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====================================================================== Spectra
                                                                       Spectra
     PROGRAM SPECTRA                                                   Spectra
     ===============                                                   Spectra
     An extension of LINEAR to linearize ALl MF=5 spectra.             Spectra
     05/28/2012 - Added MF=15 neutron induced, photon spectra.         Spectra
                                                                       Spectra
     First released in 2010 - Earlier below dates refer to LINEAR.     Spectra
                                                                       Spectra
     VERSION 74-1 (MAY 1974)                                           Spectra
     VERSION 75-1 (APRIL 1975)                                         Spectra
     VERSION 76-2 (OCTOBER 1976)                                       Spectra
     VERSION 77-1 (JANUARY 1977)                                       Spectra
     VERSION 78-1 (JULY 1978)                                          Spectra
     VERSION 79-1 (JULY 1979) CDC-7600 AND CRAY-1 VERSION.             Spectra
     VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION.                Spectra
     VERSION 80-2 (DECEMBER 1980)                                      Spectra
     VERSION 81-1 (MARCH 1981)                                         Spectra
     VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY.      Spectra
     VERSION 83-1 (JANUARY 1983) *MAJOR RE-DESIGN.                     Spectra
                                 *PAGE SIZE INCREASED - 1002 TO 3006.  Spectra
                                 *ELIMINATED COMPUTER DEPENDENT CODING. Spectra
                                 *NEW, MORE COMPATIBLE I/O UNIT NUMBER. Spectra
                                 *ADDED OPTION TO KEEP ALL ORIGINAL    Spectra
                                  ENERGY POINTS FROM EVALUATION.       Spectra
                                 *ADDED STANDARD ALLOWABLE ERROR OPTION Spectra
                                  (CURRENTLY 0.1 PER-CENT).            Spectra
     VERSION 83-2 (OCTOBER 1983) IMPROVED BASED ON USER COMMENTS.      Spectra
     VERSION 84-1 (APRIL 1984)   IMPROVED BASED ON USER COMMENTS.      Spectra
     VERSION 84-2 (JUNE 1984)   *UPDATED FOR ENDF/B-VI FORMATS.       Spectra
                                *SPECIAL I/O ROUTINES TO GUARANTEE     Spectra
                                 ACCURACY OF ENERGY.                  Spectra
                                *DOUBLE PRECISION TREATMENT OF ENERGY  Spectra
                                 (REQUIRED FOR NARROW RESONANCES).    Spectra
     VERSION 85-1 (AUGUST 1985) *FORTRAN-77/H VERSION                  Spectra
     VERSION 86-1 (JANUARY 1986)*ENDF/B-VI FORMAT                      Spectra
     VERSION 87-1 (JANUARY 1987)*DOUBLE PRECISION TREATMENT OF CROSS   Spectra
                                 SECTION                               Spectra
     VERSION 88-1 (JULY 1988)   *OPTION...INTERNALLY DEFINE ALL I/O    Spectra
                                 FILE NAMES (SEE, SUBROUTINE FILEIO    Spectra
                                 FOR DETAILS).                         Spectra
                                *IMPROVED BASED ON USER COMMENTS.      Spectra
     VERSION 89-1 (JANUARY 1989)*PSYCHOANALYZED BY PROGRAM FREUD TO    Spectra
                                 INSURE PROGRAM WILL NOT DO ANYTHING   Spectra
                                 CRAZY.                                Spectra
                                *UPDATED TO USE NEW PROGRAM CONVERT    Spectra
                                 KEYWORDS.                             Spectra
                                *ADDED LIVERMORE CIVIC COMPILER        Spectra
                                 CONVENTIONS.                          Spectra
     VERSION 90-1 (JUNE 1990)   *EXTENDED TO LINEARIZE PHOTON          Spectra
                                 INTERACTION DATA, MF=23 AND 27        Spectra
                                *ADDED FORTRAN SAVE OPTION             Spectra
                                *UPDATED BASED ON USER COMMENTS.       Spectra
                                *NEW MORE CONSISTENT ENERGY OUTPUT     Spectra
                                 ROUTINE.                              Spectra
                                *WARNING...INPUT PARAMETER FORMAT      Spectra
                                 HAS BEEN CHANGED...SEE DESCRIPTION    Spectra
                                 BELOW.                                Spectra
     VERSION 91-1 (JULY 1991)   *ADDED INTERPOLATION LAW 6 - ONLY USED Spectra
                                 FOR CHARGED PARTICLE CROSS SECTIONS   Spectra
                                 FOR COULOMB PENETRABILITIES.          Spectra
     VERSION 92-1 (JANUARY 1992)*ADDED NU-BAR (TOTAL, DELAYED, PROMPT) Spectra
                                 POLYNOMIAL OR TABULATED ALL CONVERTED Spectra
                                 TO LINEARLY INTERPOLABLE              Spectra
                                *INCREASED PAGE SIZE FROM 3006 TO 5010 Spectra
                                 POINTS.                               Spectra
                                *ALL ENERGIES INTERNALLY ROUNDED PRIOR Spectra
                                 TO CALCULATIONS.                      Spectra
                                *COMPLETELY CONSISTENT I/O AND ROUNDING Spectra
