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

cliche param
parameter (lzx=34, jrx=60, lzx2=lzx-2 )
parameter ( ltbw=2*lzx-1 )
parameter ( kxp=(lzx-2)*(jrx-2), lbw=lzx-1 )
parameter ( nplt=3000, nps=100 )
parameter ( lxfpf=4*(lzx-2),nfourxf=150)
parameter ( lxfpg=2*lzx2)
parameter ( kslm=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/x1o0(kxp),x1o(kxp),x1o1(kxp)
c ,xroo(kxp),xro(kxp),xrol(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,ix,jx,mm,lzxp,kxx,nmax,lmax,ism,iwbw
c ,fac1,fac2,bias,du,dv,dt,ndtag,ex0,b0,rho0,ex1,f11,f1zx,fj1
c ,fjrx,kplot,npn,fpsi,fz,fu,fv,azm,apsim,u0,v0,amass
c ,fourpi,omegst,omegr,omegexb,fir,sf6,sf8,kplotm,kzs,zedge
c ,cpuo,clo,syso,valfk,xu,xv,n,pl,vw,psiw,dvin,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,prin,epsp,phicen,phiplg,kin,xpot,ypot,wpot,pfudge,rpx
c ,phice,phipl,betslsh,betcent,z0,z1,z2,z3,z4,psi1,psi2,psi0
c ,betcone,betslse,pslosho,pcentee,bmax,alsi,bm1,psis1,cold
c ,p2wide,psi3rel,psi3,p1max,bv0,bv3,bv4,bceng,psloshin,psloshen
c ,nsloshin,pxp1,pxp2,p3a,p3b,p3c,p3d,psim,pe10,ael,bel,cel
c ,psi0rel,psi0e,psime,p2wide,wp2e,p2ffloor,p1ffloor,p2fflag
c ,fring,long,nn3d,no1d,dphi
common/mesh/psi(jrx),z(lzx),u(lzx),v(jrx),dpsi(jrx),dz(lzx)
c ,vpsi(jrx),uuz(lzx),vpsi(jrx),uuzh(lzx)
common/graf/ xrtimed(nplt),xrspz(lzx,nps),xrspbst(jrx,2*nps)
c ,time(nplt),xflutel(lzx,nps)
common/curvco/cr,lb,rw,beta0,delrho,stable,en0,coe,r0,
c ,echarg,omeg1,omeg2,er1,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 ,htranslizx),abq(lzx),bbq(lzx),chq(lzx),h56(lzx),abr(lzx)
c ,bbr(lzx),cbri(lzx),betring,hp0(jrx),hpm(jrx),hpmel(jrx),hfir(jrx)
c ,commun/tmfield/bvac(lzx),dbvdz(lzx),d2bvdz2(lzx),dp1dpst(jrx)
c ,p1(jrx),p1k(ksim,jrx),hpk12(ksim),hpk0(ksim),del11(ksim)
c ,del12(ksim),del13(ksim),del14(ksim),rzz(lzx,jrx),dbdpst(lzx,jrx)
c ,phi1(lzx),phi2(lzx),pperplizx,jrx),ppar(lzx,jrx),dflute3(lzx)
c ,qubv(lzx,jrx),p2(jrx),dp2dpst(jrx),dflute1(lzx),dflute2(lzx)
c ,flute1(jrx),flute2(jrx),flute3(jrx),p2k(ksim,jrx),del15(ksim)
c ,pperps(lzx,jrx),errprplizx,jrx),errprl(lzx2,jrx-1)
c ,pperpel(lzx,jrx),eps1(lzx,jrx),omeg1wkb(jrx),omeg2wkb(jrx)
c ,gamwkb(jrx),dflute4(lzx),rhoavel(jrx),xxxavel(jrx),yyyavel(jrx)
c ,p2t(jrx),dp2dpst(jrx),p3(jrx),dp3dpst(jrx),hpkm(ksim)
c ,hpkmel(ksim),droavel(jrx),droterm(lzx)
common/forced/nfour,nfourx,nfourmax,nfourp,jfour,ixp,locv

real lb,ltrans,ltran,nslosh,ncenter,nsloshin
endcliffe

return
end

c..... the main routine

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

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

c..... floral transforms variables z,psi to u,v which are always equally
c..... spaced, transformation: z=au*xu**xu, and psi=apsi*yv**xv, where
c..... zmax=uemax, psimax=vmax, and fz*zmax=fu*uemax, fpsi*psimax=fv*vmax .
c..... fz, fu, fpsi, fv, input, xu=ln fz / ln fu, xv=ln fpsi / ln fv ,
c..... au=uemax**(-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, onbar ( 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 cliche 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

