**EQATIONS, A ONE-DIMENSIONAL MULTISPECIES
FOKKER-PLANCK COMPUTER CODE**

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MASTER

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269

Contents

Abstract	1
Introduction	1
1. Basic Equations	1
2. Computation of $I^{(1)}$ and $I^{(2)}$	5
3. Source Terms	7
4. Initial Distribution Functions	7
5. Charge Exchange	7
6. Energy Conservation Checks	8
7. Boundary Conditions	9
8. Particle Conservation	9
9. Charge Neutrality Requirements	10
10. Q Calculations	10
11. Differencing	12
12. Role of Subroutines	12
13. Table of Parameters and Variables in Common	13
14. Two-Component Version	16
15. Laser Target Plasma Version	16
16. Program Listings	19
Standard Version	19
Two-Component Version	45
Laser Target Plasma Version	71

ISOTIONS, A ONE-DIMENSIONAL MULTISPECIES FOKKER-PLANCK COMPUTER CODE

Abstract

Program ISOTIONS solves the time-dependent isotropic Fokker-Planck equation for an arbitrary number of ion species and one electron species. Each species is assumed to be represented by the first normal mode. An implicit difference algorithm, which is first order accurate in time and either first or second order accurate in space, is used to advance the solution.

The velocity finite difference mesh usually consists of 1001 points (not necessarily uniformly spaced). The field length for a typical three-species calculation is approximately 400,000, and the running time is approximately 10 minutes (depending of course on the number of time steps).

The code operates without disk files or tapes. The necessary input consists merely of data cards. Both CRT plots and printed data (HSP/FICHE and OLP) make up the output.

Introduction

This paper summarizes the basic equations of the ISOTIONS code and the methods used to solve them. Each species is assumed to be represented by the first normal mode.¹ A detailed description of the program along with a listing is included.

1. Basic Equations

We let $f_a(v)$ be the distribution function for species "a," where v is the velocity magnitude. A normalized velocity x is defined by

$$v = \tilde{v}x, \quad (1.1)$$

where $\tilde{v}$ is an input constant. The normalized distribution functions are given by

$$F_a(x) = \frac{4\pi\tilde{v}^3}{K_a} f_a(v), \quad (1.2)$$

where K_a is a constant. We let m_a be the mass and Z_a the atomic number, and define

¹See A. Putch, J. Holdren, J. Killeen, and A. Mirin, "Multi-Species Fokker-Planck Calculations for D-T and D-³He Mirror Reactors, Plasma Phys. 14, 211 (1972), or preprint version UCRL-73226.

$$\Gamma_a = 4\pi e^4 Z_a^4 / m_a^2, \quad (1.3)$$

$$n_a = K_a \int_0^\infty F_a(x) x^2 dx, \quad (1.4)$$

$$F_a = \frac{1}{2} m_a \tilde{v}^2 \langle x^2 \rangle_a, \quad (1.5)$$

where

$$\langle x^2 \rangle_a = \frac{\int_0^\infty F_a(x) x^4 dx}{\int_0^\infty F_a(x) x^2 dx}. \quad (1.6)$$

We define normalized time by

$$t = \tau \tilde{t}, \quad (1.7)$$

where $\tilde{t}$ is a constant.

The equation for F_a is then

$$\frac{\partial F_a}{\partial \tau} = \frac{1}{x} \frac{\partial}{\partial x} \left(A_a F_a + B_a \frac{\partial F_a}{\partial x} \right) - \frac{C_a}{x^2} F_a + D_a, \quad (1.8)$$

where $D_a = \tilde{t} S_a$, and S_a is a source term.

The coefficients A_a , B_a , C_a are given by

$$\Lambda_a = \frac{\Gamma_a \tilde{t}}{\tilde{v}^3} \sum_b K_b \left(\frac{Z_b}{Z_a} \right)^2 \ln \Lambda_{ab} \\ \times \left\{ r_{ab} \left[\frac{m_a}{m_b} N(F_b) - x M(F_b) \right] + x M(F_b) + l^{(2)} \frac{m_a}{m_b} \left[\frac{2}{5} x^3 L(\tilde{F}_b) + \frac{3}{5} x^{-2} E(\tilde{F}_b) \right] \right\}, \quad (1.9)$$

$$B_a = \frac{\Gamma_a \tilde{t}}{\tilde{v}^3} \sum_b K_b \left(\frac{Z_b}{Z_a} \right)^2 \ln \Lambda_{ab} \left\{ \frac{1}{3x} E(F_b) + \frac{x^2}{3} M(F_b) \right. \\ \left. + I^{(2)} \left[\frac{6}{35} \left(x^4 L(\tilde{F}_b) + x^{-3} G(\tilde{F}_b) \right) - \frac{1}{15} \left(x^{-1} E(\tilde{F}_b) + x^2 M(\tilde{F}_b) \right) \right] \right\}. \quad (1.10)$$

$$C_a = \frac{\Gamma_a \tilde{t}}{\tilde{v}^3} \sum_b K_b \left(\frac{Z_b}{Z_a} \right)^2 \ln \Lambda_{ab} (2\tilde{K}_{ab}) \\ \times \left\{ \lambda_a \left[\frac{M(F_b)}{3} + \frac{N(F_b)}{2x} - \frac{E(F_b)}{6x^3} \right] + \left[-\frac{27}{70} I^{(2)} - \frac{3}{5} \frac{m_a}{m_b} I^{(2)} + \frac{\lambda_a}{70} \right] x^2 L(\tilde{F}_b) \right. \\ \left. + \left[-\frac{1}{10} I^{(2)} - \frac{3}{5} \frac{m_a}{m_b} I^{(2)} + \lambda_a \left(\frac{1}{6} I^{(2)} - \frac{1}{30} \right) \right] \frac{E(\tilde{F}_b)}{x^3} + \left[-\frac{1}{10} I^{(2)} + \lambda_a \left(\frac{1}{15} I^{(2)} - \frac{1}{30} \right) \right] M(\tilde{F}_b) \right. \\ \left. + \left[-\frac{27}{70} I^{(2)} + \lambda_a \left(\frac{1}{70} - \frac{1}{10} I^{(2)} \right) \right] x^{-5} G(\tilde{F}_b) \right\}. \quad (1.11)$$

The functionals M , N , E , L , and G are defined as

$$M(f) = \int_x^\infty f(y) y \, dy, \quad (1.12a)$$

$$N(f) = \int_0^x f(y) y^2 \, dy, \quad (1.12b)$$

$$E(f) = \int_0^x f(y) y^4 \, dy, \quad (1.12c)$$

$$L(f) = \int_x^\infty f(y) y^{-1} \, dy, \quad (1.12d)$$

$$G(f) = \int_0^x f(y) y^6 \, dy, \quad (1.12e)$$

and

$$\tilde{F}_b(x) = F_b(x) I^{(1)} \quad (1.13)$$

The quantities $I^{(1)}$ and $I^{(2)}$ are functions of x and b (species); $r_{ab} \approx 1$, and $\tilde{\kappa}_{ab} \approx 1/2$. The Coulomb logarithm is

$$\ln \Lambda_{ab} = \ln \left\{ \left(\frac{m_a m_b}{m_a + m_b} \right) \frac{2\pi \lambda_D^C}{e^2} \frac{m_{ax} \left(\frac{2F}{m} \right)^{1/2}}{m_{ab}} \right\} - \frac{1}{2}, \quad (1.14)$$

where

$$\alpha = 1/137, \quad (1.15)$$

$$e = 4.803 \times 10^{-10}, \quad (1.16)$$

$$c = 3 \times 10^{-10}, \quad (1.17)$$

$$\lambda_D = \sqrt{E_c / 6\pi n_e e^2}. \quad (1.18)$$

We define the quantity x_{ca} by

$$e\phi = \frac{1}{2} m_a \bar{v}^2 x_{ca}^2, \quad (1.19)$$

where ϕ is the ambipolar potential.

The separation constant λ_a is defined as

$$\lambda_a = 1/\log_{10} R_{\text{eff}}, \quad (1.20)$$

where for ions,

$$R_{\text{eff}} = \infty \text{ if } x \leq x_{ca} \sqrt{\frac{Z_a}{R-1}}, \quad (1.21a)$$

$$R_{\text{eff}} = R \left(1 + \frac{Z_a^2 x_{ca}^2}{x^2} \right)^{-1} \quad \text{if } x \geq x_{ca} \sqrt{\frac{Z_a}{R-1}}, \quad (1.21b)$$

and for electrons,

$$R_{\text{eff}} = \infty \quad \text{if } x \leq x_{ce} \quad (1.21c)$$

$$= R \left(1 - \frac{x_{ce}^2}{x^2} \right)^{-1} \quad \text{if } x \geq x_{ce}, \quad (1.21d)$$

Here, R is the mirror ratio. For a nonmirror problem, $\lambda_a = 0$.

2. Computation of $I^{(1)}$ and $I^{(2)}$

The quantities $I^{(1)}$ and $I^{(2)}$ are functions of species and effective mirror ratio (R_{eff}). For electrons, and for infinite R_{eff} , $I^{(1)} = I^{(2)} = 0$. For finite R_{eff} (assuming ions), we let

$$\mu_0^2 = 1 - 1/R_{\text{eff}} \quad (2.1)$$

and let $M(\mu)$ be the normal mode corresponding to μ_0 (see Ref. 1). Then

$$I^{(1)} = \int_0^1 M P_2 d\mu / \int_0^1 M d\mu \int_0^1 P_2^2 d\mu, \quad (2.2)$$

where $P_2 = \frac{1}{2} (3\mu^2 - 1)$.

Using Legendre's equation

$$M''(1 - \mu^2) - 2\mu M' + \lambda M = 0, \quad (2.3)$$

one obtains

$$I^{(1)} = \frac{\lambda(3\mu_0^2 - 1)}{10(\lambda - 6)}, \quad (2.4)$$

where $\Lambda \approx 1/\log_{10} R_{\text{eff}}$. Since $\Lambda \rightarrow 6$ at $R_{\text{eff}} = 1.5$, we approximate $I^{(1)}$ between $R_{\text{eff}} = 1.1$ and 2 by

$$I^{(1)} = \frac{1}{5} [-0.4838 + 0.193 (R_{\text{eff}} - 1.1)]. \quad (2.5)$$

The quantity $I^{(2)}$ is defined as

$$I^{(2)} = \int_0^1 M^2 P_2 d\mu / \int_0^1 M^2 d\mu. \quad (2.6)$$

A piecewise linear approximation of the form

$$I^{(2)} \approx a + b (\log_{10} R_{\text{eff}} - \log_{10} c) \quad (2.7)$$

is used. Values of a , b , c for certain R_{eff} ranges are given in Table 2.1.

Table 2.1. Values of a , b , and c for approximating $I^{(2)}$ from Eq. (2.7).

R_{eff} range	a	b	c
$R_{\text{eff}} < 1.0001$	-0.5	0	1.0001
$1.0001 \leq R_{\text{eff}} < 1.001$	-0.5	0.4513	1.0001
$1.001 \leq R_{\text{eff}} < 1.01$	-0.4998	0.4501	1.001
$1.01 \leq R_{\text{eff}} < 1.1$	-0.4981	0.4388	1.01
$1.1 \leq R_{\text{eff}} < 1.5$	-0.4818	0.3951	1.1
$1.5 \leq R_{\text{eff}} < 2$	-0.4286	0.3376	1.5
$2 \leq R_{\text{eff}} < 3$	-0.3864	0.2830	2
$3 \leq R_{\text{eff}} < 4$	-0.3366	0.2378	3
$4 \leq R_{\text{eff}} < 6$	-0.3069	0.2008	4
$6 \leq R_{\text{eff}} < 8$	-0.2715	0.1696	6
$8 \leq R_{\text{eff}} < 10$	-0.2503	0.1497	8
$10 \leq R_{\text{eff}} < 15$	-0.2358	0.1290	10
$15 \leq R_{\text{eff}}$	-0.2133	0.1072	15

3. Source Terms

Each source may be expressed in the form

$$S_a(x) = \sum_{\ell} \frac{1}{K_a} J_a^{\ell} \tilde{S}_a^{\ell}(x), \quad (3.1)$$

where J_a^{ℓ} is a current of the form

$$J_a^{\ell} = A + Bn_a + c\sqrt{n_a}, \quad (3.2)$$

and $\tilde{S}_a^{\ell}(x)$ is a shape function of density 1 of the form

$$\tilde{S}_a^{\ell}(x) = ae^{-b(x-c)^2}. \quad (3.3)$$

4. Initial Distribution Functions

Initially, $F_a(x)$ is of the form

$$F_a(x) = ae^{-b(x-c)^2}, \quad (4.1)$$

where a is directly related to K_a . There is a code option enabling one to read in $F_a(x)$ for all x from a disk file. At the beginning of a run, K_a is computed by requiring that F_a have a prescribed density.

5. Charge Exchange

The loss term C_a may be modified by

$$C_a = \text{original } C_a + \tilde{C}_a. \quad (5.1)$$

where

$$\tilde{C}_a = \tilde{t} \left\{ x_a^2 \alpha_a + \max \left[0, R_a \frac{x_a^4}{x_a^4} \left(\frac{x - b_a x_a}{1 - b_a} \right) \right] \right\}. \quad (5.2)$$

Here, α_a , R_a , b_a , and x_a are input constants.

6. Energy Conservation Checks

Energy conservation checks were built into the code before the addition of the terms involving the integrals $I^{(1)}$ and $I^{(2)}$, and they have not been modified.

We define E_{ab}^ℓ by

$$E_{ab}^\ell = +\frac{1}{2} m_a \tilde{v}^2 K_a \int_0^\infty x^4 dx \left[\frac{F_a(x) \Gamma_a \ln \Lambda_{ab} \lambda_a}{x^3 \tilde{v}^3} \right] \\ \times \left[K_b \frac{Z_b^2}{Z_a^2} \tilde{K}_{ab} \right] \left[N(F_b) - \frac{E(F_b)}{3x^2} + \frac{2x}{3} M(F_b) \right], \quad (6.1)$$

and

$$E_a^\ell = \sum_b E_{ab}^\ell. \quad (6.2)$$

The term $E_a^{(s)}$ is defined as

$$E_a^{(s)} = \sum_{\text{Sources}} J_a \times (\text{Energy of source}). \quad (6.3)$$

The transfer energy E_{ab}^t is defined by

$$E_{ab}^t = \Gamma_a \ln \Lambda_{ab} K_a K_b m_a \frac{Z_b^2}{Z_a^2 \tilde{v}} \int_0^\infty \left[M(F_b) - \frac{m_a}{m_b} \frac{N(F_b)}{x} \right] x^2 F_a(x) dx, \quad (6.4)$$

with

$$E_a^{t+} = \sum_{\substack{\text{Positive} \\ \text{terms}}} E_{ab}^t \quad (6.5)$$

and

$$E_a^{t-} = \sum_{\substack{\text{Negative} \\ \text{terms}}} (-E_{ab}^t). \quad (6.6)$$

The total energy gained by species "a" is then

$$E_a^+ = E_a^s + E_a^{t+}, \quad (6.7)$$

and the energy lost by "a" is

$$E_a^- = E_a^l + E_a^{t-}. \quad (6.8)$$

7. Boundary Conditions

For all "a," $F_a(x)$ is 0 at $x = \infty$. For electrons, we set $\partial F_a / \partial x = 0$ at $x = 0$, and for ions, $F_a(x) = 0$ for $x \leq x_{ca} \sqrt{Z_a / (R - 1)}$.

8. Particle Conservation

We let

$$P_a^+ = \sum_{\text{Sources}} J_a \quad (8.1)$$

and

$$P_a^- = \int_0^\infty \frac{1}{t} C_a dx. \quad (8.2)$$

We then compare P_a^+ with P_a^- .

9. Charge Neutrality Requirements

We let

$$n^+ = \sum_{\text{ions}} n_a Z_a. \quad (9.1)$$

$$n^- = n_e. \quad (9.2)$$

$$d^+ = n^+(t + \Delta t) - n^+(t), \quad (9.3)$$

$$d^- = n^-(t + \Delta t) - n^-(t), \quad (9.4)$$

$$d = |1 - n^+/n^-|. \quad (9.5)$$

Assume we are advancing from t to $t + \Delta t$. Then, if $n^+(t) \{ \geq \} n^-(t)$ and $d^+ \{ \geq \} d^-$, we $\left\{ \begin{smallmatrix} \text{raise} \\ \text{lower} \end{smallmatrix} \right\} x_{ce}$ by an amount Δx_{ce} and redo the time step. We keep doing this until the above test is negative. If that does not occur within a certain number of tries, the calculation is stopped.

There is a more involved option which attempts to make d , Eq. (9.5), less than some specified number. However, it is possible to cause an infinite loop if we attempt to use the above conditions along with the option bounding d .

10. Q Calculations

For DT runs (D-e-T),

$$Q = \frac{\frac{1}{2} n_1^2 \left[(\sigma v)_{DDP} E_{DDP} + (\sigma v)_{DDn} E_{DDn} \right] + n_1 n_3 (\sigma v)_{DT} E_{DT}}{\sum_a J_a (\text{Source energy})_a}. \quad (10.1)$$

For D-He³ runs (D-e-He³), we replace DT in (10.1) by DHe³. For D-T-He³ runs

(D-e-T-He³), we replace $n_3(\sigma v)_{DT} E_{DT}$ in Eq. (10.1) by

$$n_3(\sigma v)_{DT} E_{DT} + n_4(\sigma v)_{DHe3} E_{DHe3}. \quad (10.2)$$

Here, $E_{DDp} = 4.04 \times 10^6$ eV, $E_{DDn} = 3.27 \times 10^6$ eV, $E_{DT} = 2.24 \times 10^7$ eV, and $E_{DHe3} = 1.83 \times 10^7$ eV.

To compute $\langle \sigma v \rangle_{ab}$, one uses a threefold velocity integration (see UCRL-51598).² It is possible to use a one-dimensional integral approximation for $\langle \sigma v \rangle_{DT}$ and $\langle \sigma v \rangle_{DHe3}$. This is also discussed in UCRL-51598.²

The above formulas for $\langle \sigma v \rangle_{ab}$ use $\sigma_{ab}(E)$, for E in keV. The quantity σ_{DDp} is given by

$$10^{24} \times \sigma = \frac{106.4 (1 + E/493) e^{-44.4/\sqrt{E}}}{E} \quad (10.3)$$

if $E \leq 1000$, and by

$$10^{24} \times \sigma = 0.09 \left[1 - \exp \left(\frac{25.74 - E}{407.3} \right) \right] \quad (10.4)$$

if $E > 1000$. The quantity σ_{DDn} is

$$10^{24} \times \sigma = \frac{108.4 (1 + E/332) e^{-44.4/\sqrt{E}}}{E} \quad (10.5)$$

if $E \leq 500$, and

$$10^{24} \times \sigma = 0.103 \left[1 - \exp \left(\frac{37.47 - E}{358.3} \right) \right] \quad (10.6)$$

if $E > 500$.

To compute σ_{DHe3} , we let

²A. Mirin, HYBRID-1, a Two-Dimensional Fokker-Planck Code, Lawrence Livermore Laboratory Rept. UCRL-51598 (June 1974).

$$S_1 = \frac{B}{E} \frac{A^2}{A^2 + (E - C)^2} e^{-89/\sqrt{E}} \times 10^{-24}, \quad (10.7a)$$

$$S_2 = S_1 [5.75 \times 10^{-4} (E - 600) + 1], \quad (10.7b)$$

$$S_3 = S_2 \left(\frac{D + E}{D + 1000} \right)^2, \quad (10.7c)$$

where $A = 230$, $B = 27,500$, $C = 350$, and $D = 2845$. Then $\sigma_{DHe3} = S_1$ for $E \leq 600$, $\sigma_{DHe3} = S_2$ for $600 \leq E \leq 1000$, and $\sigma_{DHe3} = S_3$ for $E \geq 1000$. The formula for σ_{DT} is given in UCRL-51598.²

11. Differencing

The velocity mesh $\{x_j\}_{j=1}^J$ is not necessarily uniform. A quantity x_{max} is input. A value x_2 is chosen, and this defines a unique r satisfying

$$x_{j+1} - x_j = r (x_j - x_{j-1}) \quad (11.1)$$

if $1 < j < J$.

The difference approximations are centered in space and fully implicit in time, although there is a parameter which controls the degree of implicitness. The method of solution is described in detail in UCRL-73226, Appendix B.¹

12. Role of Subroutines

The code is controlled from MAIN. Subroutine INITIAL sets up initial data; subroutine AMBI adjusts the ambipolar potential; subroutine SIGMAVEE controls the Q calculation; subroutine FINDSIG computes $\sigma(E)$; subroutines QFUTCH, EVALS, and GETFG compute $(\sigma v)_{ab}$ using the threefold integral; subroutine QHOLD computes $(\sigma v)_{DT}$ and $(\sigma v)_{DHe3}$ using the one-dimensional integral approximation; subroutine SOURCEE computes the source; subroutine VARYSO controls variations of the source, including beam turnoff; subroutine XMESH computes the x mesh; subroutine MOMENTS computes the moments M , N , E , L , and G ; subroutine GAMMAIN computes $\ln \Lambda_{ab}$; subroutine GETCOEF computes the coefficients A_a , B_a , C_a , and D_a ; subroutine EMP2 computes $I^{(1)}$; subroutine EM2P2 computes $I^{(2)}$; subroutines ITERATE and MSOLVE advance the difference equations; subroutine TENLOG computes base-10 logarithms; subroutine CHECK stores data in time-dependent plotting arrays and computes a few output diagnostics; subroutine FINIT sets up initial distribution functions; subroutines PRINT2 and PRINT1 are general printing routines; subroutine

EEPLOT produces plots; subroutine EEPRINT produces printed data and energy conservation data; subroutine CHOPDST zeroes the ion distributions below critical velocities corresponding to ϕ ; subroutine RESTART controls restarting and outputs some diagnostic quantities dealing with partial conservation; and subroutine OFFMON is a systems routine.

13. Table of Parameters and Variables in Common

Variable	Function
JX	Number of x mesh points.
NEQ	Number of species.
NONCH	Number of simultaneously stored values in arrays for time-dependent plots.
KDOUB	Number of sources.
KNSSET	Number of problems to be run.
DT1, DT2, DT3	Future Δt values.
NSET1, NSET2, NSET3	Cycles at which Δt will change.
NPRLOS	Set to 1 for velocity distribution output, and 2 for energy distribution output.
KP2USE	Set to 1 normally, but to 0 for $I^{(1)}$, $I^{(2)} = 0$.
KELEC	Electron species number.
KTTYOUT	Set to 0 normally, 1 for teletype output.
NSL	Set to 1 for mirror system, 0 otherwise.
NRSTRT	Cycle for restarting of code.
NSTOP	Number of time steps (cycles).
NPRINT	Number of cycles between printouts.
NPLOT	Number of cycles between plots.
NCHC	Number of cycles between time-dependent sampling of data for plots.
NQCH	Set to 0 for no Q calculation. Set to 1 for D-only Q calculation. Set to 2 for D-T Q calculation. Set to 3 for D-He ³ Q calculation. Set to 4 for D-T-He ³ Q calculation.
NTLOSS	Cycle for beam turnoff.
DTR	Δt .
V ϕ	$\tilde{v}$.
RHO	ρ (see Ref. 1).
XMIN	$x_{\min} = 0$.
XMAX	$x_{\max}$.
EMASS(K)	m_a .
ANUMB(K)	Z_a .
DENSITY(K)	n_a .
BSOR(K, KK)	b (see Eq. (3.3)).

Variable	Function
XONE(K, KK)	c (see Eq. (3.3)).
EL(K, L, KK)	A, B, C (see Eq. (3.2)).
RS(K, 1)	1.
RS(K, 2-3)	b, c (see Eq. (4.1)).
XCN	x_{ce} .
DXCN	Δx_{ce} .
DELAMB	Bound on d (see Eq. (4.5)); if 0, d-option isn't used.
BRATIO	R.
MAXAMB	Maximum number of attempts to satisfy charge neutrality requirements.
CXRXB(K, L)	x_a, R_a, b_a, α_a (see Eq. (5.2)).
TNORM	$\tilde{t}$, which equals 1.
X(J)	x mesh.
X2(J)	x^2 .
X3(J)	x^3 .
DXM(J)	$\Delta x_{j-\frac{1}{2}} = x_j - x_{j-1}$.
DXP(J)	$\Delta x_{j+\frac{1}{2}} = x_{j+1} - x_j$.
DX(J)	$\Delta x_j = \frac{1}{2}(x_{j+1} - x_{j-1})$.
CON(J, K)	Integration constants for $\int f dx$.
CON1(J, K)	Integration constants for $\int f x dx$.
CON2(J, K)	Integration constants for $\int f x^2 dx$.
CON4(J, K)	Integration constants for $\int f x^4 dx$.
RATIOM(K, L)	m_a/m_b .
ULAM(K, L)	$\tilde{\kappa}_{ab}$.
ANORMK(K)	K_a .
ENERGY(K)	E_a .
GAM1(K)	Γ_a .
GAM2(K, L)	Constant part of $\ln \Lambda_{ab}$.
GAMMA(K, L)	$\Gamma_a \ln \Lambda_{ab}$.
REDEN(K)	n_a .
RATIOZ2(K, L)	Z_a^2/Z_b^2 .
SENGY(K, KK)	Mean source energy.
RMSQ(K)	$\sqrt{Z_a m_e / m_a}$.
SOSAVP(K, KK)	J_a^f .
SOSAV(K)	$\sum_f J_a^f$.
JXCPB(K)	Mesh point corresponding to $x_{ca} \sqrt{Z_a / (R-1)}$ for ions.
RATECNC(K, L)	r_{ab} .
KBUFU, KBUFV	Tell whether or not initial F_a is on disk.

Variable	Function
C'LOST(K, L)	Mirror loss and integrated mirror loss after beam turnoff.
C'LOSET(K, L)	Charge exchange loss and integrated charge exchange loss after beam turnoff.
TIME	τ .
DT	$\Delta\tau$.
N	Cycle number.
ECHARG	3.794×10^{-4} .
PI	$\pi = 3.1415926536$.
REALTIM	t .
ESUCHARG	$e = 4.803 \times 10^{-10}$.
BRCON	$1/\sqrt{R-1}$.
ONODT	$1/\Delta\tau$.
ERGTOEV	1.602×10^{-12} .
MNXCN	Flag for AMBI failure.
NEND	Controls whether or not RESTART calls OFFMON.
ENELEC	$\frac{1}{2} m_e \bar{v}^2 / 1.602 \times 10^{-12}$.
KMFLAG	Flag for MOMENTS failure.
XI(J)	$1/x$.
AN-DN(J, K)	A_a, B_a, C_a, D_a .
C'LOS(J, K)	Mirror C_a .
U(J, K)	F_a .
EMOF(J, K)	$M(F_a)$.
ENOF(J, K)	$N(F_a)$.
EEOF(J, K)	$E(F_a)$.
PROB(J, K)	λ_a .
SHAPE(J, K, KK)	$S_a^{\ell}(x)$.
C'LOSE(J, K)	Charge exchange C_a .
E'LOF2(J, K)	$L(\tilde{F}_a)$.
E'MOF2(J, K)	$M(\tilde{F}_a)$.
E'EOF2(J, K)	$E(\tilde{F}_a)$.
E'GOF2(J, K)	$G(\tilde{F}_a)$.
P'TIME(N)	Time array.
P'LT'DENS(N, K)	Time-dependent density array.
P'LT'ENG(N, K)	Time-dependent energy array.

14. Two-Component Version

Here we consider D-e-T runs, where it is assumed that $\phi = 0$ (no ambipolar potential), T is fixed, and e is fixed in shape, but with $n_e = n_D + n_T$. (T and e are usually taken as Maxwellian.)

A quantity β_0 is an input parameter, and we define

$$x_1^2 = \beta_0 \frac{4 E_e}{3 m_e \tilde{v}^2}. \quad (14.1)$$

If $\beta_0 = 0$, then $x_1 = 0$, and $f_D(x) = 0$ at $x = 0$. If $\beta_0 > 0$, the deuterium loss term is modified. Let

$$\alpha_0 = \left. \frac{4C_a^2}{\lambda_a x^6} \right|_{x=x_1}. \quad (14.2)$$

Then for $x < x_1$, C_a is redefined as

$$C_a = \frac{1}{4} \lambda_a x^6 \alpha_0 / \text{original mirror } C_a. \quad (14.3)$$

and at $x = 0$, $\partial f_D / \partial x = 0$, thereby causing the deuterium to look Maxwellian at $x = 0$.

The affected subroutines are MAIN, INITIAL, GETCOEF, and CHOPDST, and an extra data card is needed for β_0 .

15. Laser Target Plasma Version

Here we assume a two-species run. Subscript 0 refers to thermal neutrons, and subscript fc refers to Franck-Condon neutrons. A lower case n refers to inner region density, and an upper case N refers to outer region density.

The relevant equations are

$$\frac{dn_0}{dt} = \frac{v_0^2 S}{4V} (N_0 - n_0) - 2 n_1 n_0 [(\overline{\sigma_{ie} v_e}) + (\overline{\sigma_{il} v})] - K_1 \int_0^\infty F_1(x) H_1(x) x^2 dx, \quad (15.1)$$

$$\frac{dn_{fc}}{dt} = \frac{v_{fc} S}{4V} (N_{fc} - n_{fc}) - n_1 n_{fc} [(\overline{\sigma_{ie} v_e}) + (\overline{\sigma_{il} v})] - K_1 \int_0^\infty F_1(x) H_2(x) x^2 dx, \quad (15.2)$$

$$H_1(x) = \tilde{v} \times \sigma_{cx}^M n_0, \quad (15.3)$$

$$H_2(x) = \tilde{v} \times \sigma_{cx}^A n_{fc}, \quad (15.4)$$

$$\sigma_{cx}^M = \frac{1 - \exp(-0.3491 \times 10^{-30} v^4)}{\frac{10^{16}}{v} + 0.0135067 \times 10^{16} |\ln v/v_0''| + 0.050987 (v - v_0'')^2 = dv^8}, \quad (15.5)$$

$$\sigma_{cx}^A = \frac{0.6937 \times 10^{-14} (1 - 0.155 \log_{10} E)^2}{1 + 0.1112 \times 10^{-14} E^{3.3}}, \quad (15.6)$$

$$\begin{aligned} \frac{dN_0}{dt} = & C_1 \{N_0(0) - N_0(t)\} - \frac{v_0^2 S}{4V_1} (N_0 - n_0) + \frac{v_{fc} S_1 N_{fc}}{8V_1} \\ & + \frac{1}{2V_1} \frac{C_{of} \sigma_{cx}^A}{\sigma_{cx}^A + \sigma_i} \{1 - \exp[-L(\sigma_{cx}^A + \sigma_i) n_1]\} \\ & + \frac{C_{of}}{2} \frac{v}{V_1} \{K_1 \int_0^\infty F_1(x) [H_1(x) + H_2(x)] x^2 dx\} + \frac{a_0 L_c}{V_1}, \end{aligned} \quad (15.7)$$

$$\sigma_i = \sigma_{i2} + (\overline{\sigma_{ie} v_e})/v_2, \quad (15.8)$$

$$C_1 = b_0 v_0^2 S_1/4V, \quad (15.9)$$

$$\begin{aligned} L_c = & n_1 v (n_0 + n_{fc}) [(\overline{\sigma_{ie} v_e}) + (\overline{\sigma_{il} v})] + \frac{n_1^2 v}{6.3 \times 10^9 (E/10^3)^{3/2}} \\ & + VK_1 \int_0^\infty F_1(x) [H_1(x) + H_2(x)] x^2 dx, \end{aligned} \quad (15.10)$$

$$\begin{aligned} \frac{dN_{fc}}{dt} = & (IP)_{fc} \{2n_0 n_1 [(\overline{\sigma_{ie} v_e}) + (\overline{\sigma_{il} v})] + K_1 \int_0^\infty F_1(x) H_1(x) x^2 dx\} \\ & - \frac{v_{fc} S_1}{4V_1} N_{fc} - \frac{v}{V_1} \{n_1 n_{fc} [(\overline{\sigma_{ie} v_e}) + (\overline{\sigma_{il} v})] + K_1 \int_0^\infty F_1(x) H_2(x) x^2 dx\}, \end{aligned} \quad (15.11)$$

$$(IP)_{fc} = \frac{1}{2} \left\{ 1 + \left\{ 1 + \frac{4V}{v_{fc} S} [(\overline{\sigma_{ie} v_e}) + (\overline{\sigma_{il} v})] n_1 + \frac{K_1}{n_{fc}} \int_0^\infty F_1(x) H_2(x) x^2 dx \right\}^{-1} \right\}. \quad (15.12)$$

Here, $F_1(v)$ is the ion distribution function, n_1 is the density, K_1 is defined in Eq. (1.2), E is the energy corresponding to v in electron volts, and V , v_0 , v_{fc} , S , $(\sigma_{ie} v_e)$, $(\sigma_{il} v)$, v_0'' , d , V_1 , S_1 , I , C_{of} , L , a_0 , b_0 , v_2 , σ_{i2} , and $\sigma_{cx} A$ are input quantities.

These ordinary differential equations are advanced by fully implicit differencing. Affected subroutines include MAIN, INITIAL, EEPRINT, EEPLLOT, CHECK, and VARYSO. Subroutines ENNØFC and CVERT are added, along with several data cards.