                                 ROUTINES - TO MINIMIZE COMPUTER       Spectra
                                 DEPENDENCE.                           Spectra
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VERSION 92-2 (JULY 1992)   *CORRECTED CONVERSION OF NU-BAR FROM    Spectra
                            POLYNOMIAL TO TABULATED - COPY         Spectra
                            SPONTANEOUS NU-BAR (BY DEFINITION      Spectra
                            THE SPONTANEOUS NU-BAR IS NOT AN       Spectra
                            ENERGY DEPENDENT QUANTITY).            Spectra
VERSION 93-1 (MARCH 1993)  *UPDATED FOR USE WITH LAHEY COMPILER    Spectra
                            ON IBM-PCS.                            Spectra
                           *INCREASED PAGE SIZE FROM 5010 TO       Spectra
                            30000 POINTS                           Spectra
VERSION 94-1 (JANUARY 1994)*VARIABLE ENDF/B DATA FILENAMES         Spectra
                            TO ALLOW ACCESS TO FILE STRUCTURES     Spectra
                            (WARNING - INPUT PARAMETER FORMAT      Spectra
                            HAS BEEN CHANGED)                      Spectra
                           *CLOSE ALL FILES BEFORE TERMINATING     Spectra
                            (SEE, SUBROUTINE ENDIT)                Spectra
VERSION 96-1 (JANUARY 1996) *COMPLETE RE-WRITE                     Spectra
                            *IMPROVED COMPUTER INDEPENDENCE        Spectra
                            *ALL DOUBLE PRECISION                  Spectra
                            *ON SCREEN OUTPUT                      Spectra
                            *UNIFORM TREATMENT OF ENDF/B I/O       Spectra
                            *IMPROVED OUTPUT PRECISION             Spectra
                            *DEFINED SCRATCH FILE NAMES            Spectra
                            *ALWAYS INCLUDE THERMAL VALUE          Spectra
                            *INCREASED PAGE SIZE FROM 30000 TO     Spectra
                             60000 POINTS                          Spectra
VERSION 99-1 (MARCH 1999)   *CORRECTED CHARACTER TO FLOATING       Spectra
                             POINT READ FOR MORE DIGITS            Spectra
                            *UPDATED TEST FOR ENDF/B FORMAT        Spectra
                             VERSION BASED ON RECENT FORMAT CHANGE Spectra
                            *GENERAL IMPROVEMENTS BASED ON         Spectra
                             USER FEEDBACK                         Spectra
VERSION 99-2 (JUNE 1999)    *ASSUME ENDF/B-VI, NOT V, IF MISSING   Spectra
                             MF=1, MT-451.                         Spectra
VERS. 2000-1 (FEBRUARY 2000)*ADDED MF = 9 AND 10 LINEARIZATION     Spectra
                            *GENERAL IMPROVEMENTS BASED ON         Spectra
                             USER FEEDBACK                         Spectra
VERS. 2002-1 (MAY 2002)     *OPTIONAL INPUT PARAMETERS             Spectra
VERS. 2004-1 (JAN. 2004)    *GENERAL UPDATE BASED ON USER FEEDBACK Spectra
VERS. 2005-1 (JAN. 2005)    *ALWAYS KEEP ORIGINAL TABULATED        Spectra
                             NU-BAR POINTS.                        Spectra
VERS. 2006-1 (FEB. 2006)    *CORRECTED INT=6 NEAR THRESHOLD        Spectra
                            *NO SUBDIVIDE BELOW MINIMUM XCMIN      Spectra
VERS. 2007-1 (JAN. 2007)    *CHECKED AGAINST ALL ENDF/B-VII.       Spectra
                            *INCREASED PAGE SIZE FROM 60,000 TO    Spectra
                             600,000 POINTS                        Spectra
VERS. 2010-1 (JUNE 2010)    *ADDED MF = 5 - MF = 6 STILL PLANNED.  Spectra
                            *72 CHARACTER FILE NAMES.              Spectra
                            *ONLY PROCESS MF=5 - SKIP ALL OTHERS   Spectra
                             TO PREVENT CONFLICT WITH LINEAR       Spectra
                             THINNING.                             Spectra
VERS. 2012-1 (Aug. 2012)    *Added MF=15, neutron induced photon   Spectra
                             spectra.                              Spectra
                            *Added CODENAME                        Spectra
                            *32 and 64 bit Compatible              Spectra
                            *Added ERROR stop                      Spectra
VERS. 2015-1 (Jan. 2015)    *Extended OUT9.                        Spectra
                            *Replaced ALL 3 way IF Statements.     Spectra
                            *Corrected MF=15 Data - it was adding  Spectra
                             SEND between sub-sections.            Spectra
                            *Deleted unused parts, e.g., NUBAR.    Spectra
                                                                   Spectra
OWNED, MAINTAINED AND DISTRIBUTED BY                               Spectra
-----------------------------------                                Spectra
THE NUCLEAR DATA SECTION                                           Spectra
INTERNATIONAL ATOMIC ENERGY AGENCY                                 Spectra
P.O. BOX 100                                                       Spectra
A-1400, VIENNA, AUSTRIA                                            Spectra
EUROPE                                                             Spectra
                                                                   Spectra
ORIGINALLY WRITTEN BY                                              Spectra
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AUTHORS MESSAGE