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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
c.....floratm, tandem mirror equilibrium
c
c.....flortm1, tandem mirror equilibrium, with 3-d plot of equilib,
c      quantities added. ( uses tv80 and graflib )
c
c.....flortex, tandem mirror equilib, with corrections to flortm1. In-
c....., put switches swg1, swg2, swg3, swg4 added,
c
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
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 (=dphi/dpsi ) , Phi12 modified
c.... to = 1,-(psi/psi3)**ypot .
c
c.....flortm4, modified plasma pperp with addition of p3(j) to give
c..... a positive slope near the center,
c
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(psille), to p2flag ( an
c..... input value), p2 set to p2floor (an input value) and p1 set to
c..... j1floor (an input value). Long-thin ering option added. This modifies
c..... j1 dependence of ering pperp to look longer (by changing abf, bbf, cbf)
c..... i. 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 / q8locs/iocf(0:15)
common/pic100/npte
data itally/1/

c.....call link call here
  call link('unit59=terminal,unit2=(infltm6,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,floratim,1)
299  itally=-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 dd1(noplot,2,0,1)
      if(no1d.ne.1)call pstart(dev,4rplot,1,'box u21$',1)
c
      npote=1
      if(no1d.ne.1)call p100
      call input
      call inputtm
c
      call rigideon
c
      call curvecon
      call grid
      call constant
      call tmcon2
      call equiltm
c
      call equilrot
c
      call equilcur
      call f1to11
      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),xiol(1),kxx)
c
      call mymove(xroo(1),xrol(1),kxx)
c
      call mymove(xioo(1),xiol(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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20   call zmovewrld(xtol,ww1(nn),kxx)
      continue
      fac1=-.5/dt
90   fac2=.5/dt
      call zmovewrld(xtoo,xlo,kxx)
      call zmovewrld(xlo,xtol,kxx)
      call zmovewrld(xroo,xro,kxx)
      call zmovewrld(xro,xrol,kxx)
c..... time array
      xntime(n)=xro(kplot)
      if(mod(n,ndiag).eq.0)call diagno
         if(mod(n,nfourpl).eq.0)call fourier
100  continue
      call clsdsk(locv,0)
      call timeused(icp,lo,isy)
      cpo=icp*tim
      clo=lo*tim
      syso=isy*tim
      if(nold.ne.1)
c call picshor
      call close(100)
      if(no3d.eq.1)go to 300
      call keep80(1,3)
      call fr80id
      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+(jx-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 cliches here
      use param
      use const
      real klbsq

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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,stabl,en0,echarg,lb,rw,xm
      c ,z0l,dtrel,theta0
      call dd1(curve,2,3,1)
      if(nold.ne.1)    call dd0(curve,100,0,1)
      zmax=z0l*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
      k1bsq=0.
      if(kzs.ne.0)k1bsq=(pi/(2.*z0l))**2
      delomeg=0.
      if(sf8.ne.0)
1      delomeg=stable*((beta0/xm**2+k1bsq/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(ix)=zmax
      v(jx)=psimax
      du=u(ix)/(ix-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-k1bsq*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

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

c..... insert storage cliches here
      use param
      use const
      real k1bsq

