Ref.TH.3761-CERN

WIZJET: A MONTE CARLO PROGRAM FOR HADRONIC PRODUCTION OF $W^{\pm}$
AND Z^0 SIMULATING THE STANDARD MODEL WITH INCLUSION OF
INITIAL QCD BREMSSTRAHLUNG

R. Odorico*
CERN -- Geneva

Submitted to Computer Physics Communications

* Permanent address: Dipartimento di Fisica dell'Universita', via Irnerio 46,
40126 Bologna, Italy, and INFN, Sezione di Bologna.

Ref.TH.3761-CERN

November 1983

PROGRAM SUMMARY

TITLE OF PROGRAM: WIZJET

CATALOGUE NUMBER:

PROGRAM OBTAINABLE FROM: CPC Program Library, Queen's University of Belfast, N. Ireland.

COMPUTER: CDC 7600, IBM 3081 and VAX 11/780. INSTALLATION: CERN, Geneva.

OPERATING SYSTEM: NOS/BE (CDC), MVS (IBM), VMS/11 (VAX).

PROGRAMMING LANGUAGE USED: FORTRAN 77, also compatible with FTN 5 on CDC and FORTRAN H on IBM.

HIGH SPEED STORAGE REQUIRED: 112K without user's routines, 150K for the test-run set-up. Can be varied according to the choice of parameters.

NO. OF BITS IN A WORD: 64 (also compatible with 32).

OVERLAY STRUCTURE: none.

OTHER PERIPHERALS USED: line printer.

NO. OF CARDS IN COMBINED PROGRAM AND TEST DECK: 4965.

KEYWORDS: Monte Carlo simulation, Quantum Chromodynamics, Weinberg-Salam model, weak bosons, physics at hadron colliders.

NATURE OF PHYSICAL PROBLEM

Simulation of Quantum Chromodynamics (QCD) and of the Weinberg-Salam model in the hadronic production of the weak bosons $W^{\pm}$ and Z^0 and of the Drell-Yan continuum, in association with jets due to initial QCD bremsstrahlung.

TYPICAL RUNNING TIME

In antiproton-proton collisions at a c.m. energy of 540 GeV, for production of $W^\pm$ decaying into electron plus neutrino, ~3 events per c.p.u. second of CDC 7600 with the rest of the final state calculated at the particle level, ~5 events per second with the rest of the final state calculated at the level of quanta (jets) only.

UNUSUAL FEATURES OF THE PROGRAM: none.

REFERENCES

[1] R. Odorico, CERN preprint TH-3662 (1983).

1. INTRODUCTION

The recent discoveries of the $W^\pm$ and Z^0 weak bosons at the CERN $\bar{p}p$ collider [1,2] has somewhat changed the emphasis in theoretical studies concerned with the production characteristics of these particles. In the place of simple estimates of cross-sections and qualitative production characteristics, the present data, and those which will be available in the near future, demand a much more quantitative discussion of event properties. In particular, an adequate theoretical assessment of the transverse momentum with which the weak boson is produced and of the associated hadronic transverse energy and jets requires, within the framework of Quantum Chromodynamics (QCD), a quantitative treatment of the QCD bremsstrahlung emitted off the initial partons, which eventually annihilate into the weak boson (see [3]). Also the discussion of the non-leptonic decay modes of W and Z remains incomplete without the inclusion of QCD radiation effects, which are responsible for broadening of the decay jets and for softening of the decay hadron spectra.

The calculational framework presented in program COJETS [4] for the treatment of QCD radiation in hadronic production of jets and heavy flavors can be easily adapted to weak boson production. The theoretical treatment and quantitative results for the hadronic transverse energy and jets originated by initial QCD bremsstrahlung in association with hadronic production of the W boson have been presented and discussed in [3]. The program WIZJET for weak boson production presented here largely consists of rout-

ines already present in COJETS. Specifically, the QCD evolution and hadronization routines are identical. Changes and additions only concern the hard parton subprocess. The complications present in hadronic jet production because of lack of a priori knowledge of the QCD evolution scale are no longer there, the QCD evolution scale being now fixed by the weak boson mass. Therefore, no pretabulation is necessary. A new technical problem arises, however, because, when sampling on the initial parton densities and calculating initial evolution, there is no way of directing the Monte Carlo generation beforehand, so as to have at the end the annihilating parton kinematics exactly consistent with the value of the weak boson mass. The solution to this problem, adopted in the program, has been to allow for a finite mass interval ($\pm 5\%$) around the weak boson mass, within which parton configurations are accepted for annihilation into the weak boson. (The subsequent weak boson decay is treated consistently with the exact weak boson mass.) Also, the calculation of initial cascades is immediately interrupted as soon as it is clear (because of the momentum degradation character of the cascades) that the end product cannot fall within the acceptance mass interval. In this way the execution time for the initial stage turns out to be comparable with that for the calculation of the rest of the event, and does not constitute any longer a bottleneck for the accumulation of large statistics. The little kinematic imprecision in the calculation of weak boson production properties should be appreciated with reference to the accuracy of the input parton densities, especially in connection with possible systematic sources of smearing in x .

In order to estimate effects from the finite widths of W and Z , the weak boson mass can be optionally fluctuated, in the treatment of decay kinematics, according to a Breit-Wigner distribution. It should be clear, though, that this is only meant as a first, qualitative appreciation of the ensuing experimental effects. A quantitative calculation including finite widths should take into account QED radiation for the leptonic decay modes, and the extra modulation of the mass spectrum due to the (evolved) parton densities, which are not included here.

The program allows, by the same technique, to calculate also the Drell-Yan continuum at a given virtual photon mass.

2. PHYSICAL ASSUMPTIONS

The theoretical treatment of hadronic production of W and Z with inclusion of QCD bremsstrahlung has been discussed in [3], and the same assumptions are used here. For the basic coupling constants entering the production and the decay of W and Z the standard (Weinberg-Salam [5]) model is assumed. We report here the corresponding numerical values used in the program (see e.g. [6]).

Since in the program the Dirac δ function, constraining the invariant mass of the two annihilating partons to be equal to the weak boson mass, is effectively replaced by a rectangular function equal to $1/\Delta M^2$ in an interval $M_{W/Z}^2 \pm \Delta M^2/2$ and zero outside (so that normalization is 1), quark annihilations within the allowed mass interval have associated effective cross sections

$$\sigma(u\bar{d}W^+) = G\pi\sqrt{2}/3 (M_W^2/\Delta M^2) \cos^2\theta_c$$

$$\sigma(u\bar{s}W^+) = G\pi\sqrt{2}/3 (M_W^2/\Delta M^2) \sin^2\theta_c$$

$$\sigma(u\bar{u}Z^0) = 2G\pi\sqrt{2}/3 (M_Z^2/\Delta M^2) [0.25 - (2/3)x_W + (8/9)x_W^2]$$

$$\sigma(d\bar{d}Z^0) = 2G\pi\sqrt{2}/3 (M_Z^2/\Delta M^2) [0.25 - x_W/3 + (2/9)x_W^2]$$

$$\sigma(s\bar{s}Z^0) = \sigma(d\bar{d}Z^0)$$

where

$$G = (1.16632 \cdot 10^{-5})(0.19733)^2 \cdot 10^7 \text{ nb}$$

$$\cos\theta_c = 0.9737$$

$$x_W = \sin^2\theta_W = 0.23$$

with standard notations.

For Drell-Yan pair production, the quark annihilation cross section into a lepton pair is given by

$$\sigma(q_i \bar{q}_i \rightarrow \gamma^* \rightarrow l^+ l^-) = (4/3) \pi \alpha^2 / 3 e_i^2 M^{-2}$$

where M is the dilepton mass and

$$\alpha = 1/137.036$$

$$e_i^2 = 4/9 \text{ for } u\bar{u}, 1/9 \text{ for } d\bar{d} \text{ and } s\bar{s}$$

We have taken $\Delta M/M = 0.05$ in the program. This value can be changed by modifying the definitions of the lower and higher limits on M^2 , BIML2 and BIMX2, respectively, in subroutine BPREGN.

The branching fractions for W^+ and Z^0 decays are ($\cos\theta_c$ is approximated with 1 in W decays)

$$\Gamma(W^+ \rightarrow e^+ \nu) = \Gamma(W^+ \rightarrow \mu^+ \nu) = \Gamma(W^+ \rightarrow \tau^+ \nu) \propto 1$$

$$\Gamma(W^+ \rightarrow u\bar{d}) = \Gamma(W^+ \rightarrow c\bar{s}) = \Gamma(W^+ \rightarrow t\bar{b}) \propto 3$$

$$\Gamma(Z^0 \rightarrow e^- e^+) = \Gamma(Z^0 \rightarrow \mu^- \mu^+) = \Gamma(Z^0 \rightarrow \tau^- \tau^+) \propto [0.25 - x_W + 2x_W^2]$$

$$\Gamma(Z^0 \rightarrow \nu_e \bar{\nu}_e) = \Gamma(Z^0 \rightarrow \nu_\mu \bar{\nu}_\mu) = \Gamma(Z^0 \rightarrow \nu_\tau \bar{\nu}_\tau) \propto 0.25$$

$$\Gamma(Z^0 \rightarrow u\bar{u}) = \Gamma(Z^0 \rightarrow c\bar{c}) = \Gamma(Z^0 \rightarrow t\bar{t}) \propto 3 [0.25 - (2/3)x_W + (8/9)x_W^2]$$

$$\Gamma(Z^0 \rightarrow d\bar{d}) = \Gamma(Z^0 \rightarrow s\bar{s}) = \Gamma(Z^0 \rightarrow b\bar{b}) \propto 3 [0.25 - (1/3)x_W + (2/9)x_W^2]$$

For decays involving top, however, because of the top quark massiveness we introduce corrective phase space factors [7], so that eventually

$$\Gamma(W^+ \rightarrow t\bar{b}) = 3 (1-\rho) (1-0.5\rho-0.5\rho^2)$$

$$\Gamma(Z^0 \rightarrow t\bar{t}) = 3 \{0.25 - (2/3)x_W + (8/9)x_W^2 - \rho[0.25 + (4/3)x_W - (16/9)x_W^2]\}$$

with $\rho = m_t^2/M_W^2$ for W, and $\rho = m_t^2/M_Z^2$ for Z, m_t being the top quark mass.

Branching fractions are not felt, of course, if a specific decay channel is selected by the user, as it is likely to happen in most of the applications. (The value of the W/Z cross-section printed by BHEAD always corresponds to the total W/Z cross section, and is never corrected for the decay branching ratio if a specific decay channel is selected.)

The polar angle distribution in the two body process $q+\bar{q} \rightarrow W/Z \rightarrow p+\bar{p}$, where p is either the final quark or the final negative lepton or the final neutrino, is given by

$$dN/d\cos\theta \propto (1+\cos\theta)^2$$

for W

$$dN/d\cos\theta \propto (1+\cos^2\theta + A\cos\theta)$$

for Z

where θ is the angle between the final p and the initial q, and

$$A = 8 A_i B_i A_f B_f / [(A_i^2 + B_i^2)(A_f^2 + B_f^2)]$$

where i and f refer to the initial quarks and final quarks/leptons, respectively, and

$$A_{i/f} = -(2/3)x_W + 0.25 ; \quad B_{i/f} = 0.25$$

for charge 2/3 quarks;

$$A_{i/f} = (1.3)x_w^{-0.25} ; \quad B_{i/f} = -0.25$$

for charge -1/3 quarks;

$$A_{i/f} = x_w^{-0.25} ; \quad B_{i/f} = -0.25$$

for charged leptons;

$$A_{i/f} = 0.25 ; \quad B_{i/f} = 0.25$$

for neutrinos.

For Drell-Yan lepton pairs the corresponding angular distribution is

$$dN/d\cos\theta \propto (1+\cos^2\theta)$$

Full widths, used only in the optional mode with finite width effects included, are calculated as (neglecting the small corrections due to top quark massiveness)

$$\Gamma_W = \sqrt{2} G/\pi M_W^3 \quad (= 2.79 \text{ GeV with } M_W = 81 \text{ GeV})$$

$$\Gamma_Z = \sqrt{2} G/\pi M_Z^3 [1-2x_w+(8/3)x_w^2] \quad (= 3.07 \text{ GeV with } M_Z = 95 \text{ GeV})$$

For the other components of the calculation the same assumptions hold as those used in COJETS. The initial evolution scale is set equal to M^2 , where M is the W/Z or Drell-Yan photon mass. The evolution scale for W/Z decay jets is set equal to $M^2/4$ (to change it one can alter the value of QSQW as defined in subroutine BJETS).

3. GENERAL FEATURES OF THE SOFTWARE

The organization of the software follows the same scheme as in COJETS. The new routines (in the program listing, from BHEAD to DDANG, included) are all in Section B, which deals now with W/Z production and decay. The main program also has a slightly different structure: i) GEVENT is replaced by BGEVEN, ii) there is no analog of PREGEN, iii) before event generation a call to WEAKIN or DREYIN must be made to define the production channel (W, Z or Drell-Yan) and basic production and decay characteristics, iv) PRHEAD is replaced by BHEAD.

As in the case of COJETS, the whole program, except for the main program and the user's routines (BOOKH, FILLH and OUTH), can be compiled once and for all. One may also organize the new WIZJET routines together with the COJETS routines in a single (precompiled) library.

4. SPECIFIC FEATURES OF THE SOFTWARE

The only new programming feature that may need comments concerns the handling of non-leptonic decays of W/Z. The primary decay products in this case are quark-antiquark pairs, which through QCD evolution (with evolution scale set by the weak boson mass) generate two cascades of quanta. The quanta are then independently fragmented into Field-Feynman jets. Strict 4-momentum conservation is enforced at the end, by the use of a corrective algorithm (subroutine P4CORR). Because of that, the W/Z decay quanta have a sort of special status, which the user should take in due account when using quanta information. The kinematic parameters of a W/Z decay quantum, as given in PARQUA, are not those straightforwardly coming from the QCD calculation, but result from the sum of the 4-momenta of all hadrons belonging to the jet originated by the quantum. A call to FREEZE, in the main program, will not freeze the fragmentation of W/Z quanta. The only options open to the user, in this respect, are either to inhibit the W/Z decay altogether or to freeze the decay hadrons from W/Z carrying heavy flavors. A call to FREEZE(1HQ) will freeze only the initial bremsstrahlung quanta.

The user should also be aware that, when generating Drell-Yan pairs, the program internally uses storage pertaining to the particle with code number 5 in the particle data listing (normally void). No trace of that appears in the PARTAB listing.

5. USAGE

With respect to COJETS, the only differences in usage concern the calls to be made in the main program and the (optional) use of freezing/forcing routines.

MAIN PROGRAM. (Table 1). Before event generation the user must call either WEAKIN or DREYIN, to fix basic parameters for W/Z or Drell-Yan pair production, respectively. The call to WEAKIN has the form

```
CALL WEAKIN(WZ,UBOM,IDEC,IWIDTH)
```

where WZ (1HW or 1HZ) defines the type of weak boson, UBOM defines its mass in GeV (if < 10 , the default value is used), IDEC defines the decay characteristics (if negative the decay channel is generated at random according to the branching fractions listed by PARTAB, if 0 the weak boson is kept stable, otherwise by setting it equal to a decay channel number, as given in the PARTAB listing, W/Z decay is forced on that channel), IWIDTH defines whether events should be generated with W/Z width zero ($=0$) or with finite width as given by the standard model ($\neq 0$).

The call to DREYIN has the form

```
CALL DREYIN(UBOM,IDEC)
```

where UBOM is the mass in GeV of the Drell-Yan pair (no default is provided), and IDEC defines the decay channel, with conventions different now with respect to those used in the WEAKIN call (if 0 the virtual photon is kept stable, if 1-3 the final lepton pair is generated, with 1 for e^-e^+ , 2 for $\mu^-\mu^+$, 3 for $\tau^-\tau^+$).

The event generation routine is BGEVEN. A call to BGEVEN always produces the generation of a single event (differently from GEVENT in COJETS).

For the rest, the structure of the main program in WIZJET is identical to that in COJETS (the call to PRHEAD is here replaced by a call to BHEAD). Routine calls and input parameter settings which are required in COJETS to be made before the call to PREGEN, must now be made before the call to WEAKIN/DREYIN.

OUTPUT COMMON BLOCKS. (Table 2). Besides the output common blocks indicated in COJETS (/PTHARD/ does not apply here), the only new addition is /BOSON/, containing information about kinematic and decay characteristics of W/Z or the Drell-Yan virtual photon. /BOSON/ stores: i) PBOS, whose first 5 components give the 4-momentum and mass, in order, of the W/Z or Drell-Yan photon, whereas PBOS(6) gives the particle code number as listed by PARTAB (5 for the Drell-Yan photon), ii) ICHDB, defining the decay channel (0 if stable, otherwise equal to the channel code number as listed by PARTAB for W/Z, while for the Drell-Yan photon it may be equal to 1, 2 and 3, corresponding to e^-e^+ , $\mu^-\mu^+$ and $\tau^-\tau^+$, respectively), iii) IQRKFW, giving the flavor of the annihilating quark moving in the positive direction of the z-axis (that of $\bar{p}$ in $\bar{p}p$ collisions), with the usual convention (i.e. like that used for PARQUA).

MONITORING COMMON BLOCKS. These are the same as in COJETS.

INPUT PARAMETERS. Besides the input parameters given in the WEAKIN or DREYIN calls, there are no new input parameters with respect to those present COJETS. Some of the input parameters used in COJETS do not apply in WIZJET (PTMIN, SIGINL and FRATAB).

PARTICLE DATA TABLE and EVENT DUMPING are the same as in COJETS.

FORCING. The only optional forcing present in WIZJET is the forcing of electron semi-leptonic decay on heavy flavored particles. Its handling is the same as for COJETS, except for the use of FREEZE(1HQ). Such a call does not freeze all the quanta, in WIZJET, but only those arising from initial bremsstrahlung. Because of the way 4-momentum conservation is enforced in W/Z non-leptonic decays (see Sect. 4), the W/Z either remains stable or is decayed at the hadron level. Therefore, it is not possible to use FORSLE in connection with a FREEZE(1HQ) call, but it can only be used in association with the freezing of heavy flavor hadrons. If the user is interested only in the W/Z decay products, he can equally call FREEZE(1HQ) to avoid calculation of the hadronization of initial bremsstrahlung quanta and of spectator jets. Calls to FREEZE in the main program should be made before the calls to WEAKIN or DREYIN. The listings of two test set-ups illustrating the usage of electron semileptonic forcing are included in this long write up.

DO-IT-YOURSELF HADRONIZATION. To save on storage for the final state hadrons, the user may employ the same procedure of calculating hadronization and exploiting the corresponding information by segments, as indicated in COJETS. The only difference in WIZJET is that the W/Z or Drell-Yan photon decay cannot be frozen in the main program and let loose afterwards by the user in FILLH. One must decide beforehand (with the WEAKIN call in the main program) whether to freeze the boson for good or otherwise let its decay to develop down to the particle level. For the rest, the usage of the relevant routines remains unchanged.

6. DIAGNOSTICS

In addition to the diagnostic messages described in COJETS, a check is made on the input parameters given in the calls to WEAKIN or DREYIN and messages are printed if inconsistencies (see Table 1) are found.

7. TEST RUN

In the present test-run set-up the program runs with default values for the input parameters with no optional routine calls. Production of $W^\pm$ is simulated, with subsequent $W^\pm \rightarrow \text{electron} + \text{neutrino}$ decay. The CERN HBOOK package for histogramming is employed in the user's routines. Some typical distributions of interest are calculated. The excerpts of the test run output include the beginning of an event dump, and the tableau printed by PRHEAD (corresponding to an execution time on CDC 7600 of 300B sec). If the HBOOK package is not locally implemented, a first run of the program can be obtained by replacing the user's routines BOOKH, FILLH and OUTH with void routines (i.e. containing only a RETURN statement).

ACKNOWLEDGEMENTS

This work has been originally stimulated by C. Rubbia. The convenience of a number of user-oriented adaptations of the program has emerged from several conversations with G. Goggi and R. Kinnunen. The debugging of the final modifications of the program and its adaptation to IBM and VAX FORTRAN compilers has been largely due to the work of V. Vercesi, which I gratefully acknowledge.

REFERENCES

- [1] G. Arnison et al. (UA1 Collaboration), Phys. Lett. 112B (1983) 103; 126B (1983) 398; 129B (1983) 273.
- [2] M. Banner et al. (UA2 Collaboration), Phys. Lett. 125B (1983) 339;
P. Bagnaia et al. (UA2 Collaboration), Phys. Lett. 129B (1983) 130.
- [3] R. Odorico, CERN preprint TH-3662 (1983).
- [4] R. Odorico, CERN preprint TH-3760 (1983).
- [5] S.L. Glashow, Nucl. Phys. 22 (1961) 579;
S. Weinberg, Phys. Rev. Lett. 19 (1967) 1264;
A. Salam, Proc. 8th Nobel Symposium, Aspenasgarden,
1968 (Almqvist and Wiksell, Stockholm), p.367.
- [6] C. Quigg, Rev. Mod. Phys. 49 (1977) 297;
J. Kogut and J. Shigemitsu, Nucl. Phys. B129 (1977) 461.
- [7] L.M. Sehgal and P.M. Zerwas, Aachen preprint PITHA 83/10 (1983).

TABLE 1 - SCHEMATIC OUTLAY OF THE MAIN PROGRAM
(Features within brackets are optional)

(Resetting of input parameters)

(CALL BOOKH)

call to user's histogram booking (etc.) routine

(CAL FREEZE (H))

(possibly multiple calls) freezes the final state at the level of quanta (H=1HQ, see Sect. 5) or the decay of heavy flavor hadrons (H=1HC, 1HB and 1HT for charm, bottom and top, respectively)

CALL WEAKIN(WZ,UBOM,IDEC,IWIDTH) WZ = 1HW or 1HZ for W or Z production, respectively*
UBOM = W/Z mass in GeV (if less than 10, the default values of 81 GeV for W and 95 GeV for Z are used)
IDEC = no. of decay channel, as given in the particle table (if 0 W/Z does not decay, if negative the decay channel is generated at random according to b.r.'s)
IWIDTH = if 0 zero W/Z width, finite (standard model) width otherwise

Loop on:

CALL BGEVEN

at each call an event is generated and FILLH is called

CALL BHEAD

print basic input parameters and event generation results

(CALL OUTH)

call to user's output routine

(CALL PARTAB)

to print particle table and basic hadronization parameters

To generate Drell-Yan events the call to WEAKIN should be replaced by

CALL DREYIN(UBOM,IDEC)

UBOM = mass in GeV of the Drell-Yan pair (no default)
IDEC = if 0 Drell-Yan leptons are not generated, 1 for E+E-, 2 for MU+MU-, 3 for TAU+-TAU-

* N.B. On VAX hollerith arguments in subroutine calls must be given via a real variable defined in a data statement.

TABLE 2 - VARIATIONS IN INPUT/OUTPUT ETC. WITH RESPECT TO COJETS

OUTPUT COMMON BLOCKS

COMMON/BOSON/PBOSON(6)

--Parameters of W/Z boson or Drell-Yan virtual photon
PBOS(J), J=1,6, 4-momentum, mass and particle code no., with the same conventions as for the corresponding locations of PARHAD (for the Drell-Yan photon PBOS(6)=5, not printed in the particle table)

Note for /PARQUA/

Parameters of quanta originated in W/Z decays are given by the sum of the 4-momenta of the associated particles generated in their fragmentation

Note for /EVENT/

WEIGHT = 1. always in this program

INPUT PARAMETERS

There are no new input parameters, apart from those appearing in the calls to WEAKIN/DREYIN. PTMIN, SIGINL and FRATAB do not apply here.

FREEZING AND FORCING ROUTINES

A call to FREEZE(IHQ) freezes only initial bremsstrahlung quanta and not the quanta from W/Z decays.

TABLE 3 - LIST OF SUBROUTINES NOT PRESENT IN COJETS

(No. on the right gives position in the listing)

SUBROUTINE BBOOST	001429
SUBROUTINE BDECAY	001374
SUBROUTINE BGEVEN	001055
SUBROUTINE BGEXIN(XST,IXST,ALST,ALST1,X,IX,IMODE)	001265
SUBROUTINE BGPAIR	001187
SUBROUTINE BHEAD	000577
SUBROUTINE BJETS	001577
SUBROUTINE BLEPT	001486
SUBROUTINE BOSO	001289
SUBROUTINE BPREGN	000884
SUBROUTINE BWIDTH(BMAS)	001349
SUBROUTINE DDANG(THETA)	001739
SUBROUTINE DREYIN(UBOM,IDEC)	000836
SUBROUTINE WDANG(THETA)	001725
SUBROUTINE WEAKIN(WZ,UBOM,IDEC,LWIDTH)	000747
SUBROUTINE ZDANG(THETA)	001678


```

C
C-- TEST 1 (WIZJET)
C-- INCLUSIVE ELECTRON PT SPECTRUM FROM TOP DECAY IN W EVENTS
C-- SET IN MAIN PROGRAM (BEFORE CALL PREGEN)
C-- CALL FREEZE(IHT)
C-- FREEZE INITIAL BREMS. QUANTA TO SPEED UP CALCULATION
C-- CALL FREEZE(IHQ)
C--
C
      SUBROUTINE BOOKH
      COMMON//B(2000)
      CALL HLIMIT(2000)
      CALL HBOOK1(5001,10HEL PT      ,50,0.,50.)
C-- FORCE ELECTRON S.L. DECAY OF TOP
      CALL FORSLE(IHT,1)
      RETURN
      END

C
      SUBROUTINE FILLH
      COMMON/EVENT/NEVENT,ECM,PARHAD(401,7),NPART,MXPART,WEIGHT
      COMMON /JET/ K(399,2), P(399,5)
      COMMON/HADQN/LHADR(110),LCHARG(110),LCHARM(110),LBOTT(110)
      *,LTOP(110)
      DO 100 IH=1,NPART
      IPAR=PARHAD(IH,6)
C-- NEGLECT NON-TOP PARTICLES
      IF(LTOP(IPAR).EQ.0) GO TO 100
C-- LET TOP PARTICLE DECAY
      IHH=IH
      CALL LOOSEH(IHH,N)
C-- PICK UP ELECTRONS AND POSITRONS
      DO 101 I=1,N
      IF(K(I,2).NE.7.AND.K(I,2).NE.8) GO TO 101
      PTEL=SQRT(P(I,1)**2+P(I,2)**2)
      CALL HFILL(5001,PTEL,0.,1.)
101  CONTINUE
100  CONTINUE
      RETURN
      END

C
      SUBROUTINE OUTH
      CALL HISTDO
      RETURN
      END

```

```

C
C-- TEST 2 (WIZJET)
C-- SAME SIGN DI-ELECTRONS FROM TOP-BOTTOM DECAYS OF W
C-- BY HANDLING HEAVY FLAVOR PARTICLE DECAYS
C-- GIVES SCATTER PLOT IN THE TRANSVERSE MOMENTA OF THE TWO ELECTRONS
C-- SET IN MAIN PROGRAM (BEFORE CALL PREGEN)
C-- CALL FREEZE(IHT)
C-- CALL FREEZE(IHB)
C-- FREEZE INITIAL BREMS. QUANTA TO SPEED UP CALCULATION
C-- CALL FREEZE(IHQ)
C-- CALL WEAKIN(IHW,0.,175)
C
C      SUBROUTINE BOOKH
COMMON//B(2000)
CALL HLIMIT(2000)
CALL HBOOK2(5002,10HPT1 VS PT2,50,0.,50.,50,0.,50.)
C-- FORCE ELECTRON S.L. DECAY OF BOTTOM AND TOP
CALL FORSLE(IHT)
CALL FORSLE(IHB)
RETURN
END

C
SUBROUTINE FILLH
COMMON/EVENT/NEVENT,ECM,PARHAD(401,7),NPART,MXPART,WEIGHT
COMMON /JET/ K(399,2), P(399,5)
COMMON/HADQN/LHADR(110),LCHARG(110),LCHARM(110),LBOTT(110)
*,LTOP(110)
REAL PTELV(2)
PTELV(1)=0.
PTELV(2)=0.
DO 400 IH=1,NPART
IPAR=PARHAD(IH,6)
C-- NEGLECT NON-TOP .AND. NON-BOTTOM PARTICLES
IF(LTOP(IPAR).EQ.0.AND.LBOTT(IPAR).EQ.0) GO TO 400
IF(LTOP(IPAR).NE.0) ICAS=1
IF(LBOTT(IPAR).NE.0) ICAS=2
C-- LET TOP/BOTTOM PARTICLE DECAY
IHH=IH
CALL LOOSEH(IHH,N)
C-- CHOOSE ELECTRON CHARGES
IF(ICAS.EQ.1.AND.LTOP(IPAR).GT.0) IPARS=8
IF(ICAS.EQ.1.AND.LTOP(IPAR).LT.0) IPARS=7
IF(ICAS.EQ.2.AND.LBOTT(IPAR).LT.0) IPARS=8
IF(ICAS.EQ.2.AND.LBOTT(IPAR).GT.0) IPARS=7
C-- PICK UP ELECTRONS WITHIN CASCADE
DO 401 I=1,N
IF(K(I,2).NE.IPARS) GO TO 401
PTEL=SQRT(P(I,1)**2+P(I,2)**2)
PTELV(ICAS)=AMAX1(PTELV(ICAS),PTEL)
401 CONTINUE
400 CONTINUE
CALL HFILL(5002,PTELV(1),PTELV(2),1.)
RETURN
END

C
SUBROUTINE OUTH
CALL HISTDO
RETURN
END

```

(JET PARAMETERS ARE BEFORE FRAGMENTATION)

(EXCEPT FOR JETS ORIGINATED IN W DECAY)

EVENT NO. 1

W BOSON PARAMETERS

MASS = .816E+02 E = .105E+03 PX = .277E+01 PY = -.475E+01 PZ = .663E+02
 PT = .550E+01 XF = .246E+00 Y = .318E+01 THETA = .474E+01 PHI = .300E+03

W BOSON DECAY PRODUCTS

W- ----+ E- NUEB (CHANNEL NO.170)

I	ORI	PART	STAB	PX	PY	PZ	E	M
1	0	E-	STAB	-.189E+02	.146E+02	-.832E+01	.253E+02	.500E-03

I	ORI	PART	STAB	PX	PY	PZ	E	M
1	0	NUEB	STAB	.216E+02	-.194E+02	.746E+02	.801E+02	0.

JET NO. 1 FLAVOR = GL E = .582E+01
 PJX = -.276E+00 PJY = -.303E+01 PJZ = .396E+01
 ET = .304E+01 Y = .108E+01 THETA = .375E+02 PHI = .265E+03

(INITIAL BREMSSTRAHLUNG)

I	ORI	PART	STAB	PX	PY	PZ	E	M
1	0	PI+	STAB	.158E+00	-.190E+01	.305E+01	.361E+01	.140E+00
2	0	K0S	STAB	.231E+00	-.944E+00	.158E+01	.192E+01	.498E+00

JET NO. 2 FLAVOR = GL E = .170E+02
 PJX = .775E+00 PJY = .752E+01 PJZ = .149E+02
 ET = .756E+01 Y = .143E+01 THETA = .268E+02 PHI = .841E+02

(INITIAL BREMSSTRAHLUNG)

I	ORI	PART	STAB	PX	PY	PZ	E	M
1	0	K0L	STAB	.938E+00	.169E+01	.262E+01	.329E+01	.498E+00

EXCERPT OF TEST RUN OUTPUT NO. 2

```

*****
*****
***** WIZJET *****
*****
***** VERSION 2.2 -- 7 NOV 83 *****
*****
*****
W -PRODUCTION
ANTIPROTON-PROTON COLLISIONS          ECM = .540E+03 GEV
LAMBDA = .100E+00 GEV    MEAN KT**2 = .400E+00 GEV**2    W MASS = .810E+02 GEV
W MASS GENERATED WITH B.W. SPECTRUM OF FWHM = .279E+01 (GEV)
W X-SECTION = .326E+01 (NB)    (NO DECAY B.R., NO K FACTOR APPLIED)
W DECAY CHANNEL FORCED NO.170
(W+ ---+ NUC E+    AND W- ---+ E-    NUCB)
TOTAL NO. OF EVENTS          621

**UTILIZATION OF ARRAY DIMENSIONS**
MAX UTILIZATION IN THIS JOB OF THE 1ST DIMENSION OF THE INDICATED ARRAYS IS REPORTED
(THese DIMENSIONS CAN BE CHANGED TOGETHER WITH PARAMETER IN LAST BRACKET ACCORDING TO NEEDS)
PARHAD( ,7) (/EVENT/), TMV( ), YV( ) (SUB. KNO)          UP TO 208 (CURR. DIM. MXPART= 401)
PARQUA( ,7) (/PARQUA/)          UP TO 3 (CURR. DIM. MAXQUA= 79)
K( ,2), P( ,5) (/JET/), IHEV( ) (/SHEAVY/), TM2V( ) (SUB P4CORR) UP TO 231 (CURR. DIM. MAXSJO= 399)
PARACT( ,7,2) (/PARQ/), NBKCNC( ,2) (/CANC/), NENT2( ) (SUB. MATCH) UP TO 0 (CURR. DIM. MXACT = 47)
PARSPE( ,6,2) (/PARQ/)          UP TO 21 (CURR. DIM. MXSPE = 39)
CUE( ,8,2) (SUB. EVOL)          UP TO 7 (CURR. DIM. -- SEE MXNCUE IN EVOL)
CUE( ,5) (SUB. JETQCD)          UP TO 2 (CURR. DIM. -- SEE MXNCUE IN JETQCD)
*****

```

WIZJET.T37.
ACCOUNT CARD
FIND,LIB1,PROPACKLIB,ID=PROGLIB.
FIND,NEWPROD,ID=OPSYSTEM.
LIBRARY,LIB1.
BEGIN,NEWPROD.
FTNS,OB=0/PROD,PL=20000,LO=0,GO.

