```
**********************************************************************
*       Authors : A.B. Lahanas and A. Dedes                          *
*                                                                    *
*      What's new                                                   *
*                                                                    *
* Both logarithmic and finite corrections in the Yukawa couplings    *
* Pole masses of the quarks and leptons in the MSSM                  *
* The input mass for the top quark in this version, is the pole mass *
* of the top quark and not its DRbar mass at Mz.(parameter TTOP)     *
* Run of the parameters from Mgut are included !!                    *
*                                                                    *
*                                                                    *
*           SELECT YOUR OWN MODEL !!!                                *
*     If you want to change the GUT model just                       *
*     1) Look at the LIFETIME FORMULA (variable=PRODECAY)            *
*     2) Modify the input masses in the FUNCTION SEM(I)              *
*     3) Modify the factors of the thresholds in FUNCTION DE(I,J)    *
*                                                                    *
*         Uses NAGLIB                                                *
*                                                                    *
*            1      mu > 0                                           *
*           /                                                        *
*     j = -                                                          *
*           \                                                        *
*            2      mu < 0                                           *
*                                                                    *
*              1      No threshol.                                   *
*             /                                                      *
*     nai = -                                                        *
*             \                                                      *
*              2      With thresh.                                   *
*                                                                    *
*     am12    : M_1/2                                                *
*     efapto  : tanb                                                 *
*     TTOP    : Pole mass off Top                                    *
*     xcom    : Soft parameters at true ren. scale.                  *
*     reject  : Logical variable for rejecting unphysical cases      *
*                                                                    *
**********************************************************************
      SUBROUTINE evalsoft(j,efapto,TTOP,xcom,nai,reject)
      IMPLICIT DOUBLE PRECISION (A-H, O-Z)
      LOGICAL reject,suprn1,suprn2
      INTEGER NU,MU,IDO,IFFE,IREL,IFAIL,MPED,NUU,MUU
      INTEGER LO,IW,IWW,JW,JWW
C-------------------------------------------------------------
C    Lo is the # of superheavy particles
C    SPARAM   Wsp  for chf (# of eqs NU)
C    PPARAM   Wsp  for caf (# of eqs NU)
C    WORKA    Wsp  for caf (# of eqs MU)
C    NIP      # of iterations per loop
C    KIP      # of folding loops
C    TOLNAG   Tolerance for the integration routines ...
C    EXPERIMENTAL INPUTS Gfermi, Aem(0)
C-------------------------------------------------------------
      PARAMETER (NIP=17,KIP=3,TOLNAG=5.D-15,LO=10)
      PARAMETER (MU=4,JW=28+21*MU,JWW=23+21*MU)
      PARAMETER (NU=39,IW=28+21*NU,IWW=23+21*NU)
      PARAMETER (GFERMI=1.16639D-5,AEM0=1.D0/137.036D0)
      DOUBLE PRECISION WORKA(JWW)
      DOUBLE PRECISION PPARAM(IWW),SPARAM(IW)
      DOUBLE PRECISION CY(MU)
      DOUBLE PRECISION Y(NU),GY(NU),TY(NU),ZA(NU),xcom(NU)
```



```
      DOUBLE PRECISION TTY(NU),SG(2,NU)
      DOUBLE PRECISION ACHECK(LO),AMUZ(2),BETA(2),YUKL(6)
      DOUBLE PRECISION ZERO,ZTOP,ZGLU
      CHARACTER*1 tob
      COMPLEX*16 box,fzt_sig,ft_sig,wt_sig,zt_sig,wln_ren0,v_ren0
      COMPLEX*16 us_sig,uv_sig,ds_sig,dv_sig,es_sig,ev_sig
C
      COMMON /WUR/ WUR,CONPI
      COMMON /VEVW/ VOO
      COMMON /YYY/ Y
      COMMON /HI/ RAPA,RAHO,RAHOO,RACH
      COMMON /NIT/ ao,amoo,am12
      COMMON /SCALE/ AMGUT,SUSY,AMZ,AMW
      COMMON /HIG/ HIGGA,HIGGC,HIGN1,HIGN2
      COMMON /LEP/ NAIH
      COMMON /FS/ H1P,H1M,FM1,FM2,FM3,FM4
      COMMON /STOPS/ STPL,STMI,S1T,S2T,SBPL,SBMI
      COMMON /SLEP3/ SLPL,SLMI,SN3
      COMMON /SLEP12/ SEL12,SER12,SN12
      COMMON /SQUARK/ U1L,U2L,U1R,U2R,D1L,D2L,D1R,D2R
      COMMON /OSS/ TS,TEND,TOL
      COMMON /NUEQ/ NUU   !  # of ODE
      COMMON /MUU/ MUU
C---------------------------------------------
C   /ginrp/
C   Negative eigenvalue warning.
C   Handles printing for sigma corrections.
C   /LIGYUK/
C   Light yukawas
C---------------------------------------------
      COMMON /ginrp/ IAA, KITER, IALIM, KILIM
      COMMON /LIGYUK/ YUKL
C-----------------------------
C  Unused Commons
C-----------------------------
C     COMMON/GY/GY
C     COMMON/CY/CY
C     COMMON/TY/TY
C     COMMON/TTT/TIN,TFIN
C     COMMON/TOP/THTOP,THGLU
C     COMMON/XWW/XW(1)
C     COMMON/IZO/IZF,IZR
C     COMMON /hm_phys/ frm(2),frm2(2)
C     COMMON/FUTURE/SMVECTOR,SMHCOLOR,SMSIGMA,SMHFPRIME
C---------------------------------------
C  For outputs at several scales
C---------------------------------------
C     COMMON/CBF/XXEND, HSTEP, ISTEP
C     EXTERNAL D,T,G,TT,FAP,HET,HIT,OUT,SEM2,D02CBF,D02CAF
C     EXTERNAL TTZ,BBZ
C
      EXTERNAL SEM,NA,PRO,PRD,S,RLOW,ZERO,ZTOP
      EXTERNAL ZGLU,FON,DIVPRK,GF,D02CHF
C-------------------------------------------------------------------
C   XBBOT,XTTAU are physical bottom and tau masses while TTOP is
C   the pole mass of the top quark
C   Never put vanishing values for the bottom,tau otherwise you get
C   overflows from the RADH subroutine which corrects the Higgs
C   masses.
C   Masses of light families fermions in GEV
C-------------------------------------------------------------------
      DATA XBBOT,XTTAU,ASOS /5.2D0, 1.777D0, 5.D18 /
```

```
      DATA UPM,CHAM,DWNM,STRM,ELEM,WMUN /5.D-3, 1.3D0, 10.D-3,
     #  200.D-3, 0.510999D-3, 105.685D-3 /
C-----------------------------------------------------------------------
C                  *** Executable statements ***
C-----------------------------------------------------------------------
C      TORL=.0000000000005D0  !  OK
C      TORL=.0000000005D0  ! This is the default value
C
      IFAIL=0
      IDO=0
      TORL=TOLNAG    !  By common /OSS/ (rk4) TOL=TORL
      NITER=NIP
      KILIM=KIP
      NUU=NU
      MUU=MU
      IALIM=NITER-1
      LITER=NITER-2
      top_cor=0.d0
      bot_cor=0.d0
      tau_cor=0.d0
      tob=char(9)    !  tab for Gnuplot
C--------------------------------
C     Switches
C  NAI is a dummy argument  !
