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IMPURITY-EVOLUTION CODE IMPHPCG AND ANALYSIS OF
THE IMPURITY MEASUREMENTS FOR JFT-2 TOKAMAK

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Impurity-Evolution Code IMPHPCG

and

Analysis of the Impurity Measurements for JFT-2 Tokamak

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The code IMPHPCG has been prepared to study the evolution of impurities in a Tokamak plasma. It evaluates the development of impurity profiles for the given temporal and spatial plasma densities, temperatures and currents. The diffusion of impurities is assumed as neo-classical in the banana-plateau region. The spectroscopic measurement of oxygen and carbon impurities in JFT-2 Tokamak is analysed with the code.

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不純物コード " I M P H P C G " と J F T - 2 トカマクの
不純物測定の解析

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トカマク・プラズマ中の不純物分布の時間発展を追求するための計算機プログラム・コードを開発した。プログラムは、プラズマの密度、温度、電流の空間分布や時間変化は与えられるものとして、電離、再結合、拡散などの過程できまる不純物分布の時間発展を計算する。不純物の拡散は、バナナ・プラトウ領域における新古典論に従う場合を扱った。このプログラムを使って、J F T - 2 トカマクでの酸素と炭素の不純物の分光測定の解析を試みた。

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目 次 な し

§1. Introduction

In high temperature plasmas, small amounts of multiply charged impurity ions enhance the radiation losses. Impurities have a tendency to accumulation in the center of plasma and affect significantly the plasma confinement in Tokamaks. It is an important problem to investigate the behaviour of impurities in a Tokamak plasma from the point of view of thermonuclear research. There are some attempts to analyse the problem numerically^{1~4)}. The present authors calculated the time development of oxygen impurities in various ionization states for constant distributions of plasma densities and temperatures¹⁾. In this numerical study, both the atomic process, including collisional ionizations and radiative recombinations, and diffusion process are treated properly and simultaneously. Two different numerical methods were used; one is Hamming's predictor-corrector method (Runge-Kutta method) and the other is to solve the eigen value problem. The results showed a fairly good agreement.

In the present paper, we develop the numerical study of impurities in a Tokamak plasma by removing some restrictions which are imposed in reference [1]. Plasma distributions such as densities and temperatures are given as in reference [1], however, the time variations of the distributions and total plasma current may be included. Impurity diffusions are assumed to be neoclassical in the banana-plateau regime. The effects of impurity-impurity collisions and temperature gradients are included, while these are neglected in the previous work. Accordingly, the equation governing the impurity behaviours becomes non-linear, so that it is impossible to treat the equation as an eigen value problem. The computer program uses Hamming's predictor-corrector method.

In §2, equations used in the program code are presented. In §3, numerical methods are shown briefly and some remarks on the program code "IMPHPCG" are given.

In JFT-2 Tokamak, optical measurements were performed for oxygen and carbon impurities in multiply ionized states⁵⁾. In §4, we analyse the measurements numerically by using the code "IMPHPCG" developed in the present paper. The program "IMPHPCG" is listed in Appendix. It should be emphasized that the present code may be useful for the Tokamak transport simulation code as well as for the analysis of spectrum measurements of impurities.

§2. System of Equations

In this section, we present a system of equations coded in the computer program. Densities of impurities averaged over the magnetic surface are governed by the following conservation equations;

$$\frac{\partial n_k}{\partial r} = - \frac{1}{r} \frac{\partial}{\partial r} (r \Gamma_k) + n_e (\alpha_{k-1} n_{k-1} - \alpha_k n_k) - n_e (\beta_{k-1} n_k - \beta_k n_{k+1}), \quad (1)$$

(k = 1, 2, ..., K)

with

$$\alpha_0 = \beta_0 = \alpha_K = \beta_K = 0$$

Here n_k is the number density of impurity with ($k-1$) electric charges. (n_1 is the neutral atom and n_k fully ionized ion.) Γ_k is the particle flux of the impurity n_k , n_e is the electron density, α_k is the rate coefficient of ionization from the state k to $k+1$ and β_k represents the radiative recombination rate coefficient from $k+1$ to k . For α_k and β_k , we employ the approximate estimation given by Hinno⁶;

$$\alpha_k = 5.9 \times 10^{-8} q_k^{k+1} (E_k^{k+1})^{-3/2} \sqrt{x_k} K_1(x_k), \quad [\text{cm}^3/\text{sec}]$$

$$\beta_k = 5.2 \times 10^{-14} \cdot k \cdot x_k^{3/2} \cdot e^{x_k} \cdot K_1(x_k), \quad [\text{cm}^3/\text{sec}] \quad (2)$$

$$x_k = E_k^{k+1} \cdot \chi_H / T_e, \quad (T_e : \text{eV})$$

$$K_1(z) = \int_z^\infty \frac{e^{-t}}{t} dt,$$

where q_k is the number of valence electrons in the outermost shell, E_k^{k+1} is the ionization potential in rydberg unit to ionize the state k to $k+1$ and $\chi_H = 13.59$ eV.

Neo-classical diffusions are assumed for impurities. We treat banana-plateau regimes. By Hinton and Moore⁷, the particle fluxes of impurities Γ_k are given as follows;

$$\Gamma_k = \sum_{k' \neq k} C_{11}^{kk'} \left[\frac{Z_k}{Z_{k'}} \frac{\partial}{\partial r} \ln n_{k'} - \frac{\partial}{\partial r} \ln n_k \right] + \left(\sum_{k' \neq k} C_{12}^{kk'} \right) \frac{\partial}{\partial r} \ln T_i, \quad (3)$$

$$\begin{aligned}
 C_{11}^{kk'} &= z_k^2 L_{11}^{k'} L_{11}^k / s , \\
 C_{12}^{kk'} &= \frac{3}{2} z_k^2 L_{11}^{k'} L_{11}^k (z_{k'} - z_k) / s , \\
 &\quad + z_k^2 (z_k^2 L_{11}^{k'} L_{12}^k - z_{k'}^2 L_{12}^{k'} L_{11}^k) / s , \\
 S &= \sum_{k'} z_k^2 L_{11}^{k'} .
 \end{aligned} \tag{4}$$

In Eq. (3), it is assumed that all ion species have the same temperature T_i . L_{mn} 's in Eq. (4) are quantities proportional to collision frequencies which are fitted to both banana and plateau regions;

$$\begin{aligned}
 L_{mn}^i &= 0.73 d_i \frac{v_{imn}}{1+C_{mn} v_{imn}} , \\
 L_{mn}^k &= 0.73 d_k \frac{v_{kmn}}{1+C_{mn} v_{kmn}} ,
 \end{aligned} \tag{5}$$

$$\begin{aligned}
 v_{imn} &= v_i^* [F_{mn}(1) + \alpha F_{mn}(\mu^2)] , \\
 v_{kmn} &= v_k^* [F_{mn}(1) + \alpha^{-1} F_{mn}(\mu^{-2})] ,
 \end{aligned} \tag{6}$$

where the subscript i denotes the plasma ion, and $C_{11} = 1.26$, $C_{12} = 0.37$. In Eq. (5),

$$\begin{aligned}
 d_i &= n_i \rho_{i\theta}^2 \left(\frac{r}{R}\right)^2 v_{Ti} \left(\frac{B_\theta}{B_z}\right) / r , \\
 d_k &= n_k \rho_{k\theta}^2 \left(\frac{r}{R}\right)^2 v_{Ti} \left(\frac{B_\theta}{B_z}\right) / r ,
 \end{aligned} \tag{7}$$

$$\alpha = \sum_{k \neq i} n_k z_k^2 / n_i z_i^2 , \quad \mu^2 = \frac{m_i}{m_k} , \tag{8}$$

$$F_{11}(\mu^2) = (1+\mu^2)^{1/2} + \mu^2 \ln \left[\frac{\mu}{(1+\mu^2)^{1/2}+1} \right] , \tag{9}$$

$$F_{12}(\mu^2) = (1+\mu^2)^{-1/2} ,$$

where B_θ and B_z are the poloidal and toroidal magnetic field, ρ_θ being the Larmor radius in the poloidal field, v_T the thermal speed. Collisionality parameters v_i^* for plasma ions and v_k^* for impurities are defined by

$$\nu_{i*} = \nu_{ii} \frac{qR}{v_{Ti}} \left(\frac{R}{r}\right)^{3/2}, \quad (10)$$

$$\nu_{k*} = \sum_{k \neq i} \nu_{kk} \frac{qR}{v_{Tk}} \left(\frac{R}{r}\right)^{3/2} = \alpha \left(\frac{Z_k}{Z_i}\right)^2 \nu_{i*},$$

where ν_{ii} and ν_{kk} are ion-ion and impurity-impurity collision frequencies, respectively. On the basis of a system of equations (1) to (10), the time behaviours of impurity profiles are investigated numerically when temporal and spatial variations of plasma distributions are given.

§3. Program "IMPHPCG"

Impurity code "IMPHPCG" solves the Eq. (1) numerically when plasma distributions are given. At time t , the electron density $n_e(r, t)$, electron and ion temperature $T_e(r, t)$, $T_i(r, t)$ and current density $J_z(r, t)$ are given in the form of

$$n_e(r, t) = \{n_e^c(t) - n_e^w(t)\} \left\{1 - \left(\frac{r}{a}\right)^{m_1(t)}\right\} n_1(t) + n_e^w(t) \quad (11)$$

$$T_e(r, t) = \{T_e^c(t) - T_e^w(t)\} \left\{1 - \left(\frac{r}{a}\right)^{m_2(t)}\right\} n_2(t) + T_e^w(t)$$

$$T_i(r, t) = \{T_i^c(t) - T_i^w(t)\} \left\{1 - \left(\frac{r}{a}\right)^{m_3(t)}\right\} n_3(t) + T_i^w(t)$$

$$J_z(r, t) = \left\{1 - \left(\frac{r}{a}\right)^{m_4(t)}\right\} n_4(t),$$

where $r=a$ is the plasma boundary. At each time specified, $n_e^c(t)$, $n_e^w(t)$, $T_e^c(t)$, $T_e^w(t)$, $T_i^c(t)$, $T_i^w(t)$, $m_1(t)$, $m_2(t)$, $m_3(t)$, $m_4(t)$ and $n_4(t)$ are given as input data. The toroidal magnetic field B_z is constant spatially and temporally throughout the computation. The poloidal field $B_\theta(r, t)$ can be obtained by giving the profile of current density (m_4 and n_4) and total current $I_p(t)$. The plasma ion density is calculated by

$$Z_{ini}(r, t) = n_e(r, t) - \sum_{k \neq i} Z_k n_k(r, t). \quad (12)$$

At time when input data are not given, linear interpolations are performed. Then, plasma quantities can be obtained at any time required. Eq. (1) is solved numerically from time n to $n+1$ by Hamming's predictor-corrector method⁸⁾. Time meshes from n to $n+1$ are also specified by input data.

Plasma profiles are assumed to be constant from n to $n+1$; quantities at $n+1/2$ are used for Eq. (1). The different scheme of Eq. (1) is the same as in reference (1).

Initial distributions of impurities are given by solving the rate equations. We solve rate equations at each mesh point, giving neutral atoms with uniform profiles. Solutions of rate equations are given as initial values for Eq. (1) (The method for solving rate equations is referred to [9].). Boundary conditions are assumed to keep impurity numbers constant inside the plasma. In contrast with reference [1], where corona equilibria are assumed at $r=a$, in the present paper we set

$$\begin{aligned} n_{J+1/2}^k &= n_{J-1/2}^k, \\ T_{J+1/2}^i &= T_{J-1/2}^i, \\ n_{J+1/2}^i &= n_{J-1/2}^i, \end{aligned} \tag{13}$$

where $(J-1/2)$ is the half integral mesh point of plasma boundary. (See Fig. 1 of reference [1].) Under the assumption of Eq. (13), particle fluxes Γ_k vanish at the mesh point J . This boundary condition is more restricted. However, it is simpler so that users can give any boundary condition by modifying subroutine BCOND.

§4. Numerical analysis of impurity measurements in JFT-2 Tokamak

In JFT-2 Tokamak, spectrum lines of oxygen and carbon impurities were measured⁵⁾. The experimental results are found in Figs. 4 and 5. (Figures of experimental results are reprinted from reference [5].) In this section we show the results of numerical calculation by using the code developed in the previous sections and compare with experimental results.

Fig. 1 shows the time variations of plasma at $r=0$ used for computation, which are fitted to experimental data^{10,11)}. In the experiment, measurements of impurity lines and experimental conditions were not performed simultaneously. In the numerical calculations, we employed two different experimental conditions (case A and case B) for n_e and T_e . It should be mentioned that, for case B, $n_e(r=0)$ and $T_e(r=0)$ in Fig. 1 are fitted to experimental data only after 30 m.sec. Before 30 m.sec, these are not based on the experimental results. For simplicity, the ion temperature is assumed to be 100 eV at $r=0$ throughout the computation.

At first, OI and CI of density $10^{10}/\text{cm}^3$, respectively, are given at each mesh point. Then, Solutions of rate equations after 1 m.sec were used as initial distributions of impurities. The initial condition is given at 10 m.sec. Eq. (1) was solved once per 0.5 or 1 m.sec.

Figs. 2 and 3 are numerical results of spatial distributions of plasmas, oxygen and carbon impurities at the 10 m.sec, 20 m.sec, 30 m.sec, 40 m.sec and 50 m.sec for case A and B, respectively. Numbers of impurities inside the plasma are conserved throughout the computation within an accuracy of three orders.

In the experiment, each lines of oxygen and carbon impurities are measured with time. Relative values of the measurement are shown in Fig. 4-(a). (The same figure are presented in Fig. 4-(b) for comparison with numerical results.) To compare numerical results with the experiment,

$$\tilde{n}_k(t) = \int_0^a n_k(r, t) dr , \quad (14)$$

are plotted with time. Relative values are shown in Fig. 4-(a) and (b) for case A and B, respecitvely. Impurity distributions are obtained for CV at $t=30$ m.sec and for OVII at $t=30$ m.sec and $t=40$ m.sec. In Fig. 5, both experimental and numerical results are shown.

Figs. 4-(a) and (b) show that the experimental result of time developments of impurities integrated along the radius agrees better with the case A (lower electron temperature) than with the case B (higher electron temperature), while good agreements are obtained between numerical and experimental results of impurity profiles for case B. Especially, a fairly good agreement is found for OVII profile. We cannot decide which case is true for impurity measurements, but we may roughly conclude that before 30 m.sec electron temperature is rather low (case A) and about 30 m.sec a rapid increase of electron temperature is found so that CV and OVII accumulate towards the center before 30 m.sec, then they become ionized rapidly to disappear at the center at the later stage of discharge and have shell structures about 30 m.sec to 40 m.sec. Fig. 6 shows the numerical result of time behaviour of OVII profiles. This shows that OVII accumulate towards the center as they are ionized. We may conclude that a good agreement is obtained between the experiment and numerical calculation based on the neo-classical theory in the banana-plateau regime and that measurements of lines and experimental conditions are found to be quantitatively consistent, although there are some

descrepancies between the experimental and numerical results.

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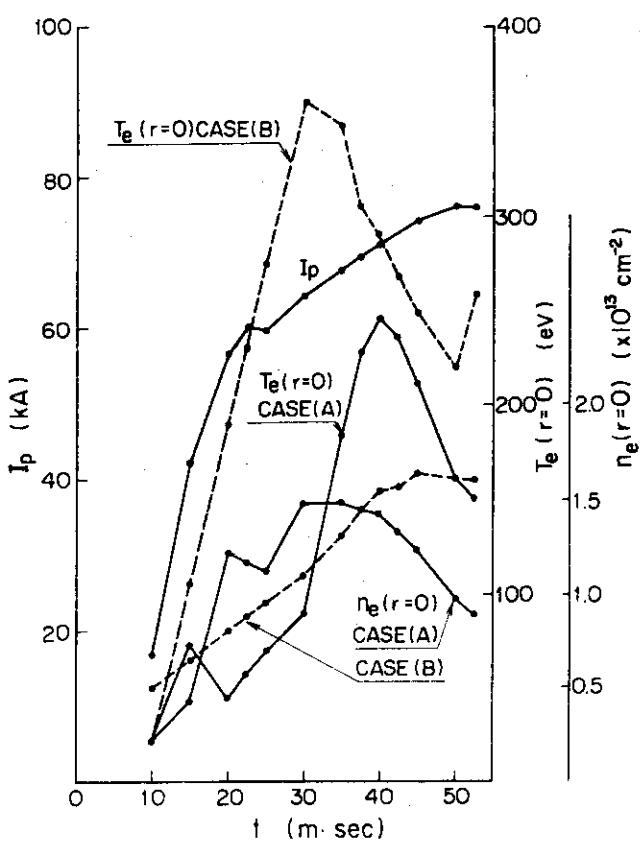


Fig. 1 Time variations of plasma at $r=0$ used for computations fitted to experimental data of reference [10] and [11]. For case B, only after 30 m·sec, fitting curves are based on the experimental data.

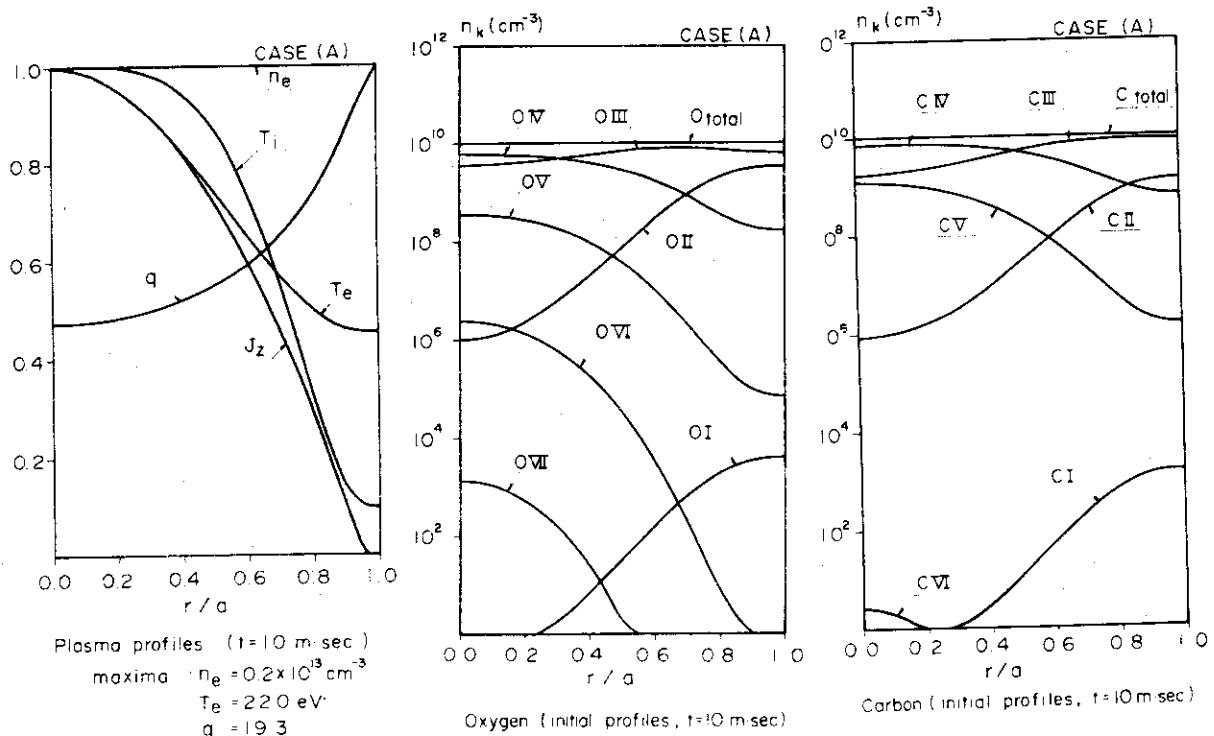
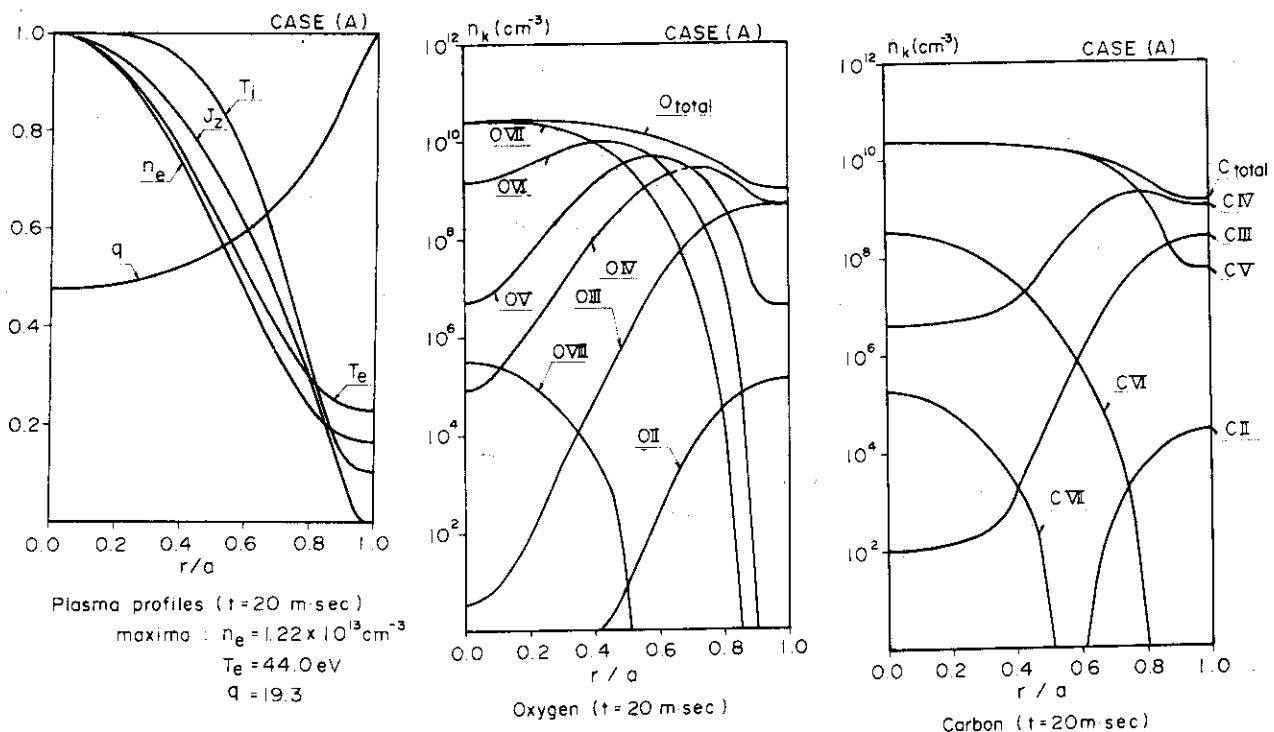
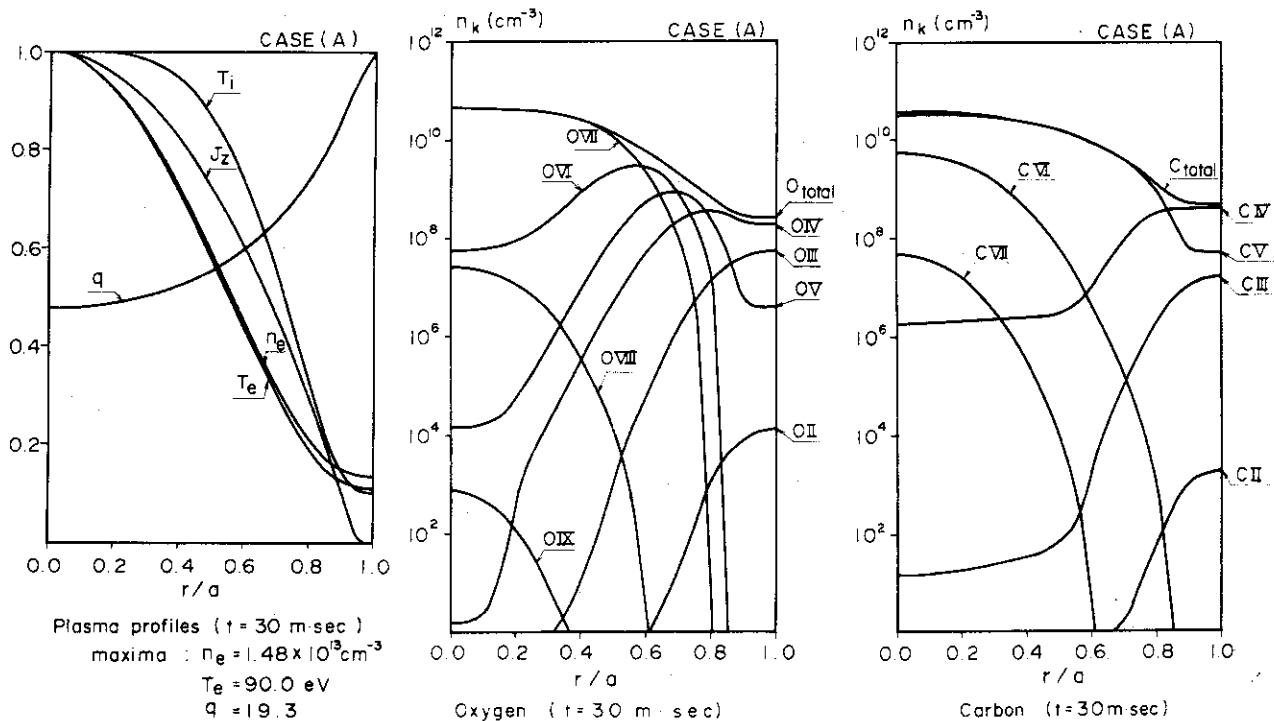
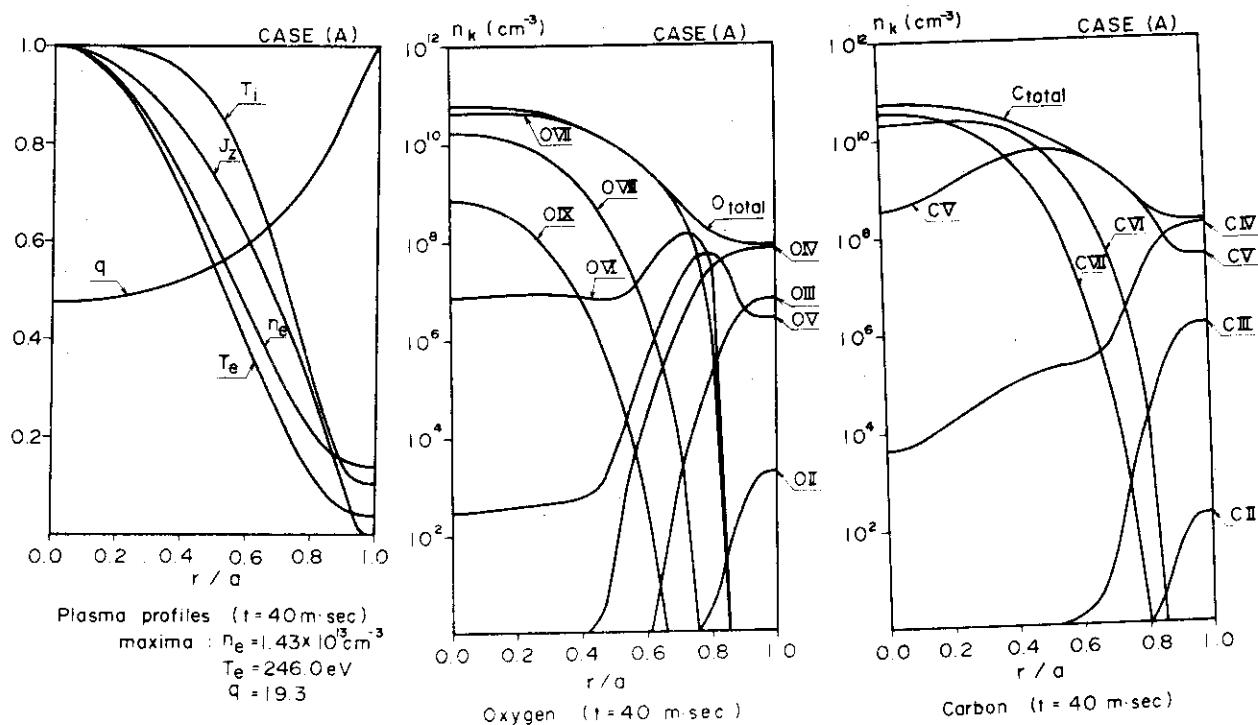
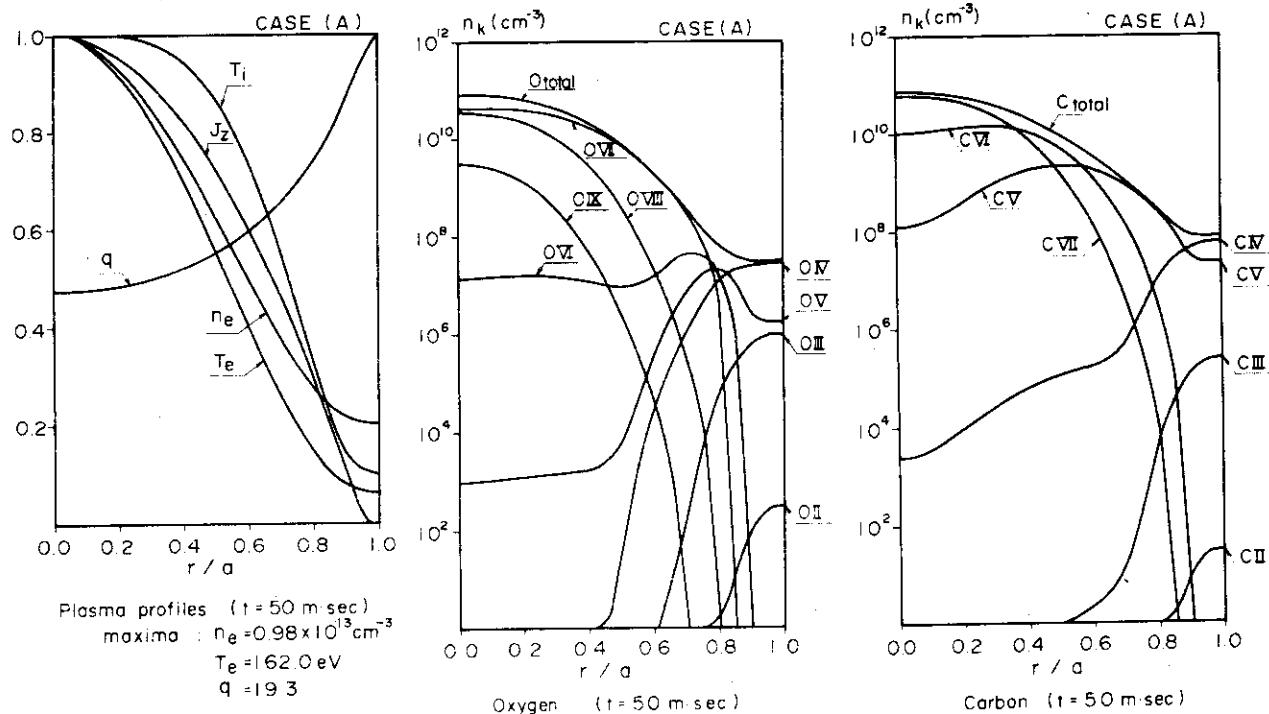