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

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

PURPOSE

THIS PROGRAM IS DESIGNED TO CONVERT ENDF/B FILE 3, 23 AND 27 DATA TO LINEAR-LINEAR INTERPOLABLE FORM. ANY SECTION THAT IS ALREADY LINEAR-LINEAR INTERPOLABLE WILL BE THINNED.

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

ENDF/B FORMAT

THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT).

IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE CORRECTLY OUTPUT ON ALL LINES. THE FORMAT OF SECTION MF=1, MT=451 AND ALL SECTIONS OF MF=3 MUST BE CORRECT. THE PROGRAM COPIES ALL OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS.

OUTPUT FORMAT

IN THIS VERSION OF LINEAR ALL ENERGIES WILL BE OUTPUT IN F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN WITH UP TO 9 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS TO THE 9 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE TO USE THE 9 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA DUE TO TRUNCATION OF ENERGIES TO 6 DIGITS DURING OUTPUT.

CONTENTS OF OUTPUT

ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE LINEARIZED DATA CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO INCLUDED.

DOCUMENTATION

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-------------                                                          Spectra
THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED      Spectra
BY THE ADDITION OF 3 COMMENT LINES AT THE END OF EACH HOLLERITH        Spectra
SECTION IN THE FORM                                                    Spectra
                                                                       Spectra
***************** PROGRAM SPECTRA (2015-1) ****************            Spectra
FOR ALL DATA GREATER THAN 1.00000-10 IN ABSOLUTE VALUE                 Spectra
DATA LINEARIZED TO WITHIN AN ACCURACY OF  0.1  PER-CENT                Spectra
                                                                       Spectra
THE ORDER OF SIMILAR COMMENTS (FROM RECENT, SIGMA1 AND GROUPIE)        Spectra
REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON            Spectra
THE DATA BY THESE PROGRAMS.                                            Spectra
                                                                       Spectra
THESE COMMENT LINES ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS,     Spectra
I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT     Spectra
OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF          Spectra
EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451        Spectra
IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF          Spectra
THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF          Spectra
MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO              Spectra
DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND       Spectra
AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT      Spectra
SHOULD BE USED TO CREATE A HOLLERITH SECTION.                          Spectra
                                                                       Spectra
REACTION INDEX                                                         Spectra
--------------                                                         Spectra
THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN         Spectra
SECTION MF=1, MT=451 OF EACH EVALUATION.                               Spectra
                                                                       Spectra
THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451.       Spectra
THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT             Spectra
REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS     Spectra
NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING      Spectra
A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE      Spectra
A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM     Spectra
YOU MAY USE PROGRAM DICTIN TO CREATE A CORRECT REACTION INDEX.         Spectra
                                                                       Spectra
SECTION SIZE                                                           Spectra
------------                                                           Spectra
SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT      Spectra
TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS          Spectra
SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS.                     Spectra
                                                                       Spectra
FOR ANY LINEARIZED SECTION THAT CONTAINS 60000 OR FEWER POINTS         Spectra
THE ENTIRE OPERATION WILL BE PERFORMED IN CORE AND THE LINEARIZED      Spectra
DATA WILL BE OUTPUT DIRECTLY TO THE ENDF/B FORMAT. FOR ANY SECTION     Spectra
THAT CONTAINS MORE POINTS THE DATA WILL BE LINEARIZED A PAGE AT A      Spectra
TIME (1 PAGE = 60000 POINTS) AND OUTPUT TO SCRATCH. AFTER THE          Spectra
ENTIRE SECTION HAS BEEN LINEARIZED THE DATA WILL BE READ BACK FROM     Spectra
SCRATCH AND OUTPUT TO THE ENDF/B FORMAT.                               Spectra
                                                                       Spectra
SELECTION OF DATA                                                      Spectra
-----------------                                                      Spectra
THE PROGRAM SELECTS DATA TO BE LINEARIZED BASED EITHER ON EITHER       Spectra
MAT (ENDF/B MAT NO.) OR ZA AS WELL AS MF AND MT NUMBERS. THIS          Spectra
PROGRAM ALLOWS UP TO 100 MAT/MF/MT OR ZA/MF/MT RANGES TO BE            Spectra
SPECIFIED BY INPUT PARAMETERS. THE PROGRAM WILL ASSUME THAT THE        Spectra
ENDF/B TAPE IS IN MAT ORDER, REGARDLESS OF THE CRITERIA USED           Spectra
TO RETRIEVE MATERIALS. IF RETRIEVAL IS BY MAT RANGE THE PROGRAM        Spectra
WILL TERMINATE WHEN A MAT IS FOUND THAT IS ABOVE ALL REQUESTED         Spectra
MAT RANGES. IF RETRIEVAL IS BY ZA RANGE THE PROGRAM WILL SEARCH        Spectra
THE ENTIRE ENDF/B TAPE.                                                Spectra
                                                                       Spectra
PROGRAM OPERATION                                                      Spectra
-----------------                                                      Spectra
EACH SECTION OF DATA IS CONSIDERED SEPARATELY. EACH SECTION OF         Spectra
ENDF/B DATA TO LINEARIZE IS REPRESENTED BY A TABLE OF ENERGY           Spectra
VS. CROSS SECTION AND ANY ONE OF FIVE ALLOWABLE INTERPOLATION LAWS     Spectra
BETWEEN ANY TWO TABULATED POINTS. THIS PROGRAM WILL REPLACE EACH       Spectra
SECTION OF DATA CROSS SECTIONS BY A NEW TABLE OF ENERGY VS.            Spectra
CROSS SECTION IN WHICH THE INTERPOLATION LAW IS ALWAYS LINEAR IN       Spectra
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ENERGY AND CROSS SECTION BETWEEN ANY TWO TABULATED POINTS. Spectra

