

JAERI-M

7 3 1 0

TWO-DIMENSIONAL SIMULATION OF THE  
MHD STABILITY (II)

September 1977

Gen'ichi KURI TA and Tsuneo AMANO\*

日本原子力研究所  
Japan Atomic Energy Research Institute

この報告書は、日本原子力研究所が JAERI-M レポートとして、不定期に刊行している研究報告書です。入手、複製などのお問合わせは、日本原子力研究所技術情報部（茨城県那珂郡東海村）あて、お申しこしください。

JAERI-M reports, issued irregularly, describe the results of research works carried out in JAERI. Inquiries about the availability of reports and their reproduction should be addressed to Division of Technical Information, Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken, Japan.

JAERI - M 7310

Two-Dimensional Simulation of the MHD Stability (II)

Gen'ichi KURITA and Tsuneo AMANO\*

Division of Thermonuclear Fusion Research,  
Tokai Research Establishment, JAERI

(Received September 2, 1977)

Growth rate and eigen-function of the MHD instability of a toroidal plasma were calculated numerically as an initial-boundary value problem.

When a conducting shell is away from the plasma, toroidicity hardly influences growth rate of the external kink modes in a slender tokamak, but it stabilizes the modes in a fat tokamak. On the other hand, when the shell is near to the plasma, the unstable external modes are stabilized by both toroidicity and shell effect.

Keywords: Tokamak Plasma, MHD Stability, Toroidal Effect, Two-Dimensional Simulation, Initial-Value Problem, Instability Growth Rate, Conducting Shell

---

\* Plasma Physics Laboratory, Faculty of Engineering, Osaka University,  
Suita, Osaka

## 2次元のMHD安定性のシミュレーション(Ⅱ)

日本原子力研究所 東海研究所 核融合研究部

栗田 源一・天野 恒雄\*

(1977年9月2日受理)

軸対称トロイダルプラズマのMHD安定性に対する成長率と固有関数が、初期値問題として数値的に計算された。

トロイダル効果は、シェルがプラズマから遠い場合には、太いトカマクに対しては、安定化に寄与するが、細いトカマクに対しては、殆んど影響を与えないこと、又シェルをプラズマに近づければ、その安定化に対する効果は大きくなり、太いトカマクでは殆んど不安定領域がなくなることが示された。

---

\* 大阪大学工学部 超高温理工学研究施設

Contents

1. Introduction .....	1
2. Equilibrium .....	1
3. Eigenfunctions of internal mode .....	3
4. Free boundary kink mode .....	4
5. Shell effect .....	5
6. Conclusion and discussion .....	5
Acknowledgement .....	6
References .....	7
Appendix .....	8

## 1. Introduction

There is an urgent need for the detailed knowledge about MHD behavior of a tokamak plasma, not only to interpret the experimental data, but also to aid the design of future device. Since the actual geometry of the system is much complicated, it is inevitable to invoke computer simulation to investigate MHD stability of a realistic plasma. There are two ways to investigate them in linear approximation: one is to extremize the Lagrangian of the whole system leading to a matrix eigen-value problem, and the other is to integrate the time dependent differential equations, that is, initial value problem<sup>1~6)</sup>. The latter, which we employ, can be extended to non-linear three-dimensional problem with non-zero plasma resistivity<sup>7)</sup>. While using the former method, many works have been done extensively<sup>8~11)</sup>. In a previous paper<sup>6)</sup>, we have given a brief explanation of our code, and have shown that the growth rate agrees with analytical one in cylindrical case.

In this paper, we show the growth rates and eigen-functions of toroidal case with and without vacuum region. The boundary conditions and numerical procedure are described in ref.6. In §.2, the equilibrium equation, which is obtained by the expansion in the inverse aspect ratio, is given. We give the eigen-functions of the internal mode in §.3. In §.4, the growth rates and eigen-functions of the external kink mode of the toroidal plasma with uniform current distribution are given. In §.5, the shell effect is considered to investigate the marginal stability condition. The discussion and conclusion are given in §.6. Our two-dimensional code is listed in the Appendix.

## 2. Equilibrium

In this section, the equilibrium equation and equilibrium solution for the uniform current distribution to calculate the stability are given. The curvilinear coordinate system ( $r, \theta, \phi$ ) is used<sup>12,13)</sup> and the transformation between this coordinate system and cylindrical system ( $X, \Phi, Z$ ) is assumed as;

$$\begin{aligned} X(r, \theta) &= R_0 - \epsilon r \cos \theta - \epsilon^2 \Delta(r) + \epsilon^3 E(r) \cos \theta \\ Z(r, \theta) &= \epsilon r \sin \theta + \epsilon^3 E(r) \sin \theta \\ \Phi &= \phi \end{aligned} \quad (2.1)$$

## 1. Introduction

There is an urgent need for the detailed knowledge about MHD behavior of a tokamak plasma, not only to interpret the experimental data, but also to aid the design of future device. Since the actual geometry of the system is much complicated, it is inevitable to invoke computer simulation to investigate MHD stability of a realistic plasma. There are two ways to investigate them in linear approximation: one is to extremize the Lagrangian of the whole system leading to a matrix eigen-value problem, and the other is to integrate the time dependent differential equations, that is, initial value problem<sup>1~6)</sup>. The latter, which we employ, can be extended to non-linear three-dimensional problem with non-zero plasma resistivity<sup>7)</sup>. While using the former method, many works have been done extensively<sup>8~11)</sup>. In a previous paper<sup>6)</sup>, we have given a brief explanation of our code, and have shown that the growth rate agrees with analytical one in cylindrical case.

In this paper, we show the growth rates and eigen-functions of toroidal case with and without vacuum region. The boundary conditions and numerical procedure are described in ref.6. In §.2, the equilibrium equation, which is obtained by the expansion in the inverse aspect ratio, is given. We give the eigen-functions of the internal mode in §.3. In §.4, the growth rates and eigen-functions of the external kink mode of the toroidal plasma with uniform current distribution are given. In §.5, the shell effect is considered to investigate the marginal stability condition. The discussion and conclusion are given in §.6. Our two-dimensional code is listed in the Appendix.

## 2. Equilibrium

In this section, the equilibrium equation and equilibrium solution for the uniform current distribution to calculate the stability are given. The curvilinear coordinate system  $(r, \theta, \phi)$  is used<sup>12,13)</sup> and the transformation between this coordinate system and cylindrical system  $(X, \Phi, Z)$  is assumed as;

$$\begin{aligned} X(r, \theta) &= R_0 - \epsilon r \cos \theta - \epsilon^2 \Delta(r) + \epsilon^3 E(r) \cos \theta \\ Z(r, \theta) &= \epsilon r \sin \theta + \epsilon^3 E(r) \sin \theta \\ \Phi &= \phi \end{aligned} \quad (2.1)$$

where  $\epsilon \sim r/R_0$  indicates the order of magnitude of each term and  $\Delta(r)$  is the displacement of the magnetic surface from the magnetic axis, and  $E(r)$  represents the elliptic deformation of magnetic surface from circle.

The equilibrium equation in  $(r, \theta, \phi)$  system is as follows;

$$p_0'(r) + \frac{h(r)h'(r)}{x^2} + \frac{f(r)}{\sqrt{g}} \left\{ \left( \frac{r}{\sqrt{g}} f(r) g_{\theta\theta} \right)' - f(r) \frac{\partial}{\partial \theta} \left( \frac{g_{r\theta}}{\sqrt{g}} \right) \right\} = 0, \quad (2.2)$$

where  $p_0(r)$ ,  $f(r)$  and  $h(r)$  are plasma pressure distribution, poloidal magnetic field and toroidal magnetic field in the equilibrium, respectively, and the prime denotes the differentiation with respect to  $r$  and  $g_{r\theta}$ ,  $g_{\theta\theta}$  and  $\sqrt{g}$  are metric tensors in the coordinate system.

Substituting Eq.(2.1) into Eq.(2.2), we set each Fourier component equal to zero. To the second order of  $\epsilon$ , the following equations hold.

$$\begin{aligned} p_0' + hh' + \frac{f}{r}(rf)' &= \frac{p_0'}{R_0} (2\Delta + 3r\Delta' - \frac{r^2}{2R_0}) \\ &\quad + \frac{3f(rf)'}{2r} \Delta'^2 - f^2 (\frac{\Delta'^2}{r} + \frac{\Delta}{R_0} + \frac{r}{2R_0^2}), \\ \Delta'' + \left\{ \frac{2(rf)'}{rf} - \frac{1}{r} \right\} \Delta' + \frac{2rp_0'}{R_0 f^2} - \frac{1}{R_0} &= 0, \\ E'' + \left\{ \frac{2(rf)'}{rf} - \frac{1}{r} \right\} E' - \frac{3}{r^2} E &= - \frac{r^2 p_0'}{2R_0^2 f^2} + \frac{3}{2} \frac{(rf)'}{rf} \Delta'^2 - \frac{r}{2R_0^2} - \frac{\Delta'}{R_0} + \frac{3rp_0'}{R_0 f^2} \Delta'. \end{aligned} \quad (2.3)$$

Next, we specify a constant current density inside the plasma and a parabolic pressure distribution, that is,

$$\begin{aligned} f(r) &= rf_a, \\ p_0(r) &= f_a^2 \beta_p (1 - r^2), \end{aligned} \quad , \quad (2.4)$$

where  $f_a = f(a)$  and  $\beta_p$  is poloidal beta. Then from Eqs.(2.3), we obtain

$$\begin{aligned} \Delta(r) &= \frac{(1+4\beta_p)r^2}{8R_0}, \\ E(r) &= E_a r - \frac{(3+16\beta_p^2)r(r^2-1)}{64 R_0^2}, \\ h(r) &= \sqrt{1-2f_a^2(1-\beta_p)(r^2-1)-\frac{f_a^2(48\beta_p^2+1)(\beta_p+5)}{16 R_0^2}(r^4-1)}, \end{aligned} \quad , \quad (2.5)$$

where  $E_a$  is elliptic deformation at plasma surface ( $r=a$ ). To obtain the equilibrium of arbitrary current distribution, we must solve Eqs.(2.3) numerically.

The stability calculations of free boundary kink mode in §.4 and §.5 are carried out with the equilibrium solutions of Eqs.(2.5).

### 3. Eigenfunctions of Internal Mode

In this section, the eigen-functions of internal mode are given. Plasma current distribution used to calculate the internal mode in this section are assumed as follows to the order of  $\epsilon^0$ ;

$$j^\phi(r) = j_0^\phi (1 - r^2)^3 \quad , \quad (3.1)$$

where  $j_0^\phi$  is the value of plasma current density at magnetic axis, which is determined from the value of safety factor at plasma surface. As an initial value, we choose random numbers for  $\xi^r$  first, and then  $\xi^\theta$  is determined from the incompressibility condition  $\vec{\nabla} \cdot \vec{\xi} = 0$ , where  $\xi^\phi$  is set to zero.

The results are shown in Fig.1. The eigen-function of each  $m$ -mode, where  $m$  is the poloidal wave number, is obtained by Fourier expansion of  $r$  component of the displacement vector  $\xi^r(r, \theta)$  in the  $\theta$  direction. It is shown that how each  $m$ -mode develops to its intrinsic eigen-function from random number which is initially given. In each subfigure, eigen function is normalized by its maximum value, and the relative magnitude of the eigen-function among them is meaningless.

Figure (1.a) shows that in the cylindrical case near each singular surface, the corresponding internal mode grows. Figures (1.b) and (1.c) are toroidal case, and show that eigen-functions have peaks not only near the corresponding singular surfaces but also near other singular surfaces by the coupling of toroidal effect. Figure 2 shows the flow pattern of the displacement in the toroidal case. The case of  $T=295$  is the eigen-function obtained. It is seen that at inner region of the plasma column  $m=1$  mode and at outer one  $m=2$  mode grow respectively.

Since the calculation of the eigen-functions in this section includes an acceleration parameter  $\alpha^{1,2}$ , the mode, which is stable actually, grows seemingly. Without this parameter  $\alpha$ , it is almost impossible to calculate the eigen-functions due to the stupendous CPU time of

where  $E_a$  is elliptic deformation at plasma surface ( $r=a$ ). To obtain the equilibrium of arbitrary current distribution, we must solve Eqs.(2.3) numerically.

The stability calculations of free boundary kink mode in §.4 and §.5 are carried out with the equilibrium solutions of Eqs.(2.5).

### 3. Eigenfunctions of Internal Mode

In this section, the eigen-functions of internal mode are given. Plasma current distribution used to calculate the internal mode in this section are assumed as follows to the order of  $\epsilon^0$ :

$$j^\phi(r) = j_0^\phi (1 - r^2)^3 \quad , \quad (3.1)$$

where  $j_0^\phi$  is the value of plasma current density at magnetic axis, which is determined from the value of safety factor at plasma surface. As an initial value, we choose random numbers for  $\xi^r$  first, and then  $\xi^\theta$  is determined from the incompressibility condition  $\vec{\nabla} \cdot \vec{\xi} = 0$ , where  $\xi^\phi$  is set to zero.

The results are shown in Fig.1. The eigen-function of each  $m$ -mode, where  $m$  is the poloidal wave number, is obtained by Fourier expansion of  $r$  component of the displacement vector  $\xi^r(r, \theta)$  in the  $\theta$  direction. It is shown that how each  $m$ -mode develops to its intrinsic eigen-function from random number which is initially given. In each subfigure, eigen function is normalized by its maximum value, and the relative magnitude of the eigen-function among them is meaningless.

Figure (1.a) shows that in the cylindrical case near each singular surface, the corresponding internal mode grows. Figures (1.b) and (1.c) are toroidal case, and show that eigen-functions have peaks not only near the corresponding singular surfaces but also near other singular surfaces by the coupling of toroidal effect. Figure 2 shows the flow pattern of the displacement in the toroidal case. The case of  $T=295$  is the eigen-function obtained. It is seen that at inner region of the plasma column  $m=1$  mode and at outer one  $m=2$  mode grow respectively.

Since the calculation of the eigen-functions in this section includes an acceleration parameter  $\alpha^{1,2}$ , the mode, which is stable actually, grows seemingly. Without this parameter  $\alpha$ , it is almost impossible to calculate the eigen-functions due to the stupendous CPU time of

the computer, if the random number is used as the initial value.

It is wellknown that the eigen-function of internal mode with the singular surface inside the plasma has a peak inside the singular one. It is due to the lack of number of grid points in the  $r$  direction that the eigen-function calculated in this case has peaks near the singular surfaces. Only 11 grid points are used in the calculation.

#### 4. Free Boundary Kink Mode

In this section, the eigen-value and eigen-function of the external kink mode are given.

Growth rates are shown in Fig.3 in the case of shell radius  $b=2a$ , where  $a$  is plasma minor radius,  $\beta_p = 1$  and uniform current distribution. Dotted curves are analytical growth rates in the cylindrical case obtained by Shafranov<sup>14)</sup>. Solid curves show the growth rates in the cylindrical case calculated by the two-dimensional code, and dotted solid curve shows the same one but the number of grid point in the  $\theta$  direction  $JMAX=35$ , while the former is in the case  $JMAX=19$ . This indicates that if we try to calculate the growth rate for higher  $m$ -mode, the numerical "shift", which appear in Fig.3 between the solid curve and the dotted curve, due to finite difference in the  $\theta$  direction becomes greater.

The other curves show the growth rates in the toroidal cases with shell radius  $b=2a$ . There are no particular difference between  $\epsilon^{-1}=15$  and  $\epsilon^{-1}=10$ , where  $\epsilon$  is inverse aspect ratio, and also between these two cases and the cylindrical results by the simulation. Thus the toroidal effect is insignificant in these cases. The calculations of toroidal cases are carried out with  $JMAX=19$ .

In the case of  $\epsilon^{-1}=5$ , the growth rates are reduced in the maximum region compared with the cylindrical results by the toroidal effects. And near the marginal region,  $nq_a \approx 2$ , the squared growth rates seem to become positive that is, the external kink mode becomes unstable, while there is a narrow stability window due to the shell effect in the case of analytical calculation of cylinder. This is attributed to not only the toroidal effects such as the coupling with the other modes or the ballooning effect but also the numerical "shift" mentioned above. But even if this "shift" does not occur in the calculation and the external mode has stability window, the internal mode is unstable near the marginal point for a slender tokamak, as will be shown in the next

the computer, if the random number is used as the initial value.

It is wellknown that the eigen-function of internal mode with the singular surface inside the plasma has a peak inside the singular one. It is due to the lack of number of grid points in the  $r$  direction that the eigen-function calculated in this case has peaks near the singular surfaces. Only 11 grid points are used in the calculation.

#### 4. Free Boundary Kink Mode

In this section, the eigen-value and eigen-function of the external kink mode are given.

Growth rates are shown in Fig.3 in the case of shell radius  $b=2a$ , where  $a$  is plasma minor radius,  $\beta_p = 1$  and uniform current distribution. Dotted curves are analytical growth rates in the cylindrical case obtained by Shafranov<sup>14)</sup>. Solid curves show the growth rates in the cylindrical case calculated by the two-dimensional code, and dotted solid curve shows the same one but the number of grid point in the  $\theta$  direction  $JMAX=35$ , while the former is in the case  $JMAX=19$ . This indicates that if we try to calculate the growth rate for higher  $m$ -mode, the numerical "shift", which appear in Fig.3 between the solid curve and the dotted curve, due to finite difference in the  $\theta$  direction becomes greater.

The other curves show the growth rates in the toroidal cases with shell radius  $b=2a$ . There are no particular difference between  $\epsilon^{-1}=15$  and  $\epsilon^{-1}=10$ , where  $\epsilon$  is inverse aspect ratio, and also between these two cases and the cylindrical results by the simulation. Thus the toroidal effect is insignificant in these cases. The calculations of toroidal cases are carried out with  $JMAX=19$ .

In the case of  $\epsilon^{-1}=5$ , the growth rates are reduced in the maximum region compared with the cylindrical results by the toroidal effects. And near the marginal region,  $nq_a \approx 2$ , the squared growth rates seem to become positive that is, the external kink mode becomes unstable, while there is a narrow stability window due to the shell effect in the case of analytical calculation of cylinder. This is attributed to not only the toroidal effects such as the coupling with the other modes or the ballooning effect but also the numerical "shift" mentioned above. But even if this "shift" does not occur in the calculation and the external mode has stability window, the internal mode is unstable near the marginal point for a slender tokamak, as will be shown in the next

section. Hence the stability window may be narrow for low- $m$  modes in the case of uniform current density and when the shell is placed far from the plasma.

We show the eigen-functions of external  $m=2$  mode in Figs.4 ~ 6. It is seen that as the aspect ratio is smaller, the coupling of  $m=1$  and  $m=3$  modes with  $m=2$  mode is greater.

## 5. Shell Effect

In order to check the marginal stability condition by our present two-dimensional code, we calculate the growth rate of the toroidal plasma with uniform current density when the shell is placed near the plasma ( $b=1.2a$ ).

The results are shown in Fig.7. The dotted curve denotes the analytical growth rate of the cylindrical plasma<sup>14)</sup>, and the other two curves are calculated growth rate of toroidal plasma, and in this case the toroidal effect is apparent compared with the case of  $b=2a$  as described in the analytical calculation<sup>15)</sup>. In the case of  $\epsilon^{-1}=5$ ,  $m=2$  external mode becomes stable, which is not shown in the figure. For a slender tokamak, however, the internal mode is unstable instead of the external one near marginal point,  $nq_a \approx 2$ . The dotted curve near the marginal point is the growth rate of the internal  $m=2$  mode calculated by our one-dimensional code for cylindrical plasma with uniform current distribution, which quite agrees with the result calculated by the other code using finite element method<sup>16)</sup>.

In Fig.8, we show the time development of the Fourier component of  $\xi^r(r, \theta)$  expanded in the  $\theta$  direction. It is seen that initial value, for which we choose the eigen-function of the external  $m=3$  mode for cylindrical plasma, induces the  $m=2$  internal mode immediately. The eigen-function of  $m=2$  mode, excluded the external one, fairly agrees with the cylindrical eigen-function of the  $m=2$  internal mode.

## 6. Conclusion and Discussion

It is shown that when the shell is placed far from the plasma, toroidicity scarcely effects the external kink mode for slender tokamak, but they reduce their growth rate for fat tokamak.

The former also shows that our two-dimensional code is correct for

section. Hence the stability window may be narrow for low- $m$  modes in the case of uniform current density and when the shell is placed far from the plasma.

We show the eigen-functions of external  $m=2$  mode in Figs.4 ~ 6. It is seen that as the aspect ratio is smaller, the coupling of  $m=1$  and  $m=3$  modes with  $m=2$  mode is greater.

## 5. Shell Effect

In order to check the marginal stability condition by our present two-dimensional code, we calculate the growth rate of the toroidal plasma with uniform current density when the shell is placed near the plasma ( $b=1.2a$ ).

The results are shown in Fig.7. The dotted curve denotes the analytical growth rate of the cylindrical plasma<sup>14)</sup>, and the other two curves are calculated growth rate of toroidal plasma, and in this case the toroidal effect is apparent compared with the case of  $b=2a$  as described in the analytical calculation<sup>15)</sup>. In the case of  $\epsilon^{-1}=5$ ,  $m=2$  external mode becomes stable, which is not shown in the figure. For a slender tokamak, however, the internal mode is unstable instead of the external one near marginal point,  $nq_a \approx 2$ . The dotted curve near the marginal point is the growth rate of the internal  $m=2$  mode calculated by our one-dimensional code for cylindrical plasma with uniform current distribution, which quite agrees with the result calculated by the other code using finite element method<sup>16)</sup>.

In Fig.8, we show the time development of the Fourier component of  $\xi^r(r, \theta)$  expanded in the  $\theta$  direction. It is seen that initial value, for which we choose the eigen-function of the external  $m=3$  mode for cylindrical plasma, induces the  $m=2$  internal mode immediately. The eigen-function of  $m=2$  mode, excluded the external one, fairly agrees with the cylindrical eigen-function of the  $m=2$  internal mode.

## 6. Conclusion and Discussion

It is shown that when the shell is placed far from the plasma, toroidicity scarcely effects the external kink mode for slender tokamak, but they reduce their growth rate for fat tokamak.

The former also shows that our two-dimensional code is correct for

section. Hence the stability window may be narrow for low- $m$  modes in the case of uniform current density and when the shell is placed far from the plasma.

We show the eigen-functions of external  $m=2$  mode in Figs.4 ~ 6. It is seen that as the aspect ratio is smaller, the coupling of  $m=1$  and  $m=3$  modes with  $m=2$  mode is greater.

## 5. Shell Effect

In order to check the marginal stability condition by our present two-dimensional code, we calculate the growth rate of the toroidal plasma with uniform current density when the shell is placed near the plasma ( $b=1.2a$ ).

The results are shown in Fig.7. The dotted curve denotes the analytical growth rate of the cylindrical plasma<sup>14)</sup>, and the other two curves are calculated growth rate of toroidal plasma, and in this case the toroidal effect is apparent compared with the case of  $b=2a$  as described in the analytical calculation<sup>15)</sup>. In the case of  $\epsilon^{-1}=5$ ,  $m=2$  external mode becomes stable, which is not shown in the figure. For a slender tokamak, however, the internal mode is unstable instead of the external one near marginal point,  $nq_a \approx 2$ . The dotted curve near the marginal point is the growth rate of the internal  $m=2$  mode calculated by our one-dimensional code for cylindrical plasma with uniform current distribution, which quite agrees with the result calculated by the other code using finite element method<sup>16)</sup>.

In Fig.8, we show the time development of the Fourier component of  $\xi^r(r, \theta)$  expanded in the  $\theta$  direction. It is seen that initial value, for which we choose the eigen-function of the external  $m=3$  mode for cylindrical plasma, induces the  $m=2$  internal mode immediately. The eigen-function of  $m=2$  mode, excluded the external one, fairly agrees with the cylindrical eigen-function of the  $m=2$  internal mode.

## 6. Conclusion and Discussion

It is shown that when the shell is placed far from the plasma, toroidicity scarcely effects the external kink mode for slender tokamak, but they reduce their growth rate for fat tokamak.

The former also shows that our two-dimensional code is correct for

low- $m$  number mode. But for higher- $m$  mode, the numerical "shift" prevents us to calculate the growth rate precisely and the error of this higher- $m$  mode extends to low- $m$  mode by the toroidal coupling. So in order to obtain more exact growth rate of toroidal plasma, it is necessary to Fourier analyse them about the  $\theta$  direction and to calculate the coupling of one mode with other ones numerically.

When the shell is placed near the plasma ( $b=1.2a$ ), the toroidal effect is notable compared with the case of  $b=2a$ , and  $m=2$  external kink mode becomes stable by the toroidal effect in the case of  $\epsilon^{-1}=5$ .

### Acknowledgement

The authors would like to express their deepest thanks to Drs. M. Tanaka, M. Okamoto and other members of the plasma theory group in JAERI, especially to Dr. M. Azumi for his frequent and helpful suggestions, and Dr. M. Wakatani in the Institute of Plasma Physics of Nagoya University for their fruitful discussions and encouragement, as well as Prof. H. Itô in Osaka University for his continuing encouragement. They also wish to thank Dr. M. Seki in Hokkaidô University for his useful suggestion to toroidal ring functions which are used to calculate the perturbed vacuum magnetic field.

One of the authors (G.K.) is indebted to Drs. T. Takeda and T. Tsunematsu in JAERI for their stimulating discussions and encouragement, as well as Dr. S. Mori in JAERI for his continuing encouragement.

The computations were performed by using FACOM 230/75 of the data processing center in JAERI.

low- $m$  number mode. But for higher- $m$  mode, the numerical "shift" prevents us to calculate the growth rate precisely and the error of this higher- $m$  mode extends to low- $m$  mode by the toroidal coupling. So in order to obtain more exact growth rate of toroidal plasma, it is necessary to Fourier analyse them about the  $\theta$  direction and to calculate the coupling of one mode with other ones numerically.

When the shell is placed near the plasma ( $b=1.2a$ ), the toroidal effect is notable compared with the case of  $b=2a$ , and  $m=2$  external kink mode becomes stable by the toroidal effect in the case of  $\epsilon^{-1}=5$ .

### Acknowledgement

The authors would like to express their deepest thanks to Drs. M. Tanaka, M. Okamoto and other members of the plasma theory group in JAERI, especially to Dr. M. Azumi for his frequent and helpful suggestions, and Dr. M. Wakatani in the Institute of Plasma Physics of Nagoya University for their fruitful discussions and encouragement, as well as Prof. H. Itô in Osaka University for his continuing encouragement. They also wish to thank Dr. M. Seki in Hokkaidô University for his useful suggestion to toroidal ring functions which are used to calculate the perturbed vacuum magnetic field.

One of the authors (G.K.) is indebted to Drs. T. Takeda and T. Tsunematsu in JAERI for their stimulating discussions and encouragement, as well as Dr. S. Mori in JAERI for his continuing encouragement.

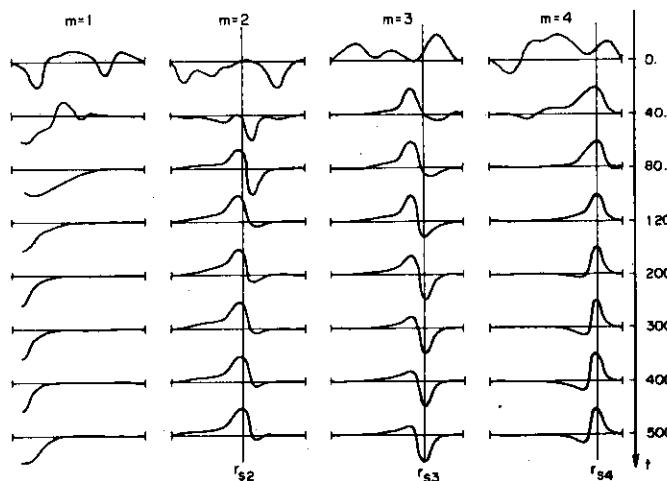
The computations were performed by using FACOM 230/75 of the data processing center in JAERI.