16. Program Listings

STANDARD VERSION

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PROGRAM DUMFQ(TAPE2,PRINT,TAPE5,TAPE6,TAPE3=TAPE6)
DIMENSION ND(5) $ ND(1)=0 $ ND(2)=1HF $ ND(3)=6 $ ND(4)=0
ND(5)=1 $ CALL HSP(ND)
CALL ASSIGN(2,0,7RINTIONS,0)
CALL CRTID(ISHAM TIONS,1,1)
CLICHE CFDP
OPTIMIZE
PARAMETER(JX=1001,NEQ=2)
PARAMETER(NONCH=1000)
PARAMETER(KDCUB=1)
PARAMETER(KNSET=1)
COMMON/MGR1D/XMIN,XMAX,X(JX),X2(JX),X3(JX),DXM(JX),DX(JX),DXP(JX),
C CON1(JX,3),CON2(JX,3),CON4(JX,3),CON(JX,3),JXM,JXM2
COMMON/MCON1/RAT10M(NEQ,NEQ),EMASS(NEQ),ANUMB(NEQ),DENSITY(NEQ),
C ULAM(NEQ,NEQ),ANORMK(NEQ),DENS(NEQ),ENERGY(NEQ),GAM1(NEQ),
C GAM2(NEQ,NEQ),GAMMA(NEQ,NEQ),REDEN(NEQ),DENSTOR(NEQ),
C RAT10Z2(NEQ,NEQ),SENGY(NEQ,KDOUB),RMSQ(NEQ),SORDEN(NEQ,KDOUB),
C RS(NEQ,3),BSOR(NEQ,KDOUB),XONE(NEQ,KDOUB),EL(NEQ,4,KDOUB),
C E1(NEQ),F1(NEQ),SOSAV(NEQ),SOSAVP(NEQ,KDOUB),JXCPB(NEQ),
C RATECNC(NEQ,NEQ),KBUFU(KNSET),KBUFV,CXRXB(NEQ,4)
C ,NTLOSS,CLOST(NEQ,2),CLOSET(NEQ,2),CLOSE34(NEQ,2)
COMMON/MSOR/TEMPJ1(JX),TEMPJ2(JX),TEMPJ3(JX),TEMPJ4(JX),
C TEMPJ5(JX),TEMPJ6(JX),TEMPN(NONCH)
COMMON/MCON2/TIME,DT,N,NPRINT,NPLOT,V0,RHO,ECHARG,P1,TWOP1,
C REALTIM,TNORM,ESUCHARG,NCH,NCH,KTTYOUT,BRCON,
C FOURPI,PISGT,KELEC,V02,V03,ONJDT,ONMRHO,ERGTOEV,NRSTRT,DTR
C ,MNXCN,NQCH,KNPROBS,NEND,NSTOP,NPRLOS,ENELEC
C ,KMFLAG
COMMON/MAMB/XCN,DXCN,DELAMB,JAMB,MAXAMB,BRATIO,NSL
C ,KAMB
COMMON/MP2EXP/KP2USE,X1(JX),TEMPJ7(JX),TEMPJ8(JX),TEMPJ9(JX)
LCM (MOMMAT)
COMMON/MOMMAT/AN(JX,NEQ),BN(JX,NEQ),CN(JX,NEQ),DN(JX,NEQ),
C CLOS(JX,NEQ),USTORE(JX,NEQ),UI(JX,NEQ),ANST(JX,NEQ),
C BNST(JX,NEQ),CNST(JX,NEQ),DNST(JX,NEQ),EMOF(JX,NEQ),
C ENOF(JX,NEQ),EEOF(JX,NEQ),PROB(JX,NEQ),SHAPE(JX,NEQ,KDOUB)
C ,CLOSE(JX,NEQ),UBUST(JX,NEQ,KNSET)
C ,ELOF2(JX,NEQ),EMOF2(JX,NEQ),EEOF2(JX,NEQ),EGOF2(JX,NEQ)
LCM (MPLOTS)
COMMON/MPLOTS/PTIME(NONCH),PLTDENS(NONCH,NEQ),PLTENGY(NONCH,NEQ)
ENDCLICHE
USE CFOP
KBUFV=0
DO 31 KNPROBS=1,KNSET
KBUFU(KNPROBS)=0 $ KBUFV=KBUFV+KBUFU(KNPROBS)
31 CONTINUE
DO 1000 KNPROBS=1,KNSET
MNXCN=0
KMFLAG=0
NEND=0
WRITE (3,1001) KNPROBS
1001 FORMAT(1H1,20HBEGINNING OF PROBLEM,2X,15)
NCYCLE=0
CALL INITIAL
IF (KMFLAG.EQ. 1) GO TO 23
CALL SOURCEE
CALL KEEP80(KTTYOUT)
CALL EEPRT
CALL EEPLOT
DT1=1.E-3 $ DT2=1.E-2 $ DT3=1.5E-2

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      NSET1=101 $ NSET2=201 $ NSET3=301
1  CONTINUE
      N=N+1
      IF (N.EQ. NSET1) DTR=DT1
      IF (N.EQ. NSET2) DTR=DT2
      IF (N.EQ. NSET3) DTR=DT3
      IF (N.EQ. NRSTRT) CALL RESTART
      DT=DTR/TNORM
      ONODT=1./DT
      TIME=TIME+DT
      REALTIM=REALTIM+DT*TNORM
      CALL SOURCEE
      KAMB=0
8  CONTINUE
      IF (SENSE SWITCH 1) B1,B2
91 CALL RESTART
82 CONTINUE
      NCYCLE=NCYCLE+1
      DO 2 K=1,NEQ
      CALL READLCM(TEMPJ1,U(1,K),JX)
      CALL WRITELCM(TEMPJ1,USTORE(1,K),JX)
2  CONTINUE
      DO 20 K=1,NEQ
20  DENSTOR(K)=REDEN(K)
      KAMB=KAMB+1
      CALL GAMMAIN
      CALL PROBE
      CALL GETCOEF
      CALL ITERATE
      CALL CHOPDST
      CALL MOMENTS
      IF (KMFLAG.EQ. 1) GO TO 23
      CALL AMB1
      IF (KMFLAG.EQ. 1) GO TO 23
      IF (MNXCN.EQ. 1) GO TO 23
      IF (JAMB.EQ. 1.AND. KAMB.LE. MAXAMB) GO TO 8
      IF (KAMB.GT. MAXAMB) GO TO 22
      CALL CHECK
      DO 101 K=1,NEQ
      CALL READLCM(TEMPJ1,AN(1,K),JX)
      CALL WRITELCM(TEMPJ1,ANST(1,K),JX)
      CALL READLCM(TEMPJ1,BN(1,K),JX)
      CALL WRITELCM(TEMPJ1,BNST(1,K),JX)
      CALL READLCM(TEMPJ1,CN(1,K),JX)
      CALL WRITELCM(TEMPJ1,CNST(1,K),JX)
      CALL READLCM(TEMPJ1,DN(1,K),JX)
      CALL WRITELCM(TEMPJ1,DNST(1,K),JX)
101 CONTINUE
      IF (FLOATF(N)/FLOATF(NPRINT)-FLOATF(N/NPRINT).GE. 1.E-4) GO TO 11
      CALL EEPINT
      IF (KTTYOUT.EQ. 0) GO TO 11
      WRITE (59,18) N,NCYCLE
18  FORMAT(15,2X,20#ITERATIONS COMPLETED,5X,16,2X,16#CYCLES COMPLETED)
      CALL OODTBF
11  IF (FLOATF(N)/FLOATF(NPLOT)-FLOATF(N/NPLOT).GE. 1.E-4) GO TO 12
      CALL EEPLOT
12  CONTINUE
      IF (N.LT. NSTOP) GO TO 1
      GO TO 23
22  WRITE (3,21)

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21 FORMAT(46HAMBIPOLAR POTENTIAL REQUIREMENTS NOT SATISFIED)
   IF (KTTYOUT.EQ. 0) GO TO 23
   WRITE (59,21) $ CALL 000TBF
23 CONTINUE
   CALL EEPRIINT $ CALL EEPLT
   IF (KMFLAG.EQ. 1) GO TO 24
   IF (MNXCN.EQ. 1 .OR. KAMB.GT. MAXAMB) GO TO 24
   NEND=1 $ CALL RESTART
24 CONTINUE
   WRITE (3,1002) KNPROBS
1002 FORMAT(/,14HEND OF PROBLEM,2X,15)
   CALL PLOTEA
   DO 1004 K=1,NEQ
   CALL READLCM(TEMPJ1,U(1,K),JX)
   CALL WRITELCM(TEMPJ1,UBUST(1,K,KNPROBS),JX)
1004 CONTINUE
1000 CONTINUE
   CALL QUIT(1)
   END
   SUBROUTINE INITIAL
   USE CFOPL
1  FORMAT(811G)
2  FORMAT(5E16.6)
   READ (2,1) KTTYOUT,NSL,NRSTRT,NSTOP
   READ (2,1) NPRINT,NPLOT,NCHC
   READ (2,1) NQCH,NTLOSS
   READ (2,2) DTR,V0,RHO
   READ (2,2) XMIN,XMAX
   DO 3 K=1,NEQ
   READ (2,2) EMASS(K),ANUMB(K)
   READ (2,2) DENSITY(K)
3  CONTINUE
   DO 4 K=1,NEQ
   DO 91 KK=1,KDOUB
   READ (2,2) BSOR(K,KK)
   READ (2,2) XONE(K,KK)
   READ (2,2) EL(K,1,KK)
   READ (2,2) (EL(K,KN,KN),KN=2,4)
91  CONTINUE
4  CONTINUE
   DO 5 I=1,NEQ $ DO 5 K=1,NEQ
   ULAM(I,K)=.5
5  CONTINUE
   DO 31 K=1,NEQ
   READ (2,2) (RS(K,1),RS(K,2),RS(K,3))
31  CONTINUE
   READ (2,2) XCN,DXCN,DELAMB,BRATIO
   READ (2,1) MAXAMB
   WRITE (3,14) NRSTRT,NSTOP
14  FORMAT(7HNRSRT=,18,5X,6HNSTOP=,18)
   WRITE (3,38) NPRINT,NPLOT,NQCH,NTLOSS
38  FORMAT(7HNPRINT=,15,5X,6HNPLT=,15,5X,5HNQCH=,15,5X,7HNTLOSS=,15)
   WRITE (3,11) DTR,V0,RHO,XMIN,XMAX
11  FORMAT(4HDTR=,E16.6,3X,3HVD=,E16.6,3X,4HRHO=,E16.6,3X,5HXM?N=,
   C E16.6,3X,5HMAX=,E16.6)
   DO 12 K=1,NEQ
   WRITE (3,13) K,EMASS(K),ANUMB(K),DENSITY(K),
   C ((BSOR(K,KK),XONE(K,KK),(EL(K,KN,KN),KN=1,4)),KK=1,KDOUB)
13  FORMAT(/,15,3X,5HMASS=,E16.6,3X,9HA NUMBER=,E16.6,3X,8HDENSITY=,
   C E16.6,/,17H5SOURCE PARAMS ARE,/,10X,6E16.6)

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12 CONTINUE
   DO 29 K=1,NEQ
      WRITE (3,30) K,RS(K,1),RS(K,2),RS(K,3)
30  FORMAT(/,15,3X,16HFINIT PARAMS ARE,3E16.6)
29 CONTINUE
   WRITE (3,28) XCN,DXCN,DELAMB,MAXAMB,BRATIO
28  FORMAT(/,4HXCN=,E16.5,5X,5HDXCN=,E16.5,5X,7HDELAMB=,E16.5,5X,
   C 7HMAXAMB=,15,5X,7HBRATIO=,E16.5)
   KP2USE=1
   IF (NSL.EQ. 0) KP2USE=0
   NPRLOS=2
   NPRLOS=1
   N=0
   NCH=0
   TIME=0.
   REALTIM=0.
   ECHARG=3.7943E-4
   ESUCHARG=4.803E-10
   ERGTOEV=(ESUCHARG/ECHARG)**2
   KELEC=2
   IF (KELEC.GT. NEQ) KELEC=NEQ
   PI=3.1415926536
   TWOP1=2.*PI
   FOURP1=4.*PI
   P1SQT=SQRTF(6.*PI)
   JXM=JX-1
   JXM2=JX-2
   V02=V0*V0
   V03=V02*V0
   ENELEC=.5*EMASS(KELEC)*V02/ERGTOEV
   BRCON=SQRTF(1.00001/(BRATIO-1.))
   IF (BRATIO.LT. 2.) BRCON=1.
   DO 34 I=1,NEQ $ DO 34 K=1,NEQ
34  RATECNC(I,K)=1.
   DO 52 I=1,NEQ
      WRITE (3,53) I,(RATECNC(I,K),K=1,NEQ)
53  FORMAT(/,2H1=,15,3X,8HRATECNC=,6E16.6,/,18X,6E16.6)
52 CONTINUE
   DO 37 J=1,J1
37  TEMPJ1(J)=0.
   DO 20 K=1,NEQ
      CALL WRITELCM(TEMPJ1,AN(I,K),JX)
      CALL WRITELCM(TEMPJ1,BN(I,K),JX)
      CALL WRITELCM(TEMPJ1,CN(I,K),JX)
      CALL WRITELCM(TEMPJ1,DN(I,K),JX)
      CALL WRITELCM(TEMPJ1,CLOS(I,K),JX)
20 CONTINUE
   DO 21 I=1,NEQ $ DO 21 K=1,NEQ
      RATIOZ2(I,K)=(ANUMB(I)/ANUMB(K))**2
21  RATIO(I,K)=EMASS(1)/EMASS(K)
   DO 22 K=1,NEQ
      GAM1(K)=FOURP1*ANUMB(K)**4*ESUCHARG**4/EMASS(K)**2
      RMSQ(K)=SQRTF(RATIO(I,KELEC,K)*ANUMB(K))
      CXRXB(K,1)=1. $ CXRXB(K,2)=0. $ CXRXB(K,3)=0. $ CXRXB(K,4)=0.
      CLOST(K,1)=0. $ CLOST(K,2)=0. $ CLOST(K,3)=0. $ CLOST(K,4)=0.
      CLOSE34(K,1)=0. $ CLOSE34(K,2)=0.
      GO TO 22
   C   SET CXRXB IF NECESSARY.
   C   READ (2,2) (CXRXB(K,L),L=1,4)
22 CONTINUE

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WRITE (3,54) ((K,(CXRXB(K,L),L=1,4)),K=1,NEQ)
54 FORMAT(/,6HCXRXB=,/,15,4E16.6)
ALP=1./137. $ R0=2.82E-13 $ CLIGHT=3.E+10
GAICON1=2.*ALP*SQRTF(2.)/(PISQT*R0*CLIGHT)
GAICON2=GAICON1/(ECHARG*EMASS(KELEC))
DO 41 I=1,NEQ $ DO 41 K=1,NEQ
GAM2(1,I)=EMASS(1)*EMASS(K)*GAICON2/(EMASS(1)+EMASS(K))
41 CONTINUE
ONMRHO=1.-RHO
CALL XMESH
DO 23 K=1,NEQ
E1(K)=1.
F1(K)=0.
23 CONTINUE
CALL FINIT
CALL MOMENTS
IF (KMFLAG.EQ.1) RETURN
DO 26 K=1,NEQ
REDEN(K)=DENSITY(K)
26 ANORMK(K)=DENSITY(K)/DENS(K)
TNORM=2.*V03/(ANORMK(KELEC)*GAMI(KELEC))
TNORM=1.
WRITE (3,101) TNORM
101 FORMAT(/,6HTNORM=,E15.5)
DT=DTR/TNORM
ONODT=1./DT
IF (NSL.EQ.1) RETURN
DO 35 I=1,NEQ $ DO 35 K=1,NEQ
35 ULAM(I,K)=0.
WRITE (3,102)
102 FORMAT(31HTHIS IS A NO SOURCE NO LOSS RUN,/,
C 41HIGNORE XCN DXCN DELAMB AMBIPOT AND BRATIO)
RETURN
END
SUBROUTINE AMBI
USE CFOPL
IF (KAMB.EQ.1) LAMB=0
JAMB=0
IF (XCN.EQ.0.) RETURN
IF (NSL.EQ.0) RETURN
QMINUS=REDEN(KELEC) $ QSMINUS=DENSTOR(KELEC)
QPLUS=0. $ QSPUS=0.
DO 42 K=1,NEQ
IF (K.EQ.KELEC) GO TO 42
QSPUS=QSPUS+ANUMB(K)*DENSTOR(K)
QPLUS=QPLUS+ANUMB(K)*REDEN(K)
42 CONTINUE
IF (DELAMB.LT.1.E-20) GO TO 40
DENDIF=ABSF(1.-QPLUS/QMINUS)
WRITE (61,4) N,DENDIF,QPLUS,QMINUS,XCN
41 FORMAT(2HN=,15,2X,7HDENDIF=,F15.5,2X,8HION DEN=,E16.5,2X,
C 9HELEC DEN=,E16.5,5X,4HXCN=,F15.5)
IF (DENDIF.GT.DELAMB) GO TO 1
IF (LAMB.EQ.0) GO TO 40
RETURN
1 JAMB=1
LAMB=1
IF (QMINUS.LE.QPLUS) XCN=XCN+DXCN
IF (QMINUS.GE.QPLUS) XCN=XCN-DXCXN
IF (XCN.LT..5*DXCN) GO TO 32

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      IF (XCN .GT. XMAX) GO TO 32
      GO TO 48
40  CONTINUE
      D1=QPLUS-QSPLUS $ D2=QMINUS-QSMINUS
      WRITE (61,43) N,QSPLUS,QPLUS,D1,QSMINUS,QMINUS,D2,XCN
43  FORMAT(2HN=,15,2X,7HQPLUS=,E16.5,3X,6HQPLUS=,E16.5,2X,3HD1=,
      C E16.5,7,8X,8HQSMINUS=,E16.5,2X,7HQMINUS=,E16.5,2X,3HD2=,E16.5,
      C 2X,4HXCN=,F15.5)
      IF (N .EQ. 1) RETURN
      IF (QSPLUS .LT. QSMINUS) GO TO 30
      IF (D2 .GE. D1) RETURN
      JAMB=1
      XCN=XCN+DXCN
      IF (XCN .GT. XMAX) GO TO 32
      GO TO 48
30  IF (D1 .GT. D2) RETURN
      JAMB=1
      XCN=XCN-DXCN
      IF (XCN .LT. .5*DXCN) GO TO 32
      GO TO 48
32  WRITE (3,33) $ MNXCN=1 $ RETURN
33  FORMAT(16HXCN OUT OF RANGE)
48  CONTINUE
      DO 2 K=1,NEQ
      CALL READLCM(TEMPJ1,USTORE(1,K),JX)
      CALL WRITELCM(TEMPJ1,U(1,K),JX)
2  CONTINUE
      CALL CHOPDST
      CALL MOMENTS
      RETURN
      END
      SUBROUTINE SIGMAVEE
      USE CFOPL
      COMMON/MQCAL/JXQ,LT,NSK,DH(JX)
      NSK=3
      IF (NQCH .EQ. 0) RETURN
      IF (N .EQ. 1) RETURN
      SIGVDDP=0. $ SIGVDDN=0.
      CALL QFUTCH(SIGVDDP,1,1,3)
      CALL QFUTCH(SIGVDDN,1,1,4)
      EDDN=3.27E+6 $ EDDP=4.04E+6
      EDH=1.83E+7 $ EDT=2.24E+7
      IF (NQCH .NE. 1) GO TO 100
      SIGVF=0. $ SIGVH=0.
      CALL QFUTCH(SIGVF,1,1,1)
      CALL QHOLD(SIGVH,1,1,1)
      WRITE (3,190) SIGVF,SIGVH,SIGVDDP,SIGVDDN
190  FORMAT(1H1,/,6HSIGVF=,E16.6,5X,6HSIGVH=,E16.6,5X,8HSIGVDDP=,
      C E16.6,5X,8HSIGVDDN=,E16.6)
      RETURN
100 IF (NQCH .NE. 2) GO TO 200
      SIGVDT=0. $ SIGVH=0.
      CALL QFUTCH(SIGVDT,1,3,1)
      CALL QHOLD(SIGVH,1,3,1)
      WRITE (3,290) SIGVDT,SIGVH,SIGVDDP,SIGVDDN
290  FORMAT(1H1,/,7HSIGVDT=,E16.6,5X,6HSIGVH=,E16.6,5X,8HSIGVDDP=,
      C E16.6,5X,8HSIGVDDN=,E16.6)
      ENUM=.5*REDEN(1)**2*(SIGVDDP*EDDP+SIGVDDN*EDDN)+
      C REDEN(1)*REDEN(3)*SIGVDT*EDT
      SUMSEN=0.

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```

DO 201 K=1,NEQ
DO 201 KK=1,KDOUB
SUMSEN=SUMSEN+EL(K,1,KK)*SENGY(K,KK)
201 CONTINUE
QDT=ENUM/SUMSEN
WRITE (3,291) QDT
291 FORMAT(/,4HQDT=,E16.6)
RETURN
200 IF (NQCH .NE. 3) GO TO 300
SIGVDH=0. $ SIGVH=0.
CALL QFUTCH(SIGVDH,1,3,2)
CALL QHOLD(SIGVH,1,3,2)
WRITE (3,390) SIGVDH,SIGVH,SIGVDDP,SIGVDDN
390 FORMAT(1H1,/,7HSIGVDH=,E16.6,5X,6HSIGVH=,E16.6,5X,8HSIGVDDP=,
C E16.6,5X,8HSIGVDDN=,E16.6)
ENUM=.5*REDEN(1)**2*SIGVDDP*EDDP+REDEN(1)*REDEN(3)*SIGVDH*EDH
ENUM=ENUM+.5*REDEN(1)**2*SIGVDDN*EDDN
SUMSEN=0.
DO 301 K=1,NEQ
DO 301 KK=1,KDOUB
SUMSEN=SUMSEN+EL(K,1,KK)*SENGY(K,KK)
301 CONTINUE
QDH=ENUM/SUMSEN $ QDHN=ENUM/SUMSEN
WRITE (3,391) QDH,QDHN
391 FORMAT(/,4HQDH=,E16.6,5X,11HWITHOUT N =,E16.6)
RETURN
300 CONTINUE
SIGVDT=0. $ SIGVDH=0.
CALL QFUTCH(SIGVDT,1,3,1)
CALL QFUTCH(SIGVDH,1,4,2)
WRITE (3,490) SIGVDH,SIGVDT,SIGVDDP,SIGVDDN
490 FORMAT(7HSIGVDH=,E16.6,5X,7HSIGVDT=,E16.6,5X,8HSIGVDDP=,
C E16.6,5X,8HSIGVDDN=,E16.6)
ENUM=.5*REDEN(1)**2*SIGVDDP*EDDP+REDEN(1)*REDEN(3)*SIGVDT*EDT+
C REDEN(1)*REDEN(4)*SIGVDH*EDH
ENUM=ENUM+.5*REDEN(1)**2*SIGVDDN*EDDN
SUMSEN=0.
DO 401 K=1,NEQ
DO 401 KK=1,KDOUB
SUMSEN=SUMSEN+EL(K,1,KK)*SENGY(K,KK)
401 CONTINUE
QDTH=ENUM/SUMSEN $ QDTHN=ENUM/SUMSEN
WRITE (3,491) QDTH,QDTHN
491 FORMAT(/,5HQDTH=,E16.6,5X,11HWITHOUT N =,E16.6)
RETURN
END
SUBROUTINE FINDSIG(NSIG,UMU)
USE CFOPL
COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
DIMENSION SIGMA(JX)
EQUIVALENCE (SIGMA(1),TEMPJ6(1))
SIGMA(1)=0.
IF (NSIG .NE. 1) GO TO 100
DO 1 J=2,JXQ
EPS=UMU*X2(J)
IF (EPS .GE. 20.) GO TO 41
TEMPQ=2.25E+4*EXP(-44.4/SQRT(EPS))/EPS $ GO TO 40
41 IF (EPS .GE. 30.) GO TO 42
TEMPQ=4.62E-4*EPS*EPS-0.137 $ GO TO 40
42 IF (EPS .GE. 50.) GO TO 43