PROGRAM WIZJET(OUTPUT)

C-----
C- VERSION 2.2 -- 7 NOV 83
C-----
C- PROGRAM SIMULATING PRODUCTION OF W AND Z BOSONS (OR DRELL-YAN
C- CONTINUUM) PLUS JETS ACCORDING TO QCD IN ANTIPROTON-PROTON AND
C- PROTON-PROTON COLLISIONS WITH INCLUSION OF QCD RADIATION EFFECTS
C- OFF INITIAL AND W/Z DECAY PARTONS
C-
C- OUTPUT COMMON BLOCKS AND INPUT PARAMETERS ARE SPECIFIED BELOW
C-
C- REFERENCE - R. ODOCRICO, CERN-TH-3662 (1983)
C- , CERN-TH-3760,3761 (1983) (LONG WRITE UP)
C-
C- FOR QUESTIONS ABOUT THIS PROGRAM CONTACT:
C- R. ODOCRICO, IST. FISICA, 40126 BOLOGNA, VIA IRNERIO 46, TEL. (51)
C- 26.09.91 (SWITCHBOARD), 26.62.39 (ROOM), TELEX 21.16.64 INFNBO I
C-
C-
C- OUTPUT COMMON BLOCKS
C-----
C- QUANTA IN /PARQUA/, HADRONS IN /EVENT/, WEAK BOSON PARAM. IN /BOSON/
C-
C- /PARQUA/
C- NQUA = NO. OF FINAL QUANTA -- PARQUA(I,J), I=1,NQUA, J=1 (PX),
C- 2 (PY), 3 (PZ), 4 (ENERGY), 5 (MASS, GIVEN BY CUTOFF), 6 (FLAVOR
C- INDEX, FOR QUARKS 1-6 CORRESPONDING TO U, D, S, C, B, T, IN ORDER --
C- NEGATIVE FOR ANTIQUARKS -- 0 FOR GLUONS), 7 (ORIGIN: -1 INITIAL
C- BREMSSTRAHLUNG, 1 W/Z DECAY POSSIBLY AFTER FINAL BREMSSTRAHLUNG)
C- MAXQUA = DIAGNOSTICS ISSUED IF NQUA.GT.MAXQUA
C-
C- /EVENT/
C- NEVENT = EVENT NUMBER -- NPART = NO. OF PARTICLES -- PARHAD(I,J),
C- I=1,NPART, J=1,2,3,4,5 (AS FOR QUANTA), 6 (PARTICLE TYPE, INTEGER,
C- ACCORDING TO TABLE AT P. 33 OF T. SJOSTRAND, UNIV. LUND PREPRINT
C- LU TP 79-8 (1979), PLUS MODIFICATIONS -- TO HAVE THE FULL TABLE
C- PRINTED JUST CALL PARTAB), 7 (NO. OF ORIGINATING QUANTUM, POSSIBLY A
C- W/Z DECAY PRODUCT, TIMES PARQUA(I,7) -- 0 FOR SPECTATOR JET HADRONS
C- -- FOR PRODUCTS OF W/Z LEPTONIC DECAYS IS 1 OR 2 ACCORDING TO
C- PRIMARY LEPTON OF ORIGIN (THE LEPTON ITSELF OR A TAU) ---- WEIGHT=1
C- POSITIVE Z AXIS DEFINED BY INITIAL ANTIPROTON DIRECTION
C- MXPART = DIAGNOSTICS ISSUED IF NPART.GT.MXPART
C-
C- /BOSON/
C- PBOS(6) = WEAK BOSON PARAMETERS, SAME CONVENTIONS AS FOR PARHAD --
C- ICHDB = DECAY CHANNEL (AS NUMBERED IN PARTICLE TABLE)
C- IQRKFW = FLAVOR OF ANNIHILATING QUARK FROM ANTIPROTON
C-
COMMON/PARQUA/PARQUA(79,7),NQUA,MAXQUA
COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,WEIGHT
COMMON/BOSON/PBOS(6),ICHDB,IQRKFW
C-
C- COMMON BLOCKS TRANSFERRING INPUT PARAMETERS (IF DEFINED IN MAIN
C- PROGRAM TO OVERRIDE DEFAULT VALUES)
COMMON/ALQGEN/MGALQT(127),MGALQ(127,5,3),Q2VECT(128),NALQ,DALQ
1 ,ALAMB,ALLAM2,PTHIN,PTMAX,PTZINT,QZEV,ALQZH,ALQI,ALQF,YF
2 ,IPBAR,NCASC,SIGINL,PROPT,IPWTGT,PROPTH,PTMGTH,FRHARD,FRAGEN,FRAT0016
3 ,ZHCUT,ZLM,ZUP,XMIN
COMMON/TOP/TOPMAS
COMMON/TLEAVE/TLEAVE
COMMON/KDUMP/KDUMP
COMMON/STABLE/IDECAY(110)
C-
C- INPUT PARAMETERS -- TO BE SET BEFORE ALL ROUTINE CALLS
C-----
C- ECH = C.M. ENERGY (GEV) (DEFAULT 540.)
C- ALAMB = QCD LAMBDA (GEV) (DEFAULT 0.1)
C- PTZINT = MEAN KTY*2 OF INITIAL PARTONS, BEFORE EVOLUTION ((GEV/C)**2)
C- (DEFAULT 0.4)
C- TOPMAS = MASS OF TOP QUARK (GEV) (DEFAULT 35.)
C- IPBAR = 1 ANTIPROTON-PROTON, OTHERWISE PROTON-PROTON (DEFAULT 1)
C- TLEAVE = EVENT GENERATION STOPS WHEN TIME LEFT .LT. TLEAVE (SEC)
C- (DEFAULT 5.)
C- KDUMP = NO. OF EVENTS TO DUMP (DEFAULT 5)
C-
C- TO HAVE AN UNSTABLE PARTICLE (PIO, KOS ETC.) MADE STABLE
C- SET IDECAY(NO. IDENTIFYING PARTICLE) = 0
IDECAY(51)=0

000001 IDECAY(57)=0
000002
000003 C- FIX TOP QUARK MASS
000004 CCC TOPMAS=40.
000005 C-
000006 C- USER BOOKING ROUTINE
000007 CALL BOOKH
000009 C-
000010 C- CALL TO WEAKIN DEFINES TYPE OF WEAK BOSON, MASS AND DECAY
000011 C- CHARACTERISTICS
000012 C- 1ST ARG. - 1HZ OR 1HM FOR Z AND W PRODUCTION, RESPECTIVELY
000013 C- 2ND ARG. - W/Z MASS IN GEV, IF LT.10. DEFAULT VALUES ARE USED
000014 C- (81. FOR W, 95. FOR Z)
000015 C- 3RD ARG. - (INTEGER) IF GT.0 AND EQUAL TO A W/Z DECAY CHANNEL NO.
000016 C- (150-161 FOR Z, 170-175 FOR W - SEE PARTICLE TABLE)
000017 C- IF NEGATIVE, THE DECAY MODE IS FORCED -- IF 0, W/Z IS LEFT STABLE --
000018 C- IF NEGATIVE, THE DECAY CHANNEL IS GENERATED AT RANDOM
000019 C- 4TH ARG. - (INTEGER) IF 0 EVENTS GENERATED WITH ZERO W/Z WIDTH,
000020 C- OTHERWISE WITH STANDARD MODEL WIDTH
000021 C-
000022 CALL WEAKIN(1HM,0.,170.1)
000023 C-
000024 C- EVENT GENERATION LOOP
000025 C-----
000026 C- AT EACH EVENT GENERATION A CALL TO FILLM IS MADE IN BGEVEN
000027 C-----
000028 C-
000029 100 CONTINUE
000030 CALL BGEVEN
000031 CALL TIMEFL(TLEFT)
000032 IF(TLEFT.LT.TLEAVE) GO TO 101
000033 GO TO 100
000034 101 CONTINUE
000035 C-
000036 C- PRINT BASIC DATA ON EVENT GENERATION
000037 CALL BHEAD
000038 C-
000039 C- USER OUTPUT ROUTINE
000040 CALL OUTH
000041 C-
000042 C- OPTIONAL CALL TO PARTAB FOR PRINTING OF PARTICLE TABLE
000043 CALL PARTAB
000044 STOP
000045 END
000046 C-----
000047 C- THE FOLLOWING SECTION (A) IS IN COMMON WITH PROGRAM COJETS
000048 C-----
000049 C-
000050 C- SECTION (A)
000051 C- BLOCK DATA, PREL. MANIPULATION OF DATA, PARTON DENSITIES
000052 C-----
000053 C-
000054 BLOCK DATA
000055 *****
000056 C-
000057 COMMON/PAR/ PUD, PSI, SIGMA, CX2, EBEG, WFIN, IFLBEG
000058 COMMON/PETER/EPSPET
000059 COMMON/HB/CLPRO,PT2PRO,FPTHM,FHJUMB,RETPIZ,RPAIR(9)
000060 COMMON/DECPAR/ PUDD, PSID, CNO1, CNO2, IOB(110)
000061 COMMON/EDPAR/ ITHROW, PZMIN, PHIN, THETA, PHI, BETA(3)
000062 COMMON/DATA1/ MESQ(36), CMIX(6,2), PMAS(110), QMAS(6)
000063 COMMON/DATA2/ CBR(180), KDP(180,3), WTCOR(10)
000064 COMMON/DATA3/ CHA1(36), CHA2(110), CHA3(2)
000065 COMMON/CBROR/CBROR(180),IDBOR(110)
000066 COMMON/PHASS/PHASND(110)
000067 COMMON/TOP/TOPMAS
000068 COMMON/ZPAR/Z2THM,COSCAR
000069 COMMON/VV/LI(180),L2(180),L3(180)
000070 COMMON/PARQ/PARACT(47,7,2),MXACT,IBEAM,NBOOK(2),JBOOK,MBOOK(2)
000071 1 ,PARSPE(39,6,2),MXSPE,SHARD
000072 COMMON/PARQUA/PARQUA(79,7),NQUA,MAXQUA
000073 COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,WEIGHT
000074 COMMON/ALQGEN/MGALQT(127),MGALQ(127,5,3),Q2VECT(128),NALQ,DALQ
000075 1 ,ALAMB,ALLAM2,PTHIN,PTMAX,PTZINT,QZEV,ALQZH,ALQI,ALQF,YF
000076 2 ,IPBAR,NCASC,SIGINL,PROPT,IPWTGT,PROPTH,PTMGTH,FRHARD,FRAGEN,FRAT0016
000077 3 ,ZHCUT,ZLM,ZUP,XMIN
000078 COMMON/QCDS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAYS,LGLUS,IYAL
000079 COMMON/CUTOFF/QZ,QZSQ,QZHASS(6),QZFL(7),QZFLSQ(7),QTHRSQ(7)
000080 1 ,NFLAVT,LGLU
000081 COMMON/TABPSQ/TABPSQ(5,129),QSRMAX,ALMAX,ALMIN(7),DSTEP(7)
000082 1 ,NPREC,NTAB,KODTAB(7),MAXTAB
000083 COMMON/TABGRK/TABGRK(127,7),NBIN,OBIN,F2XQV(7),WGRV(7),AGLU,HOBIN
000084 1 ,XV(127),ALL,AL2,IFCODE(5)
000085

000089
000090
000091
000092
000093
000094
000095
000096
000097
000098
000099
000100
000101
000102
000103
000104
000105
000106
000107
000108
000109
000110
000111
000112
000113
000114
000115
000116
000117
000118
000119
000120
000121
000122
000123
000124
000125
000126
000127
000128
000129
000130
000131
000132
000133
000134
000135
000136
000137
000138
000139
000140
000141
000142
000143
000144
000145
000146
000147
000148
000149
000150
000151
000152
000153
000154
000155
000156
000157
000158
000159
000160
000161
000162
000163
000164
000165
000166
000167
000168
000169
000170
000171
000172
000173
000174
000175
000176


```

C-- PARTICLES (INPUT, PART. ID. NO.)
  DATA
    1 LHADR/20*0.76*1.4*0.10*1/
    2 LCHARG/2*0.1,-1.2*0
    2-1,1.2*0,-1.1,2*0,-1.1,4*0.1,-1.1,-1.4*0.1,-1.1,-1
    3-1,1.4*0,-1.1,2*0.1,-1.1,-1.2*0.1,-1.1,1.0*0.1,-1.1,-1.4*0.1,-1
    3 1,-1.1,1.4*0,-1.1,2*0.1,-1.1,-1.2*0.1,-1.1,1.0*0.1,-1
    5 4*0.1,-1.1,-1.1/
    6 LCHARH/26*0.1,-1.1,-1.1,-1.34*0.1,-1.1,-1.1,-1.30*0/
    7 LBOTT/32*0.1,-1.1,-1.1,-1.1,-1.32*0.1,-1.1,-1.1,-1.1,-1.30*0/
    8 LTOP/40*0.1,-1.1,-1.1,-1.1,-1.1,-1.30*0.1,-1.1,-1.1,-1.1,-1.1,-1.30*0/
    920*0/
C-- CODING ARRAYS
  DATA IFCODE/1,-1.2,-2.3/
  DATA IMATCH/2,1,1.4,1.2,1.4,1.1,1.2,4,4.4,4.5/
C-- INITIAL SETTINGS
  DATA NGEX/0/
  DATA IDECAY/110*20/
  DATA FRATAB/0./,NEVOL/0/,KFRFLA/0/
  DATA SPYC,SPYB,SPYT,SPYQ,SPYCEL,SPYDEL,SPYTEL/7*1-/
  DATA KHADRO/1/,SPYOV/1-/
  DATA FLAPRE/1-/
  DATA MBOOK,MBOOK,MNPART,MNGUA,MNCUE,MNCUEJ,MNSJO/7*0/
  DATA WEAKBO/1H/,BOHASS/1./,IDECAY/0/,WIDTH/0./
  END
C
  SUBROUTINE SBLOCK
  *****
C-- COMPLETES BLOCK DATA SETTINGS
  COMMON /PAR/ PUO, PSI, SIGMA, CX2, EBEG, WFIN, IFLBEG
  COMMON /DECPAR/ PUDD, PSIO, CND1, CND2, IOB(110)
  COMMON /EDPAR/ ITHROW, PZMIN, PMIN, THETA, PHI, BETA(3)
  COMMON /DATA1/ MESO(36), CMIX(6,2), PHAS(110), QMAS(6)
  COMMON /DATA2/ CBR(180), KOP(180,3), WTCOR(10)
  COMMON /DATA3/ CHA1(36), CHA2(110), CHA3(2)
  COMMON /CBROR/CBROR(180),IOBOR(110)
  COMMON /PHAS/PHASD(110)
  COMMON /TOP/TOPHAS
  COMMON /ZPAR/SZTHN,COSCB
  COMMON /VV/L1(180),L2(180),L3(180)
  COMMON /PARQUA/ PARQUA(79,7),MQUA,MXQUA
  COMMON /EVENT/NEVENT,ECH,PARHADI(40,7),MPART,MXPART,WEIGHT
  COMMON /ALGEN/MSALQ(127),MSALQ(127,5),Q2VECT(128),MSALQ,DALQ
  1 ,ALAHB,ALLAHZ,PTHIN,PTMAX,PTZINT,QZEV,ALQZH,ALQI,ALQP,YF
  2 ,IPBAR,NECASC,SIGLIN,PROPT,IPTHGT,PROPTH,PTMGTH,FRHARD,FRAGEN,FRATG
  3 ,ZHCUT,ZCN,ZUP,XMIN
  COMMON /RCD/CF,CA,BALPH,PT,P12,PROGL,PROFLA(2),NFLAVS,LGLUS,IVAL
  COMMON /CUTOFF/QZ,QZSQ,QZMASS(6),QZFL(7),QZLSQ(7),QTHRSQ(7)
  1
  COMMON /TABPSQ/TABPSQ(5,129),QSMAX,ALMAX,ALMIN(7),DSTEPI(7)
  1
  COMMON /NPREC,NTAB,KOOTAB(7),MAKTAB
  COMMON /TABQRK/TABQRK(127,7),MSIN,DSIN,F2XQV(7),MSQV(7),AGLU,HOBIN
  1 ,XV(127),AL1,AL2,IFCODE(5)
  2 ,TOLIAS(127),LGLIAS(127),TGLIAS(127),LGLIAS(127)
  COMMON /INMAT/IFLAIN(2),XIN(2),PXIN(2),PYIN(2),IMATCH(4,4)
  1 ,ICHA(2,3),IMGV(3)
  COMMON /KEYJET/IZFAST
  COMMON /HAXN/MBOOK,MBOOK,MNPART,MNGUA,MNCUE,MNCUEJ,MNSJO
  COMMON /KDUMP/KDUMP
  COMMON /TLEAVE/TLEAVE
  COMMON /FRATAB/FRATAB
  COMMON /HADQN/LHADR(110),LCHARG(110),LCHARH(110),LBOTT(110)
  *,LTOP(110)
  COMMON /KEYBRE/KEYBRE
  COMMON /NFLAV/NFLAV,NFLAV,KFRFLA
  COMMON /FORGEN/PTHGE,MGGE,SIGMR
  COMMON /STABLE/IDECAY(110)
  COMMON /WEAKBO/WEAKBO,BOHASS,IDECIM,IMIDT
  COMMON /NEAKON/NEAKON,IFOC,BIM2,BIML2,BIMX2,TG2CAB,FZUDS,FXSCT,NGEX
  *,WIDTH
C
  DATA ICALL/0/
C
  IF(ICALL.GT.0) RETURN
  ICALL=1
C
  WEAKON=WEAKBO
C
C-- Z0 BRANCHING FRACTIONS
  RHQZ=(TOPHAS*1000./PHAS(3))**2
  FLX=SZTHN
  FLX=.25-XM+2.*XM**2
  FHE=.25
  FUP=3.*(.25-2./3.*XM+.8./9.*XM**2)
  FDN=3.*(.25-1./3.*XM+2./9.*XM**2)
  CBR(150)=FL
  CBR(151)=FL
  CBR(152)=FL
000353 CBR(153)=FN
000354 CBR(154)=FN
000355 CBR(155)=FN
000356 CBR(156)=FUP
000357 CBR(157)=FDN
000358 CBR(158)=FDM
000359 CBR(159)=FUP
000360 CBR(160)=FDM
000361 CBR(161)=FUP-3.*RHQZ*(.25+.3.*XM-16./9.*XM**2)
000362 DO 1 L=151,161
000363 CBR(L)=CBR(L)/CBR(L-1)
000364 DO 2 L=150,161
000365 CBR(L)=CBR(L)/CBR(161)
000366
000367 C-- N BRANCHING FRACTIONS
000368 RHQZ=(TOPHAS*1000./PHAS(3))**2
000369 CBR(170)=1.
000370 CBR(171)=1.
000371 CBR(172)=1.
000372 CBR(173)=3.
000373 CBR(174)=3.
000374 CBR(175)=3.*(.1-RHQZ)*(1-.5*RHQZ-.5*RHQZ**2)
000375 DO 3 L=171,175
000376 CBR(L)=CBR(L)/CBR(L-1)
000377 DO 4 L=170,175
000378 CBR(L)=CBR(L)/CBR(175)
000379
000380 C-- MODIFY IOB( ) ACCORDING TO IDECAY( ) REQUESTS
000381 DO 6 IP=1,110
000382 IF(IDECAY(IP).LT.10) IOB(IP)=0
000383
000384 C-- STORE ORIGINAL IOB AND CBR VALUES
000385 DO 7 L=1,180
000386 CBROR(L)=CBR(L)
000387 DO 8 L=1,110
000388 IOBOR(L)=IOB(L)
000389
000390 DO 5 I=1,180
000391 KOP(I,1)=L1(I)
000392 KOP(I,2)=L2(I)
000393 KOP(I,3)=L3(I)
000394
000395 5 CONTINUE
000396 DO 10 I=1,110
000397 PHASD(I)=PHAS(I)/1000.
000398
000399 C-- MOVABLE TOP QUARK MASS
000400 DO 15 L=1,180
000401 PHAS(15)=PHAS(L)+(TOPHAS-15.)*1000.
000402 PHAS(56)=PHAS(56)+(TOPHAS-15.)*1000.*2.
000403 DO 16 L=81,90
000404 PHAS(L)=PHAS(L)+(TOPHAS-15.)*1000.
000405 PHAS(96)=PHAS(96)+(TOPHAS-15.)*1000.*2.
000406 QMAS(6)=TOPHAS*1000.
000407 QZMASS(6)=TOPHAS
000408
000409 C
000410 RETURN
000411 END
000412
000413 C
000414 FUNCTION FZIN(X,IT)
000415 *****
000416 C-- INITIAL PARTON DENSITIES TIMES X
000417 C-- FROM NA3 DRELL-YAN PAIR PRODUCTION EXPERIMENT
000418 COMMON/FZQG/FZQG(7)
000419 DATA ICALL/0/
000420 IF(ICALL.GT.0) GO TO 5
000421 ICALL=1
000422 AU=2./BETAUI(.5,4.3)
000423 AD=1./BETAUI(.5,5.3)
000424 AS=.25
000425
000426 5 CONTINUE
000427 IF(IT.EQ.1) GO TO 10
000428 IF(IT.EQ.2) GO TO 20
000429 IF(IT.EQ.3) GO TO 30
000430 IF(IT.EQ.4) GO TO 40
000431 IF(IT.EQ.5) GO TO 50
000432 IF(IT.EQ.6) GO TO 60
000433 IF(IT.EQ.7) GO TO 70
000434
000435 C-- U
000436 10 FZIN=AU*SQRT(X)*(1.-X)**3.3+AS*(1.-X)**7.7
000437 FZQG(1)=FZIN
000438 RETURN
000439
000440 C-- D
000441 30 FZIN=AD*SQRT(X)*(1.-X)**4.3+AS*(1.-X)**7.7
000442
000443
000444
000445
000446
000447
000448
000449
000450
000451
000452
000453
000454
000455
000456
000457
000458
000459
000460
000461
000462
000463
000464
000465
000466
000467
000468
000469
000470
000471
000472
000473
000474
000475
000476
000477
000478
000479
000480
000481
000482
000483
000484
000485
000486
000487
000488
000489
000490
000491
000492
000493
000494
000495
000496
000497
000498
000499
000500
000501
000502
000503
000504
000505
000506
000507
000508
000509
000510
000511
000512
000513
000514
000515
000516
000517
000518
000519
000520
000521
000522
000523
000524
000525
000526
000527
000528

```

```

F2QG(3)=F2IN
RETURN
C-- DB
40 F2IN=AS*(1.-X)**7.7
F2QG(4)=F2IN
RETURN
C-- S
50 F2IN=AS*(1.-X)**7.7
F2QG(5)=F2IN
RETURN
C-- SB
60 XU=(1.-X)**3.3
F2IN=SQRT(X)*(AU*XU+AD*XU*(1.-X))+5.*AS*(1.-X)**7.7
F2QG(6)=F2IN
RETURN
C-- GLUON
70 F2IN=FGLU(X)
F2QG(7)=F2IN
RETURN
END
C
FUNCTION BETAU(A,B)
*****
BETAU=GAMMA(A)*GAMMA(B)/GAMMA(A+B)
RETURN
END
C
FUNCTION FGLU(X)
*****
C-- GLUON MOMENTUM DISTRIBUTION
COMMON/TABOR/TABORR(127,7),NBIN,DBIN,F2XQV(7),H2QV(7),AGLU,HDBIN
1 X=V(127),AL1,AL2,IFCODE(5)
2 TOLIAS(127),LGLIAS(127),TGLIAS(127),LGLIAS(127)
DATA EGLU/5./
FGLU=AGLU*(1.+EGLU)*(1.-X)**EGLU
RETURN
END
C
-----
C-- SECTION (8)
C-- GENERATION OF W/Z (OR DRELL-YAN PHOTON) PRODUCTION AND DECAY WITH
C-- ASSOCIATED PARTON FINAL STATE (INITIAL BREMSSTRAHLUNG)
C-- (THE FOLLOWING ROUTINES, FROM BHEAD TO ODANS INCLUDED, ARE NOT
C-- PRESENT IN PROGRAM COJETS)
C
-----
C
SUBROUTINE BHEAD
*****
C-- PRINTS HEADING
COMMON/MAXN/MBBOOK,MMBOOK,MNPART,MNQUA,MNCUE,MNCUEJ,MNSJO
COMMON/CUTOFF/QZ,QZSQ,QZMASS(6),QZFL(7),QZFLSQ(7),QTHRSG(7)
1 ,NFLAVT,LGLU
COMMON/PARG/PARGT(47,7,2),MXACT,IBEAM,NBOOK(2),JBOOK,MBOOK(2)
1 ,PARSPE(39,6,2),MXSPE,SHARD
COMMON/KEYBRE/KEYBRE
COMMON/EVENT/NEVENT,ECN,PARHAD(401,7),NPART,MXPART,WEIGHT
COMMON/PARGUA/PARGUA(79,7),NQUA,MAXQUA
COMMON/BOSON/PBOS(6),ICHDB,IQRKFW
COMMON/WEAKON/WEAKON,IFDC,BIM2,BIML2,BIMX2,TG2CAB,FZUSC,FXSCT,NGEX
* ,WIDTH
COMMON/FKQDY/FKQDY
COMMON/TOP/TOPMAS
COMMON/ALQD/ALQD(127),MGALQ(127,5,3),QZVECT(128),NALQ,DALQ
1 ,ALAMB,ALLAMB,PTMIN,PTMAX,PTZINT,QZEV,ALQZ,ALQI,ALQF,YF
2 ,IPBAR,NCASC,SIGINL,PROPT,IPTWGT,PROPTM,PTWGT,FRHARD,FRAGEN,FRAT
3 ,ZHCUT,ZLW,ZUP,XMIN
COMMON/DECPAR/PUDD,PS10,CND1,CND2,IDB(110)
COMMON/SPYFOR/SPYC,SPYB,SPYT,SPYQ,SPYCEL,SPYBEL,SPYTEL
COMMON/OVER/KOVER,SPYDVR
REAL CHI(3),CH2(3)
C
DATA ZH,WH,1HZ,1HM,1DH/2HDY/
ISTBO=0
IF(IDB(INT(PBOS(6)))).EQ.0) ISTBO=1
PRINT 1
PRINT 2
PRINT 26
PRINT 5
PRINT 22
PRINT 2
PRINT 3
PRINT 3
PRINT 25,WEAKON
IF(IPBAR.EQ.1) PRINT 23,ECM
000529 IF(IPBAR.NE.1) PRINT 24,ECM
000530 SQBIM2=SQRT(BIM2)
000531 PRINT 21,ALAMB,PTZINT,WEAKON,SQBIM2
000532 IF(WEAKON.NE.DH.AND.WIDTH.LT.1.E-3) PRINT 61,WEAKON
000533 IF(WEAKON.NE.DH.AND.WIDTH.GT.1.E-3) PRINT 62,WEAKON,WIDTH
000534 SIG=FXSCT*FLOAT(NEVENT)/FLOAT(NGEX)
000535 IF(WEAKON.NE.DH)
000536 *PRINT 27,WEAKON,SIG
000537 IF(WEAKON.EQ.DH) SIG=SIG*QDY/FLOAT(NEVENT)
000538 IF(WEAKON.EQ.DH) PRINT 60,SIG
000539 IF(IFDC.EQ.0.AND.ISTBO.EQ.0) PRINT 28,WEAKON
000540 IF(IFDC.GT.0.AND.ISTBO.EQ.0.AND.WEAKON.NE.DH)
000541 *PRINT 29,WEAKON,ICHDB
000542 IF(IFDC.GT.0.AND.ISTBO.EQ.0.AND.WEAKON.EQ.DH) PRINT 30,WEAKON
000543 IF(ISTBO.EQ.1) GO TO 14
000544 IF(WEAKON.EQ.DH) GO TO 35
000545 CALL CHDEC(2,ICHDB,CH1)
000546 PRINT 31,WEAKON,(CHI(J),J=1,2)
000547 GO TO 10
000548 CALL CHDEC(3,ICHDB,CH1)
000549 CALL CHDEC(4,ICHDB,CH2)
000550 PRINT 36,(CHI(J),J=1,2),(CH2(J),J=1,2)
000551 10 CONTINUE
000552 IF((WEAKON.EQ.ZH.AND.ICHDB.EQ.161).OR.(WEAKON.EQ.WH.AND.ICHDB.EQ
000553 *.175)) PRINT 11,TOPMAS
000554 14 CONTINUE
000555 IF(ISTBO.EQ.1) PRINT 15,WEAKON
000556 IF(SPYQ.GT.0.) PRINT 40
000557 IF(SPYC.GT.0.) PRINT 44
000558 IF(SPYB.GT.0.) PRINT 45
000559 IF(SPYT.GT.0.) PRINT 46
000560 PRINT 16,NEVENT
000561 1 FORMAT(1H,5(/))
000562 2 FORMAT(T2,120(1H)/T2,120(1H))
000563 3 FORMAT(T2,1H,T121,1H)
000564 4 FORMAT(T2,120(1H),5(/))
000565 5 FORMAT(T2,120(1H))
000566 25 FORMAT(T2,1H,10X,A2,11H-PRODUCTION ,T121,1H/T2,1H,T121,1H)
000567 23 FORMAT(T2,1H,10X,28HANTIPROTON-PROTON COLLISIONS,10X,SHECN = ,
000568 1E10.3 ,4H GEV ,T121,1H/T2,1H,T121,1H)
000569 24 FORMAT(T2,1H,10X,24HPROTON-PROTON COLLISIONS,10X,SHECN = ,E10.3
000570 1 ,4H GEV ,T121,1H/T2,1H,T121,1H)
000571 21 FORMAT(T2,1H,3X,8HLAMBD = ,E10.3,4H GEV
000572 *.5X,13HMEAN KT**2 = ,E10.3,7H GEV**2 ,
000573 *.5X,A2,1X,6HMASS = ,E10.3,4H GEV,T121,1H
000574 *T2,1H,T121,1H)
000575 61 FORMAT(T2,1H,3X,A1,1X,30HMASS GENERATED WITH ZERO WIDTH
000576 1T121,1H/T2,1H,T121,1H)
000577 62 FORMAT(T2,1H,3X,A1,1X,
000578 143HMASS GENERATED WITH S.M. SPECTRUM OF FWHM = ,
000579 2E10.3,6H (GEV),T121,1H/T2,1H,T121,1H)
000580 26 FORMAT(T2,54(1H),12X,54(1H)/T2,54(1H))
000581 * /T2,54(1H),12X,54(1H)
000582 22 FORMAT(T2,47(1H),26H VERSION 2.2 -- 7 NOV 83 ,47(1H))
000583 27 FORMAT(T2,1H,3X,
000584 *.A2,1X,11HX-SECTION = ,E10.3,5H (NB),3X,
000585 *.36H(NO DECAY B.R., NO K FACTOR APPLIED)
000586 *.T121,1H/T2,1H,T121,1H)
000587 60 FORMAT(T2,1H,3X,39HORELL-YAN X-SECTION D(SIGMA)/D(H**2) = ,
000588 1E10.3,12H (NB/GEV**2),3X,24H(NO K FACTOR IS APPLIED) ,
000589 2T121,1H/T2,1H,T121,1H)
000590 28 FORMAT(T2,1H,3X,A2,1X,20HDECAY CHANNEL RANDOM,T121,1H
000591 */T2,1H,T121,1H)
000592 29 FORMAT(T2,1H,3X,A2,1X,24HDECAY CHANNEL FORCED NO. ,I3,T121,1H
000593 */T2,1H,T121,1H)
000594 30 FORMAT(T2,1H,3X,A2,1X,23HDECAY CHANNEL REQUESTED ,
000595 1T121,1H/T2,1H,T121,1H)
000596 31 FORMAT(T2,1H,3X,1H,A2,10H ---- ,A4,2X,A4,1H),T121,1H
000597 */T2,1H,T121,1H)
000598 36 FORMAT(T2,1H,3X,13H---- ,A4,2X,A4,9H AND
000599 *.12H---- ,A4,2X,A4,1H),T121,1H/T2,1H,T121,1H)
000600 11 FORMAT(T2,1H,3X,16HTOP QUARK MASS = ,E10.3,6H (GEV),T121,1H
000601 */T2,1H,T121,1H)
000602 15 FORMAT(T2,1H,3X,A2,1X,25HBOSON REQUESTED UNDECAYED
000603 *.T121,1H/T2,1H,T121,1H)
000604 16 FORMAT(T2,1H,3X,19HTOTAL NO. OF EVENTS ,I10,T121,1H
000605 */T2,1H,T121,1H)
000606 40 FORMAT(T2,1H,3X,45HREQUESTED FREEZE OF FINAL STATE AT THE LEVEL
000607 *.9HOF QUANTA ,T121,1H/T2,1H,T121,1H)
000608 44 FORMAT(T2,1H,3X,43HREQUESTED FREEZE OF CHARM PARTICLE DECAYS
000609 *.T121,1H/T2,1H,T121,1H)
000610 45 FORMAT(T2,1H,3X,43HREQUESTED FREEZE OF BOTTOM PARTICLE DECAYS
000611 *.T121,1H/T2,1H,T121,1H)
000612 46 FORMAT(T2,1H,3X,43HREQUESTED FREEZE OF TOP PARTICLE DECAYS
000613 *.T121,1H/T2,1H,T121,1H)
000614 C
000615 C
000616 PRINT 3
000617
000618
000619
000620
000621
000622
000623
000624
000625
000626
000627
000628
000629
000630
000631
000632
000633
000634
000635
000636
000637
000638
000639
000640
000641
000642
000643
000644
000645
000646
000647
000648
000649
000650
000651
000652
000653
000654
000655
000656
000657
000658
000659
000660
000661
000662
000663
000664
000665
000666
000667
000668
000669
000670
000671
000672
000673
000674
000675
000676
000677
000678
000679
000680
000681
000682
000683
000684
000685
000686
000687
000688
000689
000690
000691
000692
000693
000694
000695
000696
000697
000698
000699
000700
000701
000702
000703
000704