## References

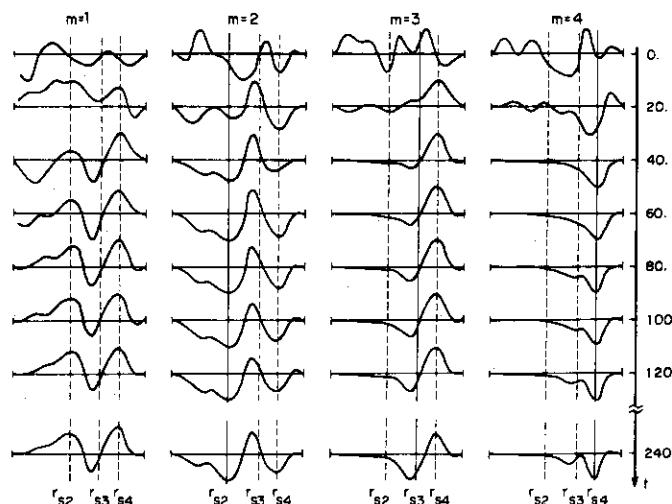
- 1) J.A. Wesson and A. Sykes, in Plasma Physics and Controlled Nuclear Fusion Research (Proc. 5th Int. Conf. Tokyo, 1974) CN-33/A12-3.
- 2) A. Sykes and J.A. Wesson, Nucl. Fusion 14, (1974) 645.
- 3) G. Bateman, W. Schneider and W. Grossmann, Nucl. Fusion 14, (1974) 669.
- 4) J.W. Wooten, H.R. Hicks, G. Bateman and R.A. Dory, Oak Ridge National Laboratory Report, ORNL/TM-4784 (1974).
- 5) G. Bateman, H.R. Hicks and J.W. Wooten, Oak Ridge National Laboratory Report, ORNL/TM-5796 (1977).
- 6) G. Kurita and T. Amano, Japan Atomic Energy Research Institute Report, JAERI-M 6474 (1976).
- 7) A. Sykes and J.A. Wesson, Phys. Rev. Letters 37, (1976) 140.
- 8) T. Takeda, Y. Shimomura, M. Ohta and M. Yoshikawa, Phys. Fluids 15, (1972) 2193.
- 9) W. Kerner, Nucl. Fusion 16, (1976) 643.
- 10) R.C. Grimm and J.L. Johnson, Princeton Plasma Physics Laboratory Report, MATT-1296 (1976).
- 11) D. Berger, L.C. Bernard, R. Gruber and F. Troyon, in Plasma Physics and Controlled Nuclear Fusion Research (Proc. 6th Int. Conf. Berechtesgaden, 1976) CN-35/B11-4.
- 12) J.M. Greene, J.L. Johnson and K.E. Weimer, Phys. Fluids 14, (1971) 671.
- 13) M. Okamoto, M. Wakatani and T. Amano, Nucl. Fusion 15, (1975) 225.
- 14) V.D. Shafranov, Sov. Phys., Tech. Phys. 15, (1970) 175.
- 15) E.A. Frieman, J.M. Greene, J.L. Johnson and K.E. Weimer, Phys. Fluids 16, (1973) 1108.
- 16) T. Tsunematsu and T. Takeda to appear JAERI-M.

## Figure Captions

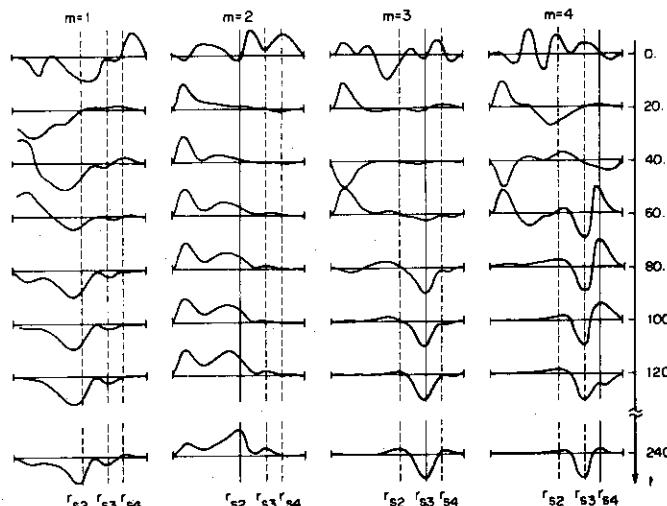
- Fig. 1 Time development of the Fourier component of  $\xi^r(r, \theta)$  expanded in  $\theta$  direction.  
 Major ordinate denotes toroidal Alfvén transit time and in each subfigure abscissa and ordinate represent a minor radius of a plasma column and a magnitude of eigen-function respectively and  $r_{sm}$  denotes the position of singular surface of each  $m$ -mode.
- 1.a) Cylindrical case,  $(q_0, q_a) = 1.0, 6.0$ ,  $n=1$ , where  $q_0$  and  $q_a$  are the values of safety factor at magnetic axis and plasma surface respectively.
- 1.b) toroidal case,  $(q_0, q_a) = (1.5, 6.54)$ ,  $n=1$ .
- 1.c) toroidal case,  $(q_0, q_a) = (0.46, 1.96)$ ,  $n=3$ .
- Fig. 2 Flow pattern of time development of two-dimensional displacement of internal mode for  $\epsilon^{-1}=5$ ,  $\beta_p=1$ ,  $n=1$  and  $(q_0, q_a) = (0.76, 3.19)$ . Last subfigure shows eigen-function with solid curves which represent equilibrium magnetic surfaces.
- Fig. 3 Normalized growth rate versus safety factor at plasma surface ( $r=a$ ) multiplied by toroidal wave number  $n$ . Solid, dotted and dotted solid curves with no mark are the growth rate in cylindrical case and other curves show toroidal one, in which the solid curve with the mark  $\times$ , the dotted curve with the mark + and the solid curve with the mark \* denote the cases of  $\epsilon^{-1}=15$ ,  $\epsilon^{-1}=10$  and  $\epsilon^{-1}=5$  respectively, for  $\beta_p=1$ ,  $b=2a$  and uniform current distribution.
- Fig. 4
- a) Equilibrium magnetic surfaces used to calculate the stability for  $\epsilon^{-1}=15$ ,  $\beta_p=1$ ,  $b=2a$  and uniform current distribution. Shaded region is the intermediate vacuum region between plasma and shell.
  - b) Eigen-functions of the external  $m=2$  mode for  $q_0=1.2$  and  $n=3$  at three different toroidal locations.
- Fig. 5
- a) Equilibrium magnetic surfaces used to calculate the stability for  $\epsilon^{-1}=10$ ,  $\beta_p=1$ ,  $b=2a$  and uniform current distribution.
  - b) Eigen-functions of the external  $m=2$  mode for  $q_0=1.2$  and  $n=2$  at three different toroidal locations.
- Fig. 6
- a) Equilibrium magnetic surfaces used to calculate the stability for  $\epsilon^{-1}=5$ ,  $\beta_p=1$ ,  $b=2a$  and uniform current distribution.
  - b) Eigen-functions of the external  $m=2$  mode for  $q_0=1.2$  and  $n=1$  at three different toroidal locations.
- Fig. 7 Normalized growth rate versus safety factor at plasma surface ( $r=a$ ) multiplied by toroidal wave number  $n$ . Dotted curves show cylindrical growth rate and other curves show toroidal one, in which solid curve with the mark  $\times$ , dotted solid curve with the mark + and solid curve with the mark \* denote the cases of  $\epsilon^{-1}=15$ ,  $\epsilon^{-1}=10$  and  $\epsilon^{-1}=7$  respectively, for  $\beta_p=1$ ,  $b=1.2a$  and uniform current distribution.
- Fig. 8 Time development of the Fourier component of  $\xi^r(r, \theta)$  expanded in  $\theta$  direction for  $\epsilon^{-1}=15$ ,  $q_0=2.0$  and uniform current distribution. Solid, dotted and dotted solid curves denote  $m=2$ ,  $m=3$  and  $m=1$  modes respectively. They are normalized by its maximum value in each subfigure.



1.a) Cylindrical case,  $(q_0, q_a) = (1.0, 6.0)$ ,  $n=1$ .  
where  $q_0$  and  $q_a$  are the values of safety factor  
at magnetic axis and plasma surface respectively.



1.b) toroidal case,  $(q_0, q_a) = (1.5, 6.54)$ ,  $n=1$ .



1.c) toroidal case,  $(q_0, q_a) = (0.46, 1.96)$ ,  $n=3$ .

Fig.1 Time development of the Fourier component of  $\xi^r(r, \theta)$  expanded in  $\theta$  direction.  
Major ordinate denotes toroidal Alfvén transit time and in each subfigure abscissa and ordinate represent a minor radius of a plasma column and a magnitude of eigen-function respectively and  $r_{SM}$  denotes the position of singular surface of each  $m$ -mode.

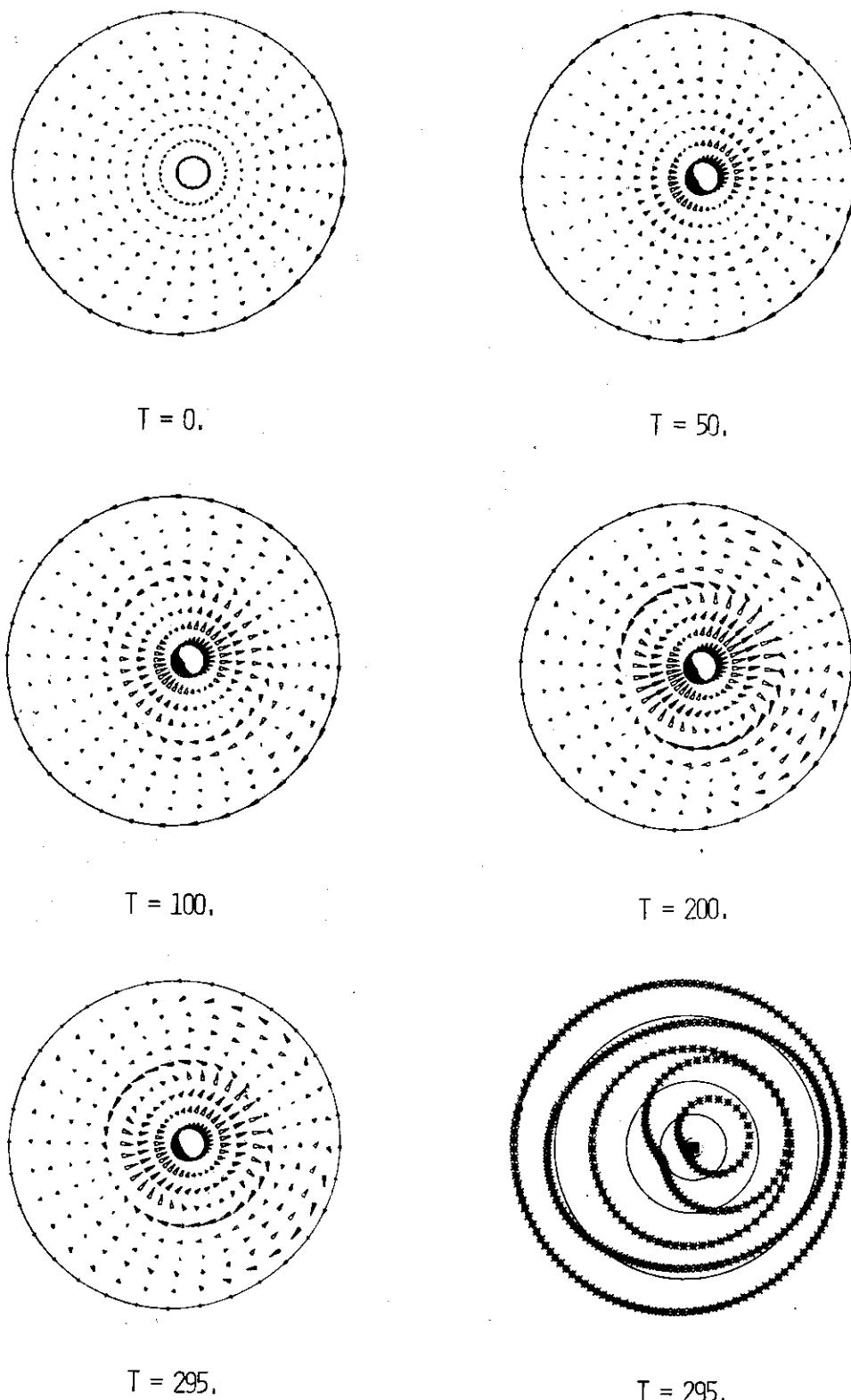


Fig.2 Flow pattern of time development of two-dimensional displacement of internal mode for  $\epsilon^{-1}=5$ ,  $\beta_p=1$ ,  $n=1$  and  $(q_0, q_a)=(0.76, 3.19)$ . Last subfigure shows eigen-function with solid curves which represent equilibrium magnetic surfaces.

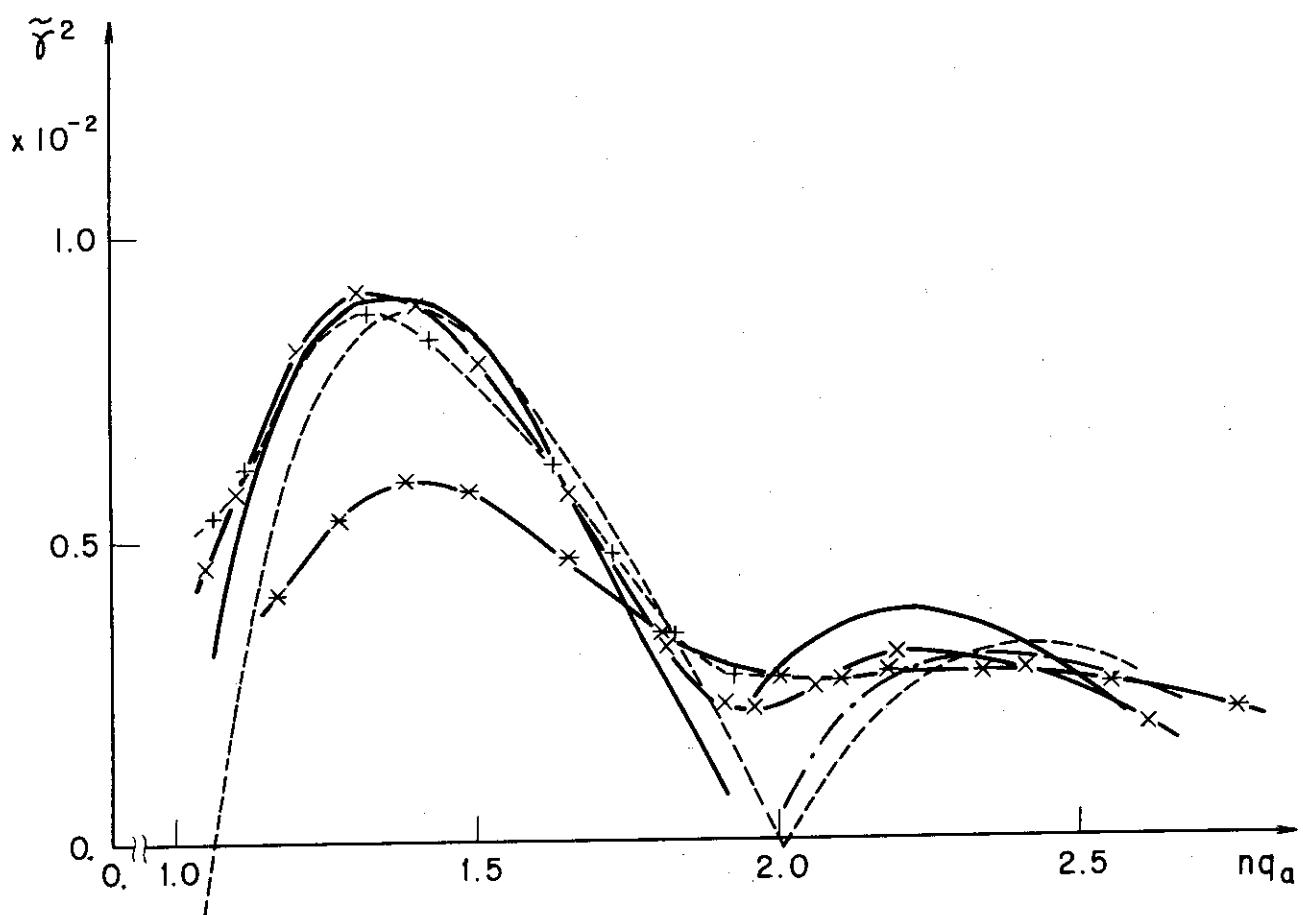


Fig.3. Normalized growth rate versus safety factor at plasma surface ( $r=a$ ) multiplied by toroidal wave number  $n$ . Solid, dotted and dotted solid curves with no mark are the growth rate in cylindrical case and other curves show toroidal one, in which the solid curve with the mark  $\times$ , the dotted curve with the mark  $+$  and the solid curve with the mark  $*$  denote the cases of  $\epsilon^- = 15$ ,  $\epsilon^{-1} = 10$  and  $\epsilon^{-1} = 5$  respectively, for  $\beta_p = 1$ ,  $b = 2a$  and uniform current distribution.

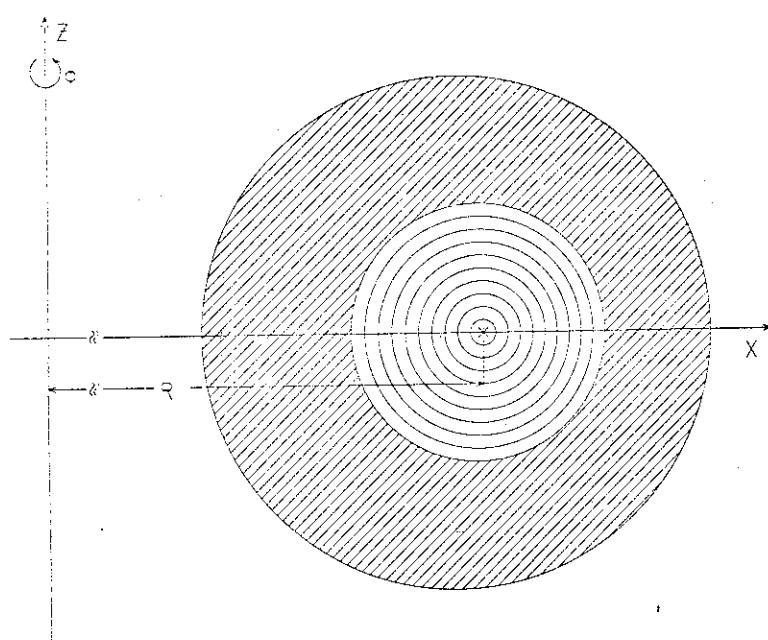
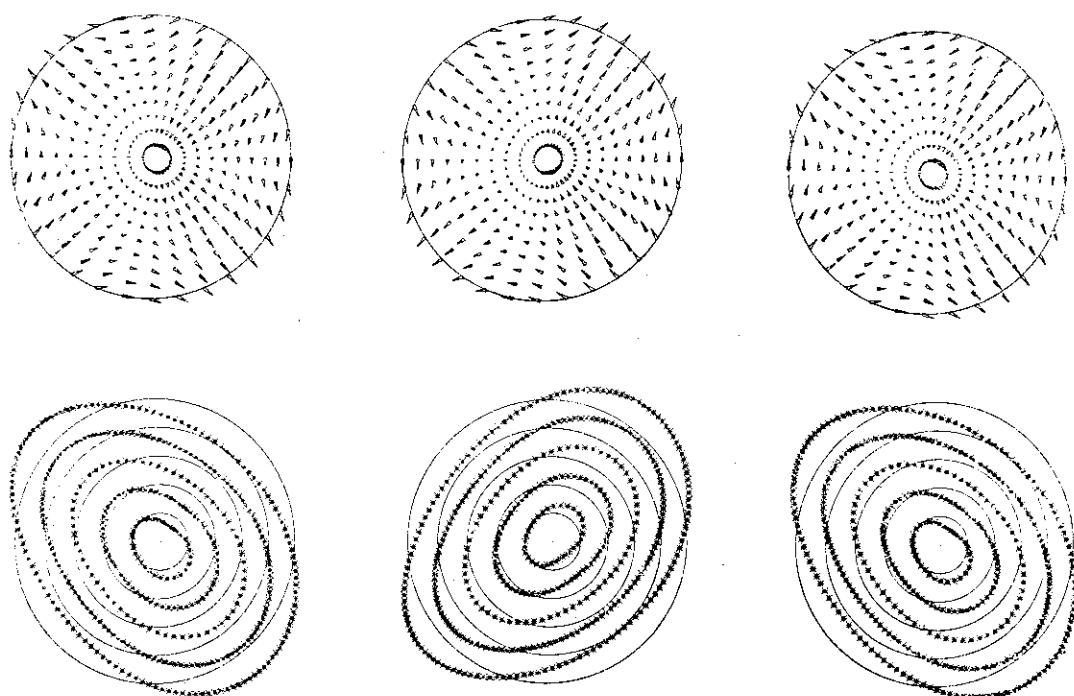


Fig.4

a) Equilibrium magnetic surfaces used to calculate the stability for  $\epsilon^{-1}=15$ ,  $\beta_p=1$ ,  $b=2a$  and uniform current distribution. Shaded region is the intermediate vacuum region between plasma and shell.



b) Eigen-functions of the external  $m=2$  mode for  $q_0=1.2$  and  $n=3$  at three different toroidal locations.

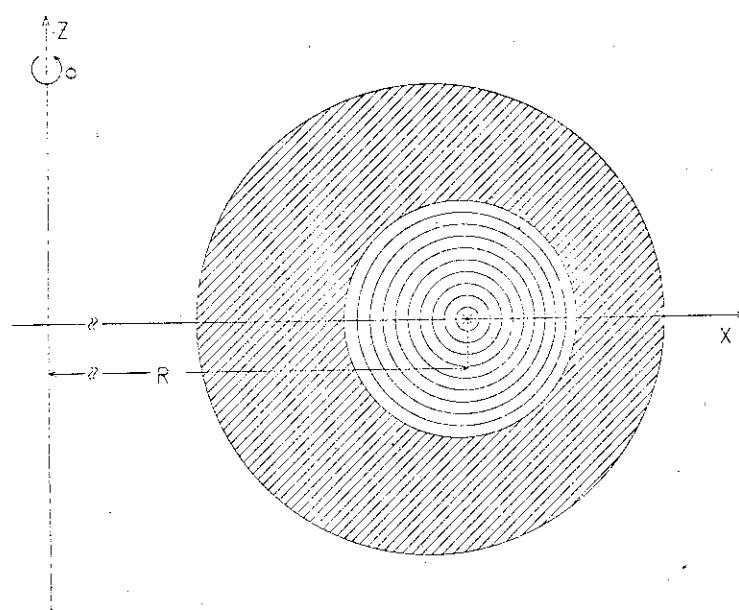
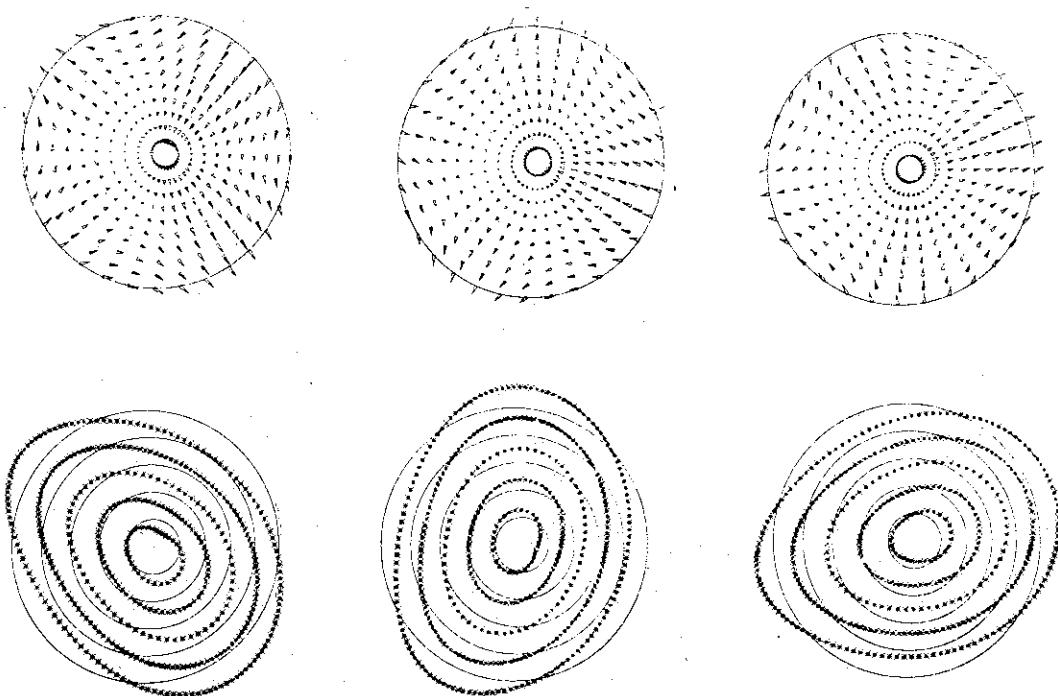


Fig.5

- a) Equilibrium magnetic surfaces used to calculate the stability for  $\epsilon^{-1}=10$ ,  $\beta_p=1$ ,  $b=2a$  and uniform current distribution.



- b) Eigen-functions of the external  $m=2$  mode for  $q_0=1.2$  and  $n=2$  at three different toroidal locations.

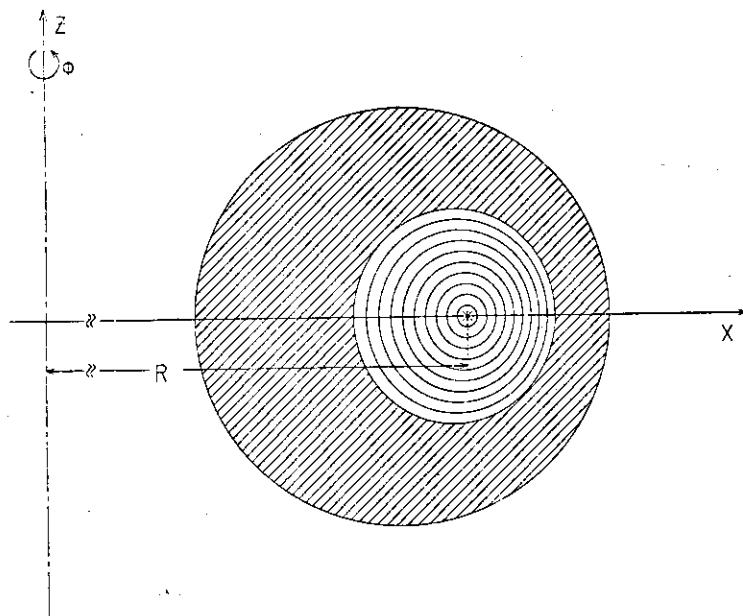
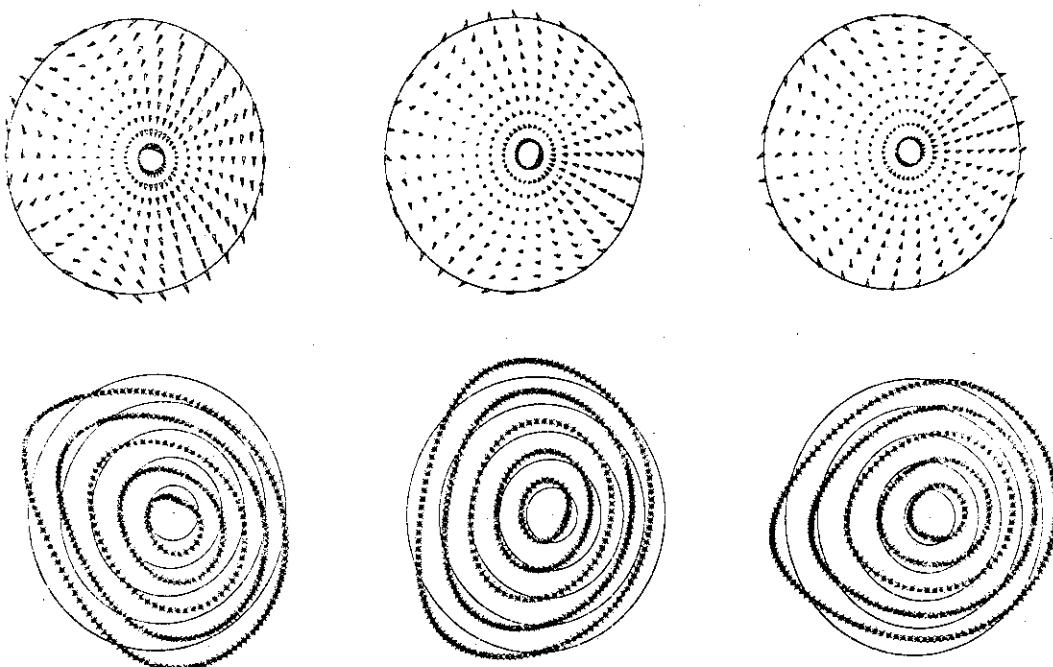


Fig.6

- a) Equilibrium magnetic surfaces used to calculate the stability for  $\epsilon^{-1}=5$ ,  $\beta_p=1$ ,  $b=2a$  and uniform current distribution.