Fig. 2-(a) Initial profiles for case A.

Fig. 2-(b) Profiles at $t = 20 \text{ m}\cdot\text{sec}$ for case A.Fig. 2-(c) Profiles at $t = 30 \text{ m}\cdot\text{sec}$ for case A.

Fig. 2-(d) Profiles at $t=40 \text{ m}\cdot\text{sec}$ for case A.Fig. 2-(e) Profiles at $t=50 \text{ m}\cdot\text{sec}$ for case A.

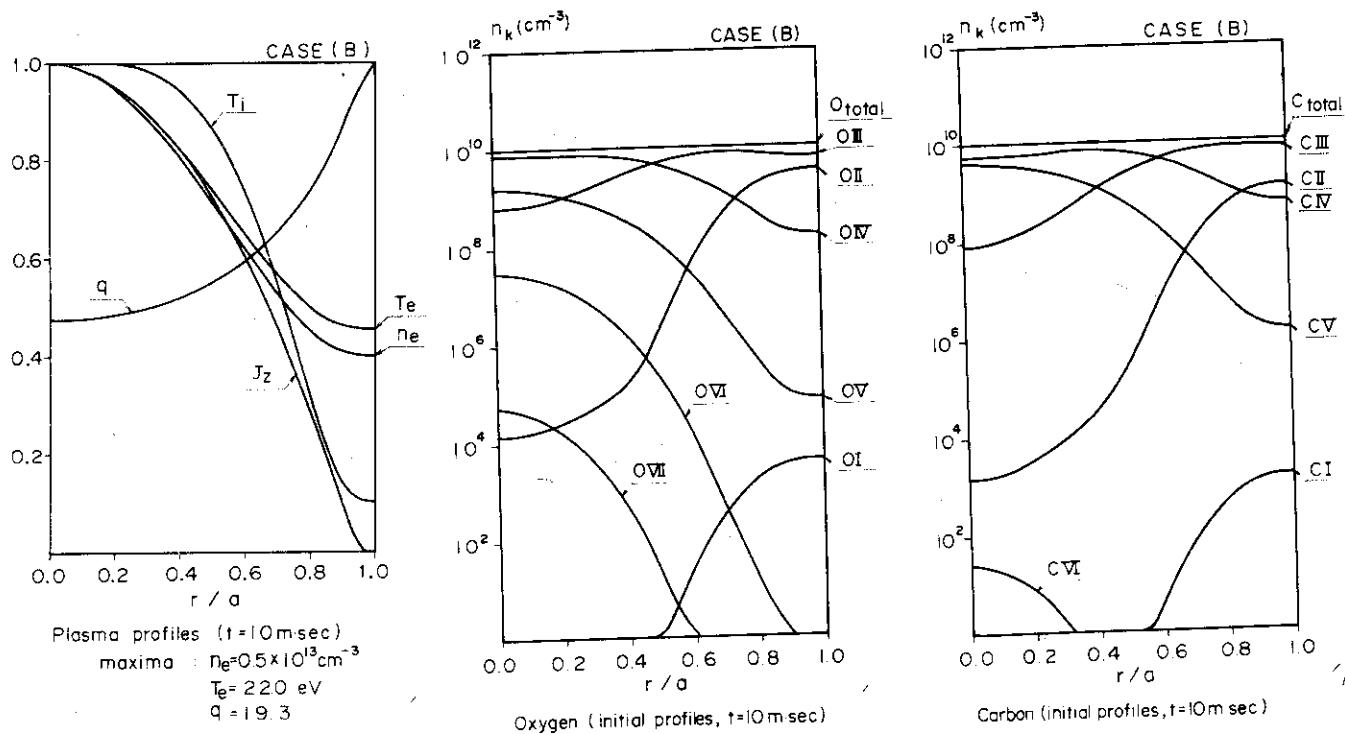
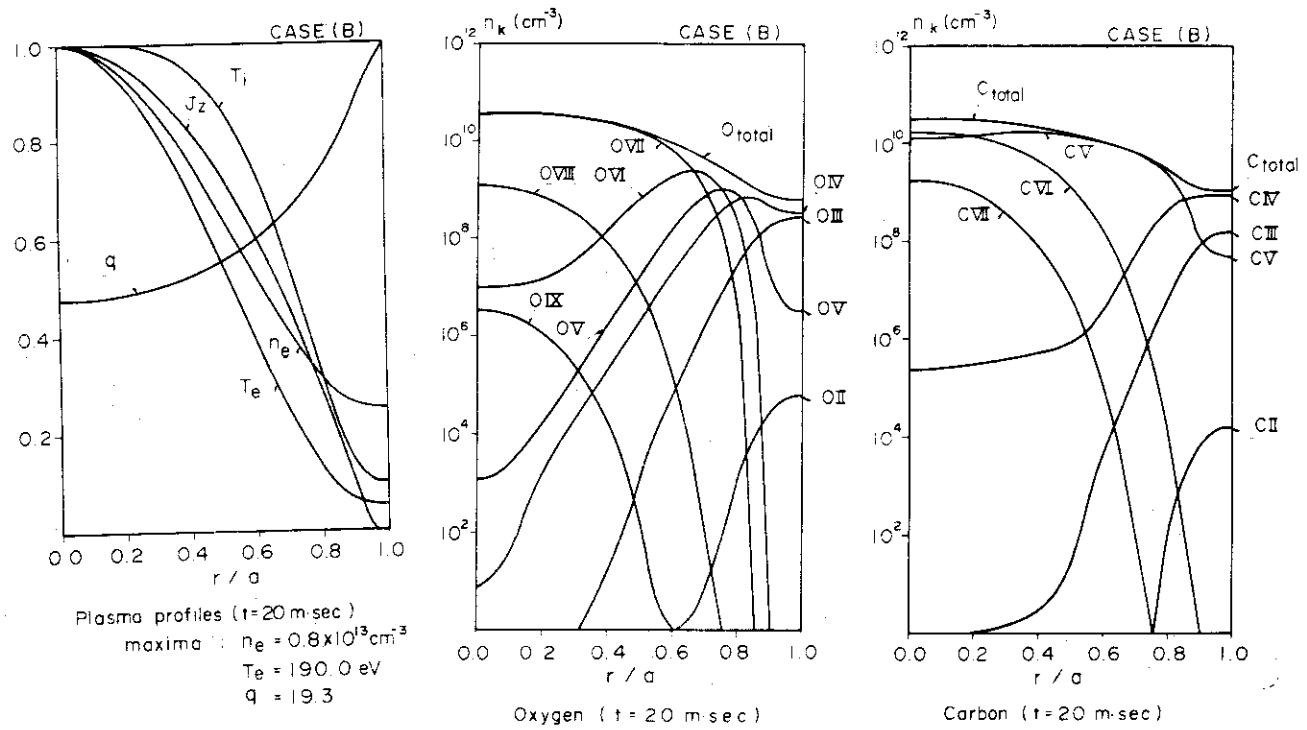
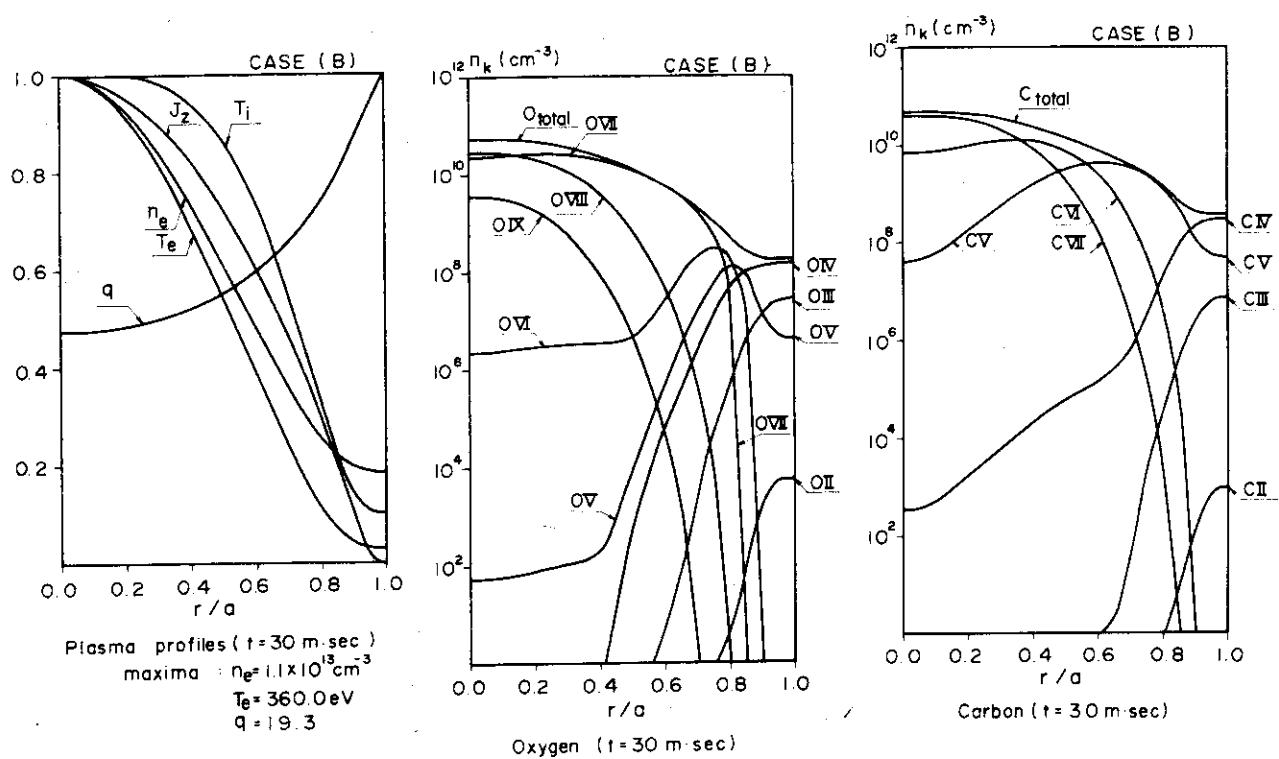
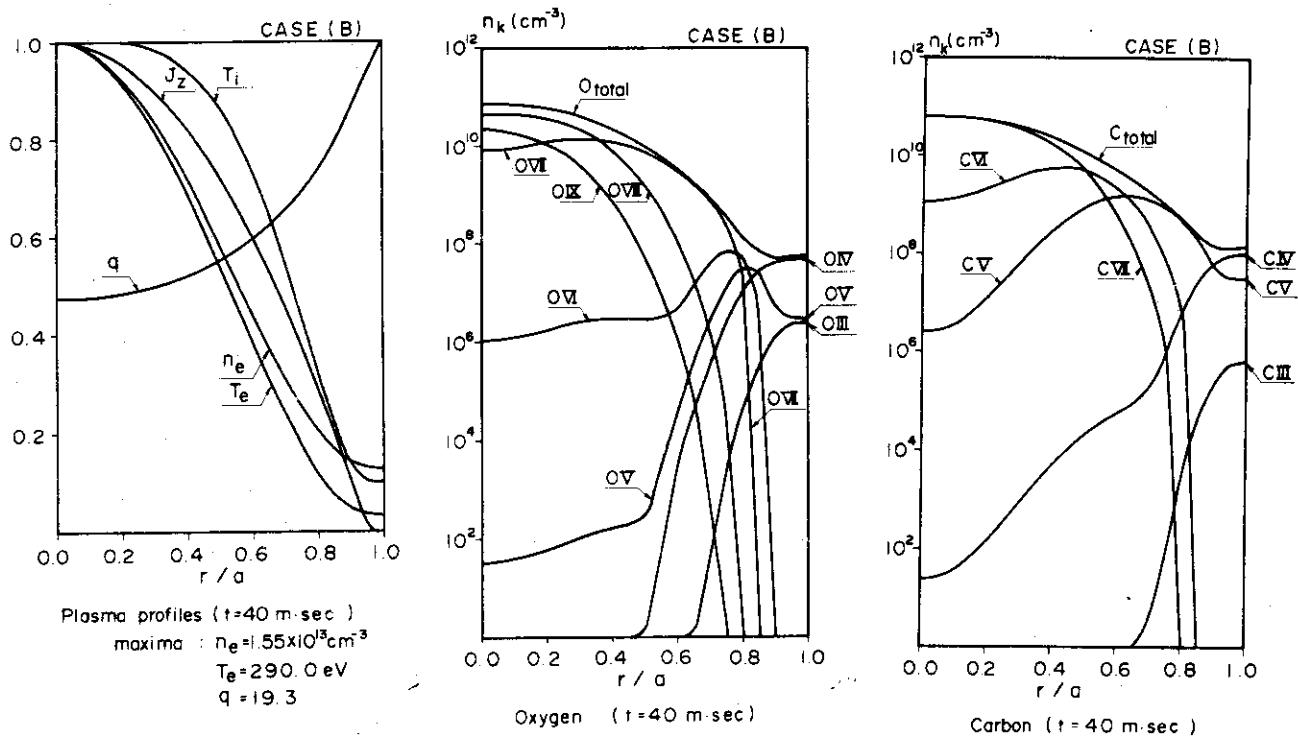
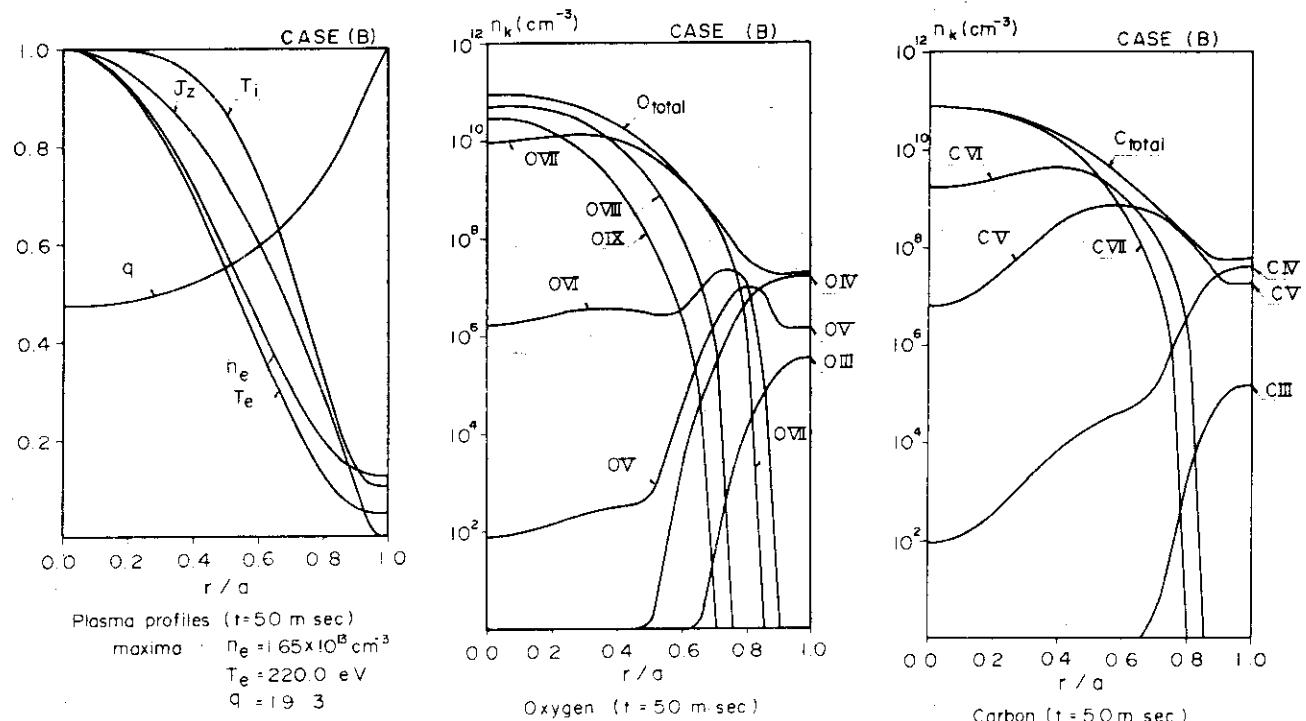


Fig. 3-(a) Initial profiles for case B.

Fig. 3-(b) Profiles at $t = 20 \text{ msec}$ for case B.

Fig. 3-(c) Profiles at $t = 30 \text{ m}\cdot\text{sec}$ for case B.Fig. 3-(d) Profiles at $t = 40 \text{ m}\cdot\text{sec}$ for case B.

Fig. 3-(e) Profiles at $t = 50 \text{ m sec}$ for case B.

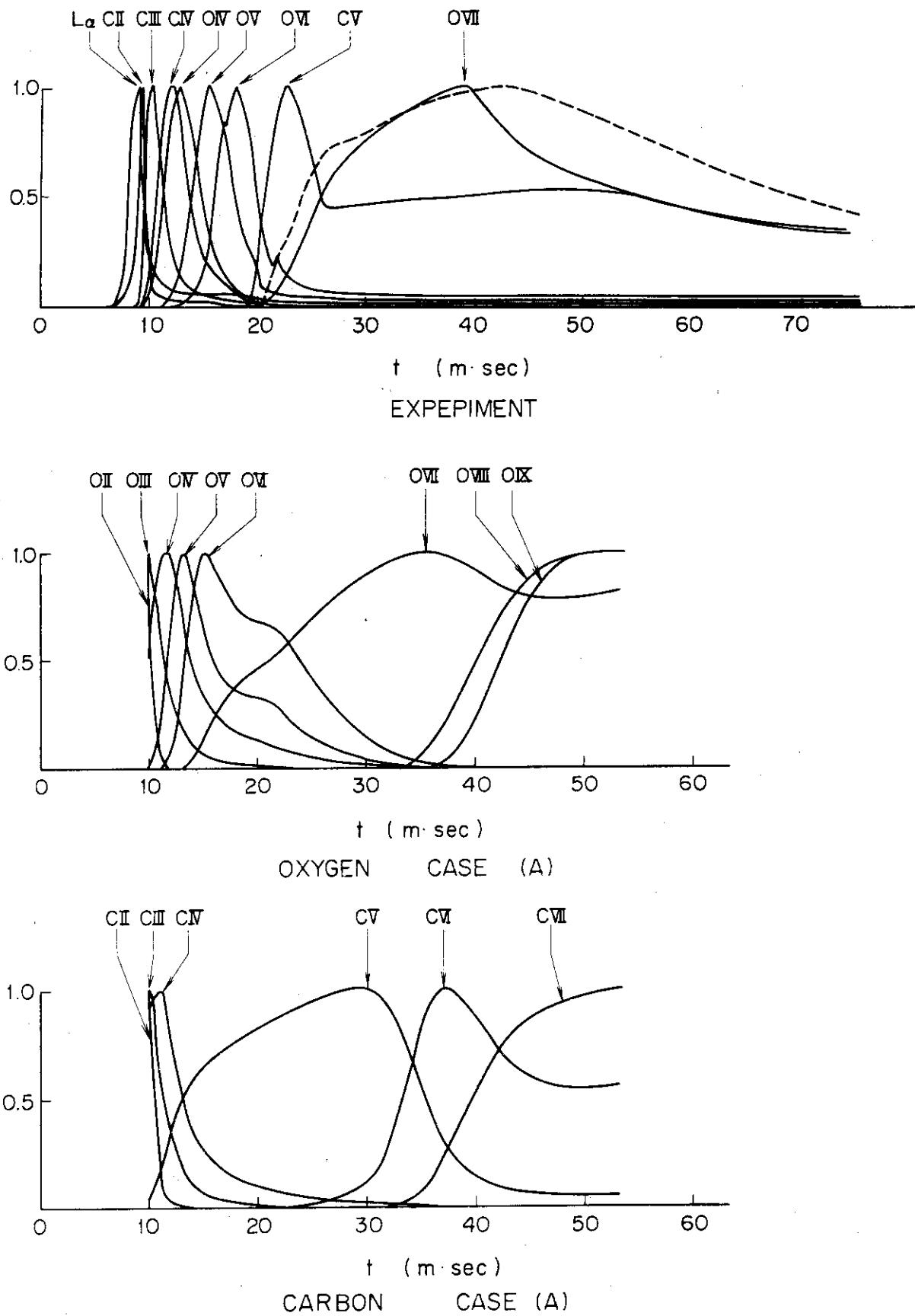


Fig. 4-(a) Time variations of each lines of impurities for case A.
(Experimental data are reprinted from reference [5].)