C--------------------------------
      NAIM=1  !  Always NAIM=1 due to PZZ corrections
      NAIH=1
      NAIHH=NAIH
C---------------------------------------------------------------------
C    Scale-other constants
C
C    Input startup Pzz corection
C    SINSQ is taken from Polonsky
C    AMGUT and AGUT are trial. The first sets a maximum scale where the
C    trial run from down up stops in trying to determine the unification
C    scale and unification couplings
C---------------------------------------------------------------------
      SUSY=1.D0
      CONPI=DACOS(-1.D0)
      WUR=4.D0*CONPI
      AMZ=91.1884D0/SUSY
      AMW=80.26D0/SUSY
      PZZ=0.d0/SUSY/SUSY
      SINSQ=.2316D0-.88D0*((1.01D0*TTOP)**2-160.D0**2)/1.D7
      COSSQ=1.D0-SINSQ
      AMGUT=ASOS
      AGUT=.04D0/WUR
C-----------------------------------------------------
C    All couplings below are MS bar couplings and
C    later should be converted to DR bar
C    The values for couplings are trial startup values
C-----------------------------------------------------
      AEMC=1.D0/127.9D0
      A3C=.130D0
      A2C=AEMC/SINSQ
      A1C=(5.D0/3.D0)*A2C*SINSQ/COSSQ
C----------------------------------------
C     We convert MS bar -> DR bar
C----------------------------------------
      COC3=(1.D0-3.D0*A3C/(6.D0*WUR))**2
      COC2=(1.D0-2.D0*A2C/(6.D0*WUR))**2
      COC1=1.D0
```



```
      AXW3=A3C/COC3
      AXW2=A2C/COC2
      AXW1=A1C/COC1
        AW3=AXW3/WUR
        AW2=AXW2/WUR
        AW1=AXW1/WUR
C
      AMMM=AMZ
C-----------------------------------------------------------------
C     TFINO,TIN are  final and initial values of the parameter
C     t=2*log(Mgut/Q)
C-----------------------------------------------------------------
      TIN=0.D0
      TFINO=2.D0*DLOG(ASOS/AMMM)
C
      BE=DATAN(EFAPTO)
      FFF=DSIN(BE)
      GGG=DCOS(BE)
      BER=2.D0*BE
      SINBB=DSIN(BER)
      AM1=AM12
      AM2=AM12
      AM3=AM12
      AMO=AMOO**2
C
      DO  JY=1,NUU       !  Initialization block
         ZA(JY)=0.D0
      ENDDO
CC
      SOFT0=AMOO*SUSY
      SOFT12=AM12*SUSY
      AOS=AO*SUSY
      WRITE(20,775) TIN,TFINO
      WRITE(20,897) AXW1,AXW2,AXW3,
     #SOFT0,SOFT12,AOS,TTOP,XBBOT,XTTAU,EFAPTO,SINBB
C-------------------------------------------------------
C                1st CALL of RK4
C     to determine couplings at Mgut (no thresholds)
C     STRO is the DR bar value for a3^2/(16 pi^2)
C-------------------------------------------------------
      VEF1=0.D0
      VEF2=0.D0
      IAA=0
      STRO=AW3
C-----------------------------------------------------
C  Iterations for the best determination of astrong
C  This requires the iteration of the whole program
C-----------------------------------------------------
      DO 795 KITER=1,KILIM     !  Start a 3-fold iteration
CC
  595 CONTINUE                 !   Start 0 -> 23 single iterations
CC
C----------------------------------------
C  Some logical definitions to save space
C----------------------------------------
      SUPRN1=IAA.EQ.IALIM .AND. KITER.EQ.KILIM
      SUPRN2=KITER.EQ.KILIM
C--------------------------------------------------
C   Below is DR bar one loop vev
C   Mz^2=(g2^2+3/5*g1^2)*(V0^2)/4  at the tree level
C--------------------------------------------------
      VO=SUSY*2.D0*DSQRT(AMZ**2-PZZ)/DSQRT(WUR*(AXW2+.6d0*AXW1))
```

```fortran
      VOO=VO/DSQRT(2.D0)
      V1Z=VOO*GGG/SUSY
      V2Z=VOO*FFF/SUSY
CC
      IF(KITER.EQ.1)THEN
C-------------------------------------------------------------------
C   In the following we extract the bottom and tau Yukawas in DR bar
C   at Mz knowing Mb(pole) and Mtau(pole) masses
C   Just below is the MS bar value for a3/(16 Pi^2)
C-------------------------------------------------------------------
        A3MS=STRO*((1.D0-.5D0*STRO+.5D0*(STRO**2))**2)
        BOFI=2.D0*DLOG(AMZ*SUSY/XBBOT)
        BOIN=0.D0
        TOFI=2.D0*DLOG(AMZ*SUSY/XTTAU)
        TOIN=0.D0
        CY(1)=A3MS
        CY(2)=AEMC/WUR
        CY(3)=0.D0
        CY(4)=0.D0
        IFAIL=0
        CALL DIVPRK(IFAIL,MU,GF,BOIN,BOFI,TORL,WORKA,CY)
C---------------------------------------------------------------
C   Just below YER is the mb(Mb) value in MS bar in terms of the
C   pole mass Mb=4.8 - 5.2 GeV (exper.)
C---------------------------------------------------------------
        YER=XBBOT/(1.D0+16.D0*CY(1)/3.D0+198.4D0*(CY(1)**2))
        IFAIL=0
        CY(3)=YER
        BOFOR=0.D0
        CALL DIVPRK(IFAIL,MU,GF,BOFI,BOFOR,TORL,WORKA,CY)
C------------------------------------------------------------------
C  BBOT is now DR bar value for running mb at Mz. CY(3) was MS bar
C------------------------------------------------------------------
        BBOT=CY(3)/(1.D0+4.D0*CY(1)/3.D0+CY(2)/9.D0)
        ABOT=BBOT/SUSY
C-----------------------------------------------
C  YBIN is (bottom Yukawa/4 Pi)^2 in the DR bar
C-----------------------------------------------
        YBIN=(ABOT/(V1Z*WUR))**2
        YBB=YBIN*WUR
        CY(1)=A3MS
        CY(2)=AEMC/WUR
        CY(3)=0.D0
        CY(4)=0.D0
        CALL DIVPRK(IFAIL,MU,GF,TOIN,TOFI,TORL,WORKA,CY)
C-------------------------------------------------------------------
C  Just below YYER is the mtau(Mtau) value in MS bar in terms of the
C  pole mass Mtau=1.777 GeV (exper.)
C-------------------------------------------------------------------
        YYER=XTTAU
        CY(4)=YYER
        TOFOR=0.D0
        CALL DIVPRK(IFAIL,MU,GF,TOFI,TOFOR,TORL,WORKA,CY)
C---------------------------------------------------------------------
C  TTAUT is now DR bar value for running mtau at Mz. CY(4) was MS bar
C---------------------------------------------------------------------
        TTAU=CY(4)/(1.D0+CY(2))
        ATAU=TTAU/SUSY
        YLIN=(ATAU/(V1Z*WUR))**2
        YLL=YLIN*WUR
C---------------------------------------------------------------
C  ATOP -> mt(Mz)
```



```fortran
C  If the mass of the top quark is 180 GeV then-> mt(Mz)=166 GeV
C  If the mass of the top quark is 174 GeV then-> mt(Mz)~161 GeV
C----------------------------------------------------------------
        ATOP=161.D0/SUSY
        YTIN=(ATOP/(V2Z*WUR))**2
        YTT=YTIN*WUR
C--------------------------------------------
C  End defining tau, bottom Yukawas in DR bar
C--------------------------------------------
       ELSE     !   When KITER>1 walk this way
C---------------------------------------------------------------
C             Pole masses of the top,bottom,tau
C      top_cor=top_s1+mt(pole)*top_sg
C      top_s1 : scalar self energies
C      top_sg : vector self energy proportional to pslash
C      top_cor: self energy correction of the fermions
C      mpole=m(Q)+top_cor
C      Top Yukawa coupling (definition)
C---------------------------------------------------------------
        top_s1=dble(us_sig(TTOP**2.D0,3,3))
        top_sg=dble(uv_sig(TTOP**2.D0,3,3))
        top_cor=top_s1+TTOP*top_sg
        YTIN=((TTOP-top_cor)/(VOO*FFF)/WUR)**2.D0
        YTT=YTIN*WUR
C---------------------------------------------
C   Bottom Yukawa coupling (definition)
C---------------------------------------------
        bot_s1=dble(ds_sig(XBBOT**2.D0,3,3))
        bot_sg=dble(dv_sig(XBBOT**2.D0,3,3))
        bot_cor=bot_s1+XBBOT*bot_sg
        YBIN=((XBBOT-bot_cor)/(VOO*GGG)/WUR)**2.D0
        YBB=YBIN*WUR
C---------------------------------------------
C   Tau Yukawa coupling (definition)
C---------------------------------------------
        tau_s1=dble(es_sig(XTTAU**2.D0,3,3))
        tau_sg=dble(ev_sig(XTTAU**2.D0,3,3))
        tau_cor=tau_s1+XTTAU*tau_sg
        YLIN=((XTTAU-tau_cor)/(VOO*GGG)/WUR)**2.D0
        YLL=YLIN*WUR
C---------------------------------------------
C   New values of top-bottom-tau running masses
C                  at Mz.
C---------------------------------------------
        ATOP=WUR*V2Z*DSQRT(YTIN)
        ABOT=WUR*V1Z*DSQRT(YBIN)
        ATAU=WUR*V1Z*DSQRT(YLIN)
      ENDIF
CC
      IF(IAA.LE.1)THEN
        NAIH=1
      ELSE
        NAIH=NAIHH
      ENDIF
C---------------------------------------
C Add High energy thresholds after IAA=0
C---------------------------------------
      IF(IAA.GE.1)THEN
        NOYA=NAI
        NGOY=NAIM
      ELSE
        NOYA=1
```

```
          NGOY=1
        ENDIF
        ZE1=AW1
        ZE2=AW2
        ZE3=STRO
        ZE4=YTIN
        ZE5=YBIN
        ZE6=YLIN
CC
        RIN=2.D0*DLOG(AMGUT/AMZ)
        RFIN=2.D0*DLOG(AMGUT/ASOS)
CC
        CALL RK4(NOYA,NGOY,TORL,RIN,RFIN,ZE1,ZE2,ZE3,ZE4,ZE5,ZE6,
       #ZA(7),ZA(8),ZA(9),ZA(10),ZA(11),ZA(12),ZA(13),ZA(14),ZA(15),
       #ZA(16),ZA(17),ZA(18),ZA(19),ZA(20),ZA(21),ZA(22),ZA(23),
       #ZA(24),ZA(25),ZA(26),ZA(27),ZA(28),ZA(29),ZA(30),ZA(31),
       #ZA(32),ZA(33),ZA(34),ZA(35),ZA(36),ZA(37),ZA(38),ZA(39))
CC
        IREL=0
        HMAX=0.0D0
        IFFE=0
        MPED=0
        CALL D02CHF(TS,TEND,NU,Y,TOL,IREL,HMAX,FON,ZERO,
       #SPARAM,IFFE)
CC
        DO  K=1,NUU
           GY(K)=Y(K)      !    Initialization Block
        ENDDO
CC
        GAUNI=.5D0*(Y(1)+Y(2))*WUR
        SUNIF=SUSY*AMGUT*DEXP(-.5D0*TS)
        AMGUT=SUNIF/SUSY
        AGUT=GAUNI/WUR
        AUNI1=Y(1)*WUR
        AUNI2=Y(2)*WUR
C-------------------------------------------
C     PRINT *,IAA    !  Iteration # 0 -> 23
C-------------------------------------------
        IRUN=IAA+1
        IF(SUPRN1)WRITE(20,716)IRUN,SUNIF,AUNI1,AUNI2,GAUNI
C------------------------------------------------
C               4th CALL of RK4
C  Now run down from the determined  Mgut
C  to know the values of parameters at Mz.
