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subroutine adummy
c,,,,, cliche storage set up here

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cliche param
parameter (lzx=66, jrx=30, lzx2=lzx-2 )
parameter ( ltbw=2*lzx-1 )
parameter (kxp=(lzx-2)*(jrx-2), lbw=lzx-1 )
parameter (nplt=3000, nps=100 )
parameter (lxpf=4*(lzx-2),nfourxf=150)
parameter (lxpg=2*lzx2)
parameter (ksim=51)
endcliche

cliche fstor
use param
common/fun/f1(lzx,jrx),f2(lzx,jrx),f3(lzx,jrx),f4(lzx,jrx)
c ,f5(lzx,jrx),f7(lzx,jrx),
c g1(lzx,jrx),g2(lzx,jrx),g3(lzx,jrx),g4(lzx,jrx)
c ,swg1,swg2,swg3,swg4

common/equil/b(lzx,jrx),rho(lzx,jrx),qub(lzx,jrx),r(lzx,jrx)
c ,phi(lzx,jrx),yyy(lzx,jrx),xxx(lzx,jrx),qv(lzx,jrx)
common/pertur/xioo(kxp),xio(kxp),xio1(kxp)
c ,xroo(kxp),xro(kxp),xro1(kxp)
endcliche

cliche matrix
use param
common/coeff/a1(kxp,9),a2(kxp,9),a3(kxp,9),b1(kxp,3)
c ,rhs1(kxp),rhs2(kxp)
c,,,,,unnamed common for dynamic memory expansion
common ww(1), ww1(1)
endcliche

cliche const
use param
common/title/aname(5)
common/con/gam1,gam2,lx,jx,mm,lzxp,kxx,nmax,lmax,lsw,lhbw
c ,fac1,fac2,bias,du,dv,dt,ndiag,ex0,b0,rho0,ex1,f11,f1zx,fj1
c ,fjrx,kplot,npm,fpsi,fz,fu,fv,azm,apsim,u0,v0,amass
c ,fourpi,omegst,omegr,omegexb,flr,sf6,sf8,kplotm,kzs,zedge
c ,cpuo,cio,syso,va1fk,xu,xv,n,pl,vw,psiw,dvln,dvout
common/contm/
c psi0rel,psi1rel,psi2rel,z1rel,z2rel,z3rel,z0rel,nslosh,bmg
c ,ncenter,pslosh,pcenter,rp,ztrans,ltrans,bm,ltran,ztran,rp1
c ,bcen,pring,epsf,phicen,phiplg,kin,xpot,ypot,wpot,pfudge,rpx
c ,phice,phipl,betslsh,betcent,z0,z1,z2,z3,z4,psi1,psi2,psi0
c ,betcene,betslse,psloshe,pcentee,bmax,alsi,bm1,psls1,cold
c ,p2wide,psi3rel,psi3,p1max,bv0,bv3,bv4,bceng,psloshin,psloshen
c ,nsloshin,pxp1,pxp2,p3a,p3b,p3c,p3d,psim,pe10,ae1,be1,ce1
c ,psi0erel,psi0e,psime,p2ewide,wp2e,p2floor,p1floor,p2flag
c ,fring,long,no3d,no1d
common/mesh/psi(jrx),z(lzx),u(lzx),v(jrx),dpsi(jrx),dz(lzx)
c ,vpsi(jrx),uuz(lzx),vpsi1(jrx),uuzh(lzx)
common/graf/ xrtime(nplt),xrspz(lzx,nps),xrsppsi(jrx,2*nps)
c ,time(nplt),xflute(lzx,nps)
common/curvco/cr,lb,rw,beta0,delrho,stable,en0,cee,r0,
c echarg,omeg1,omeg2,en1,besarg,zol,dtrel,p0,omeg0
c ,omana1,omana2,groana,theta0
common/tmcon/h12(lzx),h1(lzx),h34(lzx),abp(lzx),bbp(lzx)
c ,cbp(lzx),abf(lzx),bbf(lzx),cbf(lzx),hp3(jrx),hp12(jrx)

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c ,htrans(izx),abq(izx),bbq(izx),cbq(izx),h56(izx),abr(izx)
c ,bbr(izx),cbr(izx),betrng,hp0(jrx),hpm(jrx),hpme(jrx)
common/tmfield/bvac(izx),dbvdz(izx),d2bvdz2(izx),dp1dpsi(jrx)
c ,p1(jrx),p1k(ksim,jrx),hpk12(ksim),hpk0(ksim),deli1(ksim)
c ,deli2(ksim),deli3(ksim),deli4(ksim),rzz(izx,jrx),dbdpsi(izx,jrx)
c ,phi1(izx),phi2(izx),pperp(izx,jrx),ppar(izx,jrx),dflute3(izx)
c ,qubv(izx,jrx),p2(jrx),dp2dpsi(jrx),dflute1(izx),dflute2(izx)
c ,flute1(jrx),flute2(jrx),flute3(jrx),p2k(ksim,jrx),deli5(ksim)
c ,pperps(izx,jrx),errprp(izx,jrx),errprl(izx2,jrx-1)
c ,pperpe(izx,jrx),epsi(izx,jrx),omeg1wkb(jrx),omeg2wkb(jrx)
c ,gamwkb(jrx),dflute4(izx),rhoave(jrx),xxxave(jrx),yyyave(jrx)
c ,p2t(jrx),dp2dpst(jrx),p3(jrx),dp3dpsi(jrx),hpkm(ksim)
c ,hpkme(ksim)
common/forced/nfour,nfourx,nfourmax,nfourp,jfour,ixp,locv

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real lb,ltrans,ltran,nslosh,ncenter,nsloshln
endcliche

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return
end

```

c..... the main routine

c..... notice of 4/8/82, this version runs correctly for isw=1, and
c..... runs correctly for isw=-1 ,

c.....5/12/82, flora runs testcase 1 , 0 beta, 0 pressure, homogeneous
c..... plasma, correctly.

c..... flora1 transforms variables z,psi to u,v which are always equally
c..... spaced, transformation: $z=au*u**xu$, and $psi=apsi*v**xv$, where
c..... $zmax=umax$, $psimax=vmax$, and $fz*zmax=fu*umax$, $fpsi*psimax=fv*vmax$,
c..... fz, fu, fpsi, fv, input, $xu=\ln fz / \ln fu$, $xv=\ln fpsi / \ln fv$,
c..... $au=umax**(-xx+1)$, $apsi=vmax**(-yy+1)$,

c..... flora2 solves test case 2 , rotating rigid rotor stability, ref:
c..... freidberg and pearlstein, phys fluids 21(7) july 1978 1207

c.....flora4 includes background constant density, enbar (as does flora3),
c..... and kzs switch which when set to zero, generates initial perturbations
c..... independent of z in random spatial generator (ex0=1.) ,

c..... flora5

c..... is vectorized version of flora4,(calls rightvec instead of
c..... right), also has timing routine from b. langdon (requires
c..... bzohar loaded as a binary),
c....., insert cliché storage here

c..... flora7 is mod. flora5, with psi stretching function
c..... exactly centered in amat, (flora5 used linear interpolation
c..... to get vpsi(j+1/2)). Also revised diagnostic plots included,

c.....flora12 is flora11 (rigid rotor with corrected equil. and
c..... corrected curvature terms (flora10)) with fourier mode analyses
c..... added (using cpft and rpft) and data for zed post processing,
c.....additional input data: jfour (v index at which xr is analyzed in
c.....z), nfourp (analyze xr every nfour'th time step),nfourmax

```

c..... (number of times the buffer is read to the history file), note
c..... xr is extended a factor of 4 to look like a periodic full wave
c..... for cpft. If jfour is input 0, code sets it to jx/4 .
c
c.....flora13 is flora12 with curvature driven flute mode equilibrium
c.....(equilrot replaced by equilcur, rigidcon replaced by curvecon )

c.....floralm, tandem mirror equilibrium
c
c.....flortm1, tandem mirror equilibrium, with 3-d plot of equilb,
c      quantities added, ( uses tv80 and graflib )

c.....flortex, tandem mirror equilb, with corrections to flortm1. In-
c..... put switches swg1, swg2 swg3, swg4 added,

c.....flortm2, like flortex with revised electron ring, a la D'ippolito
c.....(e-ring pperp in b field only, and additional term in curvature
c..... drive ),

c.....flortm3, like flortm2 with corrections to pressusre normalization,
c..... and additional diagnostics, ( 3-d plots of curvature drive-e ring
c..... term, and perp. pressure balance check ) , also 3-d plots of
c..... pparallel pressure check, and e-psi ( $=-d\phi/d\psi$ ) , Phi2 modified
c..... to  $= 1, -(psi/psi3)**ypot$  ,

c.....flortm4, modified plasma pperp with addition of p3(j) to give
c..... a positive slope near the center,

c.....flortm5, modified p1 in flortm4 to be two functions, pe1 and
c..... pe2, joined at psime with equal slope and value, pe1=ae1+be1*(
c..... psi/psime)+ce1*(psi/psime)**2, and pe2=.5*(1-tanh((psi-psi0e)/p2ewide))
c
c..... flortm6, modified flortm5 as follows: for p2(psil1e, to p2flag ( an
c..... input value), p2 set to p2floor (an input value) and p1 set to
c..... p1floor (an input value), Long-thin ering option added. This modifies
c..... b dependence of ering pperp to look longer (by changing abf, bbf, cbf)
c..... if long ( an input value ) = 1, otherwise leaves pperp of ring un-
c..... changed. Plot output options, nold=1, prevents graflib plots, no3d=1
c..... prevents tv80lib 3d plots,
c

      use param
      use fstor
      use matrix
      use const

      data tim/1.e6/
      integer tallyb(2000b)
      common / q8iocs/iocf(0:15)
      common/pic100/npete
      data itally/1/

c.....,call link call here
      call link('unit59=terminal,unit2=(inftm6,open),unit3=(output,
c create) //')

      if(itally.gt,0) then
      do 200 ii=1,15
200   if(iocf(ii),eq,0)go to 210
      ii=0