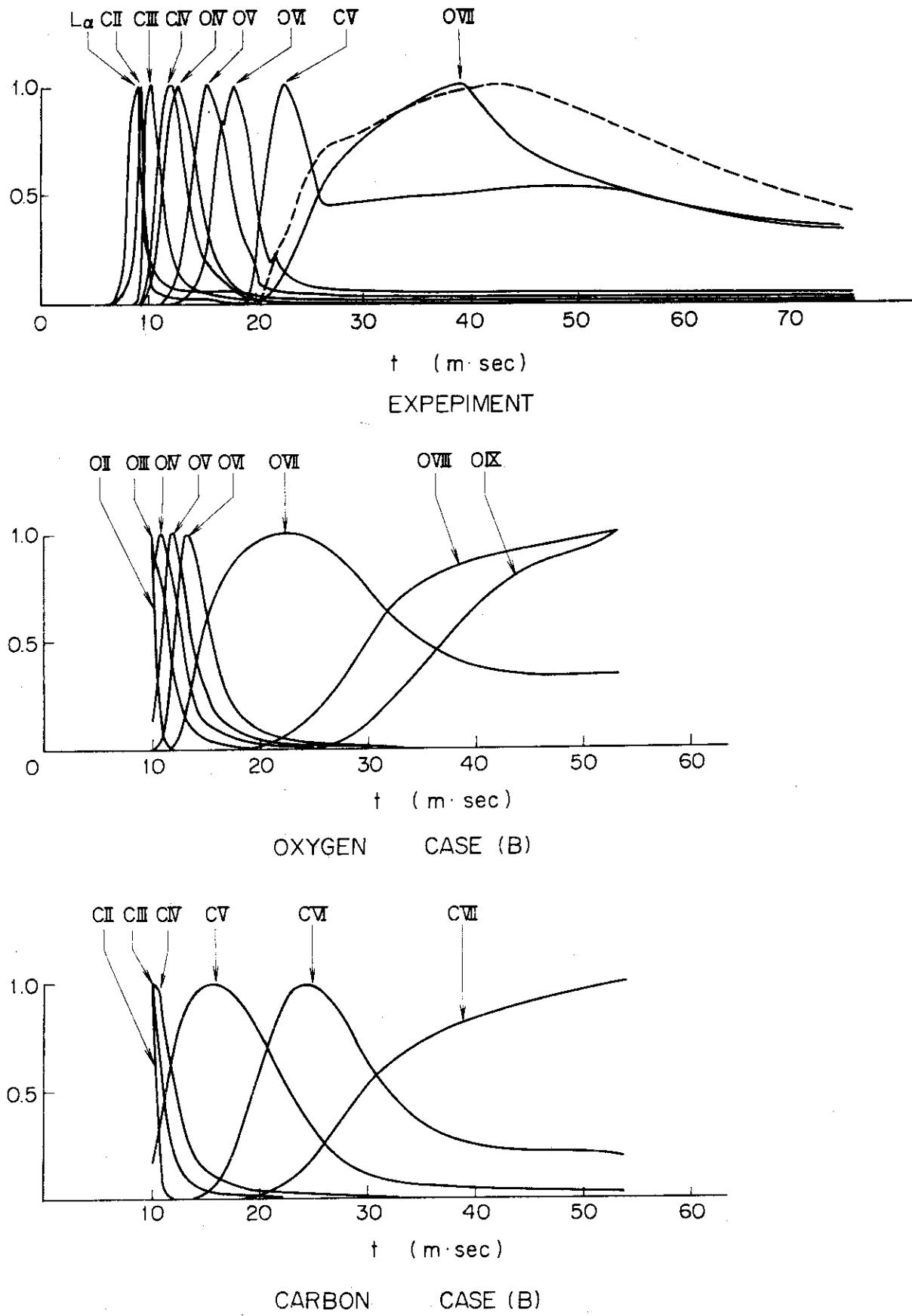


Fig. 4-(b) Time variations of each lines of impurities for case B.
(Experimental data are reprinted from reference [5].)

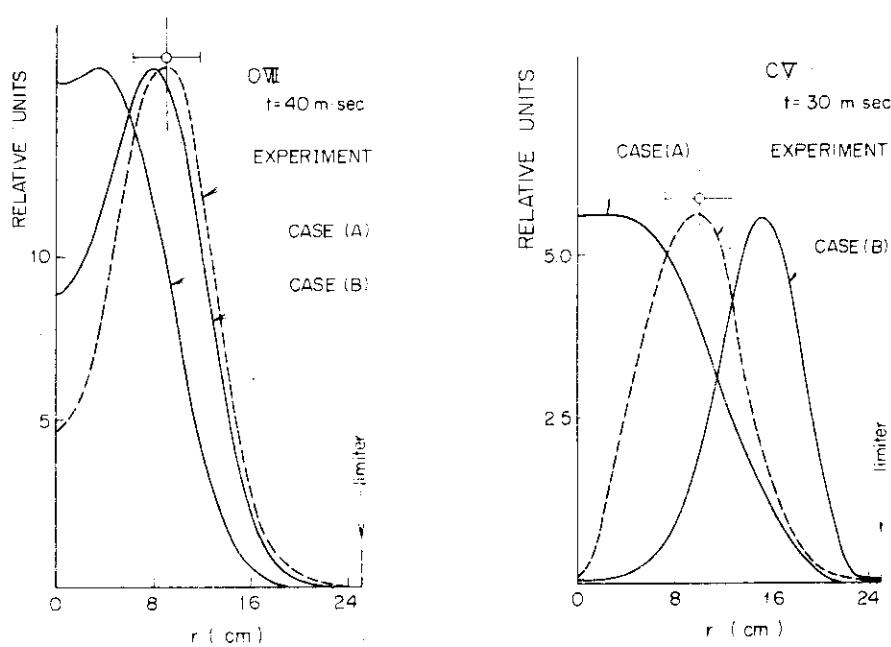
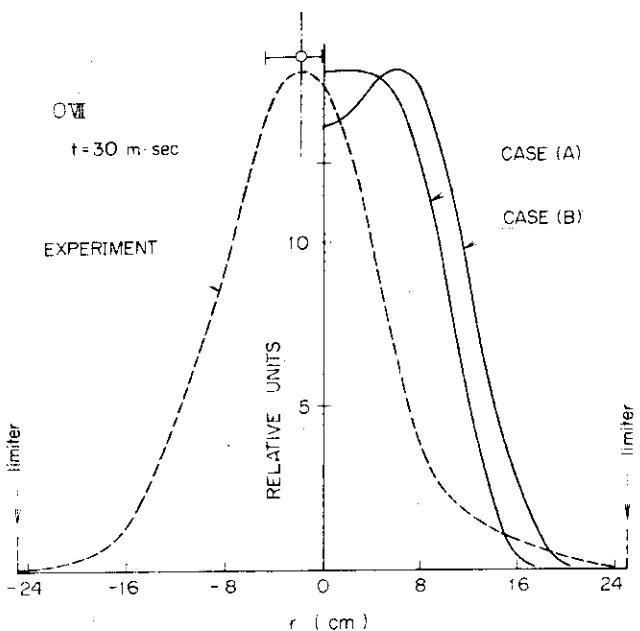


Fig. 5 Spatial distributions of CV at $t=30\text{ m sec}$ and OVII at $t=30\text{ m sec}$ and $t=40\text{ m sec}$. Solid lines are calculated results and dotted lines are experimental results.
(Experimental data are reprinted from reference [5].)

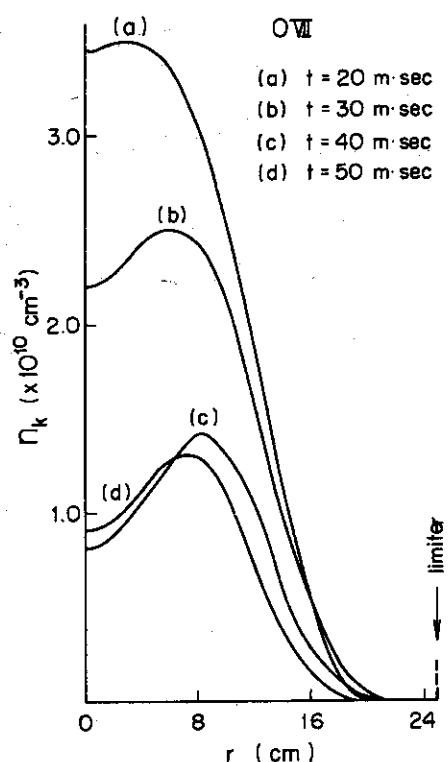


Fig. 6 Time development of OVII profiles.

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C ***** MA100010
C ***** MA100020
C ***** MA100030
C ***** MA100040
C ***** MA100050
C ***** MA100060
C ***** MA100070
C ***** MA100080
C ***** MA100090
C ***** MA100100
C ***** MA100110
C ***** MA100120
C ***** MA100130
C ***** MA100140
C ***** MA100150
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C ***** MA100310
C ***** MA100320
C ***** MA100330
C ***** MA100340
C ***** MA100350
C ***** MA100360
C ***** BLD00010
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C ***** BLD00420
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C PROGRAM I M P H F C G
C
C CODED BY M. OKAMOTO AND T. AMANO
C CODED ON OCT. 15, 1975
C
C * PURPOSE TO INVESTIGATE THE TIME DEVELOPMENTS OF RADIAL
C PROFILES AND CONCENTRATIONS OF IMPURITIES IN VARIOUS
C IONIZATION STAGES IN A TOKAMAK. PLASMA PARAMETERS SUCH AS
C TEMPERATURES, DENSITIES OR CURRENTS ARE GIVEN AS INPUT DATA.
C THE PLASMA PARAMETERS AS THE INPUT DATA (ION AND ELECTRON
C DENSITIES, ION AND ELECTRON TEMPERATURES, PLASMA CURRENT)
C MAY HAVE RADIAL DISTRIBUTIONS AND/OR MAY CHANGE WITH TIME.
C IMPURITY DIFFUSIONS ARE CLASSICAL. TWO VERSIONS OF IMPURITY
C ROUTINES ARE PREPARED, ONE IS FOR THE BANANA-PLATEAU CASE
C AND THE OTHER FOR PFIRSICH-SCHLUTER CASE. (THE LATTER CASE
C IS OF THE MOST SIMPLE FORM.)
C ONLY CARBON AND OXYGEN IMPURITIES ARE AVAILABLE.
C * METHOD HAMMING'S PREDICTOR-CORRECTOR METHOD
C
C***** LOGICAL IGS
1   IGS=.FALSE.
2   CALL PLTSK
3   100 CALL HEAD(IGS)
4   CALL IMHEAD
5   10 CALL OUTPUT
6   CALL COMPUT(IGS)
7   IF(IGS) GO TO 100
8   CALL IMPRTY
9   CALL AFPLACE
10  GO TO 10
11  END
12
1  BLOCK DATA
C
C** DEFAULT OPTIONS ARE GIVEN
C
2   LOGICAL DAYSEN(CARBON)
3   REAL NC,NWALL
4   REAL NWVLT0
5   COMMON/SCA/T0,NDVLTO,NC,RD
6   COMMON/PLO/NPLOT
7   COMMON/OXCH(OXYGE,V,CARBON)
8   COMMON/KKK(JJ,KMAX,KLMAX,LMAX)
9   COMMON/PNT/RMAJ,RTUBE,APECT,Z1,ANONC,NWALL,TEC,TEVAL,TIC,TIVAL,
1   TIME,TMIN,TMAX,DT1,DT2,DTMIN,DTMA,DTMAX
2   NMESH,JMAX,JMAX1,DX,DXH,EPN,NPRINT,NCONT
10  COMMON/EXT/ZMAX
11  COMMON/PLDATA/DTT(15),DIP(15),DNEC(15),DNEW(15),DTEC(15),DTEW(15),
1   DTIC(15),DTIW(15),TMESH(15)
12  COMMON/MUDATA/IM1(15)*IM2(15)*IM3(15)*IM4(15),
1   (IL1(15),IL2(15),IL3(15),IL4(15))
13  COMMON/PLNS/NS
14  DATA NS/0/
15  DATA T0,NL,LT0,RD,30/1.0,1.0,-1.6021E-12,1.0,1.0/
16  DATA RMAJ,RTUBE/1.0,0.23/
17  DATA Z1/1.0/
18  DATA ECMA/0.1/
19  DATA NMESH/25/
20  DATA NPRINT/20/
21  DATA TMIN,TMAX/0.0,100,DE-3/
22  DATA KMAX,KMAX/9,0/
23  DATA OXYGEN,CARBON/2*.FALSE./
24  DATA NPLOT/1000/
25  DATA IM1,IM2,IM3,IM4/15*2,15*2,15*4+15*2/
26  DATA IL1,IL2,IL3,IL4/15*2,15*2,15*2+15*1/
27  DATA DIP/15*71,42875E3/
28  DATA DIP/15*71,42875E3/
29  DATA DNEC/15*1,4E19/
30  DATA DNEC/15*0.2E19/
31  DATA DTIC/15*200,0/
32  DATA DTEC/15*10,0/
33  DATA DTEW/15*10,0/
34  DATA DTIW/15*10,0/
35  END

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1.   SUBROUTINE HEAD(IGS)          HED00010
2.   LOGICAL IGS                  HED00020
3.   LOGICAL OXYGEN,CARBON        HED00030
4.   REAL NC,NWALL                HED00040
5.   REAL KE,KI                  HED00050
6.   REAL ME,MA,N0,LTO            HED00060
7.   REAL NI,N2                  HED00070
8.   DIMENSION FF(20)             HED00080
9.   COMMON/PMT/RMAJ,RUBE,APECT,ZI,AN0,NC,N0ALL,TEC,TEWAL,TIC,TIWAL,    HED00090
10.  TIME,TMIN,TMAX,DT,DTM1N,DTMX,DTMAX,    HED00100
11.  NMESH,JMAX,JPA1,DX,DXH,EPS,NPRNT,NCONT,    HED00110
12.  COMMON/UNK/N1(59),TE1(59),T1(59),BZ1(59),BT1(59),    HED00120
13.  N2(59),TE2(59),T2(59),BZ2(59),BT2(59),    HED00130
14.  COMMON/RDR/R(59),RHS(59),DRH(59),DRM(59),DR1(59),DRH1(59),    HED00140
15.  COMMON/CEFF/ALGL1+ALGL2,ALGL3+ALGL4,ETAO,TAUE1,TAU1D,NEO,+#IO,    HED00150
16.  VTE0,VTI0,BET,EP50,AMMMA,EZO,IJ20,BHM0,BETA0,    HED00160
17.  COMMON/TRP/D(59)+E(59)+E1(59)+E2(59)+E3(59)+E4(59),    HED00170
18.  TAUE01(59),TAUE1(59),TAUE1C(59),    HED00180
19.  COMMON/EXT/B2,MMX,    HED00190
20.  COMMON/EZ1/EZ2(59)+ET(59),    HED00200
21.  COMMON/OCP/OF,CF,IMP,    HED00210
22.  COMMON/IMPY0(9,59),CAH(7,59),PL(59),PBB(59),PL1(59),    HED00220
23.  COMMON/SCAFCU,NU+LIO,RL,HD,    HED00230
24.  COMMON/MAIN/NRIP,    HED00240
25.  COMMON/RRKJ1,KMAX,LMAX,LMAX,    HED00250
26.  COMMON/PLDATA/DT(15),UT(15),DNEC(15),DNEW(15),DTEC(15),DTEW(15),    HED00270
27.  DT1(15),DT1(15),TMESH(15),    HED00280
28.  COMMON/MLDATA/IM1(15),IM2(15),IM3(15),IM4(15),    HED00290
29.  IL1(15),IL2(15),IL3(15),IL4(15),    HED00300
30.  COMMON/JBT/TM1(15),LMAX1,    HED00310
31.  COMMON/OXA/NA,GEEN,CAONON,    HED00320
32.  COMMON/PL0/NPLOT,    HED00330
33.  DATA PRM1/MA, C, E, ALPHAZ/    HED00340
34.  1. 3.16159265317*1091E-28,    HED00350
35.  2. 1.65975E-242, 9.97925E10, 4.80298E-10, 7.29720E-37,    HED00360
36.  NAMELIST /FORUS/ RMAJ,NNIN,ZI,    HED00370
37.  EZMAX,PMESH,TMIN,TMAX,    HED00380
38.  NPNT,KMAX,LMAX,    HED00390
39.  DT,UT,DNEC,DNEW,DTEC,DTEW,DT1,DT1A,TMESH,    HED00400
40.  IM1,IM2,IL1,IL2,IL3,IL4,    HED00410
41.  IM1,IL1,IL2,IL3,IL4,    HED00420
42.  OXYGEN,CARBON,NPLOT,    HED00430
43.  TFL,NOT,TOS) GO TO 4510,    HED00440
44.  CALL PLTIME,    HED00450
45.  C** FROM CGS-UNIT TO MKS-UNIT,    HED00460
46.  C
47.  CMAJ=RM0/100.0,    HED00470
48.  CMIN=RM0/100.0,    HED00480
49.  NMESH=NM0*1.0E-4,    HED00490
50.  RTDE=RTMIN,    HED00500
51.  TMESH=TMIN+DT,    HED00510
52.  TXMAX=TXMIN+DT,    HED00520
53.  TXMIN=TMIN+DT,    HED00530
54.  TXMAX=TXMIN+DT,    HED00540
55.  DO 4520 I=1,15,    HED00550
56.  DT(I)=DT(1)+I*(DT-1)/14,    HED00560
57.  DNEC(I)=DNEC(1)+I*(DNEC-1)/14,    HED00570
58.  DNEW(I)=DNEW(1)+I*(DNEW-1)/14,    HED00580
59.  DTEC(I)=DTEC(1)+I*(DTEC-1)/14,    HED00590
60.  DTEW(I)=DTEW(1)+I*(DTEW-1)/14,    HED00600
61.  DT1(I)=DT1(1)+I*(DT1-1)/14,    HED00610
62.  DT1A(I)=DT1A(1)+I*(DT1A-1)/14,    HED00620
63.  TOS=.FALSE.,    HED00630
64.  OXYGEN=.TRUE.,    HED00640
65.  CARBON=.FALSE.,    HED00650
66.  4510 15VTIME,    HED00660
67.  READ(5)ITRUS,ENU=4500+IRR*3000,    HED00670
68.  C** INPUT DATA  (NAMELIST IS USED)
69.  RMAJ ---- MAJOR RADIUS (M)    HED00680
70.  RMIN ---- MINOR RADIUS (M)    HED00690
71.  ZI ---- NUMBER OF ELECTRIC CHARGE OF PLASMA IONS    HED00700
72.  ZMAX ---- TOROIDAL MAGNETIC FIELD (AMPERES)    HED00720
73.  NMESH ---- NUMBER OF SPATIAL MESH ( LESS THAN 57)    HED00730
74.  TMIN ---- INITIAL TIME (SEC)    HED00740
75.  TMAX ---- FINAL TIME (SEC)    HED00750
76.  NPRINT ---- THE IMPURITY DENSITIES AVERAGED OVER SPACE ARE    HED00760
77.  CALCULATED BY TIME-STEP/PRINT TIMES,    HED00770
78.  NMAJ ---- ELECTRIC CHARGE NUMBER + 1    HED00780
79.  FOR OXYGEN: KMAX=4, FOR CARBON: KMAX=7,    HED00790
80.  LMAR ---- IF SOME L=1-2 IMPURITIES (SAY,NEUTRALS AND SINGLE    HED00800
81.  CHARGED IONS) ARE IONIZED AND DISAPPEARED AT THE    HED00810
82.  PLASMA SURFACE, THEN LMAX=2,    HED00820
83.  IMT ---- 15 ARRAY VARIABLES. IMT(J) IS THE J-TH PLASMA PARAMETERS    HED00830
84.  ASL GIVEN AT TIME DT(J). (SEC)    HED00840
85.  DIP ---- 15 ARRAY VARIABLES. DIP(J) IS THE J-TH PLASMA    HED00850
86.  CURRENT. (AMP)    HED00860
87.  DNEC ---- 15 ARRAY VARIABLES. DNEC(J) IS THE J-TH ELECTRON    HED00870
88.  DENSITY AT THE CENTER. (/100*3)    HED00880
89.  DNEW ---- 15 ARRAY VARIABLES. DNEW(J) IS THE J-TH ELECTRON    HED00890
90.  DTEC ---- 15 ARRAY VARIABLES. DTEC(J) IS THE J-TH ELECTRON    HED00910
91.  TEMPERATURE AT THE CENTER. (EV)    HED00920
92.  DT EW ---- 15 ARRAY VARIABLES. DT EW(J) IS THE J-TH ELECTRON    HED00930
93.  TEMPERATURE AT THE WALL. (EV)    HED00940
94.  DTIC ---- 15 ARRAY VARIABLES. DTIC(J) IS THE J-TH ION    HED00950
95.  TEMPERATURE AT THE CENTER. (EV)    HED00960
96.  DT1* ---- 15 ARRAY VARIABLES. DT1*(J) IS THE J-TH ION    HED00970
97.  TEMPERATURE AT THE WALL. (EV)    HED00980
98.  TMESH ---- 15 ARRAY VARIABLES. TMESH(J) IS THE J-TH TIME    HED00990
99.  MESH DURING WHICH PLASMA PARAMETERS DO NOT CHANGE.    HED01000
100. (SEC)    HED01010
101. TMIN ---- STARTING TIME FOR CALCULATION OF INITIAL    HED01020
102. DISTRIBUTION. (SEC)    HED01030
103. THAI ---- FINAL TIME FOR CALCULATION OF INITIAL    HED01040
104. DISTRIBUTION. (SEC)    HED01050
105. IM1,IL1 -- 15 ARRAY VARIABLES. IM1(J) AND IL1(J) DETERMINE    HED01060
106. THE J-TH ELECTRON DENSITY PROFILE,    HED01070
107. IM2,IL2 -- 15 ARRAY VARIABLES. IM2(J) AND IL2(J) DETERMINE    HED01080
108. THE J-TH ELECTRON TEMPERATURE PROFILE,    HED01090
109. IM3,IL3 -- 15 ARRAY VARIABLES. IM3(J) AND IL3(J) DETERMINE    HED01100
110. THE J-TH PLASMA ION TEMPERATURE PROFILE,    HED01110
111. IM4,IL4 -- 15 ARRAY VARIABLES. IM4(J) AND IL4(J) DETERMINE    HED01120
112. THE J-TH CURRENT DENSITY PROFILE,    HED01130
113. OXYGEN --- LOGICAL VARIABLE. IF OXYGEN=.TRUE., THE BEHAVIOUR    HED01140
114. OF OXYGEN IS CALCULATED,    HED01150
115. CARBON --- LOGICAL VARIABLE. IF CARBON=.TRUE., THE BEHAVIOUR    HED01160
116. OF CARBON IS CALCULATED,    HED01170
117. NPLOT ---- NUMBER OF P    HED01180

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154      DO 153 J=2,JMAX          HED02370
155      BT1(J)=BT1(J)*BT2M/FJMAX   HED02380
156      153 CONTINUE             HED02390
157      N1(1)=N1(2)              HED02400
158      TE1(1)=TE1(2)            HED02410
159      TI1(1)=TI1(2)            HED02420
160      BZ1(1)=BZ1(2)            HED02430
161      BT1(1)=BT1(2)            HED02440
162      A1(JM1)=A1(JMAX)         HED02450
163      TE1(JM1)=TE1(JMAX)       HED02460
164      TI1(JM1)=TI1(JMAX)       HED02470
165      BZ1(JM1)=BZ1(JMAX)       HED02480
166      BT1(JM1)=BT1(JMAX)       HED02490
167      DO 20 J=1,JM1           HED02500
168      R2(J)=N1(J)              HED02510
169      TE2(J)=TE1(J)            HED02520
170      TI2(J)=TI1(J)            HED02530
171      BZ2(J)=BZ1(J)            HED02540
172      BT2(J)=BT1(J)            HED02550
173      20 CONTINUE              HED02560
174      C** GRID POINTS AND SPATIAL MESH    DR --- HALF INTEGRAL GRID POINT HED02570
175      C          R --- INTEGRAL GRID POINT HED02580
176      R(1)=C,0                HED02590
177      DO 30 J=2,JMAX           HED02600
178      X=FLOAT(J-1)*DX          HED02610
179      R(J)=X                  HED02620
180      RH(J)=0.5*(R(J-1)+R(J))  HED02630
181      30 CONTINUE              HED02640
182      RH(1)=RH(2)              HED02650
183      DO 40 J=2,JMAX1          HED02660
184      DR(J)=RH(J+1)-RH(J)      HED02670
185      DRH(J)=R(J)-R(J-1)       HED02680
186      DRI(J)=1.0/DR(J)         HED02690
187      DRH(J)=0.5/DRH(J)        HED02700
188      40 CONTINUE              HED02710
189      DR(1)=RH(2)-RH(1)        HED02720
190      DR(JMAX)=2.0*(R(JMAX)-RH(JMAX)) HED02730
191      DRH(1)=R(2)-R(1)         HED02740
192      DRH(JMAX)=R(JMAX)-R(JMAX1) HED02750
193      DRH(1)=1.0/DR(1)         HED02760
194      DRH(JMAX)=0.5/DRH(J)     HED02770
195      DRH(JM1)=DR(JMAX)        HED02780
196      DRH(JM1)=DRH(JMAX)       HED02790
197      DRH(JM1)=DRH(JMAX)       HED02800
198      DRH(JM1)=DRH(JMAX)+DRH(JM1) HED02810
199      RH(JM1)=RH(JMAX)+DR(JMAX) HED02820
200      Z2=Z1+Z1                HED02830
201      ALGL=ALOG(Z1)            HED02840
202      DO 400 J=1,JM1           HED02850
203      ZEF(J)=Z1                HED02860
204      EZ(J)=0.0                 HED02870
205      VTE=VTE0*SQRT(TE 2(J))  HED02880
206      VT1=VT10*SQRT(TI 2(J))  HED02890
207      RH(J)=RH(J)*EZ 2(J)/(ASPECT*RTube*BT2(J)) HED02900
208      RH(J)=ABS(TR(J))         HED02910
209      ARGE=TE2(J)**3/2(J)      HED02920
210      AKI=TI2(J)**3/2(J)        HED02930
211      IF(TE 2(J)=36.19),80,70,70 HED02940
212      70 ALGLW=ALGL1+0.5*ALOG(ARGE/TE2(J))-1.5*ALGL HED03000
213      GC TO 90                 HED03010
214      80 ALGLW=ALGL2 + 0.5*ALOG(ARGE)-1.5*ALGL HED03020
215      90 ALGLW=ALGL3 + 0.5*ALOG(ARG1)-2.5*ALGL HED03030
216      TAUE1(J)=TAUE1(J)+ALGLW/TE 2(J)**1.5 HED03040
217      TAUE1(J)=TAUE1(J)+TAUE10 **22 HED03050
218      TAUI1(J)=TAUI1(J)+ALGLW/VI 2(J)**1.5 +22*22 HED03060
219      TAUI1(J)=TAUI1(J)+TAUE10 HED03070
220      RH2=AB5(RH(J))/RMAJ HED03080
221      RH1=SQRT(RR(J)) HED03090
222      RR3=RR2**1.5             HED03100
223      RR3=1.0/RR3              HED03110
224      PFC=1.41421356*RR3I HED03120
225      PFC=TAUE1(J)+RMAJ*GR(J)/VTE HED03130
226      MPC=TAU1(J)+RMAJ*GR(J)/VTI HED03140
227      MPC=TAU1(J)+RMAJ*GR(J)/VTE HED03150
228      MPC=bPCE*bPCE             HED03160
229      MPC=EPCE*EPCE            HED03170
230      CNTE(J)=EPCE             HED03180
231      CRIT(J)=EPCI             HED03190
232      400 CONTINUE              HED03200
233      C***** HED03210
234      TIMMM=TIME*TO             HED03220
235      WRITE(6,2000) TIMM          HED03230
236      2000 FORMAT(1H,'15X, INITIAL VALUES AT TIME =',E9.3,', SEC',1H) HED03240
237      BZMS=BZMX*80/10000,          HED03250
238      RMS1=RMAJ*RO/100,           HED03260
239      RMS2=RMIN*RO/100,           HED03270
240      DC=NC=NO                   HED03280
241      DWALL=NWALL=NG             HED03290
242      *      RMS1,RMS2 ,ASPECT+Z+DC,DWALL,TEC,TEWAL,TIC,TİWAL, HED03300
243      *      BZMS, NMESH,DX          HED03310
244      1000 FORMAT(1H ,          / 54X,8H RMAJ, =,F10.4,8H M /HED03320
245      1 54X,8H RMIN, =,F10.4,8H M / 54X,8H ASPECT =,F10.4, /HED03330
246      2 54X,8H Z =,F10.4,          / 54X,8H NC=NO =,F10.3,8H /CC /HED03340
247      3 54X,8H RMAJ =,F10.3,8H /CC / 54X,8H MPC =,F10.4,8H EV /HED03350
248      4 54X,8H RMIN =,F10.4,8H / 54X,8H TIC =,F10.4,8H EV /HED03360
249      5 54X,8H RMAJ =,F10.4,8H EV / 54X,8H BZ =,F10.4,8H WB/M**2/HED03370
250      6 54X,8H MPC =,F10.4,8H / 54X,8H DX =,F10.4, /HED03380
251      7 54X,8H NMESH =,I5          / 54X,8H /HED03390
252      RETURN                     HED03400
253      3000 CONTINUE               HED03410
254      WRITE(6,4001)               HED03420
255      4001 FORMAT(1H ,          DATA NO IREKATA NI AYAMARI GA ARU !) HED03430
256      GO TO 4500                 HED03440
257      4500 CONTINUE               HED03450
258      CALL PLTEND                 HED03460
259      STOP
260      END