```



```

PRINT 3                                000705
PRINT 3                                000706
IF(SPYOVR.GT.0.) PRINT 49              000707
FORMAT(T2,1H*,48H****DIMENSION OVERFLOW HAS OCCURRED (NOT COUNTED,000708
162H IN STATISTICS BELOW) -- LOOK FOR DIAGNOSTICS BEFORE THIS PRIN,000709
28HTING****,T121,1H*/T2,1H*,T121,1H*) 000710
PRINT 50                                000711
50 FORMAT(T2,1H*,1X,35H**UTILIZATION OF ARRAY DIMENSIONS** ,T121,1H*000712
1 /T2,1H*,1X,48HMAX UTILIZATION IN THIS JOB OF THE 1ST DIMENSION,000713
236H OF THE INDICATED ARRAYS IS REPORTED ,T121,1H* 000714
3 /T2,1H*,1X,46H(THESE DIMENSIONS CAN BE CHANGED TOGETHER WITH,000715
446H PARAMETER IN LAST BRACKET ACCORDING TO NEEDS) ,T121,1H* 000716
PRINT 52,MNPART,MXPART,MNGUA,MAXQUA,MNSJO,MAXSJO,MNBOOK,MXACT 000717
1,MNBOOK,MXSPE 000718
52 FORMAT( 000719
1 T2,1H*,1X,50HPARHAD( ,7) (/EVENT/), THV( ), TV( ) (SUB. KNO) 000720
2 ,T72,SHUP TO,I6,1X,19H(CURR. DIM. MXPART=,I6,1H),T121,1H* 000721
3 /T2,1H*,1X,22HPARQUA( ,7) (/PARQUA/) 000722
4 ,T72,SHUP TO,I6,1X,19H(CURR. DIM. MAXQUA=,I6,1H),T121,1H* 000723
5 /T2,1H*,1X,42H( ,2), P( ,5) (/JET/), IHEV( ) (/SHEAVY/),000724
622H, TH2V( ) (SUB P4CORR) 000725
7 ,T72,SHUP TO,I6,1X,19H(CURR. DIM. MAXSJO=,I6,1H),T121,000726
81H* /T2,1H*,1X,37HPARACT( ,7,2) (/PARQ/), NBRNC( ,2) (,000727
930H/CANC/), NENTZ( ) (SUB. MATCH) 000728
1 ,T72,SHUP TO,I6,1X,19H(CURR. DIM. MXACT =,I6,1H),000729
2T121,1H* /T2,1H*,1X,22HPARSPE( ,6,2) (/PARQ/) 000730
3 ,T72,SHUP TO,I6,1X,19H(CURR. DIM. MXSPE =,I6,000731
41H),T121,1H* 000732
PRINT 53,MNCUE,MNCUEJ 000733
53 FORMAT( 000734
1 T2,1H*,1X,22HCU( ,8,2) (SUB. EVOL) 000735
2 ,T72,SHUP TO,I6,1X,34H(CURR. DIM. -- SEE MNCUE IN EVOL),T121, 000736
31H* /T2,1H*,1X,22HCU( ,5) (SUB. JETQCD) 000737
4 ,T72,SHUP TO,I6,1X,36H(CURR. DIM. -- SEE MNCUE IN JETQCD),000738
5T121,1H* ) 000739
C PRINT 3 000740
PRINT 4 000741
C RETURN 000742
END 000743
C 000744
SUBROUTINE WEAKIN(MZ,UBOM,IDEC,LWIDTH) 000745
***** 000746
C-- ARRANGES INITIAL SET UP FOR WIZJET (W OR Z BOSON PRODUCTION) 000747
C-- WZ = 1H OR 1HZ 000748
C-- UBOM = USER VALUE FOR WEAK BOSON MASS (IF LT.10. GEV DEFAULT USED) 000749
C-- IDEC = DECAY CHANNEL FOR WEAK BOSON (150-161 FOR Z, 170-175 FOR W, 000750
C-- SEE PARTICLE TABLE) -- IF 0 WEAK BOSON IS LEFT STABLE -- IF NEGATIVE000751
C-- INTEGER DECAY CHANNEL IS CHOSEN AT RANDOM ACCORDING TO B.R. VALUES 000752
C-- IN PARTICLE TABLE) 000753
C-- LWIDTH = IF 0 EVENTS ARE GENERATED WITH ZERO W/Z WIDTH, OTHERWISE 000754
C-- THEY ARE GENERATED WITH FINITE W/Z WIDTH AS GIVEN BY THE STANDARD 000755
C-- MODEL 000756
COMMON/WEAKBO/WEAKBO,BOMASS,IDECCK,IWIDTH 000757
COMMON/STABLE/IDECAY(110) 000758
COMMON /DATA1/ MESO(36), CHIX(6,2), PHAS(110), QMAS(6) 000759
COMMON /DECPAR/ PUDD, PSID, CND1, CND2, IDB(110) 000760
COMMON/TOP/TOPMAS 000761
C DATA ZH,1H*/1HZ,1H*/ 000762
C 000763
FLAG=-1 000764
IWIDTH=LWIDTH 000765
IF(MZ.NE.1H.AND.MZ.NE.1HZ) GO TO 500 000766
WEAKBO=WZ 000767
IF(UBOM.GT.10.) GO TO 3 000768
IF(MZ.EQ.ZH) BOMASS=PHAS(2)/1000. 000769
IF(MZ.EQ.1H) BOMASS=PHAS(3)/1000. 000770
GO TO 7 000771
BOMASS=UBOM 000772
IF(MZ.EQ.ZH) PHAS(2)=BOMASS*1000. 000773
IF(MZ.EQ.1H) PHAS(3)=BOMASS*1000. 000774
IF(MZ.EQ.1HZ) PHAS(4)=BOMASS*1000. 000775
CONTINUE 000776
IF(MZ.EQ.ZH.AND.BOMASS.LT.2.*TOPMAS*10.) GO TO 850 000777
IF(MZ.EQ.1H.AND.BOMASS.LT.TOPMAS*10.) GO TO 800 000778
CONTINUE 000779
IF(IDEC.NE.0) GO TO 10 000780
IF(MZ.EQ.ZH) IDECAY(2)=0 000781
IF(MZ.EQ.1H) IDECAY(3)=0 000782
IF(MZ.EQ.1HZ) IDECAY(4)=0 000783
CONTINUE 000784
IF(IDEC.LT.0) IDECK=0 000785
IF(IDEC.GT.0) IDECK=IDEC 000786
IF(IDEC.LE.0) GO TO 15 000787
IF(MZ.EQ.ZH.AND.(IDEC.LT.150.OR.IDEC.GT.161)) GO TO 600 000788
IF(MZ.EQ.1H.AND.(IDEC.LT.170.OR.IDEC.GT.175)) GO TO 600 000789
000790
000791
000792
6 CONTINUE 000793
15 CONTINUE 000794
DO 20 I=2,4 000795
IF(IDECAY(I).LT.10) IDB(I)=0 000796
C 000797
IF(FLAG.GT.0.) GO TO 900 000798
CALL BPREG 000799
RETURN 000800
C 000801
C-- INCORRECT INPUT 000802
500 PRINT 501,WZ 000803
501 FORMAT(////1X,44H IS INCORRECT 1ST ARGUMENT IN CALL TO WEAKIN 000804
1//1X,42HACCEPTED ARGUMENTS ARE W AND Z (HOLLERITH) 000805
2//1X,20HEXECUTION TERMINATED ) 000806
FLAG=-1 000807
STOP 000808
PRINT 601,IDEC,WZ 000809
600 FORMAT(////1X,27HREQUESTED DECAY CHANNEL NO. ,I4,5H FOR ,A1, 000810
116H IS INCONSISTENT 000811
601 FORMAT(////1X,40HINCORRECT 3RD ARGUMENT IN CALL TO WEAKIN 000812
*//1X,30H(150-161 FOR Z, 170-175 FOR W) 000813
2//1X,25HCHECK WITH PARTICLE TABLE ) 000814
FLAG=-1 000815
GO TO 6 000816
800 PRINT 601,BOMASS,TOPMAS 000817
601 FORMAT(////1X,14H BOSON MASS ( ,E10.3,23H GEV) SET TOO LOW WITH 000818
127HRESPECT TO TOP QUARK MASS ( ,E10.3,5H GEV) 000819
*//1X,40HINCORRECT 2ND ARGUMENT IN CALL TO WEAKIN 000820
2//1X,47HRESET MASS VALUES (W MASS .GT. TOPMAS + 10 GEV) ) 000821
FLAG=-1 000822
GO TO 8 000823
850 PRINT 651,BOMASS,TOPMAS 000824
651 FORMAT(////1X,14H BOSON MASS ( ,E10.3,23H GEV) SET TOO LOW WITH 000825
127HRESPECT TO TOP QUARK MASS ( ,E10.3,5H GEV) 000826
*//1X,40HINCORRECT 2ND ARGUMENT IN CALL TO WEAKIN 000827
2//1X,47HRESET MASS VALUES (Z MASS .GT. 2*TOPMAS + 10 GEV) ) 000828
FLAG=-1 000829
GO TO 8 000830
900 PRINT 901 000831
901 FORMAT(////1X,20HEXECUTION TERMINATED ) 000832
STOP 000833
END 000834
C 000835
SUBROUTINE DREYIN(UBOM,IDEC) 000836
***** 000837
C-- ARRANGES INITIAL SET-UP FOR WIZJET (DRELL-YAN PAIR PRODUCTION) 000838
C-- UBOM = VIRTUAL PHOTON MASS (GEV) 000839
C-- IDEC = IF 0 PHOTON DECAY NOT HANDLED, IF 1-3 PHOTON DECAY IS 000840
HANDLED (1 FOR E-E+, 2 FOR MU-MU+, 3 FOR TAU-TAU+) 000841
C-- 000842
COMMON/ALOGEN/MGALQT(127),MGALQ(127,5,3),QVECT(128),HALQ,DALQ 000843
1 ,ALAPB,ALLAHZ,PTHIN,PTMAX,PT2INT,QZEV,ALQZM,ALQZ,ALQF,YF, 000844
2 ,IPBAR,NCASC,SIGINL,PROPT,IPTWGT,PROPTH,PTMGTH,FRHARD,FRAGEN,FRAT 000845
3 ,ZHCUT,ZLW,ZUP,XMIN 000846
COMMON/WEAKBO/WEAKBO,BOMASS,IDECCK,IWIDTH 000847
COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,HEIGHT 000848
COMMON /DATA1/ MESO(36), CHIX(6,2), PHAS(110), QMAS(6) 000849
DATA DN/2HD// 000850
C 000851
IF(IDEC.LT.0.OR.IDEC.GT.3) GO TO 500 000852
IF(UBOM.GT.ECH*.5) GO TO 600 000853
IF(UBOM.LE.QZEV) GO TO 700 000854
C 000855
WEAKBO=DN 000856
BOMASS=UBOM 000857
IF(IDEC.EQ.0) IDECK=0 000858
IF(IDEC.GT.0) IDECK=146+IDEC 000859
CALL BPREG 000860
RETURN 000861
C 000862
C-- INCORRECT INPUT 000863
500 PRINT 501,IDEC 000864
501 FORMAT(////1X,110,44H IS INCORRECT 2ND ARGUMENT IN CALL TO DREYIN,000865
1//1X,49HACCEPTED ARGUMENTS ARE 0,1,2 AND 3 FOR NO DECAY,, 000866
242HELECTRON,MUON AND TAU DECAY, RESPECTIVELY) , 000867
3//1X,20HEXECUTION TERMINATED ) 000868
STOP 000869
PRINT 601,UBOM 000870
600 FORMAT(////1X,E12.5, 000871
144H IS INCORRECT 1ST ARGUMENT IN CALL TO DREYIN , 000872
2//1X,24HTOO LARGE (MAX IS ECH/2) , 000873
3//1X,20HEXECUTION TERMINATED ) 000874
STOP 000875
PRINT 701,UBOM,QZEV 000876
700 FORMAT(////1X,E12.5, 000877
144H IS INCORRECT 1ST ARGUMENT IN CALL TO DREYIN , 000878
2//1X,20HSMALLER THAN QZEV = ,E12.5, 000879
3//1X,33HINCREASE 1ST ARGUMENT ACCORDINGLY , 000880
4//1X,20HEXECUTION TERMINATED ) 000881

```

```

STOP
END
C
SUBROUTINE BPREGN
*****
C-- M/Z (OR DRELL-YAN PAIR) PRODUCTION -- INITIALIZATION AND X-TABLES
EXTERNAL FUN1,FUN2,FUN3
COMMON/QCDS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAVS,LGLUS,IVAL
COMMON/PARQ/PARACT(47,7,2),MXACT,IDEAM,NBOOK(2),JBOOK,MBOOK(2)
1,PARSPE(39,6,2),MXSPE,SHARD
COMMON/ALGEN/MGALQT(127),MGALQ(127,5,3),QZVECT(126),NALQ,DALQ
1,ALAMB,ALLAM2,PTMIN,PTMAX,PT2INT,QZEV,ALQZM,ALQI,ALQF,YF
2,IPBAR,NCASC,SIGINL,PROPT,IPMTGT,PROPTW,PTMGTH,FRHARD,FRAGEN,FRAT000093
3,ZHCUT,ZLW,ZUP,XMIN
COMMON/DATA1/ MESO(36), CMIX(6,2), PHAS(110), QMAS(6)
COMMON/ENTREV/S,QSQ,YQSQ,IPACH,XING(2),XMING(2)
1,FXING(2),PYING(2),IFLING(2),ZCHING(2)
COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,WEIGHT
COMMON/WEAKBO/WEAKBO,BOHASS,IDECHK,IWIDTH
COMMON/WEAKON/WEAKON,IFDC,BIM2,BIML2,BIMX2,TG2CAB,FZUDS,FXSCT,NSEX000900
* .WIDTH
COMMON/FXMDY/FXMDY
COMMON/STABLE/IDECAY(110)
COMMON/DECPR/ RUDD, PS10, CND1, CND2, IDB(110)
COMMON/DATA2/ CBR(180), KDP(180,3), MTCOR(10)
COMMON/TRANSL/ALAMBT,NFLATR,LGLUT,QSQMT
COMMON/TABQRK/TABQRK(127,7),NBIN,OBIN,FXQV(7),MGQV(7),AGLU,MOBIN
1,XV(127),ALI,AL2,IFCODE(5)
2,TGLIAS(127),LGLIAS(127),TGLIAS(127),LGLIAS(127)
COMMON/KEYBRE/KEYBRE
COMMON/ZPAR/SZTHM,COSCAB
COMMON/CFUN1/IFUN
DATA ZH,WM/1M2,1HM,DM/2HDY/
C
C
C-- INITIALIZATION
CALL SBLOCK
S=ECM**2
LGLUS=7
IVAL=100
PI=4.*ATAN(1.)
JBOOK=1
NEVENT=0
ALLAM2=ALOG(ALAMB**2)
ALQZM=ALOG((QZEV/ALAMB)**2)
ZHCUT=1.
ZLW=ZHCUT/ECH
ZUP=1.-ZLW
C
C-- BOSON PARAMETERS
WEAKON=WEAKBO
IFDC=IDECMK
IF(WEAKON.EQ.ZH) GO TO 20
IF(WEAKON.EQ.DH) GO TO 40
C-- W
C2CAB=COSCAB**2
TG2CAB=(1.-C2CAB)/C2CAB
BIM=PHAS(3)/1000.
BIM2=BIM**2
BIML2=(BIM*.95)**2
BIMX2=(BIM*1.05)**2
FXSCT=(1.16632E-5*PI*SQRT(2.))*C2CAB
1 /3.
2 *BIM2/(BIMX2-BIML2)
3 *(.19733)**2*1.E7
WIDTH=(1.16632E-5*SQRT(2.)/PI)*BIM**3
IF(IWIDTH.EQ.0) WIDTH=0.
GO TO 30
C-- Z
20 CONTINUE
XM=S2THM
FU=.25-2./3.*XM+.9./9.*XM**2
FDS=.25-XM/3.+2./9.*XM**2
FZUDS=FU/FDS
BIM=PHAS(2)/1000.
BIM2=BIM**2
BIML2=(BIM*.95)**2
BIMX2=(BIM*1.05)**2
FXSCT=(1.16632E-5*PI*SQRT(2.))*2.*FDS
1 /3.
2 *BIM2/(BIMX2-BIML2)
3 *(.19733)**2*1.E7
WIDTH=(1.16632E-5*SQRT(2.)/PI)*(1.-2.*XM+.9./9.*XM**2)*BIM**3
IF(IWIDTH.EQ.0) WIDTH=0.
GO TO 30
C-- DRELL-YAN
40 CONTINUE
BIM2=BOHASS**2
000891
000892
000893
000894
000895
000896
000897
000898
000899
000900
000901
000902
000903
000904
000905
000906
000907
000908
000909
000910
000911
000912
000913
000914
000915
000916
000917
000918
000919
000920
000921
000922
000923
000924
000925
000926
000927
000928
000929
000930
000931
000932
000933
000934
000935
000936
000937
000938
000939
000940
000941
000942
000943
000944
000945
000946
000947
000948
000949
000950
000951
000952
000953
000954
000955
000956
000957
000958
000959
000960
000961
000962
000963
000964
000965
000966
000967
000968
BIML2=(BOHASS*.95)**2
BIMX2=(BOHASS*1.05)**2
WIDTH=0.
FZUDS=.25
FXSCT=(4./3.*PI*(1./137.036)**2)/BIM2**2*4./9.
1 /3.
2 *BIM2/(BIMX2-BIML2)
3 *(.19733)**2*1.E7
FXMDY=0.
IDB(5)=147
IF(1FDC.EQ.0) IDB(5)=0
KDP(147,1)=7
KDP(147,2)=8
KDP(147,3)=0
KDP(148,1)=11
KDP(148,2)=12
KDP(148,3)=0
KDP(149,1)=15
KDP(149,2)=16
KDP(149,3)=0
30 CONTINUE
C
C-- COMPLETE INITIALIZATION
XMIN=(BIML2-5.*PT2INT)/(2.*S)
ALQF=(ALOG(BIM2)-ALLAM2)/ALQZM
YF=ALOG(ALQF)
CALL INQCD
C
ALAMBT=ALAMB
NFLATR=6
QSQMT=ECM**2
CALL INQCD
C
C-- PREPARE X-TABLES
NBIN=127
OBIN=1./FLOAT(NBIN-1)
MOBIN=OBIN/2.
XVMIN=OBIN
C-- QUARKS
XV(1)=0.
DO 8 J=1,5
TABQRK(1,J)=0.
DO 8 IX=2,NBIN
X1=OBIN*FLOAT(IX-2)
X2=X1+OBIN
XV(IX)=X1+MOBIN
IF(X2.LE.XMIN) GO TO 9
X1=AMAX1(X1,XMIN)
IFUN=J
TABQRK(IX,J)=ASIMP(ALOG(X1),ALOG(X2),.001,M,2,FUN1)
GO TO 8
9 TABQRK(IX,J)=0.
XVMIN=X2+OBIN
CONTINUE
DO 1 IX=1,NBIN
TABQRK(IX,6)=0.
DO 1 J=1,5
TABQRK(IX,6)+TABQRK(IX,J)
CONTINUE
MGQ=0.
DO 10 IX=1,NBIN
MGQ=MGQ+TABQRK(IX,6)
C-- GLUONS
IFUN=6
AGLU=1.-ASIMP(0.,1.,.001,M,2,FUN2)
TABQRK(1,7)=0.
DO 11 IX=2,NBIN
X1=OBIN*FLOAT(IX-2)
X2=X1+OBIN
IF(X2.LE.XMIN) GO TO 12
X1=AMAX1(X1,XMIN)
TABQRK(IX,7)=ASIMP(ALOG(X1),ALOG(X2),.001,M,2,FUN3)
GO TO 11
12 TABQRK(IX,7)=0.
CONTINUE
MGQ=0.
DO 13 IX=1,NBIN
MGQ=MGQ+TABQRK(IX,7)
C-- COMPLETE X-SECTION FACTOR
FINT=MGQ+MGQ
FXSCT=FXSCT*FINT**2
C
RETURN
END
C
SUBROUTINE OGEVEN
*****
000969
000970
000971
000972
000973
000974
000975
000976
000977
000978
000979
000980
000981
000982
000983
000984
000985
000986
000987
000988
000989
000990
000991
000992
000993
000994
000995
000996
000997
000998
000999
010000
010001
010002
010003
010004
010005
010006
010007
010008
010009
010010
010011
010012
010013
010014
010015
010016
010017
010018
010019
010020
010021
010022
010023
010024
010025
010026
010027
010028
010029
010030
010031
010032
010033
010034
010035
010036
010037
010038
010039
010040
010041
010042
010043
010044
010045
010046
010047
010048
010049
010050
010051
010052
010053
010054
010055
010056

```

```

C-- HANDLES W AND Z (OR DRELL-YAN) EVENT GENERATION
COMMON/QCOS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAYS,LGLUS,IVAL
COMMON/PARG/PAQUA(79,7),NQUA,MAXQUA
COMMON/PARG/PARACT(47,7,2),MXACT,IBEAM,MBOOK(2),JBOOK,MBOOK(2)
1 ,PARSPE(39,6,2),MXSPE,SHARD
COMMON/ALQGEN/MGALQT(127),MGALQ(127,5,3),Q2VECT(128),NALQ,DALQ
1 ,ALAM2,ALLAM2,PTMIN,PTMAX,PT2INT,QZEV,ALQZM,ALQI,ALQF,YF
2 ,IPBAR,NCASC,SIGINL,PROPT,IPTHGT,PROPTH,PTWGT,FRHARD,FRAGEN,FRAT001064
3 ,ZHCUT,ZLM,ZUP,XMIN
COMMON/ENTREV/S,QSQ,YQSQ,IPACH,XING(2),XING(2)
1 ,PKING(2),PYING(2),IFLING(2),ICHING(2)
COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,WEIGHT
COMMON/WEAKON/WEAKON,IFDC,BIM2,BIML2,BIMX2,TG2CAB,FZUOS,FXSCT,MSEX001069
* ,WIDTH
COMMON/FXMDY/FXMDY
COMMON/INMAT/IFLAIN(2),XIN(2),PXIN(2),PYIN(2),INATCH(4,4)
1 ,ICHA(2,3),IHGV(3)
COMMON/NEVOL/NEVOL,ISTOP(2),IBACK(2),MBOOKS(2)
COMMON/TLEAVE/TLEAVE
COMMON/MAXN/MBOOK,MBOOK,MNPART,MNQUA,MNCUE,MNCUEJ,MNSJO
COMMON/KEYBRE/KEYBRE
COMMON/KDUMP/KDUMP
COMMON/KHADRO/KHADRO
DATA ZH,WH/1HZ,1HW,0H/2HDY/

C
700 IFIREF=0
C
C-- INITIALIZATION
C-- EVOLUTION SCALE
  QSQ=BIM2
  ALQ=(ALOG(QSQ)-ALLAM2)/ALQZM
  YQSQ=ALOG(ALQ)
  HEIGHT=1.
C-- GENERATE PAIR OF INITIAL PARTONS
  CALL BGPAIR
C-- GENERATE PARTON CASCADE (LLA QCO)
  JBOOK=2
  NQUA=0
  DO 12 IB=1,2
    MBOOK(IB)=1
    MBOOKS(IB)=0
    MBOOKS(IB)=0
    ISTOP(IB)=0
    IBACK(IB)=0
12  IBEAM=1
    CALL QCGEN(IFLING(1),0.,YINI,QSQINI)
    CALL BOOK(IFLING(1),0.0.,YINI,XING(1),PKING(1),PYING(1))
    IBACK(IBEAM)=0
100 CONTINUE
    IBEAM=1
    CALL EVOL(1,YQSQ)
    MBOOK=MAX0(MBOOK,MBOOK(1))
    IF(ISTOP(1).EQ.1) GO TO 200
    IBS=1
    MBOOK(2)=0
    IBEAM=2
    CALL QCGEN(IFLING(2),0.,YIN2,QSQIN2)
    CALL BOOK(IFLING(2),0.0.,YIN2,XING(2),PKING(2),PYING(2))
    IBACK(IBEAM)=0
    ISTOP(IBEAM)=0
150 CONTINUE
    CALL EVOL(1,YQSQ)
    MBOOK=MAX0(MBOOK,MBOOK(2))
    IF(ISTOP(2).EQ.1) GO TO 100
C-- PREPARE TO ENTER HARD PROCESS
  IFLA1=PARACT(1,1,1)
  XMI=PARACT(1,3,1)
  XP1=PARACT(1,5,1)
  PX1=PARACT(1,6,1)
  PY1=PARACT(1,7,1)
  MFLA1=MINO(4,IABS(IFLA1))
  IFLA2=PARACT(1,1,2)
  XM2=PARACT(1,3,2)
  XP2=PARACT(1,5,2)
  PX2=PARACT(1,6,2)
  PY2=PARACT(1,7,2)
C-- CHECK WHETHER RIGHT FLAVOR COMBINATION
  IF(IFLA1.EQ.LGLUS.OR.IFLA2.EQ.LGLUS) GO TO 150
  IF(WEAKON.EQ.ZH) GO TO 301
  IF(WEAKON.EQ.OH) GO TO 302
C-- W BOSON
  IIFLA=IFLA1+IFLA2
  IF(IIFLA.LT.-3.OR.IIFLA.GT.-2) GO TO 150
  IF(IIFLA.EQ.-2) GO TO 310
  IF(RNDM(IIFLA).GT.TG2CAB) GO TO 150
  GO TO 310
C-- Z BOSON
301 IF((IFLA1+IFLA2).NE.0) GO TO 150
001057 IF(IABS(IFLA1).GT.1) GO TO 310
001058 IF(RNDM(IFLA1).GT.FZUOS) GO TO 150
001059 GO TO 310
001060 302 CONTINUE
001061 C-- DRELL-YAN
001062 IF((IFLA1+IFLA2).NE.0) GO TO 150
001063 IF(IABS(IFLA1).EQ.1) GO TO 310
001064 IF(RNDM(IFLA1).GT.FZUOS) GO TO 150
001065 CONTINUE
001066 C-- CHECK WHETHER SHAT STAYS WITHIN BOSON MASS INTERVAL
001067 SHAT=(XP1*XP2+XMI*XMI)*S-2.*(PX1*PX2+PY1*PY2)
001068 IF(SHAT.LT.8IML2.OR.SHAT.GT.8IMX2) GO TO 150
001069 C
001070 IF(HEIGHT.LT.1.E-30) RETURN
001071 SHARD=SHAT
001072 IF(WEAKON.EQ.OH) FXMDY=FXMDY+(BIM2/SHAT)**2
001073 IF(KEYBRE.LT.2)
001074 *CALL TEVOLI(BS)
001075 NQUA=NQUA
001076 MNQUA=0
001077 MNQUA=MAX0(MNQUA,NQUA)
001078 IBS=2
001079 NEVENT=NEVENT+1
001080 NPART=0
001081 CALL BOSO
001082 IF(KHADRO.EQ.1)
001083 *CALL MADRON(1,NQUA,1)
001084 IF(HEIGHT.LT.1.E-30) GO TO 215
001085 IF(NEVENT.LE.NDUMP) CALL DUMPEV
001086 IFIREF=1
001087 CALL FZLN
001088 GO TO 150
001089 215 CONTINUE
001090 NEVENT=NEVENT-1
001091 GO TO 150
001092 200 CONTINUE
001093 C
001094 IF(IFIREF.EQ.0) GO TO 700
001095 C
001096 RETURN
001097 END
001098 C
001099 SUBROUTINE BGPAIR
001100 *****
001101 C-- GENERATES PAIR OF INITIAL PARTONS - CALLED BY BGEVEN
001102 COMMON/QCOS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAYS,LGLUS,IVAL
001103 COMMON/TABGRK/TABGRK(127,7),NBIN,DBIN,F2XQV(7),MGQV(7),AGLU,NDBIN
001104 1 ,XV(127),AL1,AL2,IFCODE(5)
001105 2 ,TGLIAS(127),LGLIAS(127),TGLIAS(127),LGLIAS(127)
001106 COMMON/ALQGEN/MGALQT(127),MGALQ(127,5,3),Q2VECT(128),NALQ,DALQ
001107 1 ,ALAM2,ALLAM2,PTMIN,PTMAX,PT2INT,QZEV,ALQZM,ALQI,ALQF,YF
001108 2 ,IPBAR,NCASC,SIGINL,PROPT,IPTHGT,PROPTH,PTWGT,FRHARD,FRAGEN,FRAT001196
001109 3 ,ZHCUT,ZLM,ZUP,XMIN
001110 COMMON/ENTREV/S,QSQ,YQSQ,IPACH,XING(2),XING(2)
001111 1 ,PKING(2),PYING(2),IFLING(2),ICHING(2)
001112 COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,WEIGHT
001113 COMMON/WEAKON/WEAKON,IFDC,BIM2,BIML2,BIMX2,TG2CAB,FZUOS,FXSCT,MSEX001201
001114 * ,WIDTH
001115 COMMON/BXGEN/TBXGEN(127),TBXAL(127),LBXAL(127),F2X
001116 INTEGER IXV(2)
001117 DATA ICALL/0/
C-- INITIALIZATION
  IF(ICALL.GT.0) GO TO 9
  ICALL=1
  DO 5 IX=1,NBIN
    TBXGEN(IX)=0
    DO 6 J=6,7
      TBXGEN(IX)=TBXGEN(IX)+TABGRK(IX,J)
      TBXT=0.
      DO 7 IX=1,NBIN
        TBXT=TBXT+TBXGEN(IX)
      DO 6 IX=1,NBIN
        TBXAL(IX)=TBXGEN(IX)/TBXT
        CALL ALIAS(LBXAL,TBXAL,NBIN)
      DO 5 IX=2,NBIN
        TBXGEN(IX)=TBXGEN(IX)+TBXGEN(IX-1)
      5 CONTINUE
      XST=XMIN
      ALST=ALOG(XMIN)
      IXST=INT(XMIN/DBIN)+1
      ALST1=ALOG(FLOAT(IXST)*DBIN)
      F2X=F2IN(XST,6)+F2IN(XST,7)
      CONTINUE
      9 CONTINUE
      10 CONTINUE
      CALL BGEXIN(XST,IXST,ALST,ALST1,XING(1),IXV(1),1)
      CALL BGEXIN(XST,IXST,ALST,ALST1,XING(2),IXV(2),1)
001145 001146 001147 001148 001149 001150 001151 001152 001153 001154 001155 001156 001157 001158 001159 001160 001161 001162 001163 001164 001165 001166 001167 001168 001169 001170 001171 001172 001173 001174 001175 001176 001177 001178 001179 001180 001181 001182 001183 001184 001185 001186 001187 001188 001189 001190 001191 001192 001193 001194 001195 001196 001197 001198 001199 001200 001201 001202 001203 001204 001205 001206 001207 001208 001209 001210 001211 001212 001213 001214 001215 001216 001217 001218 001219 001220 001221 001222 001223 001224 001225 001226 001227 001228 001229 001230 001231 001232