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210  ioc tally=11
      ioc tally=14
      if(ioc tally,eq,0)go to 299
      call timer(ioc tally,'ztally00',tallyb,2000b,floratin,1)
299  tally=-1
      endif
      isw=1
      if(izx.gt,jrx)isw=-1
      jtbw=.5*(1+isw)*itbw+.5*(1-isw)*(2*jrx-1)
      ihbw=.5*(1+isw)*ibw+.5*(1-isw)*(jrx-1)
      nn=jtbw*kxp
      nn1=jtbw+kxp
      call memory(ww,nn-1)
      call memory(ww1(nn),nn1)
      namelist/noplot/no1d,no3d
      call ddi(noplot,2,0,1)
      if(no1d,ne,1)call pstart(dev,4rplot,1,'box u21$',1)
c     npete=1
      if(no1d,ne,1)call p100
      call input
      call inputtm
c     call rigidcon
c     call curvecon
      call grid
      call constant
      call tmcon2
      call equiltm
c     call equilrot
c     call equilcur
      call fito11
      call amat
      call comat(ww,jtbw)
      call initial
c.....special version for testing fourier analysis and zed file
c..... maker
      call fourplay
      call fourier
      call mymove(xrol(1),xro(1),kxx)
      call mymove(xiol(1),xio(1),kxx)
c     call mymove(xroo(1),xro(1),kxx)
c     call mymove(xioo(1),xio(1),kxx)
      call banfac(kxp,ihbw,ww,1,-(kxp-1))
      t=0.
      do 100 n=1,nmax
      t=t+dt
      time(n)=t
      fac1=-1./dt
      fac2=1./dt
      do 90 l=0,lmax
      call rightvec
      call zmovewrd(ww1(nn),rhs1,kxx)
      call bansol(kxp,ihbw,ww,1,-(kxp-1),ww1(nn))
      do 10 j=2,jx-1
      kp=1+izxp*(j-2)
      call zmovewrd(xrol,ww1(nn),kxx)
10    continue
      call zmovewrd(ww1(nn),rhs2,kxx)
      call bansol(kxp,ihbw,ww,1,-(kxp-1),ww1(nn))
      do 20 j=2,jx-1
      kp=1+kxp*(j-2)

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      call zmovewrd(xiol,ww1(nn),kxx)
20  continue
      fac1=-.5/dt
90  fac2= .5/dt
      call zmovewrd(xloo,xio,kxx)
      call zmovewrd(xio,xiol,kxx)
      call zmovewrd(xroo,xro,kxx)
      call zmovewrd(xro,xrol,kxx)
c..... time array
      xrtime(n)=xro(kplot)
      if(mod(n,ndiag),eq,0)call diagno
      if(mod(n,nfourp),eq,0)call fourier
100  continue
      call clsdsk(locv,0)
      call timeused(lcp,lo,lsy)
      cpuo=lcp*tim
      clo=lo*tim
      syso=lsy*tim
      if(nold,ne,1)
c call picsher
      call close(100)
      if(no3d,eq,1)go to 300
      call keep80(1,3)
      call fr80ld
      call threed
      call plote
300  continue
      call timend
      call exit(1)
      end
      subroutine constant

c..... insert storage cliché here
      use param
      use fstor
      use matrix
      use const

      gam1=.25*(3*bias+1)
      gam2=.25*(1-bias)
      ip=.5*(ix-2)
      jp=.5*(jx-2)
      kp1=ip-1+(jp-2)*(ix-2)
      kp2=jp-1+(ix-2)*(ip-2)
      kplot=.5*(1+isw)*kp1+.5*(1-isw)*kp2
      if(kplotm.ne,0)kplot=kplotm
      return
      end

      subroutine curvecon

c.... calculates constants necessary for curvature driven
c.... flute mode case,

c..... insert storage clichés here
      use param
      use const
      real klsq

```

```

c..... input for curvature driven flute case
      data echarg/4.8e-10/, en0/1.00e+12/, b0/1.e4/, amass/3.34e-24/
c      , cee/3.e10/, stable/,4/, fourpi/12.56637/, pi/3.1415926/
c      , delrho/,05/,dtrel/,02/,xm/3.8317/, theta0/1.570796/
      namelist/curve/b0,beta0,delrho,stable,en0,echarg,lb,rw,xm
c      ,zol,dtrel,theta0
      call ddi(curve,2,3,1)
      if(nold,ne,1) call ddo(curve,100,0,1)
      zmax=zol*lb
      p0=beta0*b0**2*.5
      psimax=rw**2*b0*.5
      omeg0sq=b0**2/(en0*amass*lb**2)
      omeg0=sqrt(omeg0sq)
      ag1=1,-2,*delrho/xm**2
      klbsq=0,
      if(kzs,ne,0)klbsq=(pi/(2,*zol))**2
      delomeg=0,
      if(sf8,ne,0)
1 delomeg=stable*((beta0/xm**2-klbsq/mm**2)/(ag1*sf8)+1,-sf6*ag1/
2 sf8)*omeg0sq
      omeg1=omeg0+sqrt(delomeg)
      omeg2=omeg1-2*sqrt(delomeg)
      dt=dtrel/omeg1
      en1=2.*en0*delrho/rw**2
      u(1x)=zmax
      v(jx)=psimax
      du=u(1x)/(1x-1.5)
      dv=v(jx)/(jx-1.5)
      besarg=(xm/rw)
c..... calculate analytic growth rate
      tsf6=tan(theta0*.5)*sf6
      radical=((ag1*mm*tsf6)**2*(omeg1+omeg2)**2-4,*((omeg1*omeg2*ag1
c      *sf8+omeg0sq*beta0/xm**2)*mm**2-klbsq*omeg0sq))
      if(radical,lt,0)go to 5
      root=sqrt(radical)
      omana1=ag1*tsf6*mm*(omeg1+omeg2)*.5+root*.5
      omana2=omana1-root
      groana=0,
      return
5 continue
      omana1=ag1*tsf6*mm*(omeg1+omeg2)*.5
      groana=sqrt(-radical)*.5
      omana2=0,
      return
      end
      subroutine inputtm

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c..... calculates grid quantities needed by sub. grid
c..... in floratm version

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c..... insert storage cliches here
      use param
      use const
      real klbsq

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c.....glossary of input parameters
c      psi0rel..value of psi (in relative units) where plasma pperp
c      profile is half the maximum,
c      p2wide..parameter inversely proportional to "ramp width" of p2
c      psi0erel..realitive value of psi where ering pperp (pe2) is half

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```

c      the maximum
c      p2ewide,,parameter inversely proportional to "ramp width" of p2
c      psi1rel,,lower limit of psi where pring =0.
c      psi2,,upper limit of psi where pring=0.
c      z0rel,,axial center of plug
c      z1rel,,axial position of plug inward mirror
c      z2rel,,axial position of plug outboard mirror
c      z3rel,,inner axial position where pring=0.
c      z4rel,,outer axial position where pring=0.
c      nslosh,,peak sloshing ion number density
c      ncenter,,peak center cell ion density
c      betslsh,,peak sloshing ion beta-perp w.r.t. bvac(z0)
c      betcent,,peak center cell ion beta-perp w.r.t. bvac(z=0)
c      betslse,,peak sloshing electron beta-perp w.r.t. bvac(z0)
c      betcene,,peak center cell electron beta-perp w.r.t. bvac(z=0)
c      betring,,peak electron ring beta perp w.r.t. bvac(z0)
c      rp,,plug vacuum mirror ratio
c      ztrans,,begining of center cell transition region
c      ltrans,,transition length
c      bmg,,vacuum mirror peak (approx.) in gauss
c      bceng,,center cell bmax in gauss
c      epsp,,minimum pressure, below which b=bvac
c      phicen,,center cell potential relative to plug ion t perp
c      phiplg,,plug potential relative to plug ion t perp
c      kin,,number of points in simpsons rule quadratures
c      xpot,,exponent coefficient in center cell potential
c      wpot,,exponent coefficient in plug potential
c      ypot,,power of polynomial in potential psi dependence
c      pxp1,,power of polynomial in e ring pperp(psi) (p1(psi))
c      pxp2,,power of polynomial in e ring pperp(psi) (p1(psi))
c      zmax,,axial end of system in cm.
c      pe10= e ring pperp at psi=0.
c      p2flag,,value of p2 at which p2 is set constant
c      p2floor,, constant used in conjunction with p2flag
c      p1floor,,constnt for p1 used in conjunction with p2flag

c..... input for tandem mirror equilb.
      data echarg/4.8e-10/, en0/1.00e+12/, b0/1.e4/, amass/3.34e-24/
c      , cee/3.e10/, stable/./, fourpi/12.56637/, pi/3.1415926/
c      , xpot/1./, ypot/2./, wpot/2./, kin/5/psi1rel/2./, psi2rel/1.5/
c      , psi0rel/./50/, zmax/100./, z1rel/./5/, z2rel/1./, z0rel/./75/
c      , z3rel/./625/, z4rel/./875/, ztrans/./4/, ltrans/./05/, p2ewide/./1/
c      , bmg/1.e4/, bceng/1.e3/, nsloshin/2.e13/, ncenter/1.e13/,
c      betslsh/./25/, betcent/./10/, rp/4./, epsp/1.e-6/, rp1/2./
c      , phicen/./1/, phiplg/./1/, betcene/./1/, betslse/./1/
c      , dt/1.e-5/, pfudge/0./, cold/1.e-5/, betring/0./, psi3rel/1.05/
c      , pxp1/2./, pxp2/2./, safe/./9/, pe10/0./, psi0erel/./5/, p2ewide/./2/
c      , p2floor/0./, p1floor/0./, p2flag/1.e-3/, fring/./9/, long/1/, no3d/0/
c      , no1d/0/
      namelist/curve/echarg, lb, rw, xm, rw1
c      , zmax, dt, theta0, pfudge
c      , psi0rel, z1rel, z2rel, z0rel, nsloshin, cold, z3rel, z4rel
c      , ncenter, betslsh, betcent, rp, ztrans, ltrans, bmg, rp1
c      , bceng, epsp, phicen, phiplg, kin, xpot, ypot, wpot, betcene, betslse
c      , betring, psi1rel, psi2rel, p2ewide, psi3rel, pxp1, pxp2, safe, pe10
c      , p2ewide, psi0erel, p2floor, p2flag, p1floor, fring, long
      call ddi(curve, 2, 3, 1)
      if(no1d.ne.1)then
        call pframe
        call p100

