# ADAS Subroutine e2spln

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      SUBROUTINE E2SPLN( ITA    , ITVAL   ,
     &                   BWNO   ,
     &                   TETA   , TEVA    ,
     &                   SZD    , SZDA    ,
     &                   LTRNG
     &                 )
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: E2SPLN *********************
C
C  PURPOSE:
C          PERFORMS CUBIC SPLINE ON LOG(TEMPERATURE <EV> ) VERSUS
C          LOG(SCALED IONIZATION RATE COEFFICIENTS).
C          INPUT DATA FOR A GIVEN IONZING ION COMBINATION DATA-BLOCK.
C
C          USING  ONE-WAY SPLINES  IT  CALCULATES  THE  IONIZATION  RATE
C          COEFFICIENT  FOR  'ITVAL'  ELECTRON  TEMPERATURE VALUES  FROM
C          THE LIST OF ELECTRON TEMPERATURES READ IN FROM THE INPUT FILE
C
C          IF A  VALUE  CANNOT  BE  INTERPOLATED  USING  SPLINES  IT  IS
C          EXTRAPOLATED VIA 'XXSPLE'. (SEE NOTES BELOW).
C
C  CALLING PROGRAM: ADAS602/SSZD
C
C
C  SUBROUTINE:
C
C  INPUT : (I*4)  ITA     = INPUT DATA FILE: NUMBER OF ELECTRON TEMPERA-
C                           TURES READ FOR THE DATA-BLOCK BEING ASSESSED
C  INPUT : (I*4)  ITVAL   = NUMBER OF ISPF ENTERED ELECTRON TEMPERATURE
C                           VALUES FOR  WHICH  IOINIZATION RATE COEFFTS
C                           ARE REQUIRED FOR TABULAR/GRAPHICAL OUTPUT.
C
C  INPUT : (R*8)  BWNO    = INPUT DATA FILE: IONIZATION POTENTIAL (cm-1)
C                           FOR THE DATA-BLOCK BEING ASSESSED.
C
C  INPUT : (R*8)  TETA()  = INPUT DATA FILE: ELECTRON TEMPERATURES (EV)
C                           FOR THE DATA-BLOCK BEING ASSESSED.
C                           DIMENSION: ELECTRON TEMPERATURE INDEX
C  INPUT : (R*8)  TEVA()  = USER ENTERED: ELECTRON TEMPERATURES (EV)
C                           DIMENSION: TEMPERATURE/DENSITY PAIR INDEX
C
C  INPUT : (R*8)  SZD()    =INPUT DATA FILE: FULL SET OF ZERO DENSITY
C                           IONIZATION RATE COEFFTS FOR THE DATA-BLOCK
C                           BEING ANALYSED.
C                           1ST DIMENSION: ELECTRON TEMPERATURE INDEX
C  OUTPUT: (R*8)  SZDA()  = SPLINE INTERPOLATED OR  EXTRAPOLATED  ZERO
C                           DENSITY IONIZATION RATE COEFFICIENTS FOR
C                           THE USER ENTERED ELECTRON TEMPERATURES.
C                           DIMENSION: ELECTRON TEMPERATURE INDEX
C
C  OUTPUT: (L*4)  LTRNG()=  .TRUE.  => OUTPUT 'SZDA()' VALUE WAS INTER-
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C                                       POLATED  FOR  THE  USER  ENTERED
C                                       ELECTRON TEMPERATURE 'TEVA()'.
C                             .FALSE. => OUTPUT 'SZDA()' VALUE WAS EXTRA-
C                                       POLATED  FOR  THE  USER  ENTERED
C                                       ELECTRON TEMPERATURE 'TEVA()'.