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TEMPQ=6.70E-4*EPS*EPS-0.320 $ GO TO 40
43 IF (EPS .GE. 87.) GO TO 44
TEMPQ=8.55E-02*EPS-2.93 $ GO TO 40
44 IF (EPS .GE. 107.) GO TO 45
TEMPQ=1.98E+4/((EPS-107.)*2+4000.) $ GO TO 40
45 IF (EPS .GE. 137.) GO TO 46
TEMPQ=3.56E+4/((EPS-107.)*2+7200.) $ GO TO 40
46 IF (EPS .GE. 185.) GO TO 47
TEMPQ=8.70-0.0314*EPS $ GO TO 40
47 IF (EPS .GE. 400.) GO TO 48
TEMPQ=7.050E+3/(EPS*SQRTF(EPS)) $ GO TO 40
48 TEMPQ=255./(EPS-110.)
40 CONTINUE
SIGMA(J)=1.E-24*TEMPQ
1 CONTINUE
RETURN
100 IF (NSIG .NE. 2) GO TO 200
DO 11 J=2,JXQ
EPS=UMU*X2(J)
SA=230. $ SB=27500. $ SC=350. $ SD=2845.
TS1=SB/EPS $ TS2=SA**2/(SA**2+(EPS-SC)**2)
ARG=-89./SQRTF(EPS) $ TS3=EXPF(ARG)
TEMPQ=TS1*TS2*TS3
IF (EPS .LE. 600.) GO TO 12
TS5=5.75E-4*(EPS-600.)
TEMPQ=TEMPQ*(1.+TS5)
IF (EPS .LE. 1000.) GO TO 12
TS4=(SD+EPS)/(SD+1000.)
TEMPQ=TEMPQ*TS4**2
12 CONTINUE
SIGMA(J)=1.E-24*TEMPQ
11 CONTINUE
RETURN
200 IF (NSIG .NE. 3) GO TO 300
DO 21 J=2,JXQ
EPS=UMU*X2(J)
IF (EPS .GT. 1000.) GO TO 22
GEE=EXPF(-44.4/SQRTF(EPS))/EPS
TEMPQ=106.4*GEE*(1.+EPS/493.)
GO TO 23
22 CONTINUE
ARG=(EPS-25.74)/407.3
TEMPQ=.09*(1.-EXPF(-ARG))
23 CONTINUE
SIGMA(J)=1.E-24*TEMPQ
21 CONTINUE
RETURN
300 CONTINUE
DO 31 J=2,JXQ
EPS=UMU*X2(J)
IF (EPS .GT. 500.) GO TO 32
GEE=EXPF(-44.4/SQRTF(EPS))/EPS
TEMPQ=106.4*GEE*(1.+EPS/332.)
GO TO 33
32 CONTINUE
ARG=(EPS-37.47)/358.3
TEMPQ=.103*(1.-EXPF(-ARG))
33 CONTINUE
SIGMA(J)=1.E-24*TEMPQ
31 CONTINUE

```

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RETURN
END
SUBROUTINE QFUTCH(SIGV,K1,K2,NSIG)
USE CFOPL
COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
DIMENSION SIGMA(JX)
EQUIVALENCE (SIGMA(1),TEMPJ6(1))
DIMENSION ANSWER(2)
IF (K1 .GT. .NEQ .OR. K2 .GT. .NEQ) RETURN
IF (K1 .EQ. KELEC .OR. K2 .EQ. KELEC) RETURN
CALL READLCM(TEMPJ2,U(1,K1),JX)
CALL READLCM(TEMPJ3,U(1,K2),JX)
IF (.NEQ .NE. 2 .OR. NSIG .NE. 1) GO TO 161
SQIP5=SQRTF(1.5)
TEMPJ3(1)=TEMPJ2(1)
DO 162 J=2,JX
QJX3=SQIP5*X(J)
DO 163 JJ=1,JXM
IF (X(JJ) .LE. QJX3 .AND. QJX3 .LT. X(JJ+1)) GO TO 164
163 CONTINUE
TEMPJ3(J)=0. $ GO TO 162
164 RATIO=(QJX3-X(JJ))/DXP(JJ)
TEMPJ3(J)=(1.-RATIO)*TEMPJ2(JJ)+RATIO*TEMPJ2(JJ+1)
162 CONTINUE
161 CONTINUE
S1=0. $ S2=0.
DO 13 J=1,JX
IF (S1 .LT. TEMPJ2(J)) S1=TEMPJ2(J)
IF (S2 .LT. TEMPJ3(J)) S2=TEMPJ3(J)
13 CONTINUE
S1=1.E-8*S1 $ S2=1.E-8*S2
DO 14 JJ=1,JXM
J=JX-JJ
IF (TEMPJ2(J) .GT. S1 .OR. TEMPJ3(J) .GT. S2) GO TO 3
14 CONTINUE
3 JXQ=J
SJN1=FLOATF(JXQ-1)/FLOATF(NSK) $ SJN2=FLOATF(JXQ-1)/NSK
IF (ABSF(SJN1-SJN2) .LT. .0001) GO TO 46
JXQ=FLOATF(NSK)*(SJN2+1.)+1.01
46 CONTINUE
IF (JXQ .GT. JX) JXQ=JXQ-NSK
DO 47 J=1,JXQ-NSK,NSK
DXQ(J)=X(J+NSK)-X(J)
EMAU=EMASS(K1)
UMU=.5*EMAU*V02/(1.E+3*ERGTOEV)
DO 30 LT=1,2
IF (LT .EQ. 1) GO TO 31
CALL FINDSIG(NSIG,UMU)
DO 34 J=1,JXQ,NSK
ENGY=UMU*X2(J)
WRITE (3,35) ENGY,SIGMA(J)
35 FORMAT(7HENERGY=,E16.6,5X,4HSIG=,E16.6)
34 CONTINUE
GO TO 32
31 CONTINUE
DO 33 J=1,JXQ,NSK
33 SIGMA(J)=1.
32 CONTINUE
DO 1 J=1,JXQ,NSK
1 TEMPJ1(J)=EVALS(J,K1,K2)

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QANS=0.
DO 2 J=1,JXQ-NSK,NSK
  QANS=QANS+.5*DXQ(J)*(TEMPJ1(J)+TEMPJ1(J+NSK))
2 CONTINUE
ANSWER(LT)=QANS
30 CONTINUE
SIGV=V0*ANSWER(2)/ANSWER(1)
RETURN
END
FUNCTION EVALS(J,K1,K2)
USE CFOPL
COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
DIMENSION SIGMA(JX)
EQUIVALENCE (SIGMA(1),TEMPJ6(1))
DO 1 X=1,J,NSK
  TEMPJ4(K)=(X2(J)-X2(K))*GETFG(J,K)
1 CONTINUE
TEMPJ5(1)=0.
DO 2 K=1+NSK,J,NSK
  ADDIT=.5*DXQ(K-NSK)*(TEMPJ4(K-NSK)+TEMPJ4(K))
  TEMPJ5(K)=TEMPJ5(K-NSK)+ADDIT
2 CONTINUE
SUM=0.
DO 4 K=1+NSK,J,NSK
  ARGM=X(K-NSK)*.LT*SIGMA(K-NSK)*TEMPJ5(K-NSK)
  ARGP=X(K)*.LT*SIGMA(K)*TEMPJ5(K)
  SUM=SUM+.5*DXQ(K-NSK)*(ARGM+ARGP)
4 CONTINUE
EVALS=SUM
RETURN
END
FUNCTION GETFG(J,K)
USE CFOPL
COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
ARG1=.5*(X(J)+X(K))
ARG2=.5*(X(J)-X(K))
J1=0 $ J2=0
DO 1 JM=1,JXQ-NSK,NSK
  IF (X(JM) .LE. ARG1 .AND. ARG1 .LT. X(JM+NSK)) J1=JM
  IF (X(JM) .LE. ARG2 .AND. ARG2 .LT. X(JM+NSK)) J2=JM
1 CONTINUE
IF (ARG1 .GE. X(JXQ)) J1=JXQ-NSK
IF (ARG2 .GE. X(JXQ)) J2=JXQ-NSK
J1P=J1+NSK $ J2P=J2+NSK
FRAC1=(ARG1-X(J1))/(X(J1P)-X(J1))
FRAC2=(ARG2-X(J2))/(X(J2P)-X(J2))
ANS1=(1.-FRAC1)*TEMPJ2(J1)+FRAC1*TEMPJ2(J1P)
ANS2=(1.-FRAC2)*TEMPJ3(J2)+FRAC2*TEMPJ3(J2P)
ANS3=(1.-FRAC1)*TEMPJ3(J1)+FRAC1*TEMPJ3(J1P)
ANS4=(1.-FRAC2)*TEMPJ2(J2)+FRAC2*TEMPJ2(J2P)
GETFG=ANS1*ANS2+ANS3*ANS4
RETURN
END
SUBROUTINE QHOLD(SIGV,K1,K2,NSIG)
USE CFOPL
COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
DIMENSION SIGMA(JX)
EQUIVALENCE (SIGMA(1),TEMPJ6(1))
IF (K1 .GT. NEQ .OR. K2 .GT. NEQ) RETURN
IF (K1 .EQ. KELEC .OR. K2 .EQ. KELEC) RETURN

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CALL READLCM(TEMPJ2,U(1,K1),JX)
S1=0.
DO 13 J=1,JX
  IF (S1.LT. TEMPJ2(J)) S1=TEMPJ2(J)
13 CONTINUE
S1=1.E-8*S1
DO 14 JJ=1,JXM
  J=JX-JJ
  IF (TEMPJ2(J).GT. S1) GO TO 3
14 CONTINUE
3 JXQ=J
  IF (.5*FLOATF(JXQ)-FLOATF(JXQ/2).LT. .1) JXQ=JXQ+1
  JXQM=JXQ-1
  UM2=1.+RATIO(M(K1,K2)*ENERGY(K2)/ENERGY(K1))
  IF (NEQ.EQ. 2.AND. NSIG.EQ. 1) UM2=5./3.
  UM=SQRTF(UM2)
  FACTOR=UM*V0/DENS(K1)
  EMAU=EMASS(K1)
  UMU=.5*UM2*EMAU*V02/.1.E+3*ERGTOEV)
  CALL FINDSIG(NSIG,UMU)
  DO 34 J=1,JXQ
    ENGY=UMU*X2(J)
    WRITE (3,35) ENGY,SIGMA(J)
35 FORMAT(7HENERGY=,E16.6,5X,4HSIG=,E16.6)
34 CONTINUE
DO 1 J=1,JXQ
  TEMPJ1(J)=SIGMA(J)*X(J)*TEMPJ2(J)
1 CONTINUE
QANS=0.
DO 2 J=2,JXQM,2
  QANS=QANS+CON2(J,1)*TEMPJ1(J-1)+CON2(J,2)*TEMPJ1(J)+
  C CON2(J,3)*TEMPJ1(J+1)
2 CONTINUE
SIGV=FACTOR*QANS
RETURN
END
SUBROUTINE SOURCEE'
USE CFOPL
CALL VARYSO
DO 1 K=1,NEQ
DO 1 KK=1,KDOUB
DO 13 J=1,JX
  S=-BSOR(K,KK)*(X(J)-XONE(K,KK))*2
  TEMPJ1(J)=EXPF(S)
13 CONTINUE
  ZR=0. $ ZRP=0.
  DO 11 J=2,JXM,2
    SN=TEMPJ1(J-1)*CON2(J,1)+TEMPJ1(J)*CON2(J,2)+TEMPJ1(J+1)*CON2(J,3)
    SE=TEMPJ1(J-1)*CON4(J,1)+TEMPJ1(J)*CON4(J,2)+TEMPJ1(J+1)*CON4(J,3)
    ZR=ZR+SN
    ZRP=ZRP+SE
11 CONTINUE
  QUOT=ZRP/ZR
  SORDEN(K,KK)=ZR
  SENGY(K,KK)=.5*EMASS(K1)*V02*QUOT/ERGTOEV
  CALL WRITELCM(TEMPJ1,SHAPE(1,K,KK),JX)
1 CONTINUE
  RETURN
END
SUBROUTINE VARYSO

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USE CFOPL
NCHSOR=NTLOSS
IF (N.NE.NCHSOR) RETURN
ELSTOR=EL(2,2,1)
DO 1 K=1,NEQ $ DO 1 L=1,4 $ DO 1 KK=1,KDOUB
1 EL(K,L,KK)=0.
EL(2,2,1)=ELSTOR
RETURN
END
SUBROUTINE PROBE
USE CFOPL
JXCPB(KELEC)=-2
DO 1 K=1,NEQ
IF (K.NE.KELEC) GO TO 2
DO 3 J=1,JX
TEMPJ1(J)=0.
IF (X(J).LE.XCN) GO TO 3
REFF=BRATIO/(1.-(XCN/X(J))**2)
TEMPJ1(J)=1./TENLOG(REFF)
3 CONTINUE
GO TO 4
2 CONTINUE
XCP=XCN*RMSQ(K)
XCPB=XCP*BRCON
DO 7 J=1,JXM
IF (XCPB.LT.X(J).OR.X(J+1).LE.XCPB) GO TO 7
JXCPB(K)=J
7 CONTINUE
IF (NSL.EQ.0) JXCPB(K)=-2
DO 5 J=1,JX
TEMPJ1(J)=0.
IF (X(J).LE.XCPB) GO TO 5
REFF=BRATIO/(1.+(XCP/X(J))**2)
TEMPJ1(J)=1./TENLOG(REFF)
5 CONTINUE
4 CONTINUE
CALL WRITELCM(TEMPJ1,PROB(1,K),JX)
1 CONTINUE
RETURN
END
SUBROUTINE XMESH
USE CFOPL
X(1)=XMIN $ X(JX)=XMAX
H=(XMAX-XMIN)/JXM
X(2)=H $ RAM=1.
X(2)=.0002*XMAX $ RAM=1.00266584997
X(2)=.0001*XMAX $ RAM=1.00362390976
X(2)=.00005*XMAX $ RAM=1.00452698980
DO 1 J=3,JXM
X(J)=X(J-1)+RAM*(X(J-1)-X(J-2))
1 CONTINUE
WRITE (3,89) ((J,X(J)),J=1,JX)
89 FORMAT(/, '(15,5X,F20.5)')
DO 2 J=1,JX
X2(J)=X(J)*X(J)
X3(J)=X(J)*X2(J)
IF (J.EQ.1.OR.J.EQ.JX) GO TO 2
DXM(J)=X(J)-(X(J-1))
DXP(J)=X(J+1)-X(J)
DX(J)=.5*(DXM(J)+DXP(J))

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      XI(J)=1./X(J)
2  CONTINUE
      XI(1)=0.
      XI(JX)=1./X(JX)
      DXP(1)=DXM(2) $ DXM(JX)=DXP(JXM)
      DO 3 J=2,JXM
        HMINUS=DXM(J) $ HPLUS=DXP(J)
        CMINUS=.5*HMINUS $ CPLUS=.5*HPLUS $ CMID=CMINUS+CPLUS
        CON(J,1)=CMINUS $ CON(J,2)=CMID $ CON(J,3)=CPLUS
        CON1(J,1)=X(J-1)*CMINUS
        CON1(J,2)=X(J)*CMID
        CON1(J,3)=X(J+1)*CPLUS
        CON2(J,1)=X(J-1)*CON1(J,1)
        CON2(J,2)=X(J)*CON1(J,2)
        CON2(J,3)=X(J+1)*CON1(J,3)
        CON4(J,1)=X2(J-1)*CON2(J,1)
        CON4(J,2)=X2(J)*CON2(J,2)
        CON4(J,3)=X2(J+1)*CON2(J,3)
3  CONTINUE
      RETURN
      END
      SUBROUTINE MOMENTS
      USE CFOPL
      DO 1 K=1,NEQ
        CALL READLCM(TEMPJ4,U(1,K),JX)
        DO 20 J=1,JX
          TEMPJ5(J)=0.
          IF (K.EQ.KELEC) GO TO 21
          XCP=XCN*RMSQ(K)
          XCPB=XCP*BRCON
          DO 22 J=1,JX
            REFF=0. $ IF (X(J).LE.XCPB) GO TO 23
            REFF=BRAT10/(1.+(XCP/X(J))**2)
          23  CONTINUE
            EMP20M=EMP2(REFF)
            TEMPJ5(J)=TEMPJ4(J)*.5.*EMP20M
          22  CONTINUE
          21  CONTINUE
            TEMPJ1(JX)=0. $ TEMPJ2(1)=0. $ TEMPJ3(1)=0.
            TEMPJ6(JX)=0. $ TEMPJ7(JX)=0. $ TEMPJ8(1)=0. $ TEMPJ9(1)=0.
            DO 3 J=2,JXM,2
              JJ=JX+1-J
              SM=TEMPJ4(JJ-1)*CON1(JJ,1)+TEMPJ4(JJ)*CON1(JJ,2)+
              C TEMPJ4(JJ+1)*CON1(JJ,3)
              SN=TEMPJ4(J-1)*CON2(J,1)+TEMPJ4(J)*CON2(J,2)+TEMPJ4(J+1)*CON2(J,3)
              SE=TEMPJ4(J-1)*CON4(J,1)+TEMPJ4(J)*CON4(J,2)+TEMPJ4(J+1)*CON4(J,3)
              SL2=TEMPJ5(JJ-1)*X1(JJ-1)*CON1(JJ,1)+TEMPJ5(JJ)*X1(JJ)*CON1(JJ,2)+
              C TEMPJ5(JJ+1)*X1(JJ+1)*CON1(JJ,3)
              SM2=TEMPJ5(JJ-1)*CON1(JJ,1)+TEMPJ5(JJ)*CON1(JJ,2)+
              C TEMPJ5(JJ+1)*CON1(JJ,3)
              SE2=TEMPJ5(J-1)*CON4(J,1)+TEMPJ5(J)*CON4(J,2)+
              C TEMPJ5(J+1)*CON4(J,3)
              SG2=TEMPJ5(J-1)*X2(J-1)*CON4(J,1)+TEMPJ5(J)*X2(J)*CON4(J,2)+
              C TEMPJ5(J+1)*X2(J+1)*CON4(J,3)
              TEMPJ1(JJ-1)=TEMPJ1(JJ+1)+SM
              TEMPJ2(J+1)=TEMPJ2(J-1)+SN
              TEMPJ3(J+1)=TEMPJ3(J-1)+SE
              TEMPJ6(JJ-1)=TEMPJ6(JJ+1)+SL2 $ TEMPJ7(JJ-1)=TEMPJ7(JJ+1)+SM2
              TEMPJ8(J+1)=TEMPJ8(J-1)+SE2 $ TEMPJ9(J+1)=TEMPJ9(J-1)+SG2
            3  CONTINUE

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SM=.5*DXP(JXM)*(TEMPJ4(JXM)*X(JXM)+TEMPJ4(JX)*X(JX))
SN=.5*DXM(2)*(TEMPJ4(1)*X2(1)+TEMPJ4(2)*X2(2))
SE=.5*DXM(2)*(TEMPJ4(1)*X2(1)**2+TEMPJ4(2)*X2(2)**2)
SL2=.5*DXP(JXM)*(TEMPJ5(JXM)*X(JXM)+TEMPJ5(JX)*X(JX))
SM2=.5*DXP(JXM)*(TEMPJ5(JXM)*X(JXM)+TEMPJ5(JX)*X(JX))
SE2=.5*DXM(2)*(TEMPJ5(1)*X2(1)**2+TEMPJ5(2)*X2(2)**2)
SG2=.5*DXM(2)*(TEMPJ5(1)*X3(1)**2+TEMPJ5(2)*X3(2)**2)
TEMPJ1(JXM)=SM $ TEMPJ2(2)=SN $ TEMPJ3(2)=SE
TEMPJ6(JXM)=SL2 $ TEMPJ7(JXM)=SM2
TEMPJ8(2)=SE2 $ TEMPJ9(2)=SG2
DO 4 J=3,JXM,2
JJ=JX+1-J
SM=TEMPJ4(JJ-1)*CON1(JJ,1)+TEMPJ4(JJ)*CON1(JJ,2)+
C TEMPJ4(JJ+1)*CON1(JJ,3)
SN=TEMPJ4(J-1)*CON2(J,1)+TEMPJ4(J)*CON2(J,2)+TEMPJ4(J+1)*CON2(J,3)
SE=TEMPJ4(J-1)*CON4(J,1)+TEMPJ4(J)*CON4(J,2)+TEMPJ4(J+1)*CON4(J,3)
SL2=TEMPJ5(JJ-1)*X1(JJ-1)*CON(JJ,1)+TEMPJ5(JJ)*X1(JJ)*CON(JJ,2)+
C TEMPJ5(JJ+1)*X1(JJ+1)*CON(JJ,3)
SM2=TEMPJ5(JJ-1)*CON1(JJ,1)+TEMPJ5(JJ)*CON1(JJ,2)+
C TEMPJ5(JJ+1)*CON1(JJ,3)
SE2=TEMPJ5(J-1)*CON4(J,1)+TEMPJ5(J)*CON4(J,2)+
C TEMPJ5(J+1)*CON4(J,3)
SG2=TEMPJ5(J-1)*X2(J-1)*CON4(J,1)+TEMPJ5(J)*X2(J)*CON4(J,2)+
C TEMPJ5(J+1)*X2(J+1)*CON4(J,3)
TEMPJ1(JJ-1)=TEMPJ1(JJ+1)+SM
TEMPJ2(J+1)=TEMPJ2(J-1)+SN
TEMPJ3(J+1)=TEMPJ3(J-1)+SE
TEMPJ6(JJ-1)=TEMPJ6(JJ+1)+SL2 $ TEMPJ7(JJ-1)=TEMPJ7(JJ+1)+SM2
TEMPJ8(J+1)=TEMPJ8(J-1)+SE2 $ TEMPJ9(J+1)=TEMPJ9(J-1)+SG2
4 CONTINUE
DENS(K)=TEMPJ2(JX)
IF (DENS(K).LE. 0.) GO TO 9
ENERGY(K)=TEMPJ3(JX)/DENS(K)
ENERGY(K)=.5*EMASS(K)*V02*ENERGY(K)/ERGTOEV
IF (N.EQ. 0.) GO TO 5
REDEN(K)=DENS(K)*ANORM(K)
5 CONTINUE
CALL WRITELCM(TEMPJ1,EMOF(1,K),JX)
CALL WRITELCM(TEMPJ2,ENOF(1,K),JX)
CALL WRITELCM(TEMPJ3,EEOF(1,K),JX)
CALL WRITELCM(TEMPJ6,ELOF2(1,K),JX)
CALL WRITELCM(TEMPJ7,EMOF2(1,K),JX)
CALL WRITELCM(TEMPJ8,EEOF2(1,K),JX)
CALL WRITELCM(TEMPJ9,ECOF2(1,K),JX)
1 CONTINUE
RETURN
9 KFLAG=1 $ WRITE (3,10) K
10 FORMAT(1,18HDENSITY OF SPECIES,15,3X,7HLE ZERO)
RETURN
END
SUBROUTINE GAMMAIN
USE CFOPL
TEMPE=ENERGY(KELEC)
DENSE=REDEN(KELEC)
DEBY=SQRTF(TEMPE/DENSE)
DO 1 I=1,NEQ $ DO 1 K=1,NEQ
S1=ENERGY(I)/EMASS(I) $ SK=ENERGY(K)/EMASS(K)
SF=S1 $ IF (SK.GT. S1) SF=SK
VIKF=SQRTF(SF*ERGTOEV)
GAM3=GAM2(1,K)*DEBY*VIKF

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GAMMA(I,K)=GAM(I)*(LOGF(GAM3)-.5)
1 CONTINUE
RETURN
END
SUBROUTINE GETCOEF
USE CFOPL
DO 1 K=1,NEQ
TEMPJ2(I)=0. $ TEMPJ3(I)=0. $ TEMPJ4(I)=0. $ TEMPJ5(I)=0.
TEMPJ6(I)=0.
CALL READLCM(TEMPJ1,PROB(I,K),JX)
DO 2 J=2,JX
SA=0. $ SB=0. $ SC=0.
DO 3 I=1,NEQ
ANRAG=ANORMK(I)*RATIOZ2(I,K)*GAMMA(K,I)
SA=SA+ANRAG*(RATECNC(K,I)*(RATIOI(K,I)*ENOF(J,I)-X(J)*EMOF(J,I))+
C X(J)*EMOF(J,I))
SB=SB+ANRAG*(EEOF(J,I)/X(J)+X2(J)*EMOF(J,I))/3.
SC=SC+ANRAG*ULAM(K,I)*TEMPJ1(J)/X(J)*(ENOF(J,I)-(EEOF(J,I)/
C X2(J)-2.*X(J)*EMOF(J,I))/3.)
3 CONTINUE
IF (KP2USE .EQ. 0 .OR. K .EQ. KELEC .OR. TEMPJ1(J) .EQ. 0)
C GO TO 31
REFF=10.**(-1./TEMPJ1(J))
S2=EM2P2(REFF)
DO 32 I=1,NEQ
IF (I .EQ. KELEC) GO TO 32
ANRAG=ANORMK(I)*RATIOZ2(I,K)*GAMMA(K,I)
SA=SA+ANRAG*RATIOI(K,I)*S2*(.6*EEOF2(J,I)/X2(J)-.4*X3(J)*
C EEOF2(J,I))
SB=SB+ANRAG*S2*(6.*(X2(J)**2*EEOF2(J,I)+EGOF2(J,I)/X3(J))/35.-
C (X1(J)*EEOF2(J,I)+X2(J)*EMOF2(J,I))/15.)
EILAM=2.*ULAM(K,I)*TEMPJ1(J)
SC1=-S2*(27./70.+6.*RATIOI(K,I))+EILAM/70.
SC2=-S2*(1+.6*RATIOI(K,I))+EILAM/30.*(5.*S2-1.)
SC3=-.1*S2+EILAM/15.*(S2-.5)
SC4=-27.*S2/70.+EILAM*(1./70.-.1*S2)
SC=SC+ANRAG*(SC1*X2(J)*EEOF2(J,I)+SC2*EEOF2(J,I)/X3(J)+
C SC3*EMOF2(J,I)+SC4*EGOF2(J,I)/(X2(J)*X3(J)))
32 CONTINUE
31 CONTINUE
TEMPJ2(J)=SA*TNORM/V03
TEMPJ3(J)=SB*TNORM/V03
TEMPJ5(J)=SC/V03
TERM=CXRXB(K,2)*X2(J)**2*(X1(J)-CXRXB(K,1)*CXRXB(K,3))/
C (CXRXB(K,1)**2*(1.-CXRXB(K,3)))
IF (TERM .LT. 0.) TERM=0. $ TEMPJ6(J)=TERM
TEMPJ6(J)=TEMPJ6(J)+X2(J)*CXRXB(K,4)
13 CONTINUE
TEMPJ4(J)=TNORM*(TEMPJ5(J)+TEMPJ6(J))
2 CONTINUE
CALL WRITELCM(TEMPJ2,AN(I,K),JX)
CALL WRITELCM(TEMPJ3,BN(I,K),JX)
CALL WRITELCM(TEMPJ4,CN(I,K),JX)
CALL WRITELCM(TEMPJ5,CLOS(I,K),JX)
CALL WRITELCM(TEMPJ6,CLOSE(I,K),JX)
DO 12 J=1,JX
12 TEMPJ5(J)=0.
SOSAV(K)=0.
DO 11 KK=1,KDOUB
CALL READLCM(TEMPJ1,SHAPE(I,K,KK),JX)

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T=EL(K,1,KK)+REDEN(K)*EL(K,2,KK)+SQRTF(REDEN(K))*EL(K,3,KK)
SOSAVP(K,KK)=T
T=T*TNORM/(SORDEN(K,KK)*ANORMK(K))
DO 4 J=2,JX
4 TEMPJ5(J)=TEMPJ5(J)+T*TEMPJ1(J)
SOSAV(K)=SOSAV(K)+SOSAVP(K,KK)
11 CONTINUE
CALL WRITELCM(TEMPJ5,DNST(1,K),JX)
IF (N.GT. 1) GO TO 1
CALL WRITELCM(TEMPJ2,ANST(1,K),JX)
CALL WRITELCM(TEMPJ3,BNST(1,K),JX)
CALL WRITELCM(TEMPJ4,CNST(1,K),JX)
CALL WRITELCM(TEMPJ5,DNST(1,K),JX)
1 CONTINUE
RETURN
END
FUNCTION EMP2(R)
S=0. $ IF (R .LE. 1.) GO TO 1
IF (R .GE. 1.1 .AND. R .LE. 2.) GO TO 2
RLOG=TENLOG(R) $ UM02=1.-1./R
PROB=1./RLOG
S=.5*PROB*(3.*UM02-1.)/(PROB-6.)
GO TO 1
2 CONTINUE
S=-.4838+.193*(R-1.1)
1 CONTINUE
EMP2=S
RETURN
END
FUNCTION EMP2P(R)
S=0. $ IF (R .LE. 1.) GO TO 1.
RLOG=TENLOG(R)
IF (R .GE. 1.0001) GO TO 2
A=1.0001 $ B=-.5 $ SL=0.2 GO TO 3
2 IF (R .GE. 1.001) GO TO 4
A=1.0001 $ B=-.5 $ SL=.4513 $ GO TO 3
4 IF (R .GE. 1.01) GO TO 5
A=1.001 $ B=-.4998 $ SL=.4501 $ GO TO 3
5 IF (R .GE. 1.1) GO TO 6
A=1.01 $ B=-.4991 $ SL=.4388 $ GO TO 3
6 IF (R .GE. 1.5) GO TO 7
A=1.1 $ B=-.4818 $ SL=.3951 $ GO TO 3
7 IF (R .GE. 2.) GO TO 8
A=1.5 $ B=-.4286 $ SL=.3376 $ GO TO 3
8 IF (R .GE. 3.) GO TO 9
A=2. $ B=-.3864 $ SL=.2830 $ GO TO 3
9 IF (R .GE. 4.) GO TO 10
A=3. $ B=-.3366 $ SL=.2378 $ GO TO 3
10 IF (R .GE. 6.) GO TO 11
A=4. $ B=-.3069 $ SL=.2008 $ GO TO 3
11 IF (R .GE. 8.) GO TO 12
A=6. $ B=-.2715 $ SL=.1696 $ GO TO 3
12 IF (R .GE. 10.) GO TO 13
A=8. $ B=-.2503 $ SL=.1497 $ GO TO 3
13 IF (R .GE. 15.) GO TO 14
A=10. $ B=-.2358 $ SL=.1290 $ GO TO 3
14 CONTINUE
A=15. $ B=-.2133 $ SL=.1072
3 CONTINUE
ALOG=TENLOG(A)

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S=B*9L*(RLOG-ALOG)
1 CONTINUE
EM2P2=S
RETURN
END
SUBROUTINE ITERATE
C THIS VERSION ASSUMES DIAGONAL MATRICES
USE (FOPL
LCM (NSOLEQ)
COMMON/NSOLEQ/AA(JX),BB(JX),CC(JX),DD(JX)
DO 1 J=1,NEQ
CALL READLCM(TEMPJ3,AN(1,1),JX)
CALL READLCM(TEMPJ4,ANST(1,1),JX)
CALL READLCM(TEMPJ5,BN(1,1),JX)
CALL READLCM(TEMPJ6,BNST(1,1),JX)
DO 2 J=1,JX
TEMPJ1(J)=TEMPJ3(J)+TEMPJ3(J)-TEMPJ4(J)
TEMPJ2(J)=TEMPJ5(J)+TEMPJ5(J)-TEMPJ6(J)
2 CONTINUE
CALL READLCM(TEMPJ4,CN(1,1),JX)
CALL READLCM(TEMPJ5,CNST(1,1),JX)
DO 3 J=1,JX
TEMPJ3(J)=TEMPJ4(J)+TEMPJ4(J)-TEMPJ5(J)
3 CONTINUE
DO 4 J=2,JXM
ANP2=.25*(TEMPJ1(J)+TEMPJ1(J+1))
ANM2=.25*(TEMPJ1(J-1)+TEMPJ1(J))
BNP2=.5*(TEMPJ2(J)+TEMPJ2(J+1))/DX(J)
BNM2=.5*(TEMPJ2(J-1)+TEMPJ2(J))/DX(J)
TEMPJ4(J)=RHO*(ANP2+BNP2)/(X2(J)*DX(J))
TEMPJ5(J)=ONODT-RHO*(ANP2-ANM2-BNP2-BNM2)/DX(J)-TEMPJ3(J)/X2(J)
TEMPJ6(J)=RHO*(-ANM2+BNM2)/(X2(J)*DX(J))
4 CONTINUE
CALL WRITELCM(TEMPJ4,AA,JX)
CALL WRITELCM(TEMPJ5,BB,JX)
CALL WRITELCM(TEMPJ6,CC,JX)
CALL READLCM(TEMPJ2,U(1,1),JX)
DO 5 J=1,JX
TEMPJ1(J)=ONODT*TEMPJ2(J)
5 CONTINUE
IF (ONMRHO.LT.1.E-10) GO TO 6
CALL READLCM(TEMPJ3,AN(1,1),JX)
CALL READLCM(TEMPJ4,BN(1,1),JX)
CALL READLCM(TEMPJ5,CN(1,1),JX)
CALL READLCM(TEMPJ6,DN(1,1),JX)
DO 7 J=2,JXM
ANP2=.25*(TEMPJ3(J)+TEMPJ3(J+1))
ANM2=.25*(TEMPJ3(J-1)+TEMPJ3(J))
BNP2=.5*(TEMPJ4(J)+TEMPJ4(J+1))/DX(J)
BNM2=.5*(TEMPJ4(J-1)+TEMPJ4(J))/DX(J)
TERM1=TEMPJ2(J+1)*(ANP2+BNP2)/DX(J)
TERM2=TEMPJ2(J)*(ANP2-ANM2-BNP2-BNM2)/DX(J)-TEMPJ5(J)
TERM3=TEMPJ2(J-1)*(-ANM2+BNM2)/DX(J)
TERM4=(TERM1+TERM2+TERM3)/X2(J)
TERM5=(TERM4+TEMPJ6(J))/ONMRHO
TEMPJ1(J)=TEMPJ1(J)+TERM5
7 CONTINUE
GO TO 9
6 CONTINUE
CALL READLCM(TEMPJ6,DN(1,1),JX)

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9 CONTINUE
CALL READLCM(TEMPJ5,DNST(1,1),JX)
DO 8 J=2,JXM
DNP=TEMPJ6(J)+TEMPJ6(J)-TEMPJ5(J)
TEMPJ1(J)=TEMPJ1(J)+RHO*DNP
8 CONTINUE
CALL WRITELCM(TEMPJ1,DD,JX)
CALL MSOLVE(1)
1 CONTINUE
RETURN
END
SUBROUTINE MSOLVE(1)
USE CFOPL
LCM (NSOLEQ)
COMMON/NSOLEQ/AA(JX),BB(JX),CC(JX),DD(JX)
ANP2=AN(2,1)-.5*ANST(2,1)
BNP2=(2.*BN(2,1)-BNST(2,1))/DXM(2)
TEMPJ1(1)=(BNP2+ANP2)/(BNP2-ANP2)
TEMPJ2(1)=0.
CALL READLCM(TEMPJ3,AA,JX)
CALL READLCM(TEMPJ4,BB,JX)
CALL READLCM(TEMPJ5,CC,JX)
CALL READLCM(TEMPJ6,DD,JX)
DO 1 J=2,JXM
DEN=TEMPJ4(J)-TEMPJ5(J)*TEMPJ1(J-1)
TEMPJ1(J)=TEMPJ3(J)/DEN
TEMPJ2(J)=(TEMPJ6(J)+TEMPJ5(J)*TEMPJ2(J-1))/DEN
1 CONTINUE
ANP2=AN(JXM,1)+AN(JX,1)-.5*(ANST(JXM,1)+ANST(JX,1))
BNP2=(2.*BN(JXM,1)+BN(JX,1)-(BNST(JXM,1)+BNST(JX,1)))/DXP(JXM)
ABN2=(BNP2+ANP2)/(BNP2-ANP2)
TEMPJ3(JX)=TEMPJ2(JXM)/(ABN2-TEMPJ1(JXM))
DO 2 JJ=1,JXM
J=JX-JJ
TEMPJ3(J)=TEMPJ1(J)*TEMPJ3(J+1)+TEMPJ2(J)
2 CONTINUE
CALL WRITELCM(TEMPJ3,U(1,1),JX)
RETURN
END
FUNCTION TENLOG(X)
TENLOG=LOGF(X)/2.3025851
RETURN
END
SUBROUTINE CHECK
USE CFOPL
IF (FLOATF(N)/FLOATF(NCHEC)-FLOATF(N/NCHEC).GT..001) RETURN
IF (NCH.EQ.NONCH) NCH=0
NCH=NCH+1
PTIME(NCH)=TIME
DO 1 K=1,NEQ
PLTDENS(NCH,K)=REDEN(K)
PLTENGY(NCH,K)=ENERGY(K)
1 CONTINUE
DTADV=DTR*FLOATF(NCHEC)
IF (N.LT.NTLOSS) DTADV=0.
DO 2 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
CALL READLCM(TEMPJ2,CLOS(1,K),JX)
CALL READLCM(TEMPJ3,CLOSE(1,K),JX)
DO 3 J=1,JX

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TEMPJ4(J)=TEMPJ1(J)*TEMPJ2(J)
TEMPJ5(J)=TEMPJ1(J)*TEMPJ3(J)
3 CONTINUE
S=0. $ SE=0.
SE3=0. $ SE4=0.
DO 4 J=2,JXM,2
S=S+CON(J,1)*TEMPJ4(J-1)+CON(J,2)*TEMPJ4(J)+CON(J,3)*TEMPJ4(J+1)
SE=SE+CON(J,1)*TEMPJ5(J-1)+CON(J,2)*TEMPJ5(J)+CON(J,3)*TEMPJ5(J+1)
SE3=SE3+CON(J,1)*TEMPJ5(J-1)+CON(J,2)*TEMPJ5(J)+
C CON(J,3)*TEMPJ5(J+1)
SE4=SE4+CON2(J,1)*TEMPJ5(J-1)+CON2(J,2)*TEMPJ5(J)+
C CON2(J,3)*TEMPJ5(J+1)
4 CONTINUE
CLOST(K,1)=S*ANORMK(K) $ CLOSET(K,1)=SE*ANORMK(K)
CLOST(K,2)=CLOST(K,2)+CLOST(K,1)*DTADV
CLOSET(K,2)=CLOSET(K,2)+CLOSET(K,1)*DTADV
CLOSE34(K,1)=SE3*ANORMK(K) $ CLOSE34(K,2)=SE4*ANORMK(K)
2 CONTINUE
RETURN
END
SUBROUTINE FINIT
USE CFOPL
IF (KNPROBS .GT. 1) GO TO 5
IF (KBUFV .EQ. 0) GO TO 5
CALL ASSIGN(5,0,5RUSTOR,0)
BUFFER IN (5,1) (UBUST(1,1,1),UBUST(JX,NEQ,KNSET))
21 IF (UNIT,5) 21,22,23,24
23 CALL QUIT(23)
24 CALL QUIT(24)
22 CONTINUE
CALL ASSIGN(5,0,5RUSTOR,-1)
5 CONTINUE
IF (KBUFV(KNPROBS) .NE. 0) GO TO 4
DO 1 K=1,NEQ
DO 2 J=1,JX
2 TEMPJ1(J)=RS(K,1)*EXPF(-RS(K,2)*(X(J)-RS(K,3))**2)
CALL WRITELCM(TEMPJ1,U(1,K),JX)
1 CONTINUE
RETURN
4 CONTINUE
DO 6 K=1,NEQ
CALL READLCM(TEMPJ1,UBUST(1,K,KNPROBS),JX)
CALL WRITELCM(TEMPJ1,U(1,K),JX)
6 CONTINUE
RETURN
END
SUBROUTINE PRINT2(LABEL,NWDS,DATA,IDIM,JDIM)
DIMENSION LABEL(NWDS),DATA(IDIM,JDIM)
WRITE (3,1) (LABEL(I),I=1,NWDS)
1 FORMAT(1H1,30X,6A10)
DO 2 I=1,IDIM
WRITE (3,3) I,(DATA(I,J),J=1,JDIM)
3 FORMAT(15,6X,9E11.3,/,11X,9E11.3)
2 CONTINUE
RETURN
END
SUBROUTINE PRINT1(LABEL,NWDS,DATA,IDIM)
DIMENSION LABEL(NWDS),DATA(IDIM)
WRITE (3,1) (LABEL(I),I=1,NWDS)
1 FORMAT(1H1,30X,6A10)

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WRITE (3,2) ((I,DATA(I)),I=1,101M)
2 FORMAT(//,(15,6X,E11.3))
RETURN
END
SUBROUTINE EEPLOT
USE CFOPL
DIMENSION NPRNAM(2) $ NPRNAM(1)=6HVELOC. $ NPRNAM(2)=6HENERGY
ENAVG=0.
IF (NEQ .EQ. 1) GO TO 64
DO 63 K=1,NEQ
IF (K .EQ. KELEC) GO TO 63
ENAVG=ENAVG+SENGY(K)
63 CONTINUE
ENAVG=ENAVG/FLOATF(NEQ-1)
GO TO 65
64 ENAVG=.1*ENELEC*XMAX**2
65 CONTINUE
DO 1 K=1,NEQ
CALL FRAME
CALL READLCM(TEMPJ1,U(1,K),JX)
DO 2 J=1,JX
IF (TEMPJ1(J) .LT. 0.) TEMPJ1(J)=0.
TEMPJ2(J)=X(J)
IF (NPRLOS .EQ. 1) GO TO 2
TEMPJ1(J)=TEMPJ1(J)*ANORM(K)*X(J)/(EMASS(K)*V02)
TEMPJ2(J)=TEMPJ2(J)*X(J)*ENELEC*RATIO(K,KELEC)
2 CONTINUE
CALL CARTMM(JX,YMIN,YMAX,TEMPJ1,1)
YMAX=1.1*YMAX
XPMIN=0. $ XPMAX=3.*SENGY(K)
IF (K .EQ. KELEC) XPMAX=.3*ENAVG
IF (NPRLOS .EQ. 1) XPMAX=SQRTF(XPMAX/(ENELEC*RATIO(K,KELEC)))
CALL MAPS(XPMIN,XPMAX,0.,YMAX,.2,.999,.2,.999)
CALL SETCH(2.,27.,1,0,1,1)
WRITE (100,10) NPRNAM(NPRLOS),K
10 FORMAT(A7,26HDIST FCTN - SPECIES NUMBER,15)
CALL SETCH(17.,1.,1,0,1,0)
WRITE (100,11) TIME,N
11 FORMAT(8H TIME = ,E15.3,5X,7HCYCLE =,16)
CALL TRACE(TEMPJ2,TEMPJ1,JX)
IF (N .EQ. 0) GO TO 1
CALL FRAME
CALL READLCM(TEMPN,PLTDENS(1,K),NCH)
DO 14 L=1,NCH
IF (TEMPN(L) .LT. 0.) TEMPN(L)=0.
14 CONTINUE
CALL CARTMM(NCH,YMIN,YMAX,TEMPN,1)
YMAX=2.*YMAX
CALL MAPS(0.,TIME,0.,YMAX,.2,.999,.2,.999)
CALL SETCH(2.,28.,1,0,1,1)
WRITE (100,20) K
20 FORMAT(24HDENSITY - SPECIES NUMBER,15)
CALL SETCH(17.,1.,1,0,1,0)
WRITE (100,111) TIME,N
CALL SETCH(17.,3.,1,0,1,0)
WRITE (100,71) REDEN(K),SOSAV(K)
71 FORMAT(8HDENSITY=,E16.6,5X,8HCURRENT=,E16.6)
CALL TRACE(PTIME,TEMPN,NCH)
CALL FRAME
CALL READLCM(TEMPN,PLTENGY(1,K),NCH)

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DO 15 L=1,NCH
IF (TEMPN(L) .LT. 0.) TEMPN(L)=0.
15 CONTINUE
CALL CARTMM(NCH,YMIN,YMAX,TEMPN,1)
YMAX=2.*YMAX
CALL MAPS(0.,TIME,0.,YMAX,.2,.999,.2,.999)
CALL SETCH(2.,27.,1,0,1,1)
WRITE (100,30) K
30 FORMAT(23HENERGY - SPECIES NUMBER,15)
CALL SETCH(17.,1.,1,0,1,0)
WRITE (100,11) TIME,N
CALL SETCH(17.,3.,1,0,1,0)
WRITE (100,72) ENERGY(K),SENGY(K)
72 FORMAT(7HENERGY=,E16.6,5X,1;HSOURCE EN =,E16.6)
CALL TRACE(PTIME,TEMPN,NCH)
1 CONTINUE
RETURN
END
SUBROUTINE EEPRINT
USE CFOPL
DIMENSION TEMP(NEQ),CHTR(NEQ,NEQ),CHSO(NEQ),CHLO(NEQ,NEQ)
DIMENSION SEMP(NEQ),STEMP(NEQ)
WRITE (3,12)
12 FORMAT(1H1)
WRITE (3,1)
1 FORMAT(22HDISTRIBUTION FUNCTIONS,/)
DO 2 J=1,JX
ENGY=ENELEC*RAT10M(1,KELEC)*X2(J)
DO 81 K=1,NEQ
81 TEMP(K)=U(J,K)
IF (NPRLOS.EQ. 1) GO TO 82
DO 83 K=1,NEQ
83 TEMP(K)=TEMP(K)*ANORMK(K)*X(J)/(EMASS(K)*V02)
82 CONTINUE
WRITE (3,3) J,X(J),ENGY,(TEMP(K),K=1,NEQ)
3 FORMAT(2HJ=,15,2X,2HX=,F15.5,2X,7HENERGY=,E15.5,5X,4E15.5,/,
C (55X,4E15.5))
2 CONTINUE
WRITE (3,4)
4 FORMAT(//,9HDENSITIES,/)
WRITE (3,6) (REDEN(K),K=1,NEQ)
6 FORMAT(7E15.5)
WRITE (3,7)
7 FORMAT(//,8HENERGIES,/)
WRITE (3,5) (ENERGY(K),K=1,NEQ)
DO 1414 K=1,NEQ $ DO 1414 KK=1,KDOUB
WRITE (3,1415) K,KK,BSOR(K,KK),XONE(K,KK),(EL(K,L,KK),L=1,4)
1415 FORMAT(2HK=,15,2X,3HKK=,15,2X,5HBSOR=,E16.6,2X,5HXONE=,E16.6,
C //,19X,5HCURR=,4E16.6)
1414 CONTINUE
IF (N.EQ. 0) GO TO 50
DO 30 J=1,NEQ
CALL READLCM(TEMPJ1,PROB(1,1),JX)
CALL READLCM(TEMPJ2,U(1,1),JX)
DO 30 K=1,NEQ
CALL READLCM(TEMPJ3,EMOF(1,K),JX)
CALL READLCM(TEMPJ4,ENOF(1,K),JX)
CALL READLCM(TEMPJ5,EEOF(1,K),JX)
DO 31 J=1,JX
TEMPJ6(J)=0.

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      IF (J .EQ. 1 .OR. J .EQ. JX) GO TO 31
      TERM1=TEMPJ4(J)-(TEMPJ5(J)/X2(J)-2.*X(J)*TEMPJ3(J))/3.
      TERM2=ANORMK(K)*RATIO22(K,1)*ULAM(1,K)
      TERM3=GAMMA(1,K)*TEMPJ1(J)/(X3(J)*V03)
      TAUM=TERM1*TERM2*TERM3
      TEMPJ6(J)=TAUM*TEMPJ2(J)
31  CONTINUE
      T=0.
      DO 33 J=2,JXM,2
      T=T+CON4(J,1)*TEMPJ6(J-1)+CON4(J,2)*TEMPJ6(J)+
      C CON4(J,3)*TEMPJ6(J+1)
33  CONTINUE
      TERM4=-.5*EMASS(1)*V02*ANORMK(1)
30  CHLO(1,K)=TERM4*T
      DO 34 I=1,NEQ
      CHSO(1)=0.
      DO 51 KK=1,KDOUB
51  CHSO(1)=CHSO(1)+SENGY(1,KK)*SOSAVP(1,KK)
34  CHSO(1)=ERGTOEV*CHSO(1)
      DO 35 I=1,NEQ
      CALL READLCM(TEMPJ1,U(1,1),JX)
      DO 35 K=1,NEQ
      CALL READLCM(TEMPJ2,EMOF(1,K),JX)
      CALL READLCM(TEMPJ3,ENOF(1,K),JX)
      DO 36 J=1,JX
      TEMPJ4(J)=0.
      IF (J .EQ. 1 .OR. J .EQ. JX) GO TO 36
      TERM1=TEMPJ2(J)-RATIO1(1,K)*TEMPJ3(J)/X(J)
      TEMPJ4(J)=TERM1*X2(J)*TEMPJ1(J)
36  CONTINUE
      T=0.
      DO 38 J=2,JXM,2
      T=T+CON(J,1)*TEMPJ4(J-1)+CON(J,2)*TEMPJ4(J)+CON(J,3)*TEMPJ4(J+1)
38  CONTINUE
      TERM2=GAMMA(1,K)*ANORMK(1)*EMASS(1)*ANORMK(K)*RATIO22(K,1)/V0
35  CHTR(1,K)=T*TERM2
      DO 40 I=1,NEQ
      S=CHSO(1) $ T=0.
      DO 52 K=1,NEQ
      T=T+CHLO(1,K)
      IF (CHTR(1,K) .LT. 0.) T=T+CHTR(1,K)
      IF (CHTR(1,K) .GE. 0.) S=S+CHTR(1,K)
52  CONTINUE
      SEMP(1)=S $ TEMP(1)=T $ STEMP(1)=0.
      IF (SEMP(1) .LE. 0.) GO TO 40
      STEMP(1)=1.*TEMP(1)/SEMP(1)
40  CONTINUE
      WRITE (3,41)
41  FORMAT(1H1,50X,18HCONSERVATION TERMS)
      WRITE (3,42)
42  FORMAT(1H1,14HEXCHANGE TERMS)
      DO 43 I=1,NEQ
      WRITE (3,44) (CHTR(1,K),K=1,NEQ)
44  FORMAT(1,10E11.3,/)
43  CONTINUE
      WRITE (3,45)
45  FORMAT(1H1,12HSOURCE TERMS)
      WRITE (3,46) (CHSO(1),I=1,NEQ)
      WRITE (3,47)
47  FORMAT(1H1,10HLOSS TERMS)

```

```

DO 48 I=1,NEQ
WRITE (3,44) (CHLO(I,K),K=1,NEQ)
48 CONTINUE
WRITE (3,46) ((SEMP(I),TEMP(I),STEMP(I)),I=1,NEQ)
46 FORMAT(//,13HENERGY GAINED,8X,11HENERGY LOST,10X,5HERROR,/,
C (3E16.6,/)
50 CONTINUE
AMBIPOT=.5*EMASS(KELEC)*V02*XCN*XCN
AMBIPOT=AMBIPOT/ERGTOEV
WRITE (3,10) XCN,AMBIPOT
10 FORMAT(//,4HXCN=,E16.5,5X,15HAMBIPOLAR POT =,E16.5)
WRITE (3,21)
21 FORMAT(//,7HSPECIES,2X,8HEND LOSS,8X,8HCX. L635,16X,
C 13HTOT. END LOSS,3X,13HTOT. CX. LOSS,/)
DO 22 K=1,NEQ
WRITE (3,23) K,CLOST(K,1),CLOSET(K,1),CLOST(K,2),CLOSET(K,2)
23 FORMAT(15,5X,2E16.6,10X,2E16.6)
22 CONTINUE
WRITE (3,24) ((K,CLOSE34(K,1),CLOSE34(K,2)),K=1,NEQ)
24 FORMAT(//,12HK=,15,5X,4HFAD=,E16.6,5X,4HSSD=,E16.6)
WRITE (3,8) N,TIME,REALTIM
8 FORMAT(//,16HITERATION NUMBER,2X,15,2X,9HCOMPLETED,10X,6HTIME =,
C E15.5,10X,11HREAL TIME =,E15.5,/)
RETURN
END
SUBROUTINE CHOPDST
USE CFUPL
DO 4 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
DO 102 J=1,JX
IF (TEMPJ1(J) .LT. 0.) TEMPJ1(J)=0.
102 CONTINUE
CALL WRITELCM(TEMPJ1,U(1,K),JX)
4 CONTINUE
IF (NSL .EQ. 0) RETURN
DO 1 K=1,NEQ
IF (K .EQ. KELEC) GO TO 1
CALL READLCM(TEMPJ1,U(1,K),JX)
XCP=XCN*RMSQ(K)
XCPB=XCP*BRCON
DO 2 J=1,JX
IF (X(J) .LE. XCPB) TEMPJ1(J)=0.
2 CONTINUE
CALL WRITELCM(TEMPJ1,U(1,K),JX)
1 CONTINUE
RETURN
END
SUBROUTINE RESTART
USE CFUPL
WRITE (3,50) NEND
50 FORMAT(5HNEND=,15)
WRITE (3,51) N
51 FORMAT(1H1,20HRESTART ENTERED ~ N=,15)
WRITE (3,52)
52 FORMAT(//,9HDENSITIES,/)
WRITE (3,53) (REDEN(K),K=1,NEQ)
53 FORMAT(7E15.5)
WRITE (3,54)
54 FORMAT(//,8HENERGIES,/)
WRITE (3,53) (ENERGY(K),K=1,NEQ)