C------------------------------------------------
        TIN=0.D0
        TFIN=2.D0*DLOG(AMGUT/AMZ)
CC
        EG1=AGUT
        EG2=AGUT
        EG3=AGUT
        E4=GY(4)
        E5=GY(5)
        E6=GY(6)
        E7=AM1
        E8=AM2
        E9=AM3
        E10=GY(10)
        E11=GY(11)
        E12=AO
        E13=AO
        E14=AO
```



```
        E15=AMO
        E16=AMO
        E17=AMO
        E18=AMO
        E19=AMO
        E20=AMO
        E21=AMO
        E22=AMO
        E23=AMO
        E24=AMO
        E25=AMO
        E26=AMO
        E27=AMO
        E28=AMO
        E29=AMO
        E30=AMO+GY(10)**2
        E31=AMO+GY(10)**2
        E32=0.D0
        E33=0.D0
        E34=AO
        E35=AO
        E36=AO
        E37=AO
        E38=AO
        E39=AO
CC
CC
        IFAIL=0
        CALL RK4(NOYA,NGOY,TORL,TIN,TFIN,EG1
       #,EG2,EG3,E4,E5,E6,E7,E8,E9,E10,E11,
       #E12,E13,E14,E15,E16,E17,E18,E19,E20,E21,E22,E23,E24,E25,E26,E27,
       #E28,E29,E30,E31,E32,E33,E34,E35,E36,E37,E38,E39)
        CALL DIVPRK(IFAIL,NU,FON,TS,TEND,TOL,PPARAM,Y)
CC
        IF(SUPRN1)THEN
          WRITE(20,880)
          ZS1=Y(1)*WUR
          ZS2=Y(2)*WUR
          ZS3=Y(3)*WUR
          ZS4=Y(4)*WUR
          ZS5=Y(5)*WUR
          ZS6=Y(6)*WUR
          WRITE(20,870) TFIN,ZS1,ZS2,ZS3,ZS4,ZS5,ZS6
        ENDIF
C----------------------------------------------------------
C  Below we determine B(Mz) and mu(Mz) by solving the
C  minimizing equations
C  HX1,HX2 are Higgs soft masses squared
C----------------------------------------------------------
        HX1=Y(30)-Y(10)**2
        HX2=Y(31)-Y(10)**2
        TAB=EFAPTO**2
        ZMU=(HX1-HX2*TAB)/(TAB-1.D0)-(AMZ**2-PZZ)/2.D0+
       #(VEF1-VEF2*TAB)/(TAB-1.D0)
CC
        IF(ZMU.LE.0.D0)THEN
          WRITE(96,'(a)')'No elw breaking  mu**2 < 0 !!!'
          REJECT=.TRUE.
          RETURN
        ENDIF
        IF(ZMU.EQ.0.D0)THEN
          WRITE(96,'(a)')'No elw breaking  mu**2 = 0 !!!'
```

```
          REJECT=.TRUE.
          RETURN
        ENDIF
CC
        GKT=DSQRT(ZMU)
        IF(J.EQ.2)THEN
          AMUZ(J)=-GKT
        ELSE
          AMUZ(J)=GKT
        ENDIF
CC
        BETA(J)=-(HX1+HX2+2.D0*ZMU+VEF1+VEF2)*SINBB/(2.D0*AMUZ(J))
CC
        DO   JK=1,NUU
            ZA(JK)=Y(JK)      !  Initialization Block
        ENDDO
        ZA(10)=AMUZ(J)
        ZA(11)=AMUZ(J)*BETA(J)
        STRO=ZA(3)
CC
CC
        CALL SQ3(ATOP,ABOT,ATAU,FFF,GGG,ZA,V1Z,V2Z)
C--------------------------------------------------
C   Check negative eigenmass critirio after sq3
C   so that strange message value is printed
C--------------------------------------------------
        CALL CRNEG(ZA,V1Z,V2Z,REJECT)
        IF(REJECT)RETURN
CC
        VEF1=S1T
        VEF2=S2T
        DYN1=S1T
        DYN2=S2T
CC
        IAA=IAA+1
        IF(IAA.LT.NITER) GO TO 595  ! Condition for 0 -> 23 iterations
C--------------------------------
C  End of single iteration loop
C--------------------------------
CC
        DO    KK=1,NUU
            SG(J,KK)=ZA(KK)    ! Initialization Block
        ENDDO
C---------------------------------------------------------------
C  If you want to put arbitrary vevs at Mz just put them here!
C---------------------------------------------------------------
        SG(J,32)=V1Z
        SG(J,33)=V2Z
CC
        S1=SG(J,1)
        S2=SG(J,2)
        S3=SG(J,3)
        S4=SG(J,4)
        S5=SG(J,5)
        S6=SG(J,6)
        S7=SG(J,7)
        S8=SG(J,8)
        S9=SG(J,9)
        S10=SG(J,10)
        S11=SG(J,11)
        S12=SG(J,12)
        S13=SG(J,13)
```



```
        S14=SG(J,14)
        S15=SG(J,15)
        S16=SG(J,16)
        S17=SG(J,17)
        S18=SG(J,18)
        S19=SG(J,19)
        S20=SG(J,20)
        S21=SG(J,21)
        S22=SG(J,22)
        S23=SG(J,23)
        S24=SG(J,24)
        S25=SG(J,25)
        S26=SG(J,26)
        S27=SG(J,27)
        S28=SG(J,28)
        S29=SG(J,29)
        S30=SG(J,30)
        S31=SG(J,31)
        S32=SG(J,32)
        S33=SG(J,33)
        S34=SG(J,34)
        S35=SG(J,35)
        S36=SG(J,36)
        S37=SG(J,37)
        S38=SG(J,38)
        S39=SG(J,39)
C---------------------------------------------------------------
C                    6th CALL of RK4
C  Now run upwards  to get values at Mgut (final down->up run)
C---------------------------------------------------------------
        TIN=0.D0
        TFIN=2.D0*DLOG(AMGUT/AMZ)
        XINI=TFIN
        XFINI=TIN
CC
        CALL RK4(NAI,NAIM,TORL,XINI,XFINI,S1,S2,S3,S4,S5,S6,S7,S8,S9,S10,
       #S11,S12,S13,S14,S15,S16,S17,S18,S19,S20,S21,S22,S23,S24,
       #S25,S26,S27,S28,S29,S30,S31,S32,S33,S34,S35,S36,S37,S38,S39)
        CALL DIVPRK(IDO,NU,FON,TS,TEND,TOL,PPARAM,Y)
C----------------------------------------------------------
C  Below we write the output values of the 6th call
C----------------------------------------------------------
        ZYS1=Y(1)*WUR
        ZYS2=Y(2)*WUR
        ZYS3=Y(3)*WUR
        ZYS4=Y(4)*WUR
        ZYS5=Y(5)*WUR
        ZYS6=Y(6)*WUR
        ZYS10=Y(10)*SUSY
        ZYS11=SUSY*Y(11)/Y(10)
        ALAX=AMUZ(J)*SUSY
        BLAX=BETA(J)*SUSY
        YY12=Y(12)*SUSY
        YY13=Y(13)*SUSY
        YY14=Y(14)*SUSY
        YY7=Y(7)*SUSY
        YY8=Y(8)*SUSY
        YY9=Y(9)*SUSY
CC
CC
        if(SUPRN2)WRITE(20,883)
        if(SUPRN2)WRITE(20,875)XFINI,ZYS1,ZYS2,ZYS3,ZYS4,ZYS5,ZYS6
```

```
      if(SUPRN2)WRITE(20,914)ALAX,BLAX
      if(SUPRN2)WRITE(20,915)ZYS10,ZYS11
      if(SUPRN2)WRITE(20,917)YY12,YY13,YY14
      if(SUPRN2)WRITE(20,918)YY7,YY8,YY9
C----------------------------------------------------
C  Close with writing of the output of the th call
C----------------------------------------------------
CC
C----------------------------------------------------
C                      7th CALL of RK4
C              Final run down from Mgut to Mz
C----------------------------------------------------
      YTINI=Y(4)
      YBINI=Y(5)
      YLINI=Y(6)
      AMIX3=Y(11)
      AMIX=Y(10)
      BETIX=AMIX3*SUSY/AMIX
CC
      TCG1=AGUT
      TCG2=AGUT
      TCG3=AGUT
      TC4=YTINI
      TC5=YBINI
      TC6=YLINI
      TC7=AM1
      TC8=AM2
      TC9=AM3
      TC10=AMIX
      TC11=AMIX3
      TC12=AO
      TC13=AO
      TC14=AO
      TC15=AMO
      TC16=AMO
      TC17=AMO
      TC18=AMO
      TC19=AMO
      TC20=AMO
      TC21=AMO
      TC22=AMO
      TC23=AMO
      TC24=AMO
      TC25=AMO
      TC26=AMO
      TC27=AMO
      TC28=AMO
      TC29=AMO
      TC30=AMO+AMIX**2
      TC31=AMO+AMIX**2
C-----------------------------------------------------------
C  If you want to put arbitrary vevs at Mgut put them here
C-----------------------------------------------------------
      TC32=Y(32) ! I put the v1 at Mgut here
      TC33=Y(33) ! I put the v2 at Mgut here
      TC34=AO
      TC35=AO
      TC36=AO
      TC37=AO
      TC38=AO
      TC39=AO
C
```



```
      AAGUT=AGUT*WUR
      TTG1=TCG1*WUR
      TTG2=TCG2*WUR
      TTG3=TCG3*WUR
      TT4=TC4*WUR
      TT5=TC5*WUR
      TT6=TC6*WUR
      AMIXE=AMIX*SUSY
      AMOO1=AMOO*SUSY
      AM12O=AM12*SUSY
      AOP=AO*SUSY
CC
CC
      if(SUPRN2)WRITE(20,8971)
     # AAGUT,TTG1,TTG2,TTG3,TT4,TT5,TT6,AMOO1,AM12O,
     # AOP,BETIX,AMIXE
CC
CC
      CALL RK4(NAI,NAIM,TORL,TIN,TFIN,TCG1,TCG2,TCG3,TC4,TC5,TC6,TC7,
     #TC8,TC9,TC10,TC11,TC12,TC13,TC14,TC15,TC16,TC17,TC18,
     #TC19,TC20,TC21,TC22,TC23,TC24,TC25,TC26,TC27,
     #TC28,TC29,TC30,TC31,TC32,TC33,TC34,TC35,TC36,TC37,TC38,TC39)
      CALL DIVPRK(IDO,NU,FON,TS,TEND,TOL,PPARAM,Y)
CC
C-----------------------------------------------------------------------
C  Below the final values of the parameters at Mz after the 7th call
C-----------------------------------------------------------------------
      GG1=Y(1)*WUR
      GG2=Y(2)*WUR
      GG3=Y(3)*WUR
      GGT=Y(4)*WUR
      GGB=Y(5)*WUR
      GGL=Y(6)*WUR
      XAT=Y(12)*SUSY
      XAB=Y(13)*SUSY
      XAL=Y(14)*SUSY
      XAMU=Y(10)*SUSY
      ZUGER=Y(10)
      AMIGER=Y(11)
      GAU1=Y(7)
      GAU2=Y(8)
      GAU3=Y(9)
CC
      IF(XAMU.EQ.0.D0)THEN  !  Quiet unlike case
        XBETA=111111.111D0
        WRITE(96,'(A)')'STRANGE VALUE FOR XBETA'
      ELSE
        XBETA=(Y(11)/Y(10))*SUSY
        XMIXH=Y(11)*(SUSY**2)
      ENDIF
CC
      PROD=1.D0
      DO   JFF=15,29
          IF(PROD.LT.0.D0 .OR. Y(JFF).LT.0.D0 )PROD=-1.D0
      ENDDO
CC
      IF(PROD.LT.0.D0)write(96,*)'Prod is negative -- PROCEED'
      WRITE(96,'("--------- PASS 1 ----------")')
C------------------------------------------------------------
C  If prod is non-negative then everything is as before
C
C  If prod is negative the following numbers (without ABS
```

```
C  as were initialy defined) are actually NAN !!!!