```

```

C
NGEX=NGEX+1
C-- CHECK WHETHER SHAT ABOVE THRESHOLD
SHAT=XING(1)*XING(2)*S
IF(SHAT.LT.BIML2) GO TO 10
C
DO 75 L=1,2
CALL BGEXIN(XST,IXST,ALST,ALST1,XING(L),IXV(L),2)
IXV(L)=MAX0(IXV(L),2)
75 CONTINUE
SHAT=XING(1)*XING(2)*S
IF(SHAT.LT.BIML2) GO TO 10
C
DO 72 L=1,2
PT2=PT2+ALOG(RNDM(L))
XHING(L)=PT2/(XING(L)*S)
IF(XHING(L).GT.XING(L)) GO TO 73
PT=SQRT(PT2)
PHI=PI2*RNDM(L+1)
PXING(L)=PT*COS(PHI)
PYING(L)=PT*SIN(PHI)
IX=IXV(L)
IF(RNDM(L+2).GT.TABQRK(IX,6)/(TABQRK(IX,6)+TABQRK(IX,7))) GO TO 74
CALL GEFLA(IX,IFLING(L),JOUT)
IF(L.EQ.1.AND.IFDBAR.EQ.1) IFLING(L)=IFLING(L)
GO TO 72
74 IFLING(L)=LGLUS
72 CONTINUE
C
END
C
SUBROUTINE BGEXIN(XST,IXST,ALST,ALST1,X,IX,IMODE)
*****
C-- GENERATES ONE INITIAL PARTON -- CALLED BY BGPART
COMMON/BXGEN/TBXGEN(127),TBXAL(127),LBXAL(127),FZX
COMMON/TABQRK/TABQRK(127,7),NBIN,DBIN,F2XQV(7),MGQV(7),AGLU,HOBIN
1,XV(127),AL1,AL2,IFCODE(5)
2,TGLIAS(127),LGLIAS(127),TGLIAS(127),LGLIAS(127)
C
IF(IMODE.EQ.2) GO TO 50
IX=RNDM(1)*FLOAT(NBIN)+1
IF(RNDM(2).GT.TBXAL(IX)) IX=LBXAL(IX)
X=DBIN*FLOAT(IX-1)
RETURN
50 CONTINUE
IF(IX.EQ.IXST) GO TO 60
X=X-DBIN*RNDM(3)
RETURN
60 CONTINUE
X=EXP(RNDM(X)*ALST1-ALST)+ALST
FZR=(F2IN(X,6)+F2IN(X,7))/FZX
IF(RNDM(X+1).GT.FZR) GO TO 105
RETURN
105 END
C
SUBROUTINE BOSO
*****
C-- H AND Z BOSON (OR VIRTUAL ORELL-YAN PHOTON) KINEMATICS
COMMON/QCDS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAVS,LGLUS,IVAL
COMMON/PARQ/PARACT(47,7,2),MXACT,IBEAM,NBOOK(2),JBOOK,MBOOK(2)
1,PARSPE(39,6,2),MXSPE,SHARD
COMMON/PARQUA/PARQUA(79,7),NQUA,MAXQUA
COMMON/QUAOR/IQUAOR
COMMON/INMAY/IFLAIN(2),XIN(2),PXIN(2),PYIN(2),IMATCH(4,4)
1,ICHA(2,3),INGV(3)
COMMON/ENTREV/S,QSQ,YQSQ,IPACH,XING(2),XHING(2)
1,PXING(2),PYING(2),IFLING(2),ICHING(2)
COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,WEIGHT
COMMON/WEAKON/WEAKON,IFDC,BIM2,BIMX2,TG2CAB,FZUOS,FXSCT,NGEX001302
*,WIDTH
COMMON/BOSON/PBOS(6),ICHOB,IQRKFM
COMMON/ROTF/IROT,CT,ST,CPH,SPH
COMMON/TRANSL/ALAMBT,NFLATR,LGLUT,QSQRKT
COMMON/DECPAR/PUDD,PSID,CND1,CND2,IDB(110)
DATA ZH,MH,IMH,IHW,DM/2NDY/
C
IFLA1=PARACT(1,1,1)
XMI=PARACT(1,3,1)
XPI=PARACT(1,5,1)
PX1=PARACT(1,6,1)
PY1=PARACT(1,7,1)
IFLA2=PARACT(1,1,2)
XM2=PARACT(1,3,2)
XP2=PARACT(1,5,2)
PX2=PARACT(1,6,2)
PY2=PARACT(1,7,2)
001233 PBOS(5)=SQRT(BIM2)
001234 IF(WIDTH.GT.1.E-3) CALL BWIDTH(PBOS(5))
001235 PBOS(1)=PX1+PX2
001236 PBOS(2)=PY1+PY2
001237 PBOS(3)=(XPI-XP2-XMI+XM2)*ECHM*.5
001238 PBOS(4)=SQRT(PBOS(5)**2+PBOS(1)**2+PBOS(2)**2+PBOS(3)**2)
001239 C
001240 IF((IFLA1+IFLA2).EQ.0.AND.WEAKON.EQ.ZH) PBOS(6)=2
001241 IF((IFLA1+IFLA2).EQ.0.AND.WEAKON.EQ.DH) PBOS(6)=5
001242 IF((IFLA1+IFLA2).LT.0) PBOS(6)=3
001243 IF((IFLA1+IFLA2).GT.0) PBOS(6)=4
001244 C
001245 IFBOS=PBOS(6)
001246 IF(IDB(IFBOS).EQ.0) GO TO 100
001247 CALL BDECAY
001248 CALL BBOOST
001249 C
001250 RETURN
001251 C
001252 100 CONTINUE
001253 MPART=NPART+1
001254 DO 1 J=1,6
001255 PARHAD(MPART,J)=PBOS(J)
001256 PARHAD(MPART,7)=1
001257 C
001258 RETURN
001259 END
001260 C
001261 SUBROUTINE BWIDTH(BMAS)
001262 *****
001263 C-- GENERATES BREIT-WIGNER DISTRIBUTION FOR WEAK BOSON MASS
001264 COMMON/QCDS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAVS,LGLUS,IVAL
001265 COMMON/WEAKON/WEAKON,IFDC,BIM2,BIMX2,TG2CAB,FZUOS,FXSCT,NGEX001353
001266 *,WIDTH
001267 COMMON/TOP/TOPMAS
001268 DATA ZH,MH,IMH,IHW/
001269 C
001270 BMASOR=SQRT(BIM2)
001271 10 CONTINUE
001272 X=TAN(PI*(1-5*RNDM(0)))
001273 BMAS2=X*BMASOR*WIDTH+BM2
001274 IF(BMAS2.LT.0.) GO TO 10
001275 BMAS=SQRT(BMAS2)
001276 DMAS=ABS(BMAS-BMASOR)
001277 IF(DMAS.GT.4.*WIDTH.OR.BMAS.LT.10.) GO TO 10
001278 IF(IFDC.EQ.0) RETURN
001279 IF(WEAKON.EQ.ZH.AND.IFDC.EQ.161.AND.BMAS.LT.2.*TOPMAS+10.)
001280 *GO TO 10
001281 IF(WEAKON.EQ.MH.AND.IFDC.EQ.175.AND.BMAS.LT.TOPMAS+10.)
001282 *GO TO 10
001283 RETURN
001284 END
001285 C
001286 SUBROUTINE BDECAY
001287 *****
001288 C-- HANDLES INTERMEDIATE BOSON DECAY
001289 COMMON/QCDS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAVS,LGLUS,IVAL
001290 COMMON/PARQ/PARACT(47,7,2),MXACT,IBEAM,NBOOK(2),JBOOK,MBOOK(2)
001291 1,PARSPE(39,6,2),MXSPE,SHARD
001292 COMMON/WEAKON/WEAKON,IFDC,BIM2,BIMX2,TG2CAB,FZUOS,FXSCT,NGEX001380
001293 *,WIDTH
001294 COMMON/BOSON/PBOS(6),ICHOB,IQRKFM
001295 COMMON/DECPAR/PUDD,PSID,CND1,CND2,IDB(110)
001296 COMMON/JETP/NP,NPI
001297 COMMON/JETP/NP,NPI
001298 COMMON/DATAZ/CBR(180),KOP(180,3),WTCOR(10)
001299 DATA ZH,MH,IMH,IHW,DM/2NDY/
001300 C
001301 IFBOS=PBOS(6)
001302 IQRKFM=PARACT(1,1,1)
001303 C
001304 C-- WEAK BOSON DECAY MODE
001305 IF(IFDC.GT.0) GO TO 50
001306 5 CONTINUE
001307 TBR=RNDM(0)
001308 IDC=IDB(IFBOS)-1
001309 IDC=IDC+1
001310 IF(TBR.GT.CBR(IDC)) GO TO 10
001311 IF(WEAKON.EQ.ZH.AND.IDC.EQ.161.AND.PBOS(5).LT.2.*TOPMAS+10.)
001312 *GO TO 5
001313 IF(WEAKON.EQ.MH.AND.IDC.EQ.175.AND.PBOS(5).LT.TOPMAS+10.)
001314 *GO TO 5
001315 50 GO TO 60
001316 IDC=IFDC
001317 60 ICHOB=IDC
001318 C
001319 C-- CALL GENERATION OF FINAL STATE (ALONG Z AXIS)
001320 IF(WEAKON.EQ.ZH.AND.ICHOB.LE.155) GO TO 70
001321
001322
001323
001324
001325
001326
001327
001328
001329
001330
001331
001332
001333
001334
001335
001336
001337
001338
001339
001340
001341
001342
001343
001344
001345
001346
001347
001348
001349
001350
001351
001352
001353
001354
001355
001356
001357
001358
001359
001360
001361
001362
001363
001364
001365
001366
001367
001368
001369
001370
001371
001372
001373
001374
001375
001376
001377
001378
001379
001380
001381
001382
001383
001384
001385
001386
001387
001388
001389
001390
001391
001392
001393
001394
001395
001396
001397
001398
001399
001400
001401
001402
001403
001404
001405
001406
001407
001408

```

```

IF(WEAKON.EQ.WH.AND.ICHOB.LE.172) GO TO 70
IF(WEAKON.EQ.OH) GO TO 70
GO TO 80
70 CALL BLEPT
GO TO 90
80 CALL BJETS
90 CONTINUE
C
C-- APPROPRIATE ROTATION OF DECAY PRODUCTS
IF(IFBOS.EQ.2) CALL ZDANG(THETA)
IF(IFBOS.EQ.3.OR.IFBOS.EQ.4) CALL WDANG(THETA)
IF(IFBOS.EQ.5) CALL UDANG(THETA)
PHI=PI*RNOM(1)
ITHROW=0
CALL EDIT(NP)
C
C RETURN
END
C
SUBROUTINE BBOOST
*****
C-- LORENTZ BOOST OF BOSON DECAY PRODUCTS TO LAB SYSTEM
COMMON/WEAKON/WEAKON,IFOC,BIM2,BIML2,BIMX2,TG2CAB,FZUDS,FXSCT,NGEX
* .WIDTH
COMMON/BOSON/PBOS(6),ICHOB,IQRKFW
COMMON /JET/ K(399,2), P(399,5)
COMMON/JETN/NP,NP1
COMMON/PARQUA/PARQUA(79,7),NQUA,MAXQUA
COMMON/EVENT/NEVENT,ECM,PARHAD(401,7),NPART,MXPART,HEIGHT
COMMON/MAXON/MBOOK,MBOOK,MNPART,MNQUA,MNCUE,MNCUEJ,MNSJO
REAL A(4),V1(4),V2(4)
DATA ZH,WH,1HZ,1HW,DH/2HDY/
C
DO 5 J=1,4
A(J)=PBOS(J)
DO 10 I=1,NP
NPART=NPART+1
DO 11 J=1,4
V1(J)=P(I,J)
CALL LORENZ(A,V1,V2)
DO 12 J=1,4
PARHAD(NPART,J)=V2(J)
PARHAD(NPART,5)=P(I,5)
PARHAD(NPART,6)=K(I,2)
10 CONTINUE
MNPART=MAX0(MNPART,NPART)
MNSJO=MAX0(MNSJO,NPART)
C
IF(WEAKON.EQ.ZH.AND.ICHOB.GT.155) GO TO 25
IF(WEAKON.EQ.WH.AND.ICHOB.GT.172) GO TO 25
20 DO 20 I=1,NP1
PARHAD(I,7)=1
NP1=NP1+1
DO 21 I=NP1,NP
PARHAD(I,7)=2
RETURN
C
25 CONTINUE
DO 26 IQ=1,NQUA
IF(PARQUA(IQ,7).LT.0.) GO TO 26
DO 27 J=1,4
PARQUA(IQ,J)=0.
DO 28 I=1,NPART
IF(INT(PARHAD(I,7)).NE.IQ) GO TO 28
DO 29 J=1,4
PARQUA(IQ,J)=PARQUA(IQ,J)+PARHAD(I,J)
29 CONTINUE
QUAM2=PARQUA(IQ,4)**2-PARQUA(IQ,1)**2-PARQUA(IQ,2)**2
*PARQUA(IQ,3)**2
PARQUA(IQ,5)=0.
IF(QUAM2.GT.0.) PARQUA(IQ,5)=SQRT(QUAM2)
26 CONTINUE
C
RETURN
END
C
SUBROUTINE BLEPT
*****
C-- HANDLES LEPTONIC DECAY MODES OF WEAK BOSON
COMMON/QCOS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAVS,LGLUS,IVAL
COMMON/BOSON/PBOS(6),ICHOB,IQRKFW
COMMON/EVENT/NEVENT,ECM,PARHAD(401,7),NPART,MXPART,HEIGHT
COMMON /JET/ K(399,2), P(399,5)
COMMON/JETN/NP,NP1
COMMON /EQPAR/ ITHROW, PZIN, PHIN, THETA, PHI, BETA(3)
COMMON /DECPAR/ PUDD, PS10, CND1, CND2, IOB(110)
COMMON /DATA1/ MESO(36), CHIX(6,2), PHAS(110), QMAS(6)
001409 COMMON /DATA2/ CBR(100), KDP(100,3), WTCOR(10)
001410 C-- N.B. PARHAD USED ONLY AS BUFFER HERE -- FINAL LOAD IN PARHAD
001411 C-- DONE IN BBOOST
001412 REAL PJ(2,6)
001413 C
001414 IFBOS=PBOS(6)
001415 C-- Q.N.
001416 IDC=ICHOB
001417 DO 10 I=1,2
001418 K(I,2)=KOP(IDC,I)
001419 IF(IFBOS.NE.4) GO TO 12
001420 K(1,2)=K(1,2)-2
001421 K(2,2)=K(2,2)+2
001422 12 CONTINUE
001423 C-- KINEMATICS
001424 W2=(PBOS(5)+1000.)**2
001425 AM1=PHAS(K(1,2))
001426 AM2=PHAS(K(2,2))
001427 PP=5*SQRT(W2-(AM1+AM2)**2)*(W2-(AM1-AM2)**2)/W2
001428 E1=SQRT(AM1**2+PP**2)
001429 E2=SQRT(AM2**2+PP**2)
001430 C
001431 DO 15 I=1,2
001432 PJ(I,1)=0.
001433 PJ(I,2)=0.
001434 PJ(I,3)=PP*(-1.)**((I+1)
001435 PJ(I,5)=PHAS(K(I,2))
001436 PJ(I,6)=K(I,2)
001437 15 CONTINUE
001438 PJ(1,4)=E1
001439 PJ(2,4)=E2
001440 ICHN=ICHOB-IDB(IFBOS)+1
001441 IF(ICHN.EQ.3) GO TO 50
001442 C
001443 C-- DECAY PRODUCTS DO NOT INCLUDE TAU PARTICLES
001444 NP1=1
001445 NP=2
001446 DO 20 I=1,2
001447 DO 20 J=1,5
001448 PI(I,J)=PJ(I,J)/1000.
001449 C
001450 RETURN
001451 C
001452 C-- TAU DECAYS
001453 50 CONTINUE
001454 I=0
001455 DO 51 L=1,2
001456 IP=1
001457 DO 52 J=1,5
001458 P(IP,J)=PJ(L,J)
001459 K(IP,2)=PJ(L,6)
001460 IF(L.EQ.2) P(IP,3)=-P(IP,3)
001461 C
001462 IPO=0
001463 IPO=IPO+1
001464 IF(IDB(K(IP,2)).GT.0) CALL DECAY(IPO,IP)
001465 IF(IPD.LT.IP) GO TO 53
001466 ITHROW=1
001467 THETA=0.
001468 IF(L.EQ.2) THETA=PI
001469 PHI=0.
001470 M=IP
001471 CALL EDIT(N)
001472 IF(L.EQ.1) NP1=N
001473 DO 54 IP=1,N
001474 I=I+1
001475 PARHAD(I,6)=K(IP,2)
001476 DO 54 J=1,5
001477 PARHAD(I,J)=P(IP,J)
001478 54 CONTINUE
001479 NP=NP1+N
001480 C
001481 DO 55 I=1,NP
001482 K(I,2)=PARHAD(I,6)
001483 DO 55 J=1,5
001484 P(I,J)=PARHAD(I,J)/1000.
001485 55 C
001486 RETURN
001487 END
001488 C
001489 SUBROUTINE BJETS
001490 *****
001491 C-- HANDLES NON-LEPTONIC DECAY MODES OF WEAK BOSON
001492 COMMON/QCOS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAVS,LGLUS,IVAL
001493 COMMON/PARQUA/PARQUA(79,7),NQUA,MAXQUA
001494 COMMON/EVENT/NEVENT,ECM,PARHAD(401,7),NPART,MXPART,HEIGHT
001495 COMMON/BOSON/PBOS(6),ICHOB,IQRKFW
001496 COMMON/ROTA/IROT,CT,ST,CPH,SPH

```

```

COMMON/QUAOR/IQUAOR
COMMON /PAR/ PUD, PSI, SIGMA, CX2, EBEG, WFIN, IFLBEG
COMMON /JET/ K(399,2), P(399,5)
COMMON /JETM/ND,NPI
COMMON /EDPAR/ ITHROW, PZMIN, PMIN, THETA, PHI, BETA(3)
COMMON /DECPAR/ PUDD, PSID, CND1, CND2, IDB(110)
COMMON /DATA1/ MESQ(36), CHIX(6,2), PHAS(110), QMAS(6)
COMMON /DATA2/ CBR(180), KOP(180,3), MTCOR(10)
REAL PTOT(5)
INTEGER IFLJET(2)
REAL SETIN(6),PMB(4)
C
  IFBOS=PBOS(6)
C-- Q.N.
  KSTRNG=KOP(ICHDB,1)
  IFL1=(5-KSTRNG)/6
  IFL2=KSTRNG+6*(IFL1-1)
  IFLJET(1)=IFL1
  IFLJET(2)=IFL2
  IF(IFBOS.EQ.4) IFLJET(1)=-IFL2
  IF(IFBOS.EQ.4) IFLJET(2)=-IFL1
C
C-- INITIALIZATION FOR JET GENERATION (QUANTA)
30  NQUA=NQUA
  CONTINUE
  NQUA=NQUA
  QSQM=PBOS(5)**2*.25
  SETIN(1)=0.
  SETIN(2)=0.
  M2=PBOS(5)**2
  CALL PSQGENI(IABS(IFLJET(1)),QSQM,QSQ1,IG0)
  CALL PSQGENI(IABS(IFLJET(2)),QSQM,QSQ2,IG0)
  Q1=SQRT(QSQ1)
  Q2=SQRT(QSQ2)
  PCM2=(M2-(Q1+Q2)**2)*(M2-(Q1-Q2)**2)/(4.*M2)
  PCM=SQRT(PCM2)
  E1=SQRT(QSQ1+PCM2)
  E2=SQRT(QSQ2+PCM2)
  IQUAOR=1
  CPM=1.
  SPH=0.
C
C-- 1ST JET (QUANTA)
  IROT=1
  SETIN(3)=E1+PCM
  SETIN(5)=QSQ1
  SETIN(6)=IFLJET(1)
  CALL JETQCD(SETIN)
  NQUA1=NQUA
C
C-- 2ND JET (QUANTA)
  IROT=3
  CT=-1.
  ST=0.
  SETIN(3)=E2+PCM
  SETIN(5)=QSQ2
  SETIN(6)=IFLJET(2)
  CALL JETQCD(SETIN)
C
C-- HADRONIZATION
  NIT=0
40  NIT=NIT+1
  IF(NIT.GT.5) GO TO 30
  NQUAC=NQUA
  NPART=0
  CALL HADRON(NQUA+1,NQUAC,0)
  NPI=0
  DO 42 I=1,NPART
42  IF(INT(PARHAD(I,7)).LE.NQUA1) NPI=NPI+1
  NP=NPART
C
C-- CORRECT FOR EXACT BOSON MASS
  DO 52 J=1,5
52  PTOT(J)=0.
  DO 50 J=1,4
50  PMB(J)=0.
  DO 51 I=1,NPART
  K(I,2)=PARHAD(I,6)
  DO 51 J=1,5
  PTOT(J)=PTOT(J)+PARHAD(I,J)
  P(I,J)=PARHAD(I,J)
  IF(INT(PBOS(6)).EQ.4) PTOT(3)=-PTOT(3)
  PTOT(5)=SQRT(PTOT(4)**2-PTOT(1)**2-PTOT(2)**2-PTOT(3)**2)
  IF(ABS(PTOT(3))/PBOS(5).GT..30) GO TO 40
  IF(ABS(PTOT(5))-PBOS(5))/PBOS(5).GT..4) GO TO 40
  CALL P4CORR(PBOS(5),PMB,NPART,IFLAG)
  IF(IFLAG.EQ.1) GO TO 40
C
001585  NPART=0
001586  C
001587  RETURN
001588  END
001589
001590  C
001591  SUBROUTINE ZDANG(THETA)
001592  *****
001593  C-- GENERATES THETA ANGLE IN Z DECAY
001594  C-- THETA IS ANGLE BETWEEN FINAL QUARK, OR NEGATIVE LEPTON, OR NEUTRINO
001595  C-- AND INITIAL QUARK
001596  COMMON/2PAR/S2THM,CDSCAB
001597  COMMON/BOSON/PBOS(6),ICHDB,IQRKFW
001598  INTEGER LPI(12)
001599  REAL CASYH(2,4),AQ(2),BQ(2),AL(2),BL(2)
001600
001601  DATA LPI/3*1,3*2,3,4,4,3,4,3/
001602  DATA ICALL/0/
001603
001604  C
001605  ASYH(A1,B1,A2,B2)=8.*A1*B1*A2*B2/((A1**2+B1**2)*(A2**2+B2**2))
001606
001607  IF(ICALL.GT.0) GO TO 10
001608  ICALL=1
001609  XM=S2THM
001610  C-- 1 FOR CH=2/3 QUARK OR LEPTON, 2 FOR CH=1/3 QUARK OR NEUTRINO
001611  AQ(1)=-2./3.*XM+.25
001612  BQ(1)=-.25
001613  AQ(2)=1./3.*XM-.25
001614  BQ(2)=-.25
001615  AL(1)=XM-.25
001616  BL(1)=-.25
001617  AL(2)=.25
001618  BL(2)=.25
001619  DO 5 LI=1,2
001620  DO 6 LF=1,2
001621  6  CASYH(LI,LF)=ASYH(AQ(LI),BQ(LI),AL(LF),BL(LF))
001622  DO 7 LF=3,4
001623  7  CASYH(LI,LF)=ASYH(AQ(LI),BQ(LI),AQ(LF-2),BQ(LF-2))
001624  5  CONTINUE
001625  10  CONTINUE
001626
001627  LI=1
001628  IF(IABS(IQRKFW).GT.1) LI=2
001629  LF=LFV(ICHDB-150+1)
001630  CAS=CASYH(LI,LF)
001631  C=2.*RNDM(1)-1.
001632  IF(RNDM(2).GT.(1.+C**2+CAS*C)/(2.+ABS(CAS))) GO TO 20
001633  IF(IQRKFW.LT.0) C=-C
001634  THETA=ACOS(C)
001635  C
001636  RETURN
001637  END
001638
001639  C
001640  SUBROUTINE MDANG(THETA)
001641  *****
001642  C-- GENERATES THETA ANGLE IN W DECAYS
001643  C-- THETA IS ANGLE BETWEEN FINAL QUARK, OR NEGATIVE LEPTON, OR NEUTRINO
001644  C-- AND INITIAL QUARK
001645  COMMON/BOSON/PBOS(6),ICHDB,IQRKFW
001646  C
001647  C=2.*RNDM(1)-1./3.-1.
001648  IF(IQRKFW.LT.0) C=-C
001649  THETA=ACOS(C)
001650  C
001651  RETURN
001652  END
001653
001654  C
001655  SUBROUTINE DDANG(THETA)
001656  *****
001657  C-- GENERATES THETA ANGLE IN DRELL-YAN PHOTON DECAYS
001658  X=RNDM(0.)
001659  IF(RNDM(0.)**4./3..LT.1.) GO TO 10
001660  X=X**(.1./3.)
001661  X=X*(-1.)*INT(1.+2.*RNDM(1.))
001662  THETA=ACOS(X)
001663  RETURN
001664  END
001665
001666  C
001667  C-- ALL FOLLOWING ROUTINES, EXCEPT FOR THE USER ROUTINES, ARE IN COMMON
001668  C-- WITH PROGRAM COJETS
001669
001670  C
001671  FUNCTION FUN1(ALX)
001672  *****
001673  USED BY INPART
001674  COMMON/F2QG/F2QG(7)
001675  COMMON/CFUN1/IFUN
001676  X=EXP(ALX)
001677
001678  001673
001674  001674
001675  001675
001676  001676
001677  001677
001678  001678
001679  001679
001680  001680
001681  001681
001682  001682
001683  001683
001684  001684
001685  001685
001686  001686
001687  001687
001688  001688
001689  001689
001690  001690
001691  001691
001692  001692
001693  001693
001694  001694
001695  001695
001696  001696
001697  001697
001698  001698
001699  001699
001700  001700
001701  001701
001702  001702
001703  001703
001704  001704
001705  001705
001706  001706
001707  001707
001708  001708
001709  001709
001710  001710
001711  001711
001712  001712
001713  001713
001714  001714
001715  001715
001716  001716
001717  001717
001718  001718
001719  001719
001720  001720
001721  001721
001722  001722
001723  001723
001724  001724
001725  001725
001726  001726
001727  001727
001728  001728
001729  001729
001730  001730
001731  001731
001732  001732
001733  001733
001734  001734
001735  001735
001736  001736
001737  001737
001738  001738
001739  001739
001740  001740
001741  001741
001742  001742
001743  001743
001744  001744
001745  001745
001746  001746
001747  001747
001748  001748
001749  001749
001750  001750
001751  001751
001752  001752
001753  001753
001754  001754
001755  001755
001756  001756
001757  001757
001758  001758
001759  001759
001760  001760

```

```

FUN1=F2IN(X,IFUN)
RETURN
END

C
FUNCTION FUN2(X)
*****
C-- USED BY INPART
COMMON/F2QG/F2QG(7)
COMMON/CFUN1/IFUN
FUN2=F2IN(X,IFUN)
RETURN
END

C
FUNCTION FUN3(ALX)
*****
C-- USED BY INPART
X=EXP(ALX)
FUN3=FLU(X)
RETURN
END

C
SUBROUTINE SEFLA(IX,IFLA,JFLA)
*****
C-- GENERATION OF INITIAL PARTON FLAVOR - CALLED BY INPART
COMMON/TABGRK/TABGRK(127,7),NBSIN,OBIN,F2XQV(7),AGLU,NBSIN
1 ,XVI(127),ALI,AL2,IFCODE(5)
2 ,TGLIAS(127),LGLIAS(127),TGLIAS(127),LGLIAS(127)
COMMON/BKNG/BKNG,FBKNG(7)
TF=0
RTF=RNOM(0)*TABGRK(IX,6)
DO 115 J=1,5
TF=TF+TABGRK(IX,J)
JOUT=J
IF(RTF.LT.TF) GO TO 116
115 CONTINUE
116 IFLA=IFCODE(JOUT)
JFLA=JOUT
IF(IFLA.EQ.3.AND.RNOM(0).GT.5) IFLA=-IFLA
RETURN
END

C
SUBROUTINE ALIAS(L,S,NPTS)
*****
C-- ORGANIZES ARRAYS FOR ALIAS METHOD GENERATION
REAL S(250)
INTEGER L(250),ST(250)
C INPUT TO SUBROUTINE: ARRAY OF S(I) I=1,...NPTS
C OUTPUT: SAME ARRAY S(I) AND L(I)
C ST ARRAY USED TO STACK INITIAL S(I).LT.1 (FORWARD)
C AND S(I).GT.1 (BACKWARD)
C ONE PLUS AND MINUS EPSILON
ONEM=1.-1.E-5
ONEP=1.+1.E-5
C INITIALIZE
IG=NPTS+1
IS=0
DO 1 I=1,NPTS
S(I)=FLOAT(NPTS)*S(I)
IF(S(I)-1.) 2,1,5
5 IG=IG-1
ST(IG)=I
GO TO 1
IS=IS+1
ST(IS)=I
CONTINUE
1 MAIN LOOP
3 IF(IS.EQ.0) RETURN
IX=ST(IS)
IY=ST(IG)
L(IX)=IY
S(IY)=S(IY)-1.+S(IX)
IF(IG.EQ.NPTS.AND.IS.EQ.1) RETURN
IS=IS-1
C CONSTANT REALLY ONE, CHANGED TO ACCOUNT FOR ROUND OFF
IF(S(IY).LT.ONEM) GO TO 7
IF(S(IY).LT.ONEP) GO TO 8
GO TO 3
IS=IS+1
ST(IS)=ST(IG)
IG=IG+1
GO TO 3
END

C
SUBROUTINE GECD(ICHING,IFLING)
*****
C-- CHANGEL --> PARTON PAIR FLAVORS CODE
COMMON/ALQGEN/MGALQT(127),MGALQ(127,5,3),Q2VECT(128),NALQ,DALQ
1 ,ALAMB,ALLAM2,PTMIN,PTMAX,PTZINT,QZEV,ALQZM,ALQI,ALQF,YF
001761 2 ,IPBAR,NCASC,SIGINL,PROPT,IPTWGT,PROPTH,PTWGT,FRHARD,FRAGEN,FRAT001849
001762 3 ,ZMCUT,ZLM,ZUP,XMIN 001850
001763 INTEGER ICHING(2),IFLING(2) 001851
001764 INTEGER IPCOD(7),IPBCOD(7) 001852
001765 DATA IPCOD/1,-1,2,-2,3,-3,7/, IPBCOD/-1,1,-2,2,-3,3,7/ 001853
001766 IFLING(2)=IPCOD(ICHING(2)) 001854
001767 IF(IPBAR.EQ.1) GO TO 10 001855
001768 IFLING(1)=IPCOD(ICHING(1)) 001856
001769 RETURN 001857
001770 10 IFLING(1)=IPBCOD(ICHING(1)) 001858
001771 RETURN 001859
001772 END 001860
001773 C 001861
001774 SUBROUTINE TEVOL(IFS) 001862
001775 ***** 001863
001776 C-- HANDLES EVOLUTION OF TIMELIKE QUANTA DUE TO INITIAL BREMSSTRAHLUNG 001864
001777 COMMON/QCDS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAYS,LGLUS,IVAL 001865
001778 COMMON/ALQGEN/MGALQT(127),MGALQ(127,5,3),Q2VECT(128),NALQ,DALQ 001866
001779 1 ,ALAMB,ALLAM2,PTMIN,PTMAX,PTZINT,QZEV,ALQZM,ALQI,ALQF,YF 001867
001780 2 ,IPBAR,NCASC,SIGINL,PROPT,IPTWGT,PROPTH,PTWGT,FRHARD,FRAGEN,FRAT001868
001781 3 ,ZMCUT,ZLM,ZUP,XMIN 001869
001782 COMMON/INMAT/IFLAIN(2),XIN(2),PXIN(2),PYIN(2),ZMATCH(4,4) 001870
001783 1 ,ICHA(2,3),JNGV(3) 001871
001784 COMMON/ENTREV/S,QSQ,YQSQ,IPACH,XING(2),XHING(2) 001872
001785 1 ,PXING(2),PYING(2),IFLING(2),ICHING(2) 001873
001786 COMMON/PARG/PARACT(47,7,2),MXACT,IBEAM,NBOOK(2),JBOOK,MBOOK(2) 001874
001787 1 ,PARSPE(39,6,2),MXSPE,SHARD 001875
001788 COMMON/PARGUA/PARGUA(79,7),NQUA,MAXQUA 001876
001789 COMMON/QUAOR/IQUAOR 001877
001790 COMMON/EVENT/NEVENT, ECM,PARHAD(401,7),NPART,MXPART,WEIGHT 001878
001791 COMMON/ROTS/ROTR,CT,ST,CPH,SPH 001879
001792 COMMON/TRANS/L,ALAMBT,NFLATR,LGLUT,QSQMXT 001880
001793 COMMON/NEVOL/NEVOL,ISTOP(2),IBACK(2),MBOOKS(2) 001881
001794 REAL SETIN(6) 001882
001795 C 001883
001796 IB=IBS 001884
001797 IF(IB.EQ.1) NQUA=0 001885
001798 CONTINUE 001886
001799 IF(IB.EQ.2) NQUA=NQUA1 001887
001800 NJ=0 001888
001801 MBK=PARACT(1,2,IB) 001889
001802 IF(MBK.EQ.0) GO TO 8 001890
001803 NJ=NJ+1 001891
001804 DO 7 L=1,6 001892
001805 7 SETIN(L)=PARSPE(MBK,L,IB) 001893
001806 IF(INT(SETIN(6)).EQ.LGLUS) SETIN(6)=LGLUT 001894
001807 IROT=IB 001895
001808 IQUAOR=-1 001896
001809 CALL JETQCD(SETIN) 001897
001810 MBK=PARSPE(MBK,4,IB) 001898
001811 GO TO 5 001899
001812 8 IF(IB.EQ.1) NQUA1=NQUA 001900
001813 IB=IB+1 001901
001814 IF(IB.GT.2) RETURN 001902
001815 GO TO 100 001903
001816 END 001904
001817 C 001905
001818 SUBROUTINE ROTQUA 001906
001819 ***** 001907
001820 C-- ROTATES QUANTA (CALLED BY JETQCD) - ROTATION PARAMETERS SET IN TEVOL 001908
001821 COMMON/PARGUA/PARGUA(79,7),NQUA,MAXQUA 001909
001822 COMMON/ROTR/ROTR,CT,ST,CPH,SPH 001910
001823 IF(IROT.EQ.1) RETURN 001911
001824 IF(IROT.EQ.2) GO TO 10 001912
001825 PZ1=PARQUA(NQUA,3)*CT-PARQUA(NQUA,1)*ST 001913
001826 PARQUA(NQUA,1)=PARQUA(NQUA,1)*CT+PARQUA(NQUA,3)*ST 001914
001827 PARQUA(NQUA,3)=PZ1 001915
001828 PX1=PARQUA(NQUA,1)*CPH-PARQUA(NQUA,2)*SPH 001916
001829 PARQUA(NQUA,2)=PARQUA(NQUA,2)*CPH+PARQUA(NQUA,1)*SPH 001917
001830 PARQUA(NQUA,1)=PX1 001918
001831 RETURN 001919
001832 10 PARQUA(NQUA,3)=-PARQUA(NQUA,3) 001920
001833 RETURN 001921
001834 END 001922
001835 C 001923
001836 SUBROUTINE INQCDS 001924
001837 ***** 001925
001838 C-- INITIALIZES QCD PARAMETERS USED BY EVOL 001926
001839 COMMON/QCDS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAYS,LGLUS,IVAL 001927
001840 COMMON/ALQGEN/MGALQT(127),MGALQ(127,5,3),Q2VECT(128),NALQ,DALQ 001928
001841 1 ,ALAMB,ALLAM2,PTMIN,PTMAX,PTZINT,QZEV,ALQZM,ALQI,ALQF,YF 001929
001842 2 ,IPBAR,NCASC,SIGINL,PROPT,IPTWGT,PROPTH,PTWGT,FRHARD,FRAGEN,FRAT001930
001843 3 ,ZMCUT,ZLM,ZUP,XMIN 001931
001844 C 001932
001845 C-- QCD CONSTANTS 001933
001846 PI=4.*ATAN(1.) 001934
001847 PI2=PI*2 001935
001848 COLORS=3. 001936

