ADAS Subroutine start7

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       SUBROUTINE START7(IUTMP,IUPS1,IUPS2,STITLE,DSLPATH,
     &                   NBENG,NTEMP,NDENS, lbndl, lproj)
       IMPLICIT REAL*8(A-H,O-Z)
C-----------------------------------------------------------------------
C
C       *********  FORTRAN 77 ROUTINE : START7.F **********
C
C       PURPOSE : CALCULATION OF THE RESOLVED-NL POPULATION
C                 STRUCTURE.
C
C       NOTE    : THE RELEVANT QUANTUM NUMBERS ASSOCIATED WITH
C                 THE POPULATION STRUCTURE CALCULATION ARE
C                 STORED IN INTEGER ARRAYS WERE EACH ELEMENT
C                 IS 4 BYTES. THE FIRST 10 BITS OF THE 4 BYTE
C                 INTEGER ELEMENT OF THE ARRAY IS USED TO
C                 STORE THE TOTAL ANGULAR MOMENTUM QUANTUM
C                 NUMBER,L. THE NEXT TEN BITS IS USED TO STORE
C                 THE ORBITAL ANGULAR MOMENTUM QUANTUM
C                 NUMBER,l. THE LAST 12 BITS ARE USED TO STORE
C                 THE PRINCIPAL QUANTUM NUMBER,N.
C
C                 |<----------4 BYTE INTEGER---------->|
C                 |<----------32 BIT INTEGER---------->|
C                 |<-----N----->|<-----l--->|<---L---->|
C
C               [ |.....N......|.....l....|.....L....|  ]
C
C                 BIT OPERATORS ARE THEN EMPLOYED TO
C                 INTEROGATE ARRAYS,E.G IAND,ISHFR,
C                 USING HEXIDECIMAL MASKS.
C
C
C       INPUT   :
C
C       (CHR)   TITLE()     : NAME OF THE NEUTRAL BEAM SPECIES.
C       (I*4)   MN          :
C       (R*8)   RX3         :
C       (R*8)   DPT         :
C       (R*8)   EHCT        : CRITICAL ENERGY ?.
C       (I*4)   NHCT        : CRITICAL PRINCIPAL QUANTUM
C                             NUMBER ?.
C       (I*4)   LHCT        : CRITICAL ORBITAL QUANTUM
C                             NUMBER ?.
C       (I*4)   NIP         : RANGE OF DELTA N FOR IMPACT
C                             PARAMETER XSECTS. (LE.4)
C       (I*4)   NEX         :
C       (I*4)   IPRT        :
C       (I*4)   NDEL        :
C       (I*4)   INTD        : ORDER OF MAXWELL QUADRATURE
C                             FOR XSECTS. (LE.3)
C       (I*4)   IPRS        : 0 DEFAULT TO VAN REGEMORTER XSECTS.
C                               BEYOND NIP RANGE
```

```
C                              1 USE PERCIVAL-RICHARDS XSECTS.
C                                BEYOND NIP RANGE
C       (I*4)   ILOW         : 0 NO SPECIAL LOW LEVEL DATA ACCESSED.
C                              1 SPECIAL LOW LEVEL DATA ACCESSED.
C       (I*4)   IONIP        : 0 NO ION IMPACT COLLISIONS INCLUDED.
C                              1 ION IMPACT EXCITATION AND IONISATION
C                                INCLUDED.
C
C       (I*4)   NIONIP       : RANGE OF DELTA N FOR ION IMPACT
C                              EXCITATION XSECTS.
C       (I*4)   ILPRS        : 0 DEFAULT TO VAINSHTEIN ION IMPACT
C                                EXCITATION XSECTS.
C                              1 USE LODGE-PERCIVAL-RICHARDS ION
C                                IMPACT EXCITATION XSECTS.
C       (I*4)   IVDISP       : 0 ION IMPACT AT THERMAL MAXWELLIAN
C                                ENERGIES
C                              1 ION IMPACT AT DISPLACED THERMAL
C                                ENERGIES ACCORDING TO THE NEUTRAL
C                                BEAM ENERGY PARAMETER. IF(IVDISP=0 THEN
C                                SPECIAL LOW LEVEL DATA FOR ION IMPACT
C                                IS NOT SUBSTITUTED - ONLY VAINSHTEIN
C                                AND LODGE ET AL. OPTIONS ARE OPEN.