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1      SUBROUTINE COMPUT(IGS)                               COM00010
2      LOGICAL IGS                                     COM00020
3      COMMON/PLDATA/DTT(15),DIP(15),DNEC(15),DNEW(15),DTEC(15),DTEW(15),COM00030
4          * DTIC(15),DTIW(15),TMESH(15)                  COM00040
5      COMMON/MLDATA/IM1(15),IM2(15),IM3(15),IM4(15),      COM00050
6          * IL1(15),IL2(15),IL3(15),IL4(15)                  COM00060
7      REAL NC,NWALL                                    COM00070
8      REAL NL,N2                                      COM00080
9      COMMON/PMT/RMAJ,RTUBE,ASPECT,ZI,ANO,NC,NWALL,TEC,TEWAL,TIC,TIWAL,      COM00090
10     * TIME,TMIN,TMAX,DT,DTH,DTMIN,DTMX,DTMAX,      COM00100
11     * NMESH,JMAX,JMAX1,DX,DXH,EPS,NPRNT,NCONT      COM00110
12     * COMMON/UNK/N1(59),TE1(59),T1(59),BZ1(59)+BT1(59),      COM00120
13     * N2(59),TE2(59),T12(59),BZ2(59),BT2(59)      COM00130
14     * COMMON/EXT/BZMM,COMMON/ML/M1+2*M3,M4,L1,L2,L3,L4      COM00140
15     * COMMON/HEIKIN/ANE(59),ANI(59),ATE(59),ATI(59),ABT(59),ABZ(59)      COM00150
16     * COMMON/ICIMP/V(900)                                COM00160
17     * COMMON/CKJJ/KMAX,KLMAX,LMAX                      COM00170
18     * COMMON/NMAINV/DIM                                COM00180
19     * COMMON/IBC/01(9,59),08(9)                         COM00190
20     * COMMON/OUTIM/AX(9,59)                            COM00200
21     * DIMENSION FF(20)                                COM00210
22     * DIMENSION OX(9,59)                                COM00220
23     * DIMENSION DBB(20)                                COM00230
24     * DIMENSION DBB(20)                                COM00240
25     * DIMENSION DBB(20)                                COM00250
26     * C** THE J=TH PLASMA PROFILES
27     * C** PHYSICAL QUANTITIES
28     *      VTE = EL.THERMAL VEL., VTI = ION THERMAL VEL..
29     *      RR = SAFETY FACTOR, ALGLR=ALGL*I = COULOMBS LOGARITHM
30     * C** COLLISIONALITY PARAMETER      CRITE = EL.. CRITI = ION
31     * C
32     * DO 10 I=1,14
33     * TS=DTT(I)
34     * TL=DTT(I+1)
35     * IF(TIME.LT.TS) GO TO 10
36     * IF(TIME.GE.TL) GO TO 10
37     * I=I
38     * GO TO 11
39     * 10 CONTINUE
40     * 11 DT=TMESH(IT)
41     * M1=T1(1,I)
42     * M2=IN2(I)
43     * M3=IN3(I)
44     * M4=IN4(I)
45     * L1=IL1(I)
46     * L2=IL2(I)
47     * L3=IL3(I)
48     * L4=IL4(I)
49     * TIME=TIME+DT
50     * IF(TIME.GT.TMAX) GO TO 12
51     * GO TO 13
52     * 12 IGS=.TRUE.
53     * RETURN
54     * 13 CONTINUE ...
55     * C-----*
56     * CALL BOUND(BT2M)
57     * JH1=JMAX+1
58     * DO 150 J=2,JMAX
59     *      XFLOAT(J-1)=X-0.5*DX
60     *      X(J)=(NC-NWALL)*(L-0-C*X/RTUBE)*M1)**L1+NWALL
61     *      T2(J)=((TEC-TEWAL)*(1.0-(X/RTUBE)**M2)**L2+TEWAL
62     *      T12(J)=((T1-TEWAL)*(1.0-(X/RTUBE)**M3)**L3+TIWAL
63     *      P22(J)=BZMM
64     *      FF(J)=X**2*(1.0-2.0*(X/RTUBE)**M4)/(FLOAT(M4)+2.0)
65     *      IF(L4,E0,1) GO TO 152
66     *      DO 151 K=2,L4
67     *      FF(K)=(2.0/(FLOAT(K**M4)+2.0))*(X**2*(1.0-(X/RTUBE)**M4)**K
68     *      +0.5*K**4*FF(K-1))
69     *      151 CONTINUE
70     * 152 CONTINUE
71     *      IF(J.EQ.JMAX) FJMAX=FF(L4)
72     *      T12(J)=T2(J)*FJMAX
73     * 150 CONTINUE
74     *      DO 155 J=2,JMAX
75     *      T12(J)=T2(J)*FJMAX
76     *      155 CONTINUE
77     *      N2(J)=N2(2)
78     *      T2(J)=T2(2)
79     *      T12(J)=T12(2)
80     *      P22(J)=P22(2)
81     *      BT2(J)=BT2(2)
82     *      N2(JM1)=N2(JMAX)
83     *      T2(JM1)=T2(JMAX)
84     *      T12(JM1)=T12(JMAX)
85     *      P22(JM1)=P22(JMAX)
86     *      BT2(JM1)=BT2(JMAX)
87     *      DO 450 J=1,JM1
88     *      ANE(J)=0.5*(N1(J)+N2(J))
89     *      ATE(J)=0.5*(T11(J)+T12(J))
90     *      ATI(J)=0.5*(T11(J)+T12(J))
91     *      ABT(J)=0.5*(BT1(J)+BT2(J))
92     *      ABZ(J)=0.5*(BZ1(J)+BZ2(J))
93     * 400 CONTINUE
94     *      DO 900 J=1,JM1
95     *      SUM=0.0
96     *      DO 901 K=2,KMAX
97     *      SUM=SUM+(K-1)*XX(K,J)
98     *      C** NE = ZI*N1 + SIGMAR(ZK*NK)
99     *      C
100    *      ANI(J)=(ANE(J)-SUM)/ZI
101    * 900 CONTINUE
102    * C** OUTPUT OF ELECTRON DENSITY, EL. AND ION TEMPERATURES, TOROIDAL AND
103    * POLOIDAL FIELDS, CURRENT DENSITY, ELECTRIC FIELD, SAFETY FACTOR.
104    * C
105    *      WRITE(6,300)
106    *      300 FORMAT(1H ,/,3X,'J1',17X,'ANI',11X,'ANE',11X,'ATE',11X,'ATI',11X,
107    *      * 'ABZ',11X,'ABT')
108    *      DO 302 J=1,JM1
109    *      WRITE(6,301) J,ANI(J),ANE(J),ATE(J),ATI(J),ABZ(J),ABT(J)
110    *      301 FORMAT(13.8X,1P6E14.4)
111    *      302 CONTINUE
112    *      RETURN
113    *      END

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1      SUBROUTINE BOUND(RT2M)                                BND00010
2      REAL NC,NWALL                                         BND00020
3      REAL NO,LTO                                           BND00030
4      COMMON/PMT/RMAJ,RTUBE,ASPECT,ZI,AND,NC,NWALL,TEC,TEWAL,TIC,TIWAL, BND00040
5      1          TIME,TMIN,TMAX,DT,DTH,DTMIN,DTMX,DTMAX, BND00050
6      2          NMESH,JMAX,JMAX1,DX,DXH,EPS,NPRNT,NCONT   BND00060
7      COMMON/SCA/TU,NO,LTO,RH,BD                           BND00070
8      COMMON/PLDATA/DTT(15),DIP(15),DNEC(15),DNEW(15),DTEC(15),DTEW(15),BND00080
9      *          DTIC(15),DTIN(15),TMESH(15)                BND00090
10     DU 10 I=1,15                                         BND00100
11     I5=DTT(I)
12     T5=DTT(I+1)
13     IF(TIME<LT,TS) GO TO 10                            BND00110
14     IF(TIME>ET,TS) GO TO 10                            BND00120
15     TAB=(TIME-DTT(I))/(DTT(I+1)-DTT(I))               BND00130
16     ZIP=DIP(I)+(DIP(I+1)-DIP(I))*TAB                 BND00140
17     NC=DNEC(I)+(DNEC(I+1)-DNEC(I))*TAB               BND00150
18     NALL=DNEW(I)+(DNEW(I+1)-DNEW(I))*TAB             BND00160
19     TEC=DTEC(I)+(DTEC(I+1)-DTEC(I))*TAB             BND00170
20     TEW=DTEW(I)+(DTEW(I+1)-DTEW(I))*TAB              BND00180
21     TIC=DTIC(I)+(DTIC(I+1)-DTIC(I))*TAB              BND00190
22     TIW=DTIW(I)+(DTIW(I+1)-DTIW(I))*TAB              BND00200
23     CONTINUE                                             BND00210
24     RT2M=0.2*ZIP/(B0*RH*RTUBE)                         BND00220
25     RETURN                                              BND00230
26     END
27     SUBROUTINE OUTPUT                                     OUT00010
28     REAL NC,NWALL                                         OUT00020
29     REAL N1,N2                                           OUT00030
30     REAL JZ                                           OUT00040
31     REAL KE,K1                                           OUT00050
32     COMMON/PMT/RMAJ,RTUBE,ASPECT,ZI,AND,NC,NWALL,TEC,TEWAL,TIC,TIWAL, OUT00060
33     1          TIME,TMIN,TMAX,DT,DTH,DTMIN,DTMX,DTMAX, OUT00070
34     2          NMESH,JMAX,JMAX1,DX,DXH,EPS,NPRNT,NCONT   OUT00080
35     COMMON/UNK/N1(59),TE1(59),T1(59),B2(59),BT1(59), OUT00090
36     N2(59),TE2(59),T12(59),B22(59),BT2(59)           OUT00100
37     COMMON/RDR/R(59),RH(59),DR(59),DRH(59),DR1(59), OUT00110
38     COMMON/TRP/DC(59),KE(59),K1(59),ET(59),TAUE0(59),TAUE1(59), OUT00120
39     1          TAII(59),GR(59),CRITE(59),CRIT1(59)        OUT00130
40     COMMON/SAN/JZ(59),YOTA(59),EZV(59)                  OUT00140
41     COMMON/CEZ/EZT/EZ(59),ET(59)                         OUT00150
42     COMMON/CEF/AUL1,ALGL2,ALGL3,TEW1U,ETA0,TAUE0,TAUT0,WE0,W10, OUT00160
43     1          VTE0+VT10,BETA,EP50,AME1A,EZ0,AJZ0,BHM0,BETA0   OUT00170
44     DATA Ad,AP,AC,1HB,1HP,1HC/                          OUT00180
45     J1=JMAX+1                                         OUT00190
46     DU 1 J=1,JMAX                                     OUT00200
47     IF(J>Ew,1) GO TO 1                               OUT00210
48     IF(J>ew,JMAX) GO TO 1                           OUT00220
49     EZV(J)=EZV*0.5*(EZ(J-1)+EZ(J))                 OUT00230
50     JZ(J)=AJZ0+ORH(J)*(R(J)*(BT2(J)+BT2(J+1)) - R(J-1)*(BT2(J)+BT2(J-1)))/RH(J) OUT00240
51     *                                                 OUT00250
52     CONTINUE                                           OUT00260
53     JZ(J)=4.0*AJZ0*BT2(2)/ORH(1)                   OUT00270
54     JZ(JMAX)=0.0                                       OUT00280
55     JZ(JN1)=JZ(JMAX,X)                            OUT00290
56     EZV(J)=EZV(2)                                    OUT00300
57     EZV(JnAX)=0.0                                     OUT00310
58     EZV(JN1)=EZV(JMAX)                            OUT00320
59     *                                                 OUT00330
60     WRITE(6,993) TIME                               OUT00340
61     DU 100 J1,JM1                                     OUT00350
62     EZVLT=EZ 0*EZ(J)                                OUT00360
63     RR31=(RH1/ABS(RH(J)))***1.5                  OUT00370
64     IF(CRITE(J).LT.1) GO TO 10                     OUT00380
65     IF(CRITE(J).LE.RR31) GO TO 11                  OUT00390
66     HE=AC                                         OUT00400
67     GO TO 12                                         OUT00410
68     10 HE=AB                                         OUT00420
69     GO TO 12                                         OUT00430
70     11 HE=AP                                         OUT00440
71     GO TO 12                                         OUT00450
72     12 CONTINUE                                     OUT00460
73     IF(CRITE(J).LT.1) GO TO 13                     OUT00470
74     IF(CRITE(J).LE.RR31) GO TO 14                  OUT00480
75     HE=AC                                         OUT00490
76     GO TO 15                                         OUT00500
77     13 HE=AB                                         OUT00510
78     GO TO 15                                         OUT00520
79     14 HE=AP                                         OUT00530
80     15 CONTINUE                                     OUT00540
81     *                                                 OUT00550
82     WRITE(6,998) J,RH(J),ORH(J),R2(J)+TE2(J),B22(J),BT2(J+JZ(J)) +EZV(J),HE,HT    OUT00560
83     *                                                 OUT00570
84     998 FORMAT(13 ,F8.3, 1P8E14.4,2X,A1,1X,A1)    OUT00580
85     999 FURMAT(1H ,//,10X,'TIME =',1PE13.4,' SEC', OUT00590

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1           // 3X,'J1',5X,'R1',9X,'Q1',15X,'N1',13X,'TE1',      OUT00600
2 11X,'T1',11X,'BZ',11X,'BT',6X,'JZ(AMP/CM**2)',4X,'EZ(MV/CM)', OUT00610
3 4X,'E 1')
53   CALL PLTIN
54   RETURN
55   END
1   SUBROUTINE RPLACE
2   REAL N1,N2
3   REAL NC,NWALL
4   COMMON/PMT/RMAJ,RTUBE,ASPECT,Z1,AND,NC,NWALL,TEC,TEWAL,TIC,TIWAL, RPL00040
1   TIME,TMIN,TMAX,DT,DTH,DTMIN,DTMX,DTMAX, RPL00050
2   NMESH,JMAX,JMAX1,DX,DXH,EPS,NPRNT,NCONT RPL00060
5   COMMON/UNK/N1(59),TE1(59),T11(59),BZ1(59),BT1(59), RPL00070
*          N2(59),TE2(59),T12(59),BZ2(59),BT2(59) RPL00080
6   JMAX=JMAX+1
7   DO 10 J=1,JMAX
8   N1(J)=N2(J)
9   TE1(J)=TE2(J)
10  T11(J)=T12(J)
11  BT1(J)=BT2(J)
12  BZ1(J)=BZ2(J)
13  10 CONTINUE
14  RETURN
15  END

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1      SUBROUTINE IMPRTY          IMP00010
2      EXTERNAL FCT,OUTP         IMP00020
3      LOGICAL OXYGEN,CARBON    IMP00030
4      REAL NC,NALL             IMP00040
5      REAL NL,N2                IMP00050
6      REAL ME,MA,NO,LTO         IMP00060
7      DIMENSION DERY(900),       AUX(16,900),PRMT(5)   IMP00070
8      DIMENSION OBB(10)          IMP00080
9      DIMENSION DI(59)           IMP00090
10     DIMENSION AL11(59),AL12(59)  IMP00100
11     DIMENSION AL111(59),AL121(59)  IMP00110
12     DIMENSION AL112(59),AL122(59)  IMP00120
13     COMMON/OXA/OXYGEN,CARBON    IMP00130
14     COMMON/ICIMP/V(900)         IMP00140
15     COMMON/HEIKIN/ANE(59),ATE(59),ATI(59),ABT(59),ABZ(59) IMP00150
16     COMMON/PMT/RMAJ,RTUBE,ASPECT,ZI,VANG,NC,N=ALL,TEC,TEVAL,TIC,TIVAL, IMP00160
17     TIME,TMIN,TMAX,DT,DTH,DTMIN,DTMX,DTMAX, NMESS,JMAX,JMAX1,DX,DH,EPS,NPRNT,NCONT IMP00170
18     COMMON/UNK/NL(59),TE1(59),T11(59),BZ1(59),BT1(59),N2(59),TE2(59),T12(59),BZ2(59),BT2(59) IMP00180
19     COMMON/RDR/R(59),RH(59),DR(59),DRH(59),DR1(59),DRH1(59) IMP00190
20     COMMON/CFF/ALGL1,ALGL2,ALGL3,TE010,ETA0,TAU10,WED,#IO, VTE0,VT10,BET,EP50,AMEMA,EZ0,AJZ0,BHMO,BETA0 IMP00200
21     COMMON/SCA/TO,NO,LTO,RO,BO COMMON/ORA/Y(8),Z(8) IMP00210
22     COMMON/KKJJ/KMAX,KLMAX,LMAX COMMON/NMAIN/NDIM IMP00220
23     COMMON/OUTIM/AX(9,59) COMMON/IBC/OI(9,59),OB(9) IMP00230
24     COMMON/IBT/TMIN1,TMAX1 COMMON/IGNT/GN1(59),GT1(59) IMP00240
25     COMMON/ICHT/CRIT1(59),CRITK(9,59) COMMON/IPS/PS(59) IMP00250
26     COMMON/IMPC1/C11K(9,59),C11KK(9,9,59),C12K1(9,59),C12KK(9,9,59) COMMON/IMPC2/ES(59),C11K(9,59),C12K(9,59) IMP00260
27     COMMON/IMPC3/BKJ(9,59),EKJ(9,59),FKJ(9,59) DATA F111,F121/0,53284,0,707107/ IMP00270
28     DATA C11,C12,C22/1.26e0,37e0,1/ DATA C11,C12,C22/1.26e0,37e0,1/ IMP00280
29     DATA AM1,AMO,AMC/1.0e16,0.12,0/ DATA AM1,AMO,AMC/1.0e16,0.12,0/ IMP00290
30
31     C** SOLVE IMPURITY DIFFUSION EQUATION BY HAMMING'S PREDICTOR-CORRECTOR IMP00300
32     METOD (SUB, HPGC) IMP00310
33     C** PLASMA PARAMETERS ( NE,TE,T1,BZ,BT ) ARE GIVEN FROM SUB. COMPUT. IMP00320
34     C** BANANA-PLATEAU REGIMES ARE AVAILABLE. IMP00330
35     FROM F.L.MINTON AND T.B.MOORE: NUCL. FUSION 14(1974)639. IMP00340
36     C
37     AL -- EQ.(24) IMP00350
38     AN111,AN112 -- EQ.(23); AL111,AL121 -- EQ.(22) IMP00360
39     AN111,AN112 -- EQ.(31); AL11K,AL12K -- EQ.(30) IMP00370
40     ES -- EQ.(6) IMP00380
41     C11K1,C11KK -- EQ.(3) C12K1,C12KK -- EQ.(4) IMP00390
42
43     HANTEI=1.0/NO IMP00400
44     IF(OXYGEN) AMK=AMO IMP00410
45     IF(CARBON) AMK=AMC IMP00420
46     RMASS=AMK*AM1/(AMK+AM1) IMP00430
47     ANYU2=AM1/AMK IMP00440
48     F1=SQRT(ANYU2)/(F1+1.0) IMP00450
49     F2=SQRT(ANYU2)/(F2+1.0) IMP00460
50     FMN11=F1+ANYU2*ALOG(F2) IMP00470
51     FMN12=1.0/F1 IMP00480
52     ANYU1=1.0/ANYU2 IMP00490
53     F1M=SQRT(1.0+ANYU1) IMP00500
54     F2M=SQRT(ANYU1)/(F1M+1.0) IMP00510
55     FMN11M=FM1*ANYU1*ALOG(F2M) IMP00520
56     FMN12M=1.0/F1M IMP00530
57     KMAX1=KMAX-1 IMP00540
58     JM1=JMAX+1 IMP00550
59     ALGL=ALOG(Z1) IMP00560
60     DO 500 J=1,JM1 IMP00570
61     VT1=VT10*SQRT(AT1(J)) IMP00580
62     WI=10*ABZ(J)*Z1 IMP00590
63     ROUT=VT1/WI IMP00600
64     ROUT1=ROUT*T*ROUT IMP00610
65     ROUT2=ROUT1*T*ROUT IMP00620
66     D1C(J)=AN11(J)*ROUT2*RH(J)*VT1*ABT(J)/(RMAJ**2*ABZ(J)) IMP00630
67     D1B=RHLJ1*ABZ(J)/(RMAJ*ABT(J)) IMP00640
68     D1B=ABS(D1B) IMP00650
69     ARG1=AT1(J)**3/AN11(J) IMP00660
70     GO TO 501 IMP00670
71     501 CONTINUE IMP00680
72     GN1(J)=0.0 IMP00690
73     GT1(J)=0.0 IMP00700
74     502 CONTINUE IMP00710
75     500 CONTINUE IMP00720
76     DO 100 J=1,JM1 IMP00730
77     AL(J)=0.0 IMP00740
78     DO 101 K=2,KMAX IMP00750
79     AL(J)=AL(J+(K-1)**2*XX(K,J)) IMP00760
80     AL(J)=AL(J)/(Z1**2*AN11(J)) IMP00770
81     AN111=CRIT1(J)*(F111+AL(J)*FMN11) IMP00780
82     AN112=CRIT1(J)*(F121+AL(J)*FMN12) IMP00790
83     AL111(J)=0.73*D1(J)*AN111/(1.0+C11*AN111) IMP00800
84     AL121(J)=0.73*D1(J)*AN112/(1.0+C12*AN112) IMP00810
85     100 CONTINUE IMP00820
86     DO 200 K=2,KMAX IMP00830
87     ZK=-1 IMP00840
88     DO 200 J=1,JM1 IMP00850
89     DK=D1(J)*(XX(K,J)/AN11(J))*(Z1/ZK)**2+SQRT(1.0/ANYU2) IMP00860
90     CRITK(K,J)=AL(J)+(ZK/Z1)**2*CRIT1(J) IMP00870
91     ANK11=CRITK(K,J)*(F111*FMN11M/AL(J)) IMP00880
92     ANK12=CRITK(K,J)*(F121*FMN12M/AL(J)) IMP00890
93     AL11K(K,J)=0.73*DK*ANK11/(1.0+C11*ANK11) IMP00900
94     AL12K(K,J)=0.73*DK*ANK12/(1.0+C12*ANK12) IMP00910
95     200 CONTINUE IMP00920
96     DO 390 J=1,JM1 IMP00930
97     ES(J)=Z1**2*AL111(J) IMP00940
98     DO 390 K=2,KMAX IMP00950
99     ZK=-1 IMP00960
100    ES(J)=ES(J)+ZK**2*AL11K(K,J) IMP00970
101    390 CONTINUE IMP00980
102    DO 650 J=1,JM1 IMP00990