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      psi0rel..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 betsise...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 sismsons 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(ps1) (p1(ps1))
c pxp2...power of polynomial in e ring pperp(ps1) (p1(ps1))
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 equilib.
c 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 ,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/, p2wide/.1/
c ,bmg/1.e4/, bceng/1.e3/, nsloshin/2.e13/, ncenter/1.e13/,
c betsish/.25/, betcent/.10/, rp/4./, epsp/1.e-6/,rp1/2./
c ,phicen/.1/, phiplg/.1/, betcene/.1/, betsise/.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./,psi0rel/.5/,p2ewide/.2/
c ,p2floor/0./,p1floor/0./,p2flag/1.e-3/,fring/.9/,long/1/,no3d/0/
c ,no1d/0/,dphi/0./
c namelist/curve/echarg,lb,rw,xm,rw1
c ,zmax,dt,theta0,pfudge
c ,psi0rel,z1rel,z2rel,z0rel,nsloshin,cold,z3rel,z4rel
c ,ncenter,betsish,betcent,RP,ztrans,ltrans,bmg,RP1
c ,bceng,eps,phicen,phiplg,kin,xpot,ypot,wpot,betcene,betsise
c ,betring,psi1rel,psi2rel,p2wide,psi3rel,pxp1,pxp2,safe,pe10
c ,p2ewide,psi0rel,p2floor,p2flag,p1floor,fring,long,dphi
c call ddi(curve,2,3,1)
c if(nold.ne.1)then
c call pframe
c call p100

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call ddolcurve,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
arqt1=(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(arqt1))
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*psi0rel
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=(betlsh)*pmag0
pcenter=(betcent)*pmag1
psloshen=betlset*pmag0
pcentee=betcene*pmag1
prring=betring*pmag0
phicent=phicent*psloshin/(nsloshin*echarg)
phiplg=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.ksimpl)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

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    epsp=epsp*(1.e-4+psloshint+pcenter)/(1.e-8*epsp+psloshint+pcenter)
c.....check that bcon and betcon are physically consistent
    asq=.25/(12.*rp1)**(2./3.,1-1.)*(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)+bcon*.5*(1.-tanh(arget3))
    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*(bcon+bv4)**2
    if(tmin.le.betcent+betcone)then
        bcon1=sqrt((betcent+betcone)/afac)-bv4
        tmine=tmin-betcone
        write(59,210)bcon1,tmine
210  format('initial central cell beta and b are inconsistent for',
c 'equilibrium',/ 'either increase bcon to more than ',e14.6/
c 'or decrease betcent to less than ',e14.6/'use namelist',
c 'data format')
        namelist/better/betcent,bcon
        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 betsish 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

```

```

end
subroutine tmcon2

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

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

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(jj), hp3(jj) and hp12(jj)
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.psime)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*i
  c tanh(argt)**2/ltran
  d2bvdz2(i)=-3*bm*(1./(asq*fb1**5)+1./(asq*fb2**5)-eb1**2*5/
  cfb1**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/(+bv0)
  bm1=rp1*(+bv0)
  alsit=((1.-1./rp1**2)/(1.-1./rp1**2)*(rp1/rpx))**2
  alsi=alsit+.5*(1.-alsit)*pfudge

```

```

c.....calculate heaviside 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./rp1**2)**2*bmax**4
con2=con1*(-2*bmax**2)
con3=-.5*con2*bmax**2
con4=pr1ng/(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=1.5*(1.-(tanh(2.1)**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(-2.1)**2)/wp2e
g2f=.5*(1.-tanh(-2.1)
ae1=pe10
ce1=psi0e*g2p-g2f+ae1
be1=2.*((g2f-ae1)-psi0e*g2p
c.....readjust peak plug pressure for sloshing
rtemp=(bm1/bmax)**2
rpxi2=1./rp1**2
ter1=(rtemp-rpxi2)**2
ter2=(1.-rpxi2)**2
bstr2=bmax**2*(-ter1+alsi*rtemp*ter2)/(-ter1+alsi*ter2)
pfloa=((con1-don1*alsi)*bstr2**2+(con2-don2*alsi)*bstr2
c +con3-don3*alsi)*(1.+p3a)
pslosh=psloshin/pfloat
psloshe=psloshein/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))

```

```

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*fring
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 equiltm