```

```

CALL SIGMAVEE
DIMENSION TEMP(NEQ)
DIMENSION SEMP(NEQ)
DIMENSION TEMPE(NEQ)
DO 8 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
CALL READLCM(TEMPJ2,CLOS(1,K),JX)
CALL READLCM(TEMPJ3,CLOSE(1,K),JX)
DO 9 J=1,JX
TEMPJ4(J)=ANORMK(K)*TEMPJ1(J)*TEMPJ2(J)
TEMPJ5(J)=ANORMK(K)*TEMPJ1(J)*TEMPJ3(J)
IF (J.EQ.1.OR.NPRLOS.EQ.1) GO TO 9
TEMPJ4(J)=TEMPJ4(J)/(EMASS(K)*V02*X(J))
TEMPJ5(J)=TEMPJ5(J)/(EMASS(K)*V02*X(J))
9 CONTINUE
CALL WRITELCM(TEMPJ4,CLOS(1,K),JX)
CALL WRITELCM(TEMPJ5,CLOSE(1,K),JX)
8 CONTINUE
WRITE (3,666) (ANORMK(K),K=1,NEQ)
666 FORMAT(/,7HANORMK=/, (20X,E16.6))
WRITE (3,31)
31 FORMAT(1H),10X,17HLOSS COEFFICIENTS,/)
DO 32 J=1,JX
ENGY=ENELEC*RATOM(1,KELEC)*X2(J)
WRITE (3,33) J,X(J),ENGY,((CLOS(J,K),CLOSE(J,K)),K=1,NEQ)
33 FORMAT(2HJ=,15,2X,2HX=,F15.5,2X,7HENERGY=,E15.5,5X,2E15.5,4X,
C 2E15.5,/, (55X,2E15.5,4X,2E15.5))
32 CONTINUE
DO 28 K=1,NEQ
CALL READLCM(TEMPJ1,CLOS(1,K),JX)
CALL READLCM(TEMPJ2,CLOSE(1,K),JX)
IF (NPRLOS.EQ.1) GO TO 11
DO 10 J=2,JX
TEMPJ1(J)=TEMPJ1(J)*EMASS(K)*V02*X(J)
TEMPJ2(J)=TEMPJ2(J)*EMASS(K)*V02*X(J)
10 CONTINUE
CALL WRITELCM(TEMPJ1,CLOS(1,K),JX)
CALL WRITELCM(TEMPJ2,CLOSE(1,K),JX)
11 CONTINUE
S=0. $ SE=0.
DO 29 J=2,JXM,2
S=S+CON(J,1)*TEMPJ1(J-1)+CON(J,2)*TEMPJ1(J)+CON(J,3)*TEMPJ1(J+1)
SE=SE+CON(J,1)*TEMPJ2(J-1)+CON(J,2)*TEMPJ2(J)+CON(J,3)*TEMPJ2(J+1)
29 CONTINUE
TEMP(K)=S
TEMPE(K)=SE
SEMP(K)=0.
IF (SOSAV(K).EQ.0.) GO TO 28
SEMP(K)=1.-(TEMP(K)+TEMPE(K))/SOSAV(K)
28 CONTINUE
WRITE (3,20) ((K,TEMP(K),TEMPE(K),SOSAV(K),SEMP(K)),K=1,NEQ)
20 FORMAT(/,21HPARTICLE CONSERVATION,/, (15,4E16.6))
DO 40 K=1,NEQ
CALL READLCM(TEMPJ1,CLOS(1,K),JX)
S=0.
DO 41 J=1,JX
IF (TEMPJ1(J).LT.0.) TEMPJ1(J)=0.
TEMPJ2(J)=X(J)
IF (NPRLOS.EQ.1.OR.J.EQ.1) GO TO 58
TEMPJ1(J)=TEMPJ1(J)/(EMASS(K)*V02*X(J))

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TEMPJ2(J)=TEMPJ2(J)*X(J)*ENELEC*RAT10M(K,KELEC)
58 CONTINUE
IF (S.LT. TEMPJ1(J)) S=TEMPJ1(J)
41 CONTINUE
CMAX=1.5*S
CALL FRAME
SCOMP=1.E-3*S $ DO 61 JJ=1,JX
JJ=JJ+1-JJ $ IF (TEMPJ1(J).LT. SCOMP) GO TO 61
XPMAX=TEMPJ2(J) $ GO TO 62
61 CONTINUE
62 CONTINUE
CALL MAPS(0.,XPMAX,0.,CMAX,.2,.999,.2,.999)
CALL SETCH(2.,28.,1,0,1,1)
WRITE (100,42) K
42 FORMAT(21HLOSS - SPECIES NUMBER,15)
CALL SETCH(17.,1,1,0,1,0)
WRITE (100,43) TIME,N
43 FORMAT(8H TIME = ,E15.3,5X,7HNCYCLE = ,16)
CALL TRACE(TEMPJ2,TEMPJ,JX)
40 CONTINUE
IF (NEND.EQ. 1) RETURN
CALL PLOTE
CALL ASSIGN(2,0,7RINTIONS,-1)
CALL OFFMON
DIMENSION NQ(5) $ NQ(1)=0 $ NQ(2)=1HF $ NQ(3)=6 $ NQ(4)=0
NQ(5)=1 $ CALL HSP(NQ)
CALL CRTID(10HISOT RSTRT,1,1)
CALL KEEP80(KTTYOUT)
CALL ASSIGN(2,0,7RINTIONS,0)
READ (2,1) DTR,DELAMB,DXCN,NRSTRT,NSTOP,NPRINT,NPLOT,NTLOSS,NQCH
1 FORMAT(3E16.6,/,6I5)
DT=DTR/TNORM
ONDT=1./DT
WRITE (3,2) DTR,DELAMB,DXCN,NRSTRT,NSTOP,NPRINT,NPLOT,NTLOSS,NQCH
2 FORMAT(9HNEW DTR =,E16.6,5X,12HNEW DELAMB =,E16.6,5X,
C 10HNEW DXCN =,E16.6,/,7HNRRSTRT=,18.5X,6HNSTOP=,18.5X,7HNPRINT=,
C 15.5X,6HNPLT=,15.5X,7HNTLOSS=,15.5X,5HNQCH=,15)
RETURN
END
SUBROUTINE OFFMON
COMMON/GOBCOM/IX(41)
IX(24)=IX(24).INT. 7777777777777700778
IADD = .LOC. RSTRT
CALL QUIT(IADD)
RSTRT RETURN
END