- b) Eigen-functions of the external  $m=2$  mode for  $q_0=1.2$  and  $n=1$  at three different toroidal locations.

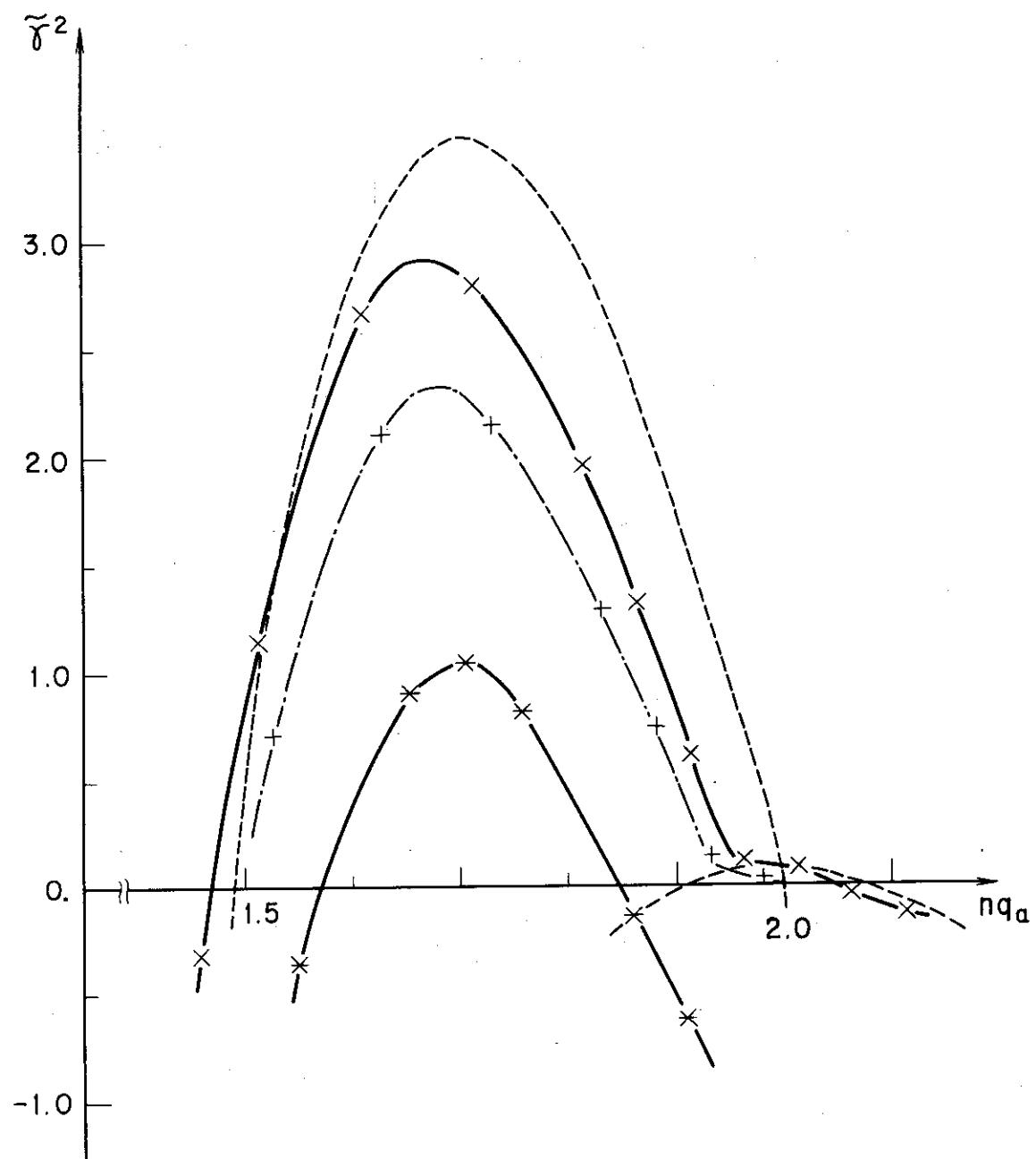


Fig.7 Normalized growth rate versus safety factor at plasma surface ( $r=a$ ) multiplied by toroidal wave number  $n$ . Dotted curves show cylindrical growth rate and other curves show toroidal one, in which solid curve with the mark  $x$ , dotted solid curve with the mark  $+$  and solid curve with the mark  $*$  denote the cases of  $\epsilon^{-1}=15$ ,  $\epsilon^{-1}=10$  and  $\epsilon^{-1}=7$  respectively, for  $\beta_p=1$ ,  $b=1.2a$  and uniform current distribution.

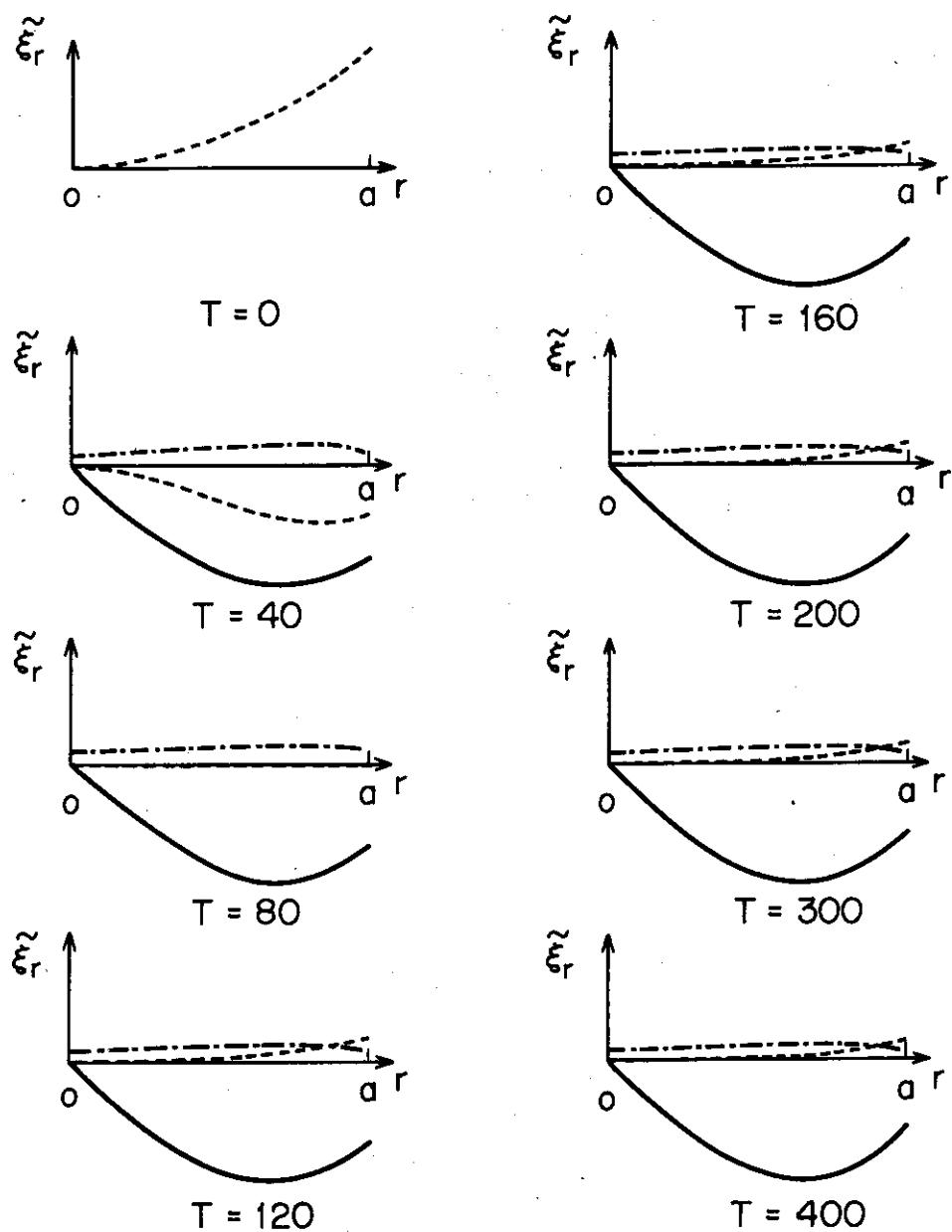


Fig.8 Time development of the Fourier component of  $\xi_r(r, \theta)$  expanded in  $\theta$  direction for  $\epsilon^{-1}=15$ ,  $q_0=2.0$  and uniform current distribution. Solid, dotted and dotted solid curves denote  $m=2$ ,  $m=3$  and  $m=1$  modes respectively. They are normalized by its maximum value in each subfigure.

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
		*****	MA100010
		*****	MA100020
		*****	MA100030
C***		2-DIMENSIONAL MHD STABILITY CODE	MA100040
C***		AS AN INITIAL-VALUE PROBLEM	MA100050
C***		CODED BY G.KURITA	MA100060
C***		AND T.AMANO	MA100070
C***			MA100080
C***			MA100090
C***			MA100100
C***			MA100110
C***			MA100120
C***			MA100130
C***			MA100140
C***			MA100150
C		MAIN PROGRAM	MA100160
C			MA100170
1	LOGICAL IGS,LPLOT		MA100180
2	COMMON/PLOT/LPLOT		MA100190
3	LPLOT=.TRUE.		MA100200
4	I GS=.FALSE.		MA100210
5	IF(IGS) STOP		MA100220
6	CALL EQUIL		MA100230
7	CALL INITI		MA100240
8	CALL PERTUR		MA100250
9	2 CALL OUTPUT(IGS)		MA100260
10	IF(IGS) GO TO 1		MA100270
11	CALL ADVANCE(IGS)		MA100280
12	CALL PERTUR		MA100290
13	GO TO 2		MA100300
14	END		MA100310
			MA100320
			MA100330

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE ERUL	EGL00010
2		IMPLICIT DOUBLE PRECISION(H=H,O=Z)	EGL00020
3		LOGICAL LPLOT	EGL00030
4		DOUBLE PRECISION(JT,JTH,JZ,JM)	EGL00040
5		DIMENSION CHR(21,19),CHH(21,19)	EGL00050
6		DIMENSION FX(3(21),X3H(21),PX3(21),PX3H(21))	EGL00060
7		DIMENSION XR(41),XKR(41),SIT(17),SSITA(17),ST(41)	EGL00070
8		DIMENSION S7(41),S22(41),YR(41),Y(41)	EGL00080
9		DIMENSION GGZ(21,19)	EGL00090
10		DIMENSION FF(21),HD(21),HDH(21),F1(21)	EGL00100
11		COMMON/AW/AJZ(41,19),GYI(21,19),GYH(21,19)	EGL00110
12		COMMON/SBL/SHELL,DPLSH	EGL00120
13		COMMON/ELT/E1,E2,E3,E4,E5	EGL00130
14		COMMON/COM/VAL(21)	EGL00140
15		COMMON/ERU/PS(21),PDD3(21),P3H(21),P03H(21),PDD3H(21),	EGL00150
*		F1(21),E3(21),ED3(21),E3H(21),ED3H(21),ED03H(21)	EGL00160
16		DIMENSION INDEX(513),S1(513),Y(1025),Z(1025)	EGL00170
17		COMMON/F67CM/	EGL00180
1		IBC,IC(1),IDIM2,INDEX,IP,IL,L1,N2,N3,N4,N7,S1,Y,Z	EGL00190
18		COMMON/PLOT/LPLOT	EGL00200
19		DIMENSION DDH(21),DDDH(21)	EGL00210
20		COMMON/DELTAD(21),DH(21),DN(21),DH(21)	EGL00220
21		COMMON/EW/X(41),XH(41),XI(41),XH(41),F(41),FH(41),H(41),HH(41),	EGL00230
1		P(41),PH(41),D(41),DP(41)	EGL00240
22		COMMON/EW/AR,AN,AK,WA,FA,IMAX,JMAX,JMAXL,N,M	EGL00250
23		COMMON/EW,BT(21,19),BTH(21,19),HZ(21,19),BZH(21,19),	EGL00260
1		RHO(41),RHOH(41)	EGL00270
24		COMMON/EW/GAUX(21,19),GGXY(21,19),GGZ(21,19),	EGL00280
1		GXX(21,19),GY(21,19),GYI(21,19),GLZ(21,19),XGV(21,19),	EGL00290
2		XGVH(21,19),GV(21,19),GVH(21,19),AH(21,19)	EGL00300
25		COMMON/EW/JA,DTHDX,IH,IHDX	EGL00310
26		COMMON/EW/JT(21),JTH(21),JZ(21,19),JZH(21,19)	EGL00320
27		COMMON/SBL/SHELL	EGL00330
28		COMMON/TET/T,TZ,TMAX	EGL00340
29		COMMON/V10/NPNPNNT	EGL00350
30		COMMON/V11/CC(4)	EGL00360
31		COMMON/GROW/ALFA	EGL00370
32		COMMON/ERU/F1(201),DF(201),DF1(201),F3(201),PP(201),POX(201)	EGL00380
*		,H2(201),H2(201)	EGL00390
33		COMMON/GEV/S1(201),S2(201),S3(201)	EGL00400
34		COMMON/EWT/EA,F,EB	EGL00410
35		COMMON/EWT/RETAP,NNNN,MMMM	EGL00420
36		COMMON/XXZ/XXX(21,19),ZZ(21,19),DX(21,19),DRZ(21,19),DTX(21,19)	EGL00430
*		,DTZ(21,19)	EGL00440
37		COMMON/WVC/CCCC	EGL00450
38		NAMELIST//CHR/CHR	EGL00460
39		NAMELIST//DATA/AR,AK,GAM,RHOH,RETAP,WA,FA,THAX,DT,IMAX,JMAX,M,N,	EGL00470
*		,NPRNT,ALFA,SHELL,EB,NNNN,MMMM,CC	EGL00480
40		DATA PI,GAM/3.141592653589793200,1.6666666666666667DD/	EGL00490
C		DEFAULT OPTION	EGL00500
C			EGL00510
41		CC(1) = 0.00	EGL00520
42		CC(2) = 0.00	EGL00530
43		CC(3) = 0.00	EGL00540
44		CC(4) = 0.00	EGL00550
45		RHO0 = 0.200	EGL00560
			EGL00570

ISN	ST-NO	SOURCE PROGRAM	( EQUIV )	SEQUENCE
66		DT = 0.0100		EQL00580
67		ALFA = 0.09		EQL00590
68		SMELL = 2.00		EQL00600
69		BETAP = 1.00		EQL00610
70		TMAX = 200.00		EQL00620
71		AK = 0.200		EQL00630
72		AK = 5.00		EQL00640
73		EB = 0.00		EQL00650
74		TMAX = 11		EQL00660
75		JMAX = 19		EQL00670
76		NNNN = 1		EQL00680
77		MMMM = 2		EQL00690
78		C 1002 READ(5,1DATA,ERR=1001,END=1000)		EQL00700
79		NP=1		EQL00710
80		BB=SHELL		EQL00720
81		NPNT=1./DT+0.01		EQL00730
82		JT2=DT*DT		EQL00740
83		M=0A+0.99999900		EQL00750
84		IF(SHELL,EB,1.) M=M+1		EQL00760
85		IF(SHELL,EB,1..AND.NNNN.EQ.0) M=M+0.500		EQL00770
86		IF(M,LE,1) M=1		EQL00780
87		An=AK*AR		EQL00790
88		N=AN+0.000100		EQL00800
89		AK=5.00		EQL00810
90		FA =1.00/(AR0*GA)		EQL00820
91		CC(M)=1.DU		EQL00830
92		MAX1 =MAX-1		EQL00840
93		JMAX1=JMAX-1		EQL00850
94		JMAX2=JMAX-2		EQL00860
95		JMAX3=JMAX-2		EQL00870
96		*RITE(e,1DATA)		EQL00880
97		PW=1.DG		EQL00890
98		DX1=DFLOAT(JMAX1)		EQL00900
99		DX=1.DC/DX1		EQL00910
100		OTHPI=FLOAT(JMAX3)		EQL00920
101		DTH=0.500/DTH		EQL00930
102		AR2=AR*AR		EQL00940
103		PK2=PR*PR		EQL00950
104		AH1=1.CC*AR		EQL00960
105		PH1=1.DD/PR		EQL00970
106		X(I)=1.DC		EQL00980
107		CALL tNLLD		FOL00990
108		DO 90 I=1,1MAX		EQL01000
109		;I=1+10*(I-1)		EQL01010
110		X(I)=DX*DFLOAT(I-1)		EQL01020
111		H(I)=H?I?		EQL01030
112		DX(X)=PD(I)?I?		EQL01040
113		F(I)=F(I)?I?		EQL01050
114		P(I)=P(I)?I?		EQL01060
115		H0(I)=DH2(I)?I?		EQL01070
116		H1(I)=DH(I)?I?		EQL01080
117		X(I)=X(I)-0.500*DX		EQL01090
118		XH(I)=1.00*XH(I)		EQL01100
119		IF(I,EG,1) GO TO 90		EQL01110
120		I=6+10*(I-2)		EQL01120
121		X(I)=1.00/X(I)		EQL01130
122		H(I)=H(I)*2(I)		EQL01140

ISN	ST-NO	SOURCE PROGRAM	( EQUIV )	SEQUENCE
102		DP(I)=PDX(I)?I?		FOL01150
103		FH(I)=F1(I)?I?		FOL01160
104		PH(I)=PP(I)?I?		FOL01170
105		PH(I)=6AH*PH(I)?I?		EQL01180
106		HDH(I)=DH2(I)?I?		EQL01190
107		90 CONTINUE		EQL01200
108		WRITC(6,610)		EQL01210
109		FORMAT(6,610) (1,P(),DP(),H(),F(),HD(I),I=2,[MAX])		EQL01220
110		611 FORMAT(1H .15,1P5E12.3)		EQL01230
111		610 FORMAT(1H .4X,11X,P(),10X,'DP',11X,'H',10X,'F',11X,'DH')//		EQL01240
112		CALC_ELI		EQL01250
113		DO 200 I=1,1MAX		EQL01260
114		I=I+10*(I-1)		EQL01270
115		DX(I)=S1(I)?I?		EQL01280
116		DD(I)=DS1(I)?I?		EQL01290
117		E3(I)=S2(I)?I?		EQL01300
118		EX3(I)=E3(I)*X(I)?I?		EQL01310
119		ED3(I)=DS2(I)?I?		EQL01320
120		PA3(I)=0.D0		EQL01330
121		FX3H(I)=0.D0		EQL01340
122		P3(I)=0.D0		EQL01350
123		PC3(I)=0.D0		FOL01360
124		PD3(I)=0.D0		EQL01370
125		PDH(I)=0.D0		EQL01380
126		PD3H(I)=0.D0		EQL01390
127		PD3H(I)=0.00		EQL01400
128		JTC(I)=-HD(I)?I?		EQL01410
129		JTH(I)=-HDH(I)?I?		EQL01420
130		KHO(I)=1.00		EQL01430
131		RHO(I)=1.00		EQL01440
132		IF(I,EG,1) GO TO 100		EQL01450
133		I=6+10*(I-2)		EQL01460
134		DX(I)=S1(I)?I?		EQL01470
135		DDH(I)=DS1(I)?I?		EQL01480
136		E3H(I)=S2(I)?I?		EQL01490
137		EX3H(I)=E3H(I)*XH(I)?I?		EQL01500
138		ED3H(I)=DS2(I)?I?		EQL01510
139		100 CONTINUE		EQL01520
140		E3(I)=E3(I)=0,		EQL01530
141		WRITC(6,612)		EQL01540
142		WRITE(6,613) (I,DC(I),DD(I),E3(I),ED3(I)),I=1,1MAX		EQL01550
143		612 FORMAT(1H //,4X!1,11X,D!,10X,DD!,10X,E3!,9X,'ED3'//)		EQL01560
144		613 FORMAT(1H //,4X!1,11X,D!,10X,DD!,10X,E3!,9X,'ED3'//)		EQL01570
145		DO 200 I=1,1MAX		EQL01580
146		X=DX(I)*X(I)?I?		EQL01590
147		XH=DXH(I)*XH(I)?I?		EQL01600
148		DO 200 J=1,JMAX		EQL01610
149		THETA=DT*DFLOAT(J-2)		EQL01620
150		CT1=DCOS(THETA)		EQL01630
151		CT2=DCOS(2.00*THTETA)		EQL01640
152		ST1=DSIN(THETA)		EQL01650
153		ST2=DSIN(2.00*THTETA)		EQL01660
154		GXX(I,J)=1.D0+DD(I)*DD(J)-2.00*(PD3(I)-DD(I)*CT1+ED3(I)*CT2)		EQL01670
155		GXYY(I,J)=DD(I)*ST1*(EX3(I)+ED3(I))*ST2		EQL01680
156		GXYH(I,J)=DD(I)*ST1*(EX3H(I)+ED3H(I))*ST2		EQL01690
157		AUX1=1.00*D(H(I)*XH(I)+0.500*XH(I)*2/AR2)		EQL01700
158		AUX2=-2.00*XH(I)*AR1*CT1+0.500*XH(I)*2/AR2*CT2		EQL01710

```

ISN ST-NR SOURCE PROGRAM < EQUIL >
SEQUENCE

159 GZZ({_,J)=AUX1+AUX2
160   AUX1=1.,D0+1.,500*X({_)*2/AR2+2,DD*D({_)*AR1
161   AUX2=2.,D0*(X({_)*AR1*CT1+1.,500*X({_)*X({_)/AR2*CT2
162 GZZ({_,J)=AUX1+AUX2
163 GGZZ({_,J)=GZZ({_
164   AUX1=1.,D0+1.,500*XH({_)*XH({_)/AR2+2,DD*DH({_)*AR1
165   AUX2=2.,D0*XH({_)*AR1*CT1+1.,500*XH({_)*XH({_)/AR2*CT2
166 GGZZ({_,J)=AUX1+AUX2
167   GYV({_,J)=1.-D0-2.,D0*XH({_)*P(3H({_)-E3H({_))/CT2
168   GYV({_,J)=1.-D0-2.,D0*XH({_)*P(3H({_)-E3({_))/CT2
169   GGYV({_,J)=1.-D0-2.,D0*DXH({_)*P(3H({_)-E3H({_))/CT2
170   AUX1 = -1.*D0*(PD3({_)+PK3({_))+D({_)*AR1*X({_)*DD({_)/(AR+AR))
171   AUX2 = -(DCD({_)-X({_)*AR1)*CT1
172   AUX3 = -(ED3({_)-E3({_)*AR1)*CT1
173   AUX3 = -(ED3({_)-E3({_)*0.,500*X({_)*DD({_)*AR1)*CT2
174   GYV({_,J)=AUX1+AUX2-AUX3
175   AUX1=1.,D0-2.,D0*D3({_)*P3H({_)*XH({_)-DH({_)*AR1-XH({_)*DDH({_)/(AR+AR)
176   AUX2=(D0H({_))*XH({_)*4H({_)*CT1
177   AUX3=(D0H({_)-E3H({_)*AH({_)*XH({_)*DDH({_)/(AR+AR))*CT2
178 GVH({_,J)=AUX1+AUX2-AUX3
179   AUX1 = 1.-D0+0.,500*DX2/AR2+PD3({_)-PX3({_)*D({_)*AR1
180   AUX2 = 0.-500*(X({_)*D({_)*AR1+*(D({_)*X({_)*AR1)*CT1
181   AUX3 = -(G.,500*D2/AR2-ED3({_)+EX3({_)*0.,500*X({_)*DD({_)*AR1)*CT2
182 A({_,J)=H({_)*(AUX1+AUX2+AUX3)
183   AUX1 = 1.-D0+0.,500*DX2/AR2-PD3H({_)-PX3H({_)*DH({_)*AR1
184   AUX2 = 0.-500*XH({_)*D({_)*AR1+(DDH({_)*XH({_)*AR1)*CT1
185   AUX3 = -(G.,500*DX2/AR2-ED3H({_)*EX3H({_)*0.,500*XH({_)*DDH({_)*AR1)*CT2
186 AH({_,J)= H({_)*(AUX1+AUX2+AUX3)
187   AUX1=1.,D0-2.,D0*PD3({_)-CT1*(2.*D0*ED3({_)+1.-500*DD({_)*Dd({_
188   AUX2=2.-D0*DD({_)*CT1*(2.*D0*ED3({_)+1.-500*DD({_)*Dd({_)*CT2
189 GGX(X({_,J)=AUX1+AUX2
190 BZ({_,J)=H({_)*GZ({_
191 RZH({_,J)=H({_)*GGZZ({_,J)
192   AUX1 = DDC({_)*X({_)*D0*(E3({_)*P3({_))*X({_)*2,DD*PD3({_))*ST1
193   AUX2 = DDC({_)*X({_)*2,DD0*D({_)*AR2-0.,75D0*D({_)*DD({_))*ST1
194   AUX3 = -(DD({_)*D0*D({_)+E3({_)*X({_)*X({_)*ED3({_))*ST2
195 GGYX({_,J)=AUX1+AUX2-AUX3
196   AUX1=1.+D0*(X({_)*P3({_))*X({_)*2,DD*PD3({_))*ST1
197   AUX2=A2/2.,D0*AR2+-(DD({_)*X({_)*AR1)*CT1+0.,500*X2/AR2*CT2
198   AUX3=(E3({_)*X({_)*X({_)*-0.,500*DD({_)*X({_)*AR1-D0*D({_))*CT2
199 XGV({_,J)=1.-D0*AUX1+AUX2-AUX3
200   AUX1=1+D0*DXH({_)*P3({_)*XH({_)*AR1-0.,500*DDH({_)*XH({_)*AR1
201   AUX2=0.,500*(DDH({_)*2*X2/2*AR2)-(DDH({_)*XH({_)*AR1)*CT1
202   AUX3=(E3M({_)*E3H({_)*XH({_)*1.-D0-500*XH({_)*DDH({_)*AR1)*CT2
203   AUX4=0.,500*(DDH({_)*D0*XH2/2*AR2)*CT2
204 XGV({_,J)=1.-D0*AUX1+AUX2+AUX3+AUX4
205   PT({_,J)= F({_)*XGV({_,J)
206   BTH({_,J)= FH({_)*XGV({_,J)

200 CONTINUE
207 DO 95 J_=1,JMAX2
208   THETA=DTH*DFL0AT(J_-1)
209   SIT(AJ)=THETA
210   SIN(AJ)=THETA
211   CONTINUE
212   X({_,J)=1.0
213   MAXD=2.*#MAX1+1
214   DDX=1.00*DFL0AT((MAX1*2)
215   DO 250 I_=1,MAXD