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        call ddol(curve,100,0,1)
        end if
c.....transform input z into physical units
        z0=z0rel*zmax
        z1=z1rel*zmax
        z2=z2rel*zmax
        z3=z3rel*zmax
        z4=z4rel*zmax
        ztran=ztrans*zmax
        ltran=ltrans*zmax
        bm=bmg/sqrt(4.*pi)
        bcen=bceng/sqrt(4.*pi)
c..... generate zmax, psimax, u(ix),v(jx), du, dv
        asq=.25/((2.*rp)**(2./3,)-1,)*(z2-z1)**2
        argt1=+(z1-ztran)/ltran
        bv0=bm*(1./((1,+(z0-z1)**2/asq)**1.5+1,/(1,+(z0-z2)**2/asq)
c **1.5)
        bmax=bm*(1,+.1./((1,+(z1-z2)**2/asq)**1.5) +bcen*.5*
c (1,-tanh(argt1))
        bv4=bm*(1./((1,+(z1)**2/asq)**1.5+1,/(1,+(z2)**2/asq)**1.5)
        psimax=rw**2*bmax*.5
        psiw=rw1**2*bmax*.5
        psi0=psimax*psi0rel
        psi0e=psimax*psi0erel
        psi3=psimax*psi3rel
        psi1=psimax*psi1rel
        psi2=psimax*psi2rel
        v(jx)=psimax
        u(ix)=zmax
        du=u(ix)/(ix-1.5)
        dv=v(jx)/(jx-1.5)
c.....transform input constants from relative to physical units
        pmag0=(bv0)**2*.5
        pmag1=(bv4+bcen)**2*.5
        psloshin=(betslsh)*pmag0
        pcenter=(betcent)*pmag1
        psloshen=betslse*pmag0
        pcentee=betcene*pmag1
        pring=betring*pmag0
        phice=phicen*psloshin/(nsloshin*echarg)
        phipl=phiplg*psloshin/(nsloshin*echarg)
c.....calculate maximum p1(psi)
        psidif=psi2-psi1
        p1max=(pxp1*psidif/((pxp1+pxp2)*psi1))**pxp1*(pxp2*psidif/
c ((pxp1+pxp2)*psi2))**pxp2
c.....check that kin is not too big
        ksimp=ksim
        if(kin.gt,ksimp)then
            kin=ksimp
            write(59,200)kin
200 format('kin initially too large, reduced to',i4)
        end if
c..... check that kin is odd for simpsons quadratures
        kch=mod(kin,2)
        if (kch.eq,0)then
            kin=kin-1
            write(59,201)kin
201 format('kin initially even, changed to',i4)
        end if
c..... adjust epsp to accomodate zero pressure case

```



```

      epsp=epsp*(1,e-4*psloshin+pcenter)/(1,e-8*epsp+psloshin+pcenter)
c.....check that bcen and betcen are physically consistent
      asq=.25/((2.*rp)**2./3.)-1.)*(z2-z1)**2
      bv0=bm*(1./(1.+(z0-z1)**2/asq)**1.5+1./(1.+(z0-z2)**2/asq)
c**1.5)
      argt3=(z3-ztran)/ltran
      bv3=bm*(1./(1.+(z3-z1)**2/asq)**1.5+1./(1.+(z3-z2)**2/asq)
c**1.5)+bcen*.5*(1.-tanh(argt3))
      rpx=bmax/(bv0)
      rp3=bv3/bv0
      afac=(rp*(1.-1./rp**2))**2/bm**2
      afac1=(rp*(1.-1./rp3**2))**2/bm**2
      tcon6=pring/((1.-1./rp3**2)**2)
      tmin=afac*(bcen+bv4)**2
      if(tmin.le.betcent+betcene)then
        bcen1=sqrt((betcent+betcene)/afac)-bv4
        tmine=tmin-betcene
        write(59,210)bcen1,tmine
210  format('initial central cell beta and b are inconsistent for',
c ' equilibrium',/'either increase bcen to more than',e14.6/
c ' or decrease betcent to less than',e14.6/'use namelist',
c ' data format')
        namelist/better/betcent,bcen
        read(59,better)
        pcenter=betcent*pmag0
      end if
c..... check plug ion beta and e ring beta
      tmin1=afac*bv0**2
      if (tmin1.le.(betslsh+betslse))then
        tbetsl=tmin1-betslse
        tbetr=(-betslsh+tmin1)
        delbet=betslsh+betslse-tmin1
        write(59,220)delbet,tbetsl,tbetr
        namelist/fix/betslsh,betslse
220  format('the sum of (betslsh+betslse) is too large by',
c e14.6/'either decrease betslsh to',e14.6/'or decrease
c betslse to',e14.6/'or something (use namelist data format)')
        read(59,fix)
        psloshin=betslsh*pmag0
        psloshen=betslse*pmag0
      end if

c..... check betring in plug
      if(tcon6.ge.(safe*.5*bv0**2))then
        ratio=safe*.5*bv0**2/tcon6
        pring=pring*ratio
        ratinv=1./ratio
        write(59,231)ratinv,pring
231  format('pring was too large by a factor ('e14.6,') , and was',
c ' reduced to ',e14.6 )
      end if

c..... check that rp1 is less than rpx
      if(rp1.ge.rpx)then
        rp1t=rp1
        rp1=.5*rpx
        write(59,230)rp1t,rpx,rp1
230  format('rp1 ('e12.6,') was larger than rpx ('e12.6,') , and was',
c ' reduced to ',e12.6 )
      end if

```

```

      and
      subroutine tmcon2

c..... calculates equilibrium quantities for tandem mirror

c..... insert storage cliches here
      use param
      use const
      real kbsq

c..... calculate heaveside step functions h12, h1, h34
      call bcast(h12(1),0,,ix)
      call bcast(h1(1),0,,ix)
      call bcast(h34(1),0,,ix)
      call bcast(htrans(1),0,,ix)
      do 2 i=1,ix
        if(z(i).ge.z1.and.z(i).le.z2)h12(i)=1,
        if(z(i).le.z1)h1(i)=1,
        if(z(i).ge.ztran)htrans(i)=1,
2      if(z(i).ge.z3.and.z(i).le.z4)h34(i)=1,

      psim=psi0*(1,-p2wide)
      psime=psi0e*(1,-p2ewide)
c..... calculate heaveside step functions hp0(j), hp3(j) and hp12(j)
      call bcast(hp12(1),0,,jx)
      call bcast(hp3(1),0,,jx)
      call bcast(hp0(1),0,,jx)
      call bcast(hpm(1),0,,jx)
      call bcast(hpme(1),0,,jx)
      do 4 j=1,jx
        if(psi(j).le.psi0)hp0(j)=1,
        if(psi(j).le.psi3)hp3(j)=1,
        if(psi(j).le.psim)hpm(j)=1,
        if(psi(j).le.psime)hpme(j)=1,
4      if(psi(j).ge.psi1.and.psi(j).le.psi2)hp12(j)=1,

c..... calculate vacuum b field (bvac) and derivatives dbv/dz, d2bv/dz2
      asq=.25/((2.*rp)**(2./3.)-1.)*(z2-z1)**2
      bv0=bm*(1./((1.+(z0-z1)**2/asq)**1.5+1./((1.+(z0-z2)**2/asq)
c**1.5)
      do 5 i=1,ix
        eb1=(z(i)-z1)/asq
        eb2=(z(i)-z2)/asq
        fb1=sqrt(1.+eb1*(z(i)-z1))
        fb2=sqrt(1.+eb2*(z(i)-z2))
        argt=(z(i)-ztran)/ltran
        dbvdz(i)=-3*bm*(eb1/fb1**5+eb2/fb2**5)-bcen*.5*(1.-
c tanh(argt)**2)/ltran
        d2bvdz2(i)=-3*bm*(1./(asq*fb1**5)+1./(asq*fb2**5)-eb1**2*5/
c fb1**7-eb2**2*5/fb2**7)+bcen*tanh(argt)*(1.-tanh(argt)**2)/
c ltran**2
5      bvac(i)=bm*(1./fb1**3+1./fb2**3)+bcen*.5*(1.-tanh(argt))
        argt3=(z3-ztran)/ltran
        bv3=bm*(1./((1.+(z3-z1)**2/asq)**1.5+1./((1.+(z3-z2)**2/asq)
c**1.5)+bcen*.5*(1.-tanh(argt3))
        rp3=bv3/(1+bv0)
        bm1=rp1*(1-bv0)
        alsit=((1.-1./rp1**2)/(1.-1./rp3**2)*(rp1/rp3))**2
        alsi=alsit+.5*(1.-alsit)*pfudge

```

```

c.....calculate heaveside function h56(i) for second component of
c..... sloshing pperp
      do 10 i=1,ix
        eb2=(z(i)-z2)/asq
        if(z(i).gt.z1.and.z(i).lt.z2.and,bm1.ge,bvac(i))
          c h56(i)=1.
10      continue

c..... calculate pressure coeff. including electron ring (pr)
      con1=1./((1.-1./rpx**2)**2*bmax**4)
      con2=con1*(-2*bmax**2)
      con3=-.5*con2*bmax**2
      con4=pring/((1.-1./rp3**2)**2*bv3**4)
      con5=con4*(-2*bv3**2)
      con6=-.5*con5*bv3**2
      don1=1./((1.-1./rp1**2)**2*bm1**4)
      don2=don1*(-2*bm1**2)
      don3=-.5*don2*bm1**2

c..... calculate constants for p3 pressure component
      data p30/.01/
      wp2=p2wide*.5*psi0
      wp2e=p2ewide*.5*psi0e
      wp3=wp2/psim
      psi0r=psi0/psim
      p3b=p30
      p3c=(.5*(1.-(tanh(2.))**2)/wp3-p3b*p2wide*(2.-p2wide))
      c *.5/p2wide
      p3d=-(p3b+2.*p3c*psi0r)/(3.*psi0r**2)
      p3a=-(p3b*psi0r+p3c*psi0r**2+p3d*psi0r**3)

c.....calculate constants for pe1
      g2p=-.5*(1.-(tanh(-2.))**2)/wp2e
      g2f=.5*(1.-tanh(-2.))
      ae1=pe10
      ce1=psime*g2p-g2f+ae1
      be1=2.*(g2f-ae1)-psime*g2p

c.....,readjust peak plug pressure for sloshing
      rtemp=(bm1/bmax)**2
      rpxi2=1./rpx**2
      ter1=(rtemp-rpxi2)**2
      ter2=(1.-rpxi2)**2
      bstr2=bmax**2*(-ter1+alsi*rtemp*ter2)/(-ter1+alsi*ter2)
      pfloat=((con1-don1*alsi)*bstr2**2+(con2-don2*alsi)*bstr2
      c +con3-don3*alsi)*(1.+p3a)
      pslosh=psloshin/pfloat
      psloshe=psloshen/pfloat
      nslosh=nsloshin/pfloat
      psls1=pslosh+psloshe
      pcen1=pcenter+pcentee
      do 6 i=1,ix
        eon1=con1-don1*alsi*h56(i)
        eon2=con2-don2*alsi*h56(i)
        eon3=con3-don3*alsi*h56(i)
        abf(i)=con4*h34(i)
        bbf(i)=con5*h34(i)
        cbf(i)=con6*h34(i)

      abp(i)=eon1*(psls1*h12(i)+pcen1*h1(i))
      bbp(i)=eon2*(psls1*h12(i)+pcen1*h1(i))
      cbp(i)=eon3*(psls1*h12(i)+pcen1*h1(i))