C
C  This affects the quantities amsq, amsl, prodecay
C  which are found later.
C-----------------------------------------------------------
      XQ3=SUSY*DSQRT(DABS(Y(15)))
      XQ2=SUSY*DSQRT(DABS(Y(16)))
      XQ1=SUSY*DSQRT(DABS(Y(17)))
CC
      XU3=SUSY*DSQRT(DABS(Y(18)))
      XU2=SUSY*DSQRT(DABS(Y(19)))
      XU1=SUSY*DSQRT(DABS(Y(20)))
CC
      XD3=SUSY*DSQRT(DABS(Y(21)))
      XD2=SUSY*DSQRT(DABS(Y(22)))
      XD1=SUSY*DSQRT(DABS(Y(23)))
CC
      XL3=SUSY*DSQRT(DABS(Y(24)))
      XL2=SUSY*DSQRT(DABS(Y(25)))
      XL1=SUSY*DSQRT(DABS(Y(26)))
CC
      XE3=SUSY*DSQRT(DABS(Y(27)))
      XE2=SUSY*DSQRT(DABS(Y(28)))
      XE1=SUSY*DSQRT(DABS(Y(29)))
CC
C---------------------------------------------------------------
C  Above is an average sparticle mass squared to be used later
C  when calling the subroutines for sparticle masses.
C---------------------------------------------------------------
      SITAR=(2.D0*(Y(15)+Y(16)+Y(17))+Y(18)+Y(19)+Y(20)+Y(21)+Y(22)
     #+Y(23)+2.D0*(Y(24)+Y(25)+Y(26))+Y(27)+Y(28)+Y(29)
     #+Y(7)**2+2.D0*(Y(8)**2)+3.D0*(Y(10)**2))/27.D0
CC
      XHIG1=Y(30)
      XHIG2=Y(31)
      XHIG3=Y(11)
      RH1=SUSY*(PRO(XHIG1))*DSQRT(DABS(XHIG1))
      RH2=SUSY*(PRO(XHIG2))*DSQRT(DABS(XHIG2))
      RH3=SUSY*(PRO(XHIG3))*DSQRT(DABS(XHIG3))
      DEBRE=(XHIG1*XHIG2-XHIG3**2)
      DSIGN=PRO(DEBRE)
      TSIN=-2.D0*XHIG3/(XHIG1+XHIG2+DYN1+DYN2)
CC
      IF(TSIN.GE.1.D0)THEN
        WRITE(96,'(a)')'No elw breaking - sin2b > 1 !!!'
        REJECT=.TRUE.
        RETURN
      ENDIF
      IF(TSIN.LT.0.D0)THEN
        WRITE(96,'(a)')'No elw breaking - sin2b < 0 !!!'
        REJECT=.TRUE.
        RETURN
      ENDIF
CC
      IF(EFAPTO.LE.1.D0)then
        TCOS=DSQRT(1.D0-TSIN**2)
      ELSE
        TCOS=-DSQRT(1.D0-TSIN**2)
      ENDIF
      WRITE(96,'("--------- PASS 2 ----------")')
C---------------------------------------------------------------
C  Different signs since cos(2beta) is negative if tanb>1 and
```



```
C  positive if tanb<1
C-----------------------------------------------------------------
      HGTR=(1.D0-TCOS)/(1.D0+TCOS)
      EFAP=DSQRT(HGTR)
      BBE=DATAN(EFAP)
      SINUS=DSIN(BBE)
      COSINUS=DCOS(BBE)
      AMAZA2=2.D0*
     #(XHIG1+DYN1-(XHIG2+DYN2)*(EFAP**2))/(EFAP**2-1.D0)
      AMAZA22=AMAZA2+PZZ
CC
      IF(AMAZA22.LE.0.D0)THEN
        WRITE(96,'(A)')'No elw breaking  Mz^2 was found < 0  !!!'
        REJECT=.TRUE.
        RETURN
      ELSE
        AMAZA=SUSY*DSQRT(AMAZA22)
      ENDIF
CC
C----------------------------------------
C   New slightly corrected value for voo
C----------------------------------------
      VOO=(DSQRT(2.d0/WUR))*DSQRT(AMAZA2/(GG1*.6d0+GG2))
      VV2Z=VOO*SINUS/SUSY
      VV1Z=VOO*COSINUS/SUSY
      GMT=SUSY*VV2Z*DSQRT(GGT*WUR)
      GMB=SUSY*VV1Z*DSQRT(GGB*WUR)
      GML=SUSY*VV1Z*DSQRT(GGL*WUR)
      GMTT=GMT/SUSY
      GMBB=GMB/SUSY
      GMLL=GML/SUSY
CC
      DO   I=1,NUU
          TY(I)=Y(I)          !   Initialization Block
      ENDDO
      TY(32)=VV1Z
      TY(33)=VV2Z
C----------------------------------------------------
C    This is the interface matrix which is used for
C    the effective potential construction.
C    Light Yukawas do not run.
C----------------------------------------------------
      do   ixs=1,NUU
          xcom(ixs) = ty(ixs)
      enddo
      YUKL(1)=UPM/VV2Z
      YUKL(2)=CHAM/VV2Z
      YUKL(3)=DWNM/VV1Z
      YUKL(4)=STRM/VV1Z
      YUKL(5)=ELEM/VV1Z
      YUKL(6)=WMUN/VV1Z
CC
      CALL CRNEG(XCOM,VV1Z,VV2Z,REJECT)
      IF(REJECT)RETURN
C----------------------------------------------------
C   Printing values at various scales
C------------------------------------------------------
C     IF(SUPRN2)THEN
C        XST=2.d0*dlog(amgut/amz)
C        XXEND=2.d0*dlog(amgut/600.d0)
C        ISTEP = 5
C        HSTEP = (XXEND-XST)/DBLE(ISTEP+1)
```

```
C        IRELAB=0
C        IFAIL = 0
C        CALL D02CBF(XST,XXEND,NU,XCOM,TOL,IRELAB,FON,OUT,PPARAM,
C    #   IFAIL)
C     ENDIF
C
      DO   JS=1,NUU
          TTY(JS)=TY(JS)     !  Initialization Block
      ENDDO
C-------------------------------------------------------
C  Below we calculate the physical top and gluino mass
C-------------------------------------------------------
      AIN=2.D0*DLOG(AMGUT/AMZ)
      BIN=AIN
      AFIN=0.D0
      BFIN=0.D0
C-----------------------------------------------------------
C   PHYSICAL TOP QUARK MASS : THTOP=TTOP (version susy5b)
C   New A3TOP for 2-loop QCD corrections in  sin^2
C-----------------------------------------------------------
      IF(KITER.EQ.1)THEN
        THTOP=TTOP
        CALL D02CHF(AIN,AFIN,NU,TY,TORL,IREL,HMAX,FON,ZTOP,
     #  SPARAM,IFFE)
        A3TOP=TY(3)*WUR
      ELSE
        THTOP=GMT+top_cor
        CALL D02CHF(AIN,AFIN,NU,TY,TORL,IREL,HMAX,FON,ZTOP,
     #  SPARAM,IFFE)
        A3TOP=TY(3)*WUR
      ENDIF
CC
      CALL D02CHF(BIN,BFIN,NU,TTY,TORL,IREL,HMAX,FON,ZGLU,
     #SPARAM,IFFE)
      THGLU=SUSY*AMGUT*DEXP(-.5D0*BIN)
C-------------------------------------
C  QCD  Corrections In GLUINO Mass
C-------------------------------------
C     GLUPHYS=THGLU*(1.D0+15.D0*TTY(3))
C-----------------------------------------------------------------------
C     ZTOP=(WUR*DSQRT(TY(4)))*TY(33)-SCALE/(1.D0+4.D0*TY(3)*5.D0/3.D0)
C   In evaluating Mt we ignored the a3^2 corrections in the DR bar
C   schemme which we do not know. In MS bar these are 11.4*(a3/Pi)**2
C     ZGLU=(GLUZ-AMZ)*(TY(9)-SCALO)
C-----------------------------------------------------------------------
      GLUPHYS=THGLU
CC
      WRITE(96,'(a)')'  --- PASS TOP / GLUINO ---  '
      CALL HIGGS(XHIG1,XHIG2,COSINUS,SINUS)
      WRITE(96,'(a)')'---------- PASS HIGGS ----------'
      EFB=(SINUS/COSINUS)**2
      SQEFB=DSQRT(EFB)
      VEV1=VV1Z
      VEV2=VV2Z
      HRMX1=Y(30)-Y(10)**2
      HRMX2=Y(31)-Y(10)**2
CC
      XM1=Y(7)*SUSY
      XM2=Y(8)*SUSY
      XM3=Y(9)*SUSY
C--------------------------------------------------------------
C   Call to know parameters at an average sparticle mass
```



```
C   which we call SITAR if we know them  at some scale.