C                                ELECTRON IMPACT DATA SUBSTITUTION
C                                DOES OCCUR.
C       (R*4)   ZEFF         : EFFECTIVE CHARGE OF THE PLASMA.
C       (R*8)   DEDEG        : CRITICAL TRANSITION ENERGY (RYDBERGS)
C                              USED IN THE NEARLY DEGENERATE LEVEL
C                              TREATMENT.
C                              IF DE<=DEDEG THEN ASSUME ZERO A-VALUE
C                              AND NO SUPPLEMENTARY DATA.
C                              IF DE> DEDEG THEN ASSUME A-VALUE
C                              CALCULABLE AND SEARCH FOR SUPPLEMENTARY
C                              DATA.
C                              N.B. APPLIES TO DELTA N TRANSITIONS
C                              ONLY.
C
C       (I*4)   NL1          : PRINCIPAL QUANTUM NUMBER FROM WHICH
C                              THE RESOLVED-NL POPULATION STRUCTURE
C                              CALCULATION STARTS FROM
C
C       (I*4)   NL2          : PRINCIPAL QUANTUM NUMBER WHICH MARKS
C                              THE END OF THE RESOLVED-NL TREATMENT
C                              WITHIN THE POPULATION STRUCTURE
C                              CALCULATION AND INDICATES THE START
C                              OF THE BUNDLED-N APPROXIMATION.
C       (I*4)   NL3          : UPPER PRINCIPAL QUANTUM NUMBER OF
C                              THE BUNDLED-N APPROXIMATION.
C       (R*8)   Z0           : NUCLEAR CHARGE OF BEAM ATOM ?.
C       (R*8)   Z1           : ION CHARGE+1 OF BEAM ION ?.
C       (R*8)   ALF          : ADJUSTABLE PARAMETER ASSOCIATED
C                              WITH THE MODIFIED POTENTIAL USED
C                              WHEN SOLVING THE RADIAL WAVE
C                              EQUATION.
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```
C       (R*8)   AMSZ0      :
C       (R*8)   AMSHYD     :
C       (I*4)   LP         :
C       (I*4)   ISP        :
C
C
C       OUTPUT  :
C
C               (R*8)  ....ETC
C
C       GENERAL :
C
C       (I*4)   NLREP()    : ARRAY CONTAINING REPRESENTATIVE
C                            LEVELS.
C       (R*8)   ENL()      : EFFECTIVE PRINCIPAL QUANTUM
C                            NUMBER.
C       (R*8)   ENL2()     : RECIPROCAL OF THE EFFECTIVE PRINCIPAL
C                            QUANTUM NUMBER SQUARED.
C       (I*4)   KPF()      : ARRAY CONTAINING THE QUANTUM NUMBERS,
C                            N,l,L FROM NMIN TO NMAX, IN ORDER
C                            OF DECREASING BINDING ENERGY. SEE
C                            NOTE AT THE TOP OF PROGRAM.
C       (I*4)   KPB()      : ARRAY CONTAINING THE INDEX OF THE
C                            CORRESPONDING LEVEL IN KPF().
C       (R*8)   EGY        : IONISATION POTENTIAL ( RYDBERGS ).
C       (I*4)   IR         : COUNTER TO REFERENCE REPRESENTATIVE
C                            LEVELS.
C       (I*4)   I          : GENERAL COUNTER.
C       (R*8)   V          : EFFECTIVE PRINCIPAL QUANTUM NUMBER.
C       (R*8)   E          : RECIPROCAL OF THE EFFECTIVE PRINCIPAL
C                            QUANTUM NUMBER SQUARED.
C       (R*8)   EXE        : VARIABLE USED TO ASSIGN THE VALUE
C                            OF EXP(I/k*Te).
C       (R*8)   EXS        : VARIABLE USED TO ASSIGN THE VALUE
C                            OF EXP(I/k*TS)
C       (I*4)   K          : GENERAL COUNTER.
C       (R*8)   C1()       : COEFFICIENT OF THE QUANTUM DEFECT
C                            EXPANSION.