```

```

CA=COLORS
CF=(COLORS**2-1.)/(2.*COLORS)
BALPH=(11.*COLORS-2.*FLOAT(NFLAVS))/(12.*PI)

C-- BASIC CONSTANTS FOR EMISSION PROBABILITIES - SPACELIKE EVOLUTION
PRO1=PAPINT(1,ZUP)-PAPINT(1,ZLM)
PRO2=PAPINT(2,ZUP)-PAPINT(2,ZLM)
PRO3=PAPINT(3,ZUP)-PAPINT(3,ZLM)
PROG1=PRO3*FLOAT(NFLAVS)
FACT=1./(2.*PI*BALPH)
PROFLA(1)=FACT*PRO1
PROFLA(2)=FACT*(PRO2+PRO3)

C
RETURN
END

C
SUBROUTINE EVOL(NBK,YQSQ)
*****
C-- GENERATES INITIAL LLA CASCADES
C
COMMON/QCDS/CF,CA,BALPH,PI,PI2,PROG1,PROFLA(2),NFLAVS,LGLUS,IVAL
COMMON/PARQ/PARACT(47,7,2),MXACT,IBEAM,NBOOK(2),JBOOK,MBOOK(2)
1,PARSPE(39,6,2),MXSPE,SHARD
COMMON/ALQGEN/NGALQT(127),NGALQ(127,5,3),QZVECT(128),NALQ,DALQ
1,ALAMB,ALLAM2,PTHIN,PTMAX,PTZINT,QZEV,ALQZH,ALRZ,ALQF,YF
2,IPBAR,NCASC,SIGINL,PROPT,IPTMGT,PROPTH,PTMGTH,FRHARD,FRAGEN,FRAT001963
3,ZHCUT,ZLN,ZUP,XMIN
COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,HEIGHT
COMMON/TRANSL/ALAMBT,NFLATR,LGLUT,QSQMXT
COMMON/NEVOL/NEVOL,ISTOP(2),IBACK(2),MBOOKS(2)
COMMON/CANC/ICANC(2),NBKNC(47,2)
COMMON/MAXN/MBOOK,MBOOK,MNPART,MNQUA,MNCUE,MNCUEJ,MNSJO
COMMON/KEYBRE/KEYBRE
REAL CUEI(41,8,2)
INTEGER NCUE(2)
DATA MNCUE/41/
DATA ICALL/0/

C
IF(ICALL.GT.0) GO TO 10
ICALL=1
IBOOK=1
IBOOK1=1
IBOOK2=1
CONTINUE

10
C
IF(IBACK(IBEAM).EQ.1) GO TO 462
NEVOL=NEVOL+1

C-- RESET
NCUE(IBEAM)=0

C-- SETTING PARAMETERS OF INITIAL LEG
IF(KEYBRE.GE.3) GO TO 100
Y=PARACT(NBK,4,IBEAM)
IF(Y.GT.YQSQ) GO TO 100
IFLA=PARACT(NBK,1,IBEAM)
IBOOK=PARACT(NBK,2,IBEAM)
QSQ=EXP(EXP(Y)*ALQZH+ALLAM2)
X=PARACT(NBK,5,IBEAM)
PX=PARACT(NBK,6,IBEAM)
PY=PARACT(NBK,7,IBEAM)
IF(JBOOK.EQ.2) GO TO 200
ICANC(IBEAM)=ICANC(IBEAM)+1
NBKNC(ICANC(IBEAM),IBEAM)=NBK
GO TO 200

C
100
IBACK(IBEAM)=1
RETURN

C-- BRANCHING LOOP
*****
C
C-- GENERATE Z AND MASS -- BOOK
C
200
CONTINUE
IF(IFLA.EQ.LGLUS) GO TO 210
C-- QUARK BRANCHING
201
CALL ZGENS(1,2,IFLAQ)
Z1=1.-Z
IFLA1=IFLA
X1=X*Z
IFLA2=LGLUS
X2=X*Z1
GO TO 300

C
C-- GLUON BRANCHING, GENERATE DECAY CHANNEL
001937 210 CONTINUE
001938 IF(RNDM(0.).GT.PROGL) GO TO 230
001939 C
001940 C-- GLUON BRANCHES INTO TWO GLUONS
001941 CALL ZGENS(2,Z,IFLAQ)
001942 Z1=1.-Z
001943 IFLA1=LGLUS
001944 IFLA2=LGLUS
001945 X1=X*Z
001946 X2=X*Z1
001947 GO TO 300
001948 C
001949 C-- GLUON BRANCHES INTO Q-QB
001950 230 CONTINUE
001951 CALL ZGENS(3,Z,IFLAQ)
001952 Z1=1.-Z
001953 IFLA1=IFLAQ
001954 IFLA2=-IFLAQ
001955 X1=X*Z
001956 X2=X*Z1
001957 C
001958 C-- GENERATE MASSES AND PT OF SECONDARIES AND BOOK
001959 C
001960 300 CONTINUE
001961 S=ECH**2
001962 IF(X1.LT.XMIN) GO TO 301
001963 CALL QZGEN(IFLA1,Y,Y1,QSQ1)
001964 TPSQ1=Z1*QSQ
001965 PTR1=SQRT(PT2R1)
001966 IF(KEYBRE.GE.1) PTR1=0.
001967 PH1=PI2-RNDM(0)
001968 PX1=PTR1*NCOS(PH1)
001969 PY1=PTR1*NSIN(PH1)
001970 PX1S=PX1+Z*PX
001971 PY1S=PY1+Z*PY
001972 THSQ1=PX1S**2+PY1S**2
001973 XM1=THSQ1/(S*XI)
001974 IF(JBOOK.EQ.1) GO TO 301
001975 PX1T=-PX1+Z1*PX
001976 PY1T=-PY1+Z1*PY
001977 C
001978 301 CONTINUE
001979 IF(X2.LT.XMIN) GO TO 400
001980 CALL QZGEN(IFLA2,Y,Y2,QSQ2)
001981 TPSQ2=Z2*QSQ
001982 PTR2=Z1*Z*QSQ
001983 PTR2=SQRT(PT2R2)
001984 IF(KEYBRE.GE.1) PTR2=0.
001985 PH2=PI2-RNDM(0)
001986 PX2=PTR2*NCOS(PH2)
001987 PY2=PTR2*NSIN(PH2)
001988 PX2S=PX2+Z1*PX
001989 PY2S=PY2+Z1*PY
001990 THSQ2=PX2S**2+PY2S**2
001991 XM2=THSQ2/(S*X2)
001992 IF(JBOOK.EQ.1) GO TO 305
001993 PX2T=-PX2+Z*PX
001994 PY2T=-PY2+Z*PY
001995 C
001996 305 CONTINUE
001997 C
001998 C-- DECIDE WHICH IS NEXT TO CASCADE, ADD TO CUE
001999 C
002000 400 CONTINUE
002001 IF(X1.LT.XMIN) GO TO 452
002002 IF(X1.LT.XM1) GO TO 452
002003 IF(X2.LT.XMIN) GO TO 450
002004 IF(X2.LT.XM2) GO TO 450
002005 NCUE(IBEAM)=NCUE(IBEAM)+1
002006 NCUE=MAX0(MNCUE,NCUE(IBEAM))
002007 NC=NCUE(IBEAM)
002008 IF(NC.GE.MXNCUE) GO TO 500
002009 IF(JBOOK.EQ.2) CALL TBOOK(IBEAM,IFLA1,TPSQ1,X1,PX1T,PY1T,IBOOK2)
002010 CUE(NC,1,IBEAM)=IFLA2
002011 CUE(NC,2,IBEAM)=Y2
002012 CUE(NC,3,IBEAM)=X2
002013 CUE(NC,4,IBEAM)=IBOOK2
002014 CUE(NC,5,IBEAM)=PX2S
002015 CUE(NC,6,IBEAM)=PY2S
002016 CUE(NC,7,IBEAM)=QSQ2
002017 CUE(NC,8,IBEAM)=XM2
002018 C
002019 450 CONTINUE
002020 IF(JBOOK.EQ.2) CALL TBOOK(IBEAM,IFLA2,TPSQ1,X2,PX1T,PY1T,IBOOK1)
002021 IF(Y1.GT.YQSQ) GO TO 402
002022 IFLA=IFLA1
002023 Y=Y1
002024 X=X1
002025 PX=PX1S
002026 PY=PY1S
002027 C
002028 C
002029 C
002030 C
002031 C
002032 C
002033 C
002034 C
002035 C
002036 C
002037 C
002038 C
002039 C
002040 C
002041 C
002042 C
002043 C
002044 C
002045 C
002046 C
002047 C
002048 C
002049 C
002050 C
002051 C
002052 C
002053 C
002054 C
002055 C
002056 C
002057 C
002058 C
002059 C
002060 C
002061 C
002062 C
002063 C
002064 C
002065 C
002066 C
002067 C
002068 C
002069 C
002070 C
002071 C
002072 C
002073 C
002074 C
002075 C
002076 C
002077 C
002078 C
002079 C
002080 C
002081 C
002082 C
002083 C
002084 C
002085 C
002086 C
002087 C
002088 C
002089 C
002090 C
002091 C
002092 C
002093 C
002094 C
002095 C
002096 C
002097 C
002098 C
002099 C
002100 C
002101 C
002102 C
002103 C
002104 C
002105 C
002106 C
002107 C
002108 C
002109 C
002110 C
002111 C
002112 C

```



```

IBOOK=IBOOK1
QSQ=QSQ1
GO TO 200
402 CONTINUE
CALL BOOK(FLA1,IBOOK1,XM1,Y1,X1,PX1S,PY1S)
IF(JBOOK.EQ.1) GO TO 462
RETURN
452 IF(X2.LT.XMIN) GO TO 462
IF(X2.LT.XM2) GO TO 462
IF(JBOOK.EQ.2) CALL TBOOK(BOOK,FLA1,TPSQ2,X1,PX2T,PY2T,IBOOK2)
IF(Y2.GT.YQSQ) GO TO 460
IFLA=IFLA2
Y=Y2
X=X2
PX=PX2S
PY=PY2S
IBOOK=IBOOK2
QSQ=QSQ2
GO TO 200
460 CONTINUE
CALL BOOK(FLA2,IBOOK2,XM2,Y2,X2,PX2S,PY2S)
IF(JBOOK.EQ.1) GO TO 462
RETURN
C
C-- PICK UP NEXT IN CUE
C
462 IF(NCUE(IBEAM).EQ.0) GO TO 480
NC=NCUE(IBEAM)
IFLA=CUE(1,IBEAM)
Y=CUE(2,IBEAM)
X=CUE(3,IBEAM)
IBOOK=CUE(4,IBEAM)
PX=CUE(5,IBEAM)
PY=CUE(6,IBEAM)
QSQ=CUE(7,IBEAM)
MBOOK(IBEAM)=IBOOK
IF(JBOOK.EQ.2) MBOOKS(IBEAM)=PARSPE(BOOK,4,IBEAM)
NCUE(IBEAM)=NCUE(IBEAM)+1
IF(Y.GT.YQSQ) GO TO 465
GO TO 200
465 CONTINUE
XM=CUE(8,IBEAM)
CALL BOOK(FLA,IBOOK,XM,Y,X,PX,PY)
IF(JBOOK.EQ.1) GO TO 462
RETURN
C
C-- EXIT
C
480 CONTINUE
ISTOP(IBEAM)=1
IBACK(IBEAM)=0
MBOOKS(IBEAM)=0
RETURN
C
C-- ABNORMAL EXIT
500 PRINT 501,MXACT,NEVOL
501 FORMAT(1H1,36HNUMBER OF QUANTA IN EVOL CUE EXCEEDS ,I10
1 //1X,13HCASCADE NO. = ,I10
2 //1X,56HINCREASE 1ST DIMENSION OF CUE( , , ) AND INCREASE MNCUE
2 )
STOP
END
C
SUBROUTINE Q2GEN(FLA,YIN,Y,QSQ)
*****
C-- GENERATES EVOLUTION PARAMETER OF LEG (Y,GE,YIN)
COMMON/BCDS/CF,CA,BALPH,PI,P12,PROGL,PROFLA(2),NPLAVS,LGLUS,IVAL
COMMON/ALQEN/MGALQ(127),MGALQ(127,5,3),Q2VECT(128),NALQ,DALQ
1 ,ALAMB,ALLAM2,PTMIN,PTMAX,PT2INT,QZEY,ALQZM,ALQZ,ALQF,YF
2 ,IPBAR,NCASC,SIGINL,PROPT,IPTHGT,PROPTH,PTMGTH,FRNARD,FRAGEN,FRAT002200
3 ,ZHCUT,ZLW,ZUP,XMIN
C
IFLA=1
IF(FLA.EQ.LGLUS) IFLA=2
Y2=ALQ(RNDM(0.))/PROFLA(IFLA)*YIN
ALQ=EXP(Y)
IF(ALQ.GT.ALQF) ALQ=ALQF
QSQ=EXP(ALQ*ALQZM+ALLAM2)
RETURN
END
C
SUBROUTINE ZGENS(IFUN,Z,IFLAQ)
*****
C-- GENERATES Z
COMMON/QCDS/CF,CA,BALPH,PI,P12,PROGL,PROFLA(2),NPLAVS,LGLUS,IVAL
COMMON/ALQEN/MGALQ(127),MGALQ(127,5,3),Q2VECT(128),NALQ,DALQ
1 ,ALAMB,ALLAM2,PTMIN,PTMAX,PT2INT,QZEY,ALQZM,ALQZ,ALQF,YF
2 ,IPBAR,NCASC,SIGINL,PROPT,IPTHGT,PROPTH,PTMGTH,FRNARD,FRAGEN,FRAT002200
002113 3 ,ZHCUT,ZLW,ZUP,XMIN
002114 C
002115 REAL MGTMAX(3)
002116 DATA MGTMAX/2.,1.125,1./
002117 DATA ICALL/0/
002118 C
002119 IF(ICALL.GT.0) GO TO 30
002120 ICALL=1
002121 ALLW=ALQ(1.-ZLW)
002122 LM(0.5)
002123 C
002124 ALLW=-.6931471
002125 ALUP=ALQ(1.-ZUP)
002126 DZ=ALLW-ALUP
002127 DZG=ALLW-ALUP
002128 CONTINUE
002129 C
002130 IF(IFUN.EQ.1) GO TO 1
002131 IF(IFUN.EQ.2) GO TO 2
002132 IF(IFUN.EQ.3) GO TO 3
002133 C-- QUARK BRANCHING
002134 1 CONTINUE
002135 11 RR=RNDM(0.)
002136 Z1=EXP(RR*DZ+ALUP)
002137 Z=1.-Z1
002138 NFUN=1.+Z**2
002139 IF(RNDM(0.).GT.NFUN/MGTMAX(IFUN)) GO TO 11
002140 RETURN
002141 C
002142 C-- GLUON BRANCHING INTO TWO GLUONS
002143 2 CONTINUE
002144 21 RR=RNDM(0.)
002145 Z1=EXP(RR*DZG+ALUP)
002146 Z=1.-Z1
002147 A=Z**2
002148 B=Z1**2
002149 NFUN=(A+B+A*B)/Z
002150 IF(RNDM(0.).GT.NFUN/MGTMAX(IFUN)) GO TO 21
002151 IF(RNDM(0.).GT.0.5) Z=Z1
002152 RETURN
002153 C
002154 C-- GLUON BRANCHING INTO Q-QB
002155 3 CONTINUE
002156 Z=ZLW+(ZUP-ZLW)*RNDM(0.)
002157 Z1=1.-Z
002158 NFUN=Z**2+Z1**2
002159 IF(RNDM(0.).GT.NFUN) GO TO 3
002160 IFLAG=INT(FLOAT(NPLAVS)*RNDM(0.))+1
002161 RETURN
002162 C
002163 END
002164 C
002165 SUBROUTINE BOOK(FLA1,IBOOK,XM1,Y1,X1,PX1S,PY1S)
002166 *****
002167 C-- BOOKS SPACELIKE QUANTA GENERATED BY EVOL
002168 COMMON/PARQ/PARACT(47,7,2),MXACT,IBEAM,NBOOK(2),JBOOK,MBOOK(2)
002169 1 ,PARSPE(39,6,2),MXSPE,SHARD
002170 COMMON/NEVOL/NEVOL,ISTOP(2),IBACK(2),MBOOKS(2)
002171 COMMON/ENTREV/S,QSQ,YQSQ,IPACH,XING(2),XING(2)
002172 1 ,PXING(2),PYING(2),IFLING(2),ICHING(2)
002173 NBK=MBOOK(IBEAM)
002174 IF(JBOOK.EQ.1)
002175 INBK=NBK+1
002176 IF(NBK.GT.MXACT) GO TO 500
002177 NBOOK(IBEAM)=NBK
002178 PARACT(NBK,1,IBEAM)=IFLA1
002179 PARACT(NBK,2,IBEAM)=IBOOK
002180 PARACT(NBK,3,IBEAM)=XM1
002181 PARACT(NBK,4,IBEAM)=Y1
002182 PARACT(NBK,5,IBEAM)=X1
002183 PARACT(NBK,6,IBEAM)=PX1S
002184 PARACT(NBK,7,IBEAM)=PY1S
002185 IBACK(IBEAM)=1
002186 RETURN
002187 C
002188 C-- ABNORMAL EXIT
002189 500 PRINT 501,MXACT,NEVOL
002190 501 FORMAT(1H1,36HNUMBER OF QUANTA PER BEAM IN PARACT EXCEEDS ,
002191 1 I10//1X,13HCASCADE NO. = ,I10
002192 2 //1X,32HINCREASE 1ST DIMENSION OF PARACT
002193 3 //1X,32HINCREASE 1ST DIMENSION OF NBKNC
002194 4 //1X,40HINCREASE DIMENSION OF NENT2 (SUB. MATCH)
002195 5 //1X,14HINCREASE MXACT )
002196 CALL OVERDM
002197 RETURN
002198 END
002199 C
002200 SUBROUTINE TBOOK(BOOK,FLA1,TPSQ1,XIT,PXIT,PYIT,IBOOK1)
002201
002202
002203
002204
002205
002206
002207
002208
002209
002210
002211
002212
002213
002214
002215
002216
002217
002218
002219
002220
002221
002222
002223
002224
002225
002226
002227
002228
002229
002230
002231
002232
002233
002234
002235
002236
002237
002238
002239
002240
002241
002242
002243
002244
002245
002246
002247
002248
002249
002250
002251
002252
002253
002254
002255
002256
002257
002258
002259
002260
002261
002262
002263
002264
002265
002266
002267
002268
002269
002270
002271
002272
002273
002274
002275
002276
002277
002278
002279
002280
002281
002282
002283
002284
002285
002286
002287
002288

```

```

C *****
C-- BOOKS TIMELIKE QUANTA GENERATED BY EVOL
COMMON/PARQ/PARACT(47,7,2),HXACT,IBEAM,NBOOK(2),JBOOK,MBOOK(2)
1 ,PARSPE(39,6,2),MXSPE,SHARD
COMMON/NEVOL/NEVOL,ISTOP(2),IBACK(2),MBOOKS(2)
COMMON/EVENT/NEVENT,ECM,PARHAD(401,7),NPART,MPART,WEIGHT
MBK=MBOOK(IBEAM)
MBK=MBK+1
IF(MBK.GT.MXSPE) GO TO 500
MBOOK(IBEAM)=MBK
IBOOKI=MBK
PARSPE(MBK,1,IBEAM)=PXIT
PARSPE(MBK,2,IBEAM)=PYIT
PARSPE(MBK,3,IBEAM)=XIT*ECM
PARSPE(MBK,4,IBEAM)=IBOOK
PARSPE(MBK,5,IBEAM)=TPSQ1
PARSPE(MBK,6,IBEAM)=IFLA1
RETURN
C
C-- ABNORMAL EXIT
500 PRINT 501,MXSPE,NEVOL
501 FORMAT(5//,1X,35HNUMBER OF QUANTA IN PARSPE EXCEEDS ,I10
1 //1X,13HCASCADE NO. = ,I10
2 //1X,52HINCREASE 1ST DIMENSION OF PARSPE AND INCREASE MXSPE
2 )
CALL OVEROM
RETURN
END
C
SUBROUTINE OVEROM
*****
C-- TAKES ACTION IN DIMENSION OVERFLOW
C-- IF KOVER.GT.0 JUST SETS WEIGHT=0. AND EXECUTION GOES ON WITH SOME
C-- DIAGNOSTICS FOR THE 1ST 100 OVERFLOWS -- IF KOVER.LT.0 STOPS
C-- EXECUTION BY PRODUCING AN ARITHMETIC ERROR)
COMMON/EVENT/NEVENT,ECM,PARHAD(401,7),NPART,MPART,WEIGHT
COMMON/OVER/KOVER,SPYOVR
C
DATA ICALL/0/
C
ICALL=ICALL+1
SPYOVR=FLOAT(ICALL)
WEIGHT=0.
IF(KOVER.GT.0..AND.ICALL.LT.100) PRINT 5,ICALL
FORMAT(1X,21HTHIS EVENT IS IGNORED
5 1 //1X,18HEXECUTION PROCEEDS
2 //1X,39HKOVER.GT.0, DIMENSION OVERFLOWS SO FAR ,I10,1H )
IF(KOVER.GT.0.AND.ICALL.LT.100) RETURN
C
PRINT 10
10 FORMAT(5//1X,80(1H*))//6X,35HTHE FOLLOWING ERROR IS DELIBERATELY,
135H PROVOCATED TO ACTIVATE MEMORY DUMP
2 //5//1X,80(1H*))
A=0.
B=1/A
RETURN
END
C
FUNCTION ASIMP(A1,B1,EP,M,N,FUN)
*****
C-- ADAPTIVE SIMPSON INTEGRATION ROUTINE
REAL F2(30),FBP(30),EST2(30)
INTEGER NRTR(30)
REAL AEST2(30),FTST(3),XB(30)
IF(N.LE.0) GO TO 210
IF(N.GT.3) GO TO 211
A=A1
B=B1
EPS=EP*15.
ESUM=0.
TSUM=0.
LVL=1
DA=B-A
FA=FUN(A)
FM=FUN((A+B)*0.5)
FB=FUN(B)
M=3
FMX=ABS(FA)
FTST(1)=FMX
FTST(2)=ABS(FM)
FTST(3)=ABS(FB)
DO 100 I=2,3
IF(FMX.GE.FTST(I)) GO TO 100
CONTINUE
EST=(FA+4.*FM+FB)*DA/6.
ABSAR=(FTST(1)+4*FTST(2)+FTST(3))*DA/6.
AEST=ABSAR
002289 C 1=RECUR
002290 1 SX=(DA/(2.*LVL))/6.
002291 FI=FUN((3.*A+B)/4.)
002292 F2(LVL)=FUN((A+3.*B)/4.)
002293 EST1=SX*(FA+4.*FI+FM)
002294 FBP(LVL)=FB
002295 XB(LVL)=B
002296 EST2(LVL)=SX*(FM+4.*F2(LVL)+FB)
002297 SUM=EST1+EST2(LVL)
002298 FTST(1)=ABS(FI)
002299 FTST(2)=ABS(F2(LVL))
002300 FTST(3)=ABS(FM)
002301 AEST1=SX*(ABS(FA)+4.*FTST(1)+FTST(3))
002302 AEST2(LVL)=SX*(FTST(3)+4.*FTST(2)+ABS(FB))
002303 ABSAR=ABSAR+AEST1+AEST2(LVL)
002304 M=M+2
002305 IF(M.EQ.1) GO TO 201
002306 IF(M.EQ.2) GO TO 200
002307 IF(M.EQ.3) GO TO 202
002308 200 DELTA=ABSAR
002309 GO TO 205
002310 210 PRINT 39
002311 39 FORMAT(20H ERROR RETURN-N.LT.0 )
002312 RETURN
002313 211 PRINT 40
002314 40 FORMAT(20H ERROR RETURN-N.GT.3 )
002315 RETURN
002316 201 DELTA=1.
002317 GO TO 205
002318 202 DO 203 I=1,2
002319 IF(FMX.GE.FTST(I)) GO TO 203
002320 FMX=FTST(I)
002321 203 CONTINUE
002322 DELTA=FMX
002323 DAFT=EST-SUM
002324 DIFF=ABS(DAFT)
002325 DAFT=DAFT/15.
002326 IF(DIFF-EPS*DELTA)6,6,3
002327 3 IF(LVL-30)4,2,2
002328 6 IF(LVL-1)2,4,2
002329 C 2=UP
002330 2 A=B
002331 ESUM=ESUM+DAFT
002332 TSUM=TSUM+SUM
002333 9 LVL=LVL-1
002334 L=NRTR(LVL)
002335 IF(L.EQ.1) GO TO 11
002336 IF(L.EQ.2) GO TO 12
002337 C 11=R1,12=R2
002338 4 NRTR(LVL)=1
002339 EST=EST1
002340 AEST=AEST1
002341 FB=FM
002342 FM=FI
002343 B=(A+B)/2.
002344 EPS=EPS/2.
002345 7 LVL=LVL+1
002346 GO TO 1
002347 11 NRTR(LVL)=2
002348 FA=FB
002349 FM=F2(LVL)
002350 FB=FBP(LVL)
002351 B=XB(LVL)
002352 EST=EST2(LVL)
002353 AEST=AEST2(LVL)
002354 GO TO 7
002355 12 EPS=2.*EPS
002356 IF(LVL-1)5,5,9
002357 5 ASIMP=TSUM-ESUM
002358 RETURN
002359 END
002360 C
002361 C-----
002362 C
002363 C-- SECTION (C)
002364 C-- PACKAGE OF ROUTINES HANDLING TIMELIKE EVOLUTION OF QUANTA
002365 C
002366 C-----
002367 C
002368 C
002369 SUBROUTINE INIQCO
002370 *****
002371 C-- INITIALIZES PARAMETERS USED BY JETQCO
002372 COMMON/TRANS/ALAMBT,NFLATR,LGLUT,QSQMXT
002373 COMMON/QCO/ALAMBO,CF,CA,BALPN,PI
002374 COMMON/CUTOFF/QZ,QZSQ,QZMASS(6),QZFL(7),QZFLSQ(7),QTHRSQ(7)
002375 1 NFLAVT,LGLU
002376 COMMON/TABPSQ/TABPSQ(5,129),QSQMAX,ALMAX,ALMIN(7),DSTEP(7)
002377 002378 002379 002380 002381 002382 002383 002384 002385 002386 002387 002388 002389 002390 002391 002392 002393 002394 002395 002396 002397 002398 002399 002400 002401 002402 002403 002404 002405 002406 002407 002408 002409 002410 002411 002412 002413 002414 002415 002416 002417 002418 002419 002420 002421 002422 002423 002424 002425 002426 002427 002428 002429 002430 002431 002432 002433 002434 002435 002436 002437 002438 002439 002440 002441 002442 002443 002444 002445 002446 002447 002448 002449 002450 002451 002452 002453 002454 002455 002456 002457 002458 002459 002460 002461 002462 002463 002464

```

```

1      ,NPREC,NTAB,KOATAB(7),MAXTAB
DATA ICALL/0/
C
IF(ICALL.GT.0) RETURN
ICALL=1
C
C-- QCD CONSTANTS
PI=4.*ATAN(1.)
COLORS=3.
CA=COLORS
CF=(COLORS**2-1.)/(2.*COLORS)
NFLAVT=NFLATR
BALPH=(11.*COLORS-2.*FLOAT(NFLAVT))/(12.*PI)
C
C-- CUTOFFS
QSQMAX=QSQMKT
ALAMB0=ALAMBT
QZSQ=QZ**2
DO 1 L=1,NFLAVT
  QZFL(L)=QZ+QZMASS(L)
  QZFLSQ(L)=QZFL(L)**2
  QTHRSQ(L)=(QZ+QZFL(L))**2
  LGLU=NFLAVT+1
  LGLUT=LGLU
  QZFL(LGLU)=QZ
  QZFLSQ(LGLU)=QZSQ
  QTHRSQ(LGLU)=4.*QZSQ
C
CALL TABLES
RETURN
END
C
SUBROUTINE TABLES
*****
C-- PREPARES TABLES FOR MASS DEGRADATION OF QUANTA
EXTERNAL FIQRK, FIGLU
COMMON/QCD/ALAMB0,CF,CA,BALPH,PI
COMMON/CUTOFF/QZ,QZSQ,QZMASS(6),QZFL(7),QZFLSQ(7),QTHRSQ(7)
1  ,NFLAVT,LGLU
COMMON/TABPSQ/TABPSQ(5,129),QSQMAX,ALMAX,ALMIN(7),DSTEP(7)
1  ,NPREC,NTAB,KOATAB(7),MAXTAB
COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,WEIGHT
COMMON/FINT/ALLAM2,LFLA
C
DO 1 L=1,NFLAVT
  IF(2.*(QZ+QZMASS(L)).LT.ECH) NFLAX=L
  NFLAVT=NFLAX
  NPREC=7
  FACT=1./(2.*PI*BALPH)
  ALLAM2=ALOG(ALAMB0**2)
  NTAB=2*NPREC+1
  ALMAX=ALOG(QSQMAX)*(1.+1.E-6)
  EPSI=FLOAT(NTAB)**(-2)
  KFLA=0
  OLQTHR=0.
C
DO 10 L=1,LGLU
  ALMIN(L)=ALOG(QTHRSQ(L))
  DSTEP(L)=(ALMAX-ALMIN(L))/FLOAT(NTAB-1)
  IF(ABS(QTHRSQ(L)-OLQTHR).LT.1.E-5.AND.L.NE.LGLU) GO TO 9
  LFLA=L
  KFLA=KFLA+1
  IF(KFLA.GT.MAXTAB) GO TO 500
  ALN=ALMIN(L)-DSTEP(L)
  BUP=ALMIN(L)
  TABPSQ(KFLA,1)=0.
C
IF(L.EQ.LGLU) GO TO 12
DO 11 I=2,NTAB
  ALN=ALN+DSTEP(L)
  BUP=BUP+DSTEP(L)
  TABPSQ(KFLA,I)=FACT*ASIMP(ALN,BUP,EPSI,M,2,FIQRK)
  +TABPSQ(KFLA,I-1)
  OLQTHR=QTHRSQ(L)
  GO TO 9
C
DO 12 I=2,NTAB
  ALN=ALN+DSTEP(L)
  BUP=BUP+DSTEP(L)
  TABPSQ(KFLA,I)=FACT*ASIMP(ALN,BUP,EPSI,M,2,FIGLU)
  +TABPSQ(KFLA,I-1)
C
CONTINUE
KOATAB(KFLA)=KFLA
CONTINUE
RETURN
C
002465 C-- ABNORMAL EXIT
002466 500 OLQTHR=0.
002467 KFLA=0
002468 DO 501 L=1,NFLAVT
002469 IF(ABS(QTHRSQ(L)-OLQTHR).LT.1.E-5) GO TO 501
002470 OLQTHR=QTHRSQ(L)
002471 KFLA=KFLA+1
002472 CONTINUE
002473 KFLA=KFLA+1
002474 PRINT 502,MAXTAB,NFLAVT,KFLA,KFLA1,KFLA1
002475 502 FORMAT(1H1,51H0THESE DIMENSIONS OF TABPSQ( , ) ARE INSUFFICIENT (TABPSQ( , )
002476 111,18H, 129) AT PRESENT)
002477 2 /1X,12,33H FLAVORS HAVE BEEN REQUESTED WITH
002478 3 ,12,18H DIFFERENT CUTOFFS
002479 4 /1X,33HINCREASE 1ST DIMENSION TO TABPSQ(
002480 5 ,11,29H, 129) AND INCREASE MAXTAB TO ,12)
002481 STOP
002482 END
002483 C
002484 FUNCTION FIQRK(ALPSQ)
002485 *****
002486 C-- QUARK INTEGRATION FUNCTION USED BY TABLES
002487 COMMON/QCD/ALAMB0,CF,CA,BALPH,PI
002488 COMMON/CUTOFF/QZ,QZSQ,QZMASS(6),QZFL(7),QZFLSQ(7),QTHRSQ(7)
002489 1  ,NFLAVT,LGLU
002490 COMMON/FINT/ALLAM2,LFLA
002491 C
002492 A=ALPSQ
002493 CALL ZLIMH(EXP(A),QZFLSQ(LFLA),QZSQ,ZLM,ZUP,FLAG)
002494 IF(FLAG.GT.0) GO TO 100
002495 FIQRK=(PAPINT(1,ZUP)-PAPINT(1,ZLM))/(A-ALLAM2)
002496 RETURN
002497 100 FIQRK=0.
002498 RETURN
002499 END
002500 C
002501 FUNCTION FIGLU(ALPSQ)
002502 *****
002503 C-- GLUON INTEGRATION FUNCTION USED BY TABLES
002504 COMMON/QCD/ALAMB0,CF,CA,BALPH,PI
002505 COMMON/CUTOFF/QZ,QZSQ,QZMASS(6),QZFL(7),QZFLSQ(7),QTHRSQ(7)
002506 1  ,NFLAVT,LGLU
002507 COMMON/FINT/ALLAM2,LFLA
002508 C
002509 A=ALPSQ
002510 PSQ=EXP(A)
002511 CALL ZLIMSY(PSQ,QZSQ,ZLM,ZUP,FLAG)
002512 FIGLU=PAPINT(2,ZUP)-PAPINT(2,ZLM)
002513 DO 1 L=1,NFLAVT
002514 CALL ZLIMSY(PSQ,QZFLSQ(L),ZLM,ZUP,FLAG)
002515 IF(FLAG.GT.0) GO TO 2
002516 FIGLU=FIGLU+PAPINT(3,ZUP)-PAPINT(3,ZLM)
002517 2 FIGLU=FIGLU/(A-ALLAM2)
002518 RETURN
002519 END
002520 C
002521 SUBROUTINE JETQCD(SETIN)
002522 *****
002523 C-- DEVELOPS TIMELIKE CASCADE OF QUANTA
002524 C
002525 COMMON/QCD/ALAMB0,CF,CA,BALPH,PI
002526 COMMON/CUTOFF/QZ,QZSQ,QZMASS(6),QZFL(7),QZFLSQ(7),QTHRSQ(7)
002527 1  ,NFLAVT,LGLU
002528 COMMON/TABPSQ/TABPSQ(5,129),QSQMAX,ALMAX,ALMIN(7),DSTEP(7)
002529 1  ,NPREC,NTAB,KOATAB(7),MAXTAB
002530 COMMON/PARQUA/PARQUA(79,7),NQUA,MAXQUA
002531 COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,WEIGHT
002532 COMMON/KEYJET/IZFAST
002533 COMMON/MAXN/MNBOOK,MNBOOK,MNPART,MNQUA,MNCUE,MNCUEJ,MNSJO
002534 COMMON/KEYBRE/KEYBRE
002535 C
002536 REAL CUE(25,5)
002537 REAL PROB(7),VZLM(7),VZUP(7),SETIN(6)
002538 DATA NJTQCD/0/, MNCUE/25/
002539 C
002540 NJTQCD=NJTQCD+1
002541 IF(NJTQCD.GT.1) GO TO 1
002542 CALL INIQCD
002543 1 CONTINUE
002544 C
002545 C-- RESET
002546 NCUE=0
002547 C
002548 C-- SETTING PARAMETERS OF INITIAL LEG
002549 IFLA=SETIN(6)
002550 IF(IFLA.EQ.0) IFLA=LGLU
002551 MFLA=IABS(IFLA)
002552 PX=SETIN(1)
002553
002554
002555
002556
002557
002558
002559
002560
002561
002562
002563
002564
002565
002566
002567
002568
002569
002570
002571
002572
002573
002574
002575
002576
002577
002578
002579
002580
002581
002582
002583
002584
002585
002586
002587
002588
002589
002590
002591
002592
002593
002594
002595
002596
002597
002598
002599
002600
002601
002602
002603
002604
002605
002606
002607
002608
002609
002610
002611
002612
002613
002614
002615
002616
002617
002618
002619
002620
002621
002622
002623
002624
002625
002626
002627
002628
002629
002630
002631
002632
002633
002634
002635
002636
002637
002638
002639
002640