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103      RR3=ABS(RMJA/RH(J))**1.5
104      DO 650 K=2,KMAX
105      ZK=K-1
106      A111=Z**2*AL11K(K,J)*AL111(J)/ES(J)
107      C11K(K,J)=A111
108      DO 651 K1=2,KMAX
109      ZK1=K-1
110      A11K =ZK1 **2*AL11K(K,J)*AL11K(K1,J)/ES(J)
111      C11KK(K,K1,J)=A11K
112      651 CONTINUE
113      A121=1.5*Z**2*AL11K(K,J)*AL111(J)*(Z1-ZK)/ES(J)
114      A121=A121+Z*(ZK*AL11K(K,J)*AL121(J)-Z1*AL12K(K,J)*AL111(J))/ES(J)
115      C12K(K,J)=A121
116      DO 651 K1=2,KMAX
117      ZK1=K-1
118      C12KA=1.5*(ZK*AL11K(K,J)*AL11K(K1,J)*(ZK1-ZK)/ES(J)
119      C12KB=ZK1*(ZK*AL11K(K,J)*AL12K(K1,J)
120      *-ZK1*AL12K(K,J)*AL11K(K1,J))/ES(J)
121      A12KK =C12KA+C12KB
122      651 CONTINUE
123      650 CONTINUE
124      DO 660 J=1,JM1
125      DO 660 K=2,KMAX
126      C11K(K,J)=0.0
127      C12KK(K,J)=0.0
128      DO 660 K1=2,KMAX
129      C11K(K,J)=C11K(K,J)+C11KK(K,K1,J)
130      C12K(K,J)=C12K(K,J)+C12KK(K,K1,J)
131      660 CONTINUE
132      /* FROM HALF INTEGRAL MESH TO INTEGRAL MESH POINTS
133      DO 700 K=2,KMAX
134      DO 700 J=1,JMAX
135      C11K(K,J)=0.5*(C11K(K,J)+C11K(K,J+1))
136      C12K(K,J)=0.5*(C12K(K,J)+C12K(K,J+1))
137      C11K(K,J)=0.5*(C11K(K,J)+C11K(K,J+1))
138      C12K(K,J)=0.5*(C12K(K,J)+C12K(K,J+1))
139      700 CONTINUE
140      DO 750 K=2,KMAX
141      DO 750 J=1,JMAX
142      750 C11KK(K,K1,J)=0.5*(C11KK(K,K1,J)+C11KK(K,K1,J+1))
143      /* RATE COEFFICIENTS  Y*ALFA = IONIZATION, Y*BETA = RECOMBINATION
144      DO 503 J=1,JM1
145      TCRATE(J)
146      IF(OXYGEN) CALL ORATE(TD)
147      IF(CARBON) CALL CRATE(TD)
148      DO 503 K=1,KMAX1
149      ALFA(K,J)=Y(E)*Y(D)*TD
150      E11A(K,J)=Z(K)*HO*TC
151      503 CONTINUE
152      DO 900 K=1,KMAX
153      DO 900 J=1,JMAX
154      BKJ1=0.0
155      BKJ2=0.0
156      EK=0.0
157      IF(K,NE,2) BKJ2=-ANE(J)*BETAK(K-1,J)
158      IF(K,NE,1) EK =ANE(J)*ALFA(K-1,J)
159      IF(K,NE,KMAX) BKJ1=-ANE(J)*ALFA(K,J)
160      IF(K,NE,KMAX) EK =ANE(J)*BETAK(J)
161      BK=BKJ1+BKJ2
162      BKJ(K,J)=BK
163      EKJ(K,J)=EK
164      FKJ(K,J)=FK
165      900 CONTINUE
166      /* CHANGE THE TIME MESH FOR HPGC, IF XX(K,J).LT.HANTEI FOR ALL J,
167      /* XX(K,J) IS THE DENSITY OF IMPURITY WITH STAGE K AT MESH POINT J.
168      CHCK=1.0E4/ND
169      ICHCK=1
170      DO 301 I=1,KMAX
171      DO 300 J=1,JM1
172      IF(XX(I,J).GE.CHCK) GO TO 302
173      300 CONTINUE
174      ICHCK=I+1
175      302 IF(ICHCK,LE,5) ICHCK=5
176      IF(ICHCK,LE,1) GO TO 310
177      IF(ICHCK,LE,3) GO TO 320
178      IF(ICHCK,LE,4) GO TO 340
179      IF(ICHCK,LE,5) GO TO 350
180      310 CONTINUE
181      IF(OXYGEN) PRMT(3)=3.0E-7/TO
182      IF(CARBON) PRMT(3)=2.0E-6/TO
183      MAXL=0
184      GO TO 400
185      320 CONTINUE
186      IF(OXYGEN) PRMT(3)=1.5E-6/TO
187      IF(CARBON) PRMT(3)=5.0E-6/TO
188      MAXL=1
189      GO TO 400
190      330 CONTINUE
191      IF(OXYGEN) PRMT(3)=5.0E-6/TO
192      IF(CARBON) PRMT(3)=5.0E-6/TO
193      MAXL=2
194      GO TO 400
195      340 CONTINUE
196      IF(OXYGEN) PRMT(3)=1.0E-5/TO
197      IF(CARBON) PRMT(3)=2.0E-5/TO
198      MAXL=3
199      GO TO 400
200      350 CONTINUE
201      IF(OXYGEN) PRMT(3)=1.0E-5 /TO
202      IF(CARBON) PRMT(3)=1.0E-4 /TO
203      MAXL=4
204      400 CONTINUE
205      WRITE(6,450) MAXL,PRMT(3)
206      450 FORMAT(1H,/,1H,'***** MAXL =',I2,', PRMT(3) =',1PE9.3/)
207      /* HPGC PRMT(1)=INITIAL TIME
208      /* PRMT(2)=FINAL TIME

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      SUBROUTINE CRATE(TE)
C
C** IONIZATION AND RECOMBINATION RATE COEFFICIENTS
C      FROM E. MINNOV, MATT=777(1970).
C
      COMMON/URAY/Y(6),Z(6)
      DIMENSION B(6),E(6),E2(6)
      DATA KMAX<MAX1/7.0/
      DATA UJ/2.0,1.0+2.0,1.0+2.0+1.0/
      DATA E1/ 0.829, 1.793, 3.521, 4.743, 28.833, 36.031/
      DATA E2/ 11.260, 24.376, 47.864, 64.476, 391.986+489.840/
      DO 6000 K=1,KMAX1
      X=E2(K)/TE
      IF (X<4.0) 10+10+20
      20 ARG4,DX
      RES=CCCC((0.00094427e14+ARG-U,0.049362007)*ARG+D,0.11723273)
      1   +ARG-0.017555779)+ARG+0.020412099)*ARG+0.022951979)
      2   +ARG+0.0310851)*ARG-0.062498584)*ARG+0.24999999)*ARG
      X2=X
      IF (X2.GT.72.0) X2=72.0
      V(X)=5.9E-9*U(J)*((1.0/(E1(K))*SORT(E1(K)))*SWRT(X)*RES*EXP(-X2))
      Z(X)=5.2E-14*FLDAT(X)*X*SORT(X)*RES
      GO TO 6000
      10 RES=ALGUM(Y(X))-CCCC((0.103917602E-11*X-A-0.15798675E-10)*X
      1   +0.16826392F-92*X-0.21915699e-u)*X+0.27635830E-7)*X
      2   +0.30726221E-62*X+0.30996040E-5)*X+0.283375790E-4)*X
      3   +0.231L-8392E-31*X+0.016666906)*X+0.010416662)*X
      4   -0.05555555201*X*(0.25)*X-1.0)*X-0.57721566
      Y(X)=5.9E-9*U(J)*(1.0/(E1(K))*SORT(E1(K)))*SORT(X)*RES
      Z(X)=5.2E-14*FLDAT(X)*X*SORT(X)*RES*EXP(X)
      6000 CONTINUE
      RETURN
      END
      SUBROUTINE IHEAD
      REAL NC,NALL
      REAL NL,NL1
      REAL ME,MANL,LTO
      DIMENSION OX(9)
      DIMENSION DERY(900),PRMT(5)
      COMMON/ICMPY/NC(900)
      COMMON/CPMT/PMY,RHAI,RTUBE,ASPECT,ZI,ANO,NC,NALL,TEC,TEWAL,TIC,TIWAL,
      1   TIME,TRH(N+1)MAX,DT,UTH,DTMIN,DTMX,DTMAX,
      2   NMESH,JMAX,JMAX1,DX,DXM,EPS,NPRINT,NCONT
      COMMON/UMA/N1(59),TE1(59),T1(59),BT1(59),BT1(59),
      1   N2(59),TE2(59),T12(59),BT2(59),BT2(59)
      COMMON/SCA/TG,LTO,RH0
      COMMON/RDH/R(59),RH(59)+DR(59)+DRM(59),DR1(59),DRH1(59)
      COMMON/URAY/Y(6)-Z(6)
      COMMON/KKJJ/KMAX,KLMAX,LMAX
      COMMON/NHAT/NTD(9)
      COMMON/IBL/OT(9,59),OB(9)
      COMMON/OUTIM/XX(9,59)
      COMMON/FTH/TE,AN
      C
C** IMPURITY STAGE
      C
      KMAX=KMAX+LMAX
      NTM=KLMAX+JMAX1
      C
      JMI=JMAX+1
      C
C** GIVE THE INITIAL DISTRIBUTION OF IMPURITIES
C      SOLVE THE RATE EQUATION FROM TMINI TO TMAXI AT ALL GRIDS,
C      AT TMINI, OI (OR CI) ARE GIVEN TO BE UNIFORM AND OTHERS ARE
C      ABSENT.
      C
      DO 100 JM2,JMAX
      DO 200 I=1,KMAX
      200 OX(I)=0.0
      OX(J)=1.0*10/UN
      TE=TE2(J)
      AN=M2(J)
      100 CONTINUE
      1K=1
      CALL RATE0(OX,IP)
      1J=J-1
      DO 300 KP=1,KLMAX
      K=KP+LMAX
      OI(KP,IJ)=OX(K)
      300 CONTINUE
      DO 400 K=1,KMAX
      DO 400 JI=1,JMI
      400 XX(K,JI)=0.0
      DO 500 KP=1,KLMAX
      K=KP+LMAX
      DO 500 IJ=1,JMAX1
      JI=IJ+1
      XX(K,JI)=OI(KP+IJ)
      500 CONTINUE
      DO 600 K=1,KMAX
      XX(K,1)=XX(K,2)
      600 XX(K,JM1)=XX(K,JMAX )

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47      600 CONTINUE                                IH00600
48      DO 700 KP=1,KLMAX                         IH00610
49      700 OB(KP)=D1(KP,JMAX1)                   IH00620
50      DO 2 KP=1,KLMAX                         IH00630
51      DO 1 IJ=1,JMAX1                         IH00640
52      KJ=(KP-1)*JMAX1+IJ                      IH00650
53      2 V(KJ)=01(KP,IJ)
54      RETURN                                     IH00670
55      ENDU                                     IH00680
1      SUBROUTINE BCND(AT,V)                     BCD00010
C
C** BOUNDARY VALUES OF IMPURITY DENSITIES AT THE PLASMA SURFACE (OR AT
C THE WALL LIMITER). GIVE R,C, AT JMAX+1.
C** PRESENT ROUTINE, I(K,JMAX+1)=J(K,JMAX)
C TOTAL AMOUNTS OF IMPURITIES ARE CONSERVED INSIDE THE PLASMA.
C
C** USERS MAY EXTEND THIS ROUTINE TO INCLUDE RECYCLINGS OR SPUTTERINGS.
C** IMPURITY ROUTINE ***
C
2      REAL NC,NALL                            BCD00110
3      REAL NI,N2                               BCD00120
4      REAL ME,MA,NO,LTO                        BCD00130
5      DIMENSION V(1)                           BCD00140
6      DIMENSION DX(9,59)                         BCD00150
7      COMMON/PMT/ RMAJ,RPIPE,ASPECT,..,I,ANO,NC,NALL,TEC,TEWAL,TIC,TIWAL,
     1      TIME,TMIN,TMAX,DT,LTH,DTMIN,DTMX,DTMAX,
     2      NMESH,JMAX,JMAX1,DX,DXM,EP$,INPRNT,INCONT
8      COMMON/SCA/T0,NO,LTO,XU,BG               BCD00160
9      COMMON/INK/N1(59),TE1(59),T11(59)+BZ1(59)+BT1(59),
     *          N2(59),TE2(59),T12(59)+BZ2(59)+BT2(59)
10     COMMON/IRC/D1(9,59),OB(9)
11     COMMON/KKJJ/KMAX,KLMAX,LMAX             BCD00170
12     COMMON/STBC/GAM(10),AL(10),AM(10)        BCD00180
13     COMMON/HETIN/ANE(59),ANI(59),ATF(59),ATI(59),ABT(59),ABZ(59)
14     COMMON/URAY/C(2,8)                      BCD00190
15     DIMENSION UBR(2,8)                      BCD00200
16     HANTE=1,0/NO                           BCD00210
17     JK1=JMAX+1                             BCD00220
18     DO 1 KP=1,KLMAX                         BCD00230
19     DO 1 IJ=1,JMAX1                         BCD00240
20     KJ=(KP-1)*JMAX1+IJ                      BCD00250
21     1 OB(KP,IJ)=V(KJ)                      BCD00260
22     DO 10 KP=1,KLMAX                        BCD00270
23     OB(KP)=OB(KP,JMAX1)                    BCD00280
24     IF(OB(KP),LT,HANTE) OB(KP)=0.0       BCD00290
25     10 CONTINUE
26     RETURN
27     END

