED TO MAKE THE PROGRAM RUN CONSIDERABLE FASTER).

ALL ENERGIES MUST BE IN ASCENDING ENERGY ORDER. FOR CONVERGENCE OF THE FILE 2 RECONSTRUCTION ALGORITHM ALL THE ERRORS MUST BE POSITIVE. IF ERROR IS NOT POSITIVE IT WILL BE SET EQUAL TO THE STANDARD OPTION (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT). IF THE FIRST LINE OF THE ERROR LAW IS BLANK IT WILL TERMINATE THE ERROR LAW AND THE ERROR WILL BE TREATED AS ENERGY INDEPENDENT, EQUAL TO THE STANDARD OPTION (CURRENTLY, 0.1 PER-CENT). SEE, EXAMPLE INPUT 4.

EXAMPLE INPUT NO. 1

 CONSIDER ALL URANIUM ISOTOPES AND TH-232. CONSIDER CROSS SECTIONS WHICH ARE LARGER THAN 1.0E-8 BARNS IN ABSOLUTE VALUE. ONLY OUTPUT REACTIONS FOR WHICH A BACKGROUND IS GIVEN. LIST ALL PARAMETERS AND CALCULATE CROSS SECTIONS. MONITOR THE EXECUTION PROGRESS OF THE PROGRAM. BETWEEN 0 AND 100 EV USE 0.1 PER-CENT ACCURACY. BETWEEN 100 EV AND 1 KEV VARY THE ACCURACY FROM 0.1 TO 1 PER-CENT. ABOVE 1 KEV USE 1 PER-CENT ACCURACY.

EXPLICITLY SPECIFY THE STANDARD FILENAMES.

THE FOLLOWING 11 INPUT CARDS ARE REQUIRED.

| | | | | | | | |
|------------|------------|------------|--|---|---|---|--------|
| | 1 | 1.00000-08 | 0 | 1 | 0 | 1 | Recent |
| ENDFB.IN | | | | | | | Recent |
| ENDFB.OUT | | | | | | | Recent |
| | 92000 | 92999 | | | | | Recent |
| | 90232 | | (UPPER LIMIT AUTOMATICALLY SET TO 90232) | | | | Recent |
| | | | (END REQUEST LIST) | | | | Recent |
| 0.00000+ 0 | 1.00000-03 | | | | | | Recent |
| 1.00000+02 | 1.00000-03 | | | | | | Recent |

(END FILE 2 ERROR LAW)

Recent

Recent

EXAMPLE INPUT NO. 5

Recent

Recent

RECONSTRUCT ALL DATA. ONLY OUTPUT REACTIONS FOR WHICH A BACKGROUND
CROSS SECTION IS GIVEN. DO NOT MONITOR THE PROGRESS OF THE PROGRAM
RECONSTRUCT CROSS SECTIONS TO 0.1 PER-CENT ACCURACY. USE ENDFB.IN
AS INPUT AND ENDFB.OUT AS OUTPUT.

Recent

Recent

Recent

Recent

Recent

THIS CORRESPONDS TO USING ALL OF THE STANDARD OPTONS BUILT-IN TO
THE PROGRAM AND ALL INPUT CARDS MAY BE BLANK.

Recent

Recent

Recent

IN THIS CASE THE FOLLOWING 5 INPUT CARDS ARE REQUIRED.

Recent

(ZEROES ARE INDICATED ON THE FIRST LINE, BELOW, ONLY TO INDICATE
WHERE THE LINE IS. THE ACTUAL INPUT LINE CAN BE COMPLETELY BLANK).

Recent

Recent

0 0.0

Recent

0

0

0

0

Recent

(USE STANDARD INPUT FILENAME = ENDFB.IN)

Recent

(USE STANDARD OUTPUT FILENAME = ENDFB.OUT)

Recent

(RETRIEVE ALL DATA, END REQUEST LIST)

Recent

(0.1 ERROR, END FILE 2 ERROR LAW)

Recent

Recent

===== Recent