C   Currently this scale is Mz
C-------------------------------------------------------------
      SUTU=DSQRT(SITAR)
      TFIN2=2.D0*DLOG(AMGUT/SUTU)
      TWIN=TFIN
CC
      CALL RK4(NAI,NAIM,TORL,TWIN,TFIN2,Y(1),Y(2),Y(3),Y(4),Y(5),Y(6),
     #Y(7),
     #Y(8),Y(9),Y(10),Y(11),Y(12),Y(13),Y(14),Y(15),Y(16),Y(17),Y(18),
     #Y(19),Y(20),Y(21),Y(22),Y(23),Y(24),Y(25),Y(26),Y(27),Y(28),
     #Y(29),Y(30),Y(31),VV1Z,VV2Z,Y(34),Y(35),Y(36),Y(37),Y(38),
     #Y(39))
      CALL DIVPRK(IDO,NU,FON,TS,TEND,TOL,PPARAM,Y)
CC
      VOO=DSQRT(Y(32)**2+Y(33)**2)
      TSINUS=DSQRT(Y(33)**2/(Y(32)**2+Y(33)**2))
      TCOSINUS=DSQRT(Y(32)**2/(Y(32)**2+Y(33)**2))
CC
      EFAP1=(TSINUS/TCOSINUS)
      BBE1=DATAN(EFAP1)
CC
      GMTO=WUR*Y(33)*DSQRT(Y(4))
      GMBO=WUR*Y(32)*DSQRT(Y(5))
      GMLE=WUR*Y(32)*DSQRT(Y(6))
CC
      VFR=TSINUS/TCOSINUS
CC
      CALL NEUCHA(Y(7),Y(8),Y(10),TCOSINUS,TSINUS,Y(1),Y(2))
      WRITE(96,'(a)')'---------- PASS NEUCHA ----------'
CC
      CALL SQ3(GMTO,GMBO,GMLE,TSINUS,TCOSINUS,Y,Y(32),Y(33))
      WRITE(96,'(a)')'---------- PASS SQ3 ----------'
CC
      CALL SQ21(Y(16),Y(17),Y(19),Y(20),Y(22),Y(23),
     #TSINUS,TCOSINUS,Y(1),Y(2),Y(32),Y(33))
      WRITE(96,'(a)')'---------- PASS SQ12 ----------'
CC
      CALL SLE3(Y(24),Y(27),GMLE,Y(14),Y(10),
     #TSINUS,TCOSINUS,Y(1),Y(2),Y(32),Y(33))
      WRITE(96,'(a)')'---------- PASS SLE3 ----------'
CC
      CALL SLE12(Y(25),Y(28),TSINUS,TCOSINUS,Y(1),Y(2),Y(32),Y(33))
      WRITE(96,'(a)')'---------- PASS SLE12 ----------'
CC
      CALL CRNEG(Y,Y(32),Y(33),REJECT)
      IF(REJECT)RETURN
C----------------------------------------------
C  Convert GG2,3 from DR bar to MS bar below
C----------------------------------------------
      GG2MS=GG2*((1.D0-GG2/(3.D0*WUR)+(2.D0/9.D0)*(GG2**2)/(WUR**2))
     #**2)
      GG3MS=GG3*((1.D0-GG3/(2.D0*WUR)+.5D0*(GG3**2)/(WUR**2))
     #**2)
      SINEX=.2316D0-.88D0*(THTOP**2-160.D0**2)/1.D7
      SINTH=.6D0*GG1/(.6D0*GG1+GG2MS)
      SINTH2=.6D0*GG1/(.6D0*GG1+GG2)
      SINDIF=SINEX-SINTH
      ELEC=1.D0/(SINTH*GG2MS)
C-----------------------------------------------
C  GG2MS,GG2M3,SINTH,ELEC are MS bar values now
C  GG3DR is DR bar value of g3
```

```
C-----------------------------------------------
      GG3DR=GG3
C-----------------------------------------------------------------
C  The MS bar values for mb , mtau are then given in terms of the
C  DR bar values GMB, GML by  --->
C-----------------------------------------------------------------
      WWBOT=GMB*(1.D0+4.D0*GG3MS/(3.D0*WUR)+1.D0/(9.D0*ELEC*WUR))
      WWTAU=GML*(1.D0+1.D0/(ELEC*WUR))
C--------------------------------------------------------------
C  These we run down to find the output pole masses Mb(pole)
C  and Mtau(pole) which should be close to the initial input
C  values. Even if they are not they are still O.K. provided
C  they are within the experimental errors.
C--------------------------------------------------------------
CC
CC
      IF(KITER.EQ.1)THEN
         YBPHYS=XBBOT
         YTPHYS=XTTAU
      ELSE
         YBPHYS=GMB+bot_cor
         YTPHYS=GML+tau_cor
      ENDIF
      SUZUKI=AMGUT*SUSY
      SUSUTU=SUSY*SUTU
CC
CC
      if(SUPRN2) WRITE(20,1551)
      if(SUPRN2)
     # WRITE(20,888) TFIN,SUZUKI,SINEX,SINTH,SINDIF,ELEC
CC
CC
      if(SUPRN2)then
      IF(PROD.LT.0.D0)write(20,'(//,a/,a,//)')'PROD is NEGATIVE !!!'
     #,' Therefore amsq - amsl for MSSM-lib are ambigious'
      WRITE(20,999) GG1,GG2MS,GG3MS,GGT,GGB,GGL,XAT,XAB,XAL,XBETA,
     #XAMU,GMT,GMB,GML,YBPHYS,YTPHYS,TSIN,SINUS,COSINUS,SUSUTU,
     #XQ3,XQ2,XQ1,XD3,XD2,XD1,XU3,XU2,XU1,XL3,XL2,XL1,
     #XE3,XE2,XE1,RH1,RH2,RH3,DSIGN,AMAZA,XM1,XM2,XM3,GLUPHYS
      WRITE(20,1333) THTOP
      WRITE(20,1349) HIGGC,HIGGA,HIGN1,HIGN2
      WRITE(20,748)
      WRITE(20,759) FM1,FM2,FM3,FM4
      WRITE(20,5700) H1P,H1M
      WRITE(20,5701) STPL,STMI
      WRITE(20,5702) SBPL,SBMI
      WRITE(20,5792) SLPL,SLMI,SN3
      WRITE(20,8797) U2L,U2R,D2L,D2R
      WRITE(20,5192) SEL12,SER12,SN12
      ENDIF
C-----------------------------------------
C   We need the parameters at scale TFIN
C   Currently this is Mz.
C-----------------------------------------
      GG1Y=GG1/WUR
      GG2Y=GG2/WUR
      GG3Y=GG3/WUR
      GGTY=GGT/WUR
      GGBY=GGB/WUR
      GGLY=GGL/WUR
      XATY=XAT/SUSY
      XABY=XAB/SUSY
```



```
      XALY=XAL/SUSY
      XAMUY=XAMU/SUSY
      ZUGYY=ZUGER
      AMIGA=AMIGER
CC
      XMIXY=XMIXH/(SUSY**2)
CC
      XQ3Y=XCOM(15)
      XQ2Y=XCOM(16)
      XQ1Y=XCOM(17)
CC
      XU3Y=XCOM(18)
      XU2Y=XCOM(19)
      XU1Y=XCOM(20)
CC
      XD3Y=XCOM(21)
      XD2Y=XCOM(22)
      XD1Y=XCOM(23)
CC
      XL3Y=XCOM(24)
      XL2Y=XCOM(25)
      XL1Y=XCOM(26)
CC
      XE3Y=XCOM(27)
      XE2Y=XCOM(28)
      XE1Y=XCOM(29)
C-------------------------------------------------------------------
C Below we find a scale Q00 that makes the rad corrections to the
C pseudoscalar almost vanish and then find the rad corrections to
C Higgs bosons.