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1      SUBROUTINE FCT(X,Y,DERY)
2      LOGICAL OXYGEN,CARBON
3      REAL NC,NALL
4      REAL AD,LTO
5      DIMENSION Y(1),DERY(1)
6      DIMENSION OX(9,59)
7      DIMENSION PBREF(9,59)
8      DIMENSION GKJ(9,59)
9      DIMENSION OBS(20)
10     COMMON/SCA/TG,NO,LTO,RU,B0
11     COMMON/PMT/RMAJ,RTUBE,ASPECT,Z1,AND,NC,NALL,TEC,TEAL,TIC,TIAL,FCT00010
12           TIME,ATMIN,THMAX,DT,DTM,DTMIN,DTMA,DTMAX,
13           NMESH,JMAX,UMAX,DX,DXM,EPS,MPRNT,INCONT,FCT00020
14           COMMON/NMAIN/NDTM,FCT00030
15           COMMON/IBC/01(9,59),08(9),FCT00040
16           COMMON/RDR/R(59),RH(59)+DX(59),DHN(59)+DR(59),DRH(59),FCT00050
17           COMMON/GN/GN(59),GT(59),FCT00060
18           COMMON/HIKIN/AHE(59),ATE(59),ATT(59),ABT(59),ABZ(59),FCT00070
19           COMMON/ICHT/CHIT(59),CRITK(59),FCT00080
20           COMMON/IPS/PS(59),FCT00090
21           COMMON/UGTM/AM(9,59),FCT00100
22           COMMON/IMPFC1/C11K(9,59),C12K(9,59),C12KK(9,59),FCT00110
23           COMMON/IMPFC2/ES(59),C11(9,59),C12K(9,59),FCT00120
24           COMMON/TMFC5/RKJ(9,59),FKJ(59),FCT00130
25           DATA AM1,AM0/AMC/1.0,1.0,1.0,0.0/FCT00140
26           DATA C11,C12,C22/1.26,0.37,0.17/FCT00150
27           DATA F111,F121/0.53284,0.707107/FCT00160
28           IF(OXYGEN) ANK=AMC,FCT00170
29           IF(CARBON) ANK=AMC,FCT00180
30           RANTF(1)=0.0/N0,FCT00190
31           RNT(1)=1.0E3/N0,FCT00200
32           KPK1=LMAX+1,FCT00210
33           JPK1=MAX+1,FCT00220
34           DO 1 KPK1=LMAX,FCT00230
35           DO 1 JPK1=JMAX1,FCT00240
36           KPK=(KP+1)*JMAX1+IJ,FCT00250
37           1 CONTINUE,FCT00260
38           CALL BCDN(X,Y),FCT00270
39           DO 2 KP=1,KMAX,FCT00280
40           DO 2 IJ=1,JMAX1,FCT00290
41           LK=PK+IJ,FCT00300
42           JPK=IJ,FCT00310
43           2 CONTINUE,KP=CA(KP+IJ),FCT00320
44           IF(CARBON,EQ,0) GO TO 7,FCT00330
45           DO 3 LK=LMAX,FCT00340
46           DO 3 JPK=JMAX,FCT00350
47           DO 3 IJ=LMAX,FCT00360
48           DO 3 IJ=1,JMAX1,FCT00370
49           KPK=(KP+1)*JMAX1+IJ,FCT00380
50           3 CONTINUE,FCT00390
51           DO 4 L=1,LMAX,FCT00400
52           DO 4 IJ=LMAX,FCT00410
53           DO 4 IJ=1,JMAX1,FCT00420
54           LK=PK+IJ,FCT00430
55           4 CONTINUE,KP=CA(KP+IJ),FCT00440
56           IF(CARBON,EQ,0) GO TO 7,FCT00450
57           DO 5 L=1,LMAX,FCT00460
58           DO 5 IJ=LMAX,FCT00470
59           DO 5 IJ=1,JMAX1,FCT00480
60           KPK=(KP+1)*JMAX1+IJ,FCT00490
61           5 CONTINUE,KP=CA(KP+IJ),FCT00500
62           DO 6 L=1,LMAX,FCT00510
63           DO 6 IJ=LMAX,FCT00520
64           DO 6 IJ=1,JMAX1,FCT00530
65           LK=PK+IJ,FCT00540
66           6 CONTINUE,KP=CA(KP+IJ),FCT00550
67           DO 7 L=1,LMAX,FCT00560
68           DO 7 IJ=LMAX,FCT00570
69           DO 7 IJ=1,JMAX1,FCT00580
70           KPK=(KP+1)*JMAX1+IJ,FCT00590
71           7 CONTINUE,KP=CA(KP+IJ),FCT00600
72           DO 8 L=1,LMAX,FCT00610
73           DO 8 IJ=LMAX,FCT00620
74           DO 8 IJ=1,JMAX1,FCT00630
75           DO 8 IJ=1,JMAX1,FCT00640
76           DO 8 IJ=1,JMAX1,FCT00650
77           DO 8 IJ=1,JMAX1,FCT00660
78           DO 8 IJ=1,JMAX1,FCT00670
79           DO 8 IJ=1,JMAX1,FCT00680
80           DO 8 IJ=1,JMAX1,FCT00690
81           DO 8 IJ=1,JMAX1,FCT00700
82           DO 8 IJ=1,JMAX1,FCT00710
83           DO 8 IJ=1,JMAX1,FCT00720
84           DO 8 IJ=1,JMAX1,FCT00730
85           DO 8 IJ=1,JMAX1,FCT00740
86           DO 8 IJ=1,JMAX1,FCT00750
87           DO 8 IJ=1,JMAX1,FCT00760
88           DO 8 IJ=1,JMAX1,FCT00770
89           DO 8 IJ=1,JMAX1,FCT00780
90           DO 8 IJ=1,JMAX1,FCT00790
91           DO 8 IJ=1,JMAX1,FCT00800
92           DO 8 IJ=1,JMAX1,FCT00810
93           DO 8 IJ=1,JMAX1,FCT00820
94           DO 8 IJ=1,JMAX1,FCT00830
95           DO 8 IJ=1,JMAX1,FCT00840
96           DO 8 IJ=1,JMAX1,FCT00850
97           DO 8 IJ=1,JMAX1,FCT00860
98           DO 8 IJ=1,JMAX1,FCT00870
99           DO 8 IJ=1,JMAX1,FCT00880
100          DO 8 IJ=1,JMAX1,FCT00890
101          DO 8 IJ=1,JMAX1,FCT00900
102          DO 8 IJ=1,JMAX1,FCT00910
103          DO 8 IJ=1,JMAX1,FCT00920
104          DO 8 IJ=1,JMAX1,FCT00930
105          DO 8 IJ=1,JMAX1,FCT00940
106          DO 8 IJ=1,JMAX1,FCT00950
107          DO 8 IJ=1,JMAX1,FCT00960
108          DO 8 IJ=1,JMAX1,FCT00970
109          DO 8 IJ=1,JMAX1,FCT00980
110          DO 8 IJ=1,JMAX1,FCT00990
111          DO 8 IJ=1,JMAX1,FCT01000
112          DO 8 IJ=1,JMAX1,FCT01010
113          DO 8 IJ=1,JMAX1,FCT01020
114          DO 8 IJ=1,JMAX1,FCT01030
115          DO 8 IJ=1,JMAX1,FCT01040
116          DO 8 IJ=1,JMAX1,FCT01050
117          DO 8 IJ=1,JMAX1,FCT01060
118          DO 8 IJ=1,JMAX1,FCT01070
119          DO 8 IJ=1,JMAX1,FCT01080
120          END,FCT01090
C** GKJ(K,J) --- PARTICLE FLUX OF IMPURITY WITH K AT J. (INTEGRAL MESH) FCT00900
C
65           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00910
66           RDO 750 J=2,JMAX,FCT00920
67           DO 750 K=1,KMAX,FCT00930
68           DO 750 K=1,KMAX,FCT00940
69           DO 750 K=1,KMAX,FCT00950
70           DO 750 K=1,KMAX,FCT00960
71           DO 750 K=1,KMAX,FCT00970
72           DO 750 K=1,KMAX,FCT00980
73           DO 750 K=1,KMAX,FCT00990
74           DO 750 K=1,KMAX,FCT01000
75           DO 750 K=1,KMAX,FCT01010
76           DO 750 K=1,KMAX,FCT01020
77           DO 750 K=1,KMAX,FCT01030
78           DO 750 K=1,KMAX,FCT01040
79           DO 750 K=1,KMAX,FCT01050
80           DO 750 K=1,KMAX,FCT01060
81           DO 750 K=1,KMAX,FCT01070
82           DO 750 K=1,KMAX,FCT01080
83           DO 750 K=1,KMAX,FCT01090
C
84           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
85           RDO 750 J=2,JMAX,FCT00910
86           DO 750 K=1,KMAX,FCT00920
87           DO 750 K=1,KMAX,FCT00930
88           DO 750 K=1,KMAX,FCT00940
89           DO 750 K=1,KMAX,FCT00950
90           DO 750 K=1,KMAX,FCT00960
91           DO 750 K=1,KMAX,FCT00970
92           DO 750 K=1,KMAX,FCT00980
93           DO 750 K=1,KMAX,FCT00990
94           DO 750 K=1,KMAX,FCT01000
95           DO 750 K=1,KMAX,FCT01010
96           DO 750 K=1,KMAX,FCT01020
97           DO 750 K=1,KMAX,FCT01030
98           DO 750 K=1,KMAX,FCT01040
99           DO 750 K=1,KMAX,FCT01050
100          DO 750 K=1,KMAX,FCT01060
101          DO 750 K=1,KMAX,FCT01070
102          DO 750 K=1,KMAX,FCT01080
103          DO 750 K=1,KMAX,FCT01090
C
104           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
105           RDO 750 J=2,JMAX,FCT00910
106           DO 750 K=1,KMAX,FCT00920
107           DO 750 K=1,KMAX,FCT00930
108           DO 750 K=1,KMAX,FCT00940
109           DO 750 K=1,KMAX,FCT00950
110           DO 750 K=1,KMAX,FCT00960
111           DO 750 K=1,KMAX,FCT00970
112           DO 750 K=1,KMAX,FCT00980
113           DO 750 K=1,KMAX,FCT00990
114           DO 750 K=1,KMAX,FCT01000
115           DO 750 K=1,KMAX,FCT01010
116           DO 750 K=1,KMAX,FCT01020
117           DO 750 K=1,KMAX,FCT01030
118           DO 750 K=1,KMAX,FCT01040
119           DO 750 K=1,KMAX,FCT01050
120           DO 750 K=1,KMAX,FCT01060
121           DO 750 K=1,KMAX,FCT01070
122           DO 750 K=1,KMAX,FCT01080
123           DO 750 K=1,KMAX,FCT01090
C
124           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
125           RDO 750 J=2,JMAX,FCT00910
126           DO 750 K=1,KMAX,FCT00920
127           DO 750 K=1,KMAX,FCT00930
128           DO 750 K=1,KMAX,FCT00940
129           DO 750 K=1,KMAX,FCT00950
130           DO 750 K=1,KMAX,FCT00960
131           DO 750 K=1,KMAX,FCT00970
132           DO 750 K=1,KMAX,FCT00980
133           DO 750 K=1,KMAX,FCT00990
134           DO 750 K=1,KMAX,FCT01000
135           DO 750 K=1,KMAX,FCT01010
136           DO 750 K=1,KMAX,FCT01020
137           DO 750 K=1,KMAX,FCT01030
138           DO 750 K=1,KMAX,FCT01040
139           DO 750 K=1,KMAX,FCT01050
140           DO 750 K=1,KMAX,FCT01060
141           DO 750 K=1,KMAX,FCT01070
142           DO 750 K=1,KMAX,FCT01080
143           DO 750 K=1,KMAX,FCT01090
C
144           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
145           RDO 750 J=2,JMAX,FCT00910
146           DO 750 K=1,KMAX,FCT00920
147           DO 750 K=1,KMAX,FCT00930
148           DO 750 K=1,KMAX,FCT00940
149           DO 750 K=1,KMAX,FCT00950
150           DO 750 K=1,KMAX,FCT00960
151           DO 750 K=1,KMAX,FCT00970
152           DO 750 K=1,KMAX,FCT00980
153           DO 750 K=1,KMAX,FCT00990
154           DO 750 K=1,KMAX,FCT01000
155           DO 750 K=1,KMAX,FCT01010
156           DO 750 K=1,KMAX,FCT01020
157           DO 750 K=1,KMAX,FCT01030
158           DO 750 K=1,KMAX,FCT01040
159           DO 750 K=1,KMAX,FCT01050
160           DO 750 K=1,KMAX,FCT01060
161           DO 750 K=1,KMAX,FCT01070
162           DO 750 K=1,KMAX,FCT01080
163           DO 750 K=1,KMAX,FCT01090
C
164           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
165           RDO 750 J=2,JMAX,FCT00910
166           DO 750 K=1,KMAX,FCT00920
167           DO 750 K=1,KMAX,FCT00930
168           DO 750 K=1,KMAX,FCT00940
169           DO 750 K=1,KMAX,FCT00950
170           DO 750 K=1,KMAX,FCT00960
171           DO 750 K=1,KMAX,FCT00970
172           DO 750 K=1,KMAX,FCT00980
173           DO 750 K=1,KMAX,FCT00990
174           DO 750 K=1,KMAX,FCT01000
175           DO 750 K=1,KMAX,FCT01010
176           DO 750 K=1,KMAX,FCT01020
177           DO 750 K=1,KMAX,FCT01030
178           DO 750 K=1,KMAX,FCT01040
179           DO 750 K=1,KMAX,FCT01050
180           DO 750 K=1,KMAX,FCT01060
181           DO 750 K=1,KMAX,FCT01070
182           DO 750 K=1,KMAX,FCT01080
183           DO 750 K=1,KMAX,FCT01090
C
184           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
185           RDO 750 J=2,JMAX,FCT00910
186           DO 750 K=1,KMAX,FCT00920
187           DO 750 K=1,KMAX,FCT00930
188           DO 750 K=1,KMAX,FCT00940
189           DO 750 K=1,KMAX,FCT00950
190           DO 750 K=1,KMAX,FCT00960
191           DO 750 K=1,KMAX,FCT00970
192           DO 750 K=1,KMAX,FCT00980
193           DO 750 K=1,KMAX,FCT00990
194           DO 750 K=1,KMAX,FCT01000
195           DO 750 K=1,KMAX,FCT01010
196           DO 750 K=1,KMAX,FCT01020
197           DO 750 K=1,KMAX,FCT01030
198           DO 750 K=1,KMAX,FCT01040
199           DO 750 K=1,KMAX,FCT01050
200           DO 750 K=1,KMAX,FCT01060
201           DO 750 K=1,KMAX,FCT01070
202           DO 750 K=1,KMAX,FCT01080
203           DO 750 K=1,KMAX,FCT01090
C
204           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
205           RDO 750 J=2,JMAX,FCT00910
206           DO 750 K=1,KMAX,FCT00920
207           DO 750 K=1,KMAX,FCT00930
208           DO 750 K=1,KMAX,FCT00940
209           DO 750 K=1,KMAX,FCT00950
210           DO 750 K=1,KMAX,FCT00960
211           DO 750 K=1,KMAX,FCT00970
212           DO 750 K=1,KMAX,FCT00980
213           DO 750 K=1,KMAX,FCT00990
214           DO 750 K=1,KMAX,FCT01000
215           DO 750 K=1,KMAX,FCT01010
216           DO 750 K=1,KMAX,FCT01020
217           DO 750 K=1,KMAX,FCT01030
218           DO 750 K=1,KMAX,FCT01040
219           DO 750 K=1,KMAX,FCT01050
220           DO 750 K=1,KMAX,FCT01060
221           DO 750 K=1,KMAX,FCT01070
222           DO 750 K=1,KMAX,FCT01080
223           DO 750 K=1,KMAX,FCT01090
C
224           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
225           RDO 750 J=2,JMAX,FCT00910
226           DO 750 K=1,KMAX,FCT00920
227           DO 750 K=1,KMAX,FCT00930
228           DO 750 K=1,KMAX,FCT00940
229           DO 750 K=1,KMAX,FCT00950
230           DO 750 K=1,KMAX,FCT00960
231           DO 750 K=1,KMAX,FCT00970
232           DO 750 K=1,KMAX,FCT00980
233           DO 750 K=1,KMAX,FCT00990
234           DO 750 K=1,KMAX,FCT01000
235           DO 750 K=1,KMAX,FCT01010
236           DO 750 K=1,KMAX,FCT01020
237           DO 750 K=1,KMAX,FCT01030
238           DO 750 K=1,KMAX,FCT01040
239           DO 750 K=1,KMAX,FCT01050
240           DO 750 K=1,KMAX,FCT01060
241           DO 750 K=1,KMAX,FCT01070
242           DO 750 K=1,KMAX,FCT01080
243           DO 750 K=1,KMAX,FCT01090
C
244           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
245           RDO 750 J=2,JMAX,FCT00910
246           DO 750 K=1,KMAX,FCT00920
247           DO 750 K=1,KMAX,FCT00930
248           DO 750 K=1,KMAX,FCT00940
249           DO 750 K=1,KMAX,FCT00950
250           DO 750 K=1,KMAX,FCT00960
251           DO 750 K=1,KMAX,FCT00970
252           DO 750 K=1,KMAX,FCT00980
253           DO 750 K=1,KMAX,FCT00990
254           DO 750 K=1,KMAX,FCT01000
255           DO 750 K=1,KMAX,FCT01010
256           DO 750 K=1,KMAX,FCT01020
257           DO 750 K=1,KMAX,FCT01030
258           DO 750 K=1,KMAX,FCT01040
259           DO 750 K=1,KMAX,FCT01050
260           DO 750 K=1,KMAX,FCT01060
261           DO 750 K=1,KMAX,FCT01070
262           DO 750 K=1,KMAX,FCT01080
263           DO 750 K=1,KMAX,FCT01090
C
264           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
265           RDO 750 J=2,JMAX,FCT00910
266           DO 750 K=1,KMAX,FCT00920
267           DO 750 K=1,KMAX,FCT00930
268           DO 750 K=1,KMAX,FCT00940
269           DO 750 K=1,KMAX,FCT00950
270           DO 750 K=1,KMAX,FCT00960
271           DO 750 K=1,KMAX,FCT00970
272           DO 750 K=1,KMAX,FCT00980
273           DO 750 K=1,KMAX,FCT00990
274           DO 750 K=1,KMAX,FCT01000
275           DO 750 K=1,KMAX,FCT01010
276           DO 750 K=1,KMAX,FCT01020
277           DO 750 K=1,KMAX,FCT01030
278           DO 750 K=1,KMAX,FCT01040
279           DO 750 K=1,KMAX,FCT01050
280           DO 750 K=1,KMAX,FCT01060
281           DO 750 K=1,KMAX,FCT01070
282           DO 750 K=1,KMAX,FCT01080
283           DO 750 K=1,KMAX,FCT01090
C
284           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
285           RDO 750 J=2,JMAX,FCT00910
286           DO 750 K=1,KMAX,FCT00920
287           DO 750 K=1,KMAX,FCT00930
288           DO 750 K=1,KMAX,FCT00940
289           DO 750 K=1,KMAX,FCT00950
290           DO 750 K=1,KMAX,FCT00960
291           DO 750 K=1,KMAX,FCT00970
292           DO 750 K=1,KMAX,FCT00980
293           DO 750 K=1,KMAX,FCT00990
294           DO 750 K=1,KMAX,FCT01000
295           DO 750 K=1,KMAX,FCT01010
296           DO 750 K=1,KMAX,FCT01020
297           DO 750 K=1,KMAX,FCT01030
298           DO 750 K=1,KMAX,FCT01040
299           DO 750 K=1,KMAX,FCT01050
300           DO 750 K=1,KMAX,FCT01060
301           DO 750 K=1,KMAX,FCT01070
302           DO 750 K=1,KMAX,FCT01080
303           DO 750 K=1,KMAX,FCT01090
C
304           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
305           RDO 750 J=2,JMAX,FCT00910
306           DO 750 K=1,KMAX,FCT00920
307           DO 750 K=1,KMAX,FCT00930
308           DO 750 K=1,KMAX,FCT00940
309           DO 750 K=1,KMAX,FCT00950
310           DO 750 K=1,KMAX,FCT00960
311           DO 750 K=1,KMAX,FCT00970
312           DO 750 K=1,KMAX,FCT00980
313           DO 750 K=1,KMAX,FCT00990
314           DO 750 K=1,KMAX,FCT01000
315           DO 750 K=1,KMAX,FCT01010
316           DO 750 K=1,KMAX,FCT01020
317           DO 750 K=1,KMAX,FCT01030
318           DO 750 K=1,KMAX,FCT01040
319           DO 750 K=1,KMAX,FCT01050
320           DO 750 K=1,KMAX,FCT01060
321           DO 750 K=1,KMAX,FCT01070
322           DO 750 K=1,KMAX,FCT01080
323           DO 750 K=1,KMAX,FCT01090
C
324           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
325           RDO 750 J=2,JMAX,FCT00910
326           DO 750 K=1,KMAX,FCT00920
327           DO 750 K=1,KMAX,FCT00930
328           DO 750 K=1,KMAX,FCT00940
329           DO 750 K=1,KMAX,FCT00950
330           DO 750 K=1,KMAX,FCT00960
331           DO 750 K=1,KMAX,FCT00970
332           DO 750 K=1,KMAX,FCT00980
333           DO 750 K=1,KMAX,FCT00990
334           DO 750 K=1,KMAX,FCT01000
335           DO 750 K=1,KMAX,FCT01010
336           DO 750 K=1,KMAX,FCT01020
337           DO 750 K=1,KMAX,FCT01030
338           DO 750 K=1,KMAX,FCT01040
339           DO 750 K=1,KMAX,FCT01050
340           DO 750 K=1,KMAX,FCT01060
341           DO 750 K=1,KMAX,FCT01070
342           DO 750 K=1,KMAX,FCT01080
343           DO 750 K=1,KMAX,FCT01090
C
344           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
345           RDO 750 J=2,JMAX,FCT00910
346           DO 750 K=1,KMAX,FCT00920
347           DO 750 K=1,KMAX,FCT00930
348           DO 750 K=1,KMAX,FCT00940
349           DO 750 K=1,KMAX,FCT00950
350           DO 750 K=1,KMAX,FCT00960
351           DO 750 K=1,KMAX,FCT00970
352           DO 750 K=1,KMAX,FCT00980
353           DO 750 K=1,KMAX,FCT00990
354           DO 750 K=1,KMAX,FCT01000
355           DO 750 K=1,KMAX,FCT01010
356           DO 750 K=1,KMAX,FCT01020
357           DO 750 K=1,KMAX,FCT01030
358           DO 750 K=1,KMAX,FCT01040
359           DO 750 K=1,KMAX,FCT01050
360           DO 750 K=1,KMAX,FCT01060
361           DO 750 K=1,KMAX,FCT01070
362           DO 750 K=1,KMAX,FCT01080
363           DO 750 K=1,KMAX,FCT01090
C
364           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
365           RDO 750 J=2,JMAX,FCT00910
366           DO 750 K=1,KMAX,FCT00920
367           DO 750 K=1,KMAX,FCT00930
368           DO 750 K=1,KMAX,FCT00940
369           DO 750 K=1,KMAX,FCT00950
370           DO 750 K=1,KMAX,FCT00960
371           DO 750 K=1,KMAX,FCT00970
372           DO 750 K=1,KMAX,FCT00980
373           DO 750 K=1,KMAX,FCT00990
374           DO 750 K=1,KMAX,FCT01000
375           DO 750 K=1,KMAX,FCT01010
376           DO 750 K=1,KMAX,FCT01020
377           DO 750 K=1,KMAX,FCT01030
378           DO 750 K=1,KMAX,FCT01040
379           DO 750 K=1,KMAX,FCT01050
380           DO 750 K=1,KMAX,FCT01060
381           DO 750 K=1,KMAX,FCT01070
382           DO 750 K=1,KMAX,FCT01080
383           DO 750 K=1,KMAX,FCT01090
C
384           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
385           RDO 750 J=2,JMAX,FCT00910
386           DO 750 K=1,KMAX,FCT00920
387           DO 750 K=1,KMAX,FCT00930
388           DO 750 K=1,KMAX,FCT00940
389           DO 750 K=1,KMAX,FCT00950
390           DO 750 K=1,KMAX,FCT00960
391           DO 750 K=1,KMAX,FCT00970
392           DO 750 K=1,KMAX,FCT00980
393           DO 750 K=1,KMAX,FCT00990
394           DO 750 K=1,KMAX,FCT01000
395           DO 750 K=1,KMAX,FCT01010
396           DO 750 K=1,KMAX,FCT01020
397           DO 750 K=1,KMAX,FCT01030
398           DO 750 K=1,KMAX,FCT01040
399           DO 750 K=1,KMAX,FCT01050
400           DO 750 K=1,KMAX,FCT01060
401           DO 750 K=1,KMAX,FCT01070
402           DO 750 K=1,KMAX,FCT01080
403           DO 750 K=1,KMAX,FCT01090
C
404           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
405           RDO 750 J=2,JMAX,FCT00910
406           DO 750 K=1,KMAX,FCT00920
407           DO 750 K=1,KMAX,FCT00930
408           DO 750 K=1,KMAX,FCT00940
409           DO 750 K=1,KMAX,FCT00950
410           DO 750 K=1,KMAX,FCT00960
411           DO 750 K=1,KMAX,FCT00970
412           DO 750 K=1,KMAX,FCT00980
413           DO 750 K=1,KMAX,FCT00990
414           DO 750 K=1,KMAX,FCT01000
415           DO 750 K=1,KMAX,FCT01010
416           DO 750 K=1,KMAX,FCT01020
417           DO 750 K=1,KMAX,FCT01030
418           DO 750 K=1,KMAX,FCT01040
419           DO 750 K=1,KMAX,FCT01050
420           DO 750 K=1,KMAX,FCT01060
421           DO 750 K=1,KMAX,FCT01070
422           DO 750 K=1,KMAX,FCT01080
423           DO 750 K=1,KMAX,FCT01090
C
424           GKJ(K,J)=GKJ1+GKJ2+GKJ3+GKJ4,FCT00900
425           RDO 750 J=2,JMAX,FCT00910
426           DO 750 K=1,KMAX,FCT00920
427           DO 750 K=1,KMAX,FCT00930
428           DO 750 K=1,KMAX,FCT00940
429           DO 750 K=1,KMAX,FCT00950
430           DO 750 K=1,KMAX,FCT00960
431           DO 750 K=1,KMAX,FCT00970
432           DO 750 K=1,KMAX,FCT00980
433           DO 750 K=1,KMAX,FCT00990
434           DO 750 K=1,KMAX,FCT01000
435           DO 750 K=
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1 SUBROUTINE OUTP(X,Y,DERY,IHLF,NDIM,PRMT) OTP00010
2 REAL NC,NWALL OTP00020
3 REAL NO,LTO OTP00030
4 REAL NI,N2 OTP00040
5 DIMENSION OBB(20) OTP00050
6 DIMENSION TO(59),TOK(10) OTP00060
7 DIMENSION Y(1),DERY(1),PRMT(1) OTP00070
8 DIMENSION OX(9,59) OTP00080
9 DIMENSION ABPC(9) OTP00090
10 COMMON/UNK/NI(59),TE1(59),TI1(59),BZ1(59),BT1(59), OTP00100
* N2(59),TE2(59),TI2(59),BZ2(59),BT2(59) OTP00110
11 COMMON/SCA/TO+NO,LTO+RO,BG OTP00120
12 COMMON/KKJJ/KMAX,KLMAX,LMAX OTP00130
13 COMMON/PNT/RMAJ,RTUBE,ASPECT,ZI,AND,NC,NWALL,TEC,TEWAL,TIC,TIWAL, OTP00140
1 TIME,THIN,TMAX,DT,DTH,DTMIN,DTMX,DTMAX, OTP00150
2 NMESH,JMAX,JMAX1,DX,DXH,EPS,NPRNT,NCONT OTP00160
14 COMMON/RDH/R(59),RH(59),DR(59),DRH(59),DR1(59),DRH1(59) OTP00170
15 COMMON/IRC/OI(9,59),OB(9) OTP00180
16 COMMON/ZEFF/ZEF(59) OTP00190
17 COMMON/ZOXY/OXY(59) OTP00200
18 COMMON/OUTIM/XX(9,59) OTP00210
19 COMMON/VST/PLTX(1000),PLOTY(9,1000),NSMAX OTP00220
20 COMMON/ICHT/CRITI(59),CR1TK(9,59) OTP00230
21 COMMON/PLNS/NS OTP00240
22 DATA NP/-1/ OTP00250
23 DATA AH,AP,AC/1HB,1HP,1HC/ OTP00260
24 JM1=JMAX+1 OTP00270
25 DO 1 KP=1,KLMAX OTP00280
26 DO 1 J=JM1,JMAX1 OTP00290
27 K=KP+1,J=JM1+1 OTP00300
28 1 OK(KP+IJ)=Y(KJ) OTP00310
29 CALL BCOND(X,Y) OTP00320
30 DO 2 KP=1,KLMAX OTP00330
31 DO 2 J=1,JMAX OTP00340
32 K=KP+1MAX OTP00350
33 J=J+1 OTP00360
34 2 XX(I,J)=OX(KP+IJ) OTP00370
35 IF(LMAX,EQ.0) GO TO 7 OTP00380
36 DO 3 L=1,LMAX OTP00390
37 DO 3 J=2,JMAX OTP00400
38 3 XX(L,J)=0.0 OTP00410
39 DO 4 J=2,JMAX OTP00420
40 4 XX(1,J)=0.0 OTP00430
41 CONTINUE OTP00440
42 DO 10 L=1,LMAX OTP00450
43 10 OBB(L)=0.0 OTP00460
44 DO 11 KP=1,KLMAX OTP00470
45 K=KP+1MAX OTP00480
46 11 OBB(K)=OB(KP) OTP00490
47 DO 12 K=1,KMAX OTP00500
48 XX(1,J)=XX(K,2) OTP00510
49 12 XX(K,JM1)=OBB(K) OTP00520
50 DO 130 K=1,KMAX OTP00530
51 DO 130 J=1,JM1 OTP00540
52 130 IF(XX(K,J).LT.-1.0) XX(K,J)=0.0 OTP00550
53 DO 1400 J=1,JMAX OTP00560
54 TO(J)=0.0 OTP00570
55 DO 1400 K=1,KMAX OTP00580
56 TO(J)=TO(J)+0.5*(XX(K,J)+XX(K,J+1)) OTP00590
57 1400 CONTINUE OTP00600
58 DO 1401 J=1,JMAX OTP00610
59 1401 TO(J)=TO(J)*R(J)*6.283185306 OTP00620
60 CALL GSF(DX,TO,TO,JMAX) OTP00630
61 TOK(10)=TO(JMAX) OTP00640
62 DO 2001 K=1,KMAX OTP00650
63 DO 2002 J=1,JMAX OTP00660
64 2002 TO(J)=0.5*(XX(K,J)+XX(K,J+1)) OTP00670
65 CALL GSF(DX,TO,TO,JMAX) OTP00680
66 TOK(J)=TO(JMAX) OTP00690
67 2001 CONTINUE OTP00700
68 DO 800 J=1,JM1 OTP00710
69 OXY(J)=0.0 OTP00720
70 DO 800 K=1,KMAX OTP00730
71 OXY(J)=OXY(J)+XX(K,J) OTP00740
72 800 CONTINUE OTP00750
73 DO 850 J=1,JM1 OTP00760
74 AB1=0.0 OTP00770
75 AB2=0.0 OTP00780
76 DO 851 K=2,KMAX OTP00790
77 AB1=AB1+(K-1)*#2*XX(K,J) OTP00800
78 AB2=AB2+(K-1)*XX(K,J) OTP00810
79 851 CONTINUE OTP00820
80 ZEF(J)=(N2(J)+AB1)/(N2(J)+AB2) OTP00830
81 850 CONTINUE OTP00840
82 NP#NP+1 OTP00850
83 IF(MOD(NP,NPRNT).NE.0) GO TO 500 OTP00860
84 NP=0 OTP00870
85 NSNS+1 OTP00880
86 NSMAXNS OTP00890
87 PLTX(NS)=X OTP00900
88 DO 400 K=1,KMAX OTP00910
89 400 PLOTY(K,NS)=TOK(K) OTP00920
90 500 TMI=PRMT(1)-0.5*PRMT(3) OTP00930
91 TMA=PRMT(1)+0.5*PRMT(3) OTP00940
92 IF(X.GT.TMI,AND,X.LT.TMA) GO TO 501 OTP00950
93 RETURN OTP00960
94 501 CONTINUE OTP00970
95 WHITE(6,6,0) X,IHLF OTP00980
96 608 FORMAT(1H //,TIME='*1PE13.6',IHLF='*15') OTP00990
97 WHITE(6,6,0) OTP01000
98 609 FORMAT(1H *,J,'.5X,'01'*10X,'02'*10X,'03'*10X,'04'*10X,'05'*10X,'06'*10X,'07'*10X,'08'*10X,'09'*10X,'0'*10X,'ZEF/') OTP01010
99 DO 100 J=1,JM1 OTP01020
100 WHITE(6,6,0) J,(XX(K,J),K=1,KMAX),OXY(J),ZEF(J) OTP01030
101 610 FORMAT(1H :15.1P11E11.3) OTP01040
102 100 CONTINUE OTP01050
103 WHITE(6,2003) TOK OTP01060
104 2003 FORMAT(1H ,TOTAL',1P10E11.3) OTP01070
105 NNKMAX OTP01080
106 CALL PLTREC(X,NN) OTP01090
107 RETURN OTP01100
108 /END OTP01110
109 OTP01120
110 OTP01130

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1      SUBROUTINE RATE0(VOX,IR)
2      LOGICAL OXYGEN,CARBON
3      COMMON/VOXA/OXYGEN,CARBON
4      DIMENSION VOX(1)
5      REAL NULLO,NC,NWALL,N1,N2
6      COMMON/PMT/RTMAJ,RTUBE,ASPECT,Z1,AND,NC,NWALL,TEC,TEAL,TIC,TIAL,
7      TIME,TRIN,IMAX,DT,DTH,LTMIN,DTMX,DTMAX,
8      NMESH,UMAX,JMAX,DX,DXM,DXM+EPS,NPRNT,NCONT
9      COMMON/SCA/T0,ND,LTG,R0,.3D0
10     COMMON/ZUNK/NI(59),TE1(59),BZ1(59),BT1(59),
11     *          N2(59),TE2(59),T12(59),BZ2(59),BT2(59)
12     COMMON/KKJU/KMAX,KLMAX,IMAX
13     COMMON/FIT,VTE,AN
14     DOUBLE PRECISION A,B,YL,P,W,DX,SOX
15     DOUBLE PRECISION E
16     COMMON/EIV/E(20)+YL(20)+DX(20)+SOX(20)
17     COMMON/CMP/A(20+20),B(23+20)
18     COMMON/ORA/ALFA(8),BETA(8)
19     COMMON/TBT/TM,INI,IMAX
20
21 C** SOLVE THE RATE EQUATION
22 C** EIGEN VALUE PROBLEM GIVES A TRIDIAGONAL MATRIX
23 C** SUB. EIGTRI ---- GIVENS, HOUSEHOLDER, BI-SECTION, INVERSE ITERATION
24 C** FUCIL ---- ENTRY IN SUB. EIGTRI
25
26      KMIN=1
27      KMAX=KMIN+1
28      KM=KMAX-KMIN+1
29      KMAXA
30      M1=1
31      M2=M1
32      DO 3 K=1,KMAX
33      3 DX(K)=VOX(K)
34      IF(OXYGEN) CALL OHATE(CF)
35      IF(CARBON) CALL CHATE(CF)
36      DO 4 K=1,KMAX1
37      ALFA(K)=ALFA(K)*NO+TO
38      BETA(K)=BETA(K)*NO+TO
39      40-DO 40 CONTINUE
40      DO 40 I=1,KMAX
41      DO 40 J=1,KMAX
42      40 A(I,J)=0.
43      DO 41 I=2,KMAX1
44      ALL,I)=-(ALFA(I)+BETA(I-1))
45      A(I,I-1)=ALFA(I-1)
46      A(I,I+1)=BETA(I)
47      41 CONTINUE
48      A(1,1)=ALFA(1)
49      A(1,2)=BETA(1)
50      A(KMAX+KMAX1)=ALFA(KMAX1)
51      A(KMAX+KMAX)=BETA(KMAX1)
52      DO 52 I=1,KMAX
53      DO 52 J=1,KMAX
54      52 A(I,J)=A(I,J)*AN
55      CALL EIGTRI(KM,IE)
56      IF(IE.EQ.0) RETURN
57      TIC=0.
58      CALL FUCIL(TT,M1,M2)
59      DO 60 I=1,KMAX
60      60 DX(I)=0.0
61      IF(DABS(DX(I)).LT.1.0) DX(I)=0.0
62      TIC=MAX1-TMIN
63      CALL FUCIL(TT,M1,M2)
64      DO 64 I=1,KMAX
65      64 DX(I)=0.0
66      DO 66 I=1,KMAX
67      66 DX(I)=0.0
68      DOX(K)=SGNL(DX(K))
69      RETURN
70      END

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1      SUBROUTINE HPCG(PRM1,Y,DERY,NDIM,[HLF,FCT,OUTP,AUX])
2      DIMENSION PRM1(1),Y(1),DERY(1),AUX(16,1)          HPC00010
3      N=1          HPC00020
4      IHLF=0          HPC00030
5      X=PRM1(1)          HPC00040
6      H=PRM1(3)          HPC00050
7      PRM1(2)=0.0          HPC00060
8      DO 1 I=1,NDIM          HPC00070
9      AUX(16,I)=0.          HPC00080
10     AUX(15,I)=DERY(I)          HPC00090
11     1 AUX(1,I)=Y(I)          HPC00100
12     1 IF(H*(PRM1(2)-X)) 3,2,4          HPC00110
13     2 IHLF=12          HPC00120
14     GOTO 4          HPC00130
15     3 IHLF=13          HPC00140
16     4 CALL FCT(X,Y+DERY)          HPC00150
17     CALL LUTP(X,Y+DERY,[HLF,NDIM,PRM1])          HPC00160
18     IF(PRM1(5)) 6,5,6          HPC00170
19     5 IF([HLF]) 7,7,6          HPC00180
20     6 RETURN          HPC00190
21     7 DO 8 I=1,NDIM          HPC00200
22     8 AUX(4,I)=DERY(I)          HPC00210
23     IS=1          HPC00220
24     GO TO 100          HPC00230
25     X=X+H          HPC00240
26     DO 10 I=1,NDIM          HPC00250
27     10 AUX(2,I)=Y(I)          HPC00260
28     11 IHLF=IHLF+1          HPC00270
29     X=X-H          HPC00280
30     DO 12 I=1,NDIM          HPC00290
31     12 AUX(4,I)=AUX(2,I)          HPC00300
32     IS=2          HPC00310
33     13 X=X+H          HPC00320
34     IS=2          HPC00330
35     GO TO 100          HPC00340
36     13 X=X+H          HPC00350
37     CALL FCT(X,Y+DERY)          HPC00360
38     I=2          HPC00370
39     DO 14 I=1,NDIM          HPC00380
40     AUX(2,I)=Y(I)          HPC00390
41     14 AUX(4,I)=DERY(I)          HPC00400
42     IS=3          HPC00410
43     GO TO 100          HPC00420
44     15 DELT=0          HPC00430
45     16 DO 17 I=1,NDIM          HPC00440
46     16 DELT=DELT+AUX(15,I)*AUX(Y(I)-AUX(4,I))          HPC00450
47     17 DELT=DELT*6667/DELT          HPC00460
48     IF([DELT]-PRM1(4)) 19,19,17          HPC00470
49     17 IF([HLF]-J0) 11,18,18          HPC00480
50     18 IHLF=11          HPC00490
51     X=X+H          HPC00500
52     GO TO 4          HPC00510
53     19 X=X+H          HPC00520
54     CALL FCT(X,Y+DERY)          HPC00530
55     DO 20 I=1,NDIM          HPC00540
56     20 AUX(3,I)=Y(I)          HPC00550
57     20 AUX(10,I)=DERY(I)          HPC00560
58     IS=3          HPC00570
59     GO TO 100          HPC00580
60     18 X=X+H          HPC00590
61     IS=1          HPC00600
62     18 X=X+H          HPC00610
63     CALL FCT(X,Y+DERY)          HPC00620
64     X=X-Y(I)          HPC00630
65     DO 22 I=1,NDIM          HPC00640
66     22 AUX(11,I)=DERY(I)          HPC00650
67     22 Y(I)=AUX(1,I)+*(L,.375*AUX(8,I)+C/.7916667*AUX(9,I))          HPC00660
       J=-.2083333*AUX(10,I)+U,.0166667*DERY(I)
68     23 X=X+H          HPC00670
69     IS=1          HPC00680
70     CALL FCT(X,Y+DERY)          HPC00690
71     CALL LUTP(X,Y+DERY,[HLF,NDIM,PRM1])          HPC00700
72     IF(PRM1(5)) 6,24,6          HPC00710
73     24 IF(N=4) 25,200,200          HPC00720
74     DO 25 I=1,NDIM          HPC00730
75     25 AUX(4,I)=Y(I)          HPC00740
76     26 AUX(4,I)=DERY(I)          HPC00750
77     26 IF(N=3) 27,29,200          HPC00760
78     27 DO 28 I=1,NDIM          HPC00770
79     28 DELT=AUX(5,I)*AUX(9,I)          HPC00780
80     DELT=DELT+DELT          HPC00790
81     29 Y(I)=AUX(1,I)+U+.375*(AUX(8,I)+DELT+AUX(10,I))          HPC00800
82     GO TO 23          HPC00810
83     29 DO 30 I=1,NDIM          HPC00820
84     30 DELT=AUX(9,I)*AUX(10,I)          HPC00830
85     DELT=DELT+DELT          HPC00840
86     30 Y(I)=AUX(1,I)+U+.375*(AUX(8,I)+DELT+AUX(10,I))          HPC00850
87     GO TO 23          HPC00860
88     100 DO 101 I=1,NDIM          HPC00870
89     Z=H*AUX(1,I)          HPC00880
90     Z=H*AUX(1,I)*Z          HPC00890
91     101 Y(I)=AUX(1,I)+U+.4*I          HPC00900
92     Z=X+U+.4*I          HPC00910
93     CALL FCT(Z,Y+DERY)          HPC00920
94     DO 102 I=1,NDIM          HPC00930
95     Z=H*DERY(I)          HPC00940
96     AUX(6,I)=Z          HPC00950
97     102 Y(I)=AUX(1,I)+          HPC00960
98     Z=AUX(6,I)+          HPC00970
99     102 Y(I)=AUX(1,I)+U-.2959776*AUX(5,I)+U.1587596*I          HPC00980
100    Z=U+0.4557372*I          HPC00990
101    CALL FCT(Z,Y+DERY)          HPC01000
102    DO 103 I=1,NDIM          HPC01010
103    Z=H*DERY(I)          HPC01020
104    AUX(7,I)=Z          HPC01030
105    103 Y(I)=AUX(1,I)+U+.2181004*AUX(5,I)+U.050965*AUX(6,I)+3.83286*I          HPC01040
106    Z=X+H          HPC01050
107    DO 104 I=1,NDIM          HPC01060
108    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01070
109    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01080
110    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01090
111    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01100
112    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01110
113    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01120
114    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01130
115    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01140
116    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01150
117    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01160
118    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01170
119    104 Y(I)=AUX(1,I)+U.1747603*AUX(5,I)+U.5514807*AUX(6,I)+U.20556*AUX(7,I)+U.171848*DERY(I)          HPC01180