```

```

      SOURCE PROGRAM      ( EQUIL   )      SEQUENCE

216      XRC(1)=DDX*DFLOAT(T(-1))
217      XKC(1)=XK(1)
218  250  CONTINUE
219      DO 251 J=1,JMAX2
220      YR(1)=0.D0
221      DO 252 I=2,JMAXD
222      IF(MOD(I,2).EQ.0) GO TO 253
223      ID=(I-1)/2
224      YR(1)=GYY((ID,J+1)*X(ID)*F(T)+XGV((ID,J+1)
225      GU TO 252
226  253  ID=(I+2)/2
227      YR(1)=GYY((ID,J+1)*XH(ID)*FH(ID)*XGVH((ID,J+1)
228  252  CONTINUE
229      CALL SPLINE(XR,YR,XR,ST,SZ1,SZ2,PROXIN,JMAXD)
230      DO 254 T=2,1,MAXD
231      AJZ((J+1))=SZ1(1)
232  251  CONTINUE
233      DO 260 I=2,1,MAXD
234      IF(MOD(I,2).EQ.0) GO TO 270
235      ID=(I-1)/2
236      DO 261 J=1,JMAX2
237      VT((J))=GAY((ID,J+1)*XGV((ID,J+1))
238      CALL SPLINE(STA,YT,SS(TA,ST,SZ1,SZ2,PROXIN,JMAX2,JMAX2))
239      DO 262 J=1,JMAX2
240      AJZ((J+1))=AJZ((J+1))-F((ID))*S21(J)
241      GO TO 260
242  270  CONTINUE
243      ID=(I+2)/2
244      DO 273 J=1,JMAX2
245      YT((J))=GXVH((ID,J+1)*XGVH((ID,J+1))
246      CALL SPLINE(STA,YT,SS(TA,ST,SZ1,SZ2,PROXIN,JMAX2,JMAX2))
247      DO 272 J=1,JMAX2
248      AJZ((J+1))=AJZ((J+1))-FH((ID))*S21(J)
249  260  CONTINUE
250      DO 280 J=2,1,MAX1
251      DO 280 I=2,1,MAX
252      ID=2*I-1
253      1E2*2*(I-1)
254      J((J,J))=AJZ((D,J)*X((1))
255      JZHC((J,J))=AJZ((E,J)*XH((1))
256  280  CONTINUE
257      DO 290 I=2,1,MAX
258      JZ((1,J))=JZ((1,J))
259      JC((1,JMAX))=JZ((1,JMAX2))
260  290  CONTINUE
261      DU 300 J=2,JMAX1
262      DO 300 T=2,1,MAX
263      CMHK((1,J))=DPX((1)-(JTH((1)*B2((1,J))-JZ((1,J))*BT((1,J)))
264      CMHK((1,J))=DPX((1)-(JTH((1)*B2((1,J))-JZ((1,J))*BT((1,J)))
265  300  CONTINUE
266      FAD=F((1,MAX))
267      1E4=4
268      CALL SETF67(1,1,0)
269      MAX=2**10+1
270      XNO=2.D0/DFLOAT(MAX-1)
271      DO 1 I=2,1,MAX
272      DO 2 J=1,MAX

```

J A E R I - M 7 3 1 0

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
273		Z(J)=GV(I,J+1)*GGZZ(I,J+1)	EQL02860
274	2	Y(J)=0.0D0	EQL02870
275		CALL FOUR67(2,IQ)	EQL02880
276		QVAL(I)=0.5D0*XND*Y(I)*H(I)/(AR0*F(I))	EQL02890
277		QVAL(I)=X(I)*QVAL(I)	EQL02900
278	1	CONTINUE	EQL02910
279		QVAL(I)>2.0D0*H(I)/(AR0*CCCC)	EQL02920
280		WRITE(6,600)	EQL02930
281	600	FORMAT(IH /* ===== EQUILIBRJUM =====*/11X,'X',11X,'F',11X,'H', + 11X,'P'+11X,'D'+1DX,'1DX','CHK','1DX','CHKH','8X,'@VALUE'/*)	EQL02940
282		JONE=2	EQL02950
283		WRITE(6,9) (X(I),F(I),H(I),PH(I),DC(I),DPX(I),CHK(I,JONE),CHKH(I,JONE), + NE),QVAL(I),I=1,IMAX)	EQL02960
284	9	FORMAT(IH ,5X,1P9E12.3)*	EQL02970
285		WRITE(6,588)	EQL02980
286	588	FORMAT(IH ///* ***** CHECK OF EQUILIBRJUM ***** */)	EQL03010
287		WRITE(6,598) ((CHK(I,J),I=2,IMAX),J=2,JMAX1)	EQL03020
288	598	FORMAT(IH ,5X,1P10E12.4)	EQL03030
289		MAX=2*I0+1	EQL03040
290		KNO=2,D0/DFLOAT(MAX-1)	EQL03050
291		WRITE(6,510)	EQL03060
292	510	FORMAT(IH ///*/)	EQL03070
293		DO 500 I=2,IMAX	EQL03080
294		DO 501 J=1,MAX	EQL03090
295		Z(J)=CHK(I,J+1)	EQL03100
296	501	Y(J)=0.0D0	EQL03110
297		CALL FOUR67(2,I0)	EQL03120
298		DO 503 I=1,MAX	EQL03130
299	503	Z(I)=XND*Y(I)	EQL03140
300		WRITE(6,502) (I,(Z(J),J=1,MAX))	EQL03150
301	502	CONTINUE	EQL03160
302		FORMAT(IH ,2X,'*'!'+12,3X,2(1P9E13.5/13X))	EQL03170
303		DO 800 J=1,JMAX	EQL03180
304		THETA=DTI*DFLOAT(J-2)	EQL03190
305		CT1=DCGS(THETA)	EQL03200
306		ST1=DSI*(THETA)	EQL03210
307		DO 800 I=1,IMAX	EQL03220
308		XXX(I,J)=AR-D(I)-(X(I)-E3(I))*CT1	EQL03230
309		ZZ(I,J)=(X(I)+E3(I))*ST1	EQL03240
310		DRX(I,J)=(1.0D0-EDS(I))*CT1-DD(I)	EQL03250
311		DRZ(I,J)=(1.0D0*ED3(I))*ST1	EQL03260
312		DTX(I,J)=(X(I)-E3(I))*ST1	EQL03270
313		DTZ(I,J)=(X(I)+E3(I))*CT1	EQL03280
314	800	CONTINUE	EQL03290
315		E1=E3(IMAX)	EQL03300
316		E2=0.D0	EQL03310
317		E3=0	EQL03320
318		E4=0.D0	EQL03330
319		SS=SHELL**2	EQL03340
320		SD = (SS-1.D0)*(2.0D0*DD(IMAX)-ARI)/4.0D0+0.5D0*SS*ARI*DLOG(SHELL)	EQL03350
321		DSHELL = DC(IMAX)+SD	EQL03360
322		DPLSM = D(IMAX)	EQL03370
323		IF(LPLOT) CALL IPLOTP	EQL03380
324		IF(LPLOT) CALL PLOTP(1)	EQL03390
325		LPLOT=.FALSE.	EQL03400
326		RETURN	EQL03410
327	1001	WRITE(6,1003)	EQL03420
328	1003	FORMAT(IH ///*/20X,'***** INPUT DATA ERROR *****//')	EQL03430
329		GO TO 1002	EQL03440
330	1000	STOP	EQL03450
331		END	EQL03460

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE FE152	EQL03470
2		IMPLICIT DOUBLE PRECISION(A-H,O-Z)	EQL03480
3		DIMENSION PRMT(5),Y(2)*DERY(2)*AUX(5,2)	EQL03490
4		COMMON/VAR/XX1(101),XX1(201),YY1(201),DY1(201),XX2(201),YY2(201), + DY2(201)	EQL03500
5		COMMON/INDEX/KIND,IJJ,JJJ	EQL03510
6		NDIM=2	EQL03520
7		XD=0.001D0	EQL03530
8		X0=0.1D0	EQL03540
9		X=1.D-3	EQL03550
10		X0=0.01D0	EQL03560
11		MAX=4	EQL03570
12		DDX=1.0D0/DFLOAT(MAX-1)	EQL03580
13		DO 100 K=1,MAX	EQL03590
14		XX(K)=DDX*DFLOAT(K-1)	EQL03600
15	100	CONTINUE	EQL03610
16		IJJ=0	EQL03620
17		JJJ=0	EQL03630
18		PRMT(1)=X0	EQL03640
19		PRMT(2)=1.0D0*X0	EQL03650
20		PRMT(3)=(PRMT(2)-PRMT(1))/40.0D0	EQL03660
21		PRMT(4)=1.D-6	EQL03670
22		PRMT(4)=1.D-4	EQL03680
23		DERY(1)=0.5D0	EQL03690
24		DERY(2)=0.5D0	EQL03700
25		Y(1)=X0	EQL03710
26		Y(2)=1.D0	EQL03720
27		Y(3)=X0**4	EQL03730
28		Y(2)**4.0D0*X0**3	EQL03740
29		WRITE(6,600)	EQL03750
30	600	FORMAT(IH //13X,'X',12X,'E2',11X,'DE2//')	EQL03760
31		KIND=1	EQL03770
32		CALL DRKGS(PRMT,Y,DERY,NDIM,IHLF,AUX)	EQL03780
33		PRMT(1)=X0	EQL03790
34		PRMT(2)=1.0D0*X0	EQL03800
35		PRMT(3)=(PRMT(2)-PRMT(1))/40.0D0	EQL03810
36		Y(1)=X0	EQL03820
37		Y(1)=1.D0/(X0**3)	EQL03830
38		Y(2)=-3.0D0*Y(1)/X0	EQL03840
39		Y(1)=1.D0	EQL03850
40		Y(2)=0.D0	EQL03860
41		DERY(1)=0.5D0	EQL03870
42		DERY(2)=0.5D0	EQL03880
43		KIND=2	EQL03890
44		WRITE(6,600)	EQL03900
45		CALL DRKGS(PRMT,Y,DERY,NDIM,IHLF,AUX)	EQL03910
46		WRITE(6,600)	EQL03920
47		WRITE(6,601) (X,XX1(K),YY1(K),DY1(K),K=1,111)	EQL03930
48		WHITE(6,600)	EQL03940
49		IF(IJJ,E6,0) STOP	EQL03950
50	601	FORMAT(IH ,(X,XX2(K),YY2(K),DY2(K),K=1,111)	EQL03960
51		RETURN	EQL03970
52		END	EQL03980
53			EQL04000

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE EL11	EQL04C10
2		IMPLICIT DOUBLE PRECISION(A=H,O-Z)	EQL04020
3		DIMENSION XR(200),XXR(200),YR(200),ST(200),ST1(200),ST2(200)	EQL04030
4		DIMENSION E1(201),E1(201),E2(201),DE2(201)	EQL04040
5		DIMENSION DE1D(201),DE2D(201)	EQL04050
6		DIMENSION DG1(201),G1(201),DG2(201),G2(201)	EQL04060
7		DIMENSION G(201)	EQL04070
8		COMMON/COR/X(201),H,IMAX	EQL04080
9		COMMON/E8!/AR,AN,AK,QA,FA,IMAXD1,JMAX,JMAX1,N,M	EQL04090
10		COMMON/SBL/RB	EQL04100
11		COMMON/EA8/EA,EB	EQL04110
12		COMMON/LGT/BET,AP,NNNN,MMMM	EQL04120
13		COMMON/EDU/I(201),DRF(201),DF1(201),F3(201),PP(201),PDX(201)	EQL04130
		+ ,P(201),DH2(201)	EQL04140
14		COMMON/GEO/S1(201),DS1(201),S2(201),DS2(201)	EQL04150
15		COMMON/VAR/XX(201),XX1(201),YY1(201),CY1(201),XX2(201),YY2(201),	EQL04160
		+ DY2(201)	EQL04170
16		COMMON/INDEX/KIND,TT,JJJ	EQL04180
17		SM=DFLOAT(MMM)	EQL04190
18		IMAX1=IMAX+1	EQL04200
19		MAX#41	EQL04210
20		CALL FE1E2	EQL04220
21		DO 500 I=1,111	EQL04230
22		AUXX=1.00*XX1(I)**3	EQL04240
23		YY1(I)=YY1(I)*AUXX	EQL04250
24		DY1(I)=DY1(I)*AUXX-3.00*YY1(I)/XX1(I)	EQL04260
25	500	CONTINUE	EQL04270
26		DO 600 J=1,JJJ	EQL04280
27		AUXX=1.00*XX2(J)**3	EQL04290
28		YY2(J)=YY2(J)*AUXX	EQL04300
29		DY2(J)=DY2(J)*AUXX-3.00*YY2(J)/XX2(J)	EQL04310
30	600	CONTINUE	EQL04320
31		MAX=111	EQL04330
32		DO 300 I=1,MAX	EQL04340
33		XXR(I)=XX1(I)	EQL04350
34		YYR(I)=YY1(I)	EQL04360
35	300	CONTINUE	EQL04370
36		DO 299 I=1,IMAX1	EQL04380
37		XXR(I)=XX1(I+1)	EQL04390
38	299	CONTINUE	EQL04400
39		CALL SPLINE(XR,YR,XXR,ST,ST1,ST2,PROX,N,MAX,IMAX1)	EQL04410
40		DO 301 I=1,IMAX1	EQL04420
41		E1(I+1)=ST(I)	EQL04430
42		DE1(I+1)=ST1(I)	EQL04440
43		DE1D(I+1)=ST1(I)	EQL04450
44	301	CONTINUE	EQL04460
45		MAX=JJJ	EQL04470
46		DO 304 I=1,MAX	EQL04480
47		YYR(I)=YY2(I)	EQL04490
48		XXR(I)=XX2(I)	EQL04500
49	304	CONTINUE	EQL04510
50		CALL SPLINE(XR,YR,XXR,ST,ST1,ST2,PROKIN,MAX,IMAX1)	EQL04520
51		DO 305 I=1,IMAX1	EQL04530
52		E2(I+1)=ST(I)	EQL04540
53		DE2(I+1)=ST1(I)	EQL04550
54		DE2D(I+1)=ST1(I)	EQL04560
55	305	CONTINUE	EQL04570

ISN	ST-NO	SOURCE PROGRAM	EL11	SEQUENCE
56		E1(I)=0.00	EQL04580	
57		E2(I)=0.00	EQL04590	
58	DO 2	I=1,IMAX	EQL04600	
59		E2(I)=E2(I)-E2(IMAX)*E1(I)/E1(IMAX)	EQL04610	
60	2	CONTINUE	EQL04620	
61		Z=2.00/(SM+2.00)	EQL04630	
62		DE1A=DE1(IMAX)	EQL04640	
63		E1A=E1(IMAX)	EQL04650	
64		DE2A=DE2(IMAX)	EQL04660	
65		E2A=E2(IMAX)	EQL04670	
66		BH=1.00/ER	EQL04680	
67		BB2=BB*BB	EQL04690	
68		BB3=BB*BB	EQL04700	
69		DO 100 I=1,IMAX	EQL04710	
70		G(I)=3.00*DRF(I)*DS1(I)+2*F1(I)*(-(X(I)/AR)**2+2.00*X(I)*DS1(I)/AR)+EQL04720		
		+ F1(I)*F1(I)+K(I)*PDX(I)*(-(X(I)/AR)**2+2.00*X(I)*DS1(I)/AR)	EQL04730	
71		G(I)=0.500*G(I)	EQL04740	
72		DG1(I)=G(I)+E1(I)	EQL04750	
73		DG2(I)=G(I)+E2(I)	EQL04760	
74	100	CONTINUE	EQL04770	
75		CALL D0SF(H,DG1,G1,IMAX)	EQL04780	
76		CALL D0SF(H,DG2,G2,IMAX)	EQL04790	
77		DO 101 I=1,IMAX	EQL04800	
78		G2(I)=G2(IMAX)-G2(I)	EQL04810	
79	101	CONTINUE	EQL04820	
80		CONST=FA*FA-E1A*DE2A	EQL04830	
81		CONST=1.00/CONST	EQL04840	
82		ETA=GL1(MAX)/(FA*FA-E1A)	EQL04850	
83		CC=E1*(1.00+4.00*AR*DS1(MAX))*(BB3-BB1)/(64.00*AR*AR)	EQL04860	
		1 + BB3*(1.00+4.00*AR*DS1(MAX))*DLOG(BB3)/(16.00*AR*AR)	EQL04870	
84		2 + BB3*(DLOG(BB3))*2*(8.00*AR*AR)-(BB3-BB1)*ETA+0.2500	EQL04880	
		CC=4.00*CC/(E1*(BB3+3.00*BB1)+DE1A*(BB3-BB1))	EQL04890	
85		EE=CC*I(IMAX)	EQL04900	
86		DO 102 I=1,IMAX	EQL04910	
87		Z1=CONST*G1(I)	EQL04920	
88		Z2=CC*CONST*G2(I)	EQL04930	
89		S2(I)=E1(I)*Z2+E2(I)*Z1	EQL04940	
90		DS2(I)=DE1(I)*Z2+E1(I)*CONST*DG2(I)	EQL04950	
		+ DE2(I)*Z1+E2(I)*DG1(I)*CONST	EQL04960	
91	102	CONTINUE	EQL04970	
92		RETURN	EQL04980	
93		END	EQL04990	

J A E R I - M 7310

ST-NO	SOURCE PROGRAM	( DRKGS )	SEQUENCE
57	X=X-H		EQL05570
58	H=.5D0*M		EQL05580
59	DO 19 I=1,NDIM		EQL05590
60	Y(:)=AUX(1,:)		EQL05600
61	DERY(:)=AUX(2,:)		EQLC5610
62	19 AUX(6,:)=AUX(3,:)		EQLC5620
63	GO TO 9		EQL05630
64	20 IMOD=ISTEP/2		EQL05640
65	IF(ISTEP-IMOD-1)MCD) 21+23,21		EQL05650
66	21 CALL FCT(X,Y,DERY)		EQL05660
67	DO 22 I=1,NDIM		EQL05670
68	AUX(5,:)=Y(:)		EQL05680
69	22 AUX(7,:)=DERY(:)		EQL05690
70	GO TO 9		EQL05700
71	23 DELT=0,DO		EQL05710
72	DO 24 I=1,NDIM		EQL05720
73	24 DELT=DELT+AUX(8,I)*DABS(AUX(4,I)-Y(I))		EQL05730
74	IF(DELT=PRMT(4)) 25,26,25		EQLC5740
75	25 IF(IHLF=10) 26,36,36		EQL05750
76	26 DO 27 I=1,NDIM		EQL05760
77	27 AUX(4,:)=AUX(5,:)		EQL05770
78	ISTEP=ISTEP+ISTEP-4		EQL05780
79	X=X-H		EQL05790
80	IEND=0		EQL05800
81	GO TO 16		EQL05810
82	28 CALL FCT(X,Y,DERY)		EQL05820
83	DO 29 I=1,NDIM		EQL05830
84	AUX(1,:)=Y(:)		EQL05840
85	AUX(2,:)=DERY(:)		EQL05850
86	AUX(3,:)=AUX(6,:)		EQL05860
87	Y(:)=AUX(5,:)		EQL05870
88	29 DERY(:)=AUX(7,:)		EQL05880
89	CALL OUTP(X-H,Y,DERY,IHLF,NDIM,PRMT)		EQL05890
90	IF(PRMT(5)) 40,30,40		EQL05900
91	30 DO 31 I=1,NDIM		EQL05910
92	Y(I)=AUX(1,I)		EQL05920
93	31 DERY(I)=AUX(2,I)		EQL05930
94	IREC=IHLF		EQL05940
95	IF(IEND) 32,32+35		EQL05950
96	32 IHLF=IHLF+1		EQL05960
97	ISTEP=ISTEP/2		EQLC5970
98	H=H+H		EQL05980
99	IF(IHLF) 4,33+33		EQL05990
100	33 IMOD=ISTEP/2		EQL06000
101	IF(ISTEP-IMOD-1)MCD) 4+34+4		EQL06010
102	34 IF(DELT-0.02D0*PRMT(4)) 35,35,4		EQL06020
103	35 IHLF=IHLF+1		EQL06030
104	ISTEP=ISTEP/2		EQL06040
105	H=H+H		EQL06050
106	GO TO 4		EQL06060
107	36 IHLF=11		EQL06070
108	CALL FCT(X,Y,DERY)		EQL06080
109	GO TO 39		EQL06090
110	37 IHLF=12		EQL06100
111	GO TO 39		EQL06110
112	38 IHLF=13		EQL06120
113	39 CALL OUTP(X,Y,DERY,IHLF,NDIM,PRMT)		EQL06130
114	40 RETURN		EQL06140

ISN	ST-N <sup>C</sup>	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE OUTP(X,Y,DERY,IMLF,NDIM,PRMT)	EQL06160
2		IMPLICIT DOUBLE PRECISION(A-H,O-Z)	EQL06180
3		DIMENSION Y(1),DERY(1),PRMT(1)	EQL06190
4		(COMMON/VAR/XX(101),XX1(201),YY1(201),XX2(201),YY2(201),	EQL06200
		DY2(201))	EQL06210
5		COMMON/INDEX/KIND,II,JJJ	EQL06220
6		IF(KIND.EQ.2) GO TO 100	EQL06230
7		III=II+1	EQL06240
8		IF(III.GT.200) GO TO 400	EQL06250
9		XX1(III)=X	EQL06260
10		YY1(III)=Y(1)	EQL06270
11		DY1(III)=Y(2)	EQL06280
12		GO TO 101	EQL06290
13	100	CONTINUE	EQL06300
14		JJJ=JJJ+1	EQL06310
15		IF(JJJ.GT.200) GO TO 400	EQL06320
16		XX2(JJJ)=X	EQL06330
17		YY2(JJJ)=Y(1)	EQL06340
18		DY2(JJJ)=Y(2)	EQL06350
19	101	CONTINUE	EQL06360
20		WRITE(6,600) X,Y(1),Y(2),DERY(1),DERY(2),IMLF	EQL06370
21	600	FORMAT(1H ,1F5E14.4,E15)	EQL06380
22		IF(DABS(X-PRMT(2)).LE.1.E-4) GO TO 401	EQL06390
23		RETURN	EQL06400
24	401	PRMT(2)=1.D0	EQL06410
25		RETURN	EQL06420
26	400	WRITE(6,601)	EQL06430
27	601	FORMAT(1H , TOO MANY DIVISIONS //)	EQL06440
28		STOP	EQL06450
29		END	

ISN	ST-N <sup>C</sup>	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE EQUILD	EQL06460
2		IMPLICIT DOUBLE PRECISION(A-H,O-Z)	EQL06480
3		DIMENSION DIST(201),S1F(201),XX1(201)	EQL06490
4		DIMENSION DF3(201),V1(201)	EQL06500
5		COMMON/CUR/X(201),H,IMAX	EQL06510
6		COMMON/IVC/FAD	EQL06520
7		COMMON/E8U/F1(201),DF1(201),F3(201),PP(201),PDX(201),	EQL06530
		,H2(201),DH2(201)	EQL06540
8		COMMON/GE0/S1(201),DS1(201),S2(201),DS2(201)	EQL06550
9		COMMON/E8L/AH,AN,AK,SA,FA,IMAX1,JMAX1,N,M	EQL06560
10		COMMON/EAB/EA,EB	EQL06570
11		COMMON/E8T/RETAP,NNNN,MMMM	EQL06580
12		COMMON/FFC/FF1(201)	EQL06590
13		MAX =MAX1=10<1	EQL06600
14		SA=DFLOAT(MMM)	EQL06610
15		SY=DFLOAT(NNN)	EQL06620
16		F1=1.0D0/DFLOAT(MAX-1)	EQL06630
17		FAB#A#FA#B#TAP	EQL06640
18		F13=1.0D0	EQL06650
19		F13=1.0D	EQL06660
20		F13#=D0/3.0D0	EQL06670
21		IF>NNNN.EQ.0) F13=1.0D	EQL06680
22		F03=F13-1.0D	EQL06690
23		C1=S1F*MAX=0.0D	EQL06700
24		PDX( MAX )=2.0D0*FAB*F13	EQL06710
25		DO 1  1 MAX	EQL06720
26		XX=H*DFLOAT( -1 )	EQL06730
27		X(1)=XX	EQL06740
28		XN=XXX*MMMM	EQL06750
29		IF(XM.EQ.1..AND,NNNN,E0,D) GO TO 2	EQL06760
30		DIST( )=1.0D0-XM)*NNNN	EQL06770
31	2	CONTINUE	EQL06780
32		PP( )= FAR*(1.0D0-XX**2)**F13	EQL06790
33		IF( .EQ.1MAX,AND,F03,E0,C,) GO TO 17	EQL06800
34		PDX( )=2.0D0*FA#B#F13*XX*(1.0D0-XX**2)**F03	EQL06810
35	17	CONTINUE	EQL06820
36		S1F( )= DIST( )*XX	EQL06830
37		F1( )=E0,1) GO TO 1	EQL06840
38		XX1( )= 1.0D0/XX	EQL06850
39	1	CONTINUE	EQL06860
40		CALL DGSF(H,S1F,S1F, MAX )	EQL06870
41		FAD#FA#S1F( MAX )	EQL06880
42		DO 10  =1 MAX	EQL06890
43		F1( )= FAD#S1F( )*XX1( )	EQL06900
44		FF1( )= S1F( )*XX1( )	EQL06910
45		DRF( )= FAD#X( )*DIST( )	EQL06920
46		DF1( )= (DRF( )-F1( ))*XX1( )	EQL06930
47		DS1( )= (F1( )**2-2.0D0*X( )*PDX( ))*X( )	EQL06940
48	10	CONTINUE	EQL06950
49		CALL DGSF(H,DS1,DS1, MAX )	EQL06960
50		DO 12  =2 MAX	EQL06970
51		DS1( )=DS1( )/(AR*X( )*F1( )**2)	EQL06980
52	12	CONTINUE	EQL06990
53		DS1( )=0.0D	EQL07000
54		DH2( )=0.0D	EQL07010
55		CALL DGSF(H,DS1,S1, MAX )	EQL07020
56		DO 4  =2 MAX	

ISN	ST-NO	SOURCE PROGRAM ( EQU1.D )	SEQUENCE
57		DH2(I)=PDX(I)*(1.0D-2.0D*DS1(I)/AR+X(I)*2*0.5D0/(AR*AR)	EQL07C30
	1	-3.0D*X(I)/AR*DS1(I))-F1(I)*DRF(I)/X(I)*(1.0D-1.5D0*DS1(I)*2*2	EQL07C40
	2	-F1(I)*2*DS1(I)*(DS1(I)/X(I)+1.0D/AR)+X(I)*0.5D0/(AR*AR))	EQL07C50
*		DH2(I)=PDX(I)-F1(I)*DRF(I)/X(I)	EQL07D60
58	4	CONTINUE	EQL07D70
59		DH2(I)=0.0D	EQL07D80
60		CALL DDFSF(M,DH2,H2,I MAX)	EQL07D90
61		DO 5 I=1,I MAX	EQL07100
62		H2(I)=DS6RT(1.0D+2.0D*(H2(I)-H2(I) MAX))	EQL07110
63		DH2(I)=DH2(I)/H2(I)	EQL07120
64	5	CONTINUE	EQL07130
65		RETURN	EQL07140
66		END	EQL07150