```

TWO-COMPONENT VERSION

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PROGRAM DUMFG(TAPE2,PRINT,TAPE5,TAPE6,TAPE3=TAPE6)
DIMENSION ND(5) $ ND(1)=0 $ ND(2)=1HF $ ND(3)=6 $ ND(4)=0
ND(5)=1 $ CALL HSP(ND)
CALL ASSIGN(2,0,7,PRINTIONS,0)
CALL CRTID(BHAM TIONS,1,1)
CLICHE CFOPL
OPTIMIZE
PARAMETER(JX=1001,NEQ=3)
PARAMETER(NONCH=1000)
PARAMETER(KDOUB=1)
PARAMETER(KNSET=1)
COMMON/MGRID/XMIN,XMAX,X(JX),X2(JX),X3(JX),DXM(JX),DX(JX),DXP(JX),
C CON1(JX,3),CON2(JX,3),CON4(JX,3),CON(JX,3),JXM,JXM2
COMMON/MCON1/RATIO1(NEQ,NEQ),EMASS(NEQ),ANUMB(NEQ),DENSITY(NEQ),
C ULAM(NEQ,NEQ),ANORMK(NEQ),DENS(NEQ),ENERGY(NEQ),GAM1(NEQ),
C GAM2(NEQ,NEQ),GAMMA(NEQ,NEQ),REDEN(NEQ),DENSTOR(NEQ),
C RATIO22(NEQ,NEQ),SENGY(NEQ,KDOUB),RMSQ(NEQ),SORDEN(NEQ,KDOUB),
C RS(NEQ,3),BSOR(NEQ,KDOUB),XONE(NEQ,KDOUB),EL(NEQ,4,KDOUB),
C E1(NEQ),F1(NEQ),SOSAV(NEQ),SOSAVP(NEQ,KDOUB),JXCPB(NEQ),
C RATECNC(NEQ,NEQ),KBUFU(KNSET),KBUFH,CXRXB(NEQ,4)
C ,NTLOSS,CLOST(NEQ,2),CLOSET(NEQ,2),CLOSE34(NEQ,2)
COMMON/MSOR/TEMPJ1(JX),TEMPJ2(JX),TEMPJ3(JX),TEMPJ4(JX),
C TEMPJ5(JX),TEMPJ6(JX),TEMPN(NONCH)
COMMON/MCON2/TIME,DT,N,NPRINT,NPLOT,V0,RHO,ECHARG,PI,TWOPI,
C REALTIM,TNORM,ESUCHARG,NCH,NCH,KTTYOUT,BRCON,
C FOURPI,PISQT,KELEC,V02,V03,ONODT,ONMRHO,ERGTOEV,NRSTRT,DTR
C ,MNXCN,NQCH,KNPROBS,NEND,NSTOP,NPLOS,ENELEC
C ,KMFLAG
C
C INSERTS IN MAIN,INITIAL,GETCOEF,CHOPDST,DATA CARD
COMMON/MXF/BETA0,XONF,JONF
C
COMMON/MAMB/XCN,DXCN,DELAMB,JAMB,MAXAMB,BRATIO,NSL
C ,KAMB
COMMON/MP2EXP/KP2USE,X1(JX),TEMPJ7(JX),TEMPJ8(JX),TEMPJ9(JX)
LCM (MOMMAT)
COMMON/MOMMAT/AN(JX,NEQ),BN(JX,NEQ),CN(JX,NEQ),DN(JX,NEQ),
C CLOS(JX,NEQ),USTORE(JX,NEQ),U(JX,NEQ),ANST(JX,NEQ),
C BNST(JX,NEQ),CNST(JX,NEQ),DNST(JX,NEQ),EMOF(JX,NEQ),
C ENOF(JX,NEQ),EEOF(JX,NEQ),PROB(JX,NEQ),SHAPE(JX,NEQ,KDOUB)
C ,CLOSE(JX,NEQ),UBUST(JX,NEQ,KNSET)
C ,ELOF2(JX,NEQ),EMOF2(JX,NEQ),EEOF2(JX,NEQ),EGOF2(JX,NEQ)
LCM (MPLOTS)
COMMON/MPLOTS/PTIME(NONCH),PLTDENS(NONCH,NEQ),PLTENGY(NONCH,NEQ)
ENDCLICHE
USE CFOPL
KBUFH=0
DO 31 KNPROBS=1,KNSET
KBUFU(KNPROBS)=0 $ KBUFH=KBUFH+KBUFU(KNPROBS)
31 CONTINUE
DO 1000 KNPROBS=1,KNSET
MNXCN=0
KMFLAG=0
NEND=0
WRITE (3,1001) KNPROBS
1001 FORMAT(1H1,20HBEGINNING OF PROBLEM,2X,15)
NCYCLE=0
CALL INITIAL
IF (KMFLAG.EQ. 1) GO TO 23
CALL SOURCEE

```

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CALL KEEPS0(KTTYOUT)
CALL EEPRIOT
CALL EEPLOT
DT1=1.E-3 $ DT2=1.E-2 $ DT3=1.E-2
NSET1=101 $ NSET2=0 $ NSET3=0
1 CONTINUE
N=N+1
IF (N .EQ. NSET1) DTR=DT1
IF (N .EQ. NSET2) DTR=DT2
IF (N .EQ. NSET3) DTR=DT3
IF (N .EQ. NRSTRT) CALL RESTART
DT=DTR/TNORM
ONODT=1./DT
TIME=TIME+DT
REALTIM=REALTIM+DT*TNORM
CALL SOURCEE
KAMB=0
8 CONTINUE
IF (SENSE SWITCH 1) B1,B2
81 CALL RESTART
82 CONTINUE
NCYCLE=NCYCLE+1
DO 2 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
CALL WRITELCM(TEMPJ1,USTORE(1,K),JX)
2 CONTINUE
DO 20 K=1,NEQ
20 DENSTOR(K)=REDEN(K)
KAMB=KAMB+1
CALL GAMMAIN
CALL PROBE
CALL GETCOEF
CALL ITERATE
CALL CHOPDST
C
CALL MOMENTS $ DENR=(REDEN(1)+REDEN(3))/REDEN(2)
CALL READLCM(TEMPJ1,U(1,2),JX)
DO 113 J=1,JX
113 TEMPJ1(J)=TEMPJ1(J)*DENR
CALL WRITELCM(TEMPJ1,U(1,2),JX)
C
CALL MOMENTS
IF (KMFLAG .EQ. 1) GO TO 23
CALL AMB1
IF (KMFLAG .EQ. 1) GO TO 23
IF (MNXCN .EQ. 1) GO TO 23
IF (JAMB .EQ. 1 .AND. KAMB .LE. MAXAMB) GO TO 8
IF (KAMB .GT. MAXAMB) GO TO 22
CALL CHECK
DO 101 K=1,NEQ
CALL READLCM(TEMPJ1,AN(1,K),JX)
CALL WRITELCM(TEMPJ1,ANST(1,K),JX)
CALL READLCM(TEMPJ1,BN(1,K),JX)
CALL WRITELCM(TEMPJ1,BNST(1,K),JX)
CALL READLCM(TEMPJ1,CN(1,K),JX)
CALL WRITELCM(TEMPJ1,CNST(1,K),JX)
CALL READLCM(TEMPJ1,DN(1,K),JX)
CALL WRITELCM(TEMPJ1,DNST(1,K),JX)
101 CONTINUE
IF (FLOATF(N)/FLOATF(NPRINT)-FLOATF(N/NPRINT) .GE. 1.E-4) GO TO 11

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      CALL EEPRI NT
      IF (KTTYOUT .EQ. 0) GO TO 11
      WRITE (59,18) N,NCYCLE
18    FORMAT(15,2X,20HITERATIONS COMPLETED,5X,16,2X,16HCYCLES COMPLETED)
      CALL ODOTBF
11    IF (FLOATF(N)/FLOATF(NPLOT)-FLOATF(N/NPLOT) .GE. 1.E-4) GO TO 12
      CALL EEPLOT
12    CONTINUE
      IF (N .LT. NSTOP) GO TO 1
      GO TO 23
22    WRITE (3,21)
21    FORMAT(46HAMBIPOLAR POTENTIAL REQUIREMENTS NOT SATISFIED)
      IF (KTTYOUT .EQ. 0) GO TO 23
      WRITE (59,21) $ CALL ODOTBF
23    CONTINUE
      CALL EEPRI NT $ CALL EEPLOT
      IF (KMFLAG .EQ. 1) GO TO 24
      IF (MNXCN .EQ. 1 .OR. KAMB .GT. MAXAMB) GO TO 24
      NEND=1 $ CALL RESTART
24    CONTINUE
      WRITE (3,1002) KNPROBS
1002  FORMAT(/,14HEND OF PROBLEM,2X,15)
      CALL PLOTEA
      DO 1004 K=1,NEQ
      CALL READLCM(TEMPJ1,U(1,K),JX)
      CALL WRITELCM(TEMPJ1,UBUST(1,K,KNPROBS),JX)
1004  CONTINUE
1000  CONTINUE
      CALL QUIT(1)
      END
      SUBROUTINE INITIAL
      USE CFOPL
1    FORMAT(8110)
2    FORMAT(5E16.6)
      READ (2,1) KTTYOUT,NSL,NRSTRT,NSTOP
      READ (2,1) NPRINT,NPLOT,NCHEC
      READ (2,1) NQCH,NTLOSS
      READ (2,2) DTR,V0,RHO
      READ (2,2) XMIN,XMAX
      DO 3 K=1,NEQ
      READ (2,2) EMASS(K),ANUMB(K)
      READ (2,2) DENSITY(K)
3    CONTINUE
      DO 4 K=1,NEQ
      DO 91 KK=1,KDOUB
      READ (2,2) BSOR(K,KK)
      READ (2,2) XONE(K,KK)
      READ (2,2) EL(K,1,KK)
      READ (2,2) (EL(K,KN,KK),KN=2,4)
91    CONTINUE
4    CONTINUE
      DO 5 I=1,NEQ $ DO 5 K=1,NEQ
      ULAM(1,K)=.5
5    CONTINUE
      DO 31 K=1,NEQ
      READ (2,2) (RS(K,1),RS(K,2),RS(K,3))
31    CONTINUE
      READ (2,2) XCN,DXCN,DELAMB,BPAT10
      READ (2,1) MAXAMB
      WRITE (3,14) NRSTRT,NSTOP

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14 FORMAT(7HNRSTRT=,18,5X,6HNSTOP=,18)
   WRITE (3,38) NPRINT,NPLOT,NQCH,NTLOSS
38 FORMAT(7HNPRT=,15,5X,6HNPLT=,15,5X,5HMQCH=,15,5X,7HNTLOSS=,15)
   WRITE (3,11) DTR,V0,RHO,XMIN,XMAX
11 FORMAT(4HDIR=,E16.6,3X,3HV0=,E16.6,3X,4HRHO=,E16.6,3X,5HXMIN=
   C E16.6,3X,5HMAX=,E16.6)
   DO 12 K=1,NEQ
     WRITE (3,13) K,EMASS(K),ANUMB(K),DENSITY(K),
     C (1BSOR(K,KK),XONE(K,KK),EL(K,KN,KK),KN=1,4),KK=1,KDOUB1
13 FORMAT(/,15,3X,5HMASS=,E16.6,3X,9HA NUMBER=,E16.6,3X,8HDENSITY=,
   C E16.6,/,17HSOURCE PARAMS ARE,/, (10X,6E16.6))
12 CONTINUE
   DO 29 K=1,NEQ
     WRITE (3,30) K,RS(K,1),RS(K,2),RS(K,3)
30 FORMAT(/,15,3X,16HFINIT PARAMS ARE,3E16.6)
29 CONTINUE
   WRITE (3,28) XCN,DXCN,DELAMB,MAXAMB,BRATIO
28 FORMAT(/,4HXCN=,E16.5,5X,5HDXCN=,E16.5,5X,7HDELAMB=,E16.5,5X,
   C 7HMAXAMB=,15,5X,7HBRATIO=,E16.5)
   KP2USE=1
   IF (NSL.EQ.0) KP2USE=0
   NPRL0S=2
   NPRL0S=1
   N=0
   NCH=0
   TIME=0.
   REALTIME=0.
   ECHARG=3.7943E-4
   ESUCHARG=4.803E-10
   ERGTOEV=(ESUCHARG/ECHARG)**2
   KELEC=2
   IF (KELEC.GT. NEQ) KELEC=NEQ
   PI=3.1415926536
   TWOPI=2.*PI
   FOURPI=4.*PI
   PISQ=SQRTF(6.*PI)
   JXM=JX-1
   JXM2=JX-2
   V02=V0*V0
   V03=V02*V0
   ENELEC=.5*EMASS(KELEC)*V02/ERGTOEV
   BRCON=SQRTF(1.00001/(BRATIO-1.))
   IF (BRATIO.LT. 2.) BRCON=1.
   DO 34 I=1,NEQ $ DO 34 K=1,NEQ
34 RATECNC(I,K)=1.
   DO 52 I=1,NEQ
     WRITE (3,53) I,(RATECNC(I,K),K=1,NEQ)
53 FORMAT(/,2HI=,15,3X,8HRATECNC=,6E16.6,/, (18X,6E16.6))
52 CONTINUE
   DO 37 J=1,JX
37 TEMPJ(J)=0.
   DO 20 K=1,NEQ
     CALL WRITELCM(TEMPJ,AN(I,K),JX)
     CALL WRITELCM(TEMPJ,BN(I,K),JX)
     CALL WRITELCM(TEMPJ,CN(I,K),JX)
     CALL WRITELCM(TEMPJ,DN(I,K),JX)
     CALL WRITELCM(TEMPJ,CLOS(I,K),JX)
20 CONTINUE
   DO 21 I=1,NEQ $ DO 21 K=1,NEQ
     RATIOZ2(I,K)=(ANUMB(I)/ANUMB(K))**2

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21 RATION(I,K)=EMASS(I)/EMASS(K)
DO 22 K=1,NEQ
GAMI(K)=FOURPI*ANUMB(K)**4*ESUCHARG**4/EMASS(K)**2
RMSQ(K)=SQRTF(RATION(KELEC,K)*ANUMB(K))
CXRXB(K,1)=1. $ CXRXB(K,2)=0. $ CXRXB(K,3)=0. $ CXRXB(K,4)=0.
CLOST(K,1)=0. $ CLOSET(K,1)=0. $ CLOST(K,2)=0. $ CLOSET(K,2)=0.
CLOSE34(K,1)=0. $ CLOSE34(K,2)=0.
C GO TO 22
C SET CXRXB IF NECESSARY.
READ (2,2) (CXRXB(K,L),L=1,4)
22 CONTINUE
WRITE (3,54) ((K,(CXRXB(K,L),L=1,4)),K=1,NEQ)
54 FORMAT(/,6HCXRXB=,/, (15,4E16.6))
ALP=1./137. $ R0=2.82E-13 $ CLIGHT=3.E+10
GACON1=2.*ALP*SQRTF(2.)/(PI*SQRT(R0*CLIGHT))
GACON2=GACON1/(ECHARG*EMASS(KELEC))
DO 41 I=1,NEQ $ DO 41 K=1,NEQ
GAM2(I,K)=EMASS(I)*EMASS(K)*GACON2/(EMASS(I)+EMASS(K))
41 CONTINUE
ONMRHO=1.-RHO
CALL XMESSH
DO 23 K=1,NEQ
E1(K)=1.
F1(K)=0.
23 CONTINUE
CALL FINIT
CALL MOMENTS
IF (KMFLAG.EQ. 1) RETURN
DO 26 K=1,NEQ
REDEN(K)=DENSITY(K)
26 ANORM(K)=DENSITY(K)/DENS(K)
TNORM=2.*V03/(ANORM(KELEC)*GAM1(KELEC))
TNORM=1.
WRITE (3,101) TNORM
101 FORMAT(/,6HTNORM=,E15.5)
DT=DTR/TNORM
ONODT=1./DT
C READ (2,2) BETA0
ETEMP=ENERGY(KELEC)*ERGTOEV*2./3.
XONF2=2.*BETA0*ETEMP/(EMASS(1)*V02)
XONF=SQRTF(XONF2)
JONF=0 $ DO 105 J=1,JXM
IF (X(J).GT. XONF .OR. X(J+1).LE. XONF) GO TO 105
JONF=J $ GO TO 106
105 CONTINUE
106 CONTINUE
WRITE (3,103) BETA0,XONF,JONF
103 FORMAT(/,6HBETA0=,E16.6,5X,5HXONF=,E16.6,5X,5HJONF=,15)
C IF (NSL.EQ. 1) RETURN
DO 35 I=1,NEQ $ DO 35 K=1,NEQ
35 ULAM(I,K)=0.
WRITE (3,102)
102 FORMAT(31HTHIS IS A NO SOURCE NO LOSS RUN,/,
C 41HIGNORE XCN DXCN DELAMB AMBIPOT AND BRATIO)
RETURN
END
SUBROUTINE AMB1
USE CFOPL

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IF (KAMB .EQ. 1) LAMB=0
JAMB=0
IF (XCN .EQ. 0.) RETURN
IF (NSL .EQ. 0) RETURN
QMINUS=REDEN(KELEC) $ QSMINUS=DENSTOR(KELEC)
QPLUS=0. $ QSPLUS=0.
DO 42 K=1,NEQ
IF (K .EQ. KELEC) GO TO 42
QSPLUS=QSPLUS+ANUMB(K)*DENSTOR(K)
QPLUS=QPLUS+ANUMB(K)*REDEN(K)
42 CONTINUE
IF (DELAMB .LT. 1.E-20) GO TO 40
DENDIF=ABSF(1.-QPLUS/QMINUS)
WRITE (61,41) N,DENDIF,QPLUS,QMINUS,XCN
41 FORMAT(2HN=,15,2X,7HDENDIF=,F15.5,2X,8H1ON DEN=,E16.5,2X,
C 9HELEC DEN=,E16.5,5X,4HXCEN=,F15.5)
IF (DENDIF .GT. DELAMB) GO TO 1
IF (LAMB .EQ. 0) GO TO 40
RETURN
1 JAMB=1
LAMB=1
IF (QMINUS .LE. QPLUS) XCN=XCN+DXCN
IF (QMINUS .GE. QPLUS) XCN=XCN-DXCEN
IF (XCN .LT. .5*DXCN) GO TO 32
IF (XCN .GT. XMAX) GO TO 32
GO TO 48
40 CONTINUE
D1=QPLUS-QSPLUS $ D2=QMINUS-QSMINUS
WRITE (61,43) N,QSPLUS,QPLUS,D1,QSMINUS,QMINUS,D2,XCN
43 FORMAT(2HN=,15,2X,7HQPLUS=,E16.5,3X,6HQPLUS=,E16.5,2X,3HD1=,
C E16.5,/,8X,8HQMINUS=,E16.5,2X,7HQMINUS=,E16.5,2X,3HD2=,E16.5,
C 2X,4HXCEN=,F15.5)
IF (N .EQ. 1) RETURN
IF (QSPLUS .LT. QSMINUS) GO TO 30
IF (D2 .GE. D1) RETURN
JAMB=1
XCN=XCN+DXCN
IF (XCN .GT. XMAX) GO TO 32
GO TO 48
30 IF (D1 .GT. D2) RETURN
JAMB=1
XCN=XCN-DXCEN
IF (XCN .LT. .5*DXCN) GO TO 32
GO TO 48
32 WRITE (3,33) $ MNXCEN=1 $ RETURN
33 FORMAT(16HXCEN OUT OF RANGE)
48 CONTINUE
DO 2 K=1,NEQ
CALL READLCM(TEMPJ1,USTORE(1,K),JX)
CALL WRITELCM(TEMPJ1,U(1,K),JX)
2 CONTINUE
CALL CHOPDST
CALL MOMENTS
RETURN
END
SUBROUTINE SIGMAVEE
USE CFOPL
COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
NSK=3
IF (NQCH .EQ. 0) RETURN

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IF (N.EQ. 1) RETURN
SIGVDDP=0. $ SIGVDDN=0.
CALL QFUTCH(SIGVDDP,1,1,3)
CALL QFUTCH(SIGVDDN,1,1,4)
EDDN=3.27E+6 $ EDDP=4.04E+6
EDH=1.83E+7 $ EDT=2.24E+7
IF (NQCH.NE. 1) GO TO 100
SIGVF=0. $ SIGVH=0.
CALL QFUTCH(SIGVF,1,1,1)
CALL QHOLD(SIGVH,1,1,1)
WRITE (3,190) SIGVF,SIGVH,SIGVDDP,SIGVDDN
190 FORMAT(1H1,/,6HSIGVF=,E16.6,5X,6HSIGVH=,E16.6,5X,8HSIGVDDP=,
C E16.6,5X,8HSIGVDDN=,E16.6)
RETURN
100 IF (NQCH.NE. 2) GO TO 200
SIGVDT=0. $ SIGVH=0.
CALL QFUTCH(SIGVDT,1,3,1)
CALL QHOLD(SIGVH,1,3,1)
WRITE (3,290) SIGVDT,SIGVH,SIGVDDP,SIGVDDN
290 FORMAT(1H1,/,7HSIGVDT=,E16.6,5X,6HSIGVH=,E16.6,5X,8HSIGVDDP=,
C E16.6,5X,8HSIGVDDN=,E16.6)
ENUM=.5*REDEN(1)**2*(SIGVDDP*EDDP+SIGVDDN*EDDN)+
C REDEN(1)*REDEN(3)*SIGVDT*EDT
SUMSEN=0.
DO 201 K=1,NEQ
DO 201 KK=1,KDOUB
SUMSEN=SUMSEN+EL(K,1,KK)*SENGY(K,KK)
201 CONTINUE
QDT=ENUM/SUMSEN
WRITE (3,291) QDT
291 FORMAT(/,4HQDT=,E16.6)
RETURN
200 IF (NQCH.NE. 3) GO TO 300
SIGVDH=0. $ SIGVH=0.
CALL QFUTCH(SIGVDH,1,3,2)
CALL QHOLD(SIGVH,1,3,2)
WRITE (3,390) SIGVDH,SIGVH,SIGVDDP,SIGVDDN
390 FORMAT(1H1,/,7HSIGVDH=,E16.6,5X,6HSIGVH=,E16.6,5X,8HSIGVDDP=,
C E16.6,5X,8HSIGVDDN=,E16.6)
ENUMN=.5*REDEN(1)**2*(SIGVDDP*EDDP+REDEN(1)*REDEN(3)*SIGVDH*EDH
ENUM=ENUMN+.5*REDEN(1)**2*SIGVDDN*EDDN
SUMSEN=0.
DO 301 K=1,NEQ
DO 301 KK=1,KDOUB
SUMSEN=SUMSEN+EL(K,1,KK)*SENGY(K,KK)
301 CONTINUE
QDH=ENUM/SUMSEN $ QDHN=ENUMN/SUMSEN
WRITE (3,391) QDH,QDHN
391 FORMAT(/,4HQDH=,E16.6,5X,11HWITHOUT N =,E16.6)
RETURN
300 CONTINUE
SIGVDT=0. $ SIGVDH=0.
CALL QFUTCH(SIGVDT,1,3,1)
CALL QFUTCH(SIGVDH,1,4,2)
WRITE (3,490) SIGVDH,SIGVDT,SIGVDDP,SIGVDDN
490 FORMAT(7HSIGVDH=,E16.6,5X,7HSIGVDT=,E16.6,5X,8HSIGVDDP=,
C E16.6,5X,8HSIGVDDN=,E16.6)
ENUMN=.5*REDEN(1)**2*(SIGVDDP*EDDP+REDEN(1)*REDEN(3)*SIGVDT*EDT+
C REDEN(1)*REDEN(4)*SIGVDH*EDH
ENUM=ENUMN+.5*REDEN(1)**2*SIGVDDN*EDDN

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```

SUMSEN=0.
DO 401 K=1,NEQ
DO 401 KK=1,KDOUB
SUMSEN=SUMSEN+EL(K,1,KK)*SENGY(K,KK)
401 CONTINUE
QDTH=ENUM/SUMSEN $ QDTHN=ENUNM/SUMSEN
WRITE (3,491) QDTH,QDTHN
491 FORMAT(/,5HQDTH=,E16.6,5X,11HWITHOUT N =,E16.6)
RETURN
END
SUBROUTINE FINDSIG(NSIG,UMU)
USE CFOPL
COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
DIMENSION SIGMA(JX)
EQUIVALENCE (SIGMA(1),TEMPJ6(1))
SIGMA(1)=0.
IF (NSIG .NE. 1) GO TO 100
DO 1 J=2,JXQ
EPS=UMU*X2(J)
IF (EPS .GE. 20.) GO TO 41
TEMPQ=2.25E+4*EXPF(-44.4/SQRTF(EPS))/EPS $ GO TO 40
41 IF (EPS .GE. 30.) GO TO 42
TEMPQ=4.62E-4*EPS*EPS-0.137 $ GO TO 40
42 IF (EPS .GE. 50.) GO TO 43
TEMPQ=6.70E-4*EPS*EPS-0.320 $ GO TO 40
43 IF (EPS .GE. 87.) GO TO 44
TEMPQ=8.55E-02*EPS-2.93 $ GO TO 40
44 IF (EPS .GE. 107.) GO TO 45
TEMPQ=1.98E+4/((EPS-107.)**2+4000.) $ GO TO 40
45 IF (EPS .GE. 137.) GO TO 46
TEMPQ=3.56E+4/((EPS-107.)**2+7200.) $ GO TO 40
46 IF (EPS .GE. 185.) GO TO 47
TEMPQ=8.70-0.0314*EPS $ GO TO 40
47 IF (EPS .GE. 400.) GO TO 48
TEMPQ=7.050E+3/(EPS*SQRTF(EPS)) $ GO TO 40
48 TEMPQ=255./(EPS-110.)
40 CONTINUE
SIGMA(J)=1.E-24*TEMPQ
1 CONTINUE
RETURN
100 IF (NSIG .NE. 2) GO TO 200
DO 11 J=2,JXQ
EPS=UMU*X2(J)
SA=230. $ SB=27500. $ SC=350. $ SD=2845.
TS1=SB/EPS $ TS2=SA**2/(SA**2+(EPS-SC)**2)
ARG=-B9./SQRTF(EPS) $ TS3=EXPF(ARG)
TEMPQ=TS1*TS2*TS3
IF (EPS .LE. 600.) GO TO 12
TS5=5.75E-4*(EPS-600.)
TEMPQ=TEMPQ*(1.+TS5)
IF (EPS .LE. 1000.) GO TO 12
TS4=(SD+EPS)/(SD+1000.)
TEMPQ=TEMPQ*TS4**2
12 CONTINUE
SIGMA(J)=1.E-24*TEMPQ
11 CONTINUE
RETURN
200 IF (NSIG .NE. 3) GO TO 300
DO 21 J=2,JXQ
EPS=UMU*X2(J)

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      IF (EPS .GT. 1000.) GO TO 22
      GEE=EXPF(-44.4/SQRTF(EPS))/EPS
      TEMPQ=106.4*GEE*(1.+EPS/493.)
      GO TO 23
22  CONTINUE
      ARG=(EPS-25.74)/407.3
      TEMPQ= .09*(1.-EXPF(-ARG))
23  CONTINUE
      SIGMA(J)=1.E-24*TEMPQ
21  CONTINUE
      RETURN
300 CONTINUE
      DO 31 J=2,JX0
      EPS=UMU*X2(J)
      IF (EPS .GT. 500.) GO TO 32
      GEE=EXPF(-44.4/SQRTF(EPS))/EPS
      TEMPQ=108.4*GEE*(1.+EPS/332.)
      GO TO 33
32  CONTINUE
      ARG=(EPS-37.47)/358.3
      TEMPQ=.103*(1.-EXPF(-ARG))
33  CONTINUE
      SIGMA(J)=1.E-24*TEMPQ
31  CONTINUE
      RETURN
      END
      SUBROUTINE QFUTCH(SIGV,K1,K2,NSIG)
      USE CFOPL
      COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
      DIMENSION SIGMA(JX)
      EQUIVALENCE (SIGMA(1),TEMPJ6(1))
      DIMENSION ANSWER(2)
      IF (K1 .GT. NEQ .OR. K2 .GT. NEQ) RETURN
      IF (K1 .EQ. KELEC .OR. K2 .EQ. KELEC) RETURN
      CALL READLCM(TEMPJ2,U(1,K1),JX)
      CALL READLCM(TEMPJ3,U(1,K2),JX)
      IF (NEQ .NE. 2 .OR. NSIG .NE. 1) GO TO 161
      SQIP5=SQRTF(1.5)
      TEMPJ3(1)=TEMPJ2(1)
      DO 162 J=2,JX
      QJX3=SQIP5*X(J)
      DO 163 JJ=1,JXM
      IF (X(JJ) .LE. QJX3 .AND. QJX3 .LT. X(JJ+1)) GO TO 164
163  CONTINUE
      TEMPJ3(J)=0. $ GO TO 162
164  RATIO=(QJX3-X(JJ))/DXP(JJ)
      TEMPJ3(J)=(1.-RATIO)*TEMPJ2(JJ)+RATIO*TEMPJ2(JJ+1)
162  CONTINUE
161  CONTINUE
      S1=0. $ S2=0.
      DO 13 J=1,JX
      IF (S1 .LT. TEMPJ2(J)) S1=TEMPJ2(J)
      IF (S2 .LT. TEMPJ3(J)) S2=TEMPJ3(J)
13  CONTINUE
      S1=1.E-8*S1 $ S2=1.E-8*S2
      DO 14 JJ=1,JXM
      J=JX-JJ
      IF (TEMPJ2(J) .GT. S1 .OR. TEMPJ3(J) .GT. S2) GO TO 3
14  CONTINUE
      JXQ=J

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      SJN1=FLOATF(JXQ-1)/FLOATF(NSK) $ SJN2=FLOATF((JXQ-1)/NSK)
      IF (ABSF(SJN1-SJN2) .LT. .0001) GO TO 46
      JXQ=FLOATF(NSK)*(SJN2+1.)+1.01
46  CONTINUE
      IF (JXQ .GT. JX) JXQ=JXQ-NSK
      DO 47 J=1,JXQ-NSK,NSK
47  DXQ(J)=X(J+NSK)-X(J)
      EMAU=EMASS(K1)
      UMU=.5*EMAU*V02/(1.E+3*ERGTOEV)
      DO 30 LT=1,2
      IF (LT .EQ. 1) GO TO 31
      CALL FINDSIG(NSIG,UMU)
      DO 34 J=1,JXQ,NSK
      ENGY=UMU*X2(J)
      WRITE (3,35) ENGY,SIGMA(J)
35  FORMAT(7HENERGY=,E16.6,5X,4HSIG=,E16.6)
34  CONTINUE
      GO TO 32
31  CONTINUE
      DO 33 J=1,JXQ,NSK
33  SIGMA(J)=1.
32  CONTINUE
      DO 1 J=1,JXQ,NSK
      1  TEMPJ1(J)=EVALS(J,K1,K2)
      QANS=0.
      DO 2 J=1,JXQ-NSK,NSK
      QANS=QANS+.5*DXQ(J)*(TEMPJ1(J)+TEMPJ1(J+NSK))
      2  CONTINUE
      ANSWER(LT)=QANS
30  CONTINUE
      SIGV=V0*ANSWER(2)/ANSWER(1)
      RETURN
      END
      FUNCTION EVALS(J,K1,K2)
      USE CFOPL
      COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
      DIMENSION SIGMA(JX)
      EQUIVALENCE (SIGMA(1),TEMPJ6(1))
      DO 1 K=1,J,NSK
      TEMPJ4(K)=(X2(J)-X2(K))*GETFG(J,K)
      1  CONTINUE
      TEMPJ5(1)=0.
      DO 2 K=1+NSK,J,NSK
      ADDIT=.5*DXQ(K-NSK)*(TEMPJ4(K-NSK)+TEMPJ4(K))
      TEMPJ5(K)=TEMPJ5(K-NSK)+ADDIT
      2  CONTINUE
      SUM=0.
      DO 4 K=1+NSK,J,NSK
      ARGM=X(K-NSK)*.5*LT*SIGMA(K-NSK)*TEMPJ5(K-NSK)
      ARGP=X(K)*.5*LT*SIGMA(K)*TEMPJ5(K)
      SUM=SUM+.5*DXQ(K-NSK)*(ARGM+ARGP)
      4  CONTINUE
      EVALS=SUM
      RETURN
      END
      FUNCTION GETFG(J,K)
      USE CFOPL
      COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
      ARG1=.5*(X(J)+X(K))
      ARG2=.5*(X(J)-X(K))

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J1=0 $ J2=0
DO 1 JM=1,JXQ-NSK,NSK
IF (X(JM) .LE. ARG1 .AND. ARG1 .LT. X(JM+NSK)) J1=JM
IF (X(JM) .LE. ARG2 .AND. ARG2 .LT. X(JM+NSK)) J2=JM
1 CONTINUE
IF (ARG1 .GE. X(JXQ)) J1=JXQ-NSK
IF (ARG2 .GE. X(JXQ)) J2=JXQ-NSK
J1P=J1+NSK $ J2P=J2+NSK
FRAC1=(ARG1-X(J1))/(X(J1P)-X(J1))
FRAC2=(ARG2-X(J2))/(X(J2P)-X(J2))
ANS1=(1.-FRAC1)*TEMPJ2(J1)+FRAC1*TEMPJ2(J1P)
ANS2=(1.-FRAC2)*TEMPJ3(J2)+FRAC2*TEMPJ3(J2P)
ANS3=(1.-FRAC1)*TEMPJ3(J1)+FRAC1*TEMPJ3(J1P)
ANS4=(1.-FRAC2)*TEMPJ2(J2)+FRAC2*TEMPJ2(J2P)
GETFG=ANS1*ANS2+ANS3*ANS4
RETURN
END
SUBROUTINE QHOLD(SIGV,K1,K2,NSIG)
USE CFOPL
COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
DIMENSION SIGMA(JX)
EQUIVALENCE (SIGMA(1),TEMPJ6(1))
IF (K1 .GT. NEQ .OR. K2 .GT. NEQ) RETURN
IF (K1 .EQ. KELEC .OR. K2 .EQ. KELEC) RETURN
CALL READLCM(TEMPJ2,U(1,K1),JX)
S1=0.
DO 13 J=1,JX
IF (S1 .LT. TEMPJ2(J)) S1=TEMPJ2(J)
13 CONTINUE
S1=1.E-B*S1
DO 14 JJ=1,JXM
J=JX-JJ
IF (TEMPJ2(J) .GT. S1) GO TO 3
14 CONTINUE
3 JXQ=J
IF (.5*FLOATF(JXQ)-FLOATF(JXQ/2) .LT. .1) JXQ=JXQ+1
JXQM=JXQ-1
UM2=1.+RAT10M(K1,K2)*ENERGY(K2)/ENERGY(K1)
IF (NEQ .EQ. 2 .AND. NSIG .EQ. 1) UM2=5./3.
UM=SQRTF(UM2)
FACTOR=UM*V0/DENS(K1)
EMAU=EMASS(K1)
UMU=.5*UM2*EMAU*V02/(1.E+3*ERGTOEV)
CALL FINDSIG(NSIG,UMU)
DO 34 J=1,JXQ
ENGY=UMU*X2(J)
WRITE (3,35) ENGY,SIGMA(J)
35 FORMAT(7HENERGY=,E16.6,5X,4H5IG=,E16.6)
34 CONTINUE
DO 1 J=1,JXQ
TEMPJ1(J)=SIGMA(J)*X(J)*TEMPJ2(J)
1 CONTINUE
QANS=0.
DO 2 J=2,JXQM,2
QANS=QANS+CON2(J,1)*TEMPJ1(J-1)+CON2(J,2)*TEMPJ1(J)+
C CON2(J,3)*TEMPJ1(J+1)
2 CONTINUE
SIGV=FACTOR*QANS
RETURN
END

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SUBROUTINE SOURCEE
USE CFOPL
CALL VARYSO
DO 1 K=1,NEQ
DO 1 KK=1,KDOUB
DO 13 J=1,JX
S=-BSOR(K,KK)*(X(J)-XONE(K,KK))*2
TEMPJ1(J)=EXP(S)
13 CONTINUE
ZR=0. $ ZRP=0.
DO 11 J=2,JXM,2
SN=TEMPJ1(J-1)*CON2(J,1)+TEMPJ1(J)*CON2(J,2)+TEMPJ1(J+1)*CON2(J,3)
SE=TEMPJ1(J-1)*CON4(J,1)+TEMPJ1(J)*CON4(J,2)+TEMPJ1(J+1)*CON4(J,3)
ZR=ZR+SN
ZRP=ZRP+SE
11 CONTINUE
QUOT=ZRP/ZR
SORDEN(K,KK)=ZR
SENCY(K,KK)=.5*EMASS(K)*V02*QUOT/ERGTOEV
CALL WRITELCM(TEMPJ1,SHAPE(1,K,KK),JX)
1 CONTINUE
RETURN
END
SUBROUTINE VARYSO
USE CFOPL
NCHSOR=NTLOSS
IF (N.NE.NCHSOR) RETURN
ELSTOR=EL(2,2,1)
DO 1 K=1,NEQ $ DO 1 L=1,4 $ DO 1 KK=1,KDOUB
1 EL(K,L,KK)=0.
EL(2,2,1)=ELSTOR
RETURN
END
SUBROUTINE PROBE
USE CFOPL
JXCPB(KELEC)=-2
DO 1 K=1,NEQ
IF (K.NE.KELEC) GO TO 2
DO 3 J=1,JX
TEMPJ1(J)=0.
IF (X(J).LE.XCN) GO TO 3
REFF=BRATIO/(1.-(XCN/X(J))*2)
TEMPJ1(J)=1./TENLOG(REFF)
3 CONTINUE
GO TO 4
2 CONTINUE
XCP=XCN*RMSQ(K)
XCPB=XCP*BRCON
DO 7 J=1,JXM
IF (XCPB.LT.X(J).OR.X(J+1).LE.XCPB) GO TO 7
JXCPB(K)=J
7 CONTINUE
IF (NSL.EQ.0) JXCPB(K)=-2
DO 5 J=1,JX
TEMPJ1(J)=0.
IF (X(J).LE.XCPB) GO TO 5
REFF=BRATIO/(1.+(XCP/X(J))*2)
TEMPJ1(J)=1./TENLOG(REFF)
5 CONTINUE
4 CONTINUE

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      CALL WRITELCM(TEMPJ1,PROB(1,K),JX)
1  CONTINUE
      RETURN
      END
      SUBROUTINE XMESH
      USE CFOPL
      X(1)=XMIN $ X(JX)=XMAX
      H=(XMAX-XMIN)/JXM
      X(2)=H $ RAM=1.
      X(2)=.0002*XMAX $ RAM=1.00266584997
      X(2)=.0001*XMAX $ RAM=1.00362390576
      X(2)=.00005*XMAX $ RAM=1.00452698980
      DO 1 J=3,JXM
      X(J)=X(J-1)+RAM*(X(J-1)-X(J-2))
1  CONTINUE
      WRITE (3,89) ((J,X(J)),J=1,JX)
89  FORMAT(/,15,5X,F20.5)
      DO 2 J=1,JX
      X2(J)=X(J)*X(J)
      X3(J)=X(J)*X2(J)
      IF (J.EQ. 1 .OR. J.EQ. JX) GO TO 2
      DXM(J)=X(J)-X(J-1)
      DXP(J)=X(J+1)-X(J)
      DX(J)=.5*(DXM(J)+DXP(J))
      X1(J)=1./X(J)
2  CONTINUE
      X1(1)=0.
      X1(JX)=1./X(JX)
      DXP(1)=DXM(2) $ DXM(JX)=DXP(JXM)
      DO 3 J=2,JXM
      HMINUS=DXM(J) $ HPLUS=DXP(J)
      CMINUS=.5*HMINUS $ CPLUS=.5*HPLUS $ CMID=CMINUS+CPLUS
      CON1(J,1)=CMINUS $ CON1(J,2)=CMID $ CON1(J,3)=CPLUS
      CON1(J,1)=X(J-1)*CMINUS
      CON1(J,2)=X(J)*CMID
      CON1(J,3)=X(J+1)*CPLUS
      CON2(J,1)=X(J-1)*CON1(J,1)
      CON2(J,2)=X(J)*CON1(J,2)
      CON2(J,3)=X(J+1)*CON1(J,3)
      CON4(J,1)=X2(J-1)*CON2(J,1)
      CON4(J,2)=X2(J)*CON2(J,2)
      CON4(J,3)=X2(J+1)*CON2(J,3)
3  CONTINUE
      RETURN
      END
      SUBROUTINE MOMENTS
      USE CFCPL
      DO 1 K=1,NEQ
      CALL READLCM(TEMPJ4,U(1,K),JX)
      DO 20 J=1,JX
20  TEMPJ5(J)=0.
      IF (K.EQ. KELEC) GO TO 21
      XCP=XCN*RMSQ(K)
      XCPB=XCP*BRCON
      DO 22 J=1,JX
      REFF=0. $ IF (X(J).LE. XCPB) GO TO 23
      REFF=BRATIO/(1.+(XCP/X(J))*2)
23  CONTINUE
      EMP2QM=EMP2(REFF)
      TEMPJ5(J)=TEMPJ4(J)*5.*EMP2QM

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22 CONTINUE
21 CONTINUE
TEMPJ1(JX)=0. $ TEMPJ2(1)=0. $ TEMPJ3(1)=0.
TEMPJ6(JX)=0. $ TEMPJ7(JX)=0. $ TEMPJ8(1)=0. $ TEMPJ9(1)=0.
DO 3 J=2,JXM,2
JJ=JX+1-J
SM=TEMPJ4(JJ-1)*CON1(JJ,1)+TEMPJ4(JJ)*CON1(JJ,2)+
C TEMPJ4(JJ+1)*CON1(JJ,3)
SN=TEMPJ4(J-1)*CON2(J,1)+TEMPJ4(J)*CON2(J,2)+TEMPJ4(J+1)*CON2(J,3)
SE=TEMPJ4(J-1)*CON4(J,1)+TEMPJ4(J)*CON4(J,2)+TEMPJ4(J+1)*CON4(J,3)
SL2=TEMPJ5(JJ-1)*X1(JJ-1)*CON(JJ,1)+TEMPJ5(JJ)*X1(JJ)*CON(JJ,2)+
C TEMPJ5(JJ+1)*X1(JJ+1)*CON(JJ,3)
SM2=TEMPJ5(JJ-1)*CON1(JJ,1)+TEMPJ5(JJ)*CON1(JJ,2)+
C TEMPJ5(JJ+1)*CON1(JJ,3)
SE2=TEMPJ5(J-1)*CON4(J,1)+TEMPJ5(J)*CON4(J,2)+
C TEMPJ5(J+1)*CON4(J,3)
SG2=TEMPJ5(J-1)*X2(J-1)*CON4(J,1)+TEMPJ5(J)*X2(J)*CON4(J,2)+
C TEMPJ5(J+1)*X2(J+1)*CON4(J,3)
TEMPJ1(JJ-1)=TEMPJ1(JJ+1)+SM
TEMPJ2(J+1)=TEMPJ2(J-1)+SN
TEMPJ3(J+1)=TEMPJ3(J-1)+SE
TEMPJ6(JJ-1)=TEMPJ6(JJ+1)+SL2 $ TEMPJ7(JJ-1)=TEMPJ7(JJ+1)+SM2
TEMPJ8(J+1)=TEMPJ8(J-1)+SE2 $ TEMPJ9(J+1)=TEMPJ9(J-1)+SG2
3 CONTINUE
SM=.5*DXP(JXM)*(TEMPJ4(JXM)*X(JXM)+TEMPJ4(JX)*X(JX))
SN=.5*DXM(2)*(TEMPJ4(1)*X2(1)+TEMPJ4(2)*X2(2))
SE=.5*DXM(2)*(TEMPJ4(1)*X2(1)**2+TEMPJ4(2)*X2(2)**2)
SL2=.5*DXP(JXM)*(TEMPJ5(JXM)*X1(JXM)+TEMPJ5(JX)*X1(JX))
SM2=.5*DXP(JXM)*(TEMPJ5(JXM)*X(JXM)+TEMPJ5(JX)*X(JX))
SE2=.5*DXM(2)*(TEMPJ5(1)*X2(1)**2+TEMPJ5(2)*X2(2)**2)
SG2=.5*DXM(2)*(TEMPJ5(1)*X3(1)**2+TEMPJ5(2)*X3(2)**2)
TEMPJ1(JXM)=SM $ TEMPJ2(2)=SN $ TEMPJ3(2)=SE
TEMPJ6(JXM)=SL2 $ TEMPJ7(JXM)=SM2
TEMPJ8(2)=SE2 $ TEMPJ9(2)=SG2
DO 4 J=3,JXM,2
JJ=JX+1-J
SM=TEMPJ4(JJ-1)*CON1(JJ,1)+TEMPJ4(JJ)*CON1(JJ,2)+
C TEMPJ4(JJ+1)*CON1(JJ,3)
SN=TEMPJ4(J-1)*CON2(J,1)+TEMPJ4(J)*CON2(J,2)+TEMPJ4(J+1)*CON2(J,3)
SE=TEMPJ4(J-1)*CON4(J,1)+TEMPJ4(J)*CON4(J,2)+TEMPJ4(J+1)*CON4(J,3)
SL2=TEMPJ5(JJ-1)*X1(JJ-1)*CON(JJ,1)+TEMPJ5(JJ)*X1(JJ)*CON(JJ,2)+
C TEMPJ5(JJ+1)*X1(JJ+1)*CON(JJ,3)
SM2=TEMPJ5(JJ-1)*CON1(JJ,1)+TEMPJ5(JJ)*CON1(JJ,2)+
C TEMPJ5(JJ+1)*CON1(JJ,3)
SE2=TEMPJ5(J-1)*CON4(J,1)+TEMPJ5(J)*CON4(J,2)+
C TEMPJ5(J+1)*CON4(J,3)
SG2=TEMPJ5(J-1)*X2(J-1)*CON4(J,1)+TEMPJ5(J)*X2(J)*CON4(J,2)+
C TEMPJ5(J+1)*X2(J+1)*CON4(J,3)
TEMPJ1(JJ-1)=TEMPJ1(JJ+1)+SM
TEMPJ2(J+1)=TEMPJ2(J-1)+SN
TEMPJ3(J+1)=TEMPJ3(J-1)+SE
TEMPJ6(JJ-1)=TEMPJ6(JJ+1)+SL2 $ TEMPJ7(JJ-1)=TEMPJ7(JJ+1)+SM2
TEMPJ8(J+1)=TEMPJ8(J-1)+SE2 $ TEMPJ9(J+1)=TEMPJ9(J-1)+SG2
4 CONTINUE
DENS(K)=TEMPJ2(JX)
IF (DENS(K) .LE. 0.) GO TO 9
ENERGY(K)=TEMPJ3(JX)/DENS(K)
ENERGY(K)=.5*EMASS(K)*V02*ENERGY(K)/ERGTOEV
IF (N .EQ. 0.) GO TO 5
REDEN(K)=DENS(K)*ANORM(K)

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5 CONTINUE
  CALL WRITELCM(TEMPJ1,EMOF(1,K),JX)
  CALL WRITELCM(TEMPJ2,ENOF(1,K),JX)
  CALL WRITELCM(TEMPJ3,EEOF(1,K),JX)
  CALL WRITELCM(TEMPJ6,ELOF2(1,K),JX)
  CALL WRITELCM(TEMPJ7,EMOF2(1,K),JX)
  CALL WRITELCM(TEMPJ8,EEOF2(1,K),JX)
  CALL WRITELCM(TEMPJ9,EGOF2(1,K),JX)
1 CONTINUE
  RETURN
9 KMFLAG=1 $ WRITE (3,10) K
10 FORMAT(/,18HDENSITY OF SPECIES,15,3X,7HLE ZERO)
  RETURN
  END
  SUBROUTINE GAMMAIN
  USE CFOPL
  TEMPE=ENERGY(KELEC)
  DENSE=REDEN(KELEC)
  DEBY=SQRTF(TEMPE/DENSE)
  DO 1 I=1,NEQ $ DO 1 K=1,NEQ
    S1=ENERGY(I)/EMASS(I) $ SK=ENERGY(K)/EMASS(K)
    SF=S1 $ IF (SK .GT. S1) SF=SK
    VIKF=SQRTF(SF*ERGTOEV)
    GAM3=GAM2(I,K)*DEBY*VIKF
    GAMMA(I,K)=GAM(I,K)*(LOGF(GAM3)-.5)
1 CONTINUE
  RETURN
  END
  SUBROUTINE GETCOEF
  USE CFOPL
  DO 1 K=1,NEQ
    TEMPJ2(1)=0. $ TEMPJ3(1)=0. $ TEMPJ4(1)=0. $ TEMPJ5(1)=0.
    TEMPJ6(1)=0.
    CALL READLCM(TEMPJ1,PROB(1,K),JX)
    DO 2 J=2,JX
      SA=0. $ SB=0. $ SC=0.
      DO 3 I=1,NEQ
        ANRAG=ANORMK(I)*RATIOZ2(I,K)*GAMMA(K,I)
        SA=SA+ANRAG*(RATECNC(K,I)*(RATIO(K,I)*ENOF(J,I)-X(J)*EMOF(J,I))+
        C X(J)*EMOF(J,I))
        SB=SB+ANRAG*(EEOF(J,I)/X(J)+X2(J)*EMOF(J,I))/3.
        SC=SC+ANRAG*ULAM(K,I)*TEMPJ1(J)/X(J)*(ENOF(J,I)-(EEOF(J,I)/
        C X2(J)-2.*X(J)*EMOF(J,I))/3.)
3 CONTINUE
    IF (KP2USE .EQ. 0 .OR. K .EQ. KELEC .OR. TEMPJ1(J) .EQ. 0)
    C GO TO 31
    REFF=:0.**(.1./TEMPJ1(J))
    S2=EM2P2(REFF)
    DO 32 I=1,NEQ
      IF (I .EQ. KELEC) GO TO 32
      ANRAG=ANORMK(I)*RATIOZ2(I,K)*GAMMA(K,I)
      SA=SA+ANRAG*RATIO(K,I)*S2*(.6*EEOF2(J,I)/X2(J)-.4*X3(J)*
      C ELOF2(J,I))
      SB=SB+ANRAG*S2*(.6*(X2(J)**2*ELOF2(J,I)+EGOF2(J,I)/X3(J))/35.-
      C (X1(J)*EEOF2(J,I)+X2(J)*EMOF2(J,I))/15.)
      EILAM=2.*ULAM(K,I)*TEMPJ1(J)
      SC1=-S2*(27./70+.6*RATIO(K,I))+EILAM/70.
      SC2=-S2*(.1+.6*RATIO(K,I))+EILAM/30.*(5.*S2-1.)
      SC3=-.1*S2+EILAM/15.*(S2-.5)
      SC4=-27.*S2/70.+EILAM*(1./70-.1*S2)

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      SC=SC+ANRAG*(SC1*X2(J)*ELOF2(J,1)+SC2*EEOF2(J,1)/X3(J)+
      C SC3*EMOF2(J,1)+SC4*EGOF2(J,1)/(X2(J)*X3(J)))
32 CONTINUE
31 CONTINUE
C
      IF (K.NE.1) SC=0.
C
      TEMPJ2(J)=SA*TNORM/V03
      TEMPJ3(J)=SB*TNORM/V03
      TEMPJ5(J)=SC/V03
C
      IF (J.NE. JONF .OR. K.NE.1) GO TO 21
      ALP0=4.*TEMPJ5(J)**2/(TEMPJ1(J)*X3(J)**2)
      JM1=J-1 $ DO 22 JF=2,JM1
      OLDC=TEMPJ5(JF)
      TEMPJ5(JF)=.25*TEMPJ1(JF)*X3(JF)**2*ALP0/OLDC
      TEMPJ4(JF)=TNORM*(TEMPJ5(JF)+TEMPJ6(JF))
22 CONTINUE
21 CONTINUE
C
      TERM=CXRXB(K,2)*X2(J)**2*(X(J)-CXRXB(K,1)*CXRXB(K,3))/
      C (CXRXB(K,1)**2*(1.-CXRXB(K,3)))
      IF (TERM.LT.0.) TERM=0. $ TEMPJ6(J)=TERM
      TEMPJ6(J)=TEMPJ6(J)+X2(J)*CXRXB(K,4)
13 CONTINUE
      TEMPJ4(J)=TNORM*(TEMPJ5(J)+TEMPJ6(J))
2 CONTINUE
      CALL WRITELCM(TEMPJ2,AN(1,K),JX)
      CALL WRITELCM(TEMPJ3,BN(1,K),JX)
      CALL WRITELCM(TEMPJ4,CN(1,K),JX)
      CALL WRITELCM(TEMPJ5,CLOS(1,K),JX)
      CALL WRITELCM(TEMPJ6,CLOSE(1,K),JX)
      DO 12 J=1,JX
12 TEMPJ5(J)=0.
      SOSAV(K)=0.
      DO 11 KK=1,KDOUB
      CALL READLCM(TEMPJ1,SHAPE(1,K,KK),JX)
      T=EL(K,1,KK)+REDEN(K)*EL(K,2,KK)+SORTF(REDEN(K))*EL(K,3,KK)
      SOSAVP(K,KK)=T
      T=T*TNORM/(SORDEN(K,KK)*ANORMK(K))
      DO 4 J=2,JX
4 TEMPJ5(J)=TEMPJ5(J)+T*TEMPJ1(J)
      SOSAV(K)=SOSAV(K)+SOSAVP(K,KK)
11 CONTINUE
      CALL WRITELCM(TEMPJ5,DN(1,K),JX)
      IF (N.GT.1) GO TO 1
      CALL WRITELCM(TEMPJ2,ANST(1,K),JX)
      CALL WRITELCM(TEMPJ3,BNST(1,K),JX)
      CALL WRITELCM(TEMPJ4,CNST(1,K),JX)
      CALL WRITELCM(TEMPJ5,DNST(1,K),JX)
1 CONTINUE
      RETURN
      END
      FUNCTON EMP2(R)
      S=0. $ IF (R.LE.1.) GO TO 1
      IF (R.GE.1.1 .AND. R.LE.2.) GO TO 2
      RLOG=TENLOG(R) $ UM02=1.-1./R
      PROB=1./RLOG
      S=.5*PROB*(3.*UM02-1.1)/(PROB-6.)
      GO TO 1

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2 CONTINUE
S=-.4838+.193*(R-1.1)
1 CONTINUE
EMP2=S
RETURN
END
FUNCTION EM2P2(R)
S=0. $ IF (R .LE. 1.) GO TO 1
RLOG=TENLOG(R)
IF (R .GE. 1.0001) GO TO 2
A=1.0001 $ B=-.5 $ SL=0. $ GO TO 3
2 IF (R .GE. 1.001) GO TO 4
A=1.0001 $ B=-.5 $ SL=.4513 $ GO TO 3
4 IF (R .GE. 1.01) GO TO 5
A=1.001 $ B=-.4998 $ SL=.4501 $ GO TO 3
5 IF (R .GE. 1.1) GO TO 6
A=1.01 $ B=-.4981 $ SL=.4388 $ GO TO 3
6 IF (R .GE. 1.5) GO TO 7
A=1.1 $ B=-.4818 $ SL=.3951 $ GO TO 3
7 IF (R .GE. 2.) GO TO 8
A=1.5 $ B=-.4286 $ SL=.3376 $ GO TO 3
8 IF (R .GE. 3.) GO TO 9
A=2. $ B=-.3864 $ SL=.2830 $ GO TO 3
9 IF (R .GE. 4.) GO TO 10
A=3. $ B=-.3366 $ SL=.2378 $ GO TO 3
10 IF (R .GE. 6.) GO TO 11
A=4. $ B=-.3069 $ SL=.2008 $ GO TO 3
11 IF (R .GE. 8.) GO TO 12
A=6. $ B=-.2715 $ SL=.1696 $ GO TO 3
12 IF (R .GE. 10.) GO TO 13
A=8. $ B=-.2503 $ SL=.1497 $ GO TO 3
13 IF (R .GE. 15.) GO TO 14
A=10. $ B=-.2358 $ SL=.1290 $ GO TO 3
14 CONTINUE
A=15. $ B=-.2133 $ SL=.1072
3 CONTINUE
ALOG=TENLOG(A)
S=B*SL*(RLOG-ALOG)
1 CONTINUE
EM2P2=S
RETURN
END
SUBROUTINE ITERATE
C THIS VERSION ASSUMES DIAGONAL MATRICES
USE CFOPL
LCM (NSOLEQ)
COMMON/NSOLEQ/AA(JX1,88(JX1),CC(JX1),DD(JX1)
DO 1 I=1,NEQ
CALL READLCM(TEMPJ3,AN(1,1),JX)
CALL READLCM(TEMPJ4,ANST(1,1),JX)
CALL READLCM(TEMPJ5,BN(1,1),JX)
CALL READLCM(TEMPJ6,BNST(1,1),JX)
DO 2 J=1,JX
TEMPJ1(J)=TEMPJ3(J)+TEMPJ3(J)-TEMPJ4(J)
TEMPJ2(J)=TEMPJ5(J)+TEMPJ5(J)-TEMPJ6(J)
2 CONTINUE
CALL READLCM(TEMPJ4,CN(1,1),JX)
CALL READLCM(TEMPJ5,CNST(1,1),JX)
DO 3 J=1,JX
TEMPJ3(J)=TEMPJ4(J)+TEMPJ4(J)-TEMPJ5(J)

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3 CONTINUE
DO 4 J=2,JXM
  ANP2=.25*(TEMPJ1(J)+TEMPJ1(J+1))
  ANM2=.25*(TEMPJ1(J-1)+TEMPJ1(J))
  BNP2=.5*(TEMPJ2(J)+TEMPJ2(J+1))/DXP(J)
  BNM2=.5*(TEMPJ2(J-1)+TEMPJ2(J))/DXM(J)
  TEMPJ4(J)=RHO*(ANP2+BNP2)/(X2(J)*DX(J))
  TEMPJ5(J)=ONODT-RHO*((ANP2-ANM2-BNP2-BNM2)/DX(J)-TEMPJ3(J))/X2(J)
  TEMPJ6(J)=RHO*(-ANM2+BNM2)/(X2(J)*DX(J))
4 CONTINUE
CALL WRITELCM(TEMPJ4,AA,JX)
CALL WRITELCM(TEMPJ5,BB,JX)
CALL WRITELCM(TEMPJ6,CC,JX)
CALL READLCM(TEMPJ2,U(1,1),JX)
DO 5 J=1,JX
  TEMPJ1(J)=ONODT*TEMPJ2(J)
5 CONTINUE
IF (ONMRHO .LT. 1.E-10) GO TO 6
CALL READLCM(TEMPJ3,AN(1,1),JX)
CALL READLCM(TEMPJ4,BN(1,1),JX)
CALL READLCM(TEMPJ5,CN(1,1),JX)
CALL READLCM(TEMPJ6,DN(1,1),JX)
DO 7 J=2,JXM
  ANP2=.25*(TEMPJ3(J)+TEMPJ3(J+1))
  ANM2=.25*(TEMPJ3(J-1)+TEMPJ3(J))
  BNP2=.5*(TEMPJ4(J)+TEMPJ4(J+1))/DXP(J)
  BNM2=.5*(TEMPJ4(J-1)+TEMPJ4(J))/DXM(J)
  TERM1=TEMPJ2(J+1)*(ANP2+BNP2)/DX(J)
  TERM2=TEMPJ2(J)*((ANP2-ANM2-BNP2-BNM2)/DX(J)-TEMPJ5(J))
  TERM3=TEMPJ2(J-1)*(-ANM2+BNM2)/DX(J)
  TERM4=(TERM1+TERM2+TERM3)/X2(J)
  TERM5=(TERM4+TEMPJ6(J))*ONMRHO
  TEMPJ1(J)=TEMPJ1(J)+TERM5
7 CONTINUE
GO TO 9
6 CONTINUE
CALL READLCM(TEMPJ6,DN(1,1),JX)
9 CONTINUE
CALL READLCM(TEMPJ5,DNST(1,1),JX)
DO 8 J=2,JXM
  DNP=TEMPJ6(J)+TEMPJ5(J)-TEMPJ5(J)
  TEMPJ1(J)=TEMPJ1(J)+RHO*DNP
8 CONTINUE
CALL WRITELCM(TEMPJ1,DD,JX)
CALL MSOLVE(1)
1 CONTINUE
RETURN
END
SUBROUTINE MSOLVE(1)
USE CFOPL
LCM(NSOLEQ)
COMMON/NSOLEQ/AA(JX),BB(JX),CC(JX),DD(JX)
ANP2=AN(2,1)-.5*ANST(2,1)
BNP2=(2.*BN(2,1)-BNST(2,1))/DXM(2)
TEMPJ1(1)=(BNP2+ANP2)/(BNP2-ANP2)
TEMPJ2(1)=0.
CALL READLCM(TEMPJ3,AA,JX)
CALL READLCM(TEMPJ4,BB,JX)
CALL READLCM(TEMPJ5,CC,JX)
CALL READLCM(TEMPJ6,DD,JX)

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DO 1 J=2,JXM
DEN=TEMPJ4(J)-TEMPJ5(J)*TEMPJ1(J-1)
TEMPJ1(J)=TEMPJ3(J)/DEN
TEMPJ2(J)=(TEMPJ5(J)+TEMPJ5(J)*TEMPJ2(J-1))/DEN
1 CONTINUE
ANP2=AN(JXM,1)+AN(JX,1)-.5*(ANST(JXM,1)+ANST(JX,1))
BNP2=(2.*(BN(JXM,1)+BN(JX,1))-(BNST(JXM,1)+BNST(JX,1)))/DXP(JXM)
ABN2=(BNP2+ANP2)/(BNP2-ANP2)
TEMPJ3(JX)=TEMPJ2(JXM)/(ABN2-TEMPJ1(JXM))
DO 2 JJ=1,JXM
J=JX-JJ
TEMPJ3(J)=TEMPJ1(J)*TEMPJ3(J+1)+TEMPJ2(J)
2 CONTINUE
CALL WRITELCM(TEMPJ3,U(1,1),JX)
RETURN
END
FUNCTION TENLOG(X)
TENLOG=LOGF(X)/2.3025851
RETURN
END
SUBROUTINE CHECK
USE CFOPL
IF (FLOATF(N)/FLOATF(NCHEC)-FLOATF(N/NCHEC).GT..001) RETURN
IF (NCH.EQ.NONCH) NCH=0
NCH=NCH+1
PTIME(NCH)=TIME
DO 1 K=1,NEQ
PLTDENS(NCH,K)=REDEN(K)
PLTENGY(NCH,K)=ENERGY(K)
1 CONTINUE
DTADV=DTR*FLOATF(NCHEC)
IF (N.LT.NTLOSS) DTADV=0.
DO 2 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
CALL READLCM(TEMPJ2,CLOSE(1,K),JX)
CALL READLCM(TEMPJ3,CLOSE(1,K),JX)
DO 3 J=1,JX
TEMPJ4(J)=TEMPJ1(J)*TEMPJ2(J)
TEMPJ5(J)=TEMPJ1(J)*TEMPJ3(J)
3 CONTINUE
S=0. $ SE=0.
SE3=0. $ SE4=0.
DO 4 J=2,JXM,2
S=S+CON(J,1)*TEMPJ4(J-1)+CON(J,2)*TEMPJ4(J)+CON(J,3)*TEMPJ4(J+1)
SE=SE+CON(J,1)*TEMPJ5(J-1)+CON(J,2)*TEMPJ5(J)+CON(J,3)*TEMPJ5(J+1)
SE3=SE3+CON1(J,1)*TEMPJ5(J-1)+CON1(J,2)*TEMPJ5(J)+
C CON1(J,3)*TEMPJ5(J+1)
SE4=SE4+CON2(J,1)*TEMPJ5(J-1)+CON2(J,2)*TEMPJ5(J)+
C CON2(J,3)*TEMPJ5(J+1)
4 CONTINUE
CLOST(K,1)=S*ANORMK(K) $ CLOSET(K,1)=SE*ANORMK(K)
CLOST(K,2)=CLOST(K,2)+CLOST(K,1)*DTADV
CLOST(K,2)=CLOSET(K,2)+CLOSET(K,1)*DTADV
CLOSE34(K,1)=SE3*ANORMK(K) $ CLOSE34(K,2)=SE4*ANORMK(K)
2 CONTINUE
RETURN
END
SUBROUTINE FINIT
USE CFOPL
IF (KNPROBS.GT.1) GO TO 5

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      IF (KBUFW .EQ. 0) GO TO 5
      CALL ASSIGN(5,0,5RUSTOR,0)
      BUFFER IN (5,1) (UBUST(1,1,1),UBUST(JX,NEQ,KNSET))
21  IF (UNIT,5) 21,22,23,24
23  CALL QUIT(23)
24  CALL QUIT(24)
22  CONTINUE
      CALL ASSIGN(5,0,5RUSTOR,-1)
5   CONTINUE
      IF (KBUFU(KNPROBS) .NE. 0) GO TO 4
      DO 1 K=1,NEQ
      DO 2 J=1,JX
2   TEMPJ1(J)=RS(K,1)*EXP(-RS(K,2)*(X(J)-RS(K,3))*2)
      CALL WRITELCM(TEMPJ1,U(1,K),JX)
1   CONTINUE
      RETURN
4   CONTINUE
      DO 6 K=1,NEQ
      CALL READLCM(TEMPJ1,UBUST(1,K,KNPROBS),JX)
      CALL WRITELCM(TEMPJ1,U(1,K),JX)
6   CONTINUE
      RETURN
      END
      SUBROUTINE PRINT2(LABEL,NWDS,DATA,IDIM,JDIM)
      DIMENSION LABEL(NWDS),DATA(IDIM,JDIM)
      WRITE (3,1) (LABEL(I),I=1,NWDS)
1   FORMAT(1H1,30X,6A10)
      DO 2 I=1,IDIM
      WRITE (3,3) 1,(DATA(I,J),J=1,JDIM)
3   FORMAT(15,6X,9E11.3,/,11X,9E11.3)
2   CONTINUE
      RETURN
      END
      SUBROUTINE PRINT1(LABEL,NWDS,DATA,IDIM)
      DIMENSION LABEL(NWDS),DATA(IDIM)
      WRITE (3,1) (LABEL(I),I=1,NWDS)
1   FORMAT(1H1,30X,6A10)
      WRITE (3,2) (1,DATA(I)),I=1,IDIM
2   FORMAT(/,15,6X,E11.3)
      RETURN
      END
      SUBROUTINE EPLOR
      USE CFOPL
      DIMENSION NPRNAM(2) $ NPRNAM(1)=GHVELOC. $ NPRNAM(2)=GHENERGY
      ENAVG=0.
      IF (NEQ .EQ. 1) GO TO 64
      DO 63 K=1,NEQ
      IF (K .EQ. KELEC) GO TO 63
      ENAVG=ENAVG+SENGY(K)
63  CONTINUE
      ENAVG=ENAVG/FLOAT(NEQ-1)
      GO TO 65
64  ENAVG=.1*ENELEC*XMAX**2
65  CONTINUE
      DO 1 K=1,NEQ
      CALL FRAME
      CALL READLCM(TEMPJ1,U(1,K),JX)
      DO 2 J=1,JX
      IF (TEMPJ1(J) .LT. 0.) TEMPJ1(J)=0.
      TEMPJ2(J)=X(J)

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IF (NPRLOS .EQ. 1) GO TO 2
TEMPJ1(J)=TEMPJ1(J)*ANORMK(K)*X(J)/(EMASS(K)*V02)
TEMPJ2(J)=TEMPJ2(J)*X(J)*ENELEC*P*TIOM(K,KELEC)
2 CONTINUE
CALL CARTMM(JX,YMIN,YMAX,TEMPJ1,1)
YMAX=1.1*YMAX
XPMIN=0. $ XPMAX=3.*SENGY(K)
IF (K .EQ. KELEC) XPMAX=.3*ENAVG
IF (NPRLOS .EQ. 1) XPMAX=SQRTF(XPMAX/(ENELEC*P*TIOM(K,KELEC)))
CALL MAPS(XPMIN,XPMAX,0.,YMAX,.2,.999,.2,.999)
CALL SETCH(2.,27.,1,0,1,1)
WRITE (100,10) NPRNAM(NPRLOS),K
10 FORMAT(A7,26HDIST FCTN - SPECIES NUMBER,15)
CALL SETCH(17.,1.,1,0,1,0)
WRITE (100,11) TIME,N
11 FORMAT(8H TIME = ,E15.3,5X,7HCYCLE = ,16)
CALL TRACE(TEMPJ2,TEMPJ1,JX)
IF (N .EQ. 0) GO TO 1
CALL FRAME
CALL READLCM(TEMPN,PLTDENS(1,K),NCH)
DO 14 L=1,NCH
IF (TEMPN(L) .LT. 0.) TEMPN(L)=0.
14 CONTINUE
CALL CARTMM(NCH,YMIN,YMAX,TEMPN,1)
YMAX=2.*YMAX
CALL MAPS(0.,TIME,0.,YMAX,.2,.999,.2,.999)
CALL SETCH(2.,28.,1,0,1,1)
WRITE (100,20) K
20 FORMAT(24HDENSITY - SPECIES NUMBER,15)
CALL SETCH(17.,1.,1,0,1,0)
WRITE (100,11) TIME,N
CALL SETCH(17.,3.,1,0,1,0)
WRITE (100,71) REDEN(K),SOSAV(K)
71 FORMAT(8HDENSITY=,E16.6,5X,8HCURRENT=,E16.6)
CALL TRACE(PTIME,TEMPN,NCH)
CALL FRAME
CALL READLCM(TEMPN,PLTENGY(1,K),NCH)
DO 15 L=1,NCH
IF (TEMPN(L) .LT. 0.) TEMPN(L)=0.
15 CONTINUE
CALL CARTMM(NCH,YMIN,YMAX,TEMPN,1)
YMAX=2.*YMAX
CALL MAPS(0.,TIME,0.,YMAX,.2,.999,.2,.999)
CALL SETCH(2.,27.,1,0,1,1)
WRITE (100,30) K
30 FORMAT(23HENERGY - SPECIES NUMBER,15)
CALL SETCH(17.,1.,1,0,1,0)
WRITE (100,11) TIME,N
CALL SETCH(17.,3.,1,0,1,0)
WRITE (100,72) ENERGY(K),SENGY(K)
72 FORMAT(7HENERGY=,E16.6,5X,11HSOURCE EN =,E16.6)
CALL TRACE(PTIME,TEMPN,NCH)
1 CONTINUE
RETURN
END
SUBROUTINE EEPRINT
USE CFOPL
DIMENSION TEMP(NEQ),CHTR(NEQ,NEQ),CHSO(NEQ),CHLO(NEQ,NEQ)
DIMENSION SEMP(NEQ),STEMP(NEQ)
WRITE (3,12)

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12 FORMAT(1H1)
WRITE (3,1)
1 FORMAT(22HDISTRIBUTION FUNCTIONS,/)
DO 2 J=1,JX
  ENGY=ENELEC*RAT10M(1,KELEC)*X2(J)
  DO 81 K=1,NEQ
81 TEMP(K)=U(J,K)
  IF (NPRLOS .EQ. 1) GO TO 82
  DO 83 K=1,NEQ
83 TEMP(K)=TEMP(K)*ANORMK(K)*X(J)/(EMASS(K)*V02)
F2 CONTINUE
  WRITE (3,3) J,X(1),ENGY,(TEMP(K),K=1,NEQ)
  3 FORMAT(2HJ=,15,2X,2HX=,F15.5,2X,7HENERGY=,E15.5,5X,4E15.5,/,
    C (55X,4E15.5))
  2 CONTINUE
  WRITE (3,4)
  4 FORMAT(//,9HDENSITIES,/)
  WRITE (3,6) (REDEN(K),K=1,NEQ)
  6 FORMAT(7E15.5)
  WRITE (3,7)
  7 FORMAT(//,8HENERGIES,/)
  WRITE (3,6) (ENERGY(K),K=1,NEQ)
  DO 1414 K=1,NEQ $ DO 1414 KK=1,KDOUB
  WRITE (3,1415) K,KK,BSOR(K,KK),XONE(K,KK),(EL(K,L,KK),L=1,4)
1415 FORMAT(2HK=,15,2X,3HKK=,15,2X,5HBSOR=,E16.6,2X,5H*ONE=,E16.6,
  C /,19X,5HCURR=,4E16.6)
1414 CONTINUE
  IF (N .EQ. 0) GO TO 30
  DO 30 J=1,NEQ
  CALL READLCM(TEMPJ1,PROB(1,1),JX)
  CALL READLCM(TEMPJ2,U(1,1),JX)
  DO 30 K=1,NEQ
  CALL READLCM(TEMPJ3,EMOF(1,K),JX)
  CALL READLCM(TEMPJ4,ENOF(1,K),JX)
  CALL READLCM(TEMPJ5,EEOF(1,K),JX)
  DO 31 J=1,JX
  TEMPJ6(J)=0.
  IF (J .EQ. 1 .OR. J .EQ. JX) GO TO 31
  TERM1=TEMPJ4(J)-(TEMPJ5(J)/X2(J)-2.*X(J)*TEMPJ3(J))/3.
  TERM2=ANORMK(K)*RAT10Z2(K,1)*ULAM(1,K)
  TERM3=GAMMA(1,K)*TEMPJ1(J)/(X3(J)*V03)
  TAUM=TERM1*TERM2*TERM3
  TEMPJ6(J)=TAUM*TEMPJ2(J)
31 CONTINUE
  T=0.
  DO 33 J=2,JXM,2
  T=T+CON4(J,1)*TEMPJ6(J-1)+CON4(J,2)*TEMPJ6(J)+
  C CON4(J,3)*TEMPJ6(J+1)
33 CONTINUE
  TERM4=-.5*EMASS(1)*V02*ANORMK(1)
30 CHLO(1,K)=TERM4*T
  DO 34 I=1,NEQ
  CHSO(I)=0.
  DO 51 KK=1,KDOUB
51 CHSO(I)=CHSO(I)+SENGY(I,KK)*SOSAVP(I,KK)
34 CHSO(I)=ERGTOEV*CHSO(I)
  DO 35 I=1,NEQ
  CALL READLCM(TEMPJ1,U(1,1),JX)
  DO 35 K=1,NEQ
  CALL READLCM(TEMPJ2,EMOF(1,K),JX)

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CALL READLCM!TEMPJ3,ENOF(I,K),JX)
DO 36 J=1,JX
TEMPJ4(J)=0.
IF (J.EQ.1.OR.J.EQ.JX) GO TO 36
TERM1=TEMPJ2(J)-RAT10M(I,K)*TEMPJ3(J)/X(J)
TEMPJ4(J)=TERM1*X2(J)*TEMPJ1(J)
36 CONTINUE
T=0.
DO 38 J=2,JXM,2
T=T+CON(J,1)*TEMPJ4(J-1)+CON(J,2)*TEMPJ4(J)+CON(J,3)*TEMPJ4(J+1)
38 CONTINUE
TERM2=GAMMA(I,K)*ANORMK(I)*EMASS(I)*ANORMK(K)*RAT10Z2(K,1)/VO
35 CHTR(I,K)=T*TERM2
DO 40 I=1,NEQ
S=CHSO(I) $ T=0.
DO 52 K=1,NEQ
T=T+CHLO(I,K)
IF (CHTR(I,K).LT.0.) T=T+CHTR(I,K)
IF (CHTR(I,K).GE.0.) S=S+CHTR(I,K)
52 CONTINUE
SEMP(I)=S $ TEMP(I)=T $ SEMPT(I)=0.
IF (SEMP(I).LE.0.) GO TO 40
SEMP(I)=1.+TEMP(I)/SEMP(I)
40 CONTINUE
WR!TE(3,41)
41 FORMAT(1H1,50X,18HCONSERVATION TERMS)
WRITE(3,42)
42 FORMAT(//,14HEXCHANGE TERMS)
DO 43 I=1,NEQ
WRITE(3,44) (CHTR(I,K),K=1,NEQ)
44 FORMAT(//,10E11.3,/)
43 CONTINUE
WRITE(3,45)
45 FORMAT(//,12HSOURCE TERMS)
WRITE(3,44) (CHSO(I),I=1,NEQ)
WRITE(3,47)
47 FORMAT(//,10HLOSS TERMS)
DO 48 I=1,NEQ
WRITE(3,44) (CHLO(I,K),K=1,NEQ)
48 CONTINUE
WRITE(3,46) ((SEMP(I),TEMP(I),SEMP(I)),I=1,NEQ)
46 FORMAT(//,13HENERGY GAINED,8X,11HENERGY LOST,10X,5HERROR,/,
C(3E16.6,/)
50 CONTINUE
AMBIPOT=.5*EMASS(KELEC)*V02*XCN*XCN
AMBIPOT=AMBIPOT/ERGTOEV
WRITE(3,10) XCN,AMBIPOT
10 FORMAT(//,4HXCN=,E16.5,5X,15HAMBIPOLAR POT =,E16.5)
WRITE(3,21)
21 FORMAT(//,7HSPECIES,2X,8HEND LOSS,8X,8HCX. LOSS,16X,
C13HTOT. END LOSS,3X,13HTOT. CX. LOSS,/)
DO 22 K=1,NEQ
WRITE(3,23) K,CLOST(K,1),CLOSET(K,1),CLOST(K,2),CLOSET(K,2)
23 FORMAT(15,5X,2E16.6,10X,2E16.6)
22 CONTINUE
WRITE(3,24) ((K,CLOSE34(K,1),CLOSE34(K,2)),K=1,NEQ)
24 FORMAT(//,12HK=,15,5X,4HFAD=,E16.6,5X,4HSSD=,E16.6)
WRITE(3,8) N,TIME,REALTIM
8 FORMAT(//,16HITERATION NUMBER,2X,15,2X,9HCOMPLETED,10X,6HTIME =,
C E15.5,10X,11HREAL TIME =,E15.5,/)