DATA IS READ AND LINEARIZED A PAGE AT A TIME (ONE PAGE CONTAINS 60000 DATA POINTS). IF THE FINAL LINEARIZED SECTION CONTAINS TWO PAGES OR LESS, DATA POINTS IT WILL BE ENTIRELY CORE RESIDENT AFTER IT HAS BEEN LINEARIZED AND WILL BE WRITTEN DIRECTLY FROM CORE TO THE OUTPUT TAPE. IF THE LINEARIZED SECTION IS LARGER THAN TWO PAGES, AFTER EACH PAGE IS LINEARIZED IT WILL BE WRITTEN TO SCRATCH. AFTER THE ENTIRE SECTION HAS BEEN LINEARIZED IT WILL BE READ BACK FROM SCRATCH, TWO PAGES AT A TIME, AND WRITTEN TO THE OUTPUT TAPE. Spectra

KEEP EVALUATED DATA POINTS Spectra

SOMETIMES IT IS CONVENIENT TO KEEP ALL ENERGY POINTS WHICH WERE PRESENT IN THE ORIGINAL EVALUATION AND TO MERELY SUPPLEMENT THESE POINTS WITH ADDITIONAL ENERGY POINTS IN ORDER TO LINEARIZE THE CROSS SECTIONS. FOR EXAMPLE, IT IS OFTEN CONVENIENT TO KEEP THE THERMAL VALUE (AT 0.0253 EV) OR THE VALUE AT 14.1 MEV. Spectra

THE CURRENT VERSION OF THIS PROGRAM WILL ALLOW THE USER TO KEEP ALL ORIGINAL EVALUATED DATA POINTS BY SPECIFYING 1 IN COLUMNS 34-44 OF THE FIRST INPUT LINE. THIS WILL TURN OFF THE BACKWARD THINNING (SEE UCRL-50400, VOL. 17, PART A FOR EXPLANATION) AND RESULT IN ALL ORIGINAL ENERGY POINTS BEING KEPT. CAUTION SHOULD BE EXERCISED IN USING THIS OPTION SINCE IT CAN RESULT IN A CONSIDERABLE INCREASE IN THE NUMBER OF DATA POINTS OUTPUT BY THIS CODE. Spectra

FOR ALL USERS WHO ARE NOT INTERESTED IN THIS OPTIONS NO CHANGES ARE REQUIRED IN THE INPUT TO THIS PROGRAM, I. E. IF COLUMNS 34-44 ARE BLANK (AS FOR ALL PREVIOUS VERSIONS OF THIS CODE) THE PROGRAM WILL OPERATE EXACTLY AS IT DID BEFORE. Spectra