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE FCT(X,Y,DERY)	EQL07160
2		IMPLICIT DOUBLE PRECISION(A-H,O-Z)	EQL07170
3		DIMENSION Y(1),DERY(1)	EQL07180
4		COMMON/EG1/AR,AN,AK,GA,FA,I MAX,I MAX1,J MAX1,N,M	EQL07190
5		COMMON/E&T/BETAP,NNNN,MMMM	EQL07200
6		COMMON/SBL/B	EQL07210
7		COMMON/FFC/FF1(201)	EQL07220
8		COMMON/COR/XXX(201),H,I MAXD	EQL07230
9		SM=DFLOAT(MMM)	EQL07240
10		DERY(1)=Y(2)	EQL07250
11		DERY(2)=3.0D-Y(2)/X	EQL07260
12		X=X*MMMM	EQL07270
13		DXF=(1.0D-XM)*NNNN	EQL07280
14		CALL SPLINE(XXX,FF1,X,XF,XFD,XFDD,PR0XIN,I MAXD,I)	EQL07290
15		DERY(2)=-(2.0D*DXF/XF-7.0D/X)*Y(2)+(6.0D*DXF/XF-12.0D/X)/X*Y(1)	EQL07300
16		RETURN	EQL07310
17		END	EQL07320

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE INITI	INT00100
2		IMPLICIT DOUBLE PRECISION(A-H,O-Z)	INT00110
3		DOUBLE PRECISION JXE,JXO,JYE,JYO,JZE,JZO	INT00120
4		DIMENSION AJM(5)	INT00130
5		DIMENSION XMM(4,41)	INT00140
6		DIMENSION SRATE(5)	INT00150
7		COMMON/INI/CC(4)	INT00160
8		COMMON/QCOM/QVAL(21)	INT00170
9		COMMON/H31/AUXE(21,19),AUXO(21,19),AUYE(21,19),AUYO(21,19),	INT00180
10		AUZE(21,19),AUZO(21,19),AUXE(21,19),AUZO(21,19),	INT00190
11		AUYE(21,19),AUZO(21,19),AUXE(21,19),AUXO(21,19),	INT00200
12		COMMON/OLD/UZE1(21,19),UZO1(21,19),UYE1(21,19),UYO1(21,19),	INT00210
13		UZE1(21,19),UZO1(21,19),UYE2(21,19),UYO2(21,19),	INT00220
14		UZE2(21,19),UZO2(21,19),UXE(21,19),UXO(21,19),	INT00230
15		UYE(21,19),UYO(21,19),UZE(21,19),UZO(21,19),JXE(21,19),	INT00240
16		JYO(21,19),JZE(21,19),JZO(21,19),JXO(21,19),	INT00250
17		PE(21,19),PO(21,19)	INT00260
18		COMMON/E0X/X(41),XH(41),X(41),F(41),FH(41),H(41),MH(41),	INT00270
19		P(41),PH(41),DP(41),DPX(41)	INT00280
20		COMMON/E01/AR,AN,AK,WA,FA,IMAX,IMAX1,JMAX1,N,M	INT00290
21		COMMON/E0D/DX,DTH,DX1,DTH1	INT00300
22		COMMON/TIME/T,DT,DT2,TMAX	INT00310
23		COMMON/SBL/SHELL	INT00320
24		COMMON/EWT/BETAP,KAPPA,MPARA	INT00330
25		DATA AJM3,B3371001.5,1356200,6,3601600,7,5883400,8,7714800/	INT00340
26		DATA U0>J1/1,0-2,1,0-2/	INT00350
27		ED = 1.0<5	INT00360
28		ED=1,e-5	INT00370
29		EXPUI=DEXP(-ui*dt)	INT00380
30		T=0,	INT00390
31		MMAX=A	INT00400
32		MMAX=MINO(4,MMAX)	INT00410
33		DO 91 J=1,IMAX	INT00420
34		AUXE(1,J)=0.0D0	INT00430
35		AUXO(1,J)=0.0D0	INT00440
36		AUYE(1,J)=0.0D0	INT00450
37		AUZO(1,J)=0.0D0	INT00460
38		AUXC(1,J)=0.0D0	INT00470
39		AUZC(1,J)=0.0D0	INT00480
40		AUZC(1,J)=0.0D0	INT00490
41		91 CONTINUE	INT00500
42		DO 100 MM=1,4	INT00510
43		DNH=DFLOAT(MM)/DFLOAT(N)	INT00520
44		MAXQ=1	INT00530
45		MAXQ=0	INT00540
46		DO 95 I=1,IMAX	INT00550
47		IF(QVAL(I),LT,DNH) MAXQ=1	INT00560
48		MAXQP=MAXQ+1	INT00570
49		WRITE(6,96) MM,MAXQ,MAXQP	INT00580
		96 FORMAT(1H ,5X,' SINGULAR POINT OF MMOD(:+I,+),[2,+*+I]2)	INT00590
		DO 100 I=1,IMAX	INT00600
		IM=I+1	INT00610
		IF(I,EQ,1) IM=1	INT00620
		XMX=X(1)*MM	INT00630
		IF(SHELL,NE,1.0D0) GO TO 107	INT00640
		IF(I,EQ,MAXQ) XM=0.5D0*(X(I)*MM+X(IM)*MM)	INT00650
			INT00660

ISN	ST-NO	SOURCE PROGRAM	( INITI )	SEQUENCE
50		IF(I,LT,MAXQ+1) XM=0.5D0*X(2)*MM	INT00670	
51		IF(I,GT,MAXQ+1) XM=0.0D0	INT00680	
52		IF(MM,GT,MMAX) XM=0.0D0	INT00690	
53		IF(KAPPA,NE,0) GO TO 107	INT00700	
54		DDAX = AJM(MM)/DFLOAT(IMAX1)	INT00710	
55		XM = DDAX*DFLOAT(I-1)	INT00720	
56		CALL BESJ(XM,MM,XX+ED,IEU)	INT00730	
57		XM = XX*XM	INT00740	
58	107	CONTINUE	INT00750	
59		XMX=XMUD	INT00760	
60		XX(MM+1)=XM	INT00770	
61		DO 100 J=1,IMAX	INT00780	
62		THETA=DTH*DFLOAT(J-2)*DFLOAT(MM)	INT00790	
63		UXD=CC(MM)*XMDSIN(THETA)	INT00800	
64		UXE=CC(MM)*XMDCOS(THETA)	INT00810	
65		IF(MM,NE,1) GO TO 99	INT00820	
66		UXO2(1,J)=UXO	INT00830	
67		UXE2(1,J)=UXE	INT00840	
68		GO TO 100	INT00850	
69		99 UXO2(1,J)=UXO2(1,J)+UXO	INT00860	
70		UXE2(1,J)=UXE2(1,J)+UXE	INT00870	
71	100	CONTINUE	INT00880	
72		DO 101 J=1,IMAX	INT00890	
73		PE((MAX,J)=0,	INT00900	
74		PO((MAX,J)=0,	INT00910	
75		QAC((MAX,J)=0,	INT00920	
76		QEX((MAX,J)=0,	INT00930	
77		UXE2((MAX,J)=0,	INT00940	
78		UXO2((MAX,J)=0,	INT00950	
79		UXO(1,J)=0,	INT00960	
80		UXE(1,J)=0,	INT00970	
81		DO 101 I=1,IMAX	INT00980	
82		IM=I+1	INT00990	
83		IF(I,LT,1) IM=1	INT01000	
84		DO 98 MM=1,4	INT01010	
85		CO = CC(MM)*(XX(MM,1)-XX(MM,IM))/(DX*DFLOAT(MM))	INT01020	
86		THETA=DTH*DFLOAT(J-2)*DFLOAT(MM)	INT01030	
87		UYO=CO*DSIN(THETA)	INT01040	
88		UYE=CO*DCOS(THETA)	INT01050	
89		IF(MM,NE,1) GO TO 97	INT01060	
90		UYO2(1,J)=UYO	INT01070	
91		UYE2(1,J)=UYE	INT01080	
92		GO TO 98	INT01090	
93		97 UY02(1,J)=UY02(1,J)+UYO	INT01100	
94		UYE2(1,J)=UYE2(1,J)+UYE	INT01110	
95	98	CONTINUE	INT01120	
96		UXO1(1,J)=UXO2(1,J)*EXPUI	INT01130	
97		UXE1(1,J)=UXE2(1,J)*EXPUI	INT01140	
98		UYO1(1,J)=UYO2(1,J)*EXPUI	INT01150	
99		UYE1(1,J)=UYE2(1,J)*EXPUI	INT01160	
100		UXE2(1,J)=0,	INT01170	
101		UXO2(1,J)=0,	INT01180	
102		UXE1(1,J)=0,	INT01190	
103		UXO1(1,J)=0,	INT01200	
104		UXE(1,J)=0,	INT01210	
105		UXO(1,J)=0,	INT01220	
106		UYE(1,J)=0,	INT01230	

ISN	ST-NO	SOURCE PROGRAM	INITI	SEQUENCE
107		GZO(I,J)=0.		INT01240
108		GEZ(I,J)=0.		INT01250
109		GOZ(I,J)=0.		INT01260
110		POZ(I,J)=0.		INT01270
111		PEZ(I,J)=0.		INT01280
112	101	CONTINUE		INT01290
113		G1=F1(MAX)**2		INT01300
114		IF(SHELL.E0,1) GO TO 700		INT01310
115		SSI=1,-1,/(SMELL**2M)		INT01320
116		SSI=1./SSI		INT01330
117		DO 500 MI=1,5		INT01340
118		FMQA=FLOAT(MI)-AK/FA		INT01350
119		SRATE(MI)=G1*2.DD*FMQA*(1.DD-FMQA*SSI)		INT01360
120	500	CONTINUE		INT01370
121		GO TO 900		INT01380
122	700	DO 800 MI=1,5		INT01390
123		FMQA=FLOAT(MI)-AK/FA		INT01400
124		SRATE(MI)=G1*FMQA*(2.*AN/(AR+AJM(MI))-FMQA)		INT01410
125	800	CONTINUE		INT01420
126	900	CONTINUE		INT01430
127		WRITE(6,600) (I,SRATE(I),I=1,5)		INT01440
128	600	FORMAT(1H0.5X,5I) SRATE('I1')=1.1E12,5//		INT01450
129		CALL 1BOUND		INT01460
130		RETURN		INT01470
131		END		INT01480

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE PERTUB	PTB00100
2		IMPLICIT DOUBLE PRECISION(4-H,O-Z)	PTB00110
3		DOUBLE PRECISION JXE,JYO,JYE,JZO	PTB00120
4		LOGICAL LBD	PTB00130
5		COMMON/DIV/DIV0(DIV(21,19),DIV0(21,19))	PTB00140
6		COMMON/E01/AR=AN*AK*64.FA,TMAX,IMAX1,JMAX1,JMAX2,N,M	PTB00150
7		COMMON/H51/AUXE(21,19),AUZO(21,19),AUYE(21,19),AUYO(21,19),	PTB00160
8		AUE(21,19),AUZC(21,19),AGRE(21,19),AGZO(21,19),	PTB00170
9		A@YE(21,19),AUYO(21,19),@ZE(21,19),AGZE(21,19),AUZO(21,19),	PTB00180
10		COMMON/KS1/UZE2(21,19),UXO2(21,19)*YE2(21,19),UYO2(21,19),	PTB00190
11		UZE2(21,19),UZO2(21,19)*XE(21,19),@XO(21,19),	PTB00200
12		SYE(21,19),@YO(21,19),@ZE(21,19),@ZC(21,19),JXE(21,19),PTB00210	PTB00210
13		JYO(21,19),JYE(21,19),JYO(21,19),JZE(21,19),JZO(21,19),	PTB00220
14		PE(21,19),PO(21,19)	PTB00230
15		COMMON/E04/XH(41),XH(41),XH(41),F(41),FH(41),MH(41),	PTB00240
16		P(41),PH(41),DP(41),DPX(41)	PTB00250
17		COMMON/E05/GGXX(21,19),GGXY(21,19),GGYY(21,19),GGZZ(21,19),	PTB00260
18		GAX(21,19),GXY(21,19),GYY(21,19),GZZ(21,19),XGV(21,19),	PTB00270
19		XGH(21,19),GVH(21,19),AH(21,19),AM(21,19)	PTB00280
20		COMMON/E06/DX1,DTH,DX1,DTH	PTB00290
21		COMMON/SBL/SHELL	PTB00300
22		COMMON/TIME/T,DT,DT2,TMAX	PTB00310
23		COMMON/E08/BT(21,19),BT(21,19),BL(21,19),BH(21,19),	PTB00320
24		* RHO1(41),RHO1H(41)	PTB00330
25		LBD=.FALSE.,	PTB00340
26		AR1=1,DC=AR	PTB00350
27		AR2=AR*AR	PTB00360
28		JMAX2=JMAX1-1	PTB00370
29		AUXO(1,JMAX)=0.0	PTB00380
30		AUXE(1,JMAX)=0.0	PTB00390
31	901	CONTINUE	PTB00400
32		DO 99 J=2,JMAX1	PTB00410
33		DO 100 I=2,IMAX	PTB00420
34		IM=I-1	PTB00430
35		IF(LBD,AND,1,NE,IMAX) GO TO 100	PTB00440
36		HGX=Y0,25D0*XH(I)*((GXV(I,J)*GXY(I,M,J))	PTB00450
37		GYY=GGYY(I,J)	PTB00460
38		AUXE(I,J)=UXE2(I,J)*X(I)	PTB00470
39		AUXO(I,J)=UXO2(I,J)*X(I)	PTB00480
40		AUYE(I,J)=GYY*(UXE2(I,J)+HGXY*(UXO2(I,J)+UXO2(IM,J)))	PTB00490
41		AUYO(I,J)=GYY*(UYO2(I,J)+HGXY*(UXE2(I,J)+UXE2(IM,J)))	PTB00500
42		AU2E(I,J)=GGZZ(I,J)*UZE2(I,J)	PTB00510
43		AUZC(I,J)=GGZZ(I,J)*UZO2(I,J)	PTB00520
44		AUXO(I,J)=0.0	PTB00530
45		AUXE(I,J)=0.0	PTB00540
46	100	CONTINUE	PTB00550
47	99	CONTINUE	PTB00560
48		DO 302 I=2,IMAX	PTB00570
49		IF(LBD,AND,1,NE,IMAX) GO TO 302	PTB00580
50		AUXO(I,1)=-AUXO(I,3)	PTB00590
51		AUXO(I,JMAX)=-AUXO(I,JMAX2)	PTB00600
52		AUYE(I,1)=AUYE(I,3)	PTB00610
53		AUYE(I,JMAX)=AUYE(I,JMAX2)	PTB00620
54		AUYO(I,1)=-AUYO(I,3)	PTB00630
55		AUYO(I,JMAX)=AUYO(I,JMAX2)	PTB00640
56		AUYE(I,1)=AUYE(I,3)	PTB00650
57		AUYE(I,JMAX)=AUYE(I,JMAX2)	PTB00660

ISN	ST-NO	SOURCE PROGRAM	C PERTUB	SEQUENCE
48		AUZO(I,1) =-AUZO(I,3)		PTB00670
49		AUZO(I,JMAX)=-AUZO(I,JMAX2)		PTB00680
50		AUZE(I,1) = AUZE(I,3)		PTB00690
51		AUZE(I,JMAX) = AUZE(I,JMAX2)		PTB00700
52	302	CONTINUE		PTB00710
53		DO 98 J=2,JMAX1		PTB00720
54		JP=J+1		PTB00730
55		JM=J-1		PTB00740
56		DO 101 I=2,IMAX		PTB00750
57		IF(LBD,AND,I,NE,IMAX) GO TO 101		PTB00760
58		IP=I+1		PTB00770
59		IM=I-1		PTB00780
60		O1 = DXI*(A(I,J)*UXO2(I,J)-A(IM,J)*UXO2(IM,J))		PTB00790
61		E1 = DXI*(A(I,J)*UXE2(I,J)-A(IM,J)*UXE2(IM,J))		PTB00800
62		O2 = DTHI*(AH(I,JP)*AUYE(I,JP)-AH(I,JM)*AUYE(I,JM))		PTB00810
63		E2 = DTHI*(AH(I,JP)*AUYO(I,JP)-AH(I,JM)*AUYO(I,JM))		PTB00820
64		QZD(I,J) = XH(I,J)*BTH(I,J)*DTHI*(AUZE(I,JP)-AUZE(I,JM))		PTB00830
		- XH(I,J)*KGVM(I,J)*(C1-O2)		PTB00840
65		QZE(I,J) = XH(I,J)*BTH(I,J)*DTHI*(AUZO(I,JP)-AUZO(I,JM))		PTB00850
		- XH(I,J)*KGVM(I,J)*(E1-E2)		PTB00860
66		QXE(I,J) = RT(I,J)*DTHI*(AUZO(I,JP)-AUZO(I,JM))		PTB00870
		- AK*BZ(I,J)*UXE2(I,J)		PTB00880
67		QXQ(I,J) = -BT(I,J)*DTHI*(AUZE(I,JP)-AUZE(I,JM))		PTB00890
		- AK*BZ(I,J)*UXO2(I,J)		PTB00900
68		QYO(I,J) = AK*(BZ(H,I,J)*AUYO(I,J)*BTH(I,J)*AUZO(I,J))		PTB00910
		- KGVM(I,J)*(DXI*(F(I,J)*UXO(I,J)*BTH(I,J)*AUZE(I,J))		PTB00920
69		QYE(I,J) = AK*(BZ(H,I,J)*AUYE(I,J)*BTH(I,J)*AUZE(I,J))		PTB00930
		- XGVM(I,J)*(DXI*(F(I,J)*AUZE(I,J)*F(IM)*AUZE(IM,J)))		PTB00940
70	101	CONTINUE		PTB00950
71	98	CONTINUE		PTB00960
72		IF(LBD) GO TO 900		PTB00970
73		CALL BOUND		PTB00980
74		LBD=.TRUE.		PTB00990
75		GO TO 901		PTB01000
76	900	CONTINUE		PTB01010
77		DO 303 I=2,IMAX		PTB01020
78		QYQ(I,1) =-QYQ(I,3)		PTB01030
79		QYQ(I,JMAX) =-QYQ(I,JMAX2)		PTB01040
80		QYE(I,1) = QYE(I,3)		PTB01050
81		QYE(I,JMAX) = QYE(I,JMAX2)		PTB01060
82	303	CONTINUE		PTB01070
83		DO 102 J=2,JMAX1		PTB01080
84		DO 102 I=2,IMAX		PTB01090
85		IP=I+1		PTB01100
86		IM=I-1		PTB01110
87		IF(I,=0,IMAX) GO TO 105		PTB01120
88		E1 = 0.5D0*GXV(I,J)*(QYQ(I,J)*QYQ(IP,J))		PTB01130
89		O1 = 0.5D0*GXV(I,J)*(QYE(I,J)*QYE(IP,J))		PTB01140
90		AGXE(I,J) = GXV(I,J)*QXE(I,J)*X(I,J)+E1		PTB01150
91		AGXO(I,J) = GXV(I,J)*UXO(I,J)*X(I,J)-O1		PTB01160
92	105	CONTINUE		PTB01170
93		HGY = 0.25D0*XH(I,J)*(GXV(I,M,J)*GXV(I,J))		PTB01180
94		AYE(I,J) = HGY*(QXO(I,M,J)*QXO(I,J))+GYV(I,J)*QYE(I,J)		PTB01190
95		ABYO(I,J) = HGY*(QXE(I,M,J)*QXE(I,J))+GYV(I,J)*QYQ(I,J)		PTB01200
96		AGZE(I,J) = GZZ(I,J)*QZE(I,J)		PTB01210
97		AGZD(I,J) = GZZ(I,J)*QZD(I,J)		PTB01220
98	102	CONTINUE		PTB01230

ISN	ST-NO	SOURCE PROGRAM	C PERTUB	SEQUENCE
99		DO 301 I=2,IMAX		PTB01240
100		AGXO(I,1) =-AGXO(I,3)		PTB01250
101		AGXO(I,JMAX)=-AGXO(I,JMAX2)		PTB01260
102		AGXE(I,1) = AGXE(I,3)		PTB01270
103		AGXE(I,JMAX) = AGXE(I,JMAX2)		PTB01280
104		AGYQ(I,1) =-AGYQ(I,3)		PTB01290
105		AGYQ(I,JMAX) =-AGYQ(I,JMAX2)		PTB01300
106		AGYE(I,1) = AGYE(I,3)		PTB01310
107		AGYE(I,JMAX) = AGYE(I,JMAX2)		PTB01320
108		AGZO(I,1) =-AGZO(I,3)		PTB01330
109		AGZO(I,JMAX)=-AGZO(I,JMAX2)		PTB01340
110		AGZE(I,1) = AGZE(I,3)		PTB01350
111		AGZE(I,JMAX) = AGZE(I,JMAX2)		PTB01360
112	301	CONTINUE		PTB01370
113		DO 200 J=2,JMAX1		PTB01380
114		JP=J+1		PTB01390
115		JM=J-1		PTB01400
116		DO 200 I=2,IMAX		PTB01410
117		IP=I+1		PTB01420
118		IM=I-1		PTB01430
119		JXE(I,J) = XH(I,J)*DTHI*(AOZO(I,JP)-AGZD(I,JM))+AK*AGYE(I,J)		PTB01440
120		JXO(I,J) = -XH(I,J)*DTHI*(AOZE(I,JP)-AGZE(I,JM))+AK*AGYQ(I,J)		PTB01450
121		IF(I,=0,IMAX) GO TO 205		PTB01460
122		JYE(I,J) = AK*AGXE(I,J)-DXI*(AOZE(IP,J)-AGZE(I,J))		PTB01470
123		JYO(I,J) = AK*AGXO(I,J)-DXI*(AOZO(IP,J)-AGZO(I,J))		PTB01480
124		JZE(I,J) = X(I,J)*(XH(IP)*QXE(IP,J)-XH(J)*QXE(I,J))+AK*AYE(I,J)		PTB01490
125		+ X(I,J)*(DTHI*(AOXO(IP,J)-AOXO(I,J)))		PTB01500
		JZO(I,J) = X(I,J)*(DXI*(XH(IP)*QYQ(IP,J)-XH(J)*QYQ(I,J)))		PTB01510
		+ X(I,J)*(DTHI*(AOXO(IP,J)-AOXO(I,J)))		PTB01520
126	205	CONTINUE		PTB01530
127		O1 = DXI*(GV(I,J)*UXO2(I,J)-GV(I,M,J)*UXO2(IM,J))		PTB01540
128		E1 = DXI*(GV(I,J)*UXE2(I,J)-GV(I,M,J)*UXE2(IM,J))		PTB01550
129		O2 = DTHI*(GVH(I,JP)*AUYE(I,JP)-GVH(I,JM)*AUYE(I,JM))		PTB01560
130		E2 = DTHI*(GVH(I,JP)*AUYO(I,JP)-GVH(I,JM)*AUYO(I,JM))		PTB01570
131		ADIV = XH(I,J)*(GXV(I,J)*(C1-O2)+AK*AUZO(I,J))		PTB01580
132		ADIVE = XH(I,J)*(GXV(I,J)*(C1-E2)+AK*AUZE(I,J))		PTB01590
133		POT(I,J) = PH(I)*ADIV=0.5D0*DPx(I)*AUZO(I,J)*DPx(IM)*AUZO(IM,J)		PTB01600
134		PEC(I,J) = PH(I)*ADIVE=0.5D0*DPx(I)*AUZE(I,J)*DPx(IM)*AUZE(IM,J)		PTB01610
135		DIVOC(I,J) = ADIV		PTB01620
136		DIVE(I,J) = ADIVE		PTB01630
137	200	CONTINUE		PTB01640
138		DO 201 I=2,IMAX		PTB01650
139		JYO(I,1) =-JYO(I,3)		PTB01660
140		JYO(I,JMAX) =-JYO(I,JMAX2)		PTB01670
141		JYE(I,1) = JYE(I,3)		PTB01680
142		JYE(I,JMAX) = JYE(I,JMAX2)		PTB01690
143		POT(I,1) =-PO(I,3)		PTB01700
144		PO(I,JMAX) =-PO(I,JMAX2)		PTB01710
145		PEC(I,1) = PEC(I,3)		PTB01720
146		PEC(I,JMAX) = PEC(I,JMAX2)		PTB01730
147	201	CONTINUE		PTB01740
148		RETURN		PTB01750
149		END		PTB01760

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE ADVANCE(IGS)	ADC00100
2		IMPLICIT DOUBLE PRECISION(A-H,O-Z)	ADC00110
3		LOGICAL IGS	ADC00120
4		DOUBLE PRECISION JT,JTH,JZ,JZH	ADC00130
5		DOUBLE PRECISION JXE,JXO,JYE,JYO,JZE,JZO	ADC00140
6		DIMENSION DDX2(21,19),DDX2E(21,19),DDY2(21,19),DDY2E(21,19)	ADC00150
7		COMMON/EQJ/JT(21),JTH(21,19),JZ(21,19),JZH(21,19)	ADC00160
8		COMMON/EWM/G6XX(21,19),GGXY(21,19),GGYY(21,19),GGZZ(21,19), GXK(21,19),GYX(21,19),GYY(21,19),GXV(21,19),AH(21,19)	ADC00170
9		XGVH(21,19),GV(21,19),GVH(21,19),AX(21,19),AH(21,19)	ADC00180
10		COMMON/TIME/T,DT,DT2,TMAX	ADC00190
11		COMMON/E3L/AR,AN,AK,@A,FA,[MAX1,JMAX1,JMAX1,M]	ADC00210
12		COMMON/EQD/DX1,DTH1,DX1,DTH1	ADC00220
13		COMMON/OLD/UXE1(21,19),UXO1(21,19),UYE1(21,19),UYO1(21,19), UZE1(21,19),UZO1(21,19)	ADC00230
14		COMMON/KSI/UXE2(21,19),UXO2(21,19),UYE2(21,19),UYO2(21,19), UZE2(21,19),UZO2(21,19),UXE(21,19),UXO(21,19), UYE(21,19),UYO(21,19),UZE(21,19),UZO(21,19),JXE(21,19),JZE(21,19), JXO(21,19),JYE(21,19),JYO(21,19),JZ(21,19),JZH(21,19), PE(21,19),PO(21,19)	ADC00240
15		COMMON/EQB/BT(21,19),BTM(21,19),BZ(21,19),BZH(21,19), RHO1(41),RHO1M(41)	ADC00250
16		COMMON/EQX/X(41),XH(41),XI(41),XH1(41),FI(41),FH(41),HM(41), P(41),PH(41),DP(41),DPX(41)	ADC00260
17		COMMON/GROW/ALFA	ADC00280
18		COMMON/SBL/SHELL	ADC00290
19		COMMON/VIO/NPVRNT	ADC00300
20		COMMON/HSI/AUXE(21,19),AUXO(21,19),AUYE(21,19),AUYO(21,19), AUZE(21,19),AUZO(21,19),AUXE(21,19),AUXO(21,19),AUZE(21,19), AUZO(21,19),AUZOD(21,19),AUZED(21,19),AUZOD(21,19), AUZED(21,19),AUZOD(21,19)	ADC00310
21		T=T+DT	ADC00320
22		AR=1.00/AR	ADC00330
23		DT2A=DT2*ALFA	ADC00340
24		DO 100 J=2,JMAX1	ADC00350
25		JM=J+1	ADC00360
26		DO 100 I=2,IMAX	ADC00370
27		IP=I+1	ADC00380
28		IF(I,EG,IMAX) GO TO 10	ADC00390
29		O1 = -X(1,J)*PO(1,P,J)-PO(1,J,P)+0.500*JT(1,J)*(GZ0(1,P,J)+GZ0(1,J))	ADC00400
30		E1 = -DX1(1,P,J)-PE(1,P,J)+DX1(1,J,P)+0.500*JT(1,J)*(GZ1(1,P,J)+GZ1(1,J))	ADC00410
31		O2 = -0.500*JZ(1,J)*(UYO1(1,P,J)+UYO1(1,J))	ADC00420
32		E2 = -0.500*JZ(1,J)*(UYO1(1,P,J)+UYE1(1,J))	ADC00430
33		E3 = -0.500*JZ(1,J)*(UYE1(1,P,J)+UYE1(1,J))	ADC00440
34		O3 = JYO(1,J)*BZ(1,J)-JZ(1,J)*BT(1,J)+BT(1,J)	ADC00450
35		E3 = JYE(1,J)*BZ(1,J)-JZ(1,J)*BT(1,J)+BT(1,J)	ADC00460
36		DDXE(1,J) = X(1,J)*E1+E2+E3	ADC00470
37		DDXO(1,J) = X(1,J)*CO1+O2+O3	ADC00480
38		10 CONTINUE	ADC00490
39		IM=I+1	ADC00500
40		O1 = XH1(1,J)*DTHI*(PE(1,J,P)-PE(1,J,M))-JXO(1,J)*BZH(1,J)	ADC00510
41		E1 = -XH1(1,J)*DTHI*(PO(1,J,P)-PO(1,J,M))-JXE(1,J)*BZH(1,J)	ADC00520
42		O2 = 0.500*XH1(1,J)*JZH(1,J)*(OXO(1,J)+OX(1,M,J))	ADC00530
43		E2 = 0.500*XH1(1,J)*JZH(1,J)*(OXE(1,J)+OXE(1,M,J))	ADC00540
44		DDYO(1,J) = O1+O2	ADC00550
45		DDYE(1,J) = E1+E2	ADC00560

