

ADAS Subroutine d9mpop

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      SUBROUTINE D9MPOP( NTDIM , NDDIM , IZDIMD, IPDIMD,  
&                      NSTAGE, ITMAX , IDMAX , NPRT  , NMSUM ,  
&                      ACDA  , SCDA  , CCDA  , QCDA  , XCDA  ,  
&                      DENS  , DENS  ,  
&                      ITEM  , IDEN  ,  
&                      CFREC , CFION , CFMET ,  
&                      POPN  , POPNMO, POPNPO,  
&                      CPOPN , CPOPND, CPOPNZ,  
&                      POPF  ,  
&                      XTEMP , YTEMP , YTEM  ,  
&                      RHS   , RDUM  , SOLVE  , LSOLVE  
&                      )  
      IMPLICIT REAL*8 (A-H,O-Z)
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C ***** FORTRAN 77 SUBROUTINE: D9MPOP *****

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C PURPOSE: CALCULATION OF METASTABLE RESOLVED IONISATION STAGE
C POPULATIONS OF A PARTICULAR ELEMENT FOR A GIVEN TEMPERATURE
C AND DENSITY. EXTENSION TO THE 2D (TEMPERATURE, DENSITY) CASE.

C

C CALLING PROGRAM: ADAS409

C

C SUBROUTINE:

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C INPUT : (I*4) NTDIM = MAXIMUM NUMBER OF TEMPERATURE VALUES
C INPUT : (I*4) NDDIM = MAXIMUM NUMBER OF DENSITY VALUES
C INPUT : (I*4) IZDIMD = MAXIMUM NUMBER OF STAGES-1
C INPUT : (I*4) IPDIMD = MAXIMUM NUMBER OF METASTABLES FOR EACH
C IONISATION STAGE
C INPUT : (I*4) NSTAGE = NUMBER OF STAGES-1
C INPUT : (I*4) ITMAX = NUMBER OF TEMPERATURE VALUES
C INPUT : (I*4) IDMAX = NUMBER OF DENSITY VALUES
C INPUT : (R*8) NPRT () = PARTITION OF TOTAL METASTABLES ACCORDING
C TO IONISATION STAGES
C 1ST DIM: STAGE INDEX
C INPUT : (I*4) NMSUM = TOTAL NUMBER OF POPULATIONS
C INPUT : (R*8) ACDA (, , ,) = GENERALISED CR RECOMBINATION COEFFICIENT
C 1ST DIM: TEMPERATURE INDEX
C 2ND DIM: DENSITY INDEX
C 3RD DIM: STAGE INDEX (LESS 1)
C 4TH DIM: METASTABLE INDEX
C 5TH DIM: METASTABLE INDEX
C INPUT : (R*8) SCDA (, , ,) = GENERALISED CR IONISATION COEFFICIENT
C 1ST DIM: TEMPERATURE INDEX
C 2ND DIM: DENSITY INDEX
C 3RD DIM: STAGE INDEX (LESS 1)
C 4TH DIM: METASTABLE INDEX
C 5TH DIM: METASTABLE INDEX