ALLOWABLE ERROR Spectra

ALLOWABLE ERROR MUST ALWAYS BE SPECIFIED IN THE INPUT TO THIS PROGRAM AS A FRACTION, NOT A PER-CENT. FOR EXAMPLE, INPUT THE ALLOWABLE FRACTIONAL ERROR 0.001 IN ORDER TO OBTAIN DATA THAT IS ACCURATE TO WITHIN 0.1 PER-CENT. Spectra

THE CONVERSION OF THE DATA FROM THE GENERAL INTERPOLATION FORM TO LINARLY INTERPOLABLE FORM CANNOT BE PERFORMED EXACTLY. HOWEVER, IT CAN BE PERFORMED TO VIRTUALLY ANY REQUIRED ACCURACY AND MOST IMPORTANTLY CAN BE PERFORMED TO A TOLERANCE THAT IS SMALL COMPARED TO THE UNCERTAINTY IN THE CROSS SECTIONS THEMSELVES. AS SUCH THE CONVERSION OF CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM CAN BE PERFORMED WITH ESSENTIALLY NO LOSE OF INFORMATION. Spectra

THE ALLOWABLE ERROR MAY BE ENERGY INDEPENDENT (CONSTANT) OR ENERGY DEPENDENT. THE ALLOWABLE ERROR IS DESCRIBED BY A TABULATED FUNCTION OF UP TO 20 (ENERGY,ERROR) PAIRS AND LINEAR INTERPOLATION BETWEEN TABULATED POINTS. IF ONLY ONE TABULATED POINT IS GIVEN THE ERROR WILL BE CONSIDERED CONSTANT OVER THE ENTIRE ENERGY RANGE. WITH THIS ENERGY DEPENDENT ERROR ONE MAY OPTIMIZE THE OUTPUT FOR ANY GIVEN APPLICATION BY USING A SMALL ERROR IN THE ENERGY RANGE OF INTEREST AND A LESS STRINGENT ERROR IN OTHER ENERGY RANGES. Spectra

DEFAULT ALLOWABLE ERROR Spectra

IN ORDER TO INSURE CONVERGENCE OF THE LINEARIZING ALGORITHM THE ALLOWABLE ERROR MUST BE POSITIVE. IF THE USER INPUTS AN ERROR THAT IS NOT POSITIVE IT WILL AUTOMATICALLY BE SET TO THE DEFAULT VALUE (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT) AND INDICATED AS SUCH IN THE OUTPUT LISTING. Spectra

COULOMB PENETRABILITY (INTERPOLATION LAW = 6) Spectra

INTRODUCED FOR ENDF/B-VI. THIS IS DEFINED AS, Spectra

SIG(E) = C1*EXP(-C2/SQRT(E - T)) Spectra

THIS PROGRAM ONLY CONSIDERS EXOTHERMIC REACTIONS - T = 0

SIG(E) = C1*EXP(-C2/SQRT(E))

WARNING...THIS INTERPOLATION LAW SHOULD ONLY BE USED FOR REACTIONS WHICH HAVE A POSITIVE Q-VALUE (EXOTHERMIC REACTIONS), SINCE HERE WE ONLY CONSIDER T = 0.0 IN THE FORMALISM. IN ALL OTHER CASES A WARNING MESSAGE WILL BE PRINTED.

INPUT FILES

UNIT	DESCRIPTION
2	INPUT LINES (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 (BINARY - 180000 WORDS/RECORD

OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILEIO)

UNIT	FILE NAME
2	SPECTRA.INP
3	SPECTRA.LST
10	ENDFB.IN
11	ENDFB.OUT
12	(SCRATCH)

INPUT PARAMETERS

FOR VERSIONS EARLIER THAN 90-1 THIS PROGRAM ONLY ALLOWED THE USER TO SPECIFY BY INPUT PARAMETERS WHICH MATERIALS (MAT) TO PROCESS. FOR EACH REQUESTED MATERIAL NEUTRON INTERACTION CROSS SECTIONS (MF=3) WOULD BE LINEARIZED AND THE REMAINDER OF THE MATERIAL WOULD BE COPIED.

FOR VERSIONS 90-1 AND LATER THIS PROGRAM WILL ALLOW THE USER TO TO SPECIFY BY INPUT PARAMETERS EXACTLY WHAT SECTIONS OF DATA TO PROCESS. FOR EACH SECTION OF DATA, SPECIFIED BY MAT, MF, MT RANGES, SECTIONS OF MF=3, 23 AND 27 WILL BE LINEARIZED AND ALL OTHER REQUESTED SECTIONS WILL BE COPIED. ALL SECTIONS WHICH ARE NOT EXPLICITLY REQUESTED WILL BE SKIPPED AND WILL NOT APPEAR ON ENDF/B FILE OUTPUT BY THIS PROGRAM.