ISN	ST-NO	SOURCE PROGRAM	( ADVANCE )	SEQUENCE
46		100 CONTINUE		ADC00670
47		DO 200 J=2,JMAX1		ADC00680
48		DO 200 I=2,IMAX		ADC00690
49		DTR=DT2*RHO1(1)		ADC00700
50		DTR=DT2*RHO1M(1)		ADC00710
51		[M]=1		ADC00720
52		ID=I+1		ADC00730
53		DYO = DDYO(1,J)		ADC00740
54		DYE = DDYE(1,J)		ADC00750
55		E1 = 0.500*XH1(1,J)*JTH(1,J)*(OXE(1,J)+OXE(1,M,J))		ADC00760
56		O1 = 0.500*XH1(1,J)*JTH(1,J)*(OXO(1,J)+OXO(1,M,J))		ADC00770
57		DZO = AK*PO(1,J,J)*XO(1,J,J)*BT(1,J,J)-O1		ADC00780
58		DZE = AK*PE(1,J,J)*JXE(1,J,J)*BT(1,J,J)+E1		ADC00790
59		UYO3=(1.+DT2A)*UYO2(1,J)*(UYO2(1,J)+UYO1(1,J))+DYO*DTR		ADC00800
60		UYE3=(1.+DT2A)*UYE2(1,J)*(UYE2(1,J)+UYE1(1,J))+DYE*DTR		ADC00810
61		UZO3=(1.+DT2A)*UZO2(1,J)*(UZO2(1,J)+UZO1(1,J))+DZO*DTR		ADC00820
62		UZE3=(1.+DT2A)*UZE2(1,J)*(UZE2(1,J)+UZE1(1,J))+DZE*DTR		ADC00830
63		UYO1(1,J)=UYO2(1,J)		ADC00840
64		UYE1(1,J)=UYE2(1,J)		ADC00850
65		JZO1(1,J)=UZO2(1,J)		ADC00860
66		UZE1(1,J)=UZE2(1,J)		ADC00870
67		UYO2(1,J)=UYO3		ADC00880
68		UYE2(1,J)=UYE3		ADC00890
69		UZO2(1,J)=UZO3		ADC00900
70		UZE2(1,J)=UZE3		ADC00910
C		THIS MUST BE DETERMINED FROM BOUNDARY CONDITION AT R=M IF(I,EG,IMAX) GO TO 205		ADC00920
71		GGXYD = 0.500*X(1,J)*GGXY(1,J)		ADC00930
72		DXO = GGXX(1,J)*DDX2(1,J)+GGXYD*(DDY2(1,J)+DDYE(1,P,J))		ADC00940
73		DXE = GGXX(1,J)*DDX2E(1,J)+GGXYD*(DDY2E(1,J)+DDYE(1,P,J))		ADC00950
74		DXD3=(1.+DT2A)*DXO2(1,J)*(DXO2(1,J)+DXO1(1,J))+DXO*DTR		ADC00960
75		DXE3=(1.+DT2A)*DXE2(1,J)*(DXE2(1,J)+DXE1(1,J))+DXE*DTR		ADC00970
76		DXE3=(1.+DT2A)*UXE2(1,J)*(UXE2(1,J)+UXE1(1,J))+DXE*DTR		ADC00980
77		UXO1(1,J)=UXO2(1,J)		ADC00990
78		UXE1(1,J)=UXE2(1,J)		ADC01000
79		UXD2(1,J)=UXO3		ADC01010
80		UXE2(1,J)=UXE3		ADC01020
81		205 CONTINUE		ADC01030
82		200 CONTINUE		ADC01040
83		IF(IGS) GO TO 900		ADC01050
C		FIRST SETTING TO OBTAIN BOUNDARY VALUE OF UXE2 + UXO2		ADC01060
84		DO 250 J=2,JMAX1		ADC01070
85		UXE2(1,MAX,J)=0,		ADC01080
86		UXO2(1,MAX,J)=0.		ADC01090
87		250 CONTINUE		ADC01100
88		DO 301 J=1,JMAX		ADC01110
89		DO 301 I=1,IMAX		ADC01120
90		AUXED(1,J)=AUXE(1,J)		ADC01130
91		AUXOD(1,J)=AUXO(1,J)		ADC01140
92		AUYED(1,J)=AUYE(1,J)		ADC01150
93		AUYOD(1,J)=AUYO(1,J)		ADC01160
94		AUZED(1,J)=AUZE(1,J)		ADC01170
95		AUZO(1,J)=AUZOC(1,J)		ADC01180
96		301 CONTINUE		ADC01190
97		JFT(1,GT,TMAX) IGS=.TRUE., RETURN		ADC01200
98		900 IF(IMAX,EG,21) GO TO 700		ADC01220
99				ADC01230

ISN	ST-NO	SOURCE PROGRAM	( ADVANCE )	SEQUENCE
100		WRITE(6+800) (J,(UXO2(I,J),I=1,IMAX),J=1,JMAX)		ADC01240
101		600 FORMAT(1H,1X,'THETA='1,2,101E11.3)		ADC01250
102		RETURN		ADC01260
103		700 WRITE(6+800) (J,(UXO2(I,J)+I=1,IMAX+2),J=1,JMAX)		ADC01270
104		RETURN		ADC01280
105		END		ADC01290

SN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE OUTPUT(IGS)	OUT00100
2		IMPLICIT DOUBLE PRECISION(A-H,O-Z)	OUT00110
3		LOGICAL IGS	OUT00120
4		DOUBLE PRECISION JXE,JXO,JYE,JYO,JZE,JZO	OUT00130
5		DIMENSION UXEGN(11)	OUT00140
6		DIMENSION INDEX(S13),S1(S13),Y(1025),Z(1025)	OUT00150
7		COMMON/F67COM/	OUT00160
8		* JBC, IDIM1,DIM2,INDEX,IP,ISL+1,N2,N3,N4,N7,S1,Y,Z	OUT00170
9		COMMON/QCOM/QVAL(21)	OUT00180
10		COMMON/TIME/T,DT,DT2,TMAX	OUT00190
11		COMMON/EG1/AK,AN,AK1,RA,FA,IMAX,IMAX1,JMAX,JMAX1,N,M	OUT00200
12		COMMON /1C/ NP,INPRNT	OUT00210
13		COMMON/HST/AUXE(21,19),AUXO(21,19),AUVE(21,19),AUVO(21,19),	OUT00220
14		1 AUZ(21,19),AUZO(21,19),AUZE(21,19),AUZO(21,19),	OUT00230
15		2 AUYE(21,19),AUZO(21,19),AUZE(21,19),AUZO(21,19),	OUT00240
16		COMMON/KS1/UXE2(21,19),UXO2(21,19),UXE2(21,19),UXO2(21,19),	OUT00250
17		1 UXE2(21,19),UXO2(21,19),UXE2(21,19),UXO2(21,19),	OUT00260
18		2 GYE(21,19)*GYO(21,19),GZE(21,19)*GZO(21,19),JXE(21,19),	OUT00270
19		3 JXO(21,19),JYE(21,19),JYO(21,19),JZE(21,19),JZO(21,19),	OUT00280
20		4 PE(21,19),PO(21,19)	OUT00290
21		COMMON/GROWTH/GRATE(11),DRATE(11),URATE(11),UXFG(11)	OUT00300
22		COMMON/FGROW/FUXE(11),FRATE(9)	OUT00310
23		COMMON/SSL/SHELL	OUT00320
24		COMMON/BCHECK/BCK	OUT00330
25		COMMON/DIV/DIVE(21,19),DIVO(21,19)	OUT00340
26		IF(T,EQ,0.) CALL BCHECK	OUT00350
27		NP=NP+1	OUT00360
28		IF(MOD(NP,NPRTD).NE.0) RETURN	OUT00370
29		NPRTD=NPRTD*25	OUT00380
30		IF(MOD(NP,NPRTD),EQ,0) CALL PLOTP(3)	OUT00390
31		UMAX=0,DO	OUT00400
32		1 IF(T,NE,0,) GO TO 1	OUT00410
33		2 WRITE(6,100)	OUT00420
34		3 100 FORMAT(1H //30(1H-),! GROWTH RATE,EIGEN FUNCTION + FOURIER COMPONENT)	OUT00430
35		4 *NT'150(1H-)//)	OUT00440
36		5 DO 200 I=1,IMAX	OUT00450
37		6 UXEG(I)=1,	OUT00460
38		7 GRATE(I)=0,	OUT00470
39		8 DRATE(I)=C,	OUT00480
40		9 FUXE(I)=1,	OUT00490
41		10 200 DRATE(I)=0,	OUT00500
42		11 MFOUR=-1	OUT00510
43		12 1 CONTINUE	OUT00520
44		13 KAN=3	OUT00530
45		14 JD=2	OUT00540
46		15 IF((MAX,EQ,21) KAN=8	OUT00550
47		16 DO 300 I=1,IMAX	OUT00560
48		17 ID=	OUT00570
49		18 IF((ID,EQ,1) GO TO 300	OUT00580
50		19 IF(UXEG(I),EQ,0,.OP,AUXE(ID,JD),EQ,0.) GO TO 300	OUT00590
51		20 ARG=DABS(AUXE(ID,JD)/UXEG(I))	OUT00600
52		21 IF(ARG,GT,0.0,OR,ARG,LT,0.0,OR,ARG,GT,1.0D0) GO TO 1000	OUT00610
53		22 GRATE(I)=(DLG(DRG)/(CDT*DFLOAT(NPRT)))**2-ALFA	OUT00620
54		23 UXEG(I)=AUXE(ID,JD)	OUT00630
55		24 IF(DABS(UXEG(I)),GT,UMAX) UMAX=DABS(UXEG(I))	OUT00640
56		25 DRATE(I)=GRATE(I)-DRATE(I)	OUT00650
57			OUT00660

ISN	ST-NO	SOURCE PROGRAM ( OUTPUT )	SEQUENCE
50		IF(SHELL,EQ,1) GO TO 300	OUT00670
51		IFF(LUXE(1),EQ,0,) GO TO 300	OUT00680
52		IFF(FXE(1),EQ,0,) GO TO 300	OUT00690
53		IFF(FXE(1),EQ,0,) GO TO 300	OUT00700
54		FARG=DABS(FXE(1)/FUXE(1))	OUT00710
55		FRATE(1)=(DLOG(FARG)/CDT+DFLOAT(NPRNT)))**2-ALFA	OUT00720
56		FUXE(1)=FXE(1)	OUT00730
57	300	ORATE(1)=GRATE(1)	OUT00740
58		DO 340 I=1,IMAX	OUT00750
59		DO 340 I=1,IMAX	OUT00760
60	340	UXEGN(1)=UXEG(1)/UMAX	OUT00770
61		WRITE(6,350) T,(GRATE(1),I=1,10)	OUT00780
62	350	FORMAT(1H,,F4.0,*,1P10E12,3,2X,1H**)	OUT00790
63		IF(SHELL,NE,1) WRITE(6,355) FRATE	OUT00800
64	355	FORMAT(1H,,6X,2H**1P9E12,3,13X,2H**)	OUT00810
65		WRITE(6,360) UMAX,(UXEGN(1),I=1,9)	OUT00820
66	360	FORMAT(1H,,8X,1P10E12,3)	OUT00830
67		MFOUR=MFOUR+1	OUT00840
68		IF(MOD(MFOUR,20),NE,0) GO TO 510	OUT00850
69		WHITE(6,401) ((D1VE(I,J),I=2,11),J=2,JMAX)	OUT00860
70		WHITE(6,402) ((D1VO(I,J),I=2,11),J=2,JMAX)	OUT00870
71	401	FORMAT(1H //4DX,**** DIVERGENCE GS1 EVEN ***!,17(/X,1P10E13,4))	OUT00880
72	402	FORMAT(1H //4DX,**** DIVERGENCE GS1 ODD ***!,17(/5X,1P10E13,4))	OUT00890
73		I=3	OUT00900
74		I=4	OUT00910
75		MAX=2**IMAX	OUT00920
76		XNO=2,DO/DFLOAT(MAX-1)	OUT00930
77		WHITE(6,504)	OUT00940
78	504	FORMAT(1H//2DX,*** EVEN FOURIER COMPONENTS ***!)	OUT00950
79		DO 505 I=2,IMAX	OUT00960
80		DO 505 J=1,MAX	OUT00970
81		((J)=AUXE(I,J+1)	OUT00980
82	501	Y(J)=0.0D	OUT00990
83		CALL FOUR67(2,10)	OUT01000
84		DO 503 J=1,MAX	OUT01010
85	503	Z(J)=XNG(Y(J))	OUT01020
86		WHITE(6,502) ((,(Z(J),J=1,9))	OUT01030
87	502	FORMAT(1H,,2X,*** !*,12,3X,1P9E13,5)	OUT01040
88	505	CONTINUE	OUT01050
89		WHITE(6,554)	OUT01060
90	554	FORMAT(1H//2DX,*** ODD FOURIER COMPONENTS ***!)	OUT01070
91		DO 550 I=2,IMAX	OUT01080
92		DO 551 J=1,MAX	OUT01090
93		Z(J)=AUXO(I,J+1)	OUT01100
94	551	Y(J)=0.0D	OUT01110
95		CALL FOUR67(1,10)	OUT01120
96		DO 552 J=1,MAX	OUT01130
97	552	Z(J)=XNO*Y(J)	OUT01140
98		WHITE(6,502) ((,(Z(J),J=1,9))	OUT01150
99	550	CONTINUE	OUT01160
100		WHITE(6,555)	OUT01170
101	555	FORMAT(1H //)	OUT01180
102	510	CONTINUE	OUT01190
103		IF(TLT,10.) RETURN	OUT01200
104		IF(T,GT,TMAX) GO TO 99	OUT01210
105		DO 400 I=1,IMAX	OUT01220
106		IF(GRATE(1),EW,0,) GO TO 400	OUT01230

ISN	ST-NO	SOURCE PROGRAM ( OUTPUT )	SEQUENCE
107		IF(DABS(GRATE(1))/GRATE(1),GT,5,E-3) RETURN	OUT01240
108	400	CONTINUE	OUT01250
109	99	CONTINUE	OUT01260
110		IGS=.TRUE.	OUT01270
111		NGR=0	OUT01280
112		GRATEM=0.	OUT01290
113		DO 450 I=1,IMAX	OUT01300
114		IF(GRATE(1),EW,0,) GO TO 450	OUT01310
115		NGR=NGR+1	OUT01320
116	450	GRATEM=GRATEM+GRATE(1)	OUT01330
117		GRATEM=GRATEM/DFLOAT(NGR)	OUT01340
118		WHITE(6,500) GA,AR,ALFA,T,GRATEM	OUT01350
119	500	FORMAT(1H,,130(1H-)//30X,*** GA=*,1PE15,8/	OUT01360
	1	30X,*** AR=*,1PE15,8/	OUT01370
	2	30X,*** ALFA=*,1PE15,8/	OUT01380
	3	30X,*** TIME=*,1PE15,8/	OUT01390
	4	30X,*** GRATE=*,1PE15,8/130(1H-)//)	OUT01400
120		RETURN	OUT01410
121	1000	WHITE(6,1001) ARG,I,UXEG(1)	OUT01420
1001		FORMAT(1H,0.9X,*** ARG=*,1PE13,4,*** UXEG(''2*'')=*,1PE13,4)	OUT01430
123		IGS=.TRUE.	OUT01440
124		RETURN	OUT01450
	END	OUT01460	

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE TBOUND	BND00010
2		IMPLICIT DOUBLE PRECISION(A-H,O-Z)	BNU00020
3		LOGICAL LAB	BNU00030
4		DOUBLE PRECISION JXE,JXO,JYE,JYO,JZE,JZO	BND00040
5		DOUBLE PRECISION JZ,JZH,JTJTH	BND00050
6		DIMENSION P(17),Q(17),PD(17),QD(17)	BND00060
7		DIMENSION ECA(17,17),ECR(17,17),ECD(15,15),ECA(15,15),FCA(17,17), 1 FCB(17,17),FCC(17,15),FCD(17,15),FSA(15,17),FSB(15,17), 2 FSC(15,15),FSD(15,15),FCB(17,17),VEC(17),VCD(15)	BND00070 BND00080 BND00090
8		DIMENSION AMAT(64,64),VECTOR(64),VEC(17),VCD(15)	BND00100
9		DIMENSION COA(32),COC(15)	BNU00110
10		DIMENSION COB(17),CDD(15)	BND00120
11		DIMENSION EMAT(32,32),DMAT(64,64)	BND00130
12		DIMENSION EMAT(17,17),FMAT(15,15),GMAT(17,15),HMAT(15,17)	BND00140
13		DIMENSION XA(17,17),XB(17,17),XC(17,17),XD(17,17),YA(17,17), 1 YB(17,17),YC(17,17),YD(17,17),ZA(17,17),ZB(17,17), 2 ZC(17,17),ZD(17,17),XNE(17),YNE(17),XTE(17), 3 YTE(17),SIFE(34),SFOD(17),SFCD(34)	BND00150 BND00160 BND00170 BND00180
14		DIMENSION CAUY(19),CQZ(17),CQD1(17),CQD2(17),CQY(17),CQYC(17), 1 CGA(17),CGB(17),BOD(17),RTD(17)	BND00190 BND00200
15		+ DIMENSION FX(32),FCM(64),FS1(64),FG2(64)	BND00210
16		DIMENSION BMAT(32,32)	BND00220
17		DIMENSION CGE(17),CGO(17)	BND00230
18		DIMENSION ZCAU(17),PCIN(17),POEX(17),PEIN(17),PEEX(17)	BND00240
19		DIMENSION FOE(17),FOC(17),FOXE(17),FOAO(17)	BND00250
20		DIMENSION FOYED(17),FOYOD(17),FOZED(17),FOZOD(17)	BND00260
21		DIMENSION FOY(17),FOYOD(17),FOZE(17),FOZOD(17), 1 FPEIN(17),FPOIN(17),FPEEX(17),FPOEX(17)	BND00270 BND00280
22		DIMENSION OITA(17,17),EITA(17,17)	BND00290
23		DIMENSION QYED(17),QYOD(17),QYD(17)	BND00300
24		DIMENSION QYE(17),QYOD(17),QZE(17),QZD(17)	BND00310
25		DIMENSION INDEX(513),S(513),Y(1025),Z(1025)	BND00320
26		COMMON/F67COM/	BND00330
27		* IBC,1,1,1,1,1,1,INDEX,(P,ISL,LL,N2,N3,N4,N7,S1,Y,Z COMMON/EWP//3(21),PD3(21),PD3(21),P3H(21),PD3H(21), 1 E3(21),ED3(21),ED3(21),E3H(21),ED3H(21)	BND00340 BND00350 BND00360
28		COMMON/E0X/W(41),AH(41),X(41),XH(41),F(41),FH(41),MH(41)	BND00370
29		1 PPPP(41),PH(41),DP(41),DPX(41)	BND00380
30		COMMON/EQC/Z(21,19),QZ(21,19),QP1(21,19),QP2(21,19),DPH(21)	BND00390
31		COMMON/DELTA/D(21),DH(21),DD(21),DDH(21)	BND00400
32		COMMON/SBL/SHELL	BND00410
33		COMMON/EBB/EB	BND00420
34		COMMON/EOT/ETAPL,<KAPP,A,MHARA	BND00430
35		COMMON/KSI/XE2(21,19),UXO2(21,19)*,UYE2(21,19),UYO2(21,19), 1 UZE2(21,19),UZO2(21,19),UXE2(21,19),UXO(21,19), 2 QYE(21,19),QZD(21,19),QZE(21,19),QZD(21,19),JXE(21,19), 3 JXO(21,19),JYE(21,19),JYO(21,19),JZE(21,19),JZO(21,19), 4 PE(21,19),PD(21,19)	BND00440 BND00450 BND00460 BND00470 BND00480 BND00490
36		COMMON/EQB/RT(21,19),BT(21,19),BZ(21,19),BZH(21,19), 1 RHO(1),RH(1),H(1)	BND00500 BND00510
37		COMMON/EQJ/AR,AN,AK,QA,FA,[MAX,[MAX1,JMAX1,JMAX1,N,MWMW COMMON/EQM/GGXX(21,19),GGXY(21,19),GGYY(21,19),GGZZ(21,19), 1 GXG(21,19),GXH(21,19),GYY(21,19),GZG(21,19),XGV(21,19), 2 XGH(21,19),GY(21,19),GV(21,19),AZ(21,19),AH(21,19)	BND00520 BND00530 BND00540 BND00550
38		COMMON/EWJ/UT(21),JTH(21),JZ(21,19),JZH(21,19)	BND00560
39		COMMON/BCHECK/FXE(17),FXU(17)	BND00570

ISN	ST-NO	SOURCE PROGRAM	C (TBOUND)	SEQUENCE
41		COMMON/TIME/T,DT,DT2,TMAX	BND00580	
42		COMMON/ADM/AJZ(41,19),GYI(21,19),GYH(21,19)	BND00590	
43		EQUIVALENCE (COA(18),COC(1))	BND00600	
44		EQUIVALENCE (SIFE(18),SFOD(1))	BND00610	
45		DATA PA1/3,14159265358979300/	BND00620	
46		CA1=2,187500	BND00630	
47		IQ=4	BND00640	
48		NM=2**10	BND00650	
49		FNM=FLOAT(NM)	BND00660	
50		XH0=2,DCG/FNM	BND00670	
51		MAX=N+M+1	BND00680	
52		CALL SETF67(1,IQ)	BND00690	
53		IF(SHELL,E0,1) RETURN	BND00700	
54		[MAX2=1,MAX-2	BND00710	
55		DTHD=PA1/DFLOAT(JMAX-3)	BND00720	
56		DTHF=DTH	BND00730	
c		NORMALIZATION FACTOR OF TOROIDAL RING FUNCTIONS	BND00740	
57		COSH=AR+1,DO(4,DO=AR)	BND00750	
58		CALL PHALF(COSH,N,MAX,P,Q,PD,AD)	BND00770	
59		MAX21=MAX/2	BND00780	
60		PNORM=ABS(1.00/P(MAX21))	RND00790	
61		QNORM=ABS(1.00/Q(MAX21))	BND00800	
62		NAMELIST/NORM/PNORM,GNORM	BND00810	
63		WHITE(6,NORM)	BND00820	
c		MAXD=MAX-2	BND00830	
64		MAX2=MAX*MAXD	BND00840	
65		MAX3=MAX2*MAX	BND00850	
66		MAX4=MAX3*MAXD	BND00860	
67		DC 140 J=1,MAX4	BND00870	
68		DO 140 J=1,MAX4	BND00880	
69		140 AMAT(I,J)=0,	BND00890	
70		MAXH=MAX-1	BND00900	
71		MAXDM=MAXD-1	BND00910	
72		FA=AF([MAX])	BND00920	
73		AR=1,PAR	BND00930	
74		AR1=1,PAR	BND00940	
75		AR2=AR*AR	BND00950	
76		FA2=FA*FA	BND00960	
77		FAD=0,SD=FA*(ARI-DD([MAX])	BND00970	
78		AND=AR-D([MAX])	BND00980	
79		SR=ARD	BND00990	
80		RDSQRT(SR*SR-1,DO)	BND01000	
81		LAB=.FALSE.,	BND01010	
82		RAB=SHELL	BND01020	
83		SS=SR*BAB	BND01030	
84		SD=(SS-1,DO)*(2.00*DD([MAX])-ARI)/4.00+0.500*SS*ARI*DLOG(RAB)	BND01040	
85		SD=SD*D([MAX])	BND01050	
86		ARD=AR-SD	BND01060	
87		100 CONTINUE	BND01070	
88		DO 110 M=1,MAX	BND01080	
89		DHETA=DTD*DFLOAT(M-1)	BND01090	
90		IF(LAB) GO TO 115	BND01100	
91		COST=(SHELL-EH)*DCOS(DHETA)	BND01110	
92		SINT=(SHELL-EH)*DSIN(DHETA)	BND01120	
		GO TO 116	BND01130	
			BND01140	

ISN	ST-NO	SOURCE PROGRAM ( IBOUND )	SEQUENCE
94	115	COST=(1.00+E3*(MAX))*DCOS(DMETA)	BND01150
95		SINT=(1.00+E3*(MAX))*DSIN(DMETA)	BND01160
96	116	CONTINUE	BND01170
97		AX=ARD-COST	BND01180
98		AZ=SINT	BND01190
99		XW=((AX+R)*(AX+R)+AZ*AZ)/((AX+R)*(AX+R)+AZ*AZ)	BND01200
100		PNUE=0.5D0*DLOG(XL)	BND01210
101		SINHP=DSINH(PNUE)	BND01220
102		COSH=DCOSH(PNUE)	BND01230
103		CALL PGHALF(COSH,N,MAX,P,Q,PD,QQ)	BND01240
104		AXD=AX*AX+AZ*AZ-R*R	BND01250
105		AZD=2.0D0*AZ	BND01260
106		IF (DABS(AXD),LT,1.0D-8) GO TO 111	BND01270
107		PITA=DATAN(AZD/AXD)	BND01280
108		IF (AXD,LT,0.) PITA=PITA+PAI	BND01290
109		GO TO 112	BND01300
110	111	PITA=PAI/2.00	BND01310
111	112	CONTINUE	BND01320
112		SINP=DSIN(PITA)	BND01330
113		COSP=DCOS(PITA)	BND01340
114		XCOS=COSH-COSP	BND01350
115		FF=DSQRT(XCOS/R)	BND01360
116		MD=M+1	BND01370
117		XCOE=AX*AH1*XGV((MAX,MD))/XCOS	BND01380
118		YCOE=1./XCOS	BND01390
119		CCOE=1.-COSH*COSP	BND01400
120		SCOE=SINH*SINP	BND01410
121		IF (LAB1) GO TO 117	BND01420
122		COST=(SHELL+EB)*DCOS(DMETA)	BND01430
123		SINT=(SHELL+EB)*DSIN(DMETA)	BND01440
124		GO TO 119	BND01450
125	117	COST=(1.00+E3*(MAX))*DCOS(DMETA)	BND01460
126		SINT=(1.00+E3*(MAX))*DSIN(DMETA)	BND01470
127		AXDR=(1.00+ED3*(MAX))*DCOS(DMETA)	BND01480
128		AZDR=(1.00+ED3*(MAX))*DSIN(DMETA)	BND01490
129	119	CONTINUE	BND01500
130		XNUE(M)=XCOE*(COST+CCOE+SINT+SCOE)	BND01510
131		XITAM()=XCOE*(COST+SCOE-SINT+CCOE)	BND01520
132		YNUE(M)=YCOE*(SINT+CCOE-COST+SCOE)	BND01530
133		YITAM()=YCOE*(SINT+SCOE+COST+CCOE)	BND01540
134		YNUE(M)=XCOE*(AZDR+CCOE+AXDR+SCOE)	BND01550
135		YITAM()=XCOE*(AZDR+SCOE-AXDR+CCOE)	BND01560
136		DO 113 MT=1,MAX	BND01570
137		P(MT)=PNORM#(MT)	BND01580
138		G(MT)=UNORM#(MT)	BND01590
139		PD(MT)=PNORM#PD(MT)	BND01600
140		GU(MT)=UNORM#QD(MT)	BND01610
141		FMT=DFL#AT(MT-1)	BND01620
142		SINHP=DSIN(FMT#PITA)	BND01630
143		COSMP=DCOS(FMT#PITA)	BND01640
144		XP=FF*SINHP*(0.5D0*P(MT))+XCOS*PD(MT)	BND01650
145		XX=FF*SINHP*(0.5D0*G(MT))+XCOS*QD(MT)	BND01660
146		XA(M,MT)=XXP+COSMP	BND01670
147		XB(M,MT)=XXQ+COSMP	BND01680
148		XC(M,MT)=XXP*SINMP	BND01690
149		XD(M,MT)=XXQ*SINMP	BND01700
150		Y1=0.5D0*SINP*COSMP=FMT*XCOS*SINMP	BND01710