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
psi0bar=-be1*.5/cel
p1max=ae1+be1*psi0bar+cel*psi0bar**2

do 10 j=1,jx
psi0=psi(j)/psim
psi0r=psi(j)/psime
pe1=(ae1+be1*psi0r+cel*psi0r**2)*hpme(j)
pe2=.5*(1.-tanh((psi(j)-psi0e)/wp2e))*(1.-hpme(j))
p1(j)=(pe1+pe2)/p1max
dp1dpsi(j)=(be1+2.*cel*psi0r)/(psime*p1max)*hpme(j)-.5*(1.-(tanh
c ((psi(j)-psi0e)/wp2e)**2)/(wp2e*p1max)*(1.-hpme(j)))
p2t(j)=(1.-tanh((psi(j)-psi0e)/wp2e))*5
dp2dpst(j)=-.5*(1.-(tanh((psi(j)-psi0e)/wp2e)**2)/wp2
p3(j)=(p3a+p3b*psi0r+p3c*psi0r**2+p3d*psi0r**3)*hp0(j)
dp3dpsi(j)=(p3b+2.*p3c*psi0r+3.*p3d*psi0r**2)*hp0(j)/psim
p2(j)=p2t(j)+p3(j)
dp2dpsi(j)=dp2dpst(j)+dp3dpsi(j)
hf1r(j)=1.

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

```

```

p2(j)=p2floor
p1(j)=p1floor
dp2dpsi(j)=0,
dp1dpsi(j)=0,
hf1r(j)=0,
end if
if((p2(j)).lt.ebsp)go to 50
do 11 i=1,ix
if(abp(i).eq.0)then
bli,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
bli,j)=sqrt(bsq)
11 continue
go to 10
c... b=bvac if p2.lt.ebsp
50 do 51 i=1,ix
51 bli,j)=bvac(i)
10 continue

c.....loop 15, calculate phi1, the electric potential
do 15 i=1,ix
arg1=((z(i)-z1)/(z1-z0))**2*(-xpolt)*(1.-h1(i))
arg2=wpot*((z(i)-z0)/(z0-z2))**2
15 phi1(i)=phice*expl(arg1)+phi1/cosh(arg2)
c.....special phi1 for high mm rotation mode test
do 17 i=1,ix
phi1(i)=phice*(1.-dphi*(1.-h1(i)))
17 continue
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*psi1
do 20 i=1,ix
do 20 j=1,jx
if(dter2.eq.0.)dter2=0.
b2=bli,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*bli,j))
ppert=(abp(i)*b4+bbp(i)*b2+cbp(i))
pperte=(abq(i)*b4+bbq(i)*b2+cbr(i))
pperp(i,j)=p2(j)*ppert
ppar(i,j)=p2(j)*ppart
qub(i,j)= (b2+ppar(i,j)-pperp(i,j))/bli,j)
rho(i,j)=amass*(p2(j)**.5*(abr(i)*b4+bbr(i)*b2+cbr(i))+c_ncenter*cold)

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```

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.
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=phi(i)*ypot*(pharg/psi3)**(ypot-1.)/
c (-psi3)*hp3(j)
eps(i,j)=-dphidpsi
dpdpsi=pperte*dp2dpsi(j)+p2(j)*dp2dbe*dbdpsi(i,j)
omegci=echarge*b(i,j)/(amass*ceo)
unit=1./{sqrt(4.*pi)}
omegstr=-unit*b(i,j)*dpdpsi/(omegci*rhol(i,j))
omeggb=unit*pperte*p2(j)*dbdpsi(i,j)/(omegci*rhol(i,j))
omegexb=-ceo*dphidpsi
xxx(i,j)=hftr(j)*rhol(i,j)*(omeggb-omegstr+2.*omegexb)*sf6
yyy(i,j)=-hftr(j)*rhol(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 prob. 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=i,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 errpri(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=1,1x
sum1=0,
sum2=0
sum3=0,
sum4=0,
sum5=0,
do 40 j=2,jx
dps=dps1(j)
psi_b=psi1(j+1)
if(j,eq,2)then
dps=psi1(2)
psi_b=0,
end if
if(j,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
psi_k=psi_b+dps*(k-1)/(kin-1)
if(psi_k,lt,psi0)hpk0(k)=1,
if(psi_k,lt,psi_m)hpkm(k)=1,
if(psi_k,lt,psi_me)hpkme(k)=1,
if(psi_k,lt,psi2,nd,psi_k,gt,psi1)hpk12(k)=1,
29 continue
c..... cal. p1 (p1k) at intermediate points in dps1 interval
do 30 k=1,kin
psi_k=psi_b+dps*(k-1)/(kin-1)
psi_kr=psi_k/psi_m
psi_kre=psi_k/psi_me
p1ek=(ae1+be1*psi_kre+ce1*psi_kre**2)*hpkm(k)
p2ek=.5*(1,-tanh((psi_k-psi0)/wp2e))*(1,-hpkm(k))
p1k(k,j)=(p1ek+p2ek)/p1max
p3k=(p3a+p3b*psi_kr+p3c*psi_kr**2+p3d*psi_kr**3)*hpk0(k)
p2k(k,j)=(1,-tanh((psi_k-psi0)/wp2f))*.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,epsp,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))
del11(k)=1./bk
del12(k)=1./(bk**3*capf)
```