```

```

PY=SETIN(2)
EPP=SETIN(3)
PSQ=SETIN(5)
IF(KEYBRE.GE.2) PSQ=1.E-5
IF(PSQ.LT.0.)
  ICALL PSQGEN(MFLA,-SETIN(5),PSQ,IGO)
  IF(PSQ.GT.QTHRSQ(MFLA)) GO TO 200
C
C-- NO EMISSION AT ALL, BOOK INITIAL LEG IN PARQUA
CALL JTBOOK(PX,PY,EPP,PSQ,IFLA)
RETURN
C
C-- BRANCHING LOOP
C *****
C
C-- GENERATE Z
C -----
200 CONTINUE
MFLA=IABS(IFLA)
IF(IFLA.EQ.LGLU) GO TO 210
C-- QUARK BRANCHING
CALL ZLIM(PSQ,QZFLSQ(MFLA),QZSQ,ZLM,ZUP,FLAG,Z)
CALL ZGEN(1,ZLM,ZUP,FLAG,Z)
IFLA1=IFLA
IFLA2=LGLU
IF(IFLA.GT.0) GO TO 201
Z=1.-Z
IFLA1=LGLU
IFLA2=IFLA
201 CONTINUE
GO TO 250
C
C-- GLUON BRANCHING - GENERATE DECAY CHANNEL
210 CONTINUE
CALL ZLIMSY(PSQ,QZSQ,ZLM,ZUP,FLAG)
PROGL=PAPINT(2,ZUP)-PAPINT(2,ZLM)
PROB(1)=PROGL
VZLM(1)=ZLM
VZUP(1)=ZUP
DO 211 L=1,NFLAVT
CALL ZLIMSY(PSQ,QZFLSQ(L),ZLM,ZUP,FLAG)
IF(FLAG.GT.0) GO TO 212
PROGGB=PAPINT(3,ZUP)-PAPINT(3,ZLM)
PROB(L+1)=PROB(L)+PROGGB
VZLM(L+1)=ZLM
VZUP(L+1)=ZUP
GO TO 211
212 PROB(L+1)=PROB(L)
211 CONTINUE
RR=RNDRND(0.)
DO 213 L=1,LGLU
LOUT=L
IF(RR.LT.PROB(L)/PROB(LGLU)) GO TO 214
213 CONTINUE
LFLA=LOUT-1
214 FLAG=-1
IF(LFLA.GT.0) GO TO 230
C
C-- GLUON BRANCHES INTO TWO GLUONS
ZLM=VZLM(1)
ZUP=VZUP(1)
CALL ZGEN(2,ZLM,ZUP,FLAG,Z)
IFLA1=LGLU
IFLA2=LGLU
GO TO 250
C
C-- GLUON BRANCHES INTO Q-QB
230 ZLM=VZLM(LFLA+1)
ZUP=VZUP(LFLA+1)
CALL ZGEN(3,ZLM,ZUP,FLAG,Z)
IFLA1=LFLA
IFLA2=LFLA
GO TO 250
C
C-- GENERATE MASSES OF SECONDARIES
C -----
250 CONTINUE
MFLA1=IABS(IFLA1)
MFLA2=IABS(IFLA2)
IF(IZFAST.EQ.1) GO TO 251
IF(RNDRND(0.).GT..5) GO TO 270
GO TO 280
251 IF(Z.GT..5) GO TO 270
GO TO 280
270 CONTINUE
XPISQ=Z*(PSQ-QZFLSQ(MFLA2)/(1.-Z))
CALL PSQGEN(MFLA1,XPISQ,PISQ,IGO1)
XP2SQ=(1.-Z)*(PSQ-PISQ/Z)
002641 CALL PSQGEN(MFLA2,XP2SQ,P2SQ,IGO2)
002642 GO TO 290
002643 280 CONTINUE
002644 XP2SQ=(1.-Z)*(PSQ-QZFLSQ(MFLA1)/Z)
002645 CALL PSQGEN(MFLA2,XP2SQ,P2SQ,IGO2)
002646 XPISQ=Z*(PSQ-P2SQ/(1.-Z))
002647 CALL PSQGEN(MFLA1,XPISQ,PISQ,IGO1)
002648 GO TO 290
002649 C
002650 C-- SET TRANSVERSE VARIABLES
002651 C -----
002652 290 CONTINUE
002653 PTRSQ=Z*(1.-Z)*(PSQ-PISQ/Z-P2SQ/(1.-Z))
002654 PTR=SQRT(PTRSQ)
002655 IF(KEYBRE.GE.1) PTR=0.
002656 PHI=2.*PI*RNDRND(0.)
002657 PTRX=PTR*COS(PHI)
002658 PTRY=PTR*SIN(PHI)
002659 PIX=Z*PX+PTRX
002660 PIY=Z*PY+PTRY
002661 P2X=(1.-Z)*PX-PTRX
002662 P2Y=(1.-Z)*PY-PTRY
002663 C
002664 C-- BOOK SECONDARIES, DECIDE WHICH IS NEXT TO CASCADE
002665 C -----
002666 EPP1=EPP*Z
002667 EPP2=EPP*(1.-Z)
002668 IF(IGO1.EQ.0) GO TO 291
002669 C-- 1ST KEEPS CASCADING
002670 IFLA=IFLA1
002671 PSQ=PISQ
002672 EPP=EPP1
002673 PX=PIX
002674 PY=PIY
002675 C-- 2ND IN CUE FOR FUTURE CASCADING
002676 NCUE=NCUE+1
002677 MNCUEJ=MAX(0,MNCUEJ,NCUE)
002678 IF(NCUE.GT.MXNCUE) GO TO 550
002679 IF(IGO2.EQ.0) P2SQ=P2SQ
002680 CUE(NCUE,1)=IFLA2
002681 CUE(NCUE,2)=P2SQ
002682 CUE(NCUE,3)=EPP2
002683 CUE(NCUE,4)=P2X
002684 CUE(NCUE,5)=P2Y
002685 GO TO 200
002686 C
002687 C-- 1ST STOPS, BOOKED IN PARQUA
002688 291 CONTINUE
002689 CALL JTBOOK(PIX,PIY,EPP1,PISQ,IFLA1)
002690 IF(IGO2.EQ.0) GO TO 293
002691 C-- 2ND KEEPS CASCADING
002692 IFLA=IFLA2
002693 PSQ=P2SQ
002694 EPP=EPP2
002695 PX=P2X
002696 PY=P2Y
002697 GO TO 200
002698 C-- 2ND STOPS, BOOKED IN PARQUA. LAST IN CUE PICKED UP FOR CASCADING
002699 293 CONTINUE
002700 CALL JTBOOK(P2X,P2Y,EPP2,P2SQ,IFLA2)
002701 C-- EXIT FROM BRANCHING LOOP, IF THERE IS NO CUE LEFT
002702 295 IF(NCUE.EQ.0) RETURN
002703 IFLA=CUE(NCUE,1)
002704 PSQ=CUE(NCUE,2)
002705 EPP=CUE(NCUE,3)
002706 PX=CUE(NCUE,4)
002707 PY=CUE(NCUE,5)
002708 NCUE=NCUE-1
002709 IF(PSQ.LT.0.) GO TO 294
002710 GO TO 200
002711 C-- LAST IN CUE STOPS, BOOKED IN PARQUA
002712 294 PSQ=PSQ
002713 CALL JTBOOK(PX,PY,EPP,PSQ,IFLA)
002714 GO TO 295
002715 C
002716 C-- ABNORMAL EXIT
002717 550 NI=NEVENT+1
002718 PRINT 551,MXNCUE,NI,NJTCQD
002719 551 FORMAT(1H1,3HNUMBER OF QUANTA IN JETQCD CUE EXCEEDS ,I10
002720 1 //1X,11HEVENT NO. = ,I10
002721 2 //1X,20HNO. OF JETQCD CALLS ,I10
002722 3 //1X,40HINCREASE 1ST DIMENSION OF CUE( , )
002723 4 //1X,40HINCREASE MXNCUE ,I10
002724 STOP
002725 END
002726 C
002727 SUBROUTINE JTBOOK(PX,PY,EPP,PSQ,IFLA)
002728 C *****

```

```

002729
002730
002731
002732
002733
002734
002735
002736
002737
002738
002739
002740
002741
002742
002743
002744
002745
002746
002747
002748
002749
002750
002751
002752
002753
002754
002755
002756
002757
002758
002759
002760
002761
002762
002763
002764
002765
002766
002767
002768
002769
002770
002771
002772
002773
002774
002775
002776
002777
002778
002779
002780
002781
002782
002783
002784
002785
002786
002787
002788
002789
002790
002791
002792
002793
002794
002795
002796
002797
002798
002799
002800
002801
002802
002803
002804
002805
002806
002807
002808
002809
002810
002811
002812
002813
002814
002815
002816

```

```

C-- BOOKS QUANTA GENERATED BY JETQCD
COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MPART,WEIGHT
COMMON/CUTOFF/QZ,QZSQ,QZMASS(6),QZFL(7),QZFLSQ(7),QTHRSQ(7)
1 NPLAVT,LGLU
COMMON/PAQUA/PAQUA(79,7),NQUA,MAXQUA
COMMON/QUAOR/IQUAOR
COMMON/MAIX/MIBOOK,MIBOOK,MNPART,MNQUA,MNCUE,MNCUEJ,MNSJD
C
EMP=(PSQ*PX**2+PY**2)/EPP
PL=(EPP-EMP)*.5
E=(EPP+EMP)*.5
IF(E.LT.QZ) RETURN
IF(NQUA+1.GE.MAXQUA) GO TO 500
NQUA=NQUA+1
MNQUA=MAX(0,(MNQUA,NQUA))
IF(IFLA.EQ.LGLU) IFLA=0
PARQUA(NQUA,1)=PX
PARQUA(NQUA,2)=PY
PARQUA(NQUA,3)=PL
PARQUA(NQUA,4)=E
PARQUA(NQUA,5)=SQRT(PSQ)
PARQUA(NQUA,6)=IFLA
PARQUA(NQUA,7)=IQUAOR
CALL ROTQUA
RETURN
C
C-- ABNORMAL EXIT
500 NI=NEVENT+1
PRINT 501,MAXQUA,NI
501 FORMAT(5I/,1X,31HNUMBER OF FINAL QUANTA EXCEEDS ,I10
1 //1X,11HEVENT NO. = ,I10
2 //1X,37HINCREASE 1ST DIMENSION OF PARQUA( , )
3 //1X,15HINCREASE MAXQUA )
CALL OVERDM
RETURN
END
C
SUBROUTINE PSQGEN(IFLA,XPSQ,PSQ,IGO)
*****
C-- GENERATES SQUARE MASS (PSQ) OF LEG
COMMON/CUTOFF/QZ,QZSQ,QZMASS(6),QZFL(7),QZFLSQ(7),QTHRSQ(7)
1 NPLAVT,LGLU
COMMON/TABPSQ/TABPSQ(5,129),QSQMAX,ALMAX,ALMIN(7),DSTEP(7)
1 NPREC,NTAB,KOATAB(7),MAXTAB
C
IF(XPSQ.LE.QTHRSQ(IFLA)) GO TO 100
C
KFLA=KOATAB(IFLA)
RIX=(ALOG(XPSQ)-ALMIN(IFLA))/DSTEP(IFLA)+1.
IF(RIX.LT.1.) GO TO 100
IX=RIX
DIX=RIX-FLD(IX)
TBX=TABPSQ(KFLA,IX)+(TABPSQ(KFLA,IX+1)-TABPSQ(KFLA,IX))*DIX
TBGEN=TBX+ALOG(RNDM(0.))
C
IF(TBGEN.LT.0.) GO TO 100
C
LEG WILL CASCADE, GENERATE MASS
IF(TBGEN.LT.TABPSQ(KFLA,IX)) GO TO 1
PSQ=EXP((FLOAT(IX) + (TBGEN-TABPSQ(KFLA,IX)))/
1 (TABPSQ(KFLA,IX+1)-TABPSQ(KFLA,IX)) - 1.) * DSTEP(IFLA))
2 + ALMIN(IFLA))
IGO=1
RETURN
C
1 CONTINUE
IUP=IX
ILW=1
3 IF(IUP.EQ.ILW+1) GO TO 4
IHALF=ILW+(IUP-ILW)/2
IF(TBGEN.LT.TABPSQ(KFLA,IHALF)) GO TO 2
ILW=IHALF
GO TO 3
2 IUP=IHALF
GO TO 3
4 PSQ=EXP((FLOAT(ILW) + (TBGEN-TABPSQ(KFLA,ILW))/
1 (TABPSQ(KFLA,ILW+1)-TABPSQ(KFLA,ILW)) - 1.)
2 * DSTEP(IFLA) + ALMIN(IFLA))
IGO=1
RETURN
C
C-- LEG STOPS, MASS SET EQUAL TO CUTOFF
100 CONTINUE
PSQ=QZFLSQ(IFLA)
IF(XPSQ.LT.PSQ) PSQ=XPSQ
IGO=0
RETURN
END
002817 C
002818 SUBROUTINE ZGEN(IFUN,ZLW,ZUP,FLAG,Z)
002819 C
002820 C-- GENERATES Z
002821 C
002822 REAL MGTMAX(3)
002823 DATA MGTMAX/2.,1.125,1./
002824 C
002825 IF(FLAG.GT.0.) GO TO 100
002826 IF(IFUN.EQ.1) GO TO 1
002827 IF(IFUN.EQ.2) GO TO 2
002828 IF(IFUN.EQ.3) GO TO 3
002829 C
002830 C-- QUARK BRANCHING
002831 1 CONTINUE
002832 ALLW=ALOG(1.-ZLW)
002833 ALUP=ALOG(1.-ZUP)
002834 DZ=ALLW-ALUP
002835 11 RR=RNDM(0.)
002836 Z1=EXP(RR*DZ+ALUP)
002837 Z=1.-Z1
002838 WFUN=1.-Z**2
002839 IF(RNDM(0.).GT.WFUN/MGTMAX(IFUN)) GO TO 11
002840 RETURN
002841 C
002842 C-- GLUON BRANCHING INTO TWO GLUONS
002843 2 CONTINUE
002844 LOG(0.5)
002845 ALLW=-.6931471
002846 ALUP=ALOG(1.-ZUP)
002847 DZ=ALLW-ALUP
002848 21 RR=RNDM(0.)
002849 Z1=EXP(RR*DZ+ALUP)
002850 Z=1.-Z1
002851 A=Z**2
002852 B=Z1**2
002853 WFUN=(A+B+A*B)/Z
002854 IF(RNDM(0.).GT.WFUN/MGTMAX(IFUN)) GO TO 21
002855 IF(RNDM(0.).GT.0.5) Z=Z1
002856 RETURN
002857 C
002858 C-- GLUON BRANCHING INTO Q-QB
002859 3 CONTINUE
002860 Z=ZLW+(ZUP-ZLW)*RNDM(0.)
002861 WFUN=Z**2+(1.-Z)**2
002862 IF(RNDM(0.).GT.WFUN) GO TO 3
002863 RETURN
002864 C
002865 100 Z=ZUP
002866 RETURN
002867 END
002868 C
002869 FUNCTION PAPINT(IFUN,Z)
002870 C
002871 C-- INDEFINITE INTEGRALS OF SPLITTING PROBABILITY FUNCTIONS
002872 DATA ICALL/0/
002873 IF(ICALL.GT.0) GO TO 10
002874 ICALL=1
002875 COLORS=3.
002876 CA=COLORS
002877 CF=(COLORS**2-1.)/(2.*COLORS)
002878 10 CONTINUE
002879 C
002880 IF(IFUN.EQ.1) GO TO 1
002881 IF(IFUN.EQ.2) GO TO 2
002882 IF(IFUN.EQ.3) GO TO 3
002883 C
002884 C-- Q --> Q + G
002885 1 CONTINUE
002886 Z1=1.-Z
002887 PAPINT=-(ALOG(Z1)+Z1*(-1.+0.25*Z1))
002888 PAPINT=2.*CF*PAPINT
002889 RETURN
002890 C
002891 C-- G --> G + G
002892 2 CONTINUE
002893 PAPINT=-ALOG(1.-Z)+ALOG(Z)+Z*(-2.+Z*(0.5-Z/3.))
002894 PAPINT=CA*PAPINT
002895 RETURN
002896 C
002897 C-- G --> Q + QB
002898 3 CONTINUE
002899 PAPINT=(Z**3-(1.-Z)**3)/6.
002900 RETURN
002901 C
002902 END
002903 C
002904 SUBROUTINE ZLIM(PSQ,QZ1SQ,QZ2SQ,ZLW,ZUP,FLAG)

```

```

002905
002906
002907
002908
002909
002910
002911
002912
002913
002914
002915
002916
002917
002918
002919
002920
002921
002922
002923
002924
002925
002926
002927
002928
002929
002930
002931
002932
002933
002934
002935
002936
002937
002938
002939
002940
002941
002942
002943
002944
002945
002946
002947
002948
002949
002950
002951
002952
002953
002954
002955
002956
002957
002958
002959
002960
002961
002962
002963
002964
002965
002966
002967
002968
002969
002970
002971
002972
002973
002974
002975
002976
002977
002978
002979
002980
002981
002982
002983
002984
002985
002986
002987
002988
002989
002990
002991
002992

```

```

C *****
C-- CALCULATES LIMITS FOR Z - INPUT, SQUARE MASSES
FLAG=1.
IF(SQRT(PSQ).LT.(SQRT(QZ1SQ)+SQRT(QZ2SQ))) GO TO 10
B=-11.+QZ1SQ/PSQ-QZ2SQ/PSQ
C=QZ1SQ/PSQ
DISCR=B**2/4.-C
IF(DISCR.LT.0.) GO TO 10
SQDIS=SQRT(DISCR)
ZLW=-B/2.-SQDIS
ZUP=-B/2.+SQDIS
RETURN
10 FLAG=1.
ZLW=0.5
ZUP=0.5
RETURN
END

C
SUBROUTINE ZLIMSY(PSQ,QZSQ,ZLW,ZUP,FLAG)
*****
C-- CALCULATES LIMITS FOR Z WHEN SECONDARY MASSES ARE EQUAL
C-- INPUT, SQUARE MASSES
C
FLAG=1.
IF(PSQ.LT.4.*QZSQ) GO TO 10
D=SQRT(1.25-QZSQ/PSQ)
ZLW=.5-D
ZUP=.5+D
RETURN
10 FLAG=1.
ZLW=.5
ZUP=.5
RETURN
END

C-----
C-- SECTION (D)
C-- PACKAGE OF ROUTINES HANDLING THE HADRONIZATION OF QUANTA
C-- AND SPECTATOR JETS
C-----
C
SUBROUTINE HADRON(NQUA1,NQUA2,IMBIAS)
*****
C-- HANDLES HADRONIZATION OF FINAL STATE
COMMON/QCD/ALAMB,CF,CA,BALPH,PI
COMMON/CUTOFF/QZ,QZSQ,QZMSS(6),QZFL(7),QZFLSQ(7),QTHRSQ(7)
1,NFLAVT,LGLU
COMMON/TABPSQ/TABPSQ(5,129),QSQMAX,ALMAX,ALMIN(7),DSTEP(7)
1,NPREC,NTAB,KOBTAB(7),MAXTAB
COMMON/PARQUA/PARQUA(79,7),NQUA,MAXQUA
COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MPART,WEIGHT
COMMON/PMBIAS/PMBIAS(5)
COMMON/HADQN/LHADR(110),LCHARG(110),LCHARM(110),LBOTT(110)
*,LTOP(110)
COMMON/HAXN/MBBOOK,MMBOOK,MNPART,MNQUA,MNCUE,MNCUEJ,MNSJO
C
C-- COMMON BLOCKS IN SJOSTRAND PROGRAM
COMMON /PAR/ PU0, PSI, SIGMA, CX2, EBEG, MFIN, IFLBEG
COMMON /JET/ K(399,2), P(399,5)
COMMON /EDPAR/ ITHROW, PZMIN, PHIN, THETA, PHI, BETA(3)
COMMON /DECPAR/ PU00, PSID, CND1, CND2, IOB(110)
COMMON /DATA1/ MESO(36), CHIX(6,2), PHAS(110), QMAS(6)
COMMON/PHASS/PHASSD(110)
COMMON/HAXSJO/HAXSJO
COMMON/KEYBRE/KEYBRE
C
C
DATA ICALL/0/
C
C-- PRELIMINARIES
IF(ICALL.GT.0) GO TO 11
ICALL=1
CALL SBLOCK
EPS=1.E-7
UEPS=1.+EPS
C
11 CONTINUE
NPARTL=NPART
NIT=0
15 CONTINUE
NIT=NIT+1
IF(NIT.GT.10) GO TO 122
NPART=NPARTL
IF(NQUA1.GT.NQUA2) GO TO 125
002993 DO 100 I=NQUA1,NQUA2
002994 C
002995 C-- PREPARE TO ENTER SJOSTRAND PROGRAM
002996 PP=SQRT(PARQUA(I,1)**2+PARQUA(I,2)**2+PARQUA(I,3)**2)
002997 E=PARQUA(I,4)
002998 EBEG=E*1000.
002999 ITHROW=1
003000 THETA=0.
003001 PHI=0.
003002 IFLBEG=PARQUA(I,6)
003003 CALL JETGEN(N)
003004 CALL EDIT(N)
003005 C
003006 C-- APPROPRIATE ROTATION IS APPLIED
003007 THETA=ACOS(PARQUA(I,3)/PP/UEPS)
003008 IF((PARQUA(I,1)**2+PARQUA(I,2)**2).LT.EPS) GO TO 21
003009 PHI=ATAN2(PARQUA(I,2),PARQUA(I,1))
003010 GO TO 22
003011 21 PHI=0.
003012 22 CONTINUE
003013 IF(PHI.LT.0.) PHI=PHI+2.*PI
003014 ITHROW=0
003015 CALL EDIT(N)
003016 C
003017 C-- BOOKING
003018 IF(N.EQ.0) GO TO 100
003019 IF(NPART.NE.GT.MXPART) GO TO 500
003020 DO 41 IH=1,N
003021 IHI=NPART+IH
003022 DO 42 J=1,5
003023 PARHAD(IHI,J)=P(IH,J)/1000.
003024 PARHAD(IHI,6)=K(IH,2)
003025 PARHAD(IHI,7)=ISIGN(1,INT(PARQUA(I,7)))
003026 41 CONTINUE
003027 NPART=NPART+N
003028 100 CONTINUE
003029 IF(IMBIAS.EQ.0) RETURN
003030 C
003031 C-- PREPARE TO CALL MBIAS
003032 125 CONTINUE
003033 DO 200 J=1,3
003034 PMBIAS(J)=0.
003035 PMBIAS(4)=ECH
003036 PMBIAS(5)=PMBIAS(4)
003037 IF(NPART.EQ.0) GO TO 105
003038 DO 201 J=1,4
003039 DO 201 IHI=1,NPART
003040 PMBIAS(IJ)=PMBIAS(IJ)-PARHAD(IH,J)
003041 IF(PMBIAS(4).LT.0.) GO TO 15
003042 AM2=PMBIAS(4)**2-PMBIAS(1)**2-PMBIAS(2)**2-PMBIAS(3)**2
003043 IF(AM2.LT.0.) GO TO 15
003044 PMBIAS(5)=SQRT(AM2)
003045 IF(PMBIAS(5).LT.ECH*.01.OR.PMBIAS(5).LT.5.) GO TO 15
003046 GO TO 105
003047 122 CONTINUE
003048 WEIGHT=0.
003049 GO TO 90
003050 C
003051 105 CONTINUE
003052 C
003053 CALL MBIAS
003054 C
003055 90 CONTINUE
003056 MNPART=MAX0(MNPART,NPART)
003057 C
003058 RETURN
003059 C
003060 C
003061 C-- ABNORMAL EXIT
003062 500 PRINT 501,MXPART,NEVENT,NQUA
003063 501 FORMAT(1X,/,1X,20HNUMBER OF PARTICLES EXCEEDS ,I10
003064 1 //1X,11HEVENT NO. = ,I10 ,10X,10HNO. JETS = ,I10
003065 2 //1X,40HINCREASE 1ST DIMENSION OF PARHAD( , ) AND MXPART
003066 3 //1X,49HINCREASE DIMENSIONS OF THV( ) AND Y( ) (SUB. KNO)
003067 4
003068 CALL OVERDM
003069 RETURN
003070 END
003071 C
003072 SUBROUTINE MBIAS
003073 *****
003074 C-- GENERATES SPECTATOR JETS
003075 COMMON/QCD/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAVS,LGLUS,IVAL
003076 COMMON/ALGEN/MGALBT(127),MGALQ(127,5,3),QZVECT(120),NALQ,DALQ
003077 1,ALAMB,ALLAH2,PTMIN,PTMAX,PT2INT,QZEV,ALQZM,ALQI,ALQF,YF
003078 2,IPBAR,NCASC,SIGINL,PROPT,IPTHGT,PROPTM,PTWGT,FRHARD,FRAGEN,FRAT
003079 3,ZHCUT,ZLW,ZUP,XMIN
003080 COMMON/PARQUA/PARQUA(79,7),NQUA,MAXQUA
003081
003082
003083
003084
003085
003086
003087
003088
003089
003090
003091
003092
003093
003094
003095
003096
003097
003098
003099
003100
003101
003102
003103
003104
003105
003106
003107
003108
003109
003110
003111
003112
003113
003114
003115
003116
003117
003118
003119
003120
003121
003122
003123
003124
003125
003126
003127
003128
003129
003130
003131
003132
003133
003134
003135
003136
003137
003138
003139
003140
003141
003142
003143
003144
003145
003146
003147
003148
003149
003150
003151
003152
003153
003154
003155
003156
003157
003158
003159
003160
003161
003162
003163
003164
003165
003166
003167
003168

```

```

COMMON/ENTREV/S,QSQ,YQSQ,IPACH,XING(2),XING(2)
1 ,PXING(2),PYING(2),IFLING(2),ICHING(2)
COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,HEIGHT
COMMON/PHBIAS/PHBIAS(5)
COMMON /JET/ K(399,2), P(399,5)
COMMON /PAR/ PUD, PSI, SIGMA, CX2, EBEG, WFIN, IFLBEG
COMMON /DECAP/ PUDD, PSID, CND1, CND2, IDB(110)
COMMON /DATA/ MESO(36), CMIX(6,2), PHAS(110), QHAS(6)
COMMON/PHASS/PHASSH(110)
COMMON/HB/CLPRO,PTZPRO,FPTMB,FHULMB,RETPIZ,RPAIR(9)
COMMON/MAXXJO/MAXXJO
COMMON/MAXN/MNBOOK,MNBOOK,MNPART,MNGUA,MNCUE,MNCUEJ,MNSJO
COMMON/KEYBRE/KEYBRE
REAL EPRR(2),EMPR(2),PHB(4),V1(4),V2(4),EPRR(2)
INTEGER NLEAD(2)

C
DATA ICALL/0/

C
C-- INITIALIZATION
IF(ICALL.GT.0) GO TO 5
ICALL=1
CALL SBLOCK
C=CLPRO
CLEAD=C
CINV=1./C
EC=1.-EXP(-C)
NLEAD(1)=102
IF(IPBAR.NE.1) NLEAD(1)=101
NLEAD(2)=101
CONTINUE

5
C
C-- PAIR OF LEADING NUCLEONS
EPRR(1)=PHBIAS(4)+PHBIAS(3)
EPRR(2)=PHBIAS(4)-PHBIAS(3)
NIT=0
NPARTH=NPART
NH=NPARTH
CONTINUE
8
NPART=NPARTH
DO 10 I=1,2
IF(NPART+1.GT.MXPART) GO TO 500
NPART=NPART+1
9
CONTINUE
NIT=NIT+1
IF(NIT.GT.30) GO TO 400
EPRR(1)=EPRR(1)*(-ALOG(1.-EC*RNDRM(I)))/CINV
PT2=PT2PRO*ALOG(RNDRM(I+1))
EMPR(I)=(PHASSH(100+I)*PT2)/EPRR(I)
IF(EMPR(I).GT.EPRR(I)) GO TO 9
PT=SQRT(PT2)
PHIP=PI*RNDRM(I+2)
PARHAD(NPART,1)=PT*COS(PHIP)
PARHAD(NPART,2)=PT* SIN(PHIP)
PARHAD(NPART,3)=(-1.)*(I+1)*(EPRR(I)-EMPR(I))*5
PARHAD(NPART,4)=(EPRR(I)+EMPR(I))*5
PARHAD(NPART,5)=PHASSH(NLEAD(I))
PARHAD(NPART,6)=NLEAD(I)
PARHAD(NPART,7)=0
10
CONTINUE
C-- DETERMINE 4-MOMENTUM OF SOFT HADRON SYSTEM
IF(IPBAR.EQ.1) PARHAD(NPART,6)=102
NPARTL=NPART+1
DO 11 J=1,4
11
PHB(J)=PHBIAS(J)-(PARHAD(NPART,J)+PARHAD(NPART-1,J))
IF(PHB(4).LT.0.) GO TO 8
W2=PHB(4)*2-PHB(1)*2-PHB(2)*2-PHB(3)*2
IF(W2.LT.1.) GO TO 8
C-- CALL KNO TO GENERATE SOFT HADRON SYSTEM
CALL KNO(SORT(W2),PHB)
C-- LONG LORENTZ BOOST TO LAB SYSTEM
IF(NPART.LT.NPARTL) RETURN
PHB(1)=0.
PHB(2)=0.
DO 110 I=NPARTL,NPART
DO 111 J=1,4
111
V1(J)=PARHAD(I,J)
CALL LOREN4(PHB,V1,V2)
DO 112 J=1,4
112
PARHAD(I,J)=V2(J)
113
PARHAD(I,7)=0
110
CONTINUE
RETURN
400
WEIGHT=0.
RETURN

C-- ABNORMAL EXIT
500
PRINT 501,MXPART,NEVENT,MNGUA
501
FORMAT(5/),IX,45HNO. OF PARTICLES DURING PHBIAS CALL EXCEEDS ,
1110/IX,11HREVENT NO. = ,110,10X,10HNO. JETS = ,110

003169 2 //IX,45HINCREASE 1ST DIMENSION OF PARHAD( , ) AND MXPART 003257
003170 3 //IX,45HINCREASE DIMENSIONS OF THV( ) AND Y( ) (SUB. KNO) 003258
003171 4 ) 003259
003172 CALL OVERON 003260
003173 RETURN 003261
003174 END 003262
003175 003263
003176 C SUBROUTINE LOREN4(PHB,V1,V2) 003264
003177 C ***** 003265
003178 C-- LORENTZ BOOST OF V1 TO V2 BY PHB 003266
003179 REAL PHB(4),V1(4),V2(4),BETA(3) 003267
003180 DO 1 J=1,3 003268
003181 BETA(J)=PHB(J)/PHB(4) 003269
003182 GA=1./SQRT(1.-BETA(1)*2-BETA(2)*2-BETA(3)*2) 003270
003183 BEP=BETA(1)*V1(1)+BETA(2)*V1(2)+BETA(3)*V1(3) 003271
003184 DO 2 J=1,3 003272
003185 V2(J)=V1(J)+GA*(GA/(1.+GA)*BEP+V1(4))*BETA(J) 003273
003186 V2(4)=GA*(V1(4)+BEP) 003274
003187 RETURN 003275
003188 END 003276
003189 C 003277
003190 C FUNCTION FHULAN) 003278
003191 C ***** 003279
003192 C-- GIVES MULTIPLICITY DISTRIBUTION OF SPECTATOR JET MESONS 003280
003193 COMMON/FHUL/AVNCH 003281
003194 Z=AN/AVNCH 003282
003195 FHUL=FHULOG(Z) 003283
003196 RETURN 003284
003197 END 003285
003198 C 003286
003199 C FUNCTION FHULOG(Z) 003287
003200 C ***** 003288
003201 C-- KNO (DE GROOT) MULTIPLICITY FUNCTION 003289
003202 FHULOG=1.333*Z/(GAMMA(2+1))*2*EXP(-.892*Z)*2.5 003290
003203 RETURN 003291
003204 END 003292
003205 C 003293
003206 SUBROUTINE KNO(M,PHB) 003294
003207 C ***** 003295
003208 C-- HELPS GENERATING SPECTATOR JETS 003296
003209 C-- TOTAL MULTIPLICITY DISTRIBUTION IN SPECTATOR JETS SAMPLED ACCORDING 003297
003210 C-- TO KNO (DE GROOT) 003298
003211 COMMON/QCDS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAVS,LGLUS,IVAL 003299
003212 COMMON/EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MXPART,HEIGHT 003300
003213 COMMON/KEYBRE/KEYBRE 003301
003214 COMMON/PHASS/PHASSH(110) 003302
003215 COMMON /JET/ K(399,2), P(399,5) 003303
003216 COMMON /PAR/ PUD, PSI, SIGMA, CX2, EBEG, WFIN, IFLBEG 003304
003217 COMMON /DECAP/ PUDD, PSID, CND1, CND2, IDB(110) 003305
003218 COMMON/HADQN/LHADN(110),LCHARG(110),LCNARM(110),LBOTT(110) 003306
003219 *,LTOP(110) 003307
003220 COMMON/HB/CLPRO,PTZPRO,FPTMB,FHULMB,RETPIZ,RPAIR(9) 003308
003221 COMMON/MAXXJO/MAXXJO 003309
003222 COMMON/MAXN/MNBOOK,MNBOOK,MNPART,MNGUA,MNCUE,MNCUEJ,MNSJO 003310
003223 REAL TPAIR(9) 003311
003224 INTEGER IFTB(2,9) 003312
003225 REAL THV(401),YV(401),VPM(7) 003313
003226 REAL PHB(4),SUM(2),A(4),V(4),V1(4) 003314
003227 DATA VPM/8.32,6.65,5.7,5.1,4.84,4.73,4.6/ 003315
003228 DATA IFTB/51,51,21,22,23,24,25,26,101,102,103,104 003316
003229 + ,105,106,107,108,109,110/ 003317
003230 DATA ICALL/0/ 003318
003231 C 003319
003232 IF(ICALL.GT.0) GO TO 10 003320
003233 ICALL=1 003321
003234 TPAIR(1)=RPAIR(1) 003322
003235 DO 11 M=2,9 003323
003236 TPAIR(M)=RPAIR(M)+TPAIR(M-1) 003324
003237 DO 12 M=1,9 003325
003238 TPAIR(M)=TPAIR(M)/TPAIR(9) 003326
003239 10 CONTINUE 003327
003240 C 003328
003241 IF(N.LT.1.) GO TO 100 003329
003242 C-- MEAN MULTIPLICITY 003330
003243 NH=NPART 003331
003244 NH=NH*1.6 003332
003245 ALB=2.50+.28*ALOG(NH)+.53*(ALOG(NH))*2 003333
003246 AVN=2.2*ALB 003334
003247 AVN=AVN*FHULMB 003335
003248 CONTINUE 003336
003249 NHUL=AVN*FRAMUL(0) 003337
003250 IF(RNDRM(0).GT..5) NHUL=NHUL*1 003338
003251 IF(NH+NHUL.GT.MXPART) GO TO 500 003339
003252 IF(NHUL.LE.1) GO TO 100 003340
003253 C 003341
003254 C 003342
003255 C-- GENERATE MULTIPLICITY AND PARTICLE Q.N. 003343
003256 NCHMB=0 003344