C-------------------------------------------------------------------
      STTT=(DSQRT(STMI*STPL))/SUSY
      SK1=(STPL/SUSY)**2
      SK2=(STMI/SUSY)**2
      SKL1=(SBPL/SUSY)**2
      SKL2=(SBMI/SUSY)**2
CC
CC
      XQOO=.5D0*(S(SK1,SK2,1.D0)*XATY*(ATOP**2/SINUS**2)+
     #S(SKL1,SKL2,1.D0)*XABY*(ABOT**2/COSINUS**2))/
     #(XATY*(ATOP**2/SINUS**2)+XABY*(ABOT**2/COSINUS**2))
      QOO=DEXP(XQOO/2.D0)
      TSTO=2.D0*DLOG(AMGUT/QOO)
CC
      CALL RK4(NAI,NAIM,TORL,TFIN,TSTO,GG1Y,GG2Y,GG3Y,GGTY,GGBY,
     #GGLY,GAU1,
     #GAU2,GAU3,ZUGYY,AMIGA,XATY,XABY,XALY,XQ3Y,XQ2Y,XQ1Y,
     #XU3Y,XU2Y,XU1Y,XD3Y,XD2Y,XD1Y,XL3Y,XL2Y,XL1Y,XE3Y,XE2Y
     #,XE1Y,XHIG1,XHIG2,VV1Z,VV2Z,XCOM(34),XCOM(35),XCOM(36),
     #XCOM(37),XCOM(38),XCOM(39))
      CALL DIVPRK(IDO,NU,FON,TS,TEND,TOL,PPARAM,Y)
CC
      EFAP2=Y(33)/Y(32)
      BBE2=DATAN(EFAP2)
C---------------------------------------------------------
C       RADHA CORRECTS THE HIGGS MASSES (NOT THE CHARGED)
C       BY TAKING A PROPER SCALE WHICH THE RAD CORRECTIONS
C       FOR THE PSEUDOSCALAR ARE VANISHING
C---------------------------------------------------------
CC
      CALL RADH(Y(12),Y(13),Y(10),Y(11),BBE2,Y(1),Y(2),
     #Y(4),Y(5),Y(15),Y(18),Y(21),Y(32),Y(33),QOO,REJECT)
```

```
CC
      IF(REJECT)RETURN
CC
      if(SUPRN2)WRITE(20,1149)
     #   HIGGC,RACH,HIGGA,RAPA,HIGN1,RAHOO,HIGN2,RAHO
C -----------------------------------------------------------------
C      CHECKING OF THE ORDERING OF HEAVY MASSES
C To check at the end if we have succeded or not take
C    acheck(k)==(NA(K)-1)*SEM(K)+(2-NA(K))*MGUT
C  This paremeter acheck is indeed the mass of the kth superheavy
C  It must be acheck<=MGUT for each K or the sum of all superheavies
C  must be less or equal to MGUT*LO
C -----------------------------------------------------------------
      DO   JAMP=1,LO
          ACHECK(JAMP)=(NA(JAMP)-1)*SEM(JAMP)+
     #     (2-NA(JAMP))*AMGUT
      ENDDO
      AMAXX=ACHECK(1)
      DO   I=1,LO
          IF(AMAXX.LT.ACHECK(I))AMAXX=ACHECK(I)
      ENDDO
      CHECKA=AMAXX-AMGUT
      IF(CHECKA.LE.0.D0)THEN
         WRITE(96,'(//,a,//)')'MASS ORDERING FOR SUPERHEAVIES IS OK'
      ELSE
         WRITE(96,'(//,a,//)')
     #    'MASS ORDERING FOR SUPERHEAVIES IS NOT MET'
      ENDIF
C---------------------------------------------------
C   ITERATIONS TO FIND THE CORRECT SIN^2
C---------------------------------------------------
      THETAW=SINTH2
      DO 2002 ITE=1,10
****************************************************
C  CALCULATION   OF MSUSY's and  DELTA             *
****************************************************
       CALL ZSUSY(BMSUSY,BMSUSYT,THTOP,RACH,STPL,
     # STMI,U2L,U2R,SBPL,SBMI,D2L,D2R,
     # SLPL,SLMI,SEL12,SER12,H1P,H1M,GLUPHYS,AMZ,AMW)
CC
CC
      DELTA=0.0682D0-2.D0*AEM0*DLOG(BMSUSY/AMZ)/WUR
CC
CC
*****************************************************************
*      MSSM LIBRARY FOR CALCULATIONS OF PWW AND PZZ   AS WELL  *
*      PHYSICAL HIGGS BOSON MASSES IN MSSM                     *
*****************************************************************
c   Set parameters now. Most of the parameters is initialized in block
c   data init_mh in file MH_INIT.FOR - look into it if you want
c   change something like b quark mass, Z mass etc. Below free parameters
c   are initialized. Convention used for the MSSM parameters and Feynman
c   rules are described in the paper Phys. Rev. D41, 3464 (1990)
c   Pseudoscalar mass [GeV]
c
c
        pm =HIGGA
c
c
c   tan(beta) (don't put exactly 1 - m_h = 0 can result in program crash)
c
c
```



```
        tanb = EFAPTO
c
c
c   Top mass [GeV]
c
c
        tm = GMT
c
c
c   Squark and slepton mass parameter (for definition see SET_PAR subroutine
c   and Phys.Rev D41,3464 (1990) - the same for other parameters below)
c
c
        amsq = (XQ3+XQ2+XQ1+XD3+XD2+XD1+XU3+XU2+XU1)/9.D0
        amsl = (XL3+XL2+XL1+XE3+XE2+XE1)/6.D0
c
c
c   Gaugino mass parameter
c   CAUTION: amg = 250 below is equivalent to gaugino mass 500 in
c   more frequently used convention (we use 2*amg as the soft gaugino
c   mass term in the lagrangian)
c
c
        amg  = XM2/2.D0
c
c
c   Mu parameter in Higgs potential
c
c
        am =-XAMU
c
c
c   Mixing parameter in sfermion sector (A parameter)
c
c
        ys = XAT/amsq
c
c
c   Subroutine set_par has been designed for simplified initialization
c   of SUSY parameters. Program is however very general and can
c   incorporate much more general set of input parameters, for example
c   independent mass parameters for binos, winos and gluinos,
c   independent non-diagonal entries in soft sfermion mass matrices,
c   complex CP breaking miu parameter in Higgs potential etc. If you
c   want to perform such calculations, don't use set_par but initialize
c   yourself necessary commons. To understand how to do it, look into
c   SET_PAR.FOR and MH_DIAG.FOR files and the paper in PRD41 listed above.
c
c
        call set_par(tanb,pm,tm,am,amsq,amsl,amg,ys,ierr)
c
c
c   If ierr<>0 something is wrong - negative sfermion masses or very
c   light -ino masses (below 1 MeV). Possible ierr values are described
c   in set_par header. Choose more reasonable parameter set and
c   try once more (actually very low gaugino masses are unreasonable,
c   but should not cause the program crash)
c
c
        if (ierr.ne.0) then
           write(96,'(a)')'Abort from MSSM lib'
           reject=.true.
```

```
            return
         endif
c
c
c   Now initialize renormalization constants in gauge and Higgs sectors
c
c

         call gr_const
         call hr_const
c
c
c   Calculate physical one-loop Higgs boson masses. They are stored
c   after this procedure in common/hm_phys/. Array frm gives masses,
c   frm2 mass squares (m_H = frm(1), m_h = frm(2)). Lighter scalar mass
c   square for some parameters sets may be negative - this is not a
c   numerical error, but the sign that the initial choice of vacuum was bad.
c
c
c         call hm_solve(ierr,errin,errout)
c
c
c   If ierr>0, error in physical Higgs masses calculations is greater
c   then required (and equal to errout).
c
c
c         if (ierr.gt.0) stop
c
c
c   For some cases (very rare - happens sometimes for 80 < M_A < 150,
c   tan(beta)>25) physical masses calculated in hm_phys are reversed:
c   m_h > m_H. Procedure switches them automatically m_H <-> m_h,
c   but cannot decide if to switch also the couplings associated to
c   the given scalar, so then there is a danger of using object with
c   mass of h and couplings of H etc. In such cases ierr flag is set
c   to ierr = - 1. One can treat it as a warning or fatal error,
c   depending how careful one wants to be.
c
c
c         if (ierr.eq.-1) write(1,'(a)')
c     1                  ' Possible error in mass ordering: m_h > m_H?'
c
c
c   Stop here if you need masses only. The rest of the code calculates
c   the cross section and branching ratios
c
c        write(*,*)'Cp even  Higgs= ',frm(1),frm(2)
C        write(1,99)'tan(beta)=',tanb,'M_A=',pm,'M_h=',frm(2),'M_H=',frm(1)
C        write(*,*)zt_ren(91.1884d0),wt_ren(0.d0),zt_3sig8(91.1884d0)
C-----------------------------------
C   CALCULATION OF EXACT SIN^2
C   TRANSLATION OF PI and 4*PI
C-----------------------------------
      PI=CONPI
      FPI=WUR
C-----------------------------------------------------------------------
C   dqcd is the two-loop QCD correction into deltar
C   Fanchiotti et.al Phys.Rev D48(1993)307
C
C   dp is the contribution of photon self energy into deltar
C
C   ro is the mw**2/(cos(theta)**2*mz)
C
```



```
C   cos2 and sin2 are on-shell definitions of sin(theta)
C
C   dvb are VERTEX+BOX corrections in deltar
C      G.Degrassi et.al Nucl.Phys.B351(1991)49
C
C   dvbsusy are VERTEX+BOX corrections in deltar from supersymmetric
C   particles(this correction are the same with the OMS scheme.