```

delt3(k)=delt2(k)/(capf*bk**2)
delt4(k)=p1k(k,j)/(capf*bk)**3
delt5(k)=p2k(k,j)/(capf*bk)**3
32    continue
call simps(delt1,dcap1,kin,dps)
call simps(delt2,dcap2,kin,dps)
call simps(delt3,dcap3,kin,dps)
c   call simps(delt4,dcap4,kin,dps)
call simps(delt5,dcap5,kin,dps)
cap1=dcap1+sum1
cap2=dcap2+sum2
cap3=dcap3+sum3
cap4=dcap4+sum4
cap5=dcap5+sum5
r(1,j)=sqrt(2.*cap1)
vv1=(bvac(1)*dbvdz(1))**2
vv2=bvac(1)*d2bvdz2(1)+dbvdz(1)**2
rzz(1,j)=-vv1*cap2**2/r(1,j)**3+3.*vv1*cap3/r(1,j)
c -vv2*cap2/r(1,j)+8.*bvac(1)**2*(abf(1)*cap4+abp(1)*
c cap5)/r(1,j)
sum1=+cap1
sum2=cap2
sum3=cap3
sum4=cap4
sum5=cap5
40    continue
c.....set r(1,1)=r(1,2)
do 41 i=1,ix
 41  r(1,1)=r(1,2)
c   calculate diagnostic quantities flute1, flute2 and flute3
do 60 j=2,jx-1
  ls=2
  if(mod(ix-2,2).eq.0)ls=3
  do 61 i=ls,ix-1
    ia=i-ls+1
    eterm=dp2dpsi(j)*(abp(1)*b(1,j)**4+bbp(1)*b(1,j)**2+cbp(1))
    c +p2(j)*(4*abp(1)*b(1,j)**3+2*bbp(1)*b(1,j))*dbdpsi(i,j)
    rterm=0,
    if(dp2dpsi(j).ne.0.)
    c rterm=dp2dpsi(j)*(abr(1)*b(1,j)**4+bbr(1)*b(1,j)**2+br(1))
    c /(2.*p2(j)**.5)
    c +p2(j)**.5*(4*abr(1)*b(1,j)**3+2*bbr(1)*b(1,j))*dbdpsi(i,j)
    droterm(ia)=rterm*amass/b(1,j)**2/uuz(1)
    ringj=dp1dpsi(j)*(abf(1)*b(1,j)**4+bbf(1)*b(1,j)**2+cbf(1))
    c +p1(j)*(4*abf(1)*b(1,j)**3+2*bbf(1)*b(1,j))*dbdpsi(i,j)
    dflute1(ia)=+rzz(1,j)*qubv(1,j)/(r(1,j)*b(1,j)**2)/uuz(1)
    c +eterm*ringj/b(1,j)**3/uuz(1)
    dflute2(ia)=yyy(1,j)/((r(1,j)*b(1,j)**2)/uuz(1))
    c )**2*b(1,j))/uuz(1)
    dflute3(ia)=rho(1,j)/((r(1,j)*b(1,j)**2*b(1,j))/uuz(1))
    dflute4(ia)=xxx(1,j)/((r(1,j)*b(1,j)**2*b(1,j))/uuz(1))
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)
call simps(droterm,ans5,ia,du)
flute1(j)=ans1*(ia-1)
flute2(j)=(ans2*(mm**2-1)+ans1)*(ia-1)

```