WITH THIS NEW PROCEDURE YOU CAN MINIMIZE THE SIZE OF THE ENDF/B FILE OUTPUT BY THIS PROGRAM, E.G., IF YOU ONLY WANT NEUTRON CROSS SECTIONS FOR SUBSEQUENT PROCESSING YOU NEED ONLY REQUEST ONLY MF=3 DATA.

HOWEVER, YOU MUST UNDERSTAND THAT ONLY THOSE SECTIONS WHICH YOU EXPLICITLY REQUEST WILL APPEAR ON THE ENDF/B FILE OUTPUT BY THIS PROGRAM. FOR EXAMPLE, IF YOU WISH TO DOCUMENT EXACTLY HOW YOU LINEARIZED THE DATA BY INCLUDING COMMENTS IN MF=1, MT=451 THEN YOU MUST EXPLICITLY REQUEST THAT MF=1, MT=451 BE PROCESSED FOR EACH MATERIAL THAT YOU REQUEST. SIMILAR IF YOU WANT THE ENTIRE EVALUATION YOU MUST REQUEST ALL MF AND MT TO BE OUTPUT.

LINE	COLS.	DESCRIPTION

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   1   1-11  SELECTION CRITERIA (0=MAT, 1=ZA)                          Spectra
      12-22  MONITOR MODE SELECTOR                                      Spectra
             = 0 - NORMAL OPERATION                                     Spectra
             = 1 - MONITOR PROGRESS OF LINEARIZING OF THE DATA.         Spectra
                   EACH TIME A PAGE OF DATA POINTS IS WRITTEN TO        Spectra
                   THE SCRATCH FILE PRINT OUT THE TOTAL NUMBER OF       Spectra
                   POINTS ON SCRATCH AND THE LOWER AND UPPER            Spectra
                   ENERGY LIMITS OF THE PAGE (THIS OPTION MAY BE        Spectra
                   USED IN ORDER TO MONITOR THE EXECUTION SPEED         Spectra
                   OF LONG RUNNING JOBS).                               Spectra
      23-33  MINIMUM CROSS SECTION OF INTEREST (BARNS).                 Spectra
             (IF 0.0 OR LESS IS INPUT THE PROGRAM WILL                  Spectra
             USE 1.0E-10). ENERGY INTERVALS WILL NOT BE                 Spectra
             SUB-DIVIDED IF THE ABSOLUTE VALUE OF THE CROSS             Spectra
             SECTION WITHIN THE INTERVAL IS LESS THAN THIS VALUE.       Spectra
             AN EXCEPTION TO THIS RULE IS NEAR THRESHOLDS ENERGY        Spectra
             INTERVALS WILL BE SUB-DIVIDED UNTIL CONVERGENCE            Spectra
             REGARDLESS OF THE MAGNITUDE OF THE CROSS SECTION.          Spectra
      34-44  KEEP ORIGINAL EVALUATED DATA POINTS.                       Spectra
             = 0 - NO.                                                  Spectra
             = 1 - YES - ADDITIONAL POINTS MAY BE ADDED IN ORDER        Spectra
                         TO LINEARIZE DATA, BUT ALL ORIGINAL            Spectra
                         DATA POINTS WILL BE INCLUDED IN THE            Spectra
                         RESULTS.                                       Spectra
   2   1-72  ENDF/B INPUT DATA FILENAME                                 Spectra
             (STANDARD OPTION = ENDFB.IN)                               Spectra
   3   1-72  ENDF/B OUTPUT DATA FILENAME                                Spectra
             (STANDARD OPTION = ENDFB.OUT)                              Spectra
 4-N   1- 6  LOWER MAT OR ZA LIMIT                                      Spectra
       7- 8  LOWER MF LIMIT                                             Spectra
       9-11  LOWER MT LIMIT                                            Spectra
      12-17  UPPER MAT OR ZA LIMIT                                      Spectra
      18-19  UPPER MF LIMIT                                            Spectra
      20-22  UPPER MT LIMIT                                            Spectra
             UP TO 100 RANGES MAY BE SPECIFIED, ONLY ONE RANGE          Spectra
             PER LINE. THE LIST OF RANGES IS TERMINATED BY A            Spectra
             BLANK LINE. IF THE UPPER MAT LIMIT OF ANY REQUEST          Spectra
             IS LESS THAN THE LOW LIMIT IT WILL BE SET EQUAL TO         Spectra
             THE LOWER LIMIT. IF THE UPPER LIMIT IS STILL ZERO          Spectra
             IT WILL BE SET EQUAL TO 999999. IF THE UPPER MF OR         Spectra
             MT LIMIT IS ZERO IT WILL BE SET TO 99 OR 999               Spectra
             RESPECTIVELY.                                              Spectra
 VARY  1-11  ENERGY FOR ERROR LAW                                       Spectra
      12-22  ALLOWABLE FRACTIONAL ERROR FOR ERROR LAW.                   Spectra
             THE ACCEPTABLE LINEARIZING ERROR MAY BE SPECIFIED TO       Spectra
             BE EITHER ENERGY INDEPENDENT (DEFINED BY A SINGLE          Spectra
             ERROR), OR ENERGY DEPENDENT (DEFINED BY UP TO 20           Spectra
             ENERGY, ERROR PAIRS). FOR THE ENERGY DEPENDENT CASE        Spectra