```

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RETURN
END
SUBROUTINE CHOPDST
USE CFOPL
DO 4 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
DO 102 J=1,JX
IF (TEMPJ1(J) .LT. 0.) TEMPJ1(J)=0.
102 CONTINUE
CALL WRITELCM(TEMPJ1,U(1,K),JX)
4 CONTINUE
IF (NSL .EQ. 0) RETURN
DO 1 K=1,NEQ
IF (K .EQ. KELEC) GO TO 1
C      IF (K .EQ. 1 .AND. JONF .GT. 0) GO TO 1
C
CALL READLCM(TEMPJ1,U(1,K),JX)
XCP=XCN*RMSQ(K)
XCPB=XCP*BRCON
DO 2 J=1,JX
IF (X(J) .LE. XCPB) TEMPJ1(J)=0.
2 CONTINUE
CALL WRITELCM(TEMPJ1,U(1,K),JX)
1 CONTINUE
RETURN
END
SUBROUTINE RESTART
USE CFOPL
WRITE (3,50) NEND
50 FORMAT(5HEND=,I5)
WRITE (3,51) N
51 FORMAT(1H1,20HRESTART ENTERED - N=,I5)
WRITE (3,52)
52 FORMAT(/,9HDENSITIES,/)
WRITE (3,53) (REDEN(K),K=1,NEQ)
53 FORMAT(7E15.5)
WRITE (3,54)
54 FORMAT(/,8HENERGIES,/)
WRITE (3,53) (ENERGY(K),K=1,NEQ)
CALL SIGMAVEE
DIMENSION TEMP(NEQ)
DIMENSION SEMP(NEQ)
DIMENSION TEMPE(NEQ)
DO 8 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
CALL READLCM(TEMPJ2,CLOS(1,K),JX)
CALL READLCM(TEMPJ3,CLOSE(1,K),JX)
DO 9 J=1,JX
TEMPJ4(J)=ANORMK(K)*TEMPJ1(J)*TEMPJ2(J)
TEMPJ5(J)=ANORMK(K)*TEMPJ1(J)*TEMPJ3(J)
IF (J .EQ. 1 .OR. NPRLOS .EQ. 1) GO TO 9
TEMPJ4(J)=TEMPJ4(J)/(EMASS(K)*V02*X(J))
TEMPJ5(J)=TEMPJ5(J)/(EMASS(K)*V02*X(J))
9 CONTINUE
CALL WRITELCM(TEMPJ4,CLOS(1,K),JX)
CALL WRITELCM(TEMPJ5,CLOSE(1,K),JX)
8 CONTINUE
WRITE (3,666) (ANORMK(K),K=1,NEQ)
666 FORMAT(/,7HANORMK=,/, (20X,E16.6))

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WRITE (3,31)
31 FORMAT(1H1,10X,17HLOSS COEFFICIENTS,/)
DO 32 J=1,JX
  ENGY=ENELEC*RAT10M(1,KELEC)*X2(J)
  WRITE (3,33) J,X(J),ENGY,((CLOS(J,K),CLOSE(J,K)),K=1,NEQ)
33 FORMAT(2HJ=,15,2X,2HX=,F15.5,2X,7HENERGY=,E15.5,5X,2E15.5,4X,
  C 2E15.5,/,155X,2E15.5,4X,2E15.5)
32 CONTINUE
DO 28 K=1,NEQ
  CALL READLCM(TEMPJ1,CLOS(1,K),JX)
  CALL READLCM(TEMPJ2,CLOSE(1,K),JX)
  IF (NPRLOS.EQ.1) GO TO 11
  DO 10 J=2,JX
    TEMPJ1(J)=TEMPJ1(J)*EMASS(K)*V02*X(J)
    TEMPJ2(J)=TEMPJ2(J)*EMASS(K)*V02*X(J)
  10 CONTINUE
  CALL WRITELCM(TEMPJ1,CLOS(1,K),JX)
  CALL WRITELCM(TEMPJ2,CLOSE(1,K),JX)
  11 CONTINUE
  S=0. $ SE=0.
  DO 29 J=2,JXM,2
    S=S+CON(J,1)*TEMPJ1(J-1)+CON(J,2)*TEMPJ1(J)+CON(J,3)*TEMPJ1(J+1)
    SE=SE+CON(J,1)*TEMPJ2(J-1)+CON(J,2)*TEMPJ2(J)+CON(J,3)*TEMPJ2(J+1)
  29 CONTINUE
  TEMP(K)=S
  TEMPE(K)=SE
  SEMP(K)=0.
  IF (SOSAV(K).EQ.0.) GO TO 28
  SEMP(K)=1.-(TEMP(K)+TEMPE(K))/SOSAV(K)
  28 CONTINUE
  WRITE (3,20) ((K,TEMP(K),TEMPE(K),SOSAV(K),SEMP(K)),K=1,NEQ)
  20 FORMAT(//,21HPARTICLE CONSERVATION,/,15,4E16.6)
  DO 40 K=1,NEQ
    CALL READLCM(TEMPJ1,CLOS(1,K),JX)
    S=0.
    DO 41 J=1,JX
      IF (TEMPJ1(J).LT.0.) TEMPJ1(J)=0.
      TEMPJ2(J)=X(J)
      IF (NPRLOS.EQ.1.OR.J.EQ.1) GO TO 58
      TEMPJ1(J)=TEMPJ1(J)/(EMASS(K)*V02*X(J))
      TEMPJ2(J)=TEMPJ2(J)*X(J)*ENELEC*RAT10M(K,KELEC)
    58 CONTINUE
    IF (S.LT. TEMPJ1(J)) S=TEMPJ1(J)
  41 CONTINUE
  CMAX=1.5*S
  CALL FRAME
  SCOMP=1.E-3*S $ DO 61 JJ=1,JX
  J=JX+1-JJ $ IF (TEMPJ1(J).LT. SCOMP) GO TO 61
  XPMAX=TEMPJ2(J) $ CO TO 62
  61 CONTINUE
  62 CONTINUE
  CALL MAPS(0.,XPMAX,0.,CMAX,.2,.999,.2,.999)
  CALL SETCH(2.,28.,1,0,1,1)
  WRITE (100,42) K
  42 FORMAT(21HLOSS - SPECIES NUMBER,15)
  CALL SETCH(17.,1.,1,0,1,0)
  WRITE (100,43) TIME,N
  43 FORMAT(8H TIME = ,E15.3,5X,7HCYCLE =,16)
  CALL TRACE(TEMPJ2,TEMPJ1,JX)
  40 CONTINUE

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```

IF (NEND.EQ.1) RETURN
CALL PLOTE
CALL ASSIGN(2,0,7RINTIONS,-1)
CALL OFFMON
DIMENSION ND(5) $ ND(1)=0 $ ND(2)=1HF $ ND(3)=6 $ ND(4)=0
ND(5)=1 $ CALL HSP(ND)
CALL CRTID(10HISOT RSTRT,1,1)
CALL KEEP80(KTTYOUT)
CALL ASSIGN(2,0,7RINTIONS,0)
READ (2,1) DTR,DELAMB,DXCN,NRSTRT,NSTOP,NPRINT,NPLOT,NTLOSS,NQCH
1 FORMAT(3E16.6,/,6I5)
DT=DTR/TNORM
ONODT=1./DT
WRITE (3,2) DTR,DELAMB,DXCN,NRSTRT,NSTOP,NPRINT,NPLOT,NTLOSS,NQCH
2 FORMAT(9HNEW DTR =,E16.6,5X,12HNEW DELAMB =,E16.6,5X,
C 10HNEW DXCN =,E16.6,/,7HNRRSTRT=,18,5X,6HNSTOP=,18,5X,7HNPRINT=,
C 15,5X,6HNPLOT=,15,5X,7HNTLOSS=,15,5X,5HNQCH=,15)
RETURN
END
SUBROUTINE OFFMON
COMMON/GOBCOM/IX(4)
IX(24)=IX(24) .INT. 777777777777/70077B
IADD = .LOC. RSTRT
CALL QUIT(IADD)
RSTRT RETURN
END

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LASER TARGET PLASMA VERSION

PROGRAM DUMFG(TAPE2,PRINT,TAPE5,TAPE6,TAPE3=TAPE6)

C INSERTS IN MAIN,INITIAL,EEPRINT,EEPLOT,CHECK,VARYSO
C EXTRA SUBROUTINES ENNOFC,CVERT - EXTRA DATA CARDS

```

    DIMENSION ND(5) $ ND(1)=0 $ ND(2)=1HF $ ND(3)=6 $ ND(4)=0
    ND(5)=1 $ CALL HSP(ND)
    CALL ASSIGN(2,0,7RINTIONS,0)
    CALL CRTID(8HAM TIONS,1,1)
    CLICHE CFOPL
    OPTIMIZE
    PARAMETER(JX=1001,NEQ=2)
    PARAMETER(NONCH=1000)
    PARAMETER(KDOUB=1)
    PARAMETER(KNSET=1)
    COMMON/MGR1D/XM1N,XMAX,X(JX),X2(JX),X3(JX),DXM1(JX),DX1(JX),DXP(JX),
C CON1(JX,3),CON2(JX,3),CON4(JX,3),CON(JX,3),JXM,JXM2
    COMMON/MCON1/RAT10M(NEQ,NEQ),EMASS(NEQ),ANUMB(NEQ),DENSITY(NEQ),
C ULAM(NEQ,NEQ),ANORMK(NEQ),DENS(NEQ),ENERGY(NEQ),GAM1(NEQ),
C GAM2(NEQ,NEQ),GAMMA(NEQ,NEQ),REDEN(NEQ),DENSTOR(NEQ),
C RAT1O2(NEQ,NEQ),SENGY(NEQ,KDOUB),RMSQ(NEQ),SORDEN(NEQ,KDOUB),
C RS(NEQ,3),BSOR(NEQ,KDOUB),XONE(NEQ,KDOUB),EL(NEQ,4,KDOUB),
C E1(NEQ),F1(NEQ),SOSAV(NEQ),SOSAVP(NEQ,KDOUB),JXCPB(NEQ),
C RATECNC(NEQ,NEQ),KBUFU(KNSET),KBUFW,CXRXB(NEQ,4)
C ,NTLOSS,CLOST(NEQ,2),CLOSET(NEQ,2),CLOSE34(NEQ,2)
    COMMON/MSOR/TEMPJ1(JX),TEMPJ2(JX),TEMPJ3(JX),TEMPJ4(JX),
C TEMPJ5(JX),TEMPJ6(JX),TEMPN(NONCH)
    COMMON/MCON2/TIME,DT,N,NPRINT,NPLOT,V0,RHO,ECHARG,P1,TWOP1,
C REALTIM,TNORM,ESUCHARG,NCH,NCH,KTTYOUT,BRCON,
C FOURP1,P1SQT,KELEC,V02,V03,ONODT,ONMRHO,ERGTOEV,NRSTR,DTR
C ,MNXC,NQCH,KNPROBS,NEND,NSTOP,NPRLS,ENELEC
C ,KMFLAG
    COMMON/MAMB/XCN,DXCN,DELAMB,JAMB,MAXAMB,BRATIO,NSL
C ,KAMB
    COMMON/MP2EXP/KP2USE,X1(JX),TEMPJ7(JX),TEMPJ8(JX),TEMPJ9(JX)
    LCM (MOMMAT)
    COMMON/MOMMAT/AN(JX,NEQ),BN(JX,NEQ),CN(JX,NEQ),DN(JX,NEQ),
C CLOS(JX,NEQ),USTORE(JX,NEQ),U(JX,NEQ),ANST(JX,NEQ),
C BNST(JX,NEQ),CNST(JX,NEQ),DNST(JX,NEQ),EMOF(JX,NEQ),
C ENOF(JX,NEQ),EEOF(JX,NEQ),PROB(JX,NEQ),SHAPE(JX,NEQ,KDOUB)
C ,CLOSE(JX,NEQ),UBUST(JX,NEQ,KNSET)
C ,ELOF2(JX,NEQ),EMOF2(JX,NEQ),EEOF2(JX,NEQ),EGOF2(JX,NEQ)
    LCM (MPLOTS)
    COMMON/MPLOTS/PTIME(NONCH),PLTDENS(NONCH,NEQ),PLTENGY(NONCH,NEQ)
C ,PLTDEN2(NONCH,4)

    COMMON/MENNOFC/EN01,ENFC1,EN02,ENFC2,ESS,VOL,VOP,VFC,VOPP,
C DEE,VOL1,ESS1,CUR1,COF,ELL,A0,B0,V2,SIG12,SIEVB,SIIVB,SCXA,
C EN020,SCXAJ(JX),SCXMJ(JX),EHH1(JX),EHH2(JX)

    ENDCLICHE
    USE CFOPL
    KBUFW=0
    DO 31 KNPROBS=1,KNSET
    KBUFU(KNPROBS)=0 $ KBUFW=KBUFW+KBUFU(KNPROBS)
31 CONTINUE
    DO 1000 KNPROBS=1,KNSET
    MNXC=0
    KMFLAG=0

```

```

NEND=0
WRITE (3,1001) KNPROBS
1001 FORMAT(1H1,20HBEGINNING OF PROBLEM,2X,15)
NCYCLE=0
CALL INITIAL
IF (KMFLAG.EQ. 1) GO TO 23
CALL SOURCEE
CALL KEEP80(KITYOUT)
CALL EEPRINT
CALL EEPL0T
DT1=1.E-9 $ DT2=1.E-8 $ DT3=2.5E-8
NSET1=101 $ NSET2=201 $ NSET3=301

DT4=1.E-7 $ DT5=2.5E-7 $ DT6=1.E-6 $ DT7=1.E-5 $ DT8=5.E-5
NSET4=401 $ NSET5=501 $ NSET6=601 $ NSET7=701 $ NSET8=801

1 CONTINUE
N=N+1
IF (N.EQ. NSET1) DTR=DT1
IF (N.EQ. NSET2) DTR=DT2
IF (N.EQ. NSET3) DTR=DT3

IF (N.EQ. NSET4) DTR=DT4
IF (N.EQ. NSET5) DTR=DT5
IF (N.EQ. NSET6) DTR=DT6
IF (N.EQ. NSET7) DTR=DT7
IF (N.EQ. NSET8) DTR=DT8

IF (N.EQ. NRSTRT) CALL RESTART
DT=DTR/TNORM
ONODT=1./DT
TIME=TIME+DT
REALTIM=REALTIM+DT*TNORM
CALL SOURCEE

CALL ENNIFC

KAMB=0
8 CONTINUE
IF (SENSE SWITCH 1) 81,82
81 CALL RESTART
82 CONTINUE
NCYCLE=NCYCLE+1
DO 2 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
CALL WRITELCM(TEMPJ1,USTORE(1,K),JX)
2 CONTINUE
DO 20 K=1,NEQ
20 DENSTOR(K)=REDEN(K)
KAMB=KAMB+1
CALL GAMMAIN
CALL PROBE
CALL GETCOEF
CALL ITERATE
CALL CHOPDST
CALL MOMENTS
IF (KMFLAG.EQ. 1) GO TO 23
CALL AMB1
IF (KMFLAG.EQ. 1) GO TO 23
IF (MNXCN.EQ. 1) GO TO 23

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```

IF (JAMB .EQ. 1 .AND. KAMB .LE. MAXAMB) GO TO 8
IF (KAMB .GT. MAXAMB) GO TO 22

CALL ENN2FC

CALL CHECK
DO 101 K=1,NEQ
CALL READLCM(TEMPJ1,AN(1,K),JX)
CALL WRITELCM(TEMPJ1,ANST(1,K),JX)
CALL READLCM(TEMPJ1,BN(1,K),JX)
CALL WRITELCM(TEMPJ1,BNST(1,K),JX)
CALL READLCM(TEMPJ1,CN(1,K),JX)
CALL WRITELCM(TEMPJ1,CNST(1,K),JX)
CALL READLCM(TEMPJ1,DN(1,K),JX)
CALL WRITELCM(TEMPJ1,DNST(1,K),JX)
101 CONTINUE
IF (FLOATF(N)/FLOATF(NPRINT)-FLOATF(N/NPRINT) .GE. 1.E-4) GO TO 11
CALL EEPRINT
IF (KTTYOUT .EQ. 0) GO TO 11
WRITE (59,18) N,NCYCLE
18 FORMAT(15,2X,20HITERATIONS COMPLETED,5X,16,2X,16HCYCLES COMPLETED)
CALL OOOTBF
11 IF (FLOATF(N)/FLOATF(NPLOT)-FLOATF(N/NPLOT) .GE. 1.E-4) GO TO 12
CALL EEPLT
12 CONTINUE
IF (IN .LT. NSTOP) GO TO 1
GO TO 23
22 WRITE (3,21)
21 FORMAT(46HAMBIPOLAR POTENTIAL REQUIREMENTS NOT SATISFIED)
IF (KTTYOUT .EQ. 0) GO TO 23
WRITE (59,21) $ CALL OOOTBF
23 CONTINUE
CALL EEPRINT $ CALL EEPLT
IF (KMFLAG .EQ. 1) GO TO 24
IF (MNXCN .EQ. 1 .OR. KAMB .GT. MAXAMB) GO TO 24
NEND=1 $ CALL RESTART
24 CONTINUE
WRITE (5,1002) KNPROBS
1002 FORMAT(//,14HEND OF PROBLEM,2X,15)
CALL PLOTEA
DO 1004 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
CALL WRITELCM(TEMPJ1,UBUST(1,K,KNPROBS),JX)
1004 CONTINUE
1000 CONTINUE
CALL QUIT(1)
END
SUBROUTINE INITIAL
USE CFOPL
1 FORMAT(8110)
2 FORMAT(5E16.6)
READ (2,1) KTTYOUT,NSL,NRSTRT,NSTOP
READ (2,1) NPRINT,NPLOT,NCHEC
READ (2,1) NQCH,NTLOSS
READ (2,2) DTR,V0,RHO
READ (2,2) XMIN,XMAX
DO 3 K=1,NEQ
READ (2,2) EMAS(K),ANUMB(K)
READ (2,2) DENSITY(K)
3 CONTINUE

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```

DO 4 K=1,NEQ
DO 91 KK=1,KDOUB
READ (2,2) BSOR(K,KK)
READ (2,2) XONE(K,KK)
READ (2,2) EL(K,1,KK)
READ (2,2) (EL(K,KN,KN),KN=2,4)
91 CONTINUE
4 CONTINUE
DO 5 I=1,NEQ $ DO 5 K=1,NEQ
ULAM(1,K)=.5
5 CONTINUE
DO 31 K=1,NEQ
READ (2,2) (RS(K,1),RS(K,2),RS(K,3))
31 CONTINUE
READ (2,2) XCN,DXCN,DELAMB,BRATIO
READ (2,1) MAXAMB
WRITE (3,14) NRSTRT,NSTOP
14 FORMAT(7HNRSTRT=,18,5X,6HNSSTOP=,18)
WRITE (3,38) NPRINT,NPLOT,NQCH,NTLOSS
38 FORMAT(7HNPRINT=,15,5X,6HNPLOT=,15,5X,5HNQCH=,15,5X,7HNTLOSS=,15)
WRITE (3,11) DTR,V0,RHO,XM11,XMAX
11 FORMAT(4HDTR=,E16.6,3X,3HVG=,E16.6,3X,4HRHO=,E16.6,3X,5HXM1N=,
C E16.6,3X,5HMAX=,E16.6)
DO 12 K=1,NEQ
WRITE (3,13) K,EMASS(K),ANUMB(K),DENSITY(K),
C ((BSOR(K,KK),XONE(K,KK),(EL(K,KN,KN),KN=1,4)),KK=1,KDOUB)
13 FORMAT(/,15,3X,5HMASS=,E16.6,3X,9HA NUMBER=,E16.6,3X,8HDENSITY=,
C E16.6,/,17HSOURCE PARAMS ARE,/,10X,6E16.6)
12 CONTINUE
DO 29 K=1,NEQ
WRITE (3,30) K,RS(K,1),RS(K,2),RS(K,3)
30 FORMAT(/,15,3X,16HFINIT PARAMS ARE,3E16.6)
29 CONTINUE
WRITE (3,28) XCN,DXCN,DELAMB,MAXAMB,BRATIO
28 FORMAT(/,4HXCEN=,E16.5,5X,5HDXCN=,E16.5,5X,7HDELAMB=,E16.5,5X,
C 7HMAXAMB=,15,5X,7HBRATIO=,E16.5)
KP2USE=1
IF (NSL.EQ.0) KP2USE=0
NPRLOS=1

NPRLOS=2

N=0
NCH=0
TIME=0.
REALTIM=0.
ECHARG=3.7943E-4
ESUCHARG=4.803E-10
ERGTOEV=(ESUCHARG/ECHARG)**2
KELEC=2
IF (KELEC.GT. NEQ) KELEC=NEQ
P1=3.1415926536
TWOPI=2.*PI
FOURPI=4.*PI
PISQT=SQRT(16.*PI)
JXM=JX-1
JXM2=JX-2
V02=V0*V0
V03=V02*V0
ENELEC=.5*EMASS(KELEC)*V02/ERGTOEV

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BRCON=SQRTF(1.00001/(BRATIO-1.))
IF (BRATIO .LT. 2.) BRCON=1.
DO 34 I=1,NEQ $ DO 34 K=1,NEQ
34 RATECNC(I,K)=1.
DO 52 I=1,NEQ
WRITE (3,53) I,(RATECNC(I,K),K=1,NEQ)
53 FORMAT(/,2H I=,15,3X,8H RATECNC=,6E16.6,/, (18X,6E16.6))
52 CONTINUE
DO 37 J=1,JX
37 TEMPJ(J)=0.
DO 20 K=1,NEQ
CALL WRITELCM(TEMPJ),AN(I,K),JX)
CALL WRITELCM(TEMPJ),BN(I,K),JX)
CALL WRITELCM(TEMPJ),CN(I,K),JX)
CALL WRITELCM(TEMPJ),DN(I,K),JX)
CALL WRITELCM(TEMPJ),CLOS(I,K),JX)
20 CONTINUE
DO 21 I=1,NEQ $ DO 21 K=1,NEQ
RATIO2(I,K)=(ANUMB(I)/ANUMB(K))**2
21 RATIO(I,K)=EMASS(I)/EMASS(K)
DO 22 K=1,NEQ
GAM1(K)=FOURPI*ANUMB(K)**4*ESUCHARG**4/EMASS(K)**2
RMSQ(K)=SQRTF(RATIO(KELEC,K)*ANUMB(K))
CXRXB(K,1)=1. $ CXRXB(K,2)=0. $ CXRXB(K,3)=0. $ CXRXB(K,4)=0.
CLOST(K,1)=0. $ CLOST(K,2)=0. $ CLOST(K,3)=0. $ CLOST(K,4)=0.
CLOSE3(K,1)=0. $ CLOSE3(K,2)=0.
GO TO 22
C
C SET CXRXB IF NECESSARY.
READ (2,2) (CXRXB(K,L),L=1,4)
22 CONTINUE
WRITE (3,54) ((K,(CXRXB(K,L),L=1,4)),K=1,NEQ)
54 FORMAT(/,6HCXRXB=,/, (15,4E16.6))

READ (2,2) ESS,ESS1,VOL,VOL1
READ (2,2) VOP,VOPP,VFC,V2
READ (2,2) SIEVEB,S11VB,SCXA,SIG12
READ (2,2) A0,B0,ELL,DEE
READ (2,2) CUR1,COF,EN020
WRITE (3,71) ESS,ESS1,VOL,VOL1,VOP,VOPP,VFC,V2,SIEVEB,
C S11VB,SCXA,SIG12,A0,B0,ELL,DEE,CUR1,COF,EN020
71 FORMAT(/,4HESS=,E16.6,5X,5HESS1=,E16.6,5X,4HVOL=,E16.6,5X,
C 5HVOL1=,E16.6,/,4HVOP=,E16.6,5X,5HVOPP=,E16.6,5X,4HVFC=,
C E16.6,5X,3HV2=,E16.6,/,7HSIEVEB=,E16.6,5X,6HS11VB=,E16.6,5X,
C 5HSCXA=,E16.6,5X,6HSIG12=,E16.6,/,3HA0=,E16.6,5X,3HB0=,E16.6,
C 5X,4HELL=,E16.6,5X,4HDEE=,E16.6,/,5HCUR1=,E16.6,5X,4HCOF=,
C E16.6,5X,6HEN020=,E16.6)
EN01=EN020 $ EN02=EN01 $ ENFC1=0. $ ENFC2=0.

ALP=1./137. $ R0=2.82E-13 $ CLIGHT=3.E+10
GACON1=2.*ALP*SQRTF(2.)/(PI*SQRT(R0*CLIGHT))
GACON2=GACON1/(ECHARC*EMASS(KELEC))
DO 41 I=1,NEQ $ DO 41 K=1,NEQ
GAM2(I,K)=EMASS(I)*EMASS(K)*GACON2/(EMASS(I)+EMASS(K))
41 CONTINUE
ONMRHO=1.-RHO
CALL XMESH
DO 23 K=1,NEQ
E1(K)=1.
F1(K)=0.
23 CONTINUE

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CALL FINIT
CALL MOMENTS
IF (KMFLAG .EQ. 1) RETURN
DO 26 K=1,NEQ
REDEN(K)=DENSITY(K)
26 ANORM(K)=DENSITY(K)/DENS(K)
TNORM=2.*V03/(ANORM(K*ELEC)*SAM(K*ELEC))
TNORM=1.
WRITE (3,101) TNORM
101 FORMAT(/,6HTNORM=,E15.5)
DT=DTR/TNORM
ONODT=1./DT

CALL ENNOFC

IF (NSL .EQ. 1) RETURN
DO 35 I=1,NEQ $ DO 35 K=1,NEQ
35 ULAM(I,K)=0.
WRITE (3,102)
102 FORMAT(31HTHIS IS A NO SOURCE NO LOSS RUN,/,
C 41HIGNORE XCN DXCN DELAMB AMBIPOT AND BRATIO)
RETURN
END
SUBROUTINE AMB1
USE CFOPL
IF (KAMB .EQ. 1) LAMB=0
JAMB=0
IF (XCN .EQ. 0.) RETURN
IF (NSL .EQ. 0) RETURN
QMINUS=REDEN(K*ELEC) $ QSMINUS=DENSTOR(K*ELEC)
QPLUS=0. $ QSPLUS=0.
DO 42 K=1,NEQ
IF (K .EQ. KELEC) GO TO 42
QSPLUS=QSPLUS+ANUMB(K)*DENSTOR(K)
QPLUS=QPLUS+ANUMB(K)*REDEN(K)
42 CONTINUE
IF (DELAMB .LT. 1.E-20) GO TO 40
DENDIF=ABSF(1.-QPLUS/QMINUS)
WRITE (6,41) N,DENDIF,QPLUS,QMINUS,XCN
41 FORMAT(2HN=,15,2X,7HDENDIF=,F15.5,2X,8HION DEN=,E16.5,2X,
C 9HELEC DEN=,E16.5,5X,4HXCN=,F15.5)
IF (DENDIF .GT. DELAMB) GO TO 1
IF (LAMB .EQ. 0) GO TO 40
RETURN
1 JAMB=1
LAMB=1
IF (QMINUS .LE. QPLUS) XCN=XCN+DXCN
IF (QMINUS .GE. QPLUS) XCN=XCN-DXCN
IF (XCN .LT. .5*DXCN) GO TO 32
IF (XCN .GT. XMAX) GO TO 32
GO TO 48
40 CONTINUE
D1=QPLUS-QSPLUS $ D2=QMINUS-QSMINUS
WRITE (6,43) N,QSPLUS,QPLUS,D1,QSMINUS,QMINUS,D2,XCN
43 FORMAT(2HN=,15,2X,7HQSPUS=,E16.5,3X,6HQPLUS=,E16.5,2X,3HD1=,
C E16.5,/,8X,8HQSMINUS=,E16.5,2X,7HQMINUS=,E16.5,2X,3HD2=,E16.5,
C 2X,4HXCN=,F15.5)
IF (N .EQ. 1) RETURN
IF (QSPLUS .LT. QSMINUS) GO TO 30
IF (D2 .GE. D1) RETURN

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JAMB=1
XCN=XCN+DXCN
IF (XCN .GT. XMAX) GO TO 32
GO TO 48
30 IF (D1 .GT. D2) RETURN
JAMB=1
XCN=XCN-DXCN
IF (XCN .LT. .5*DXCN) GO TO 32
GO TO 48
32 WRITE (3,33) $ MNXCN=1 $ RETURN
33 FORMAT(16HXCEN OUT OF RANGE)
48 CONTINUE
DO 2 K=1,NEQ
CALL READLCM(TEMPJ1,USTORE(1,K),JX)
CALL WRITELCM(TEMPJ1,U(1,K),JX)
2 CONTINUE
CALL CHOPDST
CALL MOMENTS
RETURN
END
SUBROUTINE SIGMAVEE
USE CFOPL
COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
NSK=3
IF (NQCH .EQ. 0) RETURN
IF (N .EQ. 1) RETURN
SIGVDDP=0. $ SIGVDDN=0.
CALL QFUTCH(SIGVDDP,1,1,3)
CALL QFUTCH(SIGVDDN,1,1,4)
EDDN=3.27E+6 $ EDDP=4.04E+6
EDH=1.83E+7 $ EDT=2.24E+7
IF (NQCH .NE. 1) GO TO 100
SIGVF=0. $ SIGVH=0.
CALL QFUTCH(SIGVF,1,1,1)
CALL QHOLD(SIGVH,1,1,1)
WRITE (3,190) SIGVF,SIGVH,SIGVDDP,SIGVDDN
190 FORMAT(1H1,/,6HSIGVF=,E16.6,5X,6HSIGVH=,E16.6,5X,8HSIGVDDP=,
C E16.6,5X,8HSIGVDDN=,E16.6)
RETURN
100 IF (NQCH .NE. 2) GO TO 200
SIGVDT=0. $ SIGVH=0.
CALL QFUTCH(SIGVDT,1,3,1)
CALL QHOLD(SIGVH,1,3,1)
WRITE (3,290) SIGVDT,SIGVH,SIGVDDP,SIGVDDN
290 FORMAT(1H1,/,7HSIGVDT=,E16.6,5X,6HSIGVH=,E16.6,5X,8HSIGVDDP=,
C E16.6,5X,8HSIGVDDN=,E16.6)
ENUM=.5*REDEN(1)**2*(SIGVDDP*EDDP+SIGVDDN*EDDN)+
C REDEN(1)*REDEN(3)*SIGVDT*EDT
SUMSEN=0.
DO 201 K=1,NEQ
DO 201 KK=1,KDOUB
SUMSEN=SUMSEN+EL(K,1,KK)*SENGY(K,KK)
201 CONTINUE
QDT=ENUM/SUMSEN
WRITE (3,291) QDT
291 FORMAT(/,4HQDT=,E16.6)
RETURN
200 IF (NQCH .NE. 3) GO TO 300
SIGVDH=0. $ SIGVH=0.
CALL QFUTCH(SIGVDH,1,3,2)

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CALL QHOLD(SIGVH,1,3,2)
WRITE (3,390) SIGVDH,SIGVH,SIGVDDP,SIGVDDN
390 FORMAT(1H1,/,7HSIGVDH=,E16.6,5X,6HSIGVH=,E16.6,5X,8HSIGVDDP=,
C E16.6,5X,8HSIGVDDN=,E16.6)
ENUMN=.5*REDEN(1)**2*SIGVDDP*EDDP*REDEN(1)*REDEN(3)*SIGVDH*EDH
ENUN=ENUMN+.5*REDEN(1)**2*SIGVDDN*EDDN
SUMSEN=0.
DO 301 K=1,NEQ
DO 301 KK=1,KDOUB
SUMSEN=SUMSEN+EL(K,1,KK)*SENGY(K,KK)
301 CONTINUE
QDH=ENUN/SUMSEN $ QDHN=ENUMN/SUMSEN
WRITE (3,391) QDH,QDHN
391 FORMAT(/,4HQDH=,E16.6,5X,11HWITHOUT N =,E16.6)
RETURN
300 CONTINUE
SIGVDT=0. $ SIGVDH=0.
CALL QFUTCH(SIGVDT,1,3,1)
CALL QFUTCH(SIGVDH,1,4,2)
WRITE (3,490) SIGVDH,SIGVDT,SIGVDDP,SIGVDDN
490 FORMAT(7HSIGVDH=,E16.6,5X,7HSIGVDT=,E16.6,5X,8HSIGVDDP=,
C E16.6,5X,8HSIGVDDN=,E16.6)
ENUMN=.5*REDEN(1)**2*SIGVDDP*EDDP*REDEN(1)*REDEN(3)*SIGVDT*CDT+
C REDEN(1)*REDEN(4)*SIGVDH*EDH
ENUN=ENUMN+.5*REDEN(1)**2*SIGVDDN*EDDN
SUMSEN=0.
DO 401 K=1,NEQ
DO 401 KK=1,KDOUB
SUMSEN=SUMSEN+EL(K,1,KK)*SENGY(K,KK)
401 CONTINUE
QDTH=ENUN/SUMSEN $ QDTHN=ENUMN/SUMSEN
WRITE (3,491) QDTH,QDTHN
491 FORMAT(/,5HQDTH=,E16.6,5X,11HWITHOUT N =,E16.6)
RETURN
END
SUBROUTINE FINDSIG(NSIG,UMU)
USE CFOPL
COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
DIMENSION SIGMA(JX)
EQUIVALENCE (SIGMA(1),TEMPJ6(1))
SIGMA(1)=J.
IF (NSIG .NE. 1) GO TO 100
DO 1 J=2,JXQ
EPS=UMU*X2(J)
IF (EPS .GE. 20.) GO TO 41
TEMPQ=2.25E+4*EXP(-44.4/SQRT(EPS))/EPS $ GO TO 40
41 IF (EPS .GE. 30.) GO TO 42
TEMPQ=4.62E-4*EPS*EPS-0.137 $ GO TO 40
42 IF (EPS .GE. 50.) GO TO 43
TEMPQ=6.70E-4*EPS*EPS-0.320 $ GO TO 40
43 IF (EPS .GE. 87.) GO TO 44
TEMPQ=8.55E-02*EPS-2.93 $ GO TO 40
44 IF (EPS .GE. 107.) GO TO 45
TEMPQ=1.98E+4/((EPS-107.))**2+4000.) $ GO TO 40
45 IF (EPS .GE. 137.) GO TO 46
TEMPQ=3.56E+4/((EPS-107.))**2+7200.) $ GO TO 40
46 IF (EPS .GE. 185.) GO TO 47
TEMPQ=8.70-0.0314*EPS $ GO TO 40
47 IF (EPS .GE. 400.) GO TO 48
TEMPQ=7.050E+3/(EPS*SQRT(EPS)) $ GO TO 40

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48 TEMPQ=255./(EPS-110.)
40 CONTINUE
   SIGMA(J)=1.E-24*TEMPQ
   1 CONTINUE
   RETURN
100 IF (NSIG.NE. 2) GO TO 200
   DO 11 J=2,JXQ
   EPS=UMU*X2(J)
   SA=230. $ SB=27500. $ SC=350. $ SD=2845.
   TS1=SB/EPS $ TS2=SA**2/(SA**2+(EPS-SC)**2)
   ARG=-89./SQRTF(EPS) $ TS3=EXPF(ARG)
   TEMPQ=TS1*TS2*TS3
   IF (EPS.LE. 600.) GO TO 12
   TS5=5.75E-4*(EPS-600.)
   TEMPQ=TEMPQ*(1.+TS5)
   IF (EPS.LE. 1000.) GO TO 12
   TS4=(SD+EPS)/(SD+1000.)
   TEMPQ=TEMPQ*TS4**2
   12 CONTINUE
   SIGMA(J)=1.E-24*TEMPQ
   11 CONTINUE
   RETURN
200 IF (NSIG.NE. 3) GO TO 300
   DO 21 J=2,JXQ
   EPS=UMU*X2(J)
   IF (EPS.GT. 1000.) GO TO 22
   GEE=EXPF((-44.4/SQRTF(EPS)))/EPS
   TEMPQ=106.4*GEE*(1.+EPS/493.)
   GO TO 23
   22 CONTINUE
   ARG=(EPS-25.74)/407.3
   TEMPQ=.09*(1.-EXPF(-ARG))
   23 CONTINUE
   SIGMA(J)=1.E-24*TEMPQ
   21 CONTINUE
   RETURN
300 CONTINUE
   DO 31 J=2,JXQ
   EPS=UMU*X2(J)
   IF (EPS.GT. 500.) GO TO 32
   GEE=EXPF((-44.4/SQRTF(EPS)))/EPS
   TEMPQ=108.4*GEE*(1.+EPS/332.)
   GO TO 33
   32 CONTINUE
   ARG=(EPS-37.47)/359.3
   TEMPQ=.103*(1.-EXPF(-ARG))
   33 CONTINUE
   SIGMA(J)=1.E-24*TEMPQ
   31 CONTINUE
   RETURN
END
SUBROUTINE QFUTCH'SIGV,K1,K2,NSIG)
USE CFOP1
COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
DIMENSION SIGMA(JX)
EQUIVALENCE (SIGMA(1),TEMPJ6(1))
DIMENSION ANSWER(2)
IF (K1.GT. NEQ .OR. K2.GT. NEQ) RETURN
IF (K1.EQ. KELEC .OR. K2.EQ. KELEC) RETURN
CALL READLCM(TEMPJ2,U(1,K1),JX)

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CALL READLCM(TEMPJ3,U(1,K2),JX)
IF (NEQ .NE. 2 .OR. NSIG .NE. 1) GO TO 161
SQIP5=SQRTF(1.5)
TEMPJ3(1)=TEMPJ2(1)
DO 162 J=2,JX
  QJX3=SQIP5*X(J)
DO 163 JJ=1,JXM
  IF (X(JJ) .LE. QJX3 .AND. QJX3 .LT. X(JJ+1)) GO TO 164
163 CONTINUE
  TEMPJ3(J)=0. $ GO TO 162
164 RATIO=(QJX3-X(JJ))/DXP(JJ)
  TEMPJ3(J)=(1.-RATIO)*TEMPJ2(JJ)+RATIO*TEMPJ2(JJ+1)
162 CONTINUE
161 CONTINUE
  S1=0. $ S2=0.
  DO 13 J=1,JX
    IF (S1 .LT. TEMPJ2(J)) S1=TEMPJ2(J)
    IF (S2 .LT. TEMPJ3(J)) S2=TEMPJ3(J)
  13 CONTINUE
  S1=1.E-8*S1 $ S2=1.E-8*S2
  DO 14 JJ=1,JXM
    J=JX-JJ
    IF (TEMPJ2(J) .GT. S1 .OR. TEMPJ3(J) .GT. S2) GO TO 3
  14 CONTINUE
  3 JXQ=J
  SJN1=FLOATF(JXQ-1)/FLOATF(NSK) $ SJN2=FLOATF(1/JXQ-1)/NSK
  IF (ABSF(SJN1-SJN2) .LT. .0001) GO TO 46
  JXQ=FLOATF(NSK)*(SJN2+1.)+1.01
46 CONTINUE
  IF (JXQ .GT. JX) JXQ=JXQ-NSK
  DO 47 J=1,JXQ-NSK,NSK
    DXQ(J)=X(J+NSK)-X(J)
    EMAU=EMASS(K1)
    UMU=.5*EMAU*V02/(1.E+3*ERC.OEV)
    DO 30 LT=1,2
      IF (LT .EQ. 1) GO TO 31
      CALL FINDSIG(NSIG,UMU)
      DO 34 J=1,JXQ,NSK
        ENGY=UMU*X2(J)
        WRITE (3,35) ENGY,SIGMA(J)
35 FORMAT(7HENRGY=,E16.6,5X,4HSIG=,E16.6)
34 CONTINUE
      GO TO 32
31 CONTINUE
      DO 33 J=1,JXQ,NSK
33 SIGMA(J)=1.
32 CONTINUE
      DO 1 J=1,JXQ,NSK
        1 TEMPJ1(J)=EVALS(J,K1,K2)
        QANS=0.
        DO 2 J=1,JXQ-NSK,NSK
          QANS=QANS+.5*DXQ(J)*(TEMPJ1(J)+TEMPJ1(J+NSK))
        2 CONTINUE
        ANSWER(LT)=QANS
30 CONTINUE
        SIGV=V0*ANSWER(2)/ANSWER(1)
        RETURN
      END
      FUNCTION EVALS(J,K1,K2)
      USE CFOPL

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COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
DIMENSION SIGMA(JX)
EQUIVALENCE (SIGMA(1),TEMPJ6(1))
DO 1 K=1,J,NSK
  TEMPJ4(K)=(X2(J)-X2(K))*GETFG(J,K)
1 CONTINUE
  TEMPJ5(1)=0.
  DO 2 K=1+NSK,J,NSK
    ADDIT=.5*DXQ(K-NSK)*(TEMPJ4(K-NSK)+TEMPJ4(K))
    TEMPJ5(K)=TEMPJ5(K-NSK)+ADDIT
2 CONTINUE
  SUM=0.
  DO 4 K=1+NSK,J,NSK
    ARGM=X(K-NSK)*.5*LT*SIGMA(K-NSK)*TEMPJ5(K-NSK)
    ARGP=X(K)*.5*LT*SIGMA(K)*TEMPJ5(K)
    SUM=SUM+.5*DXQ(K-NSK)*(ARGM+ARGP)
4 CONTINUE
  EVALS=SUM
  RETURN
END
FUNCTION GETFG(J,K)
  USE CFOPL
  COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
  ARG1=.5*(X(J)+X(K))
  ARG2=.5*(X(J)-X(K))
  J1=0 $ J2=0
  DO 1 JM=1,JXQ-NSK,NSK
    IF (X(JM) .LE. ARG1 .AND. ARG1 .LT. X(JM+NSK)) J1=JM
    IF (X(JM) .LE. ARG2 .AND. ARG2 .LT. X(JM+NSK)) J2=JM
1 CONTINUE
    IF (ARG1 .GE. X(JXQ)) J1=JXQ-NSK
    IF (ARG2 .GE. X(JXQ)) J2=JXQ-NSK
    J1P=J1+NSK $ J2P=J2+NSK
    FRAC1=(ARG1-X(J1))/(X(J1P)-X(J1))
    FRAC2=(ARG2-X(J2))/(X(J2P)-X(J2))
    ANS1=(1.-FRAC1)*TEMPJ2(J1)+FRAC1*TEMPJ2(J1P)
    ANS2=(1.-FRAC2)*TEMPJ3(J2)+FRAC2*TEMPJ3(J2P)
    ANS3=(1.-FRAC1)*TEMPJ3(J1)+FRAC1*TEMPJ3(J1P)
    ANS4=(1.-FRAC2)*TEMPJ2(J2)+FRAC2*TEMPJ2(J2P)
    GETFG=ANS1*ANS2+ANS3*ANS4
  RETURN
END
SUBROUTINE QHOLD(SIGV,K1,K2,NSIG)
  USE CFOPL
  COMMON/MQCAL/JXQ,LT,NSK,DXQ(JX)
  DIMENSION SIGMA(JX)
  EQUIVALENCE (SIGMA(1),TEMPJ6(1))
  IF (K1 .GT. NEG .OR. K2 .GT. NEG) RETURN
  IF (K1 .EQ. KELEC .OR. K2 .EQ. KELEC) RETURN
  CALL READLCM(TEMPJ2,U(1,K1),JX)
  S1=0.
  DO 13 J=1,JX
    IF (S1 .LT. TEMPJ2(J)) S1=TEMPJ2(J)
13 CONTINUE
  S1=1.E-8*S1
  DO 14 JJ=1,JXM
    J=JX-JJ
    IF (TEMPJ2(J) .GT. S1) GO TO 3
14 CONTINUE
3 JXQ=J