ISN	ST-NO	SOURCE PROGRAM ( IBOUND )	SEQUENCE
151		Y2=0.5D0*SINP*SINMP+FMT*XCOS*COSMP	BNU01720
152		YA(M,MT)=FF*P(MT)*Y1	BNU01730
153		YE(M,MT)=FF*G(MT)*Y1	BNU01740
154		YC(M,MT)=FF*P(MT)*Y2	BNU01750
155		YD(M,MT)=FF*G(MT)*Y2	BNU01760
156		ZZD=AR*AR+AK*XCOS**2+FF/(R+5)*INHP**2	BNU01770
157		ZA(M,MT)=ZZD#P(MT)*COSMP	BNU01780
158		ZB(M,MT)=ZZD#Q(MT)*COSMP	BNU01790
159		ZC(M,MT)=ZZD#P(MT)*SINMP	BNU01800
160		ZD(M,MT)=ZZD#Q(MT)*SINMP	BNU01810
161	113	CONTINUE	BNU01820
162	110	CONTINUE	BNU01830
C		BOUNDARY CONDITION FOR GRELX=0, AT SHELL SURFACE (LAB1,FALSE,)	BNU01840
C		AND ORIN=GRELX AT PLASMA SURFACE (LAB2,TRUE,)	BNU01850
C		DO 135 MT=1,MAX	BNU01860
163		DO 136 M=1,MAX	BNU01870
164		ECA(M,MT)=XA(M,MT)*XNUE(M)+YA(M,MT)*XITA(M)	BNU01880
165		ECB(M,MT)=XB(M,MT)*XNUE(M)+YB(M,MT)*XITA(M)	BNU01890
166		IF (M,GT,MAXD,OR,MT,GT,MAXD) GO TO 136	BNU01900
167		M#M=1	BNU01910
168		MP#MT=1	BNU01920
169		ESCM(M,MT)= XC(MP,MT)*XNUE(MP)+YC(MP,MT)*XITA(MP)	BNU01930
170		ESDC(M,MT)= XU(MP,MT)*XNUE(MP)+YD(MP,MT)*XITA(MP)	BNU01940
171		RAB=1.0D	BNU01950
172	136	CONTINUE	BNU01960
173	135	CONTINUE	BNU01970
174		IF (LAB2) GO TO 118	BNU01980
175		RAB=1.0D	BNU01990
176		AND#R#D((MAX))	BNU02000
177		LAB2,TRUE,	BNU02010
178		CALL DMATIV(ECB,MAX,VEC,0,DETERM)	BNU02020
179		CALL DMATIV(ESD,MAXD,VEC,0,DETERM)	BNU02030
180		CALL GMPRD(ECB,ECB,DCBA,MAX,MAX,MAX)	BNU02040
181		CALL GMPHD(ESD,ESD,USDC,MAXD,MAXD,MAXD)	BNU02050
182		GO TO 100	BNU02060
183	118	CONTINUE	BNU02070
C		BOUNDARY CONDITION FOR PRESSURE BALANCE AT PLASMA SURFACE	BNU02080
C		DO 120 MT=1,MAX	BNU02090
184		MP#MT=1	BNU02100
185		DO 126 M=1,MAX	BNU02110
186		MP#M=1	BNU02120
187		FCA(M,MT)=ZA(M,MT)	BNU02130
188		FCB(M,MT)=ZB(M,MT)	BNU02140
189		IF(MT,GT,MAXD) GO TO 121	BNU02150
190		FCC(M,MT)=XC(M,MT)*YNUE(M)+YC(M,MT)*YITA(M)	BNU02160
191		FCD(M,MT)=XD(M,MT)*YNUE(M)+YD(M,MT)*YITA(M)	BNU02170
192	121	CONTINUE	BNU02180
193		IF(M,GT,MAXD) GO TO 126	BNU02190
194		FA(M,MT)=XA(M,MT)*YNUE(MP)+YA(MP,MT)*YITA(MP)	BNU02200
195		FB(M,MT)=XB(M,MT)*YNUE(MP)+YB(MP,MT)*YITA(MP)	BNU02210
196		FSB(M,MT)=XB(M,MT)*YNUE(MP)+YB(MP,MT)*YITA(MP)	BNU02220
197		IF(MT,GT,MAXD) GO TO 126	BNU02230
198		FSC(M,MT)=2C(MP,MTP)	BNU02240
199		FSD(M,MT)=2D(MP,MTP)	BNU02250
200	126	CONTINUE	BNU02260

ISN	ST-NO	SOURCE PROGRAM	( IBOUND )	SEQUENCE
201	120	CONTINUE		BND02290
	C	CALCULATION OF COEFFICIENTS OF MATRIX ELEMENTS		BND02300
202		BD=DPX( MAX )		BND02310
203		BD=2,DO*(2,DO*FA*FA*DD( MAX )*DPX( MAX )*ARI)		BND02320
204		BD=DPX( MAX )		BND02330
205		BD=BD*1,DO+1,5DO/AR2+2,DD=D( MAX /AR)		BND02340
206		BD=BD*4,DO*FA2*(DD( MAX )/AR-PD3( MAX )-0,75DO/DD( MAX )*2)		BND02350
207		BD=BD-BD*(2,DO*D( MAX )+3,DO*DD( MAX )-0,5DO*AR1)*ARI		BND02360
208		BD=BD*2,DO*FA2*DD( MAX )*2+FA2*(D( MAX )*ARI)+0,5DO/AR2)		BND02370
209		BD1=BD*2,DO/AR4,DO*FA2*D( MAX )		BND02380
210		BD2=1,5DO*BD/AR2+4,DO*FA2*(DD( MAX )/AR-E3( MAX ))		BND02390
211		BD2=BD*2+3,DO*FA2*DD( MAX )*2		BND02400
212		JONE=10		BND02410
213		IF (DAB5(J,Z MAX,JONE))<LT,1,D=4) BDT=2,DO*DPX( MAX )*ARI		BND02420
214		DO 710 J=1,MAX		BND02430
215		CAUY(J)=GGY(( MAX ,J)*0,25DO*XH1( MAX )*(GXY(( MAX ,J)+GXY(( MAX ,J)))		BND02440
216	700	CONTINUE		BND02450
217		DO 710 J=1,MAX		BND02460
218		K=j+1		BND02470
219		CAU(J)= DTH1*BTK( MAX ,K)		BND02480
220		CAU(J)= AK*BZC( MAX ,K)		BND02490
221		CAU(J)= CA1*XH1( MAX )*XGVH( MAX ,K)*DX1*A( MAX ,K)		BND02500
222		CAUD1(J)= CA1*XH1( MAX )*XGVH( MAX ,K)*DTH1*A( MAX ,K+1)*CAU(J+1)		BND02510
223		CAUD2(J)= CA1*XH1( MAX )*XGVH( MAX ,K)*DTH1*A( MAX ,K+1)*CAU(J)		BND02520
224		CAU(J)= CA1*XGVH( MAX ,K)*DX1*FA		BND02530
225		CAUC(J)= CA1*AK=BZH( MAX ,K)*CAU(K)		BND02540
226	710	CONTINUE		BND02550
227		BD = F( MAX )*2+(DD( MAX )*2+DD( MAX )/AR+1,DO/(2,DO*AR*AR))		BND02560
228		DO 750 J=1,MAX		BND02570
229		THETA=DTH1*DFLOAT(J-1)		BND02580
230		BOD(J)=BD*BD*TDCOS(THETA)		BND02590
231		IF (KAPPA,E0,0) BOD(J)=BD0+BD1*D COS(THETA)+BD2*D COS(2,DO*THETA)		BND02600
232		BD(J)=BTD( MAX ,J+1)		BND02610
233	750	CONTINUE		BND02620
234		MAX2P=MAX2+1		BND02630
235		MAX3P=MAX3+1		BND02640
236		MAX0M2=MAX0M+1		BND02650
237		MAX0M3=MAX0M-3		BND02660
238		DO 150 M=1,MAX		BND02670
239		MP=M1		BND02680
240		M1=M		BND02690
241		M2=MAX+M		BND02700
242		M3=MAX2+M		BND02710
243		M4=MAX3+M		BND02720
244		AMAT(M1,M3) = C0B(M)		BND02730
245		AMAT(M3,M3) = BOD(M)+BTD(M)*C0Y(M)-C0Z(M)		BND02740
246		AMAT(M3,M3) = BOD(M)+RTD(M)*GYY(( MAX ,MP)*C0Y(M)-C0Z(M))		BND02750
247		IF (M,GT,MAXM) GO TO 150		BND02760
248		AMAT(M3+1,M3) = -C0Z01(M)		BND02770
249		AMAT(M3+1,M3) = -(C0Z02(M+1))		BND02780
250		AMAT(M3,M3+1) = -BTD(M)*GYX(( MAX ,MP)*C0A(M)-C0Z1(M))		BND02790
251		AMAT(M3+1,M3) = BTD(M)*GYX(( MAX ,MP+1)*C0A(MP)-C0Z2(MP))		BND02800
252		IF (M,GT,MAXD) GO TO 150		BND02810
253		AMAT(M1,M4) = -C0A(M)		BND02820
254		AMAT(M1+2,M4) = C0A(M+2)		BND02830
255		AMAT(M1+2,M4) = C0A(M+4)		BND02840
256		AMAT(M1+2,M4) = C0A(M+6)		BND02850

ISN	ST-NO	SOURCE PROGRAM	( IBOUND )	SEQUENCE
255		AMAT(M2+M3) = -C0A(M+1)		BND02860
256		AMAT(M2+M3+2) = C0A(M+1)		BND02870
257		AMAT(M3+1,M4) = BTD(MP)*C0Y(MP)		BND02880
258		AMAT(M4+M3+1) = -BTD(MP)*C0Y(MP)		BND02890
259		AMAT(M3+1,M4) = -BTD(MP)*(GXY(( MAX ,MP+1)*C0B(MP)-GYY(( MAX ,MP+1)*C0Y(MP)))		BND02900
260		AMAT(M4+M3+1) = BTD(MP)*(GYX(( MAX ,MP+1)*C0B(MP)-GYY(( MAX ,MP+1)*C0Y(MP)))		BND02910
261		AMAT(M4,M4) = BOD(MP)+BTD(MP)*C0Y(MP)-C0Z(MP)		BND02920
262		AMAT(M4,M4) = BOD(MP)+BTD(MP)*GYY(( MAX ,MP+1)*C0Y(MP)-C0Z(MP))		BND02930
263		AMAT(M2,M4) = C0B(MP)		BND02940
264		IF (M,GT,MAXDM) GO TO 150		BND02950
265		AMAT(M4,M4+1) = -C0Z01(MP)		BND02960
266		AMAT(M4+1,M4) = -C0Z02(MP+1)		BND02970
267		AMAT(M4,M4+1) = -BTD(MP)*GYX(( MAX ,MP+1)*C0A(MP)-C0Z1(MP))		BND02980
268		AMAT(M4+1,M4) = BTD(MP+1)*GYX(( MAX ,MP+2)*C0A(MP+1)-C0Z2(MP+1))		BND02990
269	150	CONTINUE		BND03000
270		CALL GMPRD(ECB,DCBA,EMAT,MAX,MAX,MAX)		BND03010
271		CALL GMPRD(ESD,DSDC,FMAT,MAXD,MAXD,MAXD)		BND03020
272		DO 160 J=1,MAX		BND03030
273		DO 161 I=1,MAX		BND03040
274		AMAT(I,J) = ECA(I,J)-EMAT(I,J)		BND03050
275		IF (I,GT,MAXD,OR,J,GT,MAXD) GO TO 161		BND03060
276		AMAT(I+MAX,I+MAX)=ESCI(I,J)=FMAT(I,J)		BND03070
277	161	CONTINUE		BND03080
278	160	CONTINUE		BND03090
279		DO 166 K=1,MAXD		BND03100
280		DO 166 J=1,MAX		BND03110
281		JP=j+1		BND03120
282		JM=j-1		BND03130
283		IF (J,EQ,1,OR,J,EQ,MAX) JM=1		BND03140
284		FCC(J,K)=GYX(( MAX ,JP)*ESL(JM,K)+GYY(( MAX ,JP)*FCC(J,K))		BND03150
285		FCD(J,K)=GYX(( MAX ,JP)*ESD(JM,K)+GYY(( MAX ,JP)*FCD(J,K))		BND03160
286	166	CONTINUE		BND03170
287		DO 167 K=1,MAXD		BND03180
288		DO 167 J=1,MAXD		BND03190
289		JP=j+1		BND03200
290		JP2=JP+1		BND03210
291		FSA(J,K)=GYX(( MAX ,JP2)*ECA(JP,K)+GYY(( MAX ,JP2)*FSA(J,K))		BND03220
292		FSB(J,K)=GYX(( MAX ,JP2)*ECB(JP,K)+GYY(( MAX ,JP2)*FSB(J,K))		BND03230
293	167	CONTINUE		BND03240
294		CALL GMPRD(FCB,DCBA,EMAT,MAX,MAX,MAX)		BND03250
295		CALL GMPRD(FCD,DSDC,GMAT,MAXD,MAXD,MAXD)		BND03260
296		CALL GMPRD(FSD,DCBA,HMAT,MAXD,MAXD,MAXD)		BND03270
297		CALL GMPRD(FSD,DSDC,FMAT,MAXD,MAXD,MAXD)		BND03280
298		DO 162 J=1,MAXD		BND03290
299		DO 163 I=1,MAX		BND03300
300		AMAT(I+MAX2,J) =-(FCA(I,J)-EMAT(I,J))		BND03310
301		IF (I,GT,MAXD,OR,J,GT,MAXD) GO TO 163		BND03320
302		AMAT(I+MAX3,J+MAX) = FSC(I,J)-FMAT(I,J)		BND03330
303	163	CONTINUE		BND03340
304	162	CONTINUE		BND03350
305		DO 164 I=1,MAXD		BND03360
306		DO 164 J=1,MAXD		BND03370
307		AMAT(I+MAX2,J+MAX)=BTD(I)*(FCC(I,J)-GMAT(I,J))		BND03380
308		DO 165 J=1,MAXD		BND03390
309		DO 165 I=1,MAXD		BND03400

ISN	ST-NO	SOURCE PROGRAM ( IBOUND )	SEQUENCE
310	165	AMAT(I+MAX3,J)= BTD(I+1)*(FSAC(I,J)-HMAT(I,J))	BND03430
	C	CORRECTION OF MATRIX ELEMENT	BND03440
	C	AMAT(MAX2+1,MAX2+2)=AMAT(MAX2+1,MAX2+2)-C02D2(1)	BND03450
	C	* BTD(1)*GXY([MAX,2]*C0A(1)	BND03460
311		AMAT(MAX3,MAX3-1)=AMAT(MAX3,MAX3-1)-CwZD1(MAX)	BND03470
	C	* BTD(MAX)*GXY([MAX,MAX+1])*C0A(MAX)	BND03480
312		AMAT(1,MAX3+1)=0.00*AMAT(1,MAX3+1)	BND03500
313		AMAT(MAX,MAX4)=2.00*AMAT(MAX,MAX4)	BND03510
314		DO 171 J=1,MAX4	BND03520
315		DO 171 I=1,MAX4	BND03530
316		171 DMAT(I,J)=AMAT(I,J)	BND03540
317		CALL DMATIV(AMAT,MAX4,VECTOR,0,DETERM)	BND03550
318		DO 172 J=1,MAX2	BND03560
319		DO 172 I=1,MAX2	BND03570
320		172 BMAT(I,J)=AMAT(I+MAX2,J+MAX2)	BND03580
321		DO 173 I=1,MAX2	BND03590
322		DO 173 J=1,MAX2	BND03600
323		173 CMAT(I,J)=AMAT(I,J+MAX2)	BND03610
324		DO 175 J=1,MAX	BND03620
325		DO 175 I=1,MAX	BND03630
326		175 DCBA(I,J)=DCBA(I,J)	BND03640
327		DO 176 I=1,MAXD	BND03650
328		DO 176 J=1,MAXD	BND03660
329		176 DSDC(I,J)=DSDC(I,J)	BND03670
330		WRITE(6,188) FA,FAD,BD,BDT	BND03700
331		88 FORMAT(1HO, * * FA=*,1PE14.5, * * FAD=*,1PE14.5,	BND03710
332		* * BD=*,1PE14.5, * * BDT=*,1PE14.5)	BND03720
333		RETURN	BND03730
	C	ENTRY BOUND	BND03740
334		MFCUT=5	BND03750
335		IF(SHELL,EG,1.0) GO TO 991	BND03770
336		C2=CA1	BND03780
337		IF(DABS(I),L1,1.0) MFCUT=17	BND03790
338		C3=1,3125D0	BND03800
339		C4=0,3125D0	BND03810
340		I1=IMAX	BND03820
341		I2=IMAX-1	BND03830
342		I3=IMAX-2	BND03840
343		I4=IMAX-3	BND03850
344		DO 500 J=1,MAX	BND03860
345		JD=J+1	BND03870
346		YED(J)=CA1*GYE([1,J]) + C2*GYE([2,J]) + C3*GYE([3,J]) + C4*GYE([4,J])	BND03880
347		WEZD(J)=CA1*WEZ([1,J]) + C2*WEZ([2,J]) + C3*WEZ([3,J]) + C4*WEZ([4,J])	BND03890
348		YQD(J)=CA1*YO([1,J]) + C2*YO([2,J]) + C3*YO([3,J]) + C4*YO([4,J])	BND03900
349		QZD(J)=CA1*QZD([1,J]) + C2*QZD([2,J]) + C3*QZD([3,J]) + C4*QZD([4,J])	BND03910
350		CONTINUE	BND03920
351	500	DO 560 J=1,MAX	BND03930
352		SIFE(J)= BTDC(J)*GYED(J)+WEZD(J)	BND03940
353		SIFE(J)= BTDC(J)*GYV1([MAX,J+1])*YED(J)+WEZD(J)	BND03950
354		IF(J,GT,MAXD) GO TO 560	BND03960
355		JP=J+1	BND03970
356		SIFO(J)= BTDC(JP)*GYU0(JP)+QZD(JP)	BND03980
357		CONTINUE	BND03990

ISN	ST-NO	SOURCE PROGRAM ( IBOUND )	SEQUENCE
358		SIFO(J)= BTDC(JP)*GYV1([MAX,JP+1])*YU0(JP)+QZD(JP)	BND04000
359	560	CONTINUE	BND04010
360		DO 800 M=1,MAX2	BND04020
361	800	SIFD(M)=SIFE(M)	BND04030
362		CALL GMFD(BMAT,SIFD,SIFE,MAX2,MAX2,1)	BND04040
363		DO 572 M=1,MAX2	BND04050
364		572 FX(M)=SIFE(M)	BND04060
365		DO 580 J=1,MAX	BND04070
366		Z(J)=SIFE(J)	BND04080
367		580 Y(J)=0.00	BND04090
368		CALL FOUR67(2,[0])	BND04100
369		DO 581 J=1,MAX	BND04110
370		FX(J)=XND*Y(J)	BND04120
371		Z(J)=XND*Y(J)	BND04130
372		IF(J,GT,MFCUT) Z(J)=0.00	BND04140
373	581	Y(J)=0.00	BND04150
374		CALL FOUR67(2,[0])	BND04160
375		DO 582 J=1,MAX	BND04170
376		UXE2([MAX,J+1])=Y(J)	BND04180
377		IF(J,EG,1.0R,EG,MAX) GO TO 582	BND04190
378		Z(J)=SIFO(J-1)	BND04200
379	582	Y(J)=0.00	BND04210
380		Z(J)=0.00	BND04220
381		Z(MAX)=0.00	BND04230
382		CALL FOUR67(1,[0])	BND04240
383		DO 583 J=1,MAX	BND04250
384		FX(J)=XND*Y(J)	BND04260
385		Z(J)=XND*Y(J)	BND04270
386		IF(J,GT,MFCUT) Z(J)=0.00	BND04280
387	583	Y(J)=0.00	BND04290
388		CALL FOUR67(1,[0])	BND04300
389		DO 584 J=1,MAX	BND04310
390		584 UXO2([MAX,J+1])=Y(J)	BND04320
391	991	CONTINUE	BND04330
392		DO 590 I=2,MAX1	BND04340
393		DO 591 J=1,MAX	BND04350
394		Z(J)=UXE2(I,J-1)	BND04360
395	591	Y(J)=0.00	BND04370
396		CALL FOUR67(2,[0])	BND04380
397		DO 592 J=1,MAX	BND04390
398		Z(J)=XND*Y(J)	BND04400
399		IF(J,GT,MFCUT) Z(J)=0.00	BND04410
400	592	Y(J)=0.00	BND04420
401		CALL FOUR67(2,[0])	BND04430
402		DO 593 J=1,MAX	BND04440
403		UXE2(I,J-1)=Y(J)	BND04450
404		Z(J)=UXO2(I,J+1)	BND04460
405	593	Y(J)=0.00	BND04470
406		CALL FOUR67(1,[0])	BND04480
407		DO 594 J=1,MAX	BND04490
408		Z(J)=XND*Y(J)	BND04500
409		IF(J,GT,MFCUT) Z(J)=0.00	BND04510
410	594	Y(J)=0.00	BND04520
411		CALL FOUR67(1,[0])	BND04530
412		DO 595 J=1,MAX	BND04540
413	595	UXO2(I,J+1)=Y(J)	BND04550
414		590 CONTINUE	BND04560

ISN	ST-NO	SOURCE PROGRAM	(IBOUND)	SEQUENCE
415		RETURN		BND04570
	C			BND04580
416		ENTRY BCHECK		BND04590
417		IF(SHELL,ER,1,) RETURN		BND04600
418		WRITE(6,469) SIFD		BND04610
419	469	FORMAT(IH /* ** SIFD*,4(IP9E14,5/9X))		BND04620
420		CALL GMPRD(CCB,A,COA,MAX2,MAX2,1)		BND04630
421		CALL GMPRD(CCB,A,COA,COR,MAX,MAX,1)		BND04640
422		CALL GMPRD(CDC,COC,COD,MAXD,MAXD,1)		BND04650
423		DO 460 I=1,MAX		BND04660
424		SA=0,		BND04670
425		SB=0,		BND04680
426		SC=0,		BND04690
427		SD=0,		BND04700
428		DE=0,		BND04710
429		QE=0,		BND04720
430		WE=0,		BND04730
431		WD=0,		BND04740
432		SD=0,DO		BND04750
433		SCD=0,DO		BND04760
434		DO 461 J=1,MAX		BND04770
435		JP=J		BND04780
436		SA=SA+(XA(I,J)*YNUE(I)+YA(I,J)*YTAC(I))*COA(J)		BND04790
437		SA=SA+(XB(I,J)*YNUE(I)+YB(I,J)*YTAC(I))*COB(J)		BND04800
438		SD=SD+(XA(I,J)*XNUC(I)+YA(I,J)*XTAC(I))*COA(J)		BND04810
439		SD=SD+(XB(I,J)*XNUC(I)+YB(I,J)*XTAC(I))*COB(J)		BND04820
440		SD=SD+ZAC(I,J)*COA(J)		BND04830
441		SD=SD+ZB(I,J)*COB(J)		BND04840
442		QE=QE+(XA(I,J)*YNUC(I)+YA(I,J)*XTAC(I))*COA(J)		BND04850
443		QE=QE+(XB(I,J)*XNUC(I)+YB(I,J)*XTAC(I))*COB(J)		BND04860
444		WE=WE+ECAC(I,J)*COA(J)		BND04870
445		WE=WE+ECR(I,J)*COS(J)		BND04880
446		IF(J,GT,MAXD) GO TO 461		BND04890
447		JP=J+1		BND04900
448		SB=SB+ZC(I,JP)*CDC(J)		BND04910
449		SB=SB+ZD(I,JP)*CDC(J)		BND04920
450		SC=SC+(XC(I,JP)*XNUC(I)+YC(I,JP)*YTAC(I))*CDC(J)		BND04930
451		SC=SC+(KD(I,JP)*XNUC(I)+VD(I,JP)*YTAC(I))*CDC(J)		BND04940
452		SCD=SCD+(KC(I,JP)*XNUC(I)+YC(I,JP)*XTAC(I))*CDC(J)		BND04950
453		SCD=SCD+(XD(I,JP)*XNUC(I)+YD(I,JP)*XTAC(I))*CDC(J)		BND04960
454		WD=WD+(KC(I,JP)*XNUC(I)+YC(I,JP)*XTAC(I))*CDC(J)		BND04970
455		WD=WD+(XD(I,JP)*XNUC(I)+YD(I,JP)*XTAC(I))*CDC(J)		BND04980
456		WCD=WD=ESC(I,JP)*CDC(J)		BND04990
457		WCD=WD=ESD(I,JP)*CDC(J)		BND05000
458	461	CONTINUE		BND05010
459		WYD(I)=WYD(I,MAX,I+1)*SA+GXY((MAX,I+1)*SAD		BND05020
460		QZD(I)=S0		BND05030
461		QYD(I)=QYD(I,MAX,I+1)*SC+GXY((MAX,I+1)*SCD		BND05040
462		QZED(I)=S0		BND05050
463		QE(I)=WE		BND05060
464		QD(I)=WD		BND05070
465		FE(I)=WE		BND05080
466		FO(I)=WD		BND05090
467	460	CONTINUE		BND05100
468		DO 440 M=1,MAX		BND05120
469		M0=M+1		BND05130