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abr(i)=eon1*(nslosh*h12(i)+ncenter*h1(i))
bbr(i)=eon2*(nslosh*h12(i)+ncenter*h1(i))
cbr(i)=eon3*(nslosh*h12(i)+ncenter*h1(i))

abq(i)=eon1*(pslosh*h12(i)+pcenter*h1(i))
bbq(i)=eon2*(pslosh*h12(i)+pcenter*h1(i))
6   cbq(i)=eon3*(pslosh*h12(i)+pcenter*h1(i))
c..... constants for ering pperp(b) long-thin
  if(long.eq.0)go to 21
  bstr=bmax*firing
  faccb=1./(bmax**2-bstr**2)**2
  do 20 i=1,ix
    if(bvac(i).ge.bstr)then
      abf(i)=-pring*faccb*h12(i)
      bbf(i)=2.*pring*faccb*h12(i)*bstr**2
      cbf(i)=pring*bmax**2*(bmax**2-2.*bstr**2)*faccb*h12(i)
    else
      cbf(i)=pring*h12(i)
      bbf(i)=0.
      abf(i)=0.
    end if
20   continue
21   continue
  return
end

subroutine equiltn

c.....equilibrium for tandem mirror electron ring plug

c.....insert storage cliches here
  use param
  use const
  use fstor

  data epsb/1.e-2/, p30/.01/
c..... loop 10, calculate p2 p1 and b and dp2/dpsi and dp1/dpsi
  wp2=p2wide*.5*psi0
  psibar=-be1*.5/ce1
  p1max=ae1+be1*psibar+ce1*psibar**2

  do 10 j=1,jx
    psir=psi(j)/psim
    psire=psi(j)/psime
    pe1=(ae1+be1*psire+ce1*psire**2)*hpme(j)
    pe2=.5*(1.-tanh((psi(j)-psi0e)/wp2e))*(1.-hpme(j))
    p1(j)=(pe1+pe2)/p1max
    dp1dpsi(j)=(be1+2.*ce1*psire)/(psime*p1max)*hpme(j)-.5*(1.-tanh
c ((psi(j)-psi0e)/wp2e)**2)/(wp2e*p1max)*(1.-hpme(j))
    p2t(j)=(1.-tanh((psi(j)-psi0)/wp2))*.5
    dp2dpst(j)=-.5*(1.-tanh((psi(j)-psi0)/wp2)**2)/wp2
    p3(j)=(p3a+p3b*psir+p3c*psir**2+p3d*psir**3)*hp0(j)
    dp3dpsi(j)=(p3b+2.*p3c*psir+3.*p3d*psir**2)*hp0(j)/psim
    p2(j)=p2t(j)+p3(j)
    dp2dpsi(j)=dp2dpst(j)+dp3dpsi(j)

c..... set p2 and p3 constant at large psi
  if (p2(j).le.p2flag)then
    p2(j)=p2floor

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```

p1(j)=p1floor
dp2dpsi(j)=0.
dp1dpsi(j)=0.
end if
if((p2(j)).lt.epsp)go to 50
do 11 i=1,ix
if(abp(i).eq.0)then
b(i,j)=bvac(i)
go to 11
end if
u1=p2(j)*abp(i)+p1(j)*abf(i)
u2=p2(j)*bbp(i)+.5+p1(j)*bbf(i)
t1=-u2*.5/u1
u3=p2(j)*cbp(i)-bvac(i)**2*.5+p1(j)*cbf(i)
radic=sqrt(t1**2-u3/u1)
bsq1=t1+radic
bsq2=t1-radic
bsq=bsq1
if(t1.gt.radic)bsq=bsq2
b(i,j)=sqrt(bsq)
11 continue
go to 10
c.... b=bvac if p2.lt.epsp
50 do 51 i=1,ix
51 b(i,j)=bvac(i)
10 continue

c.....loop 15, calculate phi, the electric potential
do 15 i=1,ix
arg1=((z(i)-z1)/(z1-z0))**2*(-xpot)*(1.-h1(i))
arg2=wpot*((z(i)-z0)/(z0-z2))**2
15 phi1(i)=phice*exp(arg1)+phipl/cosh(arg2)
do 16 j=2,jx
phi2(j)=(1.-(psi(j)*hp3(j)/psi3)**ypot)*hp3(j)
16 continue
c.....loop 20,calculate pperp, ppar and db/dpsi
ppt=1./(1.-1./rp1**2)**2
dter1=(-8./3-4.*(bmax/bm1)**3/3.+4.*(bmax/bm1))/bm1
dter2=-alsi*ppt*dter1*pslsl
do 20 i=1,ix
do 20 j=1,jx
b2=b(i,j)**2
b4=b2**2
dter3=dter2*h56(i)
dter=(4.*(abp(i)*bmax**2/3.+2.*(bbp(i))*bmax+dter3
ppart=(-abp(i)/3.*(b4-bbp(i)*b2+cbp(i)+dter*b(i,j))
ppert=(abp(i)*b4+bbp(i)*b2+cbp(i))
pperte=(abq(i)*b4+bbq(i)*b2+cbq(i))
pperp(i,j)=p2(j)*ppert
ppar(i,j)=p2(j)*ppart
qub(i,j)=(b2+ppar(i,j)-pperp(i,j))/b(i,j)
rho(i,j)=amass*(p2(j)**.5*(abr(i)*b4+bbr(i)*b2+cbr(i))+
c ncenter*cold)
fac=b(i,j)*(1.+2.*p1(j)*(2.*(abf(i)*b2+bbf(i)))
fac1=dp1dpsi(j)*(abf(i)*b4+bbf(i)*b2+cbf(i))
fac2=dp2dpsi(j)*(abp(i)*b4+bbp(i)*b2+cbp(i))
fac3=p2(j)*(2.*(abp(i)*b2+bbp(i))+p1(j)*(2.*(abf(i)*b2+bbf(i))
dbdpsi(i,j)=-(fac1+fac2)/(b(i,j)*(1.+fac3*2.))
dp2db=b(i,j)*(abp(i)*b2*2.+bbp(i))*2.
dp2dbe=b(i,j)*(abq(i)*b2*2.+bbq(i))*2.

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    dp3db=dp2db-4.*abp(i)*b(i,j)**3/3.-2.*bbp(i)*b(i,j)
c +dter
    qubv(i,j)=(-dp2dpsi(j)*(ppert+ppart)-p2(j)*dp3db*dbdpsi(i,j))
    pharg=psi(j)*hp3(j)
    dphidpsi=phi1(i)*ypot*(pharg/psi3)**(ypot-1.)/
c (-psi3)*hp3(j)
    epsi(i,j)=-dphidpsi
    dpdpsi=pperte*dp2dpsi(j)+p2(j)*dp2dbe*dbdpsi(i,j)
    omegci=echarg*b(i,j)/(amass*cee)
    omegstr=-b(i,j)*dpdpsi/omegci
    omeggb=pperte*p2(j)*dbdpsi(i,j)/omegci
    omegexb=-rho(i,j)*cee*dphidpsi*.5
    xxx(i,j)=(omeggb-omegstr+2.*omegexb)*sf6
    yyy(i,j)=(omegexb+omeggb)*(omegexb-omegstr)*sf8
    ppertr=(abf(i)*b4+bbf(i)*b2+cbf(i))
    pperps(i,j)=pperp(i,j)+p1(j)*ppertr
    pperpe(i,j)=p1(j)*ppertr
20 continue

c.....check for negative pressure, and terminate prcb. if necessary
    do 25 j=1,jx
    do 25 i=1,ix
        if(pperp(i,j).lt.0.or.pperpe(i,j).lt.0.)then
            write(59,101)
101 format('problem terminated due to negative pressure' )
            call exit(1)
        end if
    25 continue

c....calculate diagnostic on perpendicular pressure balance
    do 80 i=1,ix
    do 80 j=1,jx
        errprp(i,j)=(b(i,j)**2-bvac(i)**2+2.*pperps(i,j))/bvac(i)**2
80 continue
c....calculate diagnostic on parallel pressure balance
    do 81 j=2,jx
    do 81 i=2,ix-1
        delb=b(i+1,j)-b(i-1,j)
        if(abs(delb).lt.epsb)then
            abar=-abp(i)*5./3.
            bbar=-3.*bbp(i)
            dter3=dter2*h56(i)
            dter4=(4.*abp(i)*bmax**2/3.+2.*bbp(i))*bmax+dter3
            dbar=dter4*2.
            factor=-(abar*b(i,j)**4+bbar*b(i,j)**2+cbp(i)+dbar*b(i,j))
            /
        else
            factor=(ppar(i+1,j)*b(i+1,j)-ppar(i-1,j)*b(i-1,j))
c /delb
        end if
81 errprl(i-1,j-1)=(pperp(i,j)-2.*ppar(i,j)+factor)/bvac(i)**2*2

c.....cal. r and rzz*r
    do 40 i=1,ix
        sum1=0.
        sum2=0
        sum3=0.
        sum4=0.
        sum5=0.
        do 40 j=2,jx
            dps=dpsi(j)

```