C                             DIMENSION: ELECTRON TEMPERATURE INDEX
C
C          (I*4)  NIN     = PARAMETER = MAX. NO. OF INPUT  TEMPERATURE
C                                        VALUES. MUST BE >= 'ITA'
C          (I*4)  NOUT    = PARAMETER = MAX. NO. OF OUTPUT TEMPERATURE
C                                        PAIRS.  MUST BE >= 'ITVAL'
C          (I*4)  L1      = PARAMETER = 1
C
C          (R*8)  BCONST  = PARAMETER = 1/(SCALED BOLTZMANN'S CONSTANT)
C
C          (I*4)  IET     = ARRAY SUBSCRIPT USED INPUT  FILE  ELECTRON
C                           TEMPERATURES.
C          (I*4)  IT      = ARRAY  SUBSCRIPT  USED  FOR  USER  ENTERED
C                           TEMPERATURE VALUES.
C          (I*4)  IOPT    = DEFINES THE BOUNDARY DERIVATIVES FOR THE
C                           SPLINE ROUTINE 'XXSPLE', SEE 'XXSPLE'.
C                           (VALID VALUES = <0, 0, 1, 2, 3, 4)
C
C          (L*4)  LSETX   = .TRUE.  => SET UP SPLINE PARAMETERS RELATING
C                                      TO 'XIN' AXIS.
C                           .FALSE. => DO NOT SET UP SPLINE PARAMETERS
C                                      RELATING TO 'XIN' AXIS.
C                                      (I.E. THEY WERE SET IN A PREVIOUS
C                                            CALL )
C                           (VALUE SET TO .FALSE. BY 'XXSPLE')
C
C          (R*8)  R8FUN1  = FUNCTION - (SEE ROUTINES SECTION BELOW)
C          (R*8)  SCONST  = SCALING CONSTANT USED TO SCALE THE IONIZA-
C                           TION RATE COEFFT. WHEN SPLINNING.
C                           = IONIZATION POTENTIAL / BOLTZMANN CONST.
C
C          (R*8)  XIN()   = LOG( DATA FILE ELECTRON TEMPERATURES )
C          (R*8)  YIN()   = LOG( DATA FILE SCALED ION. RATE COEFFTS.)
C          (R*8)  XOUT()  = LOG( USER ENTERED ELECTRON TEMPS.)
C          (R*8)  YOUT()  = LOG( OUTPUT GENERATED SCALED ION. RATE COEF)
C          (R*8)  DF()    = SPLINE INTERPOLATED DERIVATIVES
C
C
C NOTE:
C
C          ONE-DIMENSIONAL SPLINE CARRIED OUT BY THIS SUBROUTINE:
C
C           LOG( EXP(<ion.pt.>/<k>.<Te>) . Szd )  vs. LOG( Te )
C
C           ion.pt. = ionization potential (units: cm-1)
C           k       = Boltzmann's constant (= 1/1.23977E-04)
C           Te      = electron temperature (units: eV)
C           Szd     = zero density ionization rate coefficient
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C                                          (units: cm**3/sec)
C
C           Extrapolation criteria:
C
C           Low  Te: zero gradient  extrapolation (i.e. DY(1)  = 0.0)
C           High Te: zero curvature extrapolation (i.e. DDY(N) = 0.0)
C
C           (These criteria are met by calling XXSPLE with IOPT=4)
C
C
C ROUTINES:
C           ROUTINE    SOURCE    BRIEF DESCRIPTION
C           ------------------------------------------------------------
C           XXSPLE     ADAS      SPLINE SUBROUTINE (EXTENDED DIAGNOSTICS)
C           R8FUN1     ADAS      REAL*8 FUNCTION: ( X -> X )
C
C AUTHOR:  PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C          K1/0/37
C          JET EXT. 2620
C
C DATE:    07/06/91
C
C VERSION: 1.1 DATE: ???
C MODIFIED: ???
C     - FIRST PUT UNDER SCCS
C
C VERSION: 1.2 DATE: 23/05/96
C MODIFIED: WILLIAM OSBORN (TESSELLA SUPPORT SERVICES PLC)
C     - INCREASED NOUT TO 35
C
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER             ITA,          ITVAL
      LOGICAL             LTRNG(ITVAL)
      REAL*8              BWNO,         SZD(ITA),    SZDA(ITVAL)
      REAL*8              TETA(ITA),    TEVA(ITVAL)
```