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117      DO 205 I=1,NDIM          HPC01190
118      AUX(N-1,I)=Y(I)        HPC01200
119      205 AUX(N+6,I)=DERY(I) HPC01210
120      X=X+H                  HPC01220
121      206 ISTEP=ISTEP+1       HPC01230
122      DO 207 I=1,NDIM          HPC01240
123      DELT=AUX(N-4,I)+1.333333*H*(AUX(N+6,I)+AUX(N+6,I)-AUX(N+5,I)+ HPC01250
124      1  AUX(N+4,I)+AUX(N+4,I) HPC01260
125      Y(I)=DELT-0.9256198*AUX(16,I) HPC01270
126      207 AUX(16,I)=DELT          HPC01280
127      CALL FCT(X,Y,DERY)        HPC01290
128      DO 208 I=1,NDIM          HPC01300
129      DELT=0.125*(9.*AUX(N-1,I)-AUX(N-3,I)+3.*H*(DERY(I)+AUX(N+6,I)+ HPC01310
130      1  AUX(N+6,I)-AUX(N+5,I))) HPC01320
131      AUX(16,I)=AUX(16,I)-DELT          HPC01330
132      208 Y(I)=DELT-0.7438017*AUX(16,I) HPC01340
133      DO 209 I=1,NDIM          HPC01350
134      209 DELT=DELT+AUX(15,I)*ABS(AUX(16,I)) HPC01360
135      IF(DELT-PRMT(4)) 1000,222,222 HPC01370
136      1000 IF(H<(X-PRMT(2))) 210,210,1001 HPC01380
137      210 CALL FCT(X,Y,DERY)        HPC01400
138      CALL OUTP(X,Y,DERY,IMLF,NDIM,PRMT) HPC01410
139      IF(PRMT(5)) 212,211,212 HPC01420
140      211 IF(IMLF=11) 213,212,212 HPC01430
141      212 RETURN          HPC01440
142      213 IF(H<(X-PRMT(2))) 214,212,212 HPC01450
143      1001 X=PRMT(2)          HPC01460
144      GO TO 206          HPC01470
145      214 IF(CABS(X-PRMT(2))-0.1*ABS(H)) 212,215,215 HPC01480
146      215 IF(DELT-0.02*PRMT(4)) 216,216,201 HPC01490
147      216 IF(IMLF) 201,201,217 HPC01500
148      217 IF(N=7) 201,218,218 HPC01510
149      218 IF(ISTEP>4) 201,219,219 HPC01520
150      219 IMOD=ISTEP/2          HPC01530
151      IF(ISTEP-IMOD-IMOD) 201,220,201 HPC01540
152      220 H=H+H          HPC01550
153      IMLF=IMLF-1          HPC01560
154      ISTEP=0          HPC01570
155      DO 221 I=1,NDIM          HPC01580
156      AUX(N-1,I)=AUX(N-2,I)          HPC01590
157      AUX(N-2,I)=AUX(N-4,I)          HPC01600
158      AUX(N-3,I)=AUX(N-6,I)          HPC01610
159      AUX(N+0,I)=AUX(N+5,I)          HPC01620
160      AUX(N+5,I)=AUX(N+3,I)          HPC01630
161      AUX(N+4,I)=AUX(N+1,I)          HPC01640
162      DELT=AUX(N+6,I)+AUX(N+5,I)          HPC01650
163      DELT=DELT+DELT+DELT          HPC01660
164      221 AUX(16,I)=8.962963*(Y(I)-AUX(N-3,I))-3.361111*H*(DERY(I)+DELT HPC01670
165      1  +AUX(N+4,I))          HPC01680
166      GO TO 201          HPC01690
167      222 IMLF=IMLF+1          HPC01700
168      IF(IMLF=10) 223,223,210          HPC01710
169      223 H=H*0.5          HPC01720
170      ISTEP=0          HPC01730
171      DO 224 I=1,NDIM          HPC01740
172      Y(I)=0.00390625*(80.*AUX(N-1,I)+135.*AUX(N-2,I)+40.*AUX(N-3,I)+ HPC01750
173      140.*AUX(N-4,I))-0.1171875*(AUX(N+6,I)-6.*AUX(N+5,I)-AUX(N+4,I))*H HPC01760
174      AUX(N-4,I)=0.00390625*(12.*AUX(N-1,I)+135.*AUX(N-2,I)+ HPC01770
175      110.*AUX(N-3,I)+AUX(N+4,I))-0.0234375*(AUX(N+6,I)+18.*AUX(N+5,I)- HPC01780
176      29.*AUX(N+4,I))*H          HPC01790
177      AUX(N-3,I)=AUX(N-2,I)          HPC01800
178      224 AUX(N+4,I)=AUX(N+5,I)          HPC01810
179      X=X-H          HPC01820
180      175 DELT=X=(H+H)          HPC01830
181      CALL FCT(DELT,Y,DERY)        HPC01840
182      DO 225 I=1,NDIM          HPC01850
183      AUX(N-2,I)=Y(I)          HPC01860
184      AUX(N+4,I)=DERY(I)        HPC01870
185      225 Y(I)=AUX(N+4,I)          HPC01880
186      DELT=DELT-(H+H)          HPC01890
187      CALL FCT(DELT,Y,DERY)        HPC01900
188      DO 226 I=1,NDIM          HPC01910
189      DELT=AUX(N+5,I)+AUX(N+4,I)          HPC01920
190      DELT=DELT+DELT+DELT          HPC01930
191      AUX(16,I)=8.962963*(AUX(N-1,I)-Y(I))-3.361111*H*(AUX(N+6,I)+DELT HPC01940
192      1  *DERY(I))          HPC01950
193      226 AUX(N+3,I)=DERY(I)          HPC01960
194      GO TO 206          HPC01970
195      END          HPC01980

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1      SUBROUTINE QSF(H,Y,Z,NDIM)          QSF00010
C
C** INTEGRATION BY SIMPSON'S METHOD          QSF00020
C      H --- MESH WIDTH, Y --- INTEGRAND(ARRAY VARIABLE),
C      Z --- RESULTS(ARRAY VARIABLE), NDIM --- NO. OF GRID POINTS          QSF00030
C      QSF GIVES THE RESULTS AT EACH GRID POINT, Z(1)+Z(2)+...+Z(NDIM)          QSF00040
C
C      DIMENSION Y(1),Z(1)          QSF00050
C      HT=0.3333333*H          QSF00060
C      IF(NDIM=5) 7,8,1          QSF00070
1   SUM1=Y(2)+Y(2)          QSF00080
2   SUM1=SUM1+SUM1          QSF00090
3   SUM1=HT*(Y(1)+SUM1+Y(3))          QSF00100
4   AUX1=Y(4)+Y(4)          QSF00110
5   AUX1=AUX1+AUX1          QSF00120
6   AUX1=SUM1+HT*(Y(3)+AUX1+Y(5))          QSF00130
7   AUX2=HT*(Y(1)+3.875*(Y(2)+Y(5))+2.625*(Y(3)+Y(4))+Y(6))          QSF00140
8   AUX2=AUX2+HT*(Y(4)+SUM2+Y(6))          QSF00150
9   SUM2=SUM2+SUM2          QSF00160
10  SUM2=AUX2-HT*(Y(4)+SUM2+Y(6))          QSF00170
11  Z(2)=SUM2-AUX2          QSF00180
12  Z(3)=SUM1          QSF00190
13  Z(4)=SUM2          QSF00200
14  Z(1)=0.0          QSF00210
15  AUX=Y(3)+Y(3)          QSF00220
16  AUX=AUX+AUX          QSF00230
17  Z(2)=SUM2-HT*(Y(2)+AUX+Y(4))          QSF00240
18  Z(3)=SUM1          QSF00250
19  Z(4)=SUM2          QSF00260
20  Z(1)=0.0          QSF00270
21  IF(NDIM=6) 5,5,2          QSF00280
22  DO 4 I=7,NDIM+2          QSF00290
23  SUM1=AUX1          QSF00300
24  SUM2=AUX2          QSF00310
25  AUX1=Y(I-1)+Y(I-1)          QSF00320
26  AUX1=AUX1+AUX1          QSF00330
27  AUX1=SUM1+HT*(Y(I-2)+AUX1+Y(I))          QSF00340
28  Z(I-2)=SUM1          QSF00350
29  IF(I=NDIM) 3,6,6          QSF00360
30  AUX2=Y(I)+Y(I)          QSF00370
31  AUX2=AUX2+AUX2          QSF00380
32  AUX2=SUM2+HT*(Y(I-1)+AUX2+Y(I+1))          QSF00390
33  Z(I-1)=SUM2          QSF00400
34  Z(NDIM)=AUX1          QSF00410
35  Z(NDIM)=AUX2          QSF00420
36  RETURN          QSF00430
37  Z(NDIM-1)=SUM2          QSF00440
38  Z(NDIM)=AUX1          QSF00450
39  RETURN          QSF00460
40  IF(NDIM=3) 12,11,8          QSF00470
41  SUM2=1.125*HT*(Y(1)+Y(2)+Y(2)+Y(3)+Y(3)+Y(3)+Y(4))          QSF00480
42  SUM1=Y(2)+Y(2)          QSF00490
43  SUM1=SUM1+SUM1          QSF00500
44  SUM1=HT*(Y(1)+SUM1+Y(3))          QSF00510
45  Z(1)=0.0          QSF00520
46  AUX1=Y(3)+Y(3)          QSF00530
47  AUX1=AUX1+AUX1          QSF00540
48  Z(2)=SUM2-HT*(Y(2)+AUX1+Y(4))          QSF00550
49  IF(NDIM=5) 10,9,9          QSF00560
50  9  AUX1=Y(4)+Y(4)          QSF00570
51  AUX1=AUX1+AUX1          QSF00580
52  Z(5)=SUM1+HT*(Y(3)+AUX1+Y(5))          QSF00590
53  10 Z(3)=SUM1          QSF00600
54  Z(4)=SUM2          QSF00610
55  RETURN          QSF00620
56  11 SUM1=HT*(1.25*Y(1)+Y(2)+Y(2)-0.25*Y(3))          QSF00630
57  SUM2=Y(2)+Y(2)          QSF00640
58  SUM2=SUM2+SUM2          QSF00650
59  Z(3)=HT*(Y(1)+SUM2+Y(3))          QSF00660
60  Z(1)=0.0          QSF00670
61  Z(2)=SUM1          QSF00680
62  12 RETURN          QSF00690
63  END

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1      SUBROUTINE EIGTRI(NN,IER)
2      LOGICAL FIRST,IN
3      INTEGER AG
4      DOUBLE PRECISION PKT
5      DOUBLE PRECISION A(UL,V,OX,SOX)
6      DOUBLE PRECISION E
7      DOUBLE PRECISION LAMBDA,NORM,L,T,U,S,MULT
8      DOUBLE PRECISION ERR,Y1(20),YMAX,S(20)
9      DOUBLE PRECISION PC(20),YC(22),BC(20),C(20),W(20),R(20)
10     DIMENSION IN(20)
11     COMMON/EIV/E(20),V(20,20),OX(20),SOX(20)
12     COMMON/CMF/A(20,20),UL(23,20)
13     N=NN
14     IER=0
15     NORM=DABS(A(1,1))+DABS(A(1,2))
16     NI=N-1
17     DO 2010 I=2,N1
18     T=DABS(A(I,I))+DABS(A(I,I+1))+DABS(A(I,I-1))
19     2010 NORM=DMAX1(NORM,T)
20     T=DABS(A(N,N))+DABS(A(N,N-1))
21     NORM=DMAX1(NORM,T)
22     DO 2011 I=2,N
23     2011 W(I)=A(I-1,I)*A(I,I-1)
24     K=1
25     U=1.0
26     DO 2012 I=1,N
27     2012 E(I)=NORM
28     ITER=0
29     2013 L=E(I)
30     2014 LAMBDA=0.500*(L+U)
31     IF(DABS(LAMBDA-E(I)) .LE. 1.0E-8) GO TO 2030
32     AG=0
33     I=1
34     S=A(I,I)-LAMBDA
35     IF(S.GE.0.0) AG=AG+1
36     IF(S.LE.0.0) GO TO 2020
37     I=I+1
38     IF(I.GT.N) GO TO 2020
39     S=A(I,I)-LAMBDA-W(I)/S
40     GO TO 2018
41     2020 I=I+2
42     IF(I.LE.N) GO TO 2016
43     2022 IF(AG.GE.1) GO TO 2024
44     U=LAMBDA
45     CU TO 2014
46     2024 L=LAMBDA
47     M=MNUKA(G,E,I)
48     DO 2026 I=K,M
49     2026 E(I)=LAMBDA
50     ITER=ITER+1
51     IF(ITER.GT.2000) GO TO 2040
52     GO TO 2014
53     2030 E(K)=LAMBDA
54     K=K+1
55     IF(K.LE.N) GO TO 2013
56     2040 CONTINUE
57     DO 2082 J=1,N
58     DO 2044 J1=1,N1
59     B(J1)=0.0
60     S(J1)=A(J,J)+E(I)
61     R(J1)=A(J,J)-E(I)
62     B(J1)=B(J1,J)
63     2044 Y(J1)=1.00
64     Y(N1)=1.00
65     B(N1)=0.
66     S(N1)=0.
67     R(N1)=AN(N,J)-E(I)
68     Y(N1)=0.0
69     Y(N2)=0.0
70     FIRST=.TRUE.
71     DO 2050 J1=1,N1
72     IF(DABS(R(J1)).LT.DABS(S(J1))) GO TO 2046
73     MULT=R(J1)/R(J)
74     IN(J1)=.FALSE.
75     GO TO 2048
76     2046 MULT=R(J1)/S(J)
77     IN(J1)=.TRUE.
78     R(J1)=B(J1)
79     T=R(J1+1)
80     R(J1+1)=S(J)
81     S(J)=T
82     P(J)=G(J+1)
83     G(J+1)=0.0
84     2048 W(J)=MULT
85     S(J+1)=R(J+1)-MULT*P(J)
86     P(J+1)=R(J+1)-MULT*S(J)
87     IF(S(J).EQ.0.0) R(J)=1.0E-30
88     2050 CONTINUE
89     IF(R(N).EQ.0.0) R(N)=1.0E-30
90     2054 CONTINUE
91     DO 2060 I=1,N
92     DO 2066 J1=1,N1
93     K=N-J1+1
94     T=Y(K)
95     2062 Y(K)=(T-Y(K+1)*R(K)-Y(K+2)*P(K))/R(K)
96     2066 CONTINUE
97     ERRO=0.
98     T=DABS(Y(1))
99     K=1
100    DO 100 J=2,N
101    S=DABS(Y(J))
102    IF(S.LE.T) GO TO 100
103    T=S
104    K=J
105    100 CONTINUE
106    T=1.0/Y(1)
107    DO 101 J=1,N
108    101 Y(J)=Y(J)*T
109    IF(J1.EQ.1) GO TO 201
110    DO 102 K=1,N
111    102 ERR=ERR+DABS(Y(K)-Y1(K))
112    ERR=ERR/N
113    IF(ERR.LE.1.E-5) GO TO 2074
114    IF(J1.EQ.4) GO TO 200
115    201 DO 223 K=1,N
116    223 Y1(K)=Y(K)
117    DO 2070 J=1,N1
118    IF(INC(J)) GO TO 2068

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119      Y(J+1)=Y(J+1)-W(J)*Y(J)          E1G01190
120      GO TO 2070                      E1G01200
121      2068 T=Y(J)                     E1G01210
122      Y(J+1)=Y(J+1)                   E1G01220
123      Y(J+1)=T-W(J)*Y(J+1)           E1G01230
124      2070 CONTINUE                  E1G01240
125      200 CONTINUE                   E1G01250
126      WRITE(6,600) ERR,I,E(I)        E1G01260
127      |ER=1                          E1G01270
128      2074 CONTINUE                  E1G01280
129      DO 2082 J=1,N                 E1G01290
130      2082 V(J+1)=Y(J)             E1G01300
131      DO 2083 I=1,N                 E1G01310
132      DO 2083 J=1,N                 E1G01320
133      A(I,J)=V(I,J)              E1G01330
134      2083 CONTINUE                  E1G01340
135      601 FORMAT(1P8E12.3)          E1G01350
136      CALL DECOMP(N)               E1G01360
137      CALL SOLVE(N,OX,C,IE)       E1G01370
138      IF(IE,E0,1) GO TO 5000      E1G01380
139      CALL IMPRUVCN(OX,C,DIGITS) E1G01390
140      RETURN                         E1G01400
141      5000 CONTINUE                  E1G01410
142      DO 1001 I=1,N                 E1G01420
143      305 C(I)=OX(I)              E1G01430
144      DO 1001 J=1,N                 E1G01440
145      A(I,J)=V(I,J)              E1G01450
146      1001 CONTINUE                  E1G01460
147      CALL DMATI(N+1,C)           E1G01470
148      RETURN                         E1G01480
149      ENTRY FUCJ1(DT,M1,M2)       E1G01490
150      DO 303 I=M1,N2                E1G01500
151      OX(I)=0.0                    E1G01510
152      DO 304 K=1,N                 E1G01520
153      21 PKT*E(K)*DT              E1G01530
154      IF(PKT.LE.(-70.0)) GO TO 304 E1G01540
155      OX(I)=OX(I)+C(K)*V(I,K)*DEXP(PKT) E1G01550
156      304 CONTINUE                  E1G01560
157      303 CONTINUE                  E1G01570
158      RETURN                         E1G01580
159      600 FORMAT(1H /, ' EIGEN VECTOR DOES NOT CONVERGE!', ERR =',
160      *     1PE12.3, ' I =',I5,' E(I) =',1PE12.3/) E1G01590
160      END                           E1G01600
1   SUBROUTINE DMATI(NN,M,B)
2   DOUBLE PRECISION A+UL
3   DOUBLE PRECISION B,DETERM,AMAX,T,SWAP,PIVOT
4   DIMENSION F(1)
5   COMMON/CMF/A(2U,2U),UL(23,20)
6   DIMENSION [PIVOT(59),INDEX1(59),INDEX2(59),PIVOT(59)]
7   EQUIVALENCE([IROW,JROW],[ICOLUMN,JCOLUMN],[AMAX,T],SWAP)
C   INITIALIZATION
8   NN
9   DO 20 J=1,N
10  20 PIVOT(J)=0
11  DO 555 I=1,N
C   SEARCH FOR PIVOT ELEMENT
12  AMAX=0.0
13  DO 105 J=1,N
14  IF(PIVOT(J).EQ.1) GO TO 105
15  DO 100 K=1,N
16  IF(PIVOT(K).EQ.1) GO TO 100
17  80 IF(DABS(AKMAX).GE.DABS(AJ,K))) GO TO 100
18  IROW=J
19  ICOLUMN=K
20  AMAX=A(J,K)
21  100 CONTINUE
22  105 CONTINUE
23  1PIVOT(ICOLUMN)=1PIVOT(ICOLUMN)+1
C   INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL
24  IF(IROW.EQ.ICOLUMN) GO TO 260
25  DO 200 L=1,N
26  SWAP=A(IROW,L)
27  A(IROW,L)=A(ICOLUMN,L)
28  A(ICOLUMN,L)=SWAP
29  IF(M,EN,0) GO TO 260
30  SWAP=B(IROW)
31  B(IROW)=B(ICOLUMN)
32  B(ICOLUMN)=SWAP
33  260 INDEX1(I)=IROW
34  INDEX2(I)=ICOLUMN
35  PIVOT(I)=AC(ICOLUMN,ICOLUMN)
C   DIVIDE PIVOT ROW BY PIVOT ELEMENT
36  AC(ICOLUMN,ICOLUMN)=1.0
37  DO 350 L=1,N
38  IF(DABS(AC(ICOLUMN,L)).LT.1.E-30) AC(ICOLUMN,L)=0.0
39  350 AC(ICOLUMN,L)=AC(ICOLUMN,L)/PIVOT(I)
40  IF(M,EN,0) GO TO 380
41  IF(ICOLUMN)=B(ICOLUMN)/PIVOT(I)
C   REDUCE NON-PIVOT ROWS
42  380 DO 550 L=1,N
43  IF(L1,E0,ICOLUMN) GO TO 550
44  T=AC(L1,ICOLUMN)
45  AC(L1,ICOLUMN)=0.0
46  DO 450 L=1,N
47  IF(DABS(AC(ICOLUMN,L)).LT.1.E-30) AC(ICOLUMN,L)=0.0
48  IF(DABS(T).LT.1.E-30) T=0.0
49  450 AC(L1,L)=AC(L1,L)-AC(ICOLUMN,L)*T
50  IF(M,EN,0) GO TO 550
51  B(L1)=B(L1)-B(ICOLUMN)*T
52  550 CONTINUE
53  555 CONTINUE
C   INTERCHANGE COLUMNS

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54      DO 710 I=1,N          DMT00600
55      L=N+1-I          DMT00610
56      IF(LINDEX1(L),EQ,INDEX2(L)) GO TO 710
57      JROW=INDEX1(L)          DMT00620
58      JCOLUMN=INDEX2(L)          DMT00630
59      DO 700 K=1,N          DMT00640
60      SWAP=A(K,JROW)          DMT00650
61      A(K,JCOLUMN)=A(K,JCOLUMN)          DMT00660
62      700 A(K,JCOLUMN)=SWAP          DMT00670
63      710 CONTINUE          DMT00680
64      740 RETURN          DMT00690
65      END          DMT00700
1      SUBROUTINE DECOMP(NN)          DEC00010
2      DOUBLE PRECISION A+UL          DEC00020
3      DOUBLE PRECISION SCALES,RO*NRM,BIG,SIZE,PIVOT,EM          DEC00030
4      DIMENSION SCALES(20)          DEC00040
5      COMMON/CMF/A(20,20),UL(23,20)          DEC00050
6      COMMON/DES/IPS(20)          DEC00060
7      N=NN          DEC00070
8      DO 5 I=1,N          DEC00080
9      IPS(I)=1          DEC00090
10     ROWNRM=0.0          DEC00100
11     DO 2 J=1,N          DEC00110
12     UL(I,J)=A(I,J)          DEC00120
13     IF(ROWNRM=DABS(UL(I,J))) 1,2,2          DEC00130
14     1 ROWNRM=DABS(UL(I,J))          DEC00140
15     2 CONTINUE          DEC00150
16     IF(ROWNRM) 3,4,3          DEC00160
17     3 SCALES(I)=1.000/ROWNRM          DEC00170
18     GO TO 5          DEC00180
19     4 CALL SING(1)          DEC00190
20     SCALES(I) =0.0          DEC00200
21     5 CONTINUE          DEC00210
22     NM1=N-1          DEC00220
23     DO 17 K=1,N,M1          DEC00230
24     BIG=0.0          DEC00240
25     DO 11 I=K,N          DEC00250
26     IP=IPS(I)          DEC00260
27     SIZE=DABS(UL(IP,K))*SCALES(IP)          DEC00270
28     IF(SIZE=BIG) 11,11,10          DEC00280
29     10 BIG=SIZE          DEC00290
30     IDXPIV=I          DEC00300
31     11 CONTINUE          DEC00310
32     12 CALL SING(2)          DEC00320
33     GO TO 17          DEC00330
34     13 IF(IDXPIV=I) 14,15,14          DEC00340
35     14 J=IPS(K)          DEC00350
36     IPS(K)=IPS(IDXPIV)          DEC00360
37     IPS(IDXPIV)=J          DEC00370
38     15 KP=IPS(K)          DEC00380
39     PIVOT=UL(KP,K)          DEC00390
40     KP1=K+1          DEC00400
41     DO 16 I=KP1,N          DEC00410
42     IP=IPS(I)          DEC00420
43     EM=UL(IP,K)/PIVOT          DEC00430
44     UL(IP,K)=-EM          DEC00440
45     DO 16 J=KP1,N          DEC00450
46     IF(DABS(EM),LE,1.0E-20) EM=0.0          DEC00460
47     IF(DABS(UL(KP,J)),LE,1.0E-20) UL(KP,J)=0.0          DEC00470
48     UL(IP,J)=UL(IP,J)+EM*UL(KP,J)          DEC00480
49     18 UL(KP,N)=1.0D-20          DEC00490
50     16 CONTINUE          DEC00500
51     17 CONTINUE          DEC00510
52     KP=IPS(N)          DEC00520
53     IF(UL(KP,N)) 19,18,19          DEC00530
54     19 UL(KP,N)=1.0D-20          DEC00540
55     19 RETURN          DEC00550
56     END          DEC00560