```

      psib=psl(j-1)
      if(j.eq,2)then
      dps=psl(2)
      psib=0,
      end if
      if(l.gt,2)go to 31
      call bcast(hpk0(1),0,,kin)
      call bcast(hpk12(1),0,,kin)
      call bcast(hpkm(1),0,,kin)
      call bcast(hpkme(1),0,,kin)
      do 29 k=1,kin
      psik=psib+dps*(k-1)/(kin-1)
      if(psik.lt,psl0)hpk0(k)=1,
      if(psik.lt,psim)hpkm(k)=1,
      if(psik.lt,psime)hpkme(k)=1,
      if(psik.lt,psl2.and,psik.gt,psl1)hpk12(k)=1,
29      continue
c,...., call p1 (p1k) at intermediate points in dps1 interval
      do 30 k=1,kin
      psik=psib+dps*(k-1)/(kin-1)
      psikr=psik/psim
      psikre=psik/psime
      p1ek=(ae1+be1*psikre+ce1*psikre**2)*hpkme(k)
      p2ek=.5*(1,-tanh((psik-psl0e1)/wp2e1))*(1,-hpkme(k))
      p1k(k,j)=(p1ek+p2ek)/p1max
      p3k=(p3a+p3b*psikr+p3c*psikr**2+p3d*psikr**3)*hpk0(k)
      p2k(k,j)=(1,-tanh((psik-psl0)/wp21))*5 +p3k
30      continue
31      continue
      do 32 k=1,kin
      if(p2k(k,j).le,p2flag)then
      p2k(k,j)=p2floor
      p1k(k,j)=p1floor
      end if
      if((p2k(k,j)).le,eps,or,abp(1).eq,0) then
      bk=bvac(1)
      else
      u1=p2k(k,j)*abp(1)+p1k(k,j)*abf(1)
      u2=p2k(k,j)*bbp(1)+p1k(k,j)*bbf(1)+.5
      t1=-u2*.5/u1
      u3=p2k(k,j)*cbp(1)+p1k(k,j)*cbf(1)-bvac(1)**2*.5
      radic=sqrt(t1**2-u3/u1)
      bsq1=t1+radic
      bsq2=t1-radic
      bsq=bsq1
      if(t1.gt,radic)bsq=bsq2
      bk=sqrt(bsq)
      end if
      capf=1.+2.*p1k(k,j)*(2.*abf(1)*bk**2+bbf(1))+2.*p2k(k,j)*
c (2.*abp(1)*bk**2+bbp(1))
      deli1(k)=1./bk
      deli2(k)=1./(bk**3*capf)
      deli3(k)=deli2(k)/(capf*bk**2)
      deli4(k)=p1k(k,j)/(capf*bk)**3
      deli5(k)=p2k(k,j)/(capf*bk)**3
32      continue
      call simps(deli1,dcap1,kin,dps)
      call simps(deli2,dcap2,kin,dps)
      call simps(deli3,dcap3,kin,dps)
c      call simps(deli4,dcap4,kin,dps)

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      call simps(dell5,dcap15,kin,dps)
      cap11=dcap11+sum1
      cap12=dcap12+sum2
      cap13=dcap13+sum3
      cap14=dcap14+sum4
      cap15=dcap15+sum5
      r(i,j)=sqrt(2,*cap11)
      vv1=(bvac(i)*dbvdz(i))**2
      vv2=bvac(i)*d2bvdz2(i)+dbvdz(i)**2
      rzz(i,j)=-vv1*cap12**2/r(i,j)**3+3,*vv1*cap13/r(i,j)
c -vv2*cap12/r(i,j)+8,*bvac(i)**2*(abf(i)*cap14+abp(i)*
c cap15)/r(i,j)
      sum1=+cap11
      sum2=cap12
      sum3=cap13
      sum4=cap14
      sum5=cap15
40      continue
c .....set r(i,1)=r(i,2)
      do 41 i=1,ix
41      r(i,1)=r(i,2)
c      calculate diagnostic quantities flute1, flute2 and flute3
      do 60 j=2,jx-1
        is=2
        if(mod(ix-2,2).eq.0)is=3
        do 61 i=is,ix-1
          ia=i-is+1
          eterm=dp2dpsi(j)*(abp(i)*b(i,j)**4+bbp(i)*b(i,j)**2+cbp(i))
c +p2(j)*(4*abp(i)*b(i,j)**3+2*bbp(i)*b(i,j))*dbdpsi(i,j)
          ringj=dp1dpsi(j)*(abf(i)*b(i,j)**4+bbf(i)*b(i,j)**2+cbf(i))
c +p1(j)*(4*abf(i)*b(i,j)**3+2*bbf(i)*b(i,j))*dbdpsi(i,j)
          dflute1(ia)=+rzz(i,j)*qubv(i,j)/(r(i,j)*b(i,j)**2)/uuz(i)
c +eterm*ringj/b(i,j)**3/uuz(i)
          dflute2(ia)=yyy(i,j)/((r(i,j)*b(i,j)
c )**2*b(i,j))/uuz(i)
          dflute3(ia)=rho(i,j)/((r(i,j)*b(i,j)**2*b(i,j))/uuz(i)
          dflute4(ia)=xxx(i,j)/((r(i,j)*b(i,j)**2*b(i,j))/uuz(i)
61      continue
      call simps(dflute1,ans1,ia,du)
      call simps(dflute2,ans2,ia,du)
      call simps(dflute3,ans3,ia,du)
      call simps(dflute4,ans4,ia,du)
      flute1(j)=ans1*(ia-1)
      flute2(j)=(ans2*(mm**2-1)+ans1)*(ia-1)
      flute3(j)=-ans1/ans3
      rhoave(j)=ans3*(ia-1)
      xxxave(j)=ans4*(ia-1)
      yyyave(j)=ans2*(ia-1)
60      continue

      grow=0,
      growmax=0,
      do 62 j=2,jx-1
        if(flute3(j).gt.0)grow=grow+flute3(j)
        growmax=amax1(growmax,flute3(j))
62      continue
      write(59,102)grow,growmax
102      format('grow=',e14.6,3x,'growmax=',e14.6)
c ..... local growth rate for high mm, (wkb approx. )
      do 70 j=2,jx-1

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```

      omegwkb=mm*.5*xxxave(j)/rhoave(j)
      trad=.25*mm**2*(xxxave(j)**2+4.*rhoave(j)*yyyave(j))
c -rhoave(j)**2*flute3(j)
      if(trad.le.0.)then
        gamwkb(j)=sqrt(-trad)/rhoave(j)
        omeg1wkb(j)=omegwkb
        omeg2wkb(j)=0.
      else
        omeg1wkb(j)=omegwkb +sqrt(trad)/rhoave(j)
        omeg2wkb(j)=omegwkb-sqrt(trad)/rhoave(j)
      end if
70  continue
      return
    end
    subroutine simps(fin,fout,knn,df)
c.....simpsons rule quadratures, knn must be odd
    dimension fin(1)
    nse=(knn-1)/2
    se=ssum(nse,fin(2),2)
    nso=nse-1
    so=ssum(nso,fin(3),2)
    fout=df/(3.*(knn-1))*(fin(1)+fin(knn)+4.*se+2.*so)
    return
    end
    subroutine equilcur

c.....equilibrium for curvature driven flute mode case.

c.....insert storage cliches here.
      use param
      use const
      use fstor

      do 10 i=1,ix
      do 10 j=1,jx
c..... special b(i,j) to test b,c, on flute test case
      b(i,j)=b0
      r(i,j)=sqrt(2*psi(j)/b(i,j))
      rho(i,j)=(len0-en1*r(i,j)**2*.5)*amass
      xxx(i,j)=rho(i,j)*(omeg1+omeg2)*sf6
      yyy(i,j)=rho(i,j)*(-omeg1*omeg2)*sf8
      qub(i,j)=b(i,j)
      qv(i,j)=p0/psi(jx)
10  continue
      return
    end
    subroutine equil

c.....special case equilibrium, 0 beta, 0 pressure, rho=const.
c..... test case 1
c.....set up 1/4/82 by r. freis

c.....insert cliché storage here
      use param
      use matrix
      use const
      use fstor

      data rho0/1.e12/,b0/1.e4/,azm/1./,apsim/1./

```

```

do 10 j=1,jx
do 10 i=1,ix
uz=uuz(i)
rho(i,j)=rho0
b(i,j)=b0
r(i,j)=sqrt(2.*abs(psi(j))/b0)
xxx(i,j)=0.
yyy(i,j)=0.
qub(i,j)=b0
10 continue
return
end
subroutine equilrot

c..... sets up equilibrium for rigid rotor, test case 2 .
c..... flora3 adds cold plasma halo to equilibrium density

c..... insert cliché storage here
use param
use const
use fstor

psi0=b0*r0sq*.5/sqrt(fourpi)
omegr=ratrod*omegst*(1,-enbar/en0)
foursq=sqrt(fourpi)
do 5 i=1,ix
uz=uuz(i)
do 5 j=1,jx
fac=exp(psi(j)/psi0)/sqrt(beta0)
b(i,j)=b0*sqrt(fac**2-1.)/(fac*foursq)
rho(i,j)=en0*amass/(beta0*fac**2)+enbar*amass
beta=1/fac**2
arg1=fac+sqrt(fac**2-1.)
acosh=alog(arg1)
r(i,j)=r0*sqrt(-cr+acosh)
qub(i,j)=b(i,j)
omegstr=omegst*(1,-enbar*amass/rho(i,j))
entest=enbar*amass
if(entest.ge.rho(i,j))omegstr=0.
omegexb=(1.+ratrod)*omegstr
omeggb=+beta*omegstr*.5/(1.-beta)
xxx(i,j)=rho(i,j)*(2.*omegexb+omeggb-omegst)
yyy(i,j)=-rho(i,j)*(omegexb+omeggb)*(omegexb-omegst)
xxx(i,j)=xxx(i,j)*flr
yyy(i,j)=yyy(i,j)*flr
5 continue
do 30 i=1,ix
do 30 j=2,jx-1
qv(i,j)=.5*(qub(i,j+1)*b(i,j+1)-qub(i,j-1)*b(i,j-1))
30 continue
return
end
subroutine initial