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C INPUT : (R*8) CCDA ( , , , ) = GENERALISED CR CHARGE EXCH. COEFFICIENT
C                                     1ST DIM: TEMPERATURE INDEX
C                                     2ND DIM: DENSITY INDEX
C                                     3RD DIM: STAGE INDEX (LESS 1)
C                                     4TH DIM: METASTABLE INDEX
C                                     5TH DIM: METASTABLE INDEX
C INPUT : (R*8) QCDA ( , , ) = GENERALISED CR CROSS-COUPLED COEFFICIENT
C                                     1ST DIM: TEMPERATURE INDEX
C                                     2ND DIM: DENSITY INDEX
C                                     3RD DIM: STAGE INDEX (LESS 1)
C                                     4TH DIM: METASTABLE INDEX
C                                     5TH DIM: METASTABLE INDEX
C INPUT : (R*8) XCDA ( , , ) = GENERALISED CR PARENT X-COUPLED COEFFICIENT
C                                     1ST DIM: TEMPERATURE INDEX
C                                     2ND DIM: DENSITY INDEX
C                                     3RD DIM: STAGE INDEX (LESS 1)
C                                     4TH DIM: METASTABLE INDEX
C                                     5TH DIM: METASTABLE INDEX
C INPUT : (R*8) DENS ( ) = ELECTRON DENSITIES FOR MODEL
C INPUT : (R*8) DENS ( ) = NEUTRAL HYDROGEN DENSITIES FOR MODEL
C
C INPUT : (I*4) ITEM = CURRENT TEMPERATURE INDEX
C INPUT : (I*4) IDEN = CURRENT DENSITY INDEX
C
C OUTPUT: (R*8) CFREC ( , , ) = RECOMBINATION RATE COEFFICIENTS TO ALL
C                                     METASTABLE IPDIMD; STARTING FROM FIRST TO
C                                     GROUND LEVEL, WITH CFREC(1, IPDIMD, IPDIMD)
C                                     SET TO ZERO
C                                     DIMENSIONS = (IPDIMD, IPDIMD, IZDIMD)
C OUTPUT: (R*8) CFION ( , , ) = IONISATION RATE COEFFICIENTS TO ALL
C                                     METASTABLE IPDIMD; STARTING FROM GROUND
C                                     TO FIRST LEVEL, WITH
C                                     CFION(NSTAGE, IPDIMD, IPDIMD)
C                                     SET TO ZERO
C                                     DIMENSIONS = (IPDIMD, IPDIMD, IZDIMD)
C OUTPUT: (R*8) CFMET ( , , ) = CROSS COUPLING COEFFICIENTS BETWEEN
C                                     METASTABLE IPDIMD WITH LEADING DIAGONAL
C                                     CALCULATED
C                                     DIMENSIONS = (IPDIMD, IPDIMD, IZDIMD)
C
C OUTPUT: (R*8) POPN ( , , ) = ARRAY HOLDING POPULATION STATE VALUES
C                                     WITH SECOND DIMENSION SET TO 1
C                                     DIMENSIONS = (IPDIMD, NDONE, IZDIMD+1)
C OUTPUT: (R*8) POPNMO ( , , ) = TEMPORARY NAME OF MATRIX HOLDING POPULATION
C                                     STATE VALUES AFTER NORMALIZATION, TO BE
C                                     SUBSTITUTED INTO NEXT EQUATION IN
C                                     DOWNWARD LOOP
C                                     DIMENSIONS = (IPDIMD, NDONE, IZDIMD+1)
C OUTPUT: (R*8) POPNPO ( , , ) = TEMPORARY NAME OF MATRIX HOLDING POPULATION
C                                     STATE VALUES AFTER NORMALIZATION, TO BE
C                                     SUBSTITUTED INTO NEXT EQUATION IN UPWARD
C                                     LOOP
C                                     DIMENSIONS = (IPDIMD, NDONE, IZDIMD+1)

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C
C OUTPUT: (R*8) CPOPN( , , ) = ARRAY HOLDING COEFFICIENTS OF POPULATION
C                               STATE EQUATIONS
C                               DIMENSIONS = (IPDIMD,IPDIMD,IZDIMD+1)
C OUTPUT: (R*8) CPOPND( , , ) = TEMPORARY NAME OF MATRIX TO BE SUBSTITUTED
C                               INTO NEXT EQUATION IN UPWARD LOOP
C                               DIMENSIONS = (IPDIMD,IPDIMD,IZDIMD+1)
C OUTPUT: (R*8) CPOPNZ( , , ) = TEMPORARY NAME OF MATRIX TO BE SUBSTITUTED
C                               INTO NEXT EQUATION IN DOWNWARD LOOP
C                               DIMENSIONS = (IPDIMD,IPDIMD,IZDIMD+1)
C
C OUTPUT: (R*8) POPF( )          = POPULATIONS FOR A SPECIFIED TEMPERATURE  D
C                               1ST DIM: INDEX OVER STAGES/METASTABLES
C
C OUTPUT: (R*8) XTEMP( , )      = TEMPORARY MATRIX USED DURING SUBROUTINE
C                               CALCULATIONS
C                               DIMENSIONS = (IPDIMD,IPDIMD)
C OUTPUT: (R*8) YTEMP( , )      = TEMPORARY MATRIX FOR DURING SUBROUTINE
C                               CALCULATIONS
C                               DIMENSIONS = (IPDIMD,IPDIMD)
C OUTPUT: (R*8) YTEM( )         = TEMPORARY ARRAY FOR HOLDING VALUES OF
C                               DIFFERENCE BETWEEN RECOMBINATION AND
C                               IONISATION GROUND LEVEL COEFFICIENTS
C                               DIMENSIONS = (NSTAGE)
C
C OUTPUT: (R*8) RHS( )          = SIPHONED OFF COLUMN OF NORMALIZATION
C                               MATRIX, USED TO CALCULATE METASTABLE
C                               IPDIMD OF DOMINANT STAGE THROUGH MATINV
C                               DIMENSIONS = (2*IPDIMD-1)
C OUTPUT: (R*8) RDUM( )         = DUMMY ARRAY USED IN MATINV AS RHS WHEN
C                               LSOLVE = FALSE
C OUTPUT: (R*8) SOLVE( , )      = NORMALIZATION MATRIX AT CRITICAL STAGE
C                               DIMENSIONS = (2*IPDIMD-1,2*IPDIMD-1)
C OUTPUT: (L*4) LSOLVE          = .TRUE. => SOLVE SET OF EQUATIONS
C                               = .FALSE. => INVERT MATRIX ONLY
C
C      (I*4) NDONE                = PARAMETER = 1 TO ALLOW 3D MATRIX USE
C      (I*4) ID                    = POSITION OF DOMINANT TERM
C      (I*4) ISTATE                = STAGE INDEX
C      (I*4) ITEM                  = GENERAL INDEX
C      (I*4) I                     = GENERAL INDEX
C      (I*4) J                     = GENERAL INDEX
C      (I*4) K                     = GENERAL INDEX
C      (R*8) YMIN                  = VALUE OF DIFFERENCE BETWEEN
C                               RECOMBINATION AND IONISATION COEFFICIENTS
C                               OF GROUND IPDIMD