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1      SUBROUTINE SOLVE(NN,B,X,IE)          SOL00010
2      DOUBLE PRECISION A+UL              SOL00020
3      DOUBLE PRECISION B+X              SOL00030
4      DOUBLE PRECISION SUM              SOL00040
5      DIMENSION B(1),X(1)                SOL00050
6      COMMON/CMF/A(20,20),UL(23,20)     SOL00060
7      COMMON/DES/IPS(20)               SOL00070
8      IE=0                            SOL00080
9      NN=NN                           SOL00090
10     NP1=N+1                         SOL00100
11     IP=IPS(1)                      SOL00110
12     X(1)=B(1,P)                    SOL00120
13     DO 2 I=2,N                     SOL00130
14     IP=IPS(I)                      SOL00140
15     IM1=I-1                        SOL00150
16     SUM=0.0                         SOL00160
17     DO 1 J=1,IM1                   SOL00170
18     1 SUM=SUM+UL(IP,J)*X(J)        SOL00180
19     2 X(1)=B(1,P)-SUM             SOL00190
20     10 IP=IPS(N)                  SOL00200
21     IF(UL(IP,N),E,0.000) GO TO 100 SOL00210
22     X(N)=X(N)/UL(IP,N)           SOL00220
23     DO 4 IBACK=2,N                SOL00230
24     I=NP1-IBACK                 SOL00240
25     IP=IPS(I)                      SOL00250
26     IP1=I+1                       SOL00260
27     SUM=0.0                         SOL00270
28     DO 3 J=IP1,N                  SOL00280
29     3 SUM=SUM+UL(IP,J)*X(J)        SOL00290
30     IF(UL(IP,I),E,0.000) GO TO 100 SOL00300
31     4 X(I)=(X(I)-SUM)/UL(IP,I)    SOL00310
32     RETURN                         SOL00320
33     100 IE=1                      SOL00330
34     RETURN                         SOL00340
35     END                            SOL00350
36
37     SUBROUTINE IMPRUV(NN,B,X,DIGITS)
38     DOUBLE PRECISION A+UL            IMR00010
39     DOUBLE PRECISION B,X,R,DX,T    IMR00020
40     DOUBLE PRECISION SUM+A1J,XJ   IMR00030
41     DIMENSION B(1),X(1),R(20),DX(20) IMR00040
42     COMMON/CMF/A(20,20),UL(23,20) IMR00050
43     NP1=NN                          IMR00060
44     EPS=1.E-7                      IMR00070
45     ITMAX=3                         IMR00080
46
47     C
48     XNORM=0.0                        IMR00090
49     DO 1 I=1,N                      IMR00100
50     X1=DABS(X(I))                  IMR00110
51     1 XNORM=AMAX1(XNORM,X1)        IMR00120
52     IF (XNORM>3.2E3)                IMR00130
53     2 CONTINUE                      IMR00140
54     GO TO 10                         IMR00150
55     C
56     3 DO 9 ITER=1,ITMAX            IMR00160
57     4 DO 5 I=1,N                   IMR00170
58     5 SUM=0.0                        IMR00180
59     6 DO 4 J=1,N                   IMR00190
60     7 A1J=A(I,J)                  IMR00200
61     8 XJ=X(J)                      IMR00210
62     9 SUM=SUM+A1J*XJ               IMR00220
63     10 H(I)=SUM                   IMR00230
64     11 CALL SOLVE(N,H,DX,IE)       IMR00240
65     12 DANORM=0.0                   IMR00250
66     13 DO 6 I=1,N                  IMR00260
67     14 T=X(I)                      IMR00270
68     15 X(I)=X(I)+DX(I)            IMR00280
69     16 X1=DABS(X(I)-T)            IMR00290
70     17 DANORM=AMAX1(DANORM+X1)     IMR00300
71     18 CONTINUE                     IMR00310
72     19 IF (ITER>1) 8,7,8          IMR00320
73     20 DIGITS=ALOG10(AMAX1(DXNORM/XNORM,EFS)) IMR00330
74     21 IF (DXNORM>EPS*XNORM) 10,10,9 IMR00340
75     22 9 CONTINUE                   IMR00350
76     23 ITERATION DID NOT CONVERGE IMR00360
77     24 10 RETURN                   IMR00370
78     25 END                         IMR00380
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1      SUBROUTINE SINGL(NMY)                               SNG00010
2      11 FORMAT(54H MATRIX WITH ZERO ROW IN DECOMPOSE,    ) SNG00020
3      12 FORMAT(54H SINGULAR MATRIX IN DECOMPOSE, ZERO DIVIDE IN SOLVE, ) SNG00030
4      13 FORMAT(54H NO CONVERGENCE IN IMPROV, MATRIX IS NEARLY SINGULAR, ) SNG00040
5          NOUT=6
6          GO TO (1,2,3) ,IMNY
7          1 WRITE(NOUT,11)
8          GO TO 10
9          2 WRITE(NOUT,12)
10         GO TO 10
11         3 WRITE(NOUT,13)
12         10 RETURN
13         END
1
1      SUBROUTINE PLTSRT
C
C** OPEN THE PLOTTER ROUTINE
C
2      DIMENSION BUFFER(1024)
3      CALL PLOTS(BUFFER(1),1024)
4      CALL PLOT(100.0,50.0, -3)
5      RETURN
6      END
1
1      SUBROUTINE PLTEND
C
C** CLOSE THE PLOTTER ROUTINE
C
2      CALL PLOT(0.0,0.0,999)
3      RETURN
4      END

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SNG00050
SNG00060
SNG00070
SNG00080
SNG00090
SNG00100
SNG00110
SNG00120
SNG00130
PLT00010
PLT00020
PLT00030
PLT00040
PLT00050
PLT00060
PLT00070
PLT00080
PLT00090
PLT00100
PLT00110
PLT00120
PLT00130
PLT00140
PLT00150
PLT00160

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1      SUBROUTINE PLTIME
2      COMMON/KKJJ,KMAX,KLMAX,LMAX
3      COMMON/VST/PLOTX(1000),PLOTY(9,1000),NSMAX
4      COMMON/FLNS/NSU
5      DIMENSION SM(9)
6      DIMENSION XI(1000),YI(9,1000)
7      CALL PLOT(300,0,0,0,-3)
8      CALL PLOT(210,0,0,0,2)
9      CALL PLOT(180,0,0,0,3)
10     CALL PLOT(180,0,-2,0,2)
11     CALL PLOT(150,0,0,0,3)
12     CALL PLOT(150,0,-2,0,2)
13     CALL PLOT(120,0,0,0,3)
14     CALL PLOT(120,0,-2,0,2)
15     CALL PLOT(90,0,0,0,3)
16     CALL PLOT(90,0,-2,0,2)
17     CALL PLOT(60,0,0,0,3)
18     CALL PLOT(60,0,-2,0,2)
19     CALL PLOT(30,0,0,0,3)
20     CALL PLOT(30,0,-2,0,2)
21     CALL PLOT(0,0,0,0,3)
22     CALL PLOT(0,0,0,0,2)
23     DO 100 K=1,KMAX
24   100 SM(K)=AMAX1(PLOTY(K,1),PLOTY(K,2))
25     DO 110 K=1,KMAX
26     110 NS(1)=NSMAX
27     110 SM(K)=AMAX1(SM(K),PLOTY(K,NS))
28     DO 120 K=1,KMAX
29     120 YI(K,NS)=PLOTY(K,NS)/SM(K)*60.0
30     DO 130 NS=1,NSMAX
31   130 X(1,NS)=3.0*PLOTX(NS)/1.0E-3
32     DO 140 K=1,KMAX
33     140 CALL PLOT(X(1,1),YI(K,1),3)
34     DO 140 NS=1,NSMAX
35     140 CALL PLOT(X(1,NS),YI(K,NS),2)
36     140 CONTINUE
37     CALL PLOT(200,0,0,0,-3)
38     DO 150 J=1,1000
39   150 PLOTX(J)=0
40     DO 150 K=1,9
41   150 PLOTY(K,J)=0.0
42     150 CONTINUE
43     NS=0
44     RETURN
45   END
46   SUBROUTINE PLTIN
47   REAL NC,NALL
48   REAL N1,N2
49   REAL JZ
50   REAL R0,I10
51   COMMON/SCA/T0,NU,LTO,RU,RU
52   COMMON/PMT/RMAJ,RTUBE,ASPECT,Z,ANG,NC,NWALL,TEC,TEWAL,TIC,TIWAL,
53   COMMON/TIME,THIN,THMAX,UT,DT,UTMIN,DTMX,DTMAX,
54   COMMON/MSH,JMAX,JMAX1,DX,DHM,EPS,NPRNT,NCONT
55   COMMON/ZINK/N1(59),TE1(59),T11(59),BZ1(59),BT1(59),
56   * N2(59),TE2(59),T12(59),BZ2(59),BT2(59)
57   COMMON/RDIK/(59),RH(59),DRH(59),DRH(59)+DRJ(59),DRM(59)
58   COMMON/SAK/JZ(59),YOTAC(59),EZV(59)
59   COMMON/DSA/STINE(30)
60   COMMON/PLO/NPLOT
61   LOGICAL YUSU,KAIRO,IMPRIV,NEUTRL,PLTTER,GPHCS
62   COMMON/Log/YUSU,KAIRO,IMPRIV,NEUTRL,PLTTER,GPHCS
63   REAL ND
64   COMMON/NTL/ND(59),TNH(59),TNC(59),AND,EVN
65   DIMENSION YN(59),YTE(59),YT1(59),YT2(59),YEZ(59),YQR(59),XH(59)
66   REAL KE,K1
67   COMMON/TRP/D(59),E(59),K1(59),ETA(59),TAUE(59),TAUEI(59),TAUEI(59),
68   * TAU1(59),XH(59),CRITF(59),CRITI(59)
69   * DIMENSION YND(59),YTH(59)
70   DIMENSION XAXIS(13),YAXIS(13)
71   DOUBLE PRECISION A1,A2
72   DATA A1,A2/SH,LO=1,SHGEUD/
73   DATA WIDTH,HEIGHT/100,0/150,0/
74   DATA FP2,FP4,FP6,FP8,FP10/0.20,0.40,0.60,0.80,1.00/
75   IF(TIME,GT, 9.9E-3,AND,TIME,LT,1.0,1E-3) GO TO 888
76   IF(TIME,GT,19.9E-3,AND,TIME,LT,20.1E-3) GO TO 888
77   IF(TIME,GT,29.9E-3,AND,TIME,LT,30.1E-3) GO TO 888
78   IF(TIME,GT,39.9E-3,AND,TIME,LT,40.1E-3) GO TO 888
79   IF(TIME,GT,49.9E-3,AND,TIME,LT,50.1E-3) GO TO 888
80   RETURN
81   888 CONTINUE
82   FN=FLOAT(NPLOT)
83   JN=JMAX+1
84   DO 10 J=2, JN
85   XH(J)=H(J)/PH(JM1)
86   10 CONTINUE
87   XH(1)=0.0
88   S1=AMAX1(N2(1),N2(2))
89   ST=AMAX1(TE2(1),TE2(2))
90   ST1=AMAX1(T12(1),T12(2))
91   SJ=AMAX1(JZ(1),JZ(2))
92   SJ2=AMAX1(SJ(1),SJ(2))
93   SW=AMAX1(SR,SR(J))
94   DU 20 J=3,JM1
95   S1=AMAX1(SN+N2(J))
96   ST=AMAX1(STE,TE2(J))
97   ST1=AMAX1(ST1,T12(J))
98   SJ2=AMAX1(SJ1,JZ(J))
99   SW=AMAX1(SR,SR(J))
100  20 CONTINUE
101  DU 30 J=1,JM1
102  YN(J)=N2(J)/SH
103  YTE(J)=T2(J)/STE
104  YT1(J)=T12(J)/ST1
105  YJZ(J)=JZ(J)/SJ2

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56      YQR(J)=QR(J)/SQR          PLT01220
57      30 CONTINUE               PLT01230
58      YN(1)=0.5*(YN(1)+YN(2))   PLT01240
59      YTE(1)=0.5*(YTE(1)+YTE(2)) PLT01250
60      YT(1)=0.5*(YT(1)+YT(2))  PLT01260
61      YQR(1)=0.5*(YQR(1)+YQR(2)) PLT01270
62      YJZ(1)=0.5*(YJZ(1)+YJZ(2)) PLT01280
63      CALL PLOT(150.0,0.0,-3)    PLT01290
       AXIS 0 EGAKU             PLT01300
64      DO 302 K=1,11            PLT01310
65      XAXIS(K)=FLOAT(K-1)*0.1   PLT01320
66      YAXIS(K)=FLOAT(K-1)*0.1   PLT01330
67      302 CONTINUE              PLT01340
68      CALL SCALE(XAXIS,100.0,11.1,10.0)  PLT01350
69      CALL AXIS(0.0,0.3*HR/A,-3,100.0,0.0,XAXIS(12),XAXIS(13),10.0) PLT01360
70      CALL PLOT(0.0,0.0,3)         PLT01370
71      CALL PLOT(0.0,150.0,2)      PLT01380
72      CALL PLOT(-2.0,150.0,2)     PLT01390
73      CALL PLOT(0.0,120.0,3)      PLT01400
74      CALL PLOT(-2.0,120.0,2)     PLT01410
75      CALL PLOT(0.0,90.0,3)       PLT01420
76      CALL PLOT(-2.0,90.0,2)      PLT01430
77      CALL PLOT(0.0,60.0,3)       PLT01440
78      CALL PLOT(-2.0,60.0,2)      PLT01450
79      CALL PLOT(0.0,30.0,3)       PLT01460
80      CALL PLOT(-2.0,30.0,2)      PLT01470
81      CALL NUMBER(-10.0,29.0,2.0,FP2 ,0.0,2)  PLT01480
82      CALL NUMBER(-10.0,59.0,2.0,FP4 ,0.0,2)  PLT01490
83      CALL NUMBER(-10.0,89.0,2.0,FP6 ,0.0,2)  PLT01500
84      CALL NUMBER(-10.0,119.0,2.0,FP8 ,0.0,2)  PLT01510
85      CALL NUMBER(-10.0,149.0,2.0,FP10,0.0,2)  PLT01520
86      SNP$NN$NO/1.E13           PLT01530
87      CALL SYMBOL(130.0, 85.0,0.4,0, 7HMAXIMUM ,0.0, 7)  PLT01540
88      CALL SYMBOL(140.0, 75.0,0.4,0,20HN = E13/CC,0.0+20)  PLT01550
89      CALL NUMBER(155.0, 75.0,0.4,0,SNP,0.0,3)  PLT01560
90      CALL SYMBOL(140.0, 65.0,0.4,0,20HTE = EV ,0.0+20)  PLT01570
91      CALL NUMBER(155.0, 65.0,0.4,0,STE+0.0,3)  PLT01580
92      CALL SYMBOL(140.0, 55.0,0.4,0,20HTI = EV ,0.0+20)  PLT01590
93      CALL NUMBER(155.0, 55.0,0.4,0,STI+0.0,3)  PLT01600
94      CALL SYMBOL(140.0, 45.0,0.4,0,25HZJ = AMP/CM**2 ,0.0,25)  PLT01610
95      CALL NUMBER(155.0, 45.0,0.4,0,SJL+0.0,1)  PLT01620
96      CALL SYMBOL(140.0, 25.0,0.4,0,20H8 = ,0.0,20)  PLT01630
97      CALL NUMBER(155.0, 25.0,0.4,0,S6R+0.0,3)  PLT01640
98      CALL NUMBER(140.0,-60.0,0.4,0,FNP+0.0,-1)  PLT01650
99      DO 150 J=1,JM1            PLT01660
100     XH(J)=XH(J)*#10TH        PLT01670
101     YN (J)=YN (J)*HEIGHT    PLT01680
102     YTE(J)=YTE(J)*HEIGHT    PLT01690
103     YT(J)=YT(J)*HEIGHT      PLT01700
104     YJZ(J)=YJZ(J)*HEIGHT    PLT01710
105     YQR(J)=YQR(J)*HEIGHT    PLT01720
106     150 CONTINUE              PLT01730
107     CALL PLOT(XH(1)+YN(1),3)  PLT01740
108     DO 51 J=2,JM1            PLT01750
109     CALL PLOT(XH(J),YN(J),2)  PLT01760
110     51 CONTINUE               PLT01770
111     CALL SYMBOL(XH(4),YN(4),4,0,1HN+0.0,1)  PLT01780
112     CALL PLOT(XH(1)+YTE(1),3)  PLT01790
113     DO 52 J=2,JM1            PLT01800
114     CALL PLOT(XH(J),YTE(J),2)  PLT01810
115     52 CONTINUE               PLT01820
116     CALL SYMBOL(XH(6),YTE(6),4,0,2HTE+0.0,2)  PLT01830
117     CALL PLOT(XH(1)+YT(1),3)  PLT01840
118     DO 53 J=2,JM1            PLT01850
119     CALL PLOT(XH(J)+YT(J),2)  PLT01860
120     53 CONTINUE               PLT01870
121     CALL SYMBOL(XH(8),YT(8),4,0,2HTI+0.0,2)  PLT01880
122     CALL PLOT(XH(1)+YJZ(1),3)  PLT01890
123     DO 54 J=2,JM1            PLT01900
124     CALL PLOT(XH(J)+YJZ(J),2)  PLT01910
125     54 CONTINUE               PLT01920
126     CALL SYMBOL(XH(10),YJZ(10),4,0,2HJL+0.0,2)  PLT01930
127     CALL PLOT(XH(1)+YQR(1),3)  PLT01940
128     DO 56 J=2,JM1            PLT01950
129     CALL PLOT(XH(J)+YQR(J),2)  PLT01960
130     56 CONTINUE               PLT01970
131     CALL SYMBOL(XH(14),YQR(14),4,0,1HW +0.0,1)  PLT01980
132     RETURN                   PLT01990
133     END                      PLT02000

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1      SUBROUTINE PLTREC(X,NN)
2      COMMON/OUTIM/AX(9,59)
3      COMMON/ZEFF/ZEFF(59)
4      COMMON/ZOXY/OXY(59)
5      DIMENSION TOTAL(59)
6      DIMENSION YMAX(9),MJ(9)
7      REAL NCN WALL
8      COMMON/PMT/DRM1,RTURE,ASPECT,Z1,ANO,NC,NWALL,TEC,TEWAL,TIC,TIWAL,
1       TIME,THIN,THIN,DTM,DTMIN,DTMX,DTMAX,
2       NMESH,JMAX,JMAX1,DX,DXH,EPS,NPRINT,NCNT
9       COMMON/RDR/R(59),RH(59),DR(59),DRH(59),DR1(59),DRH1(59)
10      COMMON/KKJJ/KMAX,KLMAX,LMAX
11      DIMENSION AXAIS(20),YAXIS(20)
12      DIMENSION YO(9,59),XH(59)
13      COMMON/PLD/NPLGT
14      LOGICAL OXYGEN,CARBON
15      COMMON/OXCA/OXYGEN,CARBON
16      REAL NO,LTO
17      COMMON/SCA/T0,NU,LTO,RQ,B0
18      DIMENSION AIMP(59)
19      DATA P1,P2,P3/8.0,16.0,24.0/
20      DATA HEIGHT/15TH/180.0,100.0/
21      DATA FP1,FP2,FP4,FP6,FP8,FP10,FP12/2.0,4.0,5.0,8.0,10.0,12.0/
22      IF(X.GT. 9.9E-3,AND,X.LT.10.1E-3) GO TO 886
23      IF(X.GT.19.9E-3,AND,X.LT.20.1E-3) GO TO 888
24      IF(X.GT.29.9E-3,AND,X.LT.30.1E-3) GO TO 888
25      IF(X.GT.39.9E-3,AND,X.LT.40.1E-3) GO TO 888
26      IF(X.GT.49.9E-3,AND,X.LT.50.1E-3) GO TO 886
27      RETURN
28      886 CONTINUE
29      CALL PLOT(250.0,0.0,-3)
30      JM1=JMAX+1
31      DO 10 J=2,JM1
32      10 XH(CJ)=RH(CJ)/RH(JM1)
33      XH(CJ)=0.0
34      XH(JM1)=1.0
35      DO 302 K=1,11
36      302 XAXIS(K)=FLOAT(K-1)*0.0
37      CALL SCALE(XAXIS,100.0,11+L+10.0)
38      CALL AXIS (0.0+0.0*3H/A+3+100.0+0.0*XAXIS(12)+XAXIS(13)+10.0)
39      CALL PLOT(0.0+0.0*3)
40      CALL PLOT(0.0+10.0,0.2)
41      CALL PLOT(0.0+10.0,0.2)
42      CALL PLOT(0.0+10.0,0.3)
43      CALL PLOT(0.0+10.0,0.2)
44      CALL PLOT(0.0+10.0,0.3)
45      CALL PLOT(-2.0,120.0,0.2)
46      CALL PLOT(0.0,90.0,0.3)
47      CALL PLOT(-2.0,90.0,0.2)
48      CALL PLOT(0.0,60.0,0.3)
49      CALL PLOT(0.0,30.0,0.3)
50      CALL PLOT(-2.0,30.0,0.2)
51      CALL NUMBER(-10.0,-29.0+2.0, FP2+0.0,-1)
52      CALL NUMBER(-10.0,-59.0+2.0, FP4+0.0,-1)
53      CALL NUMBER(-10.0,-89.0+2.0, FP6+0.0,-1)
54      CALL NUMBER(-10.0,-119.0+2.0, FP8+0.0,-1)
55      CALL NUMBER(-10.0,-149.0+2.0, FP10+0.0,-1)
56      CALL NUMBER(-10.0,-179.0+2.0, FP12+0.0,-1)
57      CALL SYMBOL(-10.0,-190.0,0.4,0.6HLOG(D),0.0,6)
58      IF(X.LT.1.0E-10) GO TO 102
59      DO 100 INDEX=1,8
60      100 INDEX=INDEX+1
61      A1=0.9*(1.0-0.9*INDEX)
62      X=9.7*AI
63      IF(X.GE.X1,AND,X.LE.X2) GO TO 101
64      GO TO 100
65      101 T1AX=10.0*INDEX
66      T2=FLOAT(INDEX)
67      CONTINUE
68      100 GO TO 103
69      T1=0.0
70      T2=0.0
71      103 CONTINUE
72      CALL SYMBOL(30.0,-30.0,4.0,19HT = E SEC.0.0,19)
73      CALL NUMBER(43.0,-36.0,4.0,T1,0.0,J)
74      CALL NUMBER(74.0,-30.0,4.0,T2,0.0,-1)
75      FNPN=FLOAT(NPLGT)
76      CALL NUMBER(0.0,-60.0,4.0,FNPN+0.0,-1)
77      CALL NUMBER(K1,KMAX)
78      DO 500 JM1=1,JM1
79      DO 500 J=1,JM1
80      IF(XAX(K,J),LE,0.0) GO TO 600
81      YUK(J)=ALOG10(XAX(K,J))
82      GO TO 601
83      600 YUK(J)=0.0
84      601 CONTINUE
85      YUK(CJ)=YUK(CJ)*HEIGHT/12.0
86      500 CONTINUE
87      DO 501 JM1=1,JM1
88      501 XH(CJ)=RH(CJ)*10TH
89      DO 51 K=1,KMAX
90      CALL PLOT(XH(CJ),YU(K)+3)
91      DO 51 JM1=1,JM1
92      CALL PLOT(XH(CJ)+YU(K)+2)
93      51 CONTINUE
94      DO 700 J=1,JM1
95      IF(OAX(CJ),LE,0.0) GO TO 710
96      TOTAL(CJ)=ALOG10(XAX(CJ))
97      GO TO 711
98      710 TOTAL(CJ)=0.0
99      711 TOTAL(CJ)=TOTAL(CJ)*HEIGHT/12.0
100     CONTINUE
101     CALL PLOT(XH(CJ),TOTAL(CJ)+3)
102     DO 720 JM1=1,JM1
103     720 CALL PLOT(XH(CJ)+TOTAL(CJ)+2)
104     DO 60 K=1,KMAX
105     YMAX(K)=MAX1(YO(K+1),YO(K+2))
106     DO 40 JM1=1,JM1
107     YMAX(K)=MAX1(YMAX(K),YO(K,JM1))
108     60 CONTINUE
109     DO 61 K=1,KMAX
110     YMAX1=YMAX(K)-0.01
111     YMAX2=YMAX(K)+0.01
112     DO 61 JM1=1,JM1
113     IF(YD(K,J),GT,YMAX1,AND,YO(K,J),LT,YMAX2) MJ(K)=J
114     61 CONTINUE

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115      DO 62 K=1,KMAX          PLT03190
116      IF(YMAX(K),LE.0.0) GO TO 62
117      IJ=NJ(K)             PLT03200
118      FPN=FLOAT(K)         PLT03210
119      CALL NUMBER(XH(IJ),YO(K+IJ),4.0,FPN+0.0,-1)
120      62 CONTINUE          PLT03220
121      IF(OXYGEN) LS=7       PLT03230
122      IF(CARBON) LS=5      PLT03240
123      SM=AMAX1(XX(LS+1),XX(LS+2))    PLT03250
124      DO 800 J=2,JM1        PLT03260
125      800 SM=AMAX1(SM,XX(LS,J))    PLT03270
126      HANTEI=1;OE3/N0      PLT03280
127      IF(SM.LE.HANTEI) RETURN  PLT03290
128      HEIT=113.0           PLT03300
129      IF(OXYGEN) HEIT=155.0  PLT03310
130      802 CONTINUE          PLT03320
131      DO 803 J=1,JM1        PLT03330
132      803 AIMP(J)=HEIT*XX(LS,J)/SM  PLT03340
133      CALL PLOT(150,0,0,0,-3)        PLT03350
134      CALL PLOT(95,0,0,0,2)         PLT03360
135      CALL PLOT(90,0,0,0,3)         PLT03370
136      CALL PLOT(90,0,-2,0,2)        PLT03380
137      CALL PLOT(60,0,0,0,3)         PLT03390
138      CALL PLOT(60,0,-2,0,2)        PLT03400
139      CALL PLOT(30,0,0,0,3)         PLT03410
140      CALL PLOT(30,0,-2,0,2)        PLT03420
141      CALL NUMBER(28.0,-4.0,2.0,P1,0,0,-1)  PLT03430
142      CALL NUMBER(58.0,-4.0,2.0,P2,0,0,-1)  PLT03440
143      CALL NUMBER(88.0,-4.0,2.0,P3,0,0,-1)  PLT03450
144      CALL PLOT(0,0,0,0,3)         PLT03460
145      CALL PLOT(0,0,150,0,2)        PLT03470
146      DO 850 J=2,JM1          PLT03480
147      850 XH(J)=93.75*RH(J)/RH(JM1)  PLT03490
148      XH(1)=0.0              PLT03500
149      CALL PLOT(XH(1),AIMP(1),3)        PLT03510
150      DO 860 J=2,JM1          PLT03520
151      860 CALL PLOT(XH(J),AIMP(J),2)        PLT03530
152      IF(OXYGEN) CALL SYMBOL(50.0,160.,4.0,5HO-VII,0.0,5)  PLT03540
153      IF(CARBON) CALL SYMBOL(50.0,160.,4.0,3HC-V, 0.0,3)  PLT03550
154      RETURN                 PLT03560
155      END                     PLT03570
                                PLT03580
                                PLT03590

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