             LINEAR INTERPOLATION WILL BE USED TO DEFINE THE ERROR      Spectra
             AT ENERGIES BETWEEN THOSE AT WHICH IT IS TABULATED.        Spectra
             IN ALL CASES THE ERROR LAW IS TERMINATED BY A BLANK        Spectra
             LINE. IF ONLY ONE ENERGY, ERROR PAIR IS GIVEN THE          Spectra
             THE LAW WILL BE CONSIDERED TO BE ENERGY INDEPENDENT.       Spectra
             IF MORE THAN ONE PAIR IS GIVEN IT WILL BE CONSIDERED       Spectra
             TO BE ENERGY DEPENDENT (NOTE, ENERGY INDEPENDENT           Spectra
             FORM WILL RUN FASTER THAN THE EQUIVALENT ENERGY            Spectra
             DEPENDENT FORM). FOR AN ENERGY DEPENDENT ERROR LAW         Spectra
             ALL ENERGIES MUST BE ASCENDING ENERGY ORDER. FOR           Spectra
             CONVERGENCE OF THE LINEARIZING ALGORITHM ALL ERRORS        Spectra
             MUST BE POSITIVE. IF AN ALLOWABLE ERROR IS NOT             Spectra
             POSITIVE IT WILL BE SET EQUAL TO THE STANDARD OPTION       Spectra
             (CURRENTLY 0.001, CORRESPONDING TO 0.1 PER-CENT).          Spectra
             IF THE FIRST ERROR LINE IS BLANK IT WILL TERMINATE         Spectra
             THE ERROR LAW AND THE ERROR WILL BE TREATED AS             Spectra
             ENERGY INDEPENDENT, EQUAL TO THE STANDARD OPTION           Spectra
             (CURRENTLY 0.1 PER-CENT). (SEE EXAMPLE INPUT 4).           Spectra
                                                                        Spectra
EXAMPLE INPUT NO. 1                                                     Spectra
------------------                                                      Spectra
RETRIEVE DATA BY ZA IN ORDER TO FIND ALL URANIUM ISOTOPES AND           Spectra
```

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    THORIUM 232. RETRIEVE ALL NEUTRON INTERACTION CROSS SECTIONS       Spectra
    (MF=3). ALL ENERGY INTERVALS IN WHICH THE CROSS SECTION IS         Spectra
    AT LEAST 1 MICRO-BARN (1.0E-06 BARNS) WILL BE SUBDIVIDED.          Spectra
    BACKWARD THINNING WILL BE PERFORMED. FROM 0 TO 100 EV LINEARIZE    Spectra
    TO WITHIN 0.1 PER-CENT ACCURACY. FROM 100 EV TO 1 KEV VARY         Spectra
    ACCURACY BETWEEN 0.1 AND 1.0 PER-CENT. ABOVE 1 KEV USE 1           Spectra
    PER-CENT ACCURACY.                                                 Spectra
                                                                       Spectra
    EXPLICITLY SPECIFY THE STANDARD FILENAMES.                         Spectra
                                                                       Spectra
    IN THIS CASE THE FOLLOWING 11 INPUT LINES ARE REQUIRED             Spectra
                                                                       Spectra
         1          0 1.00000- 6          0                          Spectra
ENDFB.IN                                                               Spectra
ENDFB.OUT                                                              Spectra
92000 3  0 92999 3999                                                  Spectra
90232 3  0     0 3  0    (UPPER LIMIT AUTOMATICALLY SET TO 90232 3999) Spectra
                         (END OF REQUEST LIST)                         Spectra
0.00000+ 0 1.00000-03                                                  Spectra
1.00000+ 2 1.00000-03                                                  Spectra
1.00000+ 3 1.00000-02                                                  Spectra
1.00000+ 9 1.00000-02                                                  Spectra
                         (END OF ERROR LAW)                            Spectra
                                                                       Spectra
    EXAMPLE INPUT NO. 2                                                Spectra
    ------------------                                                 Spectra
    SAME AS THE ABOVE CASE, EXCEPT LINEARIZE ALL DATA TO WITHIN THE    Spectra
    STANDARD ACCURACY (CURRENTLY 0.1 PER-CENT). IN ORDER TO USE THE    Spectra
    STANDARD ACCURACY YOU NEED NOT SPECIFY ANY ERROR LAW AT ALL. IN    Spectra
    THIS CASE INCLUDE THE HOLLERITH SECTION, MF=1, MT=451, FOR EACH    Spectra
    MATERIAL.                                                          Spectra
                                                                       Spectra
    LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL     Spectra
    THEN USE STANDARD FILENAMES.                                       Spectra
