from /common/transp_shared/Code/transp/JET_62/codesys/source/fppmod/sccf.for

```
      subroutine SCCF(ifasti)
C
c mod dmc August, 1995 at JET -- up-down asymmetric geometry support
c   see note, below.
c
c dmc March 2002 -- btime vs. theta distribution calculated.
c   this allows proper un-bounce-averaging of distribution e.g. for later
c   fast ion - fast ion fusion rate calculations
c
c dmc April 2002 -- sccf involves does not depend on fast ion species;
c   so, pass a fast ion specie counter; if .gt.1 do not recalculate; just
c   restore answer from prior loop iteration.  (ifasti).
c
c This subroutine calculates a number of different bounce-averaging
c integrals, using the zero-banana-width approximation, for each
c different pitch angle.  The integrals which are calculated are
c listed below:
c
c btime       (Integral dl/abs(v_parrallel))/(2 pi q Rmaj/v) normed bounce time
c vp2av   <vpar**2/v**2>          to get beam perp and par betas
c bratio  <Bmin/B>-1       needed for pitch angle scattering operator
c vparav  <Vpar/V>
c rvparav <R Vpar/V>
c rmaj2av <R**2>
c vparvr  <Vpar/V/R>
c driav   <1/dr>     (bounce averaged gradient operator -- for diffusion)
c
c vprec   toroidal transit frequency (sec**-1) for trapped and passing ions
c         (added by Rob Goldston, 1/29/83)
c           (nb dmc Apr 2002 -- this is not used elsewhere in fppmod)
c
c dVolnorm = (2 pi q Rmaj / Bmin Integral dl/B)
c
c Additional quantities calculated by this subroutine:
c njtrap
c
c Most of the specifics about the plasma geometry come into the problem
c through the bounce-averages.  For general axisymmetric toroidal geometry,
c the bounce time can be written as:
c
c Tau_bounce = Integral dl/abs(v_par)
c          = Integral d(theta) J B / abs(v_par)
c
c With the proper choice of the poloidal angle theta, the jacobian
c J can be written as J=(q R**2 / It), where It= (R B_tor) is a flux
c surface quantity, and q is the inverse rotational transform and is
c also a flux surface quantity.
c
c However, FPP and TRANSP do not use this choice of poloidal angle,
c so the Jacobian must be explictly evaluated.  This is done in
c MOMRY and FPGEO.
c
c--Tau bounce is defined by gwh for circulating particles as
c     the time to make one complete orbit to return to the
c     same poloidal angle, and for trapped particles it is
c     the time it takes to make one half orbit from one banana
c     tip to the other.  For vpar>>vperp, the passing particle
c     bounce time reduces to (2 pi q Rmaj)/vpar.
c
c--SCCF calculates BTIME,which is related to the bounce time by:
c           tau bounce = (2 pi q Rmaj / v) * btime
```

```
c
c--while I am on the subject, I might as well define other
c normalizations. f_fpp used in this code has the units
c of particles per (cm)**3 (eV)**1.5, and is related
c to the velocity space distribution function f by
c
c     f_fpp = (2**.5 2 pi / 25) (erg / (m eV))**1.5 f
c
c where m is the particle mass in grams.
c f has units of particles per (cm)**3 (cm/sec)**3, and is
c normalized such that the local particle density is given
c by (in TeX notation):
c
c     n = \int d^3 v f
c
c--so the average number of particles on a flux surface is:
c     <n> = 25 dVolnorm (sum over xsi of) (sum over energy of)
c           dxsi dE sqrt(E) abs(xsi) btime f_fpp
C
c where dVolnorm = (2 pi q Rmaj / Bmin Integral dl/B)
C

c
c large aspect ratio concentric circular flux surface definitions:
c
c     VPREC == <[VPAR**2/V**2 + VPER**2/(2*V**2)]
c     * [Q*CTH/rOverR + STH*(TH-PI)*r*dq/dr/rOverR]> (UNTRAPPED PTCLS)
c     * [Q*CTH/rOverR + STH*TH*r*dq/dr/rOverR]>  (TRAPPED PTCLS)
c
c Note that the definition of the precession speed for untrapped
c particles is probably not well defined.  Because of the shear in
c the magnetic field (dq/dr), the measure of the precession of a particle
c relative to a field line depends on which flux surface you choose the
c reference field line from.  It may depend on the type of mode you
c are interacting with, i.e., ballooning modes are localized to the
c large R side of the plasma, while kink modes are more constant,
c and barely passing ions spend most of their time on the small R side
c of the plasma.  The choice made here (TH-PI) is perhaps best for
c strongly passing particles and ballooning-type modes, while Rob's
c original choice (PI-TH) is perhaps best for looking at barely
c passing particles and flute modes (like the m=1 kink usually
c driving the fishbone instability).
c
c-----------------------------------------
c dmc at JET:  Aug 1995
c   in the presence of up-down asymmetric plasma geometry, the
c following assumptions (in the old code) were not correct:
c (a) Bmin is at theta=0 & Bmax is at theta=pi
c (b) orbits are updown symmetric.
c   so, call check symflag to determine if the
c geometry is asymmetric; if it is,integrate from theta(Bmin)
c to theta(Bmax) in both the up and down directions, adding the
c results, instead of just going one way round and doubling the
c results, and, don't assume theta(Bmin)=0.0.
c   subroutine fpgeoinv is also modified -- calling arguments
c changed.  Its called only from sccf.
c dmc -- d. mccune -- dmccune@pppl.gov
c-----------------------------------------
c
```