```

```

IF (.5*FLOATF(JXQ)-FLOATF(JXQ/2) .LT. .1) JXQ=JXQ+1
JXQM=JXQ-1
UM2=1.+RATIO(M(K1,K2)*ENERGY(K2)/ENERGY(K1))
IF (NEQ .EQ. 2 .AND. NSIG .EQ. 1) UM2=5./3.
UM=SQRTF(UM2)
FACTOR=UM*V0/DENS(K1)
EMAU=EMASS(K1)
UMU=.5*UM2*EMAU*V02/(1.E+3*ERGTOEV)
CALL FINDSIG(NSIG,UMU)
DO 34 J=1,JXQ
  ENGY=UMU*X2(J)
  WRITE (3,35) ENGY,SIGMA(J)
35 FORMAT(7HENERGY=,E16.6,5X,4HSIG=,E16.6)
34 CONTINUE
DO 1 J=1,JXQ
  TEMPJ1(J)=SIGMA(J)*X(J)*TEMPJ2(J)
1 CONTINUE
QANS=0.
DO 2 J=2,JXQM,2
  QANS=QANS+CON2(J,1)*TEMPJ1(J-1)+CON2(J,2)*TEMPJ1(J)+
  C CON2(J,3)*TEMPJ1(J+1)
2 CONTINUE
SIGV=FACTOR*QANS
RETURN
END
SUBROUTINE SOURCEE
USE CFOPL
CALL VARYSO
DO 1 K=1,NEQ
DO 1 KK=1,KDOUB
DO 13 J=1,JX
  S=-BSOR(K,KK)*(X(J)-XONE(K,KK))*2
  TEMPJ1(J)=EXPF(S)
13 CONTINUE
  ZR=0. $ ZRP=0.
  DO 11 J=2,JXM,2
    SN=TEMPJ1(J-1)*CON2(J,1)+TEMPJ1(J)*CON2(J,2)+TEMPJ1(J+1)*CON2(J,3)
    SE=TEMPJ1(J-1)*CON4(J,1)+TEMPJ1(J)*CON4(J,2)+TEMPJ1(J+1)*CON4(J,3)
    ZR=ZR+SN
    ZRP=ZRP+SE
11 CONTINUE
  QUOT=ZR/ZR
  SORDEN(K,KK)=ZR
  SENGY(K,KK)=.5*EMASS(K)*V02*QUOT/ERGTOEV
  CALL WRITELCM(TEMPJ1,SHAPE(1,K,KK),JX)
1 CONTINUE
RETURN
END
SUBROUTINE VARYSD
USE CFOPL

IF (N .GT. 0) GO TO 21
DO 22 K=1,NEQ
22 EL(K,4,1)=EL(K,1,1)
21 CONTINUE
DO 23 K=1,NEQ
23 EL(K,1,1)=EL(K,4,1)*(1.-EXPF(-4.844E-15*REDEN(K)))
DO 24 K=1,NEQ
  CXRXB(K,4)=EL(K,4,1)/REDEN(K)*(1.-EXPF(-3.92E-15*REDEN(K)))
24 CONTINUE

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```

NCHSOR=NTLOSS
IF (N.NE.NCHSOR) RETURN
ELSTOR=EL(2,2,1)
DO 1 K=1,NEQ $ DO 1 L=1,4 $ DO 1 KK=1,KDOUB
1 EL(K,L,KK)=0.
EL(2,2,1)=ELSTOR
RETURN
END
SUBROUTINE PROBE
USE CFOPL
JXCPB(KELEC)=-2
DO 1 K=1,NEQ
IF (K.NE.KELEC) GO TO 2
DO 3 J=1,JX
TEMPJ1(J)=0.
IF (X(J).LE.XCN) GO TO 3
REFF=BRAT10/(1.-(XCN/X(J))**2)
TEMPJ1(J)=1./TENLOG(REFF)
3 CONTINUE
GO TO 4
2 CONTINUE
XCP=XCN*RMSQ(K)
XCPB=XCP*BRCON
DO 7 J=1,JXM
IF (XCPB.LT.X(J).OR.X(J+1).LE.XCPB) GO TO 7
JXCPB(K)=J
7 CONTINUE
IF (NSL.EQ.0) JXCPB(K)=-2
DO 5 J=1,JX
TEMPJ1(J)=0.
IF (X(J).LE.XCPB) GO TO 5
REFF=BRAT10/(1.+(XCP/X(J))**2)
TEMPJ1(J)=1./TENLOG(REFF)
5 CONTINUE
4 CONTINUE
CALL WRITELCM(TEMPJ1,PROB(1,K),JX)
1 CONTINUE
RETURN
END
SUBROUTINE XMESH
USE CFOPL
X(1)=XMIN $ X(JX)=XMAX
H=(XMAX-XMIN)/JXM
X(2)=H $ RAM=1.
X(2)=.0002*XMAX $ RAM=1.00266584997
X(2)=.0001*XMAX $ RAM=1.00362390976
X(2)=.00005*XMAX $ RAM=1.00452698980
DO 1 J=3,JXM
X(J)=X(J-1)+RAM*(X(J-1)-X(J-2))
1 CONTINUE
WRITE (3,89) ((J,X(J)),J=1,JX)
89 FORMAT(//,(15,5X,F20.5))
DO 2 J=1,JX
X2(J)=X(J)*X(J)
X3(J)=X(J)*X2(J)
IF (J.EQ.1.OR.J.EQ.JX) GO TO 2
DXM(J)=X(J)-X(J-1)
DXP(J)=X(J+1)-X(J)
DX(J)=.5*(DXM(J)+DXP(J))

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X1(J)=1./X(J)
2 CONTINUE
X1(1)=0.
X1(JX)=1./X(JX)
DXP(1)=DXM(2) $ DXM(JX)=DXP(JXM)
DO 3 J=2,JXM
HMINUS=DXM(J) $ HPLUS=DXP(J)
CMINUS=.5*HMINUS $ CPLUS=.5*HPLUS $ CMID=CMINUS+CPLUS
CON1(J,1)=CMINUS $ CON(J,2)=CMID $ CON(J,3)=CPLUS
CON1(J,1)=X(J-1)*CMINUS
CON1(J,2)=X(J)*CMID
CON1(J,3)=X(J+1)*CPLUS
CON2(J,1)=X(J-1)*CON1(J,1)
CON2(J,2)=X(J)*CON1(J,2)
CON2(J,3)=X(J+1)*CON1(J,3)
CON4(J,1)=X2(J-1)*CON2(J,1)
CON4(J,2)=X2(J)*CON2(J,2)
CON4(J,3)=X2(J+1)*CON2(J,3)
3 CONTINUE
RETURN
END
SUBROUTINE MOMENTS
USE CFOPL
DO 1 K=1,NEQ
CALL READLCM(TEMPJ4,U(1,K),JX)
DO 20 J=1,JX
20 TEMPJ5(J)=0.
IF (K.EQ.KELEC) GO TO 21
XCP=XCN*RMSQ(K)
XCPB=XCP*BRCON
DO 22 J=1,JX
REFF=0. $ IF (X(J).LE.XCPB) GO TO 23
REFF=BRATIO/(1.+(XCP/X(J))*2)
23 CONTINUE
EMP2OM=EMP2(REFF)
TEMPJ5(J)=TEMPJ4(J)*5.*EMP2OM
22 CONTINUE
21 CONTINUE
TEMPJ1(JX)=0. $ TEMPJ2(1)=0. $ TEMPJ3(1)=0.
TEMPJ6(JX)=0. $ TEMPJ7(JX)=0. $ TEMPJ8(1)=0. $ TEMPJ9(1)=0.
DO 3 JJ=2,JXM,2
JJ=JJ+1-J
SM=TEMPJ4(JJ-1)*CON1(JJ,1)+TEMPJ4(JJ)*CON1(JJ,2)+
C TEMPJ4(JJ+1)*CON1(JJ,3)
SN=TEMPJ4(J-1)*CON2(J,1)+TEMPJ4(J)*CON2(J,2)+TEMPJ4(J+1)*CON2(J,3)
SE=TEMPJ4(J-1)*CON4(J,1)+TEMPJ4(J)*CON4(J,2)+TEMPJ4(J+1)*CON4(J,3)
SL2=TEMPJ5(JJ-1)*X1(JJ-1)*CON(JJ,1)+TEMPJ5(JJ)*X1(JJ)*CON(JJ,2)+
C TEMPJ5(JJ+1)*X1(JJ+1)*CON(JJ,3)
SM2=TEMPJ5(JJ-1)*CON1(JJ,1)+TEMPJ5(JJ)*CON1(JJ,2)+
C TEMPJ5(JJ+1)*CON1(JJ,3)
SE2=TEMPJ5(J-1)*CON4(J,1)+TEMPJ5(J)*CON4(J,2)+
C TEMPJ5(J+1)*CON4(J,3)
SG2=TEMPJ5(J-1)*X2(J-1)*CON4(J,1)+TEMPJ5(J)*X2(J)*CON4(J,2)+
C TEMPJ5(J+1)*X2(J+1)*CON4(J,3)
TEMPJ1(JJ-1)=TEMPJ1(JJ+1)+SM
TEMPJ2(J+1)=TEMPJ2(J-1)+SN
TEMPJ3(J+1)=TEMPJ3(J-1)+SE
TEMPJ6(JJ-1)=TEMPJ6(JJ+1)+SL2 $ TEMPJ7(JJ-1)=TEMPJ7(JJ+1)+SM2
TEMPJ8(J+1)=TEMPJ8(J-1)+SE2 $ TEMPJ9(J+1)=TEMPJ9(J-1)+SG2
3 CONTINUE

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SM=.5*DXP(JXM)*(TEMPJ4(JXM)*X(JXM)+TEMPJ4(JX)*X(JX))
SN=.5*DXM(2)*(TEMPJ4(1)*X2(1)+TEMPJ4(2)*X2(2))
SE=.5*DXM(2)*(TEMPJ4(1)*X2(1)**2+TEMPJ4(2)*X2(2)**2)
SL2=.5*DXP(JXM)*(TEMPJ5(JXM)*X(JXM)+TEMPJ5(JX)*X(JX))
SM2=.5*DXP(JXM)*(TEMPJ5(JXM)*X(JXM)+TEMPJ5(JX)*X(JX))
SE2=.5*DXM(2)*(TEMPJ5(1)*X2(1)**2+TEMPJ5(2)*X2(2)**2)
SG2=.5*DXM(2)*(TEMPJ5(1)*X3(1)**2+TEMPJ5(2)*X3(2)**2)
TEMPJ1(JXM)=SM $ TEMPJ2(2)=SN $ TEMPJ3(2)=SE
TEMPJ6(JXM)=SL2 $ TEMPJ7(JXM)=SM2
TEMPJ8(2)=SE2 $ TEMPJ9(2)=SG2
DO 4 J=3,JXM2,2
JJ=JX+1-J
SM=TEMPJ4(JJ-1)*CON1(JJ,1)+TEMPJ4(JJ)*CON1(JJ,2)+
C TEMPJ4(JJ+1)*CON1(JJ,3)
SN=TEMPJ4(J-1)*CON2(J,1)+TEMPJ4(J)*CON2(J,2)+TEMPJ4(J+1)*CON2(J,3)
SE=TEMPJ4(J-1)*CON4(J,1)+TEMPJ4(J)*CON4(J,2)+TEMPJ4(J+1)*CON4(J,3)
SL2=TEMPJ5(JJ-1)*X1(JJ-1)*CON(JJ,1)+TEMPJ5(JJ)*X1(JJ)*CON(JJ,2)+
C TEMPJ5(JJ+1)*X1(JJ+1)*CON(JJ,3)
SM2=TEMPJ5(JJ-1)*CON1(JJ,1)+TEMPJ5(JJ)*CON1(JJ,2)+
C TEMPJ5(JJ+1)*CON1(JJ,3)
SE2=TEMPJ5(J-1)*CON4(J,1)+TEMPJ5(J)*CON4(J,2)+
C TEMPJ5(J+1)*CON4(J,3)
SG2=TEMPJ5(J-1)*X2(J-1)*CON4(J,1)+TEMPJ5(J)*X2(J)*CON4(J,2)+
C TEMPJ5(J+1)*X2(J+1)*CON4(J,3)
TEMPJ1(JJ-1)=TEMPJ1(JJ+1)+SM
TEMPJ2(J+1)=TEMPJ2(J-1)+SN
TEMPJ3(J+1)=TEMPJ3(J-1)+SE
TEMPJ6(JJ-1)=TEMPJ6(JJ+1)+SL2 $ TEMPJ7(JJ-1)=TEMPJ7(JJ+1)+SM2
TEMPJ8(J+1)=TEMPJ8(J-1)+SE2 $ TEMPJ9(J+1)=TEMPJ9(J-1)+SG2
4 CONTINUE
DENS(K)=TEMPJ2(JX)
IF (DENS(K) .LE. 0.) GO TO 9
ENERGY(K)=TEMPJ3(JX)/DENS(K)
ENERGY(K)=.5*EMASS(K)*V02*ENERGY(K)/ERGTOEV
IF (N .EQ. 0.) GO TO 5
REDEN(K)=DENS(K)*ANORMK(K)
5 CONTINUE
CALL WRITELCM(TEMPJ1,EMOF(1,K),JX)
CALL WRITELCM(TEMPJ2,ENOF(1,K),JX)
CALL WRITELCM(TEMPJ3,EEOF(1,K),JX)
CALL WRITELCM(TEMPJ6,ELOF2(1,K),JX)
CALL WRITELCM(TEMPJ7,EMOF2(1,K),JX)
CALL WRITELCM(TEMPJ8,EEOF2(1,K),JX)
CALL WRITELCM(TEMPJ9,ECOF2(1,K),JX)
1 CONTINUE
RETURN
9 KMFLAG=1 $ WRITE (3,10) K
10 FORMAT(1,10HDENSITY OF SPECIES,15,3X,7HLE ZERO)
RETURN
END
SUBROUTINE GAMMAIN
USE CF0PL
TEMPE=ENERGY(KELEC)
DENSE=REDEN(KELEC)
DEBY=SQRTF(TEMPE/DENSE)
DO 1 I=1,NEQ $ DO 1 K=1,NEQ
SI=ENERGY(I)/EMASS(1) $ SK=ENERGY(K)/EMASS(K)
SF=SI $ IF (SK .GT. SI) SF=SK
VIKF=SQRTF(SF*ERGTOEV)
GAM3=GAM2(1,K)*DEBY*VIKF

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      GAMMA(I,K)=GAM(I)* (LOGF(GAM3)-.5)
1  CONTINUE
      RETURN
      END
      SUBROUTINE GETCOEF
      USE CFOPL
      DO 1 K=1,NEQ
      TEMPJ2(I)=0. $ TEMPJ3(I)=0. $ TEMPJ4(I)=0. $ TEMPJ5(I)=0.
      TEMPJ6(I)=0.
      CALL READLCM(TEMPJ1,PROB(I,K),JX)
      JO 2 J=2,JX
      SA=0. $ SB=0. $ SC=0.
      DO 3 I=1,NEQ
      ANRAG=ANORMK(I)*RATIOZ2(I,K)*GAMMA(K,I)
      SA=SA+ANRAG*(RATECNC(K,I)*(RATIOI(K,I)*EMOF(J,I)-X(J)*EMOF(J,I))+
      C X(J)*EMOF(J,I))
      SB=SB+ANRAG*(EEOF(J,I)/X(J)+X2(J)*EMOF(J,I))/3.
      SC=SC+ANRAG*ULAM(K,I)*TEMPJ1(J)/X(J)*(EEOF(J,I)-(EEOF(J,I)/
      C X2(J)-2.*X(J)*EMOF(J,I))/3.)
3  CONTINUE
      IF (KP2USE .EQ. 0 .OR. K .EQ. KELEC .OR. TEMPJ1(J) .EQ. 0)
      C GO TO 31
      REFF=10.*(1./TEMPJ1(J))
      S2=EM2P2(REFF)
      DO 32 I=1,NEQ
      IF (I .EQ. KELEC) GO TO 32
      ANRAG=ANORMK(I)*RATIOZ2(I,K)*GAMMA(K,I)
      SA=SA+ANRAG*(RATIOI(K,I)*S2*(.6*EEOF2(J,I)/X2(J)-.4*X3(J)*
      C EEOF2(J,I))
      SB=SB+ANRAG*S2*(6.*(X2(J)**2*EEOF2(J,I)+EEOF2(J,I)/X3(J))/35.-
      C (X1(J)*EEOF2(J,I)+X2(J)*EMOF2(J,I))/15.)
      EILAM=2.*ULAM(K,I)*TEMPJ1(J)
      SC1=-S2*(27./70.+6.*RATIOI(K,I)+EILAM/70.
      SC2=-S2*(1.+6.*RATIOI(K,I)+EILAM/30.)*(5.*S2-1.)
      SC3=-.1*S2+EILAM/15.*(S2-.5)
      SC4=-27.*S2/70.+EILAM*(1./70.-.1*S2)
      SC=SC+ANRAG*(SC1*X2(J)*EEOF2(J,I)+SC2*EEOF2(J,I)/X3(J)+
      C SC3*EMOF2(J,I)+SC4*EEOF2(J,I)/(X2(J)*X3(J)))
32 CONTINUE
31 CONTINUE
      TEMPJ2(J)=SA*TNORM/V03
      TEMPJ3(J)=SB*TNORM/V03
      TEMPJ5(J)=SC/V03
      TERM=CXRXB(K,2)*X2(J)**2*(X(J)-CXRXB(K,1)*CXRXB(K,3))/
      C (CXRXB(K,1)**2*(1.-CXRXB(K,3)))
      IF (TERM .LT. 0.) TERM=0. $ TEMPJ6(J)=TERM
      TEMPJ6(J)=TEMPJ6(J)*X2(J)*CXRXB(K,4)
      TEMPJ6(J)=TEMPJ6(J)*X2(J)*EHH1(J)
13 CONTINUE
      TEMPJ4(J)=TNORM*(TEMPJ5(J)+TEMPJ6(J))
2  CONTINUE
      CALL WRITELCM(TEMPJ2,AN(I,K),JX)
      CALL WRITELCM(TEMPJ3,BN(I,K),JX)
      CALL WRITELCM(TEMPJ4,CN(I,K),JX)
      CALL WRITELCM(TEMPJ5,CLOS(I,K),JX)
      CALL WRITELCM(TEMPJ6,CLOSE(I,K),JX)
      DO 12 J=1,JX
12 TEMPJ5(J)=0.
      SOSAV(K)=0.
      DO 11 KK=1,KDOUB

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CALL READLCM(TEMPJ1,SHAPE(1,K,KK),JX)
T=EL(K,1,KK)+REDEN(K)*EL(K,2,KK)+SQRTF(REDEN(K))*EL(K,3,KK)
SOSAVP(K,KK)=T
T=T*TNORM/(SORDEN(K,KK)*ANORMK(K))
DO 4 J=2,JX
4 TEMPJ5(J)=TEMPJ5(J)+T*TEMPJ1(J)
SOSAV(K)=SOSAV(K)+SOSAVP(K,KK)
11 CONTINUE
CALL WRITELCM(TEMPJ5,DN(1,K),JX)
IF (N.GT. 1) GO TO 1
CALL WRITELCM(TEMPJ2,ANST(1,K),JX)
CALL WRITELCM(TEMPJ3,BNST(1,K),JX)
CALL WRITELCM(TEMPJ4,CNST(1,K),JX)
CALL WRITELCM(TEMPJ5,DNST(1,K),JX)
1 CONTINUE
RETURN
END
FUNCTION EMP2(R)
S=0. $ IF (R.LE. 1.) GO TO 1
IF (R.GE. 1.1.AND. R.LE. 2.) GO TO 2
RLOG=TENLOG(R) $ UM02=1.-1./R
PROB=1./RLOG
S=.5*PROB*(3.*UM02-1.)/(PROB-6.)
GO TO 1
2 CONTINUE
S=-.4838+.193*(R-1.1)
1 CONTINUE
EMP2=S
RETURN
END
FUNCTION EM2P2(R)
S=0. $ IF (R.LE. 1.) GO TO 1
RLOG=TENLOG(R)
IF (R.GE. 1.0001) GO TO 2
A=1.0001 $ B=-.5 $ SL=0. $ GO TO 3
2 IF (R.GE. 1.001) GO TO 4
A=.1.0001 $ B=-.5 $ SL=.4513 $ GO TO 3
4 IF (R.GE. 1.01) GO TO 5
A=1.001 $ B=-.4998 $ SL=.4501 $ GO TO 3
5 IF (R.GE. 1.1) GO TO 6
A=1.01 $ B=-.4981 $ SL=.4388 $ GO TO 3
6 IF (R.GE. 1.5) GO TO 7
A=1.1 $ B=-.4818 $ SL=.3951 $ GO TO 3
7 IF (R.GE. 2.) GO TO 8
A=1.5 $ B=-.4286 $ SL=.3376 $ GO TO 3
8 IF (R.GE. 3.) GO TO 9
A=2. $ B=-.3864 $ SL=.2830 $ GO TO 3
9 IF (R.GE. 4.) GO TO 10
A=3. $ B=-.3366 $ SL=.2379 $ GO TO 3
10 IF (R.GE. 6.) GO TO 11
A=4. $ B=-.3069 $ SL=.2008 $ GO TO 3
11 IF (R.GE. 8.) GO TO 12
A=6. $ B=-.2715 $ SL=.1695 $ GO TO 3
12 IF (R.GE. 10.) GO TO 13
A=8. $ B=-.2503 $ SL=.1497 $ GO TO 3
13 IF (R.GE. 15.) GO TO 14
A=10. $ B=-.2358 $ SL=.1290 $ GO TO 3
14 CONTINUE
A=15. $ B=-.2133 $ SL=.1072
3 CONTINUE

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      ALOG=TENLOG(A)
      S=B+SL*(RLOG-ALOG)
1    CONTINUE
      EM2P2=S
      RETURN
      END
      SUBROUTINE ITERATE
C    THIS VERSION ASSUMES DIAGONAL MATRICES
      USE CFOPL
      LCM (NSOLEQ)
      COMMON/NSOLEQ/AA(JX),BB(JX),CC(JX),DD(JX)
      DO 1 I=1,NEQ
      CALL READLCM(TEMPJ3,AN(1,1),JX)
      CALL READLCM(TEMPJ4,ANST(1,1),JX)
      CALL READLCM(TEMPJ5,BN(1,1),JX)
      CALL READLCM(TEMPJ6,BNST(1,1),JX)
      DO 2 J=1,JX
      TEMPJ1(J)=TEMPJ3(J)+TEMPJ3(J)-TEMPJ4(J)
      TEMPJ2(J)=TEMPJ5(J)+TEMPJ5(J)-TEMPJ6(J)
2    CONTINUE
      CALL READLCM(TEMPJ4,CN(1,1),JX)
      CALL READLCM(TEMPJ5,CNST(1,1),JX)
      DO 3 J=1,JX
      TEMPJ3(J)=TEMPJ4(J)+TEMPJ4(J)-TEMPJ5(J)
3    CONTINUE
      DO 4 J=2,JXM
      ANP2=.25*(TEMPJ1(J)+TEMPJ1(J+1))
      ANM2=.25*(TEMPJ1(J-1)+TEMPJ1(J))
      BNP2=.5*(TEMPJ2(J)+TEMPJ2(J+1))/DXP(J)
      BNM2=.5*(TEMPJ2(J-1)+TEMPJ2(J))/DXM(J)
      TEMPJ4(J)=RHO*(ANP2+BNP2)/(X2(J)*DX(J))
      TEMPJ5(J)=ONODT-RHO*((ANP2-ANM2-BNP2-BNM2)/DX(J)-TEMPJ3(J))/X2(J)
      TEMPJ6(J)=RHO*(-ANM2+BNM2)/(X2(J)*DX(J))
4    CONTINUE
      CALL WRITELCM(TEMPJ4,AA,JX)
      CALL WRITELCM(TEMPJ5,BB,JX)
      CALL WRITELCM(TEMPJ6,CC,JX)
      CALL READLCM(TEMPJ2,U(1,1),JX)
      DO 5 J=1,JX
      TEMPJ1(J)=ONODT*TEMPJ2(J)
5    CONTINUE
      IF (ONMRHO.LT.1.E-10) GO TO 6
      CALL READLCM(TEMPJ3,AN(1,1),JX)
      CALL READLCM(TEMPJ4,BN(1,1),JX)
      CALL READLCM(TEMPJ5,CN(1,1),JX)
      CALL READLCM(TEMPJ6,DN(1,1),JX)
      DO 7 J=2,JXM
      ANP2=.25*(TEMPJ3(J)+TEMPJ3(J+1))
      ANM2=.25*(TEMPJ3(J-1)+TEMPJ3(J))
      BNP2=.5*(TEMPJ4(J)+TEMPJ4(J+1))/DXP(J)
      BNM2=.5*(TEMPJ4(J-1)+TEMPJ4(J))/DXM(J)
      TERM1=TEMPJ2(J+1)*((ANP2+BNP2)/DX(J))
      TERM2=TEMPJ2(J)*((ANP2-ANM2-BNP2-BNM2)/DX(J)-TEMPJ5(J))
      TERM3=TEMPJ2(J-1)*(-ANM2+BNM2)/DX(J)
      TERM4=(TERM1+TERM2+TERM3)/X2(J)
      TERM5=(TERM4+TEMPJ6(J))*ONMRHO
      TEMPJ1(J)=TEMPJ1(J)+TERM5
7    CONTINUE
      GO TO 9
6    CONTINUE

```

```

CALL READLCM(TEMPJ6,DN(1,1),JX)
9 CONTINUE
CALL READLCM(TEMPJ5,DN5*(1,1),JX)
DO 8 J=2,JXM
DNP=TEMPJ5(J)+TEMPJ6(J)-TEMPJ5(J)
TEMPJ1(J)=TEMPJ1(J)+RHO*DNP
8 CONTINUE
CALL WRITELCM(TEMPJ1,DD,JX)
CALL MSOLVE(1)
1 CONTINUE
RETURN
END
SUBROUTINE MSOLVE(1)
USE CROPL
LCM (NSOLEQ)
COMMON/NSOLEQ/AA(JX),BB(JX),CC(JX),DD(JX)
ANP2=AN(2,1)-.5*ANST(2,1)
BNP2=(2.*BN(2,1)-BNST(2,1))/DXM(2)
TEMPJ1(1)=(BNP2+ANP2)/(BNP2-ANP2)
TEMPJ2(1)=0.
CALL READLCM(TEMPJ3,AA,JX)
CALL READLCM(TEMPJ4,BB,JX)
CALL READLCM(TEMPJ5,CC,JX)
CALL READLCM(TEMPJ6,DD,JX)
DO 1 J=2,JXM
DEN=TEMPJ4(J)-TEMPJ5(J)*TEMPJ1(J-1)
TEMPJ1(J)=TEMPJ3(J)/DEN
TEMPJ2(J)=(TEMPJ6(J)+TEMPJ5(J)*TEMPJ2(J-1))/DEN
1 CONTINUE
ANP2=AN(JXM,1)+AN(JX,1)-.5*(ANST(JXM,1)+ANST(JX,1))
BNP2=(2.*(BN(JXM,1)+BN(JX,1))-(BNST(JXM,1)+BNST(JX,1)))/DXP(JXM)
ABN2=(BNP2+ANP2)/(BNP2-ANP2)
TEMPJ3(JX)=TEMPJ2(JXM)/(ABN2-TEMPJ1(JXM))
DO 2 JJ=1,JXM
J=JX-JJ
TEMPJ3(J)=TEMPJ1(J)*TEMPJ3(J+1)+TEMPJ2(J)
2 CONTINUE
CALL WRITELCM(TEMPJ3,U(1,1),JX)
RETURN
END
FUNCTION TENLOG(X)
TENLOG=LOGF(X)/2.3025851
RETURN
END
SUBROUTINE CHECK
USE CROPL
IF (FLOATF(N)/FLOATF(NCHEC)-FLOATF(N/NCHEC).GT..001) RETURN
IF (NCH.EQ. NONCH) NCH=0
NCH=NCH+1
PTIME(NCH)=TIME
DO 1 K=1,NEQ
PLTDENS(NCH,K)=REDEN(K)
PLTENGY(NCH,K)=ENERGY(K)
1 CONTINUE

PLTDEN2(NCH,1)=EN0 $ PLTDEN2(NCH,2)=ENFC1
PLTDEN2(NCH,3)=EN02 $ PLTDEN2(NCH,4)=ENFC2

DIADV=DTR*FLOATF(NCHEC)
IF (N.LT. NTLOSS) DIADV=0.