                                                                       Spectra
    IN THIS CASE THE FOLLOWING 9 INPUT LINES ARE REQUIRED              Spectra
                                                                       Spectra
         1          0 1.00000- 6          0                          Spectra
                         (USE DEFAULT FILENAME = ENDFB.IN)             Spectra
                         (USE DEFAULT FILENAME = ENDFB.OUT)            Spectra
92000 1451 92999 1451                                                  Spectra
92000 3  0 92999 3999                                                  Spectra
90232 1451     0 1451                                                  Spectra
90232 3  0     0 3  0    (UPPER LIMIT AUTOMATICALLY SET TO 90232 3999) Spectra
                         (END OF REQUEST LIST)                         Spectra
                         (0.1 PER-CENT ERROR, END OF ERROR LAW)        Spectra
                                                                       Spectra
    EXAMPLE INPUT NO. 3                                                Spectra
    ------------------                                                 Spectra
    LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO WITHIN AN ACCURACY    Spectra
    OF 0.5 PER-CENT (0.005 AS A FRACTION). IN THIS CASE YOU NEED NOT   Spectra
    SPECIFY THE MAT, MF, MT RANGES.                                    Spectra
                                                                       Spectra
    READ THE ENDF/B DATA FROM \ENDFB6\ZA092238 AND WRITE THE ENDF/B    Spectra
    DATA TO \ENDFB6\LINEAR\ZA092238.                                   Spectra
                                                                       Spectra
    IN THIS CASE THE FOLLOWING 6 INPUT LINES ARE REQUIRED              Spectra
                                                                       Spectra
                                          (MAT, 1.0E-10 BARNS, THIN)   Spectra
\ENDFB6\ZA092238                                                       Spectra
\ENDFB6\LINEAR\ZA092238                                                Spectra
                         (RETRIEVE ALL DATA, END REQUEST LIST)         Spectra
           5.00000-03                                                  Spectra
                         (END OF ERROR LAW)                            Spectra
                                                                       Spectra
    NOTE THAT IN THIS CASE IF THE INPUT HAD SPECIFIED AN EQUIVALENT    Spectra
    ENERGY DEPENDENT ERROR LAW BY GIVING A NUMBER OF ENERGY POINTS     Spectra
    AT EACH OF WHICH THE ERROR IS 0.5 PER-CENT THE PROGRAM WOULD TAKE  Spectra
    LONGER TO RUN (I.E., ONLY USE AN ENERGY DEPENDENT ERROR LAW WHEN   Spectra
    IT IS NECESSARY).                                                  Spectra
                                                                       Spectra
```

```
     EXAMPLE INPUT NO. 4                                                    Spectra
     -------------------                                                    Spectra
     IN ORDER TO LINEARIZE ALL MATERIALS ON AN ENDF/B TAPE TO THE           Spectra
     STANDARD OPTION OF 0.1 PER-CENT IT IS ADEQUATE TO INPUT A SET          Spectra
     OF COMPLETELY BLANK LINES WHICH WILL AUTOMATICALLY INVOKE ALL          Spectra
     OF THE STANDARD OPTIONS.                                               Spectra
                                                                            Spectra
     LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL         Spectra
     THEN USE STANDARD FILENAMES.                                           Spectra
                                                                            Spectra
     IN THIS CASE THE FOLLOWING THREE INPUT LINES ARE REQUIRED              Spectra
                                                                            Spectra
                                          (MAT, 1.0E-10 BARNS, THIN)        Spectra
                          (USE DEFAULT FILENAME = ENDFB.IN)                 Spectra
                          (USE DEFAULT FILENAME = ENDFB.OUT)                Spectra
                          (RETRIEVE ALL DATA, END REQUEST LIST)             Spectra
                          (0.1 PER-CENT ERROR, END OF ERROR LAW)            Spectra
                                                                            Spectra
================================================================================ Spectra
```