c.....set up initial displacement vectors, xro and xio
c..... test case 1, cos(kz) in z, flat in psi
c..... set up 1/4/82 by r. freis

c.....insert cliché storage here
use param

```

```

      use fstor
      use matrix
      use const

      data pi/3,1415926/

      rbf=1,
      do 10 j=2,jx-1
      r1=ranf(b1)
      r2=ranf(b1)
      r3=ranf(b1)
      r4=ranf(b1)
      do 10 i=2,ix-1
      if(kzs,eq,0)then
      rbf=1./(r(i,j)*b(i,j))
      else
      r1=ranf(b1)
      r2=ranf(b1)
      r3=ranf(b1)
      r4=ranf(b1)
      endif
5    continue
      k1=i-1+(j-2)*(ix-2)
      k2=j-1+(jx-2)*(i-2)
      k=.5*(1+isw)*k1+.5*(1-isw)*k2
      xro(k)=ex0*rbf*(r1+r2-1.)+ex1*cos(.5*pi*(z(i))/zedge)
      xio(k)=ex0*rbf*(r3+r4-1.)+ex1*cos(.5*pi*z(i)/zedge)
c    xio(k)=cos(theta0)*xro(k)
10   continue
      do 20 j=2,jx-1
      r1=ranf(b1)
      r2=ranf(b1)
      r3=ranf(b1)
      r4=ranf(b1)
      do 20 i=2,ix-1
      if(kzs,eq,0)then
      rbf=1./(r(i,j)*b(i,j))
      else
      r1=ranf(b1)
      r2=ranf(b1)
      r3=ranf(b1)
      r4=ranf(b1)
      endif
15   continue
      k1=i-1+(j-2)*(ix-2)
      k2=j-1+(jx-2)*(i-2)
      k=.5*(1+isw)*k1+.5*(1-isw)*k2
      xroo(k)=ex0*rbf*(r1+r2-1.)+ex1*cos(.5*pi*(z(i))/zedge)
      xioo(k)=ex0*rbf*(r3+r4-1.)+ex1*cos(.5*pi*z(i)/zedge)
c    xioo(k)=cos(theta0)*xroo(k)
20   continue
      return
      end

      subroutine input
c.....insert storage cliches here
      use param
      use const
      use fstor

```

```

c..... boundary conditions are set as follows:
c.....      at z=z0 (i=1), fl1=-1, implies x=0,
c.....      fl1=1, implies slope=0,
c.....      at z=zmax (i=ix), fizx=-1, implies x=0
c.....      fizx=1, implies slope=0,
c.....      at psi=psi0 (j=1), fj1=-1, implies x=0,
c.....      fj1=1, implies slope=0,
c.....      at psi=psimax (j=jx), fjrx=-1, implies x=0,
c.....      fjrx=1, implies slope=0,
c.....      data mm/4/, bias/.,5/ lmax/2/, nmax/5/,dv/1./, du/1./
c.....      ,ndiag/100/,fl1/1./,fizx/1./,fj1/1./,fjrx/1./,flr/1./
c.....      ,sf6/1./, sf8/1./, kplotm/0/, kzs/1/, swg1/1./, swg2/1./
c.....      , swg3/1./, swg4/1./

c.....,forced data loaded for testing fourier analyses and zed file
c.....,maker
c.....      data jfour/1/,nfourp/1/,nfourmax/5/
c.....      namelist/now1/aname,mm, bias, lmax, nmax,ndiag
c.....      ,fl1,fizx,fj1,fjrx,ex0,ex1,fpsi,fu,fv,fz
c.....      ,kplotm,kzs,jfour,nfourp,nfourmax,sf6,sf8,swg1,swg2,swg3,swg4

c.....      call ddi(now1,2,3,1)
c.....      if(now1d.ne.1)call ddo(now1,100,0,1)
c.....      jx=jrx
c.....      kxx=kxp
c.....      ix=izx
c.....      return
c.....      end

c.....      subroutine grid

c.....      relates physical grid z,psi to computational grid u,v (equally
c.....      spaced ), uses input fpsi, fv, fz, fu and azm, apsim .

c.....      insert cliché storage here
c.....      use param
c.....      use const

c.....      xv=alog(fpsi)/alog(fv)
c.....      xu=alog(fz)/alog(fu)
c.....      zzp=0,
c.....      psip=0,
5      do 5 i=1,ix
c.....      u(i)=u0+du*(i-1,5)
c.....      u(1)=-u(1)
c.....      azm=u(ix)**(1,-xu)
c.....      do 10 i=1,ix
c.....      uuz(i)=u(i)**(1,-xu)/(xu*azm)
c.....      z(i)=azm*u(i)**xu

c.....      uuzh(i)=(u(i)+.5*du)**(1,-xu)/(xu*azm)
c.....      dz(i)=z(i)-zzp
c.....      zzp=z(i)
10     continue
c.....      zedge=azm*.5*(u(ix)**xu+u(ix-1)**xu)
c.....      do 15 j=1,jx
c.....      v(j)=v0+(j-1,5)*dv
15     continue
c.....      v(1)=-v(1)
c.....      apsim=v(jx)**(1,-xv)

```

```

do 20 j=1,jx
vpsi(j)=v(j)**(1.-xv)/(apsim*xv)
vpsih(j)=(v(j)+.5*dv)**(1.-xv)/(apsim*xv)
psi(j)=apsim*v(j)**xv
dpsi(j)=psi(j)-psip
psip=psi(j)
20 continue
c..... calculates v at plasma edge
vw=(psiw/apsim)**(1./xv)
dvin=(vw-v(jx-1))/dv
dvout=(v(jx)-vw)/dv
return
end
subroutine fltoll
c.....calculates the f1 to f11 functions needed to generate the a and
c..... b matrices . uses the equilibrium quantities r, rho, b, etc.
c..... insert cliché storage here

use param
use fstor
use matrix
use const

m2=mm**2
du2=du**2
do 10 i=1,ix
do 10 j=2,jx
r2=r(i,j)**2
uz=uuz(i)
bb=b(i,j)
vp=vpsi(j)
r4=r2**2
f1(i,j)=rho(i,j)*bb*r4
f2t=(1.-m2)*rho(i,j)/bb+r2*vp*(rho(i,j+1)-rho(i,j-1))/(2.*dv)
f2(i,j)=f2t/vp
f3(i,j)=mm*xxx(i,j)*r4*bb
f4(i,j)=(1.-m2)*mm*xxx(i,j)/bb
f5(i,j)=-m2*yyy(i,j)*r4*bb
f7(i,j)=(1.-m2)*(-m2)*yyy(i,j)/(bb*vp)
g4(i,j)=qub(i,j)*r(i,j)**2
g3(i,j)=r(i,j)*b(i,j)
g2(i,j)=qub(i,j)/(r(i,j)*b(i,j))**2
dppdpsi=dp2dpsi(j)*(abp(i)*b(i,j)**4+bbp(i)*b(i,j)**2+cbp(i))
c +p2(j)*(4*abp(i)*b(i,j)**3+2*bbp(i)*b(i,j))*dbdpsi(i,j)
dpedpsi=dp1dpsi(j)*(abf(i)*b(i,j)**4+bbf(i)*b(i,j)**2+cbf(i))
c +p1(j)*(4*abf(i)*b(i,j)**3+2*bbf(i)*b(i,j))*dbdpsi(i,j)
g1(i,j)=+(mm*uuz(i))**2*r(i,j)*(rzz(i,j)
c*qubv(i,j)+/ppdpsi*dpedpsi*r(i,j)/b(i,j))
g1(i,j)=g1(i,j)*swg1
g2(i,j)=g2(i,j)*swg2
g3(i,j)=g3(i,j)*swg3
g4(i,j)=g4(i,j)*swg4
c..... special g1 to test b.c. on flute test case
c g1(i,j)=-(mm*uuz(i))**2*r(i,j)*r(i,j)/lb**2
c c*qv(i,j)

10 continue
c..... fill in edge values
do 20 i=1,ix

```

```

      f1(i,1)=-f1(i,2)
      f2(i,1)=f2(i,2)
      f3(i,1)=-f3(i,2)
      f4(i,1)=f4(i,2)
      f5(i,1)=-f5(i,2)
      f7(i,1)=f7(i,2)
      g4(i,1)=-g4(i,2)
20  continue
      return
      end

```

```

      subroutine amat

```

```

c..... calculates the matrix coefficients for a1, a2, a3, b1, b2
c..... in the equation  $a1*x(n+1)=a2*x(n)+a3*x(n-1)+b1*y(n)+b2*y(n-1)$  ,
c..... uses f1 to f11 from subroutine fltol1 and equilibrium quantities.

```

```

c..... cliché storage here

```

```

      use param
      use fstor
      use matrix
      use const

```

```

      data unit/1,/

```

```

      gam3=-gam2
      du2=du**2
      dt2=dt**2
      dv2=dv**2
      dvt=2,*dv
      m2=mm**2
      jx=jrx
      ix=izx
      do 10 i=2,ix-1
      do 10 j=2,jx-1
      k1=i-1+(j-2)*(ix-2)
      k2=j-1+(jx-2)*(i-2)
      k=.5*(1+isw)*k1+.5*(1-isw)*k2
      r2=r(i,j)**2
      vp=vpsi(j)
      uz=uuz(i)
      bijmh=(b(i,j)+b(i,j-1))* .5
      bijph=(b(i,j)+b(i,j+1))* .5
      bip1jph=(b(i+1,j+1)+b(i+1,j))* .5
      bip1jmh=(b(i+1,j-1)+b(i+1,j))* .5
      bim1jph=(b(i-1,j+1)+b(i-1,j))* .5
      bim1jmh=(b(i-1,j-1)+b(i-1,j))* .5
      g4iphjph=(g4(i+1,j+1)+g4(i,j)+g4(i+1,j)+g4(i,j+1))* .25*uuzh(i)
      g4iphjmh=(g4(i+1,j-1)+g4(i,j)+g4(i+1,j)+g4(i,j-1))* .25*uuzh(i)
      g4imhjph=(g4(i-1,j+1)+g4(i,j)+g4(i-1,j)+g4(i,j+1))* .25*uuzh(i)
      g4imhjmh=(g4(i-1,j-1)+g4(i,j)+g4(i-1,j)+g4(i,j-1))* .25*uuzh(i)
      g2iphj=(g2(i+1,j)+g2(i,j))* .5*uuzh(i)
      g2imhj=(g2(i-1,j)+g2(i,j))* .5*uuzh(i-1)
      g3iphj=(g3(i+1,j)+g3(i,j))* .5*uuzh(i)
      g3imhj=(g3(i-1,j)+g3(i,j))* .5*uuzh(i-1)

      f1ijph=(f1(i,j)+f1(i,j+1))* .5*vpsi(j)
      f1ijmh=(f1(i,j)+f1(i,j-1))* .5*vpsi(j-1)

```