C
C   deltar is the entire one loop  contribution to sin**2
C      G.Degrassi et.al Nucl.Phys.B351(1991)49
C
C   deltar2 is deltar + 2-loop Higgs corrections
C
C   Radiative corrected sin(theta)
C
C   Physical mw mass corrected by ro as the above definition
C-----------------------------------------------------------------------
      dqcd=(THTOP**2)*A3TOP*GFERMI*((PI**2)/3.D0+1)/
     &  (4.D0*DSQRT(2.D0)*(PI**3.D0))
      dp=(dble(fzt_sig(AMZ**2)))**2/(AMZ**2-dble(ft_sig(AMZ**2)))
      ro=1.D0+dble(wt_sig(AMW**2))/AMW**2-dble(zt_sig(AMZ**2))/AMZ**2-
     &  dp/AMZ**2-dqcd
      cos2=AMW**2/(AMZ**2)
      sin2=1.d0-cos2
      dvb=AEM0*(6.D0+(DLOG(cos2)/sin2)*(3.5D0-2.5D0*sin2-
     #  THETAW*(5.D0-1.5D0*(cos2/(1.D0-THETAW)))))/(WUR*THETAW)
      dvbsusy=dble(box(2,2,1,1))+dble(wln_ren0(2))+
     &    dble(wln_ren0(1))+
     &  0.5d0*(dble(v_ren0(1))+dble(v_ren0(2)))
      deltar=DELTA-dble(wt_sig(0.d0))/AMW**2+
     &  dble(zt_sig(AMZ**2))/AMZ**2+
     &  dvb+dvbsusy+dqcd
      HRAT=HIGN2/TTOP
      HXT=3.D0*GFERMI*TTOP**2.D0/(8.D0*PI**2.D0*DSQRT(2.D0))
      deltar2=deltar- (1.D0/3.D0)*RLOW(HRAT)*(HXT**2.D0)*
     #  ro*(1.D0-deltar)
      THETAW=0.5D0*(1.D0-DSQRT(1.D0-(FPI*AEM0)/(DSQRT(2.D0)*
     #  GFERMI*AMZ**2.D0*(1.D0-deltar2))))
      AMW=AMZ*DSQRT(1.D0-THETAW)*DSQRT(ro)
CC
CC
CC
2002      CONTINUE
C----------------------------------------------------
C   PRINTING IN SIN FILE THE ELECTROWEAK CORRECTIONS
C   The AMAZA should be equal to AMZ if absolute
C   convergence is reached
C----------------------------------------------------
      if(SUPRN2)then
         write(22,*)'***************   ********************'
         write(22,*)'MSUSY = ',BMSUSY
         write(22,*)'MSUSYT = ',BMSUSYT
         write(22,*)'DELTA = ',DELTA
         write(22,*)'pm = ',pm
         write(22,*)'tanb = ',tanb
         write(22,*)'top = ',tm
         write(22,*)'amsq = ',amsq
         write(22,*)'amsl = ',amsl
         write(22,*)'amg = ',amg
         write(22,*)'mu = ',am
         write(22,*)'ys = ',ys
         write(22,*)'QCD = ',dqcd
```

```
        write(22,*)'RO = ',ro
        write(22,*)' vertex+box = ',dvb
        write(22,*)' vertex+box (SUSY) = ',dvbsusy
        write(22,*)'2-loop Higgs cor = ',deltar2-deltar
        write(22,*)'Pzz = ',dble(zt_sig(AMZ**2))/AMZ**2
        write(22,*)'Pww = ',dble(wt_sig(0.d0))/AMW**2
        write(22,*)'DELTAR = ',deltar2
        write(22,*)'THETAW = ',THETAW
        write(22,*)' Mz = as comes out ',AMAZA
        write(22,*)'Mw = ',AMW
        write(22,*)'************   *********************'
      endif
C---------------------------------------------------------------
C  New Definitions of sin^2 and gauge couplings for iterations
C  in DR bar
C---------------------------------------------------------------
      SINSQW=THETAW
      COSSQW=1.D0-SINSQW
      AXW3=1.D0/(1.D0/GG3MS -1.D0/WUR + DLOG(BMSUSYT/AMZ)*2.D0/
     &  WUR)
      AXW2=1.D0/(SINSQW*(1.D0-0.0682D0)/AEM0+SINSQW*2.D0*DLOG(BMSUSY/
     &  AMZ)/WUR)
      AXW1=1.D0/(3.D0*COSSQW*(1.D0-0.0682D0)/(5.D0*AEM0)+
     &  3.D0*COSSQW*DLOG(BMSUSY/AMZ)/(10.D0*CONPI))
C-----------------------------------------------------------
C  AEMC is the MS bar value for aem at Mz which is needed
C  to determine Yukawa couplings from Mtau, Mbottom
C-----------------------------------------------------------
      AINVER=1.d0/(AXW2*SINSQW)+1.D0/(6.d0*PI)
      AEMC=1.d0/AINVER
C------------------------------------------
C    Inputs for the Runge Kutta CHF,CAF
C------------------------------------------
      STRO=AXW3/WUR
      AW2=AXW2/WUR
      AW1=AXW1/WUR
      voukos=AMZ**2
      PZZ=dble(zt_sig(voukos))
CC
CC
      IAA=0  !  We must count again the Iterations
      WRITE(*,*)INT(AO),INT(AMOO),INT(AM12)
CC
CC
C--------------------------------------------
C   Comparison of astrong's Lahanas - Rizos
C--------------------------------------------
        ALFAS=1.D0/(1.D0/GG3DR + 1.D0/WUR -
     #  DLOG(BMSUSYT/AMZ)/(2.D0*PI))
C-----------------------------------------------
C  Only if prod > 0 XQ,XU,XD,XL,XE quantities
C  are real numbers
C-----------------------------------------------
      if(prod.gt.0.d0)then
C--------------------------------------------
C          LIFETIME FORMULA,H3min,AS
C--------------------------------------------
      ASPROT=((GG1/AAGUT)**(7.D0/99.D0))*((GG3/AAGUT)**
     #  (-4.D0/9.D0))
      PRMHCOLOR=ASPROT*0.4D0*1.8D+20*(PRD(XM2,XQ3,XD3)+
     #  PRD(XM2,XQ3,XL3))/DSIN(2.D0*BE)
C--------------------------------------------
```



```
C   Proton Decay Formula in the minimal SU(5)
C---------------------------------------------
       PRODECAY=6.9D+31*(0.67D0*ACHECK(2)
     #  *DSIN(2.D0*BE)/0.4D0/
     #  ASPROT/1.0D+20/(PRD(XM2,XQ3,XD3)+PRD(XM2,XQ3,XL3)))**2.D0
C-------------------------------------
C   Proton Decay Formula in the MDM+PQ
C-------------------------------------
C      PRODECAY=6.9D+31*(0.67D0*(ACHECK(2)**2.D0/ACHECK(7))
C     #  *DSIN(2.D0*BE)/0.4D0/
C     #  ASPROT/1.0D+20/(PRD(XM2,XQ3,XD3)+PRD(XM2,XQ3,XL3)))**2.D0
C---------------------------------
C   PROTON DECAY BOUNDS ON M_hcolor
C---------------------------------
       IF((ACHECK(2)**2.D0/ACHECK(7)).LT.PRMHCOLOR)THEN
         WRITE(96,'(A/,2(A,D14.7)/,2(A,D14.7)/,A)')
     #  '          CASE with   ',
     #  ' M_H_c = ',ACHECK(2),' Msigma= ',ACHECK(3),
     #  ' Mvector= ',ACHECK(1),' H3min= ',PRMHCOLOR,
     #  ' ***** is RULED OUT from PROTON DECAY ****'
       ENDIF
C------------------------------
C   PERTURBATIVITY BOUNDS
C------------------------------
       IF(ACHECK(2).GT.1.9D0*ACHECK(1).OR.ACHECK(3).
     #  GT.3.8D0*ACHECK(1))THEN
         WRITE(96,'(A/,2(A,D14.7)/,A,D14.7/,A)')
     #  '          CASE with ',
     #  ' M_H_c= ',ACHECK(2),' Msigma= ',ACHECK(3),
     #  ' Mvector= ',ACHECK(1),
     #  ' ***** is RULED OUT from PERTURBATIVITY ****'
       ENDIF
CC
CC
       endif
C----------------------------------------------------
C   END OF EXPERIMENTAL BOUNDS
C   END OF 3-FOLD ITERATIONS FOR THE CONVERGENCE
C   OF astrong
C----------------------------------------------------
  795   CONTINUE   !   End of 3-fold iterations
CC
CC
C-------------------------------
C     EXPERIMENTAL   LIMITS
C-------------------------------
       IF(FM1.LT.20.D0 .OR. FM2.LT.45.D0 .OR. FM3.LT.70.D0 .OR.
     #  ABS(FM4).LT.108.D0 .OR. H1P.LT.99.D0 .OR.
     #  H1M.LT.45.D0 .OR. SN3.LT.42.D0 .OR. amsl.LT.45.D0 .OR.
     #  STPL.LT.45.D0 .OR. RAHO.LT.60.D0 .OR. RAPA.LT.21.D0 .OR.
     #  RACH.LT.40.D0)THEN
         WRITE(96,*)'***** CASE RULED OUT BY EXP. LIMITS [1] ****'
         REJECT=.TRUE.
       ENDIF
CC
       IF(amsq.LT.90.D0 .AND. GLUPHYS.LT.410.D0)THEN
         WRITE(96,*)'***** CASE RULED OUT BY EXP. LIMITS [2] ****'
         REJECT=.TRUE.