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ROUTINES:

| ROUTINE | SOURCE | BRIEF DESCRIPTION |
|---------|--------|---------------------------------------|
| D5DIAG | ADAS | SETS UP ON-DIAGONAL ELEMENT OF MATRIX |
| D5MFSP | ADAS | EXECUTES PARTITION MATRIX INVERSION |
| DXMADD | ADAS | MATRIX ADDITION/SUBTRACTION |

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C          DXMMUL      ADAS      MATRIX MULTIPLICATION
C          XXMINV      ADAS      MATRIX INVERSION
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C
C AUTHOR:  Alessandro Lanzafame, University of Strathclyde
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C DATE:    11 December 1995

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C
C VERSION: 1.1                                DATE: 12-03-98
C MODIFIED: RICHARD MARTIN
C          - PUT UNDER SCCS CONTROL

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INTEGER      IDEN,          IDMAX,          IPDIMD,          ITEM
INTEGER      ITMAX,        IZDIMD,          NDDIM,          NMSUM
INTEGER      NPRT ( IZDIMD ) ,          NSTAGE,          NTDIM
LOGICAL      LSOLVE
REAL*8       ACDA (NTDIM, NDDIM, IZDIMD, IPDIMD, IPDIMD)
REAL*8       CCDA (NTDIM, NDDIM, IZDIMD, IPDIMD, IPDIMD)
REAL*8       CFION (IPDIMD, IPDIMD, IZDIMD)
REAL*8       CFMET (IPDIMD, IPDIMD, IZDIMD)
REAL*8       CFREC (IPDIMD, IPDIMD, IZDIMD)
REAL*8       CPOPN (IPDIMD, IPDIMD, IZDIMD+1)
REAL*8       CPOPND (IPDIMD, IPDIMD, IZDIMD+1)
REAL*8       CPOPNZ (IPDIMD, IPDIMD, IZDIMD+1)
REAL*8       DENS (NDDIM) ,  DENS (NTDIM)
REAL*8       POPF (NMSUM) ,  POPN (IPDIMD, NDDIM, IZDIMD+1)
REAL*8       POPNMO (IPDIMD, NDDIM, IZDIMD+1)
REAL*8       POPNPO (IPDIMD, NDDIM, IZDIMD+1)
REAL*8       QCDA (NTDIM, NDDIM, IZDIMD, IPDIMD, IPDIMD)
REAL*8       RDUM (IPDIMD) ,          RHS (2*IPDIMD-1)
REAL*8       SCDA (NTDIM, NDDIM, IZDIMD, IPDIMD, IPDIMD)
REAL*8       SOLVE (2*IPDIMD-1, 2*IPDIMD-1)
REAL*8       XCDA (NTDIM, NDDIM, IZDIMD, IPDIMD, IPDIMD)
REAL*8       XTEMP (IPDIMD, IPDIMD) ,          YTEM (IZDIMD)
REAL*8       YTEMP (IPDIMD, IPDIMD)

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