C       (R*8)   C2()       : COEFFICIENT OF THE QUANTUM DEFECT
C                            EXPANSION.
C       (R*8)   C3()       : COEFFICIENT OF THE QUANTUM DEFECT
C                            EXPANSION.
C
C
C
C
C
C       ROUTINES:
C
C               ROUTINE        SOURCE     BRIEF DESCRIPTION
C               -----------------------------------------------
c               SUPPHE1         ADAS    OBTAINS FUNDAMENTAL DATA
C                                       FROM APPROPRIATE DATABASES.
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C               OVLP            ADAS    ??????????????????????????
C               SETUP3          ADAS    ??????????????????????????
C               SPIJ            ADAS    ??????????????????????????
C               CCNST7          ADAS    ASSEMBLES ARRAYS USED TO
C                                       CONSTRUCT THE COLLISIONAL-
C                                       RADIATIVE MATRIX.
C               CCNSE4          ADAS    APPLIES MATRIX CONDENSATION
C                                       SCHEME TO ARRAYS USED TO
C                                       ASSEMBLE THE COLLISIONAL-
C                                       RADIATIVE MATRIX.
C               HYSCL           ADAS    ??????????????????????????
C
C
C       HISTORY : ORIGINALLY WRITTEN BY H.P.SUMMERS.
C
C       NOTE    : THE RESOLVED-NL CALCULATION WAS STRUCTURED
C                 IN SUCH A MANNER THAT THE CALCULATION WAS
C                 PERFORMED IN TWO STAGES. THIS TWO STAGE
C                 PROCCESS HAS BEEN REMOVED. CUBIC SPLINE
C                 INTERPLOATION IN L. THE DIMENSIONALITIES
C                 FOR EACH SPIN SYSTEM ARE AS FOLLOWS :
C
C                 NUMBER OF LEVELS <1000.
C                 NUMBER OF PRINCIPAL QUANTUM LEVELS<300.
C                 NUMBER OF RESOLVED PRINCIPAL QUANTUM LEVELS<40.
C                 NUMBER OF RESOLVED LEVELS <800
C                 NUMBER OF RESOLVED REPR.PRINC.QUANTUM LEVELS<11.
C                 NUMBER OF REPRESENTATIVE LEVELS<80.
C                 NUMBER OF PRINCIPAL QUANTUM REPRESENTATIVE LEVELS<30.
C
C
C       CONTACT : HARVEY ANDERSON
C                 UNIVERSITY OF STRATHCLYDE
C                 ANDERSON@PHYS.STRATH.AC.UK
C
C       DATE    : 2/2/98
C
C       NOTE :
C                 THE C-R MATRIX IS PASSED TO THE ROUTINE FINISH5.F
C                 VIA A SCRTACH FILE ON STREAM 12. IDEALLY THE VARIBLES
C                 SHOULD BE PASSED DIRECTLY TO THE ROUTINE.
C
C
C       MODIFIED
C
C VERSION:      1.2                                     DATE:   21-10-99
C MODIFIED: RICHARD MARTIN
C               CHANGED HEXADECIMAL CONSTANTS TO Z'FFF00000' FORM.
C
C VERSION : 1.3
C MODIFIED: Martin O'Mullane
C DATE    : 08-11-2004
C           Alter nmax in gamaf() from 200 to 500.
```

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C
C VERSION : 1.4
C DATE    : 18-11-2004
C MODIFIED: Martin O'Mullane
C            - Align with Harvey Anderson's last version.
C            - Add lproj if projection output is requested.
C            - Add lbndl if adf36 output file is requested.
C            - The dsnps1 variable is replaced by iups2 in the
C              parameter list.
C
C VERSION : 1.5
C DATE    : 16-05-07
C MODIFIED: Allan Whiteford
C            - Moved parameter statement to below comment block
C              as part of subroutine documentation procedure.
C
C-----------------------------------------------------------------------
      CHARACTER*80        DSLPATH,     STITLE
      INTEGER             IUPS1,       IUPS2,       IUTMP,       NBENG
      INTEGER             NDENS,       NTEMP
      LOGICAL             LBNDL,       LPROJ
```