```

```

DO 2 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
CALL READLCM(TEMPJ2,CLOS(1,K),JX)
CALL READLCM(TEMPJ3,CLOSE(1,K),JX)
DO 3 J=1,JX
TEMPJ4(J)=TEMPJ1(J)*TEMPJ2(J)
TEMPJ5(J)=TEMPJ1(J)*TEMPJ3(J)
3 CONTINUE
S=0. $ SE=0.
SE3=0. $ SE4=0.
DO 4 J=2,JXM,2
S=S+CON(J,1)*TEMPJ4(J-1)+CON(J,2)*TEMPJ4(J)+CON(J,3)*TEMPJ4(J+1)
SE=SE+CON(J,1)*TEMPJ5(J-1)+CON(J,2)*TEMPJ5(J)+CON(J,3)*TEMPJ5(J+1)
SE3=SE3+CON(J,1)*TEMPJ5(J-1)+CON(J,2)*TEMPJ5(J)+
C CON1(J,3)*TEMPJ5(J+1)
SE4=SE4+CON2(J,1)*TEMPJ5(J-1)+CON2(J,2)*TEMPJ5(J)+
C CON2(J,3)*TEMPJ5(J+1)
4 CONTINUE
CLOST(K,1)=S*ANORMK(K) $ CLOSET(K,1)=SE*ANORMK(K)
CLOST(K,2)=CLOST(K,2)+CLOST(K,1)*DTADV
CLOSET(K,2)=CLOSET(K,2)+CLOSET(K,1)*DTADV
CLOSE3(K,1)=SE3*ANORMK(K) $ CLOSE3(K,2)=SE4*ANORMK(K)
2 CONTINUE
RETURN
END
SUBROUTINE FINIT
USE CFOPL
IF (KNPROBS.GT. 1) GO TO 5
IF (KBUFW.EQ. 0) GO TO 5
CALL ASSIGN(5,0,SRUSTOR,0)
BUFFER IN (5,1) (UBUST(1,1,1),UBUST(JX,NEQ,KNSET))
21 IF (UNIT,5) 21,22,23,24
23 CALL QUIT(23)
24 CALL QUIT(24)
22 CONTINUE
CALL ASSIGN(5,0,SRUSTOR,-1)
5 CONTINUE
IF (KBUFW(KNPROBS).NE. 0) GO TO 4
DO 1 K=1,NEQ
DO 2 J=1,JX
2 TEMPJ1(J)=RS(K,1)*EXP(-RS(K,2)*(X(J)-RS(K,3))**2)
CALL WRITELCM(TEMPJ1,U(1,K),JX)
1 CONTINUE
RETURN
4 CONTINUE
DO 6 K=1,NEQ
CALL READLCM(TEMPJ1,UBUST(1,K,KNPROBS),JX)
CALL WRITELCM(TEMPJ1,U(1,K),JX)
6 CONTINUE
RETURN
END
SUBROUTINE PRINT2(LABEL,NWDS,DATA,IDIM,JDIM)
DIMENSION LABEL(NWDS),DATA(IDIM,JDIM)
WRITE (3,1) (LABEL(I),I=1,NWDS)
1 FORMAT(1H1,30X,6A10)
DO 2 I=1,IDIM
WRITE (3,3) I,(DATA(I,J),J=1,JDIM)
3 FORMAT(15,6X,9E11.3,/,11X,9E11.3)
2 CONTINUE
RETURN

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END
SUBROUTINE PRINT1(LABEL,NWDS,DATA,IDIM)
DIMENSION LABEL(NWDS),DATA(IDIM)
WRITE (3,1) (LABEL(I),I=1,NWDS)
1 FORMAT(1H1,30X,6A10)
WRITE (3,2) ((I,DATA(I)),I=1,IDIM)
2 FORMAT(//,(15,6X,E11.3))
RETURN
END
SUBROUTINE EEPL0T
USE CFOPL
DIMENSION NPRNAM(2) $ NPRNAM(1)=6HVELOC. $ NPRNAM(2)=6HENERGY
ENAVG=0.
IF (NEQ .EQ. 1) GO TO 64
DO 63 K=1,NEQ
IF (K .EQ. KELEC) GO TO 63
ENAVG=ENAVG+SENGY(K)
63 CONTINUE
ENAVG=ENAVG/FLOATF(NEQ-1)
GO TO 65
64 ENAVG=.1*ENELEC*XMAX**2
65 CONTINUE
DO 1 K=1,NEQ
CALL FRAME
CALL READLCM(TEMPJ1,U(1,K),JX)
DO 2 J=1,JX
IF (TEMPJ1(J) .LT. 0.) TEMPJ1(J)=0.
TEMPJ2(J)=X(J)
IF (NPRLOS .EQ. 1) GO TO 2
TEMPJ1(J)=TEMPJ1(J)*ANORMK(K)*X(J)/(EMASS(K)*V02)
TEMPJ2(J)=TEMPJ2(J)*X(J)*ENELEC*RAT10M(K,KELEC)
2 CONTINUE
CALL CARTMM(JX,YMIN,YMAX,TEMPJ1,1)
YMAX=1.1*YMAX
XPMIN=0. $ XPMAX=3.*SENGY(K)
IF (K .EQ. KELEC) XPMAX=.3*ENAVG
IF (NPRLOS .EQ. 1) XPMAX=SQRTF(XPMAX/(ENELEC*RAT10M(K,KELEC)))
CALL MAPS(XPMIN,XPMAX,0.,YMAX,.2,.999,.2,.999)
CALL SETCH(2,.27,.1,0,1,1)
WRITE (100,10) NPRNAM(NPRLOS),K
10 FORMAT(A7,26HDIST FCTN - SPECIES NUMBER,15)
CALL SETCH(17,.1,.1,0,1,0)
WRITE (100,11) TIME,N
11 FORMAT(8H TIME = ,E15.3,5X,7HCYCLE =,16)
CALL TRACE(TEMPJ2,TEMPJ1,JX)
IF (N .EQ. 0) GO TO 1
CALL FRAME
CALL READLCM(TEMPN,PLTDENS(1,K),NCH)
DO 14 L=1,NCH
IF (TEMPN(L) .LT. 0.) TEMPN(L)=0.
14 CONTINUE
CALL CARTMM(NCH,YMIN,YMAX,TEMPN,1)
YMAX=2.*YMAX
CALL MAPS(0.,TIME,0.,YMAX,.2,.999,.2,.999)
CALL SETCH(2,.28,.1,0,1,1)
WRITE (100,20) K
20 FORMAT(24HDENSITY - SPECIES NUMBER,15)
CALL SETCH(17,.1,.1,0,1,0)
WRITE (100,11) TIME,N
CALL SETCH(17,.3,.1,0,1,0)

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WRITE (100,71) REDEN(K),SOSAV(K)
71 FORMAT(8HDENSITY=,E16.6,5X,8HCURRENT=,E16.6:
CALL TRACE(PTIME,TEMPN,NCH)
CALL FRAME
CALL READLCM(TEMPN,PLTENGY(1,K),NCH)
DO 15 L=1,NCH
IF (TEMPN(L).LT. 0.) TEMPN(L)=0.
15 CONTINUE
CALL CARTMM(NCH,YMIN,YMAX,TEMPN,1)
YMAX=2.*YMAX
CALL MAPS(0.,TIME,0.,YMAX,.2,.999,.2,.999)
CALL SETCH(2.,27.,1,0,1,1)
WRITE (100,30) K
30 FORMAT(23HENERGY - SPECIES NUMBER,15)
CALL SETCH(17.,1.,1,0,1,0)
WRITE (100,11) TIME,N
CALL SETCH(17.,3.,1,0,1,0)
WRITE (100,72) ENERGY(K),SENGY(K)
72 FORMAT(7HENERGY=,E16.6,5X,11HSOURCE EN =,E16.6)
CALL TRACE(PTIME,TEMPN,NCH)
1 CONTINUE

CALL FRAME
CALL READLCM(TEMPN,PLTDEN2(1,1),NONCH)
CALL CARTMM(NCH,YMIN,YMAX,TEMPN,1)
YMAX=1.5*YMAX
CALL MAPS(0.,TIME,0.,YMAX,.2,.999,.65,.999)
CALL TRACE(PTIME,TEMPN,NCH)
CALL READLCM(TEMPN,PLTDEN2(1,2),NONCH)
CALL CARTMM(NCH,YMIN,YMAX,TEMPN,1)
YMAX=1.5*YMAX
CALL MAPS(0.,TIME,0.,YMAX,.2,.999,.15,.5)
CALL TRACE(PTIME,TEMPN,NCH)
CALL SETCH(17.,1.,1,0,1,0)
WRITE (100,11) TIME,N
CALL SETCH(1.,17.,1,0,1,1)
WRITE (100,51)
51 FORMAT(10HEN01 - TOP)
CALL SETCH(2.,17.,1,0,1,1)
WRITE (100,52)
52 FORMAT(14HENFC1 - BOTTOM)
CALL SETCH(17.,3.,1,0,1,0)
WRITE (100,53) EN01,ENFC1
53 FORMAT(5HEN01=,E16.6,5X,6HENFC1=,E16.6)
CALL FRAME
CALL READLCM(TEMPN,PLTDEN2(1,3),NONCH)
CALL CARTMM(NCH,YMIN,YMAX,TEMPN,1)
YMAX=1.5*YMAX
CALL MAPS(0.,TIME,0.,YMAX,.2,.999,.65,.999)
CALL TRACE(PTIME,TEMPN,NCH)
CALL READLCM(TEMPN,PLTDEN2(1,4),NONCH)
CALL CARTMM(NCH,YMIN,YMAX,TEMPN,1)
YMAX=1.5*YMAX
CALL MAPS(0.,TIME,0.,YMAX,.2,.999,.15,.5)
CALL TRACE(PTIME,TEMPN,NCH)
CALL SETCH(17.,1.,1,0,1,0)
WRITE (100,11) TIME,N
CALL SETCH(1.,17.,1,0,1,1)
WRITE (100,54)
54 FORMAT(10HEN02 - TOP)

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CALL SETCH(2.,17.,1,0,1,1)
WRITE (100,55)
55 FORMAT(14HENFC2 - BOTTOM)
CALL SETCH(17.,3.,1,0,1,0)
WRITE (100,56) EN02,ENFC2
56 FORM1(5HEN02=,E16.6,5X,6HENFC2=,E16.6)

RETURN
END
SUBROUTINE ENN0FC
USE CFOPL
VOPSO4V=VOP*ESS/(4.*VOL)
VFC504V=VFC*ESS/(4.*VOL)
SIG1=SIG12+SIEVEB/V2
C1=B0*VOP*ESS/(4.*VOL1)
VOPSO4V1=VOP*ESS/(4.*VOL1)
SUMSIG=SIEVEB+S11VB
VFC510BV1=VFC*ESS1/(8.*VOL1)
C10F02V1=CUR1*COF/(2.*VOL1)
SCXA0SUM=SCXA/(SCXA+SIG1)
COFV02V1=COF*VOL/(2.*VOL1)
FVOVFC5=4.*VOL/(VFC*ESS)
DO 13 J=2,JX
ENUM=1.-EXP(-3.491E-31*V02**2*X2(J)**2)
DENOM=1.E+16/9.+1.35067E+14*ABSF(LOGF(V0*X(J)/VOPP))+
C .050987*(V0*X(J)-VOPP)**2+DEE*V02**4*X2(J)**4
SCXMJ(J)=ENUM/DENOM
ENGY=.5*EMASS(1)*V02*X2(J)/ERGTOEV
ENUM=6.937E-15*(1.-.155*TENLOG(ENGY))**2
DENOM=1.+1.112E-15*ENGY**3.3
SCXAJ(J)=ENUM/DENOM
13 CONTINUE
SCXMJ(1)=0. $ SCXAJ(1)=0.

VFC=0.

RETURN
ENTRY ENN1FC
DO 2 J=1,JX
EHH1(J)=V0*X(J)*SCXMJ(J)*EN01
EHH2(J)=V0*X(J)*SCXAJ(J)*ENFC1
2 CONTINUE
RETURN
ENTRY ENN2FC
DIMENSION AM(4,4),AM11(4,4),AM12(4,4),AMVERT(4,8),BM(4),BM1(4)
DIMENSION VM1(4),VM2(4),VM3(4)
RHO=1.
H1INT=0. $ H2INT=0.
CALL READLCM(TEMPJ1,U,JX)
DO 503 J=2,JXM,2
H1INT=H1INT+CON2(J,1)*EHH1(J-1)*TEMPJ1(J-1)+CON2(J,2)*EHH1(J)*
C TEMPJ1(J)+CON2(J,3)*EHH1(J+1)*TEMPJ1(J+1)
H2INT=H2INT+CON2(J,1)*EHH2(J-1)*TEMPJ1(J-1)+CON2(J,2)*EHH2(J)*
C TEMPJ1(J)+CON2(J,3)*EHH2(J+1)*TEMPJ1(J+1)
503 CONTINUE
H1INT=ANORMK(1)*H1INT $ H2INT=ANORMK(1)*H2INT
IF (EN01.GT. 0.) H1INT=H1INT/EN01
IF (ENFC1.GT. 0.) H2INT=H2INT/ENFC1
AM(1,1)=-VOPSO4V-2.*REDEN(1)*SUMSIG-H1INT
AM(1,2)=0.

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AM(1,3)=VOPSO4V
AM(1,4)=0.
AM(2,1)=0.
AM(2,2)=-VFCSO4V-REDEN(1)*SUMSIG-H2INT
AM(2,3)=C
AM(2,4)=VFCSO4V
ENGY=ENERGY(1)
ELC=VOL*REDEN(1)*SUMSIG
ELC1=ELC+VOL*H1INT $ ELC2=ELC+VOL*H2INT
ELC3=VOL*REDEN(1)**2/(6.3E+9*(1.E-3*ENGY)**1.5)
TERM1=CDFV2V1*SCXAOSUM*(1.-EXP(-ELL*REDEN(1)*(SCXA+S
TERM2=C1*EN02
TERM3=A0*ELC3/VOL)
BNO=TERM1+TERM2+TERM3
AM(3,1)=VOPSO4V1+CDFV2V1*H1INT+A0*ELC1/VOL)
AM(3,2)=CDFV2V1*H2INT+A0*ELC2/VOL)
AM(3,3)=-C1-VOPSO4V1
AM(3,4)=VFCS10BV1
TIP1=FVOVFCS*(SUMSIG*REDEN(1)+H2INT)
TIP2=1./(1.+TIP1) $ FCIP=.5*(1.+TIP2)

FCIP=0.

AM(4,1)=(2.*REDEN(1)*SUMSIG+H1INT)*FCIP
AM(4,2)=-VOL/VOL1*(REDEN(1)*SUMSIG+H2INT)
AM(4,3)=0.
AM(4,4)=-2.*VFCS10BV1
BM(1)=0. $ BM(2)=0. $ BM(3)=BNO $ BM(4)=0.
VM1(1)=EN01 $ VM1(2)=ENFC1 $ VM1(3)=EN02 $ VM1(4)=ENFC2
DO 5021 L=1,4
S=0. $ DO 5022 LL=1,4
T=(1.-RHOU)*DTR*AM(L,LL) $ IF (L.EQ. LL) T=T+1.
5022 S=S+T*VM1(LL)
5021 BM1(L)=S+BM(L)*DTR
DO 5023 L=1,4 $ DO 5023 LL=1,4
T=-RHOU*DTR*AM(L,LL) $ IF (L.EQ. LL) T=T+1.
5023 AM1(L,LL)=T
CALL CVERT(4,AM11,AM12,AMVERT,KSING)
IF (KSING.EQ. 1) GO TO 5024
DO 5025 L=1,4
S=0. $ DO 5026 LL=1,4
5026 S=S+AM12(L,LL)*BM1(LL)
5025 VM1(L)=S
EN01=VM1(1) $ ENFC1=VM1(2) $ EN02=VM1(3) $ ENFC2=VM1(4)
IF (EN01.LT. 0.) EN01=0. $ IF (ENFC1.LT. 0.) ENFC1=0.
IF (EN02.LT. 0.) EN02=0. $ IF (ENFC2.LT. 0.) ENFC2=0.
RETURN
5024 WRITE (3,5027) EN01,ENFC1,EN02,ENFC2,N
5027 FORMAT(/,21HSINGULAR INPUT MATRIX,4E16.6,15)
KMFLAG=1 $ RETURN
END
SUBROUTINE CVERT(NA,CM,CM1,A,KSING)
DIMENSION CM(1),CM1(1)
DIMENSION A(NA,2*NA)
KSING=0
MIMAXNA=NA**2
SUMNORM=0.
DO 701 I=1,MIMAXNA
701 SUMNORM=SUMNORM+ABSF(CM(I))
SUMNORM=SUMNORM/FLOATF(MIMAXNA)

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      IF (SUMNORM .EQ. 0.) GO TO 704
      DO 702 I=1,MIMAXNA
702  CM(I)=CM(I)/SUMNORM
      M1=NA $ MO=NA
      JJJ = 1
      NB = NA + 1
      NC = 2 * NA
      IX = 1
      DO 1 I = 1,NA
      DO 1 J = 1,NA
      M = M1 * (J - JJJ) + 1
1  A(I,J) = CM(M)
      DO 4 I = 1,NA
      DO 4 J = NB,NC
      IF (I - J + NA) 3,2,3
2  A(I,J) = 1.0
      GO TO 4
3  A(I,J) = 0.0
4  CONTINUE
      IX = 2
      DO 10 I = 1,NA
16  IF (I .EQ. NA) GO TO 15
      AD = ABSF (A(I,1))
      SG1 = 1.0
      IF (AD) ,40,
      SG1 = SIGNF (1.0,A(I,1))
40  CONTINUE
      SG2 = SG1
17  IK = I + 1
      JK = 0
      DO 18 J = IK,NA
      IF (ABSF (A(J,1)) - AD) 18,18,
      JK = J
      AD = ABSF (A(J,1))
      SG2 = SIGNF (1.0,A(J,1))
18  CONTINUE
      SG = ABSF (SG1 + SG2) - 1.0
      IF (JK) ,15,
19  DO 20 J = 1,NC
20  A(I,J) = A(I,J) + A(JK,J)*SG
15  TEMP = A(I,1)
      IF (ABSF (TEMP) .LT. 1.E-12) GO TO 30
      DO 5 J = 1,NC
5  A(I,J) = A(I,J)/TEMP
      IF (I - NA) 6,38,38
6  IK = I + 1
      DO 9 J = IK ,NA
      IF (A(J,1)) 7,9,7
7  TEMP = A(J,1)
      DO 8 IT = 1,NC
8  A(J,IT) = A(J,IT) - TEMP*A(I,IT)
9  CONTINUE
38  CONTINUE
10  CONTINUE
      IX = 3
      DO 13 I = 1,NA
      IK = NB - I
      IT = IK - 1
      IF (IT) 11,39,11
11  DO 12 J = 1,IT

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      TEMP = A(J,K)
      DO 12 M = 1,NC
12  A(J,M) = A(J,M) - TEMP*A(I,K,M)
39  CONTINUE
13  CONTINUE
      DO 14 I = 1,NA
      DO 14 J = NB,NC
      M = MO * (J - NA - JJJ) + 1
42  CMI(M) = A(I,J)
14  CONTINUE
      DO 703 I=1,MIMAXNA
      CM(I)=CM(I)*SUMNORM
703  CMI(I)=CMI(I)/SUMNORM
      RETURN
30  WRITE (3,31)
31  FORMAT(21HSINGULAR INPUT MATRIX)
      DO 32 I = 1,NA
      DO 32 J = 1,NA
      M = MO * (J - JJJ) + 1
32  CMI(M) = 0.0
      DO 706 I=1,MIMAXNA
706  CM(I)=CM(I)*SUMNORM
      KSING=1
      RETURN
704  WRITE (3,31) $ KSING=1 $ RETURN
      END
      SUBROUTINE EEPRI
      USE CFIPL
      DIMENSION TEMP(NEQ),CHTR(NEQ,NEQ),CHSO(NEQ),CHLO(NEQ,NEQ)
      DIMENSION SEMP(NEQ),STEMP(NEQ)
      WRITE (3,12)
12  FORMAT(1H1)
      WRITE (3,1)
      1  FORMAT(22HDISTRIBUTION FUNCTIONS,/)
      DO 2 J=1,JX
      ENGY=ENELEC*RATIO(1,KELEC)*X2(J)
      DO 81 K=1,NEQ
81  TEMP(K)=U(J,K)
      IF (NPRLOS.EQ. 1) GO TO 82
      DO 83 K=1,NEQ
83  TEMP(K)=TEMP(K)*ANORM(K)*X(J)/(EMASS(K)*V02)
82  CONTINUE
      WRITE (3,3) J,X(J),ENGY,(TEMP(K),K=1,NEQ)
      3  FORMAT(2HJ=,15,2X,2HX=,F15.5,2X,7HENERGY=,E15.5,5X,4F15.5,/,
      C (55X,4E15.5))
      2  CONTINUE
      WRITE (3,4)
      4  FORMAT(//,9HDENSITIES,/)
      WRITE (3,6) (REDEN(K),K=1,NEQ)
      6  FORMAT(7E15.5)
      WRITE (3,7)
      7  FORMAT(//,8HENERGIES,/)
      WRITE (3,6) (ENERGY(K),K=1,NEQ)
      DO 1414 K=1,NEQ $ DO 1414 KK=1,KDOUB
      WRITE (3,1415) K,KK,BSOR(K,KK),XONE(K,L,KK),(EL(K,L,KK),L=1,4)
1415  FORMAT(2HK=,15,2X,3HKK=,15,2X,5HBSOR=,E16.6,2X,5HXONE=,E16.6,
      C /,19X,5HCURR=,4E16.6)
1414  CONTINUE
      IF (N.EQ. 0) GO TO 50
      DO 30 I=1,NEQ

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CALL READLCM(TEMPJ1,PROB(1,1),JX)
CALL READLCM(TEMPJ2,U(1,1),JX)
DO 30 K=1,NEQ
CALL READLCM(TEMPJ3,EMOF(1,K),JX)
CALL READLCM(TEMPJ4,ENOF(1,K),JX)
CALL READLCM(TEMPJ5,EEOF(1,K),JX)
DO 31 J=1,JX
TEMPJ6(J)=0.
IF (J.EQ. 1 .OR. J.EQ. JX) GO TO 31
TERM1=TEMPJ4(J)-(TEMPJ5(J)/X2(J)-2.*X(J)*TEMPJ3(J))/3.
TERM2=ANORMK(K)*RATIO22(K,1)*ULAM(1,K)
TERM3=GAMMA(1,K)*TEMPJ1(J)/(X3(J)*V03)
TAUM=TERM1*TERM2*TERM3
TEMPJ6(J)=TAUM*TEMPJ2(J)
31 CONTINUE
T=0.
DO 33 J=2,JXM,2
T=T+CON4(J,1)*TEMPJ6(J-1)+CON4(J,2)*TEMPJ6(J)+
C CON4(J,3)*TEMPJ6(J+1)
33 CONTINUE
TERM4=-.5*EMASS(1)*V02*ANORMK(1)
30 CHLO(1,K)=TERM4*T
DO 34 I=1,NEQ
CHSO(1)=0.
DO 51 KK=1,KDOUB
51 CHSO(1)=CHSO(1)+SENGY(1,KK)*S0SAVP(1,KK)
34 CHSO(1)=ERGTOEV*CHSO(1)
DO 35 I=1,NEQ
CALL READLCM(TEMPJ1,U(1,1),JX)
DO 35 K=1,NEQ
CALL READLCM(TEMPJ2,EMOF(1,K),JX)
CALL READLCM(TEMPJ3,ENOF(1,K),JX)
DO 36 J=1,JX
TEMPJ4(J)=0.
IF (J.EQ. 1 .OR. J.EQ. JX) GO TO 36
TERM1=TEMPJ2(J)-RATIO(1,K)*TEMPJ3(J)/X(J)
TEMPJ4(J)=TERM1*X2(J)*TEMPJ1(J)
36 CONTINUE
T=0.
DO 38 J=2,JXM,2
T=T+CON(J,1)*TEMPJ4(J-1)+CON(J,2)*TEMPJ4(J)+CON(J,3)*TEMPJ4(J+1)
38 CONTINUE
TERM2=GAMMA(1,K)*ANORMK(1)*EMASS(1)*ANORMK(K)*RATIO22(K,1)/V0
35 CHTR(1,K)=T*TERM2
DO 40 I=1,NEQ
S=CHSO(1) $ T=0.
DO 52 K=1,NEQ
T=T+CHLO(1,K)
IF (CHTR(1,K) .LT. 0.) T=T+CHTR(1,K)
IF (CHTR(1,K) .GE. 0.) S=S+CHTR(1,K)
52 CONTINUE
SEMP(1)=S $ TEMP(1)=T $ STEMP(1)=0.
IF (SEMP(1) .LE. 0.) GO TO 40
STEMP(1)=1.+TEMP(1)/SEMP(1)
40 CONTINUE
WRITE (3,41)
41 FORMAT(1H1,50X,18HCONSERVATION TERMS)
WRITE (3,42)
42 FORMAT(//,14HEXCHANGE TERMS)
DO 43 I=1,NEQ

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WRITE (3,44) (CHTR(1,K),K=1,NEQ)
44 FORMAT(/,10E11.3,/)
43 CONTINUE
WRITE (3,45)
45 FORMAT(/,12HSOURCE TERMS)
WRITE (3,44) (CHSO(1),1=1,NEQ)
WRITE (3,47)
47 FORMAT(/,10HLOSS TERMS)
DO 48 1=1,NEQ
WRITE (3,44) (CHLO(1,K),K=1,NEQ)
48 CONTINUE
WRITE (3,46) ((SEMP(1),TEMP(1),STEMP(1)),1=1,NEQ)
46 FORMAT(/,13HENERGY GAINED,8X,11HENERGY LOST,10X,5HERROR,/,
C (3E16.6,/)
50 CONTINUE
AMBIPOT=.5*EMASS(KELEC)*V02*XCN*XCN
AMBIPOT=AMBIPOT/ERGTOEV

WRITE (3,72) EN01,ENFC1,EN02,ENFC2
72 FORMAT(/,5HEN01=,E16.6,5X,6HENFC1=,E16.6,5X,5HEN02=,E16.6,
C 5X,6HENFC2=,E1E.6,/)

WRITE (3,101) XCN,AMBIPOT
10 FORMAT(/,4HXCN=,E16.5,5X,15HAMBIPOLAR POT =,E16.5)
WRITE (3,21)
21 FORMAT(/,7HSPECIES,2X,8HEND LOSS,8X,8HCX. LOSS,16X,
C 13HTOT. END LOSS,3X,13HTOT. CX. LOSS,/)
DO 22 K=1,NEQ
WRITE (3,23) K,CLOST(K,1),CLOSET(K,1),CLOST(K,2),CLOSET(K,2)
23 FORMAT(15.5X,2E16.6,10X,2E16.6)
22 CONTINUE
WRITE (3,24) ((K,CLOSE34(K,1),CLOSE34(K,2)),K=1,NEQ)
24 FORMAT(/,12HK=,15.5X,4HFA0=,E16.6,5X,4HSS0=,E16.6))
WRITE (3,8) N,TIME,REALTIME
8 FORMAT(/,16HITERATION NUMBER,2X,15.2X,9HCOMPLETED,10X,6HTIME =,
C E15.5,10X,11HREAL TIME =,E15.5,/)
RETURN
END
SUBROUTINE CHOPDST
USE CFOPL
DO 4 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
DO 102 J=1,JX
IF (TEMPJ1(J).LT. 0.) TEMPJ1(J)=0.
102 CONTINUE
CALL WRITELCM(TEMPJ1,U(1,K),JX)
4 CONTINUE
IF (NSL.EQ. 0) RETURN
DO 1 K=1,NEQ
IF (K.EQ. KELEC) GO TO 1
CALL READLCM(TEMPJ1,U(1,K),JX)
XCP=XCN*RMQ(K)
XCPB=XCP*BRCON
DO 2 J=1,JX
IF (X(J).LE. XCPB) TEMPJ1(J)=0.
2 CONTINUE
CALL WRITELCM(TEMPJ1,U(1,K),JX)
1 CONTINUE
RETURN
END

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SUBROUTINE RESTART
USE CFOPL
WRITE (3,50) NEND
50 FORMAT(5HNEND=,15)
WRITE (3,51) N
51 FORMAT(1H1,2CHRESTART ENTERED - N=,15)
WRITE (3,52)
52 FORMAT(//,9HDENSITIES,/)
WRITE (3,53) (REDEN(K),K=1,NEQ)
53 FORMAT(7E15.5)
WRITE (3,54)
54 FORMAT(//,8HENERGIES,/)
WRITE (3,53) (ENERGY(K),K=1,NEQ)
CALL SIGMAVEE
DIMENSION TEMP(NEQ)
DIMENSION SEMP(NEQ)
DIMENSION TEMPE(NEQ)
DO 8 K=1,NEQ
CALL READLCM(TEMPJ1,U(1,K),JX)
CALL READLCM(TEMPJ2,CLOS(1,K),JX)
CALL READLCM(TEMPJ3,CLOSE(1,K),JX)
DO 9 J=1,JX
TEMPJ4(J)=ANORMK(K)*TEMPJ1(J)*TEMPJ2(J)
TEMPJ5(J)=ANORMK(K)*TEMPJ1(J)*TEMPJ3(J)
IF (J.EQ. 1 .OR. NPRL05.EQ. 1) GO TO 9
TEMPJ4(J)=TEMPJ4(J)/(EMASS(K)*V02*X(J))
TEMPJ5(J)=TEMPJ5(J)/(EMASS(K)*V02*X(J))
9 CONTINUE
CALL WRITELCM(TEMPJ4,CLOS(1,K),JX)
CALL WRITELCM(TEMPJ5,CLOSE(1,K),JX)
8 CONTINUE
WRITE (3,666) (ANORMK(K),K=1,NEQ)
666 FORMAT(//,7HANORMK=,/, (20X,E16.6))
WRITE (3,31)
31 FORMAT(1H1,10X,17HLOSS COEFFICIENTS,/)
DO 32 J=1,JX
ENGY=ENELEC*RAT10M(1,KELEC)*X2(J)
WRITE (3,33) J,X(J),ENGY,((CLOS(J,K),CLOSE(J,K)),K=1,NEQ)
33 FORMAT(2HJ=,15,2X,2HX=,F15.5,2X,7HENERGY=,E15.5,5X,2E15.5,4X,
C 2E15.5,/, (55X,2E15.5,4X,2E15.5))
32 CONTINUE
DO 28 K=1,NEQ
CALL READLCM(TEMPJ1,CLOS(1,K),JX)
CALL READLCM(TEMPJ2,CLOSE(1,K),JX)
IF (NPRL05.EQ. 1) GO TO 11
DO 10 J=2,JX
TEMPJ1(J)=TEMPJ1(J)*EMASS(K)*V02*X(J)
TEMPJ2(J)=TEMPJ2(J)*EMASS(K)*V02*X(J)
10 CONTINUE
CALL WRITELCM(TEMPJ1,CLOS(1,K),JX)
CALL WRITELCM(TEMPJ2,CLOSE(1,K),JX)
11 CONTINUE
S=0. $ SE=0.
DO 29 J=2,JXM,2
S=S+CON(J,1)*TEMPJ1(J-1)+CON(J,2)*TEMPJ1(J)+CON(J,3)*TEMPJ1(J+1)
SE=SE+CON(J,1)*TEMPJ2(J-1)+CON(J,2)*TEMPJ2(J)+CON(J,3)*TEMPJ2(J+1)
29 CONTINUE
TEMP(K)=S
TEMPE(K)=SE
SEMP(K)=0.

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      IF (SOSAV(K) .EQ. 0.) GO TO 28
      SEMP(K)=1.-(TEMP(K)+TEMPE(K))/SOSAV(K)
28  CONTINUE
      WRITE (3,20) ((K,TEMP(K),TEMPE(K),SOSAV(K),SEMP(K)),K=1,NEQ)
20  FORMAT(//,21HPARTICLE CONSERVATION,/,15,4E16.6)
      DO 40 K=1,NEQ
      CALL READLCM(TEMPJ1,CLGS(1,K),JX)
      S=0.
      DO 41 J=1,JX
      IF (TEMPJ1(J) .LT. 0.) TEMPJ1(J)=0.
      TEMPJ2(J)=X(J)
      IF (NPRLOS .EQ. 1 .OR. J .EQ. 1) GO TO 58
      TEMPJ1(J)=TEMPJ1(J)/(EMASS(K)*V02*X(J))
      TEMPJ2(J)=TEMPJ2(J)*X(J)*ENELEC*RAT10M(K,KELEC)
58  CONTINUE
      IF (S .LT. TEMPJ1(J)) S=TEMPJ1(J)
41  CONTINUE
      CMAX=1.5*S
      CALL FRAME
      SCOMP=1.E-3*S $ DO 61 JJ=1,JX
      J=JX+1-JJ $ IF (TEMPJ1(J) .LT. SCOMP) GO TO 61
      XPMAX=TEMPJ2(J) $ GO TO 62
61  CONTINUE
62  CONTINUE
      CALL MAPS(0.,XPMAX,0.,CMAX,.2,.999,.2,.999)
      CALL SETCH(2.,28.,1,0,1,1)
      WRITE (100,42) K
42  FORMAT(21HLOSS - SPECIES NUMBER,15)
      CALL SETCH(17.,1.,1,0,1,0)
      WRITE (100,43) TIME,N
43  FORMAT(8H TIME = ,E15.3,5X,7HCYCLE = ,16)
      CALL TRACE(TEMPJ2,TEMPJ1,JX)
40  CONTINUE
      IF (NEND .EQ. 1) RETURN
      CALL PLOTE
      CALL ASSIGN(2,0,7RINTIONS,-1)
      CALL OFFMON
      DIMENSION ND(5) $ ND(1)=0 $ ND(2)=1HF $ ND(3)=6 $ ND(4)=0
      ND(5)=1 $ CALL HSP(ND)
      CALL CRTID(10HISOT RSTRT,1,1)
      CALL KEEP80(KTTYOUT)
      CALL ASSIGN(2,0,7RINTIONS,0)
      READ (2,1) DTR,DELAMB,DXCN,NRSTRT,NSTOP,NPRINT,NPLOT,NTLOSS,NQCH
1  FORMAT('3E16.6,/,6I5)
      DT=DTR/TNORM
      ONODT=1./DT
      WRITE (3,2) DTR,DELAMB,DXCN,NRSTRT,NSTOP,NPRINT,NPLOT,NTLOSS,NQCH
2  FORMAT(9HNEW DTR =,E16.6,5X,12HNEW DELAMB =,E16.6,5X,
      C 10HNEW DXCN =,E16.6,/,7HNRSTRT=,18,5X,6HNSTOP=,18,5X,7HNPRINT=,
      C 15,5X,6HNPLOT=,15,5X,7HNTLOSS=,15,5X,5HNQCH=,15)
      RETURN
      END
      SUBROUTINE OFFMON
      COMMON/GOBCOM/IX(4)
      IX(24)=IX(24).INT. 777777777777770077B
      IADD = .LOC. RSTRT
      CALL QUIT(IADD)
RSTRT RETURN
      END

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