ISN	ST-NO	SOURCE PROGRAM	(IBOUND)	SEQUENCE
470		THETA=DTHD*FLOAT(M-1)		BND05140
471		WYE=CA1*WYE((1,MD)*C2*WYE((2,MD)*C3*WYE((3,MD)*C4*WYE((4,MD)		BND05150
472		WZEB=CA1*WZE((1,MD)*C2*WZE((2,MD)*C3*WZE((3,MD)*C4*WZE((4,MD)		BND05160
473		WYD=CA1*WYD((1,MD)*C2*WYD((2,MD)*C3*WYD((3,MD)*C4*WYD((4,MD)		BND05170
474		WZOB=CA1*WZOB((1,MD)*C2*WZOB((2,MD)*C3*WZOB((3,MD)*C4*WZOB((4,MD)		BND05180
475		QYD=QYD((MAX,MD)*QAE((MAX,MD)*GYY((MAX,MD)*WYD		BND05190
476		QYD=QYD((MAX,MD)*QAE((MAX,MD)*GYY((MAX,MD)*QYD		BND05200
477		QE(I)=WE		BND05210
478		QYD(I)=WYD		BND05220
479		QZET(I)=WZEB		BND05230
480		QZD(I)=WZOB		BND05240
481		BT1=BTD(M)		BND05250
482		BDH=BD(M)		BND05260
483		PEIN(M)= BT1*WYD*WZEB		BND05270
484		PEEX(M)= -BT1*WYD(M)-WZED(M)+BDH*UXE2((MAX,MD)		BND05280
485		PGIN(M)= BT1*WYD*WZOB		BND05290
486		PDEX(M)= BT1*WYD(M)+QZOD(M)+BDH*UXO2((MAX,MD)		BND05300
487	440	CONTINUE		BND05310
488		WRITE(6,1300) WYD,QYEI,WYD,QZD,WZD,QZD		BND05320
489	1300	FORMAT(IH /* ** WYD*,QYEI*,WYD,QZD,WZD,QZD		BND05330
1		1 * * 1WYD*,1P9E13,4/9X,1P8E13,4/		BND05340
2		2 * * 1WYD*,1P9E13,4/9X,1P8E13,4/		BND05350
3		3 * * 1WYD*,1P9E13,4/9X,1P8E13,4/		BND05360
4		4 * * 1WZD*,1P9E13,4/9X,1P8E13,4/		BND05370
5		5 * * 1WZD*,1P9E13,4/9X,1P8E13,4/		BND05380
	C	CHECK OF PRESSURE BALANCE AT PLASMA SURFACE		BND05420
490		WHITE(6,1002) PEIN,PEEX,POIN,POEX		BND05430
491	1002	FORMAT(IH /* ** CHECK OF PRESSURE BALANCE***/*		BND05440
1		1 * * PEIN*,1P9E13,4/22X,1P8E13,4/		BND05450
2		2 * * PEEX*,1P9E13,4/22X,1P8E13,4/		BND05460
3		3 * * POIN*,1P9E13,4/22X,1P8E13,4/		BND05470
4		4 * * POEX*,1P9E13,4/22X,1P8E13,4/		BND05480
	C	CHECK OF CONTINUITY OF QR AT PLASMA SURFACE		BND05500
492		WHITE(6,1003) COE+CQQ		BND05510
493	1005	FORMAT(IH /* ** COE*,1P9E13,4/22X,1P8E13,4/		BND05520
		*, COQ*,1P9E13,4/22X,1P8E13,4/		BND05530
494		WHITE(6,1400) (QXE((MAX,J),J+2,JMAX1),(QXO((MAX,J)+J+2,JMAX1)		BND05540
495	1400	FORMAT(IH /* ** QXE*,1P9E13,4/22X,1P8E13,4/		BND05550
		*, QXO*,1P9E13,4/22X,1P8E13,4/		BND05560
496		WHITE(6,1003) COA,COB+COD		BND05570
497	1003	FORMAT(IH /* ** COA=!,8(IP8E14,5/8X))		BND05580
		DO 462 I=1,MAX4		BND05590
498		S=0,		BND05600
499		FQ11=0,		BND05610
500		FQ22=0,		BND05620
501		DO 463 J=1,MAX4		BND05630
502		IF(J,GT,MAX2) GO TO 464		BND05640
503		S=S+DMAT(I,J)*COA(J)		BND05650
504		FQ11=FQ11+DMAT(I,J)*COA(J)		BND05660
505		GO TO 463		BND05670
506		464 JD=J=MAX2		BND05680
507				BND05690
				BND05700

## JAERI-M 7310

ISN	ST-NO	SOURCE PROGRAM	C [OUND]	SEQUENCE
508		S=S+DMAT(I,J)*FX(JD)		BND05710
509		F022=F022+DMAT(I,J)*FX(JD)		BND05720
510	463	CONTINUE		BND05730
511		FCHK(I)=S		BND05740
512		F01(I)=F011		BND05750
513		F02(I)=F022		BND05760
514	462	CONTINUE		BND05770
515		WRITE(6,1036) FCHK		BND05780
516		WRITE(6,1037) F01		BND05790
517		WRITE(6,1038) F02		BND05800
518	1036	FORMAT(1H /' ** FCK=' ,8(1P8E15.6/8X))		BND05810
519	1038	FORMAT(1H /' ** F02=' ,8(1P8E15.6/8X))		BND05820
520	1037	FORMAT(1H /' ** F01=' ,8(1P8E15.6/8X))		BND05830
521		RETURN		BND05840
522	C	END		BND05850
				BND05860

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE JPLOTP	PLT00100
2		IMPLICIT DOUBLE PRECISION(A-H,O-Z)	PLT00110
3		DOUBLE PRECISION JXE,JXO,JYE,JYO,JZE,JZO	PLT00120
4		REAL MOJI(1)	PLT00130
5		DIMENSION GP(21,41)	PLT00140
6		DIMENSION A(11)	PLT00150
7		COMMON/E61/AR,AN,AK,BA,FA,IMAX,IMAX1,JMAX,JMAX1,NNNNN,WMMM	PLT00160
8		COMMON/KSI/UXE2(21,19),UA02(21,19),UYE2(21,19),UYO2(21,19),	PLT00170
1		UZE2(21,19),UZ02(21,19),XKE(21,19),XKO(21,19),	PLT00180
2		GVE(21,19),UYO(21,19),ULF(21,19),UZO(21,19),JXE(21,19),	PLT00190
3		JXC(21,19),JYE(21,19),UYO(21,19),JZE(21,19),JZO(21,19),	PLT00200
4		PE(21,19),PO(21,19)	PLT00210
9		COMMON/EQX/Z(41),AH(41),K(41),XM(41),F(41),FH(41),H(41),MH(41),	PLT00220
1		P(41),PH(41),PD(41),DPX(41)	PLT00230
10		COMMON/E80/DR,DP,DR1,DP1	PLT0240
11		COMMON/GRAPH/ G101*61),JJ(101,61),PH(101,61)	PLT00250
12		DATA MOJI /1H1*1H 1H2*1H 1H3*1H 1H4*1H 1H5*1H 1H6/	PLT00260
13		DATA BLANK /1H /	PLT00270
14		DATA PA(73,14)5926535857932D0/	PLT00280
15		ESU1VALUENCE(MAX,N),(JMAX,M)	PLT00290
16		ABSI(X) = DABS(X)	PLT00300
17		ATAN(X) = DATAN(X)	PLT00310
18		SQRT(X) = DSQRT(X)	PLT00320
19		E=0.6	PLT00330
20		DX=2./100.	PLT00340
21		DY=2./60.	PLT00350
22		NP=N+1	PLT00360
23		DO 100 K=1,101	PLT00370
24		DO 100 L=1,61	PLT00380
25		X=D*FLOAT(K+51)	PLT00390
26		Y=D*FLOAT(31-L)	PLT00400
27		RC=X*X+Y*Y	PLT00410
28		IF(RC.GT.1.) GO TO 100	PLT00420
29		XFD=X	PLT00430
30		1 IF(ABSI(XFD).LT.1.E-30) GO TO 8	PLT00440
31		PHI=ATAN(Y/XFD)	PLT00450
32		IF(XFD.GT.0.,AND,Y,LT.0.) PHAI=PHAI+2.*PAI	PLT00460
33		IF(XFD.LT.0.) PHAI=PHAI+PAI	PLT00470
34		GO TO 9	PLT00480
35		8 PHI=PAI/2,	PLT00490
36		IF(YC,LT.0.) PHI=PHAI+PAI	PLT00500
37		9 J=PHAI/DP+2.1	PLT00510
38		JJK(L)=J	PLT00520
39		PHI(K,L)=PHAI	PLT00530
40		100 CONTINUE	PLT00540
41		RETURN	PLT00550
42		ENTRY PLOTP(IPRI)	PLT00560
43		GMAX=-1.0E10	PLT00570
44		GMIN=1.0E10	PLT00580
45		DO 10 I=1:101	PLT00590
46		DO 10 J=1:61	PLT00600
47		10 G(I,J)=BLANK	PLT00610
48		JMAX2=JMAX-2	PLT00620
49		JMAX3=JMAX-3	PLT00630
50		M1=JMAX1+JMAX1	PLT00640
51		M2=JMAX2+JMAX2	PLT00650
52		M3=JMAX3+JMAX3	PLT00660

ISN	ST-NO	SOURCE PROGRAM	[ IPLOTP ]	SEQUENCE
53		M2P=M2+1		PLT00670
54		DO 20 I=1,N		PLT00680
55		DO 20 J=2,M2		PLT00690
56		JD=J		PLT00700
57		IF(J,GT,JMAX1) JD=M1-J		PLT00710
58		IF(JD,GT,M2P) JD=JD-M3		PLT00720
59		IF(IPRI,E0,1) GP(I,J)=P()		PLT00730
60		IF(IPRI,E0,2) GP(I,J)=PHI() + PE(I,JD)		PLT00740
61		IF(IPRI,E0,4) GP(I,J)=PHI() + PE(I,JD)		PLT00750
62		IF(IPRI,Ew,3) GP(I,J)=PO(I,JD)		PLT00760
63		IF(IPRI,Ew,3,AND,I,GT,JMAX1) GP(I,J)==PO(I,JD)		PLT00770
64		IF(GP(I,J),GT,GMAX) GMAX=GP(I,J)		PLT00780
65		IF(GP(I,J),LT,GMIN) GMIN=GP(I,J)		PLT00790
66		20 CONTINUE		PLT00800
67		GMAX=GMAX+GMIN		PLT00810
68		IF(GMAX,EW,0,) GMAX=1.		PLT00820
69		DO 110 K=1,101		PLT00830
70		DO 110 L=1,61		PLT00840
71		X=D*FLOAT(K-51)		PLT00850
72		Y=D*FLOAT(31-L)		PLT00860
73		RC=X*X+Y*Y		PLT00870
74		IF(RC,GT,1.) GO TO 110		PLT00880
75		R=SQRT(RC)		PLT00890
76		I=R/DR+1.001		PLT00900
77		IP=I		PLT00910
78		IF(I,E0,1)MAX !P=IMAX		PLT00920
79		J=JJK(L)		PLT00930
80		PHAI=P(I,K,L)		PLT00940
81		R1=DR*FLOAT(I-1)		PLT00950
82		R2=R1+DR		PLT00960
83		P1=DP*FLOAT(J-2)		PLT00970
84		P2=P1+DP		PLT00980
85		R1=(R-R1)*(R-R1)+(PHAI-P1)		PLT00990
86		R12=(R-R1)*(R-R1)+(P2-PHAI)		PLT01000
87		R21=(R2-R1)*(R2-R1)+(PHAI-P1)		PLT01010
88		R22=(R2-R1)*(R2-R1)+(P2-PHAI)		PLT01020
89		JP=J-1		PLT01030
90		IF(JP,GT,M2P) JP=JP-M2		PLT01040
91		RR=R1+R12+R21+R22		PLT01050
92		GK(L)=(R22*GP(I,J))+R21*GP(I,J)+R12*GP(I,J)+R11*GP(IP,JP))/RR		PLT01060
93		MG=1.0*(GK(L)-GMIN)/GMAX+1.5		PLT01070
94		IF(MG,LT,1) MG=1		PLT01080
95		IF(MG,GT,1) MG=11		PLT01090
96		GK(L)=MOJI(MG)		PLT01100
97		110 CONTINUE		PLT01110
98		WRITE(6,200)		PLT01120
99		200 FORMAT(1H0,20X,'*** PRESSURE DISTRIBUTION ***')		PLT01130
100		IF(IPRI,E0,1) WRITE(6,400)		PLT01140
101		400 FORMAT(1H+,100X,'(EQUILIBRIUM)'//)		PLT01150
102		IF(IPRI,E0,3) WRITE(6,500)		PLT01160
103		500 FORMAT(1H+,100X,'(ODO PERTURBATION)'//)		PLT01170
104		IF(IPRI,E0,2) WRITE(6,600)		PLT01180
105		600 FORMAT(1H+,100X,'(EVEN PERTURBATION)'//)		PLT01190
106		WRITE(6,600) GMAX		PLT01200
107		DA=GMAX/10,		PLT01210
108		DO 40 I=1:11		PLT01220
109		A(I)=DA*FLOAT(I-1)*GMIN		PLT01230

ISN	ST-NO	SOURCE PROGRAM	C(IPLTOP)	SEQUENCE
110		40 CONTINUE		PLT01240
111		WRITE(6,900) ((MOJ(I),A(I)),I=1,11)		PLT01250
112		900 FORMAT(1H0,5X,6(2X,A1,1H',1PE10.3),/+51X,5(2X,A1,1H', * 1PE10.3),//)		PLT01260
113		*WRITE(6,700) G		PLT01270
114		700 FORMAT(1H ,15X,1D1A1)		PLT01280
115		800 FORMAT(1H ,30X,'*** GMAX*',1PE15.8)		PLT01290
116		RETURN		PLT01300
117		END		PLT01310
				PLT01320

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		SUBROUTINE P0HALF(Z,M,NJ,P,W,PD,DD)	P0F00100
2		DIMENSION P(NJ),S(NJ),PD(NJ),WD(NJ)	P0F00110
3		DOUBLE PRECISION Z,PD,WD,P,W,PHALF,GHALF	P0F00120
4		DOUBLE PRECISION A,B,C,AN,AM	P0F00130
5		DOUBLE PRECISION Z1,ANJ,PNJ	P0F00140
6		A=PHALF(Z,M,0)	P0F00150
7		B=GHALF(Z,M,1)	P0F00160
8		P(1)=A	P0F00170
9		P(2)=B	P0F00180
10		AM=AM	P0F00190
11		N=NJ-2	P0F00200
12		DO 10 N=1,K	P0F00210
13		AN=N	P0F00220
14		J=N+2	P0F00230
15		C=Z,DD=AN+Z*B-(AN+AM=0,5DD)*A	P0F00240
16		C=C/(AN+AM=0,5DD)	P0F00250
17		P(J)=C	P0F00260
18		A=B	P0F00270
19		B=C	P0F00280
20		10 CONTINUE	P0F00290
21		NJ=NJ-1	P0F00300
22		A=GHALF(Z,M,NJ)	P0F00310
23		B=GHALF(Z,M,K)	P0F00320
24		W(NJ)=A	P0F00330
25		W(NJM)=B	P0F00340
26		DO 20 NN=1,K	P0F00350
27		N=NJM-NN	P0F00360
28		AN=N	P0F00370
29		C=Z,DD=AN+Z*B-(AN+AM=0,5DD)*A	P0F00380
30		C=C/(AN+AM=0,5DD)	P0F00390
31		W(N)=C	P0F00400
32		A=B	P0F00410
33		B=C	P0F00420
34		20 CONTINUE	P0F00430
35		Z=1.0D/(Z-Z=1.0D)	P0F00440
36		DO 40 N=1,NJM	P0F00450
37		AN=NN=1	P0F00460
38		NP=NN+1	P0F00470
39		PD(N)=(A(1-AM=0,5DD)*P(NP)-(AN+0,5DD)*Z*P(N))/Z1	P0F00480
40		WD(N)=(AN+AM=0,5DD)*W(NP)-(AN+0,5DD)*Z*W(N)/Z1	P0F00490
41		40 CONTINUE	P0F00500
42		NJ=NJ-1	P0F00510
43		PNJ=2.0D*ANJ*Z*P(NJ)-(ANJ+AM=0,5DD)*P(NJM)	P0F00520
44		PNJ=PNJ/(ANJ+AM=0,5DD)	P0F00530
45		PD(NJ)=((ANJ+AM=0,5DD)*PNJ-(AN+0,5DD)*Z*P(NJ))/Z1	P0F00540
46		WD(NJ)=((ANJ+AM=0,5DD)*GHALF(Z,M,NJ)-(AN+0,5DD)*Z*W(NJ))/Z1	P0F00550
47		RETURN	P0F00560
48		END	P0F00570

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		DOUBLE PRECISION FUNCTION GHALF(Z,M,N)	P0F00540
2		DOUBLE PRECISION A,B,C,F,G,A1	P0F00550
3		DOUBLE PRECISION Z,Z1,Z2,W,GAUSS	P0F00600
4		DOUBLE PRECISION PA1	P0F00610
5		PA1=3.1415926535897932D0	P0F00620
6		Z1=D5QRT(Z**2-1.0D0)	P0F00630
7		Z2=Z-Z1	P0F00640
8		W=Z**2	P0F00650
9		AM=AM	P0F00660
10		AN=N	P0F00670
11		A=AM+AN=0.5	P0F00680
12		B=AM=0.5	P0F00690
13		C=AN=1.0	P0F00700
14		F=GAUSS(A,B,C,W)	P0F00710
15		LN=NN	P0F00720
16		GHALF=PA1*D5QRT(Z2)*F	P0F00730
17		IF(L1,E0,0) RETURN	P0F00740
18		G=1.0D0	P0F00750
19		DO 10 I=1,L	P0F00760
20		A=I!	P0F00770
21		A=2.0D0*A!-1.0D0	P0F00780
22		B=Z2/(2.0D0*A!)	P0F00790
23		IF(I1.GT.N) B=1.0D0	P0F00800
24		G=A*B*G	P0F00810
25		20 CONTINUE	P0F00820
26		A=(-Z1*Z2)**M	P0F00830
27		GHALF=GHALF*A*G	P0F00840
28		RETURN	P0F00850
29		END	P0F00860

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		DOUBLE PRECISION FUNCTION GFCT(Z,M,N,NR,NJ)	PQF00870
2		DOUBLE PRECISION Z>Z2,A1,A+B,C+B	PQF00880
3		G=1.000	PQF00890
4		Z2=(2.000*Z)**2	PQF00900
5		L=ABS(M)	PQF00910
6		J=L	PQF00920
7		IF(NR.GE.L.AND.NR.GE.N) J=NR	PQF00930
8		IF(N.GE.L.AND.N.GE.NR) J=N	PQF00940
9		GFCT=1.000	PQF00950
10		IF(J.EQ.0) RETURN	PQF00960
11		DO 10 I=1,J	PQF00970
12		A=I	PQF00980
13		IF(I.LE.NR) A=1.000/(A1+Z2)	PQF00990
14		IF(I.GT.NH) A=1.000	PQF01000
15		IF(I.LE.N) B=A1	PQF01010
16		IF(I.GT.N) B=1.000	PQF01020
17		H=2.000*I-1.000	PQF01030
18		IF(I.LE.L.AND.M.GT.0) C=0.5D0/H	PQF01040
19		IF(I.LE.L.AND.M.LT.0) C=-2.000/H	PQF01050
20		IF(I.GT.L) C=1.000	PQF01060
21		GO TO (1+2)*NJ	PQF01070
22	1	CONTINUE	PQF01080
23		G=A+C*G/B	PQF01090
24		GO TO 10	PQF01100
25	2	CONTINUE	PQF01110
26		G=A+C*G/B	PQF01120
27		10 CONTINUE	PQF01130
28		GFCT=G	PQF01140
29		RETURN	PQF01150
30		END	PQF01160
ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		DOUBLE PRECISION FUNCTION DEGAM(N,J)	PQF01170
2		DOUBLE PRECISION A1	PQF01180
3		GO TO (1+2)*J	PQF01190
4	1	CONTINUE	PQF01200
5		DEGAM=-0.577215664900	PQF01210
6		IF(N.EQ.1) RETURN	PQF01220
7		K=N-1	PQF01230
8		DO 10 I=1,K	PQF01240
9		A=I	PQF01250
10		DEGAM=DEGAM+1.000/A1	PQF01260
11	10	CONTINUE	PQF01270
12		RETURN	PQF01280
13	2	CONTINUE	PQF01290
14		DEGAM=-1.963510026D0	PQF01300
15		IF(N.EQ.0) RETURN	PQF01310
16		DO 20 I=1,N	PQF01320
17		A=I	PQF01330
18		DEGAM=DEGAM+2.000/(2.000*A)-1.000	PQF01340
19	20	CONTINUE	PQF01350
20		RETURN	PQF01360
21		END	PQF01370
ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		DOUBLE PRECISION FUNCTION PHALF(Z,M,N)	PQF01380
2		IMPLICIT DOUBLE PRECISION(A+B,C+D)	PQF01390
3		IF(Z.GE.4.0D0) GO TO 200	PQF01400
4		A=0.5D0+DFLOAT(N)	PQF01410
5		B=0.5D0+DFLOAT(M)	PQF01420
6		C=1.0D0+DFLOAT(M)	PQF01430
7		Z2=(Z-1.0D0)/(Z+1.0D0)	PQF01440
8		AZ=DSQRT(Z2)	PQF01450
9		D1=(Z/2.0D0+0.5D0)**(2*N-1)	PQF01460
10		D1=DSQRT(D1)	PQF01470
11		D2=GMFTC(AZ,N,M,1)	PQF01480
12		D3=GAUSS(A,B,C,Z2)	PQF01490
13		PHALF=D1*D2*D3	PQF01500
14		RETURN	PQF01510
15	200	CONTINUE	PQF01520
16		PA1=3.1415926535897932D0	PQF01530
17		AZ=2.0D0*DLOG(2.0D0*Z)	PQF01540
18		Z2=2.0D0*Z	PQF01550
19		Z22=N*Z2*N	PQF01560
20		D1=DEGAM(M+N,2)	PQF01570
21		D2=DEGAM(N+1,1)	PQF01580
22		D3=DEGAM(1,1)	PQF01590
23		SUMA=AZ-2.0D0*D1+D2+D3	PQF01600
24		A=GMFTC(Z,M+N,N,0.1)	PQF01610
25		SUMA=A*SUMA	PQF01620
26		DO 10 NR=1,50	PQF01630
27		J=2*NR*M+N	PQF01640
28		B=GMFTC(Z,J,N+NR,NR+1)	PQF01650
29		D1=DEGAM(C,J,2)	PQF01660
30		D2=DEGAM(N+NR+1,1)	PQF01670
31		D3=DEGAM(NR+1,1)	PQF01680
32		B=BA*(AZ-2.0D0*D1+D2+D3)	PQF01690
33		SUMA=SUMA+B	PQF01700
34		TA=B/SUMA	PQF01710
35		IF(DABS(TA).LT.1.0D-8) GO TO 11	PQF01720
36	10	CONTINUE	PQF01730
37		WRITE(6,6000) TA	PQF01740
38		6000 FORMAT(1X,'PHALF DOES NOT CONVERGE',2X,1PE10.3)	PQF01750
39		11 CONTINUE	PQF01760
40		SUMA=SUMA/Z22N	PQF01770
41		SUMB=0.0D0	PQF01780
42		IF(N.EQ.0) GO TO 50	PQF01790
43		SUMB=GMFTC(Z,M+N,N-1,0.2)	PQF01800
44		IF(N.EQ.1) GO TO 50	PQF01810
45		N1=N-1	PQF01820
46		DO 20 NR=1,N1	PQF01830
47		J=2*NR*M-N	PQF01840
48		K=N-NR-1	PQF01850
49		A=1.0D0	PQF01860
50		IF(NR/2>2,EQ.NR) A=1.0D0	PQF01870
51		A=A*GMFTC(Z,J,K+NR,2)	PQF01880
52		SUMB=SUMB+A	PQF01890
53	20	CONTINUE	PQF01900
54	50	CONTINUE	PQF01910
55		A=1.0D0	PQF01920
			PQF01930
			PQF01940

ISN	ST-NO	SOURCE PROGRAM	C PHALF >	SEQUENCE
56		IF(N/2*2,NE,N) A=-1,DO		P0F01950
57		SUMB=A*(Z2N*SUMB		P0F01960
58		A=DSQRT(Z*Z+2*1,DO)/Z		P0F01970
59		A=A*PI/DSQRT(Z*2)		P0F01980
60		PHALF=A*(SUMA+SUMB)/PAI		P0F01990
61		RETURN		P0F02000
62		END		P0F02010

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		DOUBLE PRECISION FUNCTION GMFCT(Z,N,L,J)	P0F02020
2		IMPLICIT DOUBLE PRECISION(A-H,O-Z)	P0F02030
3		A=1,DO	P0F02040
4		KK=N-L	P0F02050
5		GO TO (100,200),J	P0F02060
		C *****	P0F02070
		J=1 : Z**L, GAMMA(N-L+1/2)/LGAMMA(N-L+1/2)	P0F02080
		J=2 : GAMMA(N-L+1/2)/SQRT(PAI)	P0F02090
		C *****	P0F02100
6	100	CONTINUE	P0F02110
		ZL=Z/4,DO	P0F02120
7		GMFCT=A	P0F02130
8		IF(KK,LT,0) GO TO 101	P0F02140
9		IF(L,EQ,0) RETURN	P0F02150
10		K1=2*(N-L)+1	P0F02160
11		K2=2*(N+L)-1	P0F02170
12		II=0	P0F02180
13		DO 10 I=K1,K2,2	P0F02190
14		A =1	P0F02200
15		II=II+1	P0F02210
16		A =II	P0F02220
17		IF(I,GT,L) AII=ZL=I,DO	P0F02230
18		A=A I ZL/AII	P0F02240
19	10	CONTINUE	P0F02250
20		GMFCT=A	P0F02260
21		RETURN	P0F02270
22		C	P0F02280
23	101	CONTINUE	P0F02290
24		K1=2*(L-N)-1	P0F02300
25		K2=2*(N+L)-1	P0F02310
26		II=0	P0F02320
27		DO 11 I=1,K2,2	P0F02330
28		A =1	P0F02340
29		II=II+1	P0F02350
30		A =I	P0F02360
31		IF(I,LE,<1) A =AI**2	P0F02370
32		IF(I,GT,L) AII=ZL=I,DO	P0F02380
33		A=A I ZL/AII	P0F02390
34	11	CONTINUE	P0F02400
35		IF(KK/2*K2-KK,NE,0) A==A	P0F02410
36		GMFCT=A	P0F02420
37		RETURN	P0F02430
38	200	CONTINUE	P0F02440
39		IF(KK,EQ,0) GO TO 21	P0F02450
40		K0=KK	P0F02460
41		IF(KK,LT,0) KK=KK	P0F02470
42		DO 20 I=1,KK	P0F02480
43		A =2*I-1	P0F02490
44		A=A A /2,DO	P0F02500
45	20	CONTINUE	P0F02510
46		IF(K0,LT,0,AND,K0/2*2-K0,EQ,0) A =1,DO/A	P0F02520
47		IF(K0,LT,0,AND,K0/2*2-K0,NE,0) A=-1,DO/A	P0F02530
48	21	CONTINUE	P0F02540
49		GMFCT=A	P0F02550
50		RETURN	P0F02560
51		END	

ISN	ST-NO	SOURCE PROGRAM	SEQUENCE
1		DOUBLE PRECISION FUNCTION GAUSS(A,B,C,Z)	P0F02590
2		IMPLICIT DOUBLE PRECISION(A-H,O-Z)	P0F02600
3		A0=1,DO	P0F02610
4		SUM=A0	P0F02620
5		DO 10 N=1,100	P0F02630
6		V=A*D-1,DO	P0F02640
7		D=DFLOAT(N)	P0F02650
8		V=A*D-1,DO	P0F02660
9		VC=D*(C*D-1,DO)	P0F02670
10		A1=A0*VA*VB*Z/VC	P0F02680
11		SUM=SUM+A1	P0F02690
12		T=A1/SUM	P0F02700
13		IF(DABS(T),LT,1,D=8) GO TO 25	P0F02710
14		A0=A1	P0F02720
15	10	CONTINUE	P0F02730
16		WRITE(6,6000) T	P0F02740
17		6000 FORMAT(1H ,GAUSS DOES NOT CONVERGE!,2X,1PE10,3)	P0F02750
18	25	CONTINUE	P0F02760
19		GAUSS=SUM	P0F02770
20		RETURN	P0F02780
21		END	P0F02790