```

f5ijph=(f5(i,j)+f5(i,j+1))*5*vpsih(j)
f5ijmh=(f5(i,j)+f5(i,j-1))*5*vpsih(j-1)

if(j.gt.2)go to 60
f1ijmh=0,
f6ijmh=0,
60 continue
uzbar=-uuz(i)*r(i,j)/(du2*dv2)
a1(k,1)=-gam1*bim1jmh*g4imhjmh*bijmh*uzbar*vpsih(j-1)
c *r(i-1,j-1)
a2(k,1)=-gam2*bim1jmh*g4imhjmh*bijmh*uzbar*vpsih(j-1)
c *r(i-1,j-1)
a3(k,1)=-gam3*bim1jmh*g4imhjmh*bijmh*uzbar*vpsih(j-1)
c *r(i-1,j-1)

a1(k,2)=-f1ijmh/((dt*dv)**2)+gam1*(f5ijmh/dv2+bijmh**2*uzbar
c *vpsih(j-1)*r(i,j-1)*(g4imhjmh+g4iphjmh))
a2(k,2)=-f1ijmh/((dt*dv)**2)+gam2*(f5ijmh/dv2+bijmh**2*uzbar
c *vpsih(j-1)*r(i,j-1)*(g4imhjmh+g4iphjmh))
a3(k,2)=-f1ijmh/((dt*dv)**2)+gam3*(f5ijmh/dv2+bijmh**2*uzbar
c *vpsih(j-1)*r(i,j-1)*(g4imhjmh+g4iphjmh))

a1(k,3)=-gam1*bip1jmh*g4iphjmh*bijmh*uzbar*vpsih(j-1)*r(i+1,j-1)
a2(k,3)=-gam2*bip1jmh*g4iphjmh*bijmh*uzbar*vpsih(j-1)*r(i+1,j-1)
a3(k,3)=-gam3*bip1jmh*g4iphjmh*bijmh*uzbar*vpsih(j-1)*r(i+1,j-1)
a1(k,4)=gam1*((bim1jmh*g4imhjmh*vpsih(j-1)*bijmh+bim1jph*g4imhjph
c *vpsih(j)*bijph)*uzbar*r(i-1,j)+mm**2*b(i,j)*uzbar*
c g2imhj*g3(i-1,j)*dv2/vpsi(j))
a2(k,4)=gam2*((bim1jmh*g4imhjmh*vpsih(j-1)*bijmh+bim1jph*g4imhjph
c *vpsih(j)*bijph)*uzbar*r(i-1,j)+mm**2*b(i,j)*uzbar*
c g2imhj*g3(i-1,j)*dv2/vpsi(j))
a3(k,4)=gam3*((bim1jmh*g4imhjmh*vpsih(j-1)*bijmh+bim1jph*g4imhjph
c *vpsih(j)*bijph)*uzbar*r(i-1,j)+mm**2*b(i,j)*uzbar*
c g2imhj*g3(i-1,j)*dv2/vpsi(j))

a1(k,5)=((f1ijph+f1ijmh)/dv2-f2(i,j))/dt2+gam1*(-(f5ijph+f5ijmh
c )/dv2+f7(i,j)+g1(i,j)+(-bijmh**2*(g4imhjmh+g4iphjmh)*vpsih(j-1)
c -bijph**2*(g4imhjph+g4iphjph)*vpsih(j))*r(i,j)*uzbar-
c mm**2*b(i,j)*uzbar*(g2imhj+g2iphj)*g3(i,j)*dv2/vpsi(j))
a2(k,5)=((f1ijph+f1ijmh)/dv2-f2(i,j))/dt2+gam2*(-(f5ijph+f5ijmh
c )/dv2+f7(i,j)+g1(i,j)+(-bijmh**2*(g4imhjmh+g4iphjmh)*vpsih(j-1)
c -bijph**2*(g4imhjph+g4iphjph)*vpsih(j))*r(i,j)*uzbar-
c mm**2*b(i,j)*uzbar*(g2imhj+g2iphj)*g3(i,j)*dv2/vpsi(j))
a3(k,5)=((f1ijph+f1ijmh)/dv2-f2(i,j))/dt2+gam3*(-(f5ijph+f5ijmh
c )/dv2+f7(i,j)+g1(i,j)+(-bijmh**2*(g4imhjmh+g4iphjmh)*vpsih(j-1)
c -bijph**2*(g4imhjph+g4iphjph)*vpsih(j))*r(i,j)*uzbar-
c mm**2*b(i,j)*uzbar*(g2imhj+g2iphj)*g3(i,j)*dv2/vpsi(j))

a1(k,6)=gam1*((bip1jmh*g4iphjmh*bijmh*vpsih(j-1)+bip1jph*g4iphjph
c *bijph*vpsih(j))*uzbar*r(i+1,j)+mm**2*b(i,j)*uzbar*
c g2iphj*g3(i+1,j)*dv2/vpsi(j))
a2(k,6)=gam2*((bip1jmh*g4iphjmh*bijmh*vpsih(j-1)+bip1jph*g4iphjph
c *bijph*vpsih(j))*uzbar*r(i+1,j)+mm**2*b(i,j)*uzbar*
c g2iphj*g3(i+1,j)*dv2/vpsi(j))
a3(k,6)=gam3*((bip1jmh*g4iphjmh*bijmh*vpsih(j-1)+bip1jph*g4iphjph
c *bijph*vpsih(j))*uzbar*r(i+1,j)+mm**2*b(i,j)*uzbar*
c g2iphj*g3(i+1,j)*dv2/vpsi(j))

a1(k,7)=gam1*(-bim1jph*g4imhjph*bijph*vpsih(j)*uzbar*r(i-1,j+1))

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a2(k,7)=gam2*(-bim1jph*g4imhjph*bijph*vpsih(j)*uzbar*r(i-1,j+1))
a3(k,7)=gam3*(-bim1jph*g4imhjph*bijph*vpsih(j)*uzbar*r(i-1,j+1))
a1(k,8)=-f1ijph/(dt2*dv2)+gam1*(f5ijph/dv2+(bijph**2*(g4imhjph
c +g4iphjph)*vpsih(j)*r(i,j+1)*uzbar))
a2(k,8)=-f1ijph/(dt2*dv2)+gam2*(f5ijph/dv2+(bijph**2*(g4imhjph
c +g4iphjph)*vpsih(j)*r(i,j+1)*uzbar))
a3(k,8)=-f1ijph/(dt2*dv2)+gam3*(f5ijph/dv2+(bijph**2*(g4imhjph
c +g4iphjph)*vpsih(j)*r(i,j+1)*uzbar))
a1(k,9)=gam1*(-bip1jph*g4iphjph*bijph*vpsih(j)*uzbar*r(i+1,j+1))
a2(k,9)=gam2*(-bip1jph*g4iphjph*bijph*vpsih(j)*uzbar*r(i+1,j+1))
a3(k,9)=gam3*(-bip1jph*g4iphjph*bijph*vpsih(j)*uzbar*r(i+1,j+1))
c.....b1 array for rhs
f3ijmh=(f3(i,j)+f3(i,j-1))*0.5*vpsih(j-1)
f3ijph=(f3(i,j)+f3(i,j+1))*0.5*vpsih(j)
denom=1./(dv2)
b1(k,1)=f3ijmh*denom
b1(k,3)=f3ijph*denom
b1(k,2)=-(f3ijmh+f3ijph-f4(i,j)*dv2/vp1)*denom
10 continue
c.....correct coefficients on boundaries
sf11=sign(unit,f11)
sfj1=sign(unit,fj1)
sfjrx=sign(unit,fjrx)
sfizx=sign(unit,fizx)
c..... set corners to 0
k1i=ix-2
k1j=1+(ix-3)*(jx-2)
k1=.5*(1+isw)*k1i+.5*(1-isw)*k1j
fac1=-1.
if(sfj1.eq.1.and,sfizx.eq.1)fac1=r(ix-1,2)*b(ix-1,2)/
c (r(ix,2)*b(ix,2))
a1(k1,5)=a1(k1,5)+fac1*a1(k1,3)
a2(k1,5)=a2(k1,5)+fac1*a2(k1,3)
a3(k1,5)=a3(k1,5)+fac1*a3(k1,3)
a1(k1,3)=0.
a2(k1,3)=0.
a3(k1,3)=0.
k2i=1+(ix-2)*(jx-3)
k2j=jx-2
k2=.5*(1+isw)*k2i+.5*(1-isw)*k2j
fac3=-dvout/dvin
if(sfjrx.eq.1.and,sf11.eq.1)fac3=r(2,jx-1)*b(2,jx-1)/
c (r(1,jx-1)*b(1,jx-1))
a1(k2,5)=a1(k2,5)+fac3*a1(k2,7)
a2(k2,5)=a2(k2,5)+fac3*a2(k2,7)
a3(k2,5)=a3(k2,5)+fac3*a3(k2,7)
a1(k2,7)=0.
a2(k2,7)=0.
a3(k2,7)=0.
fac2=-1.
if(sfj1.eq.1.and,sf11.eq.1)fac2=r(2,2)*b(2,2)/(r(1,2)*b(1,2))
a1(1,5)=a1(1,5)+fac2*a1(1,1)
a2(1,5)=a2(1,5)+fac2*a2(1,1)
a3(1,5)=a3(1,5)+fac2*a3(1,1)
a1(1,1)=0.
a2(1,1)=0.
a3(1,1)=0.
fac4=-dvout/dvin
if(sfjrx.eq.1.and,sfizx.eq.1)fac4=r(ix-1,jx-1)*b(ix-1,jx-1)/
c (r(ix,jx-1)*b(ix,jx-1))

```