```

```

29  IT=0
    CONTINUE
    IT=IT+1
    IF(IT.GT.10) GO TO 30
    I=NM
    IODD=1
    IF(I-1)*NMUL.GT.0) IODD=0
    IF(IOND.EQ.0) GO TO 21
    I=I+1
    PARHAD(I,4)=51
    NPAIR=NMUL/2
    DO 20 N2=1,NPAIR
    RR=RNDRM(N2)
    IF(RR.GE.TBPAIR(1)) GO TO 26
    IF(IOND.EQ.0) GO TO 27
    IF(RNDRM(N2+3).LT.1./(2.*FLOAT(NMUL))) GO TO 26
27  IPAIR=1
    GO TO 23
26  CONTINUE
    DO 22 M=2,8
    IPAIR=M
    IF(RR.LT.TBPAIR(M)) GO TO 23
22  CONTINUE
23  PARHAD(I+1,6)=IFTB(1,IPAIR)
    PARHAD(I+2,6)=IFTB(2,IPAIR)
    IF(IPAIR.NE.1) GO TO 24
    IF(RNDRM(N2+1).LT.RETPIZ) PARHAD(I+1,6)=52
    IF(RNDRM(N2+2).LT.RETPIZ) PARHAD(I+2,6)=52
24  I=I+2
20  CONTINUE
    NPART=NM+NMUL
    NM1=NM+1
    TMASS=0.
    DO 25 I=NM1,NPART
    IPART=PARHAD(I,6)
    IF(LCHARG(IPART).NE.0) NCHMB=NCHMB+1
    PARHAD(I,5)=PHASND(IPART)
    TMASS=TMASS+PARHAD(I,5)
    IF(TMASS.GT.M) GO TO 29
C
C-- MEAN PT RISING WITH MULTIPLICITY
    AISIG=FLOAT(NCHMB)/6.
    IF(AISIG.GE.15.) GO TO 31
    RISIG=PARHAD(2,5)+1.
    ISIG=RISIG
    DELSG=RISIG-FLOAT(ISIG)
    SIGHAB=VPMH(ISIG)*(1.-DELSG)+VPMH(ISIG+1)*DELSG/FPTRB
    GO TO 32
31  SIGHAB=VPMH(7)*FPTRB
32  CONTINUE
C
C-- GENERATE PT'S
    DO 17 I=NM1,NPART
    K2=PARHAD(I,6)
    PERPH=X1EXPI(SIGHAB*PARHAD(I,5))/SIGHAB
    TM2=PERPH**2
    PT2=TM2-PARHAD(I,5)**2
    PT=AMAX1(PT2,0.)
    PT=SQRT(PT2)
    PHI=PI2*RNDRM(0)
    PARHAD(I,1)=PT*COS(PHI)
    PARHAD(I,2)=PT*SIN(PHI)
    CONTINUE
17  C
C-- PT BALANCE WITH PREVIOUS HADRONS
    DO 81 J=1,2
    SUM(J)=PHB(J)
    DO 82 I=NM1,NPART
    SUM(J)=SUM(J)+PARHAD(I,J)
82  SUM(J)=SUM(J)/FLOAT(NPART-NM1+1)
    DO 83 I=NM1,NPART
    PARHAD(I,J)=PARHAD(I,J)-SUM(J)
83  CONTINUE
81  C
C-- TRANSVERSE MASSES
    THTOT=0.
    DO 85 I=NM1,NPART
    THV(I)=SQRT(PARHAD(I,5)**2+PARHAD(I,1)**2+PARHAD(I,2)**2)
    THTOT=THTOT+THV(I)
85  EN=SQRT(M**2+PHB(1)**2+PHB(2)**2)
    IF(THTOT.GT.EN) GO TO 30
C
C-- GENERATE Y'S
    YHAX=ALOG(M/PHASND(21))
    ETOT=0.
    DO 86 I=NM1,NPART
    YV(I)=YHAX+RNDRM(0)
    EY=EXP(YV(I))
003345  PARHAD(I,4)=.5*THV(I)*(EY+1./EY)
003346  ETOT=ETOT+PARHAD(I,4)
003347  CONTINUE
003348  C
003349  C-- CORRECT Y'S ITERATIVELY SO AS TO GET RIGHT TOTAL ENERGY M
003350  IF(ETOT.LT.EN) GO TO 18
003351  C
003352  IMOVE=-1
003353  YFACT=.5
003354  YFACTX=1.
003355  INIT=1
003356  GO TO 19
003357  C
003358  18  IMOVE=1
003359  YFACT=2.
003360  YFACTX=1.
003361  INIT=2
003362  19  CONTINUE
003363  C
003364  50  CONTINUE
003365  ETOT=0.
003366  DO 51 I=NM1,NPART
003367  Y=YV(I)*YFACT
003368  EY=EXP(Y)
003369  PARHAD(I,4)=.5*THV(I)*(EY+1./EY)
003370  ETOT=ETOT+PARHAD(I,4)
003371  CONTINUE
003372  IF(ABS(ETOT-EN)/EN.LT..01) GO TO 70
003373  IMOVE=-1
003374  IF(ETOT.LT.EN) IMOVE=1
003375  C
003376  IF(INIT.EQ.3) GO TO 40
003377  IF(INIT.EQ.2) GO TO 55
003378  C
003379  IF(IMOVE.LT.0) GO TO 52
003380  YFACT=YFACT
003381  YFACT=.5*(YFACT+YFACTX)
003382  INIT=3
003383  GO TO 50
003384  52  YFACT=YFACT*.5
003385  GO TO 50
003386  C
003387  55  IF(IMOVE.GT.0) GO TO 56
003388  YFACTX=YFACT
003389  YFACT=.5*(YFACT+YFACTX)
003390  INIT=3
003391  GO TO 50
003392  56  YFACT=YFACT*2.
003393  GO TO 50
003394  C
003395  60  IF(IMOVE.GT.0) YFACT=YFACT
003396  IF(IMOVE.LT.0) YFACTX=YFACT
003397  YFACT=.5*(YFACT+YFACTX)
003398  GO TO 50
003399  C
003400  70  CONTINUE
003401  C
003402  C-- LONGITUDINAL MOMENTUM BALANCE
003403  PLONG=0.
003404  DO 72 I=NM1,NPART
003405  PARHAD(I,3)=0.
003406  PAR3=PARHAD(I,4)**2-THV(I)**2
003407  IF(PAR3.GT.0.) PARHAD(I,3)=SQRT(PAR3)
003408  THV(I)=1.
003409  DO 73 IT=NM1,NPART
003410  PLX=0.
003411  DO 74 I=NM1,NPART
003412  IF(THV(I).LT.0.) GO TO 74
003413  IF(PARHAD(I,3).LT.PLX) GO TO 74
003414  IX=I
003415  PLX=PARHAD(I,3)
003416  74  CONTINUE
003417  THV(IX)=1.
003418  IF(IT.GT.NM1) GO TO 75
003419  IF(RNDRM(IT).GT..5) PARHAD(IX,3)=-PARHAD(IX,3)
003420  CONTINUE
003421  75  IF(PLONG.GT.0.) PARHAD(IX,3)=-PARHAD(IX,3)
003422  PLONG=PLONG+PARHAD(IX,3)
003423  CONTINUE
003424  C-- CALL CORRECTIVE ROUTINE
003425  IP=0
003426  DO 76 I=NM1,NPART
003427  IP=IP+1
003428  DO 76 J=1,5
003429  P(IP,J)=PARHAD(I,J)
003430  CALL P4CORR(EN,PHB,IP,IFLAG)
003431  IF(IFLAG.NE.0) GO TO 30
003432  IP=0
003433  003433  003434  003435  003436  003437  003438  003439  003440  003441  003442  003443  003444  003445  003446  003447  003448  003449  003450  003451  003452  003453  003454  003455  003456  003457  003458  003459  003460  003461  003462  003463  003464  003465  003466  003467  003468  003469  003470  003471  003472  003473  003474  003475  003476  003477  003478  003479  003480  003481  003482  003483  003484  003485  003486  003487  003488  003489  003490  003491  003492  003493  003494  003495  003496  003497  003498  003499  003500  003501  003502  003503  003504  003505  003506  003507  003508  003509  003510  003511  003512  003513  003514  003515  003516  003517  003518  003519  003520

```



```

DO 77 I=NH1,NPART
IP=IP+1
DO 77 J=1,5
77 PARHAD(I,J)=P(IP,J)
GO TO 200

C
C-- VERY SMALL M, EMIT TWO P10
100 CONTINUE
SIGMAB=VPM(1)/FPTMB
EM=SQRT(M**2+PHB(1)**2+PHB(2)**2)
A(1)=PHB(1)
A(2)=PHB(2)
A(3)=0.
A(4)=EM
NH1=NH+1
NPART=NP+2
IF(NPART.GT.MXPART) GO TO 500
PERPH=XIEXP(SIGMAB*PMASHO(51))/SIGMAB
PL2=M**2*.25-PERPH**2
IF(PL2.LT.0.) GO TO 101
PL=SQRT(PL2)
PT2=PERPH**2-PMASHO(51)**2
PT=SQRT(PT2)
PHI=PI2*RNOM(0)
DO 78 I=1,2
V(1)=PT*COS(PHI)*(-1)**I
V(2)=PT*SIN(PHI)*(-1)**I
V(3)=PL*(-1)**I
V(4)=SQRT(PMASHO(51)**2+PT2+PL2)
CALL LOREN4(A,V,V1)
DO 79 J=1,4
79 PARHAD(NH+I,J)=V(I,J)
PARHAD(NH+I,5)=PMASHO(51)
PARHAD(NH+I,6)=51
78 CONTINUE
C
C-- OPTIONAL DECAY OF P10'S
200 CONTINUE
ND1=NH1
ND2=NPART
I=0
DO 201 M=ND1,ND2
I=I+1
DO 202 J=1,5
202 P(I,J)=PARHAD(M,J)*1000.
K(I,2)=PARHAD(M,6)
201 CONTINUE
IST=I
IPD=0
203 IPD=IPD+1
IF(10B(K(IPD,2)).GT.0) CALL DECAY(IPD,I)
IF(IPD.LT.I.AND.I.LT.(MAXSJ0-3)) GO TO 203
IF(I.GT.(MAXSJ0-4)) GO TO 550
MNSJ0=MAX0(MNSJ0,I)
IF(I.EQ.1ST) GO TO 206
NPART=NH
DO 204 M=1,I
IF(10B(K(M,2)).GT.0) GO TO 204
IF(NPART+1.GT.MXPART) GO TO 500
NPART=NPART+1
DO 205 J=1,5
205 PARHAD(NPART,J)=P(M,J)/1000.
PARHAD(NPART,6)=K(M,2)
204 CONTINUE
206 CONTINUE
RETURN
C-- ABNORMAL EXIT
500 PRINT 501,MXPART,NEVENT
501 FORMAT(5//,IX,4SHNO. OF PARTICLES DURING KNO CALL EXCEEDS ,
1I10//,IX,1IHEVENT NO. = ,I10
2 //,IX,4SHINCREASE 1ST DIMENSION OF PARHAD( , ) AND MXPART
3 //,IX,5SHINCREASE DIMENSIONS OF THV( ) AND YV( ) (SUB. KNO)
4 )
CALL OVEROM
RETURN
C
C-- ABNORMAL EXIT
550 PRINT 551,MXSJ0,NEVENT
551 FORMAT(5//,IX,4SHNO. OF PARTICLES IN SJOSTRAND P( , ) EXCEEDS ,
1I10//,IX,46HSUB. DECAY CALLED BY KNO
2 //,IX,1IHEVENT NO. = ,I10
3 //,IX,5SHINCREASE 1ST DIMENSIONS OF K( , ) AND P( , ) AND MAXSJ0,
4//,IX,5SHINCREASE DIMENSIONS OF IHEV( ) (/CANC/) AND TH2V( ) ( ,
5I2HSUB. P4CORR)
CALL OVEROM
RETURN
END

003521 FUNCTION FRAMUL(D)
003522 C *****
003523 C-- GENERATES MULTIPLICITY ACCORDING TO KNO
003524 REAL VKNO(250)
003525 INTEGER LKNO(250)
003526 DATA ICALL/0/
003527 C
003528 IF(ICALL.GT.0) GO TO 10
003529 ICALL=1
003530 TVKNO=0.
003531 NB=250
003532 DB=10./FLOAT(NB)
003533 NDB=DB*.5
003534 DO 1 M=1,NB
003535 VKNO(M)=FMULDG(FLOAT(M)*NB)
003536 TVKNO=TVKNO+VKNO(M)
003537 DO 2 M=1,NB
003538 VKNO(M)=VKNO(M)/TVKNO
003539 CALL ALIAS(LKNO,VKNO,NB)
003540 10 CONTINUE
003541 C
003542 MK=RNOM(0)*FLOAT(NB)+1.
003543 IF(RNOM(0).GT.VKNO(MK)) MK=LKNO(MK)
003544 FRAMUL=DB*FLOAT(MK-1)*NDB
003545 RETURN
003546 END
003547 C
003548 FUNCTION XIEXP(A)
003549 C *****
003550 C--RETURNS X WHERE DISTRIB. IN X IS GIVEN BY
003551 C-- F(X) = X*EXP(-X)
003552 C--WHERE A IS MIN. VALUE OF X, MAX. ASSUMED INFINITY.
003553 REAL F(100),X(100)
003554 DATA AP/0./
003555 IF(A.EQ.AP) GO TO 150
003556 C--ON FIRST CALL SET UP TABLE
003557 DO 100 I=1,100
003558 X(I)=0.2*(FLOAT(I)-1.)*A
003559 F(I)=EXP(A-X(I))*((1.-X(I))/(1.+A))
003560 100 CONTINUE
003561 C--
003562 150 CONTINUE
003563 R=RNOM(XXX)
003564 DO 300 I=1,100
003565 IF(R.GT.F(I)) GO TO 400
003566 300 CONTINUE
003567 400 CONTINUE
003568 IF(I.GT.1) GO TO 450
003569 XIEXP=0.
003570 AP=A
003571 RETURN
003572 450 CONTINUE
003573 XIEXP=X(I-1)+0.2*(R-F(I-1))/(F(I)-F(I-1))
003574 RETURN
003575 END
003576 C
003577 SUBROUTINE P4CORR(M,PHB,NP,IFLAG)
003578 C *****
003579 C-- CORRECT TO HAVE ENERGY-MOMENTUM CONSERVATION
003580 COMMON /JET/ K(399,2), P(399,5)
003581 REAL TH2V(399),SUM(2),PHB(4)
003582 C
003583 IFLAG=0
003584 NSQ=M**2
003585 C-- TRANSVERSE MOMENTUM, FIRST
003586 DO 81 J=1,2
003587 SUM(J)=PHB(J)
003588 DO 82 I=1,NP
003589 SUM(J)=SUM(J)+P(I,J)
003590 81 SUM(J)=SUM(J)/NP
003591 WHIN=0.
003592 DO 83 I=1,NP
003593 DO 84 J=1,2
003594 P(I,J)=P(I,J)-SUM(J)
003595 TH2V(I)=P(I,5)**2+P(I,1)**2+P(I,2)**2
003596 WHIN=WHIN+SQRT(TH2V(I))
003597 83 CONTINUE
003598 IF(WHIN*WHIN) GO TO 90
003599 C-- LONGITUDINAL MOMENTUM AND ENERGY
003600 SUM3=0.
003601 SUM4=0.
003602 DO 85 I=1,NP
003603 SUM3=SUM3+P(I,3)
003604 P(I,4)=SQRT(P(I,3)**2+TH2V(I))
003605 SUM4=SUM4+P(I,4)
003606 F3=SUM3/SUM4
003607 SUM3=0.
003608 DO 86 I=1,NP
003609
003610
003611
003612
003613
003614
003615
003616
003617
003618
003619
003620
003621
003622
003623
003624
003625
003626
003627
003628
003629
003630
003631
003632
003633
003634
003635
003636
003637
003638
003639
003640
003641
003642
003643
003644
003645
003646
003647
003648
003649
003650
003651
003652
003653
003654
003655
003656
003657
003658
003659
003660
003661
003662
003663
003664
003665
003666
003667
003668
003669
003670
003671
003672
003673
003674
003675
003676
003677
003678
003679
003680
003681
003682
003683
003684
003685
003686
003687
003688
003689
003690
003691
003692
003693
003694
003695
003696

```

```

P(I,3)=P(I,3)-F3*P(I,4)
SUM3=SUM3+ABS(P(I,3))
MMINSQ=MMINSQ+2
FF=MSQ-MMINSQ
F2=SQRT(FF)/SUM3
DO 87 IT=1,20
TEST=0.
SUM3=0.
DO 88 I=1,NP
P(I,3)=F2*P(I,3)
SUM3=SUM3+ABS(P(I,3))
P(I,4)=SQRT(P(I,3)**2+TM2V(I))
TEST=TEST+P(I,4)
88 CONTINUE
IF(ABS(TEST-W).LT.0.01) GO TO 89
F2=W/TEST
GG=TEST**2-MMINSQ
IF(GG.GT.0.) F2=SQRT(FF/GG)
87 CONTINUE
90 CONTINUE
IFLAG=1
89 CONTINUE
RETURN
END

C
SUBROUTINE PARTAB
*****
C-- PRINTS TABLE OF PARAMETERS FOR PARTICLES AND THEIR DECAYS USED IN
C-- SJOSTRAND PROGRAM (P. 33 OF PREPRINT)
COMMON /PAR/ PUD, PSI, SIGMA, CK2, EBEG, WFIN, IFLBEG
COMMON /DECPAR/ PUDD, PSID, CND1, CND2, IDB(110)
COMMON /DATA1/ MESO(36), CMX(6,2), PHAS(110), QHAS(6)
COMMON /DATA2/ CBR(180), KDP(180,3), MTCOR(10)
COMMON /DATA3/ CHA1(36), CHA2(110), CHA3(2)
COMMON /YB/ CLPRO, PT2PRO, FPTH, FMULB, RETPIZ, RPAIR(9)
COMMON /CBROR/ CBROR(180), IDBOR(110)
REAL CH(3)

C
DATA BLANK1/1H /
C
CALL SBLOCK

C-- PARTICLE TABLE
PRINT 11
FORMAT(1H1,35HPARTICLE TABLE IN SJOSTRAND PROGRAM
1 //1X,35(1H-1)///)
PRINT 1
FORMAT(3X,6HK(1,2),7X,8HPARTICLE,3X,8H MASS
1 ,5X,20H DECAY PRODUCTS ,5X,4HB.R.,3X,11HDEC. CHANN.
2 //1X,11HPARNAD(1,6),60X,11HIDB(K(1,2))///)

C
DO 2 I=1,110
IF(CHAI(1).EQ.BLANK1) PRINT 3,I
PH1000=PHAS(I)/1000.
IF(CHAI(1).NE.BLANK1) PRINT 3,I,CHA2(I),PH1000
IDC=IDBOR(I)
IF(IDC.EQ.0) GO TO 2
CONTINUE
IPAR=I
CALL CHDEC(IPAR,IDC,CH)
BR=CBROR(IDC)
IF(IDC.EQ.IDBOR(I)) GO TO 4
IF(ABS(CBROR(IDC)-1)-1).GT.1.E-5) BR=BR-CBROR(IDC-1)
CONTINUE
PRINT 5,CH,BR,IDC
FORMAT(1H+,39X,A4,4X,A4,4X,A4,5X,F4,2,6X,I3/)
IF(ABS(CBROR(IDC)-1)-1).LT.1.E-5) GO TO 7
IDC=IDC+1
GO TO 6
CONTINUE
3 FORMAT(4X,I3,11X,A4,4X,F8,4)
2 CONTINUE

C
PRINT 50
FORMAT(///1X,44HN.B. -- B.R. DATA ARE STORED IN CBR( ) NOT
161HSTRAIGHTFORWARDLY BUT ARRANGED IN TABLE FORMAT FOR GENERATION,
2//6X,56H-- PARTICLE MASSES IN PHAS( ) ARE DEFINED IN BLOCK DATA ,
321HIN MEV AND NOT IN GEV)
C-- FRAGMENTATION PARAMETERS IN SJOSTRAND PROGRAM
PRINT 100,CK2,EPSPET,SIGMA
100 FORMAT(5//1X,47HMAIN FRAGMENTATION PARAMETERS IN SJOSTRAND PROG,
13HRAH/1X,50(1H-1)
2//1X,9HCK2 = ,E12.4,38H IN FRAGMENTATION FUNCTION FOR LIGHT ,
3 6HQARKS/24X,35HD(X) = (1-CX2+3*CX2*(1-X)**2)
4 //1X,9HEPSPET = ,E12.4,33H IN PETERSON ET AL. FRAGMENTATIO,
5 527HN FUNCTION FOR HEAVY QUARKS/24X,27HD(X) = 1/(X*(1-1/X-EPSPET*(
6 628HCHHARH/HEAVY)**2/(1-X)**2)

003697 7 //1X,9HSIGMA = ,E12.4,24H (MEV) -- PT GENERATION) 003785
003698 C 003786
003699 C-- HADRONIZATION PARAMETERS IN HNBAS 003787
003700 PRINT 110,CLPRO,PT2PRO 003788
003701 110 FORMAT(5//1X,17HNBAS PARAMETERS/1X,17(1H-1) 003789
003702 1 //1X,10HCLPRO = ,E12.4,34H IN EXP(-CLPRO*X) -- LONGITUDINAL 003790
003703 2 32HDISTRIBUTION OF LEADING NUCLEONS 003791
003704 3//1X,9HPT2PRO = ,E12.4,39H GEV**2 MEAN PT**2 OF LEADING NUCLEONS 003792
003705 3 ) 003793
003706 C 003794
003707 PRINT 111,FMULB,FPTH 003795
003708 111 FORMAT(///1X,48HMEAN MULTIPLICITY AND MEAN PT OF HNBAS HADRONS , 003796
003709 161HORIGINALLY SET UP TO REPRODUCE MINIMUM BIAS 1981 DATA OF UA1 , 003797
003710 37HND UAS/1X,43HARE NOW MULTIPLIED BY THE FOLLOWING FACTORS , 003798
003711 4 //1X,9HFHULB = ,E12.4,26H FOR THE MEAN MULTIPLICITY 003799
003712 5 //1X,9HFPTH = ,E12.4,16H FOR THE MEAN PT ) 003800
003713 C 003801
003714 PRINT 112,RETPIZ,RPAIR 003802
003715 112 FORMAT(///1X,50HPARTICLE RATIOS (PARTICLES ARE GENERATED IN PAIRS003803
003716 1,31H-- DATA ARE STORED IN RPAIR( ) 003804
003717 2 //1X,56H(REF. K.ALPGARD ET AL. (UAS) PHYS.LETT. 121B (1983) 209) 003805
003718 3 //1X,10HETA/PI0 = ,E12.4,9H (RETPIZ) 003806
003719 4 //1X,20HPAIR OF (PI0 OR ETA),T30,E12.4 003807
003720 5 //1X,12HPAIR PI-,PI+,T30,E12.4 003808
003721 6 //1X,11HPAIR K+,K-,T30,E12.4 003809
003722 7 //1X,11HPAIR K0,K0B,T30,E12.4 003810
003723 8 //1X,9HPAIR P,PB,T30,E12.4 003811
003724 9 //1X,9HPAIR N,NB,T30,E12.4 003812
003725 1 //1X,19HPAIR LAMBDA,LAMBDA0,T30,E12.4 003813
003726 2 //1X,19HPAIR SIGMA+,SIGMA0,T30,E12.4 003814
003727 3 //1X,19HPAIR SIGMA-,SIGMA0,T30,E12.4 003815
003728 4 //5(//1) 003816
003729 C 003817
003730 PRINT 120 003818
003731 120 FORMAT(5//1X,44HN.B. -- ALL ABOVE PARAMETERS ARE DEFINED IN , 003819
003732 137HBLOCK DATA AND CAN BE CHANGED BY USER , 003820
003733 2 //9X,35HND CHECKS ARE MADE ON MODIFICATIONS/5(//1) 003821
003734 C 003822
003735 RETURN 003823
003736 END 003824
003737 C 003825
003738 SUBROUTINE DUMPEV 003826
003739 ***** 003827
003740 C-- DUMPS EVENTS 003828
003741 COMMON /CCDS/CF,CA,BALPH,PI,PI2,PROGL,PROFLA(2),NFLAYS,LGLUS,IVAL 003829
003742 COMMON /PARQUA/ PARQUA(79,7),NQUA,MAXQUA 003830
003743 COMMON /EVENT/ NEVENT,ECH,PARHAD(401,7),NPART,MXPART,WEIGHT 003831
003744 COMMON /NEAKON/ NEAKON,IFDC,B1H2,B1H2L,B1H2R,TG2CAD,FZLDS,FXSCT,MSEX003832
003745 * ,MIDTH 003833
003746 COMMON /BOSON/ PBOS(6),ICHOB,IOKRFW 003834
003747 COMMON /JET/ K(399,2), PI(399,5) 003835
003748 COMMON /JETN/ NP,NPI 003836
003749 COMMON /DATA2/ CBR(180), KDP(180,3), MTCOR(10) 003837
003750 COMMON /DECPAR/ PUDD, PSID, CND1, CND2, IDB(110) 003838
003751 COMMON /DATA3/ CHA1(36), CHA2(110), CHA3(2) 003839
003752 COMMON /PMBIAS/ PMBIAS(5) 003840
003753 COMMON /KBURP/ KBURP 003841
003754 COMMON /SPYFOR/ SPYC,SPYB,SPYT,SPYQ,SPYCEL,SPYBEL,SPYTEL 003842
003755 REAL CH(3) 003843
003756 DATA QFLA(6),QBFLA(6) 003844
003757 REAL CH(3) 003845
003758 DATA QFLA/2HU,2HD,2HS,2HC,2HB,2HT/ 003846
003759 * ,QBFLA/2HUB,2HDB,2HCB,2HCB,2HDB,2HTB/,GLUON/2HGL/ 003847
003760 DATA MH/1HM/,ZH/1HZ/,DH/2HDY/ 003848
003761 C 003849
003762 IF(NEVENT.EQ.1) PRINT 2 003850
003763 FORMAT(1X,41H(JET PARAMETERS ARE BEFORE FRAGMENTATION) ) 003851
003764 IF(NEVENT.EQ.1.AND.(NEAKON.EQ.ZH.OR.NEAKON.EQ.MH)) PRINT3,NEAKON 003852
003765 FORMAT(1X,31H(EXCEPT FOR JETS ORIGINATED IN ,A2,7H DECAY) ) 003853
003766 PRINT 4 003854
003767 FORMAT(////) 003855
003768 C 003856
003769 PRINT 1,NEVENT 003857
003770 FORMAT(1X,10HEVENT NO. ,15/1X,15(1H-1)///) 003858
003771 IPRO=1 003859
003772 NPARTH=1 003860
003773 IF(NEAKON.EQ.ZH.OR.NEAKON.EQ.MH.OR.NEAKON.EQ.DH) IPRO=2 003861
003774 IF(IPRO.NE.2) GO TO 30 003862
003775 C-- BOSON DECAY PRODUCTS 003863
003776 PT=SQRT(PBOS(1)**2+PBOS(2)**2) 003864
003777 PP=SQRT(PT**2+PBOS(3)**2) 003865
003778 THETA=ACOS(PBOS(3)/PP)*180./PI 003866
003779 Y=SIGN(-ALOG(TAN(ATANH(PT/ABS(PBOS(3)))/2.)),PBOS(3)) 003867
003780 PHI=ATAN2(PBOS(2),PBOS(1))*180./PI 003868
003781 IF(PHI.LT.0.) PHI=PHI+360. 003869
003782 XF=PBOS(3)/(.5*ECH) 003870
003783 PRINT 5,NEAKON,PBOS(5),PBOS(4),(PBOS(J),J=1,3) 003871
003784 * ,PT,XF,Y,THETA,PHI 003872