```
rhoave(j)=ans3*(ia-1)
xxxave(j)=ans4*(ia-1)
yyyave(j)=ans2*(ia-1)
droave(j)=ans5*(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
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)-droave(j)*yyyave(j)
if(trad,le,0.)then
gammwkb(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)=(en0-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(j)x
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 cliche 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 cliche storage here
  use param
  use const
  use fstor

  psi0=b0*i_0sq*.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=a log(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)
      xio(k)=cos(theta0)*xro(k)

c     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)
xtoo(k)=ex0*rbf*(r3+r4-1.)+ex1*cos(.5*pi*z(i)/zedge)
c xtoo(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), f11=-1, implies x=0,
c..... f11=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), fji=-1, implies x=0,
c..... fji=1, implies slope=0.
c..... at psi=max (j=jx), fjrxx=-1, implies x=0,
c..... fjrxx=1, implies slope=0.
c..... data mm/4/, bias/.5/ lmax/2/, nmax/5/, dv/1./, du/1./
c ,ndiag/100/, f11/1./, fizx/1./, fji/1./, fjrxx/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
      data jfour/1/,nfourp/1/,nfourmax/5/
      namelist/now1/aname,mm, bias, lmax, nmax,ndiag
c ,f11,fizx,fji,fjrxx,ex0,ex1,fpsi,fu,fv,fz
c ,kplotm,kzs,jfour,nfourp,nfourmax,sf6,sf8,swg1,swg2,swg3,swg4

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

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 cliche storage here
use param
use const

      xv=alog(fpsi)/alog(fv)
      xu=alog(fz)/alog(fu)
      zzp=0.
      psip=0.
      do 5 i=1,ix
      5 u(i)=u0+du*(i-1.5)

```

```

      u(1)=-u(1)
      azm=u(ix)**(1.-xu)
      do 10 i=1,ix
      uuuz(i)=u(i)**(1.-xu)/(xu*azm)
      z(i)=azm*u(i)**xu

      uuuh(i)=(u(i)+.5*du)**(1.-xu)/(xu*azm)
      dz(i)=z(i)-zzp
      zzp=z(i)
10   continue
      zedge=azm*.5*(u(ix)**xu+u(ix-1)**xu)
      do 15 j=1,jx
      v(j)=v0+(j-1.5)*dv
15   continue
      v(1)=-v(1)
      apsim=v(jx)**(1.-xv)
      do 20 j=1,jx
      vpsi(j)=v(j)**(1.-xv)/(apsim*xv)
      vpsi(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 f1to11
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 cliche 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=uuuz(i)
      bb=b(i,ji)
      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
      dpdpzi=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)+dppdpsi*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)/1b**2
c   c*qv(i,j)

10 continue
c..... fill in edge values
do 20 i=1,1x
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 f1to11 and equilibrium quantities.
c..... clique 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=2,1x-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

```

```

b1jph=(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*vpsihi(j)
f1ijmh=(f1(i,j)+f1(i,j-1))*5*vpsihi(j-1)
f5ijph=(f5(i,j)+f5(i,j+1))*5*vpsihi(j)
f5ijmh=(f5(i,j)+f5(i,j-1))*5*vpsihi(j-1)

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

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

a1(k,3)=-gam1*bip1jmh*g4iphjmh*bijmh*uzbar*vpsihi(j-1)*r(i+1,j-1)
a2(k,3)=-gam2*bip1jmh*g4iphjmh*bijmh*uzbar*vpsihi(j-1)*r(i+1,j-1)
a3(k,3)=-gam3*bip1jmh*g4iphjmh*bijmh*uzbar*vpsihi(j-1)*r(i+1,j-1)
a1(k,4)=gam1*((bim1jmh*g4imhjmh*vpsihi(j-1)*bijmh+bim1jph*g4imhjmh
c *vpsihi(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*vpsihi(j-1)*bijmh+bim1jph*g4imhjmh
c *vpsihi(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*vpsihi(j-1)*bijmh+bim1jph*g4imhjmh
c *vpsihi(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)*vpsihi(j-1)
c -bijph**2*(g4imhjmh+g4iphjmh)*vpsihi(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)*vpsihi(j-1)
c -bijph**2*(g4imhjmh+g4iphjmh)*vpsihi(j))*r(i,j)*uzbar-
c mm**2*b(i,j)*uzbar*(g2imhj+g2iphj)*g3(i,j)*dv2/vpsi(j))