```

a1(kxp,5)=a1(kxp,5)+fac4*a1(kxp,9)
a2(kxp,5)=a2(kxp,5)+fac4*a2(kxp,9)
a3(kxp,5)=a3(kxp,5)+fac4*a3(kxp,9)
a1(kxp,9)=0.
a2(kxp,9)=0.
a3(kxp,9)=0.
i=2
do 11 j=2,jx-1
  if(sf11.eq.1.)sf11=r(2,j)*b(2,j)/(r(1,j)*b(1,j))
  k1=i-1+(j-2)*(ix-2)
  k2=j-1+(jx-2)*(i-2)
  k=.5*(1+isw)*k1+.5*(1-isw)*k2
  do 11 m=2,8,3
    a1(k,m)=a1(k,m)+sf11*a1(k,m-1)
    a2(k,m)=a2(k,m)+sf11*a2(k,m-1)
    a3(k,m)=a3(k,m)+sf11*a3(k,m-1)
11  continue
13  continue
    i=ix-1
    do 12 j=2,jx-1
      if(sfizx.eq.1.)sfizx=r(ix-1,j)*b(ix-1,j)/(r(ix,j)*b(ix,j))
      k1=i-1+(j-2)*(ix-2)
      k2=j-1+(jx-2)*(i-2)
      k=.5*(1+isw)*k1+.5*(1-isw)*k2
      do 12 m=2,8,3
        a1(k,m)=a1(k,m)+sfizx*a1(k,m+1)
        a2(k,m)=a2(k,m)+sfizx*a2(k,m+1)
        a3(k,m)=a3(k,m)+sfizx*a3(k,m+1)
12  continue
20  continue
    i=2
    do 21 j=2,jx-1
      k1=i-1+(j-2)*(ix-2)
      k2=j-1+(jx-2)*(i-2)
      k=.5*(1+isw)*k1+.5*(1-isw)*k2
      do 21 m=1,7,3
        a1(k,m)=0.
        a2(k,m)=0.
        a3(k,m)=0.
21  continue
    i=ix-1
    do 22 j=2,jx-1
      k1=i-1+(j-2)*(ix-2)
      k2=j-1+(jx-2)*(i-2)
      k=.5*(1+isw)*k1+.5*(1-isw)*k2
      do 22 m=3,9,3
        a1(k,m)=0.
        a2(k,m)=0.
        a3(k,m)=0.
22  continue
    j=2
    do 31 i=2,ix-1
      k1=i-1+(j-2)*(ix-2)
      k2=j-1+(jx-2)*(i-2)
      k=.5*(1+isw)*k1+.5*(1-isw)*k2
      do 30 m=4,6
        a1(k,m)=a1(k,m)+sfj1*a1(k,m-3)
        a2(k,m)=a2(k,m)+sfj1*a2(k,m-3)
        a3(k,m)=a3(k,m)+sfj1*a3(k,m-3)
30  continue

```

```

      b1(k,2)=b1(k,2)+sfj1*b1(k,1)
31  continue
32  continue
      j=jx-1
      fac5=sfjrx
      if(sfjrx.eq.-1)fac5=fac5*dvout/dvin
      do 35 i=2,ix-1
      k1=i-1+(j-2)*(ix-2)
      k2=j-1+(jx-2)*(i-2)
      k=.5*(1+isw)*k1+.5*(1-isw)*k2
      do 34 m=4,6
      a1(k,m)=a1(k,m)+fac5*a1(k,m+3)
      a2(k,m)=a2(k,m)+fac5*a2(k,m+3)
      a3(k,m)=a3(k,m)+fac5*a3(k,m+3)
34  continue
      b1(k,2)=b1(k,2)+fac5*b1(k,3)
35  continue
40  continue
      j=2
      do 45 i=2,ix-1
      k1=i-1+(j-2)*(ix-2)
      k2=j-1+(jx-2)*(i-2)
      k=.5*(1+isw)*k1+.5*(1-isw)*k2
      do 44 m=4,6
      a1(k,m-3)=0.
      a2(k,m-3)=0.
      a3(k,m-3)=0.
44  continue
      b1(k,1)=0.
45  continue
      j=jx-1
      do 48 i=2,ix-1
      k1=i-1+(j-2)*(ix-2)
      k2=j-1+(jx-2)*(i-2)
      k=.5*(1+isw)*k1+.5*(1-isw)*k2
      do 47 m=4,6
      a1(k,m+3)=0.
      a3(k,m+3)=0.
      a2(k,m+3)=0.
47  continue
      b1(k,3)=0.
48  continue
      return
      end

```

```

      subroutine comat(abar,nd)

```

c.....transforms the elements of the a1(k,m) array into into the
c..... elements of the compressed column matrix abar which will be
c..... operated upon by banfac and bansol.

c..... insert storage cliches here

```

      use param
      use fstor
      use matrix
      use const

```

```

      dimension abar(kxp,1)

```

```

      kxx=kxp
      len=nd*kxp
      call bcast(labar(1,1),0..len)
      do 10 k=1,kxx
      do 10 m=1,9
      lp1=m+((m-1)/3)*(ihbw-4)
      lp2=1+mod(m-1,3)*(ihbw-1)+(m-1)/3
      lp=.5*(1+isw)*lp1+.5*(1-isw)*lp2
      abar(k,lp)=a1(k,m)
10    continue
      return
      end

```

subroutine right

c..... calculates right hand side vector for both equations.
 c..... rhs1(k)=2*a2*xr(n)-a2*xr(n-1)+b1*(xi(1)-xi(n-1)) , and
 c..... rhs2(k)=2*a3*xi(n)-a2*xi(n-1)+b1*(xr(1)-xr(n-1)) .

c..... insert cliches for storage here

```

      use param
      use fstor
      use matrix
      use const

```

```

      do 10 j=2,jx-1
      do 10 i=2,ix-1
      k1=i-1+(j-2)*(ix-2)
      k2=j-1+(jx-2)*(i-2)
      k=.5*(1+isw)*k1+.5*(1-isw)*k2
      t1=0.
      t2=0.
      t3=0.
      tt1=0.
      tt2=0.
      tt3=0.

```

```

      do 5 m=1,9
      lp=i-2+m-((m-1)/3)*3
      jp=j-1+(m-1)/3
      if(jp.eq.1.or.jp.eq.jrx.or.lp.eq.1.or.lp.eq.ix)go to 5
      kp1=lp-1+(ix-2)*(jp-2)
      kp2=jp-1+(jx-2)*(lp-2)
      kp=.5*(1+isw)*kp1+.5*(1-isw)*kp2
      t1=t1+a2(k,m)*xroo(kp)
      t2=t2+a3(k,m)*xro(kp)
      tt1=tt1+a2(k,m)*xi00(kp)
      tt2=tt2+a3(k,m)*xi0(kp)

```

```

5    continue
      do 6 mn=1,3
      jq=j-2+mn
      if(jq.eq.1.or(jq.eq.jrx)go to 6
      kq1=i-1+(ix-2)*(jq-2)
      kq2=jq-1+(jx-2)*(i-2)
      kq=.5*(1+isw)*kq1+.5*(1-isw)*kq2
      t3=t3+b1(k,mn)*(xi01(kq)-xi00(kq))
      tt3=tt3+b1(k,mn)*(xro1(kq)-xro0(kq))

```

```

6    continue
      rhs1(k)=(2.*t2-t1+fac1*t3)
      rhs2(k)=(2.*tt2-tt1+fac2*tt3)
10   continue

```

```

        return
        nd
        subroutine rightvec

c..... calculates right hand side vector for both equations.
c..... rhs1(k)=2*a2*xr(n)-a2*xr(n-1)+b1*(xi(1)-xi(n-1)) , and
c..... rhs2(k)=2*a3*xi(n)-a2*xi(n-1)+b1*(xr(1)-xr(n-1)) ,

c..... insert cliches for storage here
        use param
        use fstor
        use matrix
        use const

        call sscal(kxx,0,,rhs1,1)
        call sscal(kxx,0,,rhs2,1)
        do 100 m=1,9
            mdel=(m-1)/3
            m1=m-1
            koff1=-mdel*5+m+(mdel-1)*ix
            koff2=(m-((mdel+1)*3-1))*jx+1-2*m1+7*mdel
            koff=.5*(1+isw)*koff1+.5*(1-isw)*koff2
            do 110 k=1,kxx
                rhs1(k)=rhs1(k)+2.*a3(k,m)*xro(k+koff)-a2(k,m)*xroo(k+koff)
110          rhs2(k)=rhs2(k)+2.*a3(k,m)*xio(k+koff)-a2(k,m)*xioo(k+koff)
                if(m.eq.2.or.m.eq.5.or.m.eq.8)go to 119
            go to 100
119          continue
            do 120 k=1,kxx
                mbar=m-1-(m/4)*2
                rhs1(k)=rhs1(k)+fac1*b1(k,mbar)*(xiol(k+koff)-xioo(k+koff))
120          rhs2(k)=rhs2(k)+fac2*b1(k,mbar)*(xrol(k+koff)-xroo(k+koff))
100          continue
        return
        end
        subroutine rigidcon

c..... special constants needed for rigid rotor equilibrium.

c..... storage cliche here
        use param
        use const

c..... input for rigid rotor
        data echarg/4.8e-10/, en0/1.00e+12/, b0/1.e4/, amass/3.34e-24/
        c , cee/3.e10/, valfk/.4/, fourpi/12.56637/, pi/3.1415926/
        c , enbar/0.e11/
        namelist/rotor/b0,beta0,ratrod,valfk,en0,echarg,r0,rwb,enbar
        call ddi(rotor,2,3,1)

        carg=sqrt(1.-beta0)
        r0sq=r0**2
        aasq=r0sq*(1.-carg)/beta0
        cr=.5*(alog(1.+carg)-alog(1.-carg))
        aa=sqrt(aasq)
        rw=rwb*aa
        valf=b0/(sqrt(fourpi*en0*amass)) /
        omegci=echarg*b0/(amass*cee)
        omegp2=fourpi*en0*echarg**2/amass
        omegst=2.*beta0*omegci*cee**2/(omegp2*r0sq)

```