       ENDIF
       IF(amsq.LT.180.D0 .AND. GLUPHYS.LT.amsq)THEN
         WRITE(96,*)'***** CASE RULED OUT BY EXP. LIMITS [3] ****'
         REJECT=.TRUE.
```

```
         ENDIF
         IF(GLUPHYS.LT.218.D0 .AND. amsq.LE.GLUPHYS) THEN
           WRITE(96,*)'***** CASE RULED OUT BY EXP. LIMITS [4] ****'
           REJECT=.TRUE.
         ENDIF
         IF(GLUPHYS.LT.100.D0) THEN
           WRITE(96,*)'***** CASE RULED OUT BY EXP. LIMITS [5] ****'
           REJECT=.TRUE.
         ENDIF
C----------------------------------------
C    END OF EXPERIMENTAL BOUNDS
C----------------------------------------
CC
CC
C-----------------------------------------
C          FORMAT'S     UNIVERSE
C-----------------------------------------
  775 FORMAT(//,' *****  INITIAL t =',F10.6,'  FINAL t =',F10.6
     #,' *********')
  897 FORMAT(//,'************ INITIAL TEST VALUES',
     #', a1,2,3 and mt(Mz) in DR bar  *******',//,
     #'  a1(Mz)= ',F7.5,'  a2(Mz)= ',F7.5,'  a3(Mz)= ',F7.5,/,
     #//,'  Mo =',F10.3,'    M1/2 =',F10.3,
     #'   Ao =',F10.3,/,
     #'  mt(Mz)= ',F7.2,'  Mb(pole)= ',F7.2,' Mtau(pole)=',F7.2,/,
     #'  tanb   ,    sin2b = ',2F10.6,/,
     #'****************************************************',
     #'*************************',//)
  716 FORMAT(//,' ** Iter.=',I3,
     #' MGut=',D11.5,' a1=',F7.5,' a2=',F7.5,' aGUT=',F7.5)
  880    FORMAT(/,'*** Output values for couplings in this run ',
     #' *********')
  870    FORMAT(/,'***       FINAL t = ',F10.6,
     #'       ***',/,
     #'  a1(Mz)= ',F7.5,'  a2(Mz)= ',F7.5,'  a3(Mz)= ',F7.5,/,
     #'  at(Mz)= ',F7.5,'  ab(Mz)= ',F7.5,'  aL(Mz)= ',F7.5,/,
     #'***********************************',
     #'***************',/)
  883 FORMAT(////,'*** Output values for couplings after the 6th CALL',
     #' *********',/,
     #'              , Mz-->Mgut          ')
  875 FORMAT(/,'***************    FINAL t = ',F10.6,
     #'  ***********************',/,
     #' a1(Mgut)= ',F7.5,'  a2(Mgut)= ',F7.5,'  a3(Mgut)= ',F7.5,/,
     #' at(Mgut)= ',F7.5,'  ab(Mgut)= ',F7.5,'  aL(Mgut)= ',F7.5,//,
     #'***********************************',
     #'***************',//)
 914   FORMAT(/,'  mu(Mz)  = ',F12.3,'    B(Mz) =',F12.3,/)
 915   FORMAT('  mu(Mgut) = ',F12.3,'  B(Mgut) =',F12.3,/)
 917   FORMAT(/,'  At(Mgut) = ',F12.3,'  Ab(Mgut) =',F12.3,
     #'  AL(Mgut) =',F12.3,/)
 918   FORMAT('  M1(Mgut) = ',F12.3,'  M2(Mgut) =',F12.3,
     #'  M3(Mgut) =',F12.3,/)
 8971 FORMAT(//,'*************** INITIAL  VALUES AFTER 6th',
     #'= INPUTS FOR THE 7th CALL ******************',/,
     #'  a(Mgut)= ',F8.5,//,
     #' a1(Mgut)= ',F7.5,'  a2(Mgut)= ',F7.5,'  a3(Mgut)= ',F7.5,/,
     #' at(Mgut)= ',F7.5,'  ab(Mgut)= ',F7.5,'  aL(Mgut)= ',F7.5,
     #//,'  Mo =',F10.3,'    M1/2 =',F10.3,
     #'   Ao =',F10.3,//,
     #'    B(Mgut) = ',F15.6,'  mu(Mgut) = ',F15.6,//,
     #'****************************************************',
```



```
     #'***************************')
 1551 FORMAT(////,'****** FINAL VALUES ( sin^2 , aem in MS bar ',
     #' as well as all gauge couplings, NOT YUKAWAS) **********')
  888 FORMAT(//,' *******   t final  ******** ',F12.7
     #,' ********',/
     #,'     Mgut = ',D11.5,//,
     #' sin^2(exp) = ',F8.6,'  sin^2(th) = ',F8.6,
     #'  sin^2(exp)-sin^2(th) = ',F8.6,'    1/aem = ',F9.4
     #,' sin^2(exp) = .2316-.88 (mt^2-160^2)/10^7 '  )
 999  FORMAT(/,'******************************************',
     #'*****************************',//,'  a1(Mz)= ',F7.5,
     #'  a2(Mz)= ',F7.5,'  a3(Mz)= ',F7.5,//,
     #'  at(Mz)= ',F7.5,'  ab(Mz)= ',F7.5,'  aL(Mz)= ',F7.5,//,
     #'**********************************************************',
     #'*************',/,
     #'  At(Mz) = ',F10.3,'  Ab(Mz)= ',F10.3,'  Al(Mz)= ',F10.3,//,
     #'      B(Mz)= ',F10.3,
     #'   Mu(Mz)= ',F10.3,//,
     #' DR-> mt(Mz)= ',F7.2,' DR-> mb(Mz)= ',F7.2,' DR-> mtau(Mz)=',
     #F7.2,/,
     #'    Mbottom(pole) = ',F12.5,'    Mtau(pole) = ',F12.5,/,
     #'  sin2b = ',F9.7,'  sinb = ',F9.7,'  cosb = ',F9.7,/,
     #'**********************************************************',
     #'*************',/,'      AVRG MASS =    ',F12.3,/,
     #'        Q3 =',F12.3,'  Q2 =',F12.3,'  Q1 =',F12.3,//,
     #'        D3 =',F12.3,'  D2 =',F12.3,'  D1 =',F12.3,//,
     #'        U3 =',F12.3,'  U2 =',F12.3,'  U1 =',F12.3,//,
     #'        L3 =',F12.3,'  L2 =',F12.3,'  L1 =',F12.3,//,
     #'        E3 =',F12.3,'  E2 =',F12.3,'  E1 =',F12.3,//,
     #'**********************************************************',
     #'*************',//,
     #' Below m1,2,3 are  mi=sign(mi^2)*sqrt(mi^2)',/,
     #' m1= ',F11.3,'  m2= ',F11.3,'  m3= ',F11.3,//,
     #' IF det POSITIVE NO EW BREAKING   det = ',F5.2,//,
     #' Value of Mz from  (m1^2-m2^2*tan^2)/(tan^2-1) ',F10.3,///,
     #' Gauginos  M1 =',F12.3,' M2 =',F12.3,'  M3 =',F12.3,/,
     #' Physical gluino mass  Mg = ',F13.5)
 1333 FORMAT(///,' ***** PHYSICAL TOP MASS  Mt =  ',F11.5)
 1349 FORMAT(///,' ########## tree level  HIGGS MASSES ###########',//,
     #'   CHARGED   HIGGSES   H+- = ',F10.5,/,
     #'   CP - ODD    HIGGS    A  = ',F10.5,/,
     #'   CP - EVEN HIGGSES    Ho  = ',F10.5,/,
     #'                        ho  = ',F10.5,//)
  748 FORMAT(//,'  *******    NEUTRALINO MASSES    *********',/)
  759 FORMAT('    N1 = ',F11.5,'  N2 = ',F11.5,
     #'   N3 = ',F11.5,'  N4 = ',F11.5,/)
 5700 FORMAT(//,'  ********   CHARGINO MASSES',
     #'    **********',//,'     C1 = ',F11.5,
     #'  C2 = ',F11.5,/)
 5701 FORMAT(//,'  ********   STOPS  ',
     #'    **********',//,'     ST1 = ',F11.3,
     #'  ST2 = ',F11.3,/)
 5702 FORMAT(//,'  ********   SBOTTOMS  ',
     #'    **********',//,'     SB1 = ',F11.3,
     #'  SB2 = ',F11.3,/)
 5792 FORMAT(//,'  ********   SLEPTONS (3d gen.) ',
     #'    **********',//,'     SE3+ = ',F11.3,
     #'  SE3- = ',F11.3,/,'     SN3 = ',F11.3  )
 8797 FORMAT(//,'********** REMAINING SQUARKS ',
     #' **********',//,
     #'   UL = ',F10.5,'  UR = ',F10.5,/,
     #'   DL = ',F10.5,'  DR = ',F10.5,////)
```

```
 5192 FORMAT(//,'  ********  SLEPTONS (1+2 gen.)',
     #'   **********',//,'    SEL = ',F11.3,
     #'   SER = ',F11.3,/,'     SNL = ',F11.3 )
 1149 FORMAT(///,' ### RAD CORRECTED MASSES TO HIGGS #######',//,
     #' The rad corrections to A are made to vanish by',/,
     #' a proper choice of the scale',//,
     #' On the left are the tree masses',/,
     #'   CHARGED  HIGGSES   H+- = ',F14.5,' cor = ',F14.5,/,
     #'   CP - ODD   HIGGS   A   = ',F14.5,' cor = ',F14.5,/,
     #'   CP - EVEN HIGGSES:  Ho  = ',F14.5,' cor = ',F14.5,/,
     #'                       ho  = ',F14.5,' cor = ',F14.5,//)
CC
CC
      RETURN
      END
```