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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)*vpsi(j-1)
c -bijph**2*(g4imhjph+g4iphjph)*vpsi(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*vpsi(j-1)+bip1jph*g4iphjph
c *bijph*vpsi(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*vpsi(j-1)+bip1jph*g4iphjph
c *bijph*vpsi(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*vpsi(j-1)+bip1jph*g4iphjph
c *bijph*vpsi(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*vpsi(j)*uzbar*r(i-1,j+1))
a2(k,7)=gam2*(-bim1jph*g4imhjph*bijph*vpsi(j)*uzbar*r(i-1,j+1))
a3(k,7)=gam3*(-bim1jph*g4imhjph*bijph*vpsi(j)*uzbar*r(i-1,j+1))
a1(k,8)=-f1ijph/(dt2*dv2)+gam1*(f5ijph/dv2+(bijph**2*(g4imhjph
c +g4iphjph)*vpsi(j)*r(i,j+1)*uzbar))
a2(k,8)=-f1ijph/(dt2*dv2)+gam2*(f5ijph/dv2+(bijph**2*(g4imhjph
c +g4iphjph)*vpsi(j)*r(i,j+1)*uzbar))
a3(k,8)=-f1ijph/(dt2*dv2)+gam3*(f5ijph/dv2+(bijph**2*(g4imhjph
c +g4iphjph)*vpsi(j)*r(i,j+1)*uzbar))
a1(k,9)=gam1*(-bip1jph*g4iphjph*bijph*vpsi(j)*uzbar*r(i+1,j+1))
a2(k,9)=gam2*(-bip1jph*g4iphjph*bijph*vpsi(j)*uzbar*r(i+1,j+1))
a3(k,9)=gam3*(-bip1jph*g4iphjph*bijph*vpsi(j)*uzbar*r(i+1,j+1))
c.....b1 array for rhs
      f3ijmh=(f3(i,j)+f3(i,j-1))* .5*vpsi(j-1)
      f3ijph=(f3(i,j)+f3(i,j+1))* .5*vpsi(j)
      denom=1./(dv2)
      b1(k,1)=f3ijmh*denom
      b1(k,3)=f3ijph*denom
      b1(k,2)=-(f3ijmh+f3ijph-f4(i,j)*dv2/vp)*denom
10   continue
c.....correct coefficients on boundaries
      sf1i=sign(unit,f1i)
      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.sf1i.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)

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```

      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.sfi1.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.sfi1zx.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(sfi1.eq.1.)sfi1=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)+sfi1*a1(k,m-1)
      a2(k,m)=a2(k,m)+sfi1*a2(k,m-1)
      a3(k,m)=a3(k,m)+sfi1*a3(k,m-1)
11  continue
13  continue
      i=ix-1
      do 12 j=2,jx-1
      if(sfi1zx.eq.1.)sfi1zx=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)+sfi1zx*a1(k,m+1)
      a2(k,m)=a2(k,m)+sfi1zx*a2(k,m+1)
      a3(k,m)=a3(k,m)+sfi1zx*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=ix-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=ix-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(abar(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*xt(n)-a2*xt(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
ip=i-2+m-((m-1)/3)*3
jp=j-1+(m-1)/3
if(jp.eq.1.or.jp.eq.jrx.or.ip.eq.1.or.ip.eq.izx)go to 5
kp1=ip-1+(ix-2)*(jp-2)
kp2=jp-1+(jx-2)*(ip-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 f mn=1,3
jq=j-2+mn
if(jq.eq.1 or jq.eq.jrx)go to 6
kq1=i-1+(jx-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)*(xrol(kq)-xroo(kq))
6 continue
rhs1(k)=2.*t2-t1+fac1*t3
rhs2(k)=2.*tt2-tt1+fac2*tt3
10 continue
return
end
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*xl(n)-a2*xl(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
mde1=(m-1)/3
m1=m-1
koff1=-mde1*5+m+(mde1-1)*ix
koff2=(m-(mde1+1)*3-1)*jx+1-2*m1+7*mde1
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)*xi0(k+koff)-a2(k,m)*xi00(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)*(xi01(k+koff)-xi00(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

```