```

```

5  FORMAT(///1X,A2,17H BOSON PARAMETERS//5X, 003873
16HMASS =,1X,E10.3,5X,3HE =,1X,E10.3,5X,4HPX =,1X,E10.3,5X,4HPY =, 003874
21X,E10.3 ,5X,4HPZ =,1X,E10.3//5X,4HPT =,1X,E10.3,5X,4HFX =,1X, 003875
3E10.3 ,5X,3HY =,1X,E10.3,5X,7HTheta =,1X,E10.3,5X, 003876
35HPhi =,1X,E10.3//)
7  IF(IDB(INT(PBOS(6))) .EQ.0) PRINT 7,WEAKON
FORMAT(1X,A2,1X,22HREQUESTED UNDECAYED )
IF(IDB(INT(PBOS(6))) .EQ.0) GO TO 31
6  PRINT 6,WEAKON
FORMAT(1X,A2,1X,20HBOSON DECAY PRODUCTS )
IDC=ICHO8
IFBOS=PBOS(6)
CALL CHDEC(IPBOS,IDC,CH)
ICHAN=ICHO8
IF(WEAKON.EQ.0H) ICHAN=ICHO8-146
PRINT 51,CHAR(ICHAN),(CH(J),J=1,2),ICHAN
51  FORMAT(///1X,A4,8H ----, A4,2X,A4,3X,12HCHANNEL NO. ,I3,1H)
IF(WEAKON.EQ.0H AND ICHO8.GT.155) GO TO 30
IF(WEAKON.EQ.0H AND ICHO8.GT.172) GO TO 30
NPARTH=N+1
DO 15 IB=1,2
N=0
DO 10 I=1,NPART
IOR=PARHAD(I,7)
IF(IOR.NE.0) GO TO 10
N=N+1
DO 11 J=1,5
P(N,J)=PARHAD(I,J)
K(N,1)=0
K(N,2)=PARHAD(I,6)
10  CONTINUE
CALL LIST(N)
15  CONTINUE
C-- JETS
30  IF(NQUA.EQ.0) GO TO 100
IF(WEAKON.EQ.0H AND ICHO8.GT.155) OR (WEAKON.EQ.0H AND ICHO8.GT.
*.172) PRINT 34,WEAKON
34  FORMAT(///1X,11HJETS FROM ,A2,12HDECAY FIRST)
31  CONTINUE
IF(NQUA.EQ.0) GO TO 100
IQMX=NQUA
DO 32 IQ=1,NQUA
IF(PARQUA(IQ,7).GT.0.) GO TO 33
32  IQMX=IQ
33  CONTINUE
DO 40 IQC=1,NQUA
IQ=IQC
IF(IPRO.EQ.2 AND IQC.LE.NQUA-IQMX) IQ=IQMX+IQC
IF(IPRO.EQ.2 AND IQC.GT.NQUA-IQMX) IQ=IQC-(NQUA-IQMX)
PT=SQRT(PARQUA(IQ,1)**2+PARQUA(IQ,2)**2)
PP=SQRT(PT**2+PARQUA(IQ,3)**2)
THETA=ACOS(PARQUA(IQ,3)/PP)*180./PI
YSIGMA=ALOG(TAN(ATAN(PT/ABS(PARQUA(IQ,3)))/2.)),PARQUA(IQ,3))
PHI=ATAN2(PARQUA(IQ,2),PARQUA(IQ,1))*180./PI
IF(PHI.LT.0.) PHI=PHI+360.
IFLA=PARQUA(IQ,6)
IF(IFLA.GT.0) FLA=QFLA(IFLA)
IF(IFLA.LT.0) FLA=QFLA(-IFLA)
IF(IFLA.EQ.0) FLA=GLUON
IQOR=PARQUA(IQ,7)
PRINT 35,1X,FLA,PARQUA(IQ,4)
35  1, (PARQUA(IQ,J),J=1,3)
FORMAT(///1X,8HJET NO. ,I3,15H FLAVOR = ,A2,
1  9H E = ,E10.3
2  //34X,10H PJX = ,E10.3,10H PJY = ,E10.3,10H PJZ =,E10.3,10H
2E10.3)
PRINT 38,PT,Y,THETA,PHI
38  FORMAT(18X,4HET =,E10.3,5X,3HY =,E10.3,5X,7HTheta =,E10.3
1  ,5X,5HPhi =,E10.3)
IF(IQOR.LT.0) PRINT 36
IF(IPRO.EQ.1 AND IQOR.GT.0) PRINT 37
IF(IPRO.EQ.2 AND IQOR.GT.0) PRINT 39,WEAKON
36  FORMAT(//18X,24HINITIAL BREMSSTRAHLUNG)
37  FORMAT(//18X,20H(PARTON FINAL STATE) )
39  FORMAT(//18X,1H(A4,2X,6HDECAY) )
IF(1SPYQ.GT.0 AND (IPRO.NE.2 OR PARQUA(IQ,7).LT.0.)) GO TO 40
N=0
DO 45 I=NPARTH,NPART
IOR=PARHAD(I,7)
IAOR=IABS(IOR)
IF(IAOR.NE.0) GO TO 45
N=N+1
DO 46 J=1,5
P(N,J)=PARHAD(I,J)
K(N,1)=0
K(N,2)=PARHAD(I,6)
46  CONTINUE
45  IF(N.EQ.0) GO TO 40
CALL LIST(N)
CONTINUE
C-- SOFT PARTICLE SYSTEM
100 CONTINUE
IF(1SPYQ.GT.0.) RETURN
PRINT 101,PHBIAS
101  FORMAT(///1X,14HSPECTATOR JETS
1  //1X,44HKINEMATIC PARAMETERS OF SOFT PARTICLE SYSTEM
2  //10X,4HPX =,E10.3,10X,4HPY =,E10.3,10X,4HPZ =,E10.3
3  //10X,3HE =,E10.3,10X,16HINVARIANT MASS =,E10.3)
N=0
DO 105 I=NPARTH,NPART
IOR=PARHAD(I,7)
IF(IOR.NE.0) GO TO 105
N=N+1
DO 106 J=1,5
P(N,J)=PARHAD(I,J)
K(N,1)=0
K(N,2)=PARHAD(I,6)
105  CONTINUE
IF(N.NE.0) CALL LIST(N)
C  PRINT 107
107  FORMAT(15H/)
C  RETURN
END
SUBROUTINE CHDEC(IP,IDC,CH)
*****
C-- GIVES DESCRIPTION OF DECAY CHANNEL
COMMON /DATA2/ CBR(180), KDP(180,3), WTCOR(10)
COMMON /DATA3/ CHA1(36), CHA2(110), CHA3(2)
INTEGER JCNPAR(110),JCNQRB(36)
REAL PAIRS(36)
REAL CH(3)
C  DATA BLANK/4H /
DATA PAIRS/4HU-UB,4HU-DB,4HU-SB,4HU-CB,4HU-BB,4HU-TB
1  ,4HD-UB,4HD-DB,4HD-SB,4HD-CB,4HD-BB,4HD-TB
2  ,4HS-UB,4HS-DB,4HS-SB,4HS-CB,4HS-BB,4HS-TB
3  ,4HC-UB,4HC-DB,4HC-SB,4HC-CB,4HC-BB,4HC-TB
4  ,4HB-UB,4HB-DB,4HB-SB,4HB-CB,4HB-BB,4HB-TB
5  ,4HT-UB,4HT-DB,4HT-SB,4HT-CB,4HT-BB,4HT-TB/
DATA ICALL/0/
C  IF(ICALL.GT.0) GO TO 10
ICALL=0
CALL SBLOCK
C  DO 21 I=1,110
JCNPAR(I)=1
IF(I.LE.2 OR (I.GE.5 AND I.LE.6)
* IF(I.LE.2 OR (I.GE.51 AND I.LE.60) OR I.GE.91) GO TO 21
IF((-1)**I.LT.0.) JCNPAR(I)=I+1
IF((-1)**I.GT.0.) JCNPAR(I)=I-1
CONTINUE
21  DO 22 J=1,6
DO 22 J2=1,6
I=6*(J1-1)+J2
IB=6*(J2-1)+J1
JCNQRB(I)=IB
22  CONTINUE
C  DO 6 J=1,3
JJ=KDP(IDC,J)
IF(IP.EQ.4 AND JJ.GT.0) JJ=JCNPAR(JJ)
IF(IP.EQ.4 AND JJ.LT.0) JJ=-JCNQRB(-JJ)
IF(JJ.EQ.0) CH(J)=BLANK
IF(JJ.GT.0) CH(J)=CHA2(JJ)
IF(JJ.LT.0) CH(J)=PAIRS(-JJ)
CONTINUE
6  IF(IP.NE.4 OR IDC.GT.172) GO TO 30
CH2=CH(1)
CH1=CH(2)
CH(1)=CH1
CH(2)=CH2
30  CONTINUE
C  RETURN
END
C-- SECTION (01)

```

```

C-- PACKAGE OF ROUTINES FOR QUARK JET GENERATION ACCORDING TO THE FIELD-004049
C-- FEYNMAN CASCADE MODEL (T.SJOSTRAND, UNIV. LUND PREPRINT LU TP 79-8
C-- (1979), WITH MINOR REVISIONS).
C
C-----
C
SUBROUTINE JETGEN(N)
*****
COMMON /JET/ K(399,2), P(399,5)
COMMON /PAR/ PUDD, PS10, SIGMA, CX2, EBEG, WFIN, IFLBEG
COMMON /DECPAR/ PUDD, PS10, CND1, CND2, IDB(110)
COMMON /DATA1/ MESO(36), CHIX(6,2), PHAS(110), QMAS(6)
COMMON /MAXSJO/MXSJO
COMMON /SHEAVY/IHEV(399)
COMMON /EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MPART,WEIGHT
COMMON /MAXN/MNBOOK,MNBOOK,MNPART,MNQUA,MNCUE,MNCUEJ,MNSJO
COMMON /PETER/EPSPET
REAL TG(100),TGV(100,3)
INTEGER LG(100),LGV(100,3)
DATA ICALL/0/
IF(IFLBEG.EQ.0) IFLBEG=(3.*RNDM(0)+1.)*(1.-1.)*INT(2.*RNDM(1)+1.))
C
C
IF(ICALL.GT.0) GO TO 50
ICALL=1
CALL SBLOCK
NG=100
DG=1./FLOAT(NG)
HDG=DG/2.
DO 10 JG=1,3
TTG=0.
RM2=(QMAS(4)+QMAS(JG+3))*2
DO 11 IG=1,NG
XG=DG*FLOAT(IG-1)+HDG
TG(IG)=1./((XG*(1.-1./XG-EPSPET*RM2/(1.-XG)))*2)
11 TTG=TTG+TG(IG)
DO 12 IG=1,NG
TG(IG)=TG(IG)/TTG
CALL ALIAS(LG,TG,NG)
DO 13 IG=1,NG
TGV(IG,JG)=TG(IG)
LGV(IG,JG)=LG(IG)
10 CONTINUE
50 CONTINUE
C
C 1 INITIAL VALUES, PT FOR FIRST QUARK
DO 201 L=1,MAXSJO
IHEVL=L/0
I=0
IPD=0
M=2.*EBEG
IFL1=IFLBEG
PT1=SIGMA*SQRT(-ALOG(RNDM(0)))
PHI1=6.2832*RNDM(0)
PX1=PT1*COS(PHI1)
PY1=PT1*SIN(PHI1)
C 2 FLAVOUR AND PT FOR NEXT ANTIQUARK
100 I=I+1
IFL2=ISIGN(1+INT(RNDM(0)/PUDD),-IFL1)
PT2=SIGMA*SQRT(-ALOG(RNDM(0)))
PHI2=6.2832*RNDM(0)
PX2=PT2*COS(PHI2)
PY2=PT2*SIN(PHI2)
C 3 MESON FORMED, SPIN ADDED AND FLAVOUR MIXED
K(I,1)=MESO(6*(MAXO(IFL1,IFL2)-1)-MINO(IFL1,IFL2))
ISPIN=INT(PS1+RNDM(0))
K(I,2)=20+40*ISPIN+K(I,1)
IF(K(I,1).GE.31.AND.K(I,1).LE.33) GO TO 802
GO TO 801
802 CONTINUE
THIX=RNDM(0)
KH=K(I,1)-30+3*ISPIN
K(I,2)=51+40*ISPIN+INT(THIX+CHIX(KH,1))+INT(THIX+CHIX(KH,2))
801 CONTINUE
C 4 MESON MASS FROM TABLE, PT FROM CONSTITUENTS
P(I,5)=PHAS(K(I,2))
P(I,1)=PX1+PX2
P(I,2)=PY1+PY2
PHTS=P(I,1)*2+P(I,2)*2+P(I,5)*2
C 5 SCALING IN X GIVES E AND PZ, CUT IN PZ FOR FIRST MESON
110 X=RNDM(0)
C
IF(IABS(IFL1).GT.3) GO TO 51
IF(RNDM(0).LT.CX2) X=1.-X*(1./3.)
GO TO 60
JG=IABS(IFL1)-3
IXG=X*FLOAT(NG)+1.
IF(RNDM(0).GT.TGV(IXG,JG)) IXG=LGV(IXG,JG)
X=DG*FLOAT(IXG-1)+HDG
CONTINUE
C
P(I,3)=(X*M-PHTS/(X*M))/2.
P(I,4)=(X*M+PHTS/(X*M))/2.
IF(I.EQ.1.AND.P(I,3).LE.0.) GO TO 110
C 6 IF UNSTABLE, DECAY CHAIN INTO STABLE PARTICLES
IL=1
CALL CHEAVY(IL)
120 IPD=IPD+1
IF(IDB(K(IPD,2)).GT.0) CALL DECAY(IPD,I)
IF(IPD.LT.1.AND.I.LT.(MAXSJO-3)) GO TO 120
IF(IHEV(IL).NE.1) GO TO 202
DO 203 L=IL,I
IHEVL=L/1
CONTINUE
C 7 FLAVOUR AND PT FOR QUARK FORMED IN PAIR WITH ANTIQUARK ABOVE
IFL1=IFL2
PX1=PX2
PY1=PY2
C 8 IF ENOUGH E+PZ LEFT, GO TO 2
M=(1.-X)*M
C-----
C-- MODIFIED -- THROW AWAY UNSTABLE PARTICLES IN INTERMEDIATE STEPS OF
C-- THE JET CASCADE
C-----
IL=0
DO 210 I2=1,I
IF(IDB(K(I2,2)).GT.0) GO TO 210
I1=I+1
K(I1,1)=K(I2,1)
K(I1,2)=K(I2,2)
DO 211 J=1,5
P(I1,J)=P(I2,J)
IHEV(I1)=IHEV(I2)
210 CONTINUE
I=I1
IPD=I
IF(I.GT.(MAXSJO-4)) GO TO 500
IF(W.GT.WFIN) GO TO 100
N=I
MNSJO=MAXO(MNSJO,N)
RETURN
C
C-- ABNORMAL EXIT
500 CONTINUE
EBEG=EBEG/1000.
PRINT 501,MAXSJO,IFLBEG,EBEG,NEVENT
FORMAT(5//,1X,4SHNO. OF ALL PARTICLES IN SJOSTRAND JET EXCEEDS,
110//,1X,7MFAVOR ,110,10X,4HE = ,E10.3
2 //,1X,1IHEVENT NO. = ,I10
3//,1X,5SHINCREASE 1ST DIMENSIONS OF K( , ) AND P( , ) AND MAXSJO ,
4//,1X,5SHINCREASE DIMENSIONS OF IHEV( ) (/CANC/) AND TH2V( , )
51H/SUB. P4CORR)
CALL OVERDM
RETURN
END
C
SUBROUTINE DECAY(IPD,I)
*****
COMMON /JET/ K(399,2), P(399,5)
COMMON /DECPAR/ PUDD, PS10, CND1, CND2, IDB(110)
COMMON /DATA2/ CBR(180), KDP(180,3), WTCOR(10)
COMMON /EVENT/NEVENT,ECH,PARHAD(401,7),NPART,MPART,WEIGHT
COMMON /MAXSJO/MXSJO
COMMON /MAXN/MNBOOK,MNBOOK,MNPART,MNQUA,MNCUE,MNCUEJ,MNSJO
REAL PH(10,5), RND(10), U(3), BE(3)
INTEGER IFLQ(4),IFLR(4)
PANT(A,B,C)=SQRT((A**2-(B+C)**2)*(A**2-(B-C)**2))/(2.*A)
FOUR(I,J)=P(I,4)*P(J,4)-P(I,1)*P(J,1)-P(I,2)*P(J,2)-P(I,3)*P(J,3)
C 1 DECAY CHANNEL CHOICE, GIVES DECAY PRODUCTS
TBR=RNDM(0)
IDC=IDB(K(IPD,2))-1
100 IDC=IDC+1
IF(TBR.GT.CBR(IDC)) GO TO 100
NP=0
NQ=0
PSUMP=0.
IILM=I+1
IIUP=I+3
DO 110 I1=IILM,IIUP
K(I1,2)=KDP(IDC,I1-I)
IF(K(I1,2).GT.0) GO TO 812
GO TO 811
CONTINUE
NP=NP+1

```

```

      K(I1,1)=-IPO
      P(I1,5)=PMAS(K(I1,2))
      PSUMP=PSUMP+P(I1,5)
      GO TO 813
811 IF(K(I1,2).LT.0) GO TO 814
      GO TO 813
814 CONTINUE
      NQ=NQ+1
      IF(LQ(2*NQ-1)=(5-K(I1,2))/6
      IF(LQ(2*NQ)=K(I1,2)+6*(IF(LQ(2*NQ-1)-1)
813 CONTINUE
110 CONTINUE
C 2 DECAY MULTIPLICITY
      ND=NP+NQ
      IF(IND.GT.MAXSJO) GO TO 500
      PSUM=PSUMP
      IF(IND.EQ.0) GO TO 170
      CND=CND1+ALOG(P(IPO,5)/CND2)
120 GAUSS=SQRT(-2.*CND+ALOG(RNDM(0)))=5IN(6.2832*RNDM(0))
      ND=0.5+0.5*(NP+NQ)+CND+GAUSS
      IF(IND.GT.MAXSJO) GO TO 500
      IF(IND.LT.NP+NQ.OR.IND.LT.2.OR.IND.GT.10) GO TO 120
      IF(NP+NQ.EQ.3.AND.K(I1,2).GE.7.AND.K(I1,2).LE.18) ND=3
      IF(IND.GT.MAXSJO) GO TO 500
C 3 GENERATION AND PAIRING OFF OF QUARK-ANTIQUARK PAIRS
      DO 130 J=1,4
130 IF(LR(J)=IFLR(J))
      IF(IND.EQ.NP+NQ) GO TO 150
      I1LW=I+NP+1
      I1UP=I+ND-NQ
      DO 140 I1=I1LW,I1UP
      IQ=1+INT(2*NQ*RNDM(0))
      IF(LN=ISIGN(1+INT(RNDM(0)/PUDD),-IFLR(IQ))
      K(I1,1)=MESO(6*(MAX0(IFLR(IQ),IFLN)-1)-MIN0(IFLR(IQ),IFLN))
140 IF(LR(IQ)=-IFLN
150 IQ=2+2*INT(NQ*RNDM(0))
      K(I1+ND-NQ+1,1)=MESO(6*(IFLR(1)-1)-IFLR(IQ))
      IF(NQ.EQ.2) K(I1+ND,1)=MESO(6*(IFLR(3)-1)-IFLR(6-IQ))
C 4 MESONS ARE FORMED, IF TOTAL MASS TOO LARGE GO TO 2
      PSUM=PSUMP
      I1LW=I+NP+1
      I1UP=I+ND
      DO 160 I1=I1LW,I1UP
      ISPIN=INT(PSID+RNDM(0))
      K(I1,2)=20+40*ISPIN*(K(I1,1)
      IF(K(I1,1).GE.31.AND.K(I1,1).LE.33) GO TO 822
      GO TO 821
822 CONTINUE
      THIX=RNDM(0)
      KM=K(I1,1)-30+3*ISPIN
      K(I1,2)=51+40*ISPIN+INT(THIX+CMIX(KM,1))+INT(THIX+CMIX(KM,2))
821 CONTINUE
      K(I1,1)=-IPO
      P(I1,5)=PMAS(K(I1,2))
160 PSUM=PSUMP+P(I1,5)
      IF(PSUM>5..GT.P(IPO,5)) GO TO 120
C 5 PRODUCT CHARGE CONJUGATION FOR DECAYING ANTIPARTICLE
170 IF(2*(K(IPO,2)/2).EQ.K(IPO,2)) GO TO 832
      GO TO 831
832 CONTINUE
      I1LW=I+1
      I1UP=I+ND
      DO 180 I1=I1LW,I1UP
      KCOR=K(I1,2)-(-1)**(K(I1,2)-2*(K(I1,2)/2))
      IF(K(I1,2).GE.7.AND.K(I1,2).LE.50) K(I1,2)=KCOR
180 IF(K(I1,2).GE.61.AND.K(I1,2).LE.90) K(I1,2)=KCOR
831 CONTINUE
C 6 ONE-PARTICLE DECAY, START NO-PARTICLE DECAY
      IF(IND.EQ.1) GO TO 842
      GO TO 841
842 CONTINUE
      DO 190 J=1,4
190 P(I1,J)=P(IPO,J)
      GO TO 330
841 CONTINUE
      DO 200 J=1,5
200 PM(I1,J)=P(IPO,J)
      PM(ND,5)=P(I1+ND,5)
      IF(IND.EQ.2) GO TO 260
C 7 CALCULATION OF MAXIMUM WEIGHT
      WTHAX=1./WTCOR(ND)
      PHAX=PM(I1,5)-PSUM+P(I1+ND,5)
      PHIN=0.
      MLLW=1
      MLUP=ND-1
      DO 210 ML=MLLW,MLUP
      IL=MLUP-ML+1
      PHAX=PHAX+P(I1+IL,5)
      PHIN=PHIN+P(I1+IL,5)
      210 WTHAX=WTHAX*PANT(PHAX,PHIN,P(I1+IL,5))
C 8 M-GENERATOR GIVES WEIGHT, IF REJECTED TRY AGAIN
      220 RND(1)=1.
      I1LW=2
      I1UP=ND-1
      DO 240 I1=I1LW,I1UP
      RAN=RNDM(0)
      ML2LW=1
      ML2UP=I1-1
      DO 230 ML2=ML2LW,ML2UP
      IL2=ML2UP-ML2+1
      IF(RAN.LE.RND(IL2)) GO TO 240
230 RND(IL2+1)=RND(IL2)
240 RND(IL2+1)=RAN
      RND(ND)=0.
      WT=1.
      MLLW=1
      MLUP=ND-1
      DO 250 ML=MLLW,MLUP
      IL=MLUP-ML+1
      PH(IL,5)=PM(I1+IL,5)+P(I1+IL,5)+(RND(IL)-RND(IL+1))*(P(IPO,5)-PSUM)
250 WT=WT*PANT(PH(IL,5),PM(I1+IL,5),P(I1+IL,5))
      IF(WT.LT.RNDM(0)*WTHAX) GO TO 220
C 9 TWO-PARTICLE DECAY IN CM
260 CONTINUE
      I1LW=1
      I1UP=ND-1
      DO 280 I1=I1LW,I1UP
      PA=PANT(PH(I1,5),PM(I1+IL,5),P(I1+IL,5))
      U(3)=2.*RNDM(0)-1.
      PHI=6.2832*RNDM(0)
      U(1)=SQRT(1.-U(3)**2)*COS(PHI)
      U(2)=SQRT(1.-U(3)**2)*SIN(PHI)
      DO 270 J=1,3
      P(I1+J,J)=PA*U(J)
270 P(I1+J,J)=PA*U(J)
      P(I1+J,4)=SQRT(PA**2+P(I1+J,5)**2)
280 P(I1+J,4)=SQRT(PA**2+P(I1+J,5)**2)
C 10 DECAY PRODUCTS LORENTZ TRANSFORMED TO LAB SYSTEM
      DO 290 J=1,4
290 P(I1+ND,J)=PM(ND,J)
      MLLW=1
      MLUP=ND-1
      DO 320 ML=MLLW,MLUP
      IL=MLUP-ML+1
      DO 300 J=1,3
300 BE(J)=PM(IL,J)/PM(IL,4)
      GA=PM(IL,4)/PM(IL,5)
      I1LW=I+IL
      I1UP=I+ND
      DO 320 I1=I1LW,I1UP
      BEP=BE(1)*P(I1,1)+BE(2)*P(I1,2)+BE(3)*P(I1,3)
      DO 310 J=1,3
310 P(I1,J)=P(I1,J)+GA*(GA/(1.+GA)*BEP+P(I1,4))*BE(J)
320 P(I1,4)=GA*(P(I1,4)+BEP)
C 11 MATRIX ELEMENTS FOR SEMILEPTONIC AND OMEGA AND PHI DECAYS
      IF(IND.EQ.3.AND.K(I1+2,2).GE.7.AND.K(I1+2,2).LE.18) GO TO 852
      GO TO 851
852 CONTINUE
      WT=FOUR(IPO,I1+1)*FOUR(I1+2,I1+3)
      IF(WT.LT.RNDM(0)*P(IPO,5)**4/WTCOR(1)) GO TO 220
      GO TO 853
851 IF(IND.EQ.3.AND.(K(IPO,2).EQ.92.OR.K(IPO,2).EQ.93)) GO TO 854
      GO TO 853
854 CONTINUE
      WT=(P(I1+1,5)*P(I1+2,5)*P(I1+3,5))**2-(P(I1+1,5)*FOUR(I1+2,I1+3))**2
      +-(P(I1+2,5)*FOUR(I1+1,I1+3))**2-(P(I1+3,5)*FOUR(I1+1,I1+2))**2
      +2.*FOUR(I1+1,I1+2)*FOUR(I1+1,I1+3)*FOUR(I1+2,I1+3)
      IF(WT.LT.RNDM(0)*P(IPO,5)**4/WTCOR(2)) GO TO 220
853 CONTINUE
      CONTINUE
      IF(IND.EQ.0) RETURN
      DO 331 L=1,ND
331 K(I1,L)=-IPO
      T=I+ND
      PHISJO=MAX0(PHISJO,I)
      RETURN
C-- ABNORMAL EXIT
500 PRINT 501,MAXSJO,NEVENT
501 FORMAT(5(/),1X,4SHND, OF PARTICLES IN SJOSTRAND P( , ) EXCEEDS ,
110//1X,31HNOVERFLOW OCCURRED IN SUB. DECAY
2 //1X,11HEVENT NO. = ,I10
3//1X,55HINCREASE 1ST DIMENSIONS OF K( , ) AND P( , ) AND MAXSJO,
4//1X,52HINCREASE DIMENSIONS OF IHEV( ) (/CANC/) AND TH2V( ) ,
513H(SUB. P4CORR)
      CALL OVERDM

```

```

RETURN
END

C
SUBROUTINE LIST(N)
*****
COMMON /JET/ K(399,2), P(399,5)
COMMON /DECPAR/ PUDD, PS10, CND1, CND2, IDB(110)
COMMON /DATA3/ CHA1(36), CHA2(110), CHA3(2)
PRINT 110
DO 100 I=1,N
  IF(K(I,1).GT.0) C1=CHA1(K(I,1))
  IF(K(I,1).LE.0) IC1=-K(I,1)
  C2=CHA2(K(I,2))
  C3=CHA3(K(I,2))
  IF(IDB(K(I,2),EQ.0) C3=CHA3(2)
  IF(K(I,1).GT.0) PRINT 120, I, C1, C2, C3, (P(I,J), J=1,5)
  IF(K(I,1).LE.0) PRINT 130, I, IC1, C2, C3, (P(I,J), J=1,5)
100 RETURN
110 FORMAT(///T11,IH1,T17,3MORI,T24,4HPART,T32,4HSTAB,
+T44,2HPX,T56,2HPY,T68,2HPZ,T80,1HE,T92,1HM/)
120 FORMAT(8X,I4,4X,A2,1X,2(4X,A4),5(3X,E9.3))
130 FORMAT(8X,I4,4X,I1,2(4X,A4),5(3X,E9.3))
END

C
SUBROUTINE EDIT(N)
*****
C-- MODIFIED -- DECAY PRODUCTS OF HEAVY FLAVOR PARTICLES ARE ALWAYS
C-- KEPT IF STABLE
C*****
COMMON /JET/ K(399,2), P(399,5)
COMMON /DECPAR/ PUDD, PS10, CND1, CND2, IDB(110)
COMMON /EDPAR/ ITHROW, PZMIN, PHIN, THETA, PHI, BETA(3)
COMMON /SHEAVY/ IHEV(399)
REAL ROT(3,3), PR(3)
C 1 THROW AWAY NEUTRALS OR UNSTABLE OR WITH TOO LOW PZ OR P
  IF(ITHROW.EQ.0) GOTO 120
  I1=0
  DO 110 I=1,N
    IF(ITHROW.GT.0.0.(ITHROW.LT.0.AND.K(I,1).GT.0)) PZ=P(I,3)
    IF(IABS(ITHROW).GE.1.AND.IDB(K(I,2),GT.0) GOTO 110
    IF(IHEV(I,1).EQ.1) GO TO 111
    IF(IABS(ITHROW).GE.2.AND.(K(I,2).EQ.9.OR.K(I,2).EQ.10.OR.K(I,2).
+EQ.13.OR.K(I,2).EQ.14.OR.K(I,2).EQ.17.OR.K(I,2).EQ.18)) GOTO 110
    IF(IABS(ITHROW).GE.3.AND.(K(I,2).EQ.1.OR.K(I,2).EQ.50)) GOTO 110
    IF(PZ.LT.PZMIN.OR.P(I,4)*2-P(I,5)*2.LT.PMIN*2) GOTO 110
111 CONTINUE
    I1=I1+1
    K(I,1)=IDIM(K(I,1),0)
    IF(ITHROW.GT.0) K(I,1)=0
    K(I,2)=K(I,2)
    DO 100 J=1,5
      P(I,J)=P(I,J)
100 CONTINUE
    N=I1
C 2 ROTATE TO GIVE JET PRODUCED IN DIRECTION THETA, PHI
120 IF(THETA.LT.1E-4) GOTO 150
    ROT(1,1)=COS(THETA)*COS(PHI)
    ROT(1,2)=-SIN(PHI)
    ROT(1,3)=SIN(THETA)*COS(PHI)
    ROT(2,1)=COS(THETA)*SIN(PHI)
    ROT(2,2)=COS(PHI)
    ROT(2,3)=SIN(THETA)*SIN(PHI)
    ROT(3,1)=-SIN(THETA)
    ROT(3,2)=0
    ROT(3,3)=COS(THETA)
    DO 140 I=1,N
      DO 130 J=1,3
        PR(J)=P(I,J)
      DO 140 J=1,3
        P(I,J)=ROT(J,1)*PR(1)+ROT(J,2)*PR(2)+ROT(J,3)*PR(3)
C 3 OVERALL LORENTZ BOOST GIVEN BY BETA VECTOR
150 IF(BETA(1)*2+BETA(2)*2+BETA(3)*2.LT.1E-8) RETURN
    GA=1./SQRT(1.-BETA(1)*2-BETA(2)*2-BETA(3)*2)
    DO 170 I=1,N
      BEP=BETA(1)*P(I,1)+BETA(2)*P(I,2)+BETA(3)*P(I,3)
      DO 160 J=1,3
        P(I,J)=P(I,J)+GA*(GA*(1.+GA)*BEP+P(I,4)+BETA(J)
160 P(I,4)=GA*(P(I,4)+BEP)
170 P(I,4)=GA*(P(I,4)+BEP)
    RETURN
    END

C
SUBROUTINE CHEAVY(IL)
*****
C-- FLAVS DECAY PRODUCTS OF HEAVY FLAVOR PARTICLES
COMMON /JET/ K(399,2), P(399,5)
COMMON /SHEAVY/ IHEV(399)
C
004401 IPAR=K(IL,2)
004402 IHEV(IL)=0
004403 IF(IPAR.GE.27.AND.IPAR.LE.50) IHEV(IL)=1
004404 IF(IPAR.GE.54.AND.IPAR.LE.56) IHEV(IL)=1
004405 IF(IPAR.GE.67.AND.IPAR.LE.90) IHEV(IL)=1
004406 IF(IPAR.GE.94.AND.IPAR.LE.96) IHEV(IL)=1
004407 RETURN
004408 END
C
004409 C
004410 C-- SECTION (E)
004411 C
004412 C-- FREEZING, FORCING ETC. ROUTINES
004413 C
004414 C
004415 C
004416 C
004417 C
004418 SUBROUTINE FREEZE(HFLAG)
004419 *****
004420 C-- FREEZES DECAY OF ALL QUANTA OR OF CHARM, BOTTOM, TOP PARTICLES
004421 C-- ACCORDING TO THE VALUE OF HFLAG
004422 COMMON /DECPAR/ PUDD, PS10, CND1, CND2, IDB(110)
004423 COMMON /CBROR/ CBROR(100), IDBOR(110)
004424 COMMON /SPYFOR/ SPYC, SPYB, SPYT, SPYQ, SPYCEL, SPYBEL, SPYTEL
004425 COMMON /KHADRO/ KHADRO
004426 DATA HC,HB,HT,HQ,INC,IMB,IHT,IHQ/
004427 C
004428 CALL SBLOCK
004429 C
004430 IF(HFLAG.EQ.HC) GO TO 40
004431 IF(HFLAG.EQ.HB) GO TO 50
004432 IF(HFLAG.EQ.HT) GO TO 60
004433 IF(HFLAG.EQ.HQ) GO TO 100
004434 GO TO 500
004435 C
004436 C-- CHARM
004437 40 CONTINUE
004438 SPYC=1
004439 DO 41 L=27,32
004440 IDB(L)=0
004441 DO 42 L=67,72
004442 IDB(L)=0
004443 RETURN
004444 C
004445 C-- BOTTOM
004446 50 CONTINUE
004447 SPYB=1
004448 DO 51 L=33,40
004449 IDB(L)=0
004450 DO 52 L=73,80
004451 IDB(L)=0
004452 RETURN
004453 C
004454 C-- TOP
004455 60 CONTINUE
004456 SPYT=1
004457 DO 61 L=41,50
004458 IDB(L)=0
004459 DO 62 L=81,90
004460 IDB(L)=0
004461 RETURN
004462 C
004463 C-- QUANTA
004464 100 CONTINUE
004465 SPYQ=1
004466 KHADRO=0
004467 RETURN
004468 C
004469 C-- ABNORMAL EXIT
004470 500 PRINT 501,HFLAG
004471 501 FORMAT(1H1,1X,24HINCORRECT CALL TO FREEZE
004472 1 //1X,27HCALLED WITH 1ST ARGUMENT = ,A1
004473 2 //1X,44HONLY C,B,T AND Q (IN HOLLERITH) ARE ACCEPTED
004474 STOP
004475 END
004476 C
004477 SUBROUTINE LOOSEQ(IQ,N)
004478 *****
004479 C-- CARRIES ON DECAY OF QUANTUM STORED IN PARQUA(IQ,7)
004480 C-- STABLE CASCADE HADRONS ARE STORED IN P( , ) AND K( , )
004481 C-- N IS LENGTH OF CASCADE
004482 COMMON /EVENT/ NEVENT, ECM, PARHAD(401,7), NPART, HXPART, WEIGHT
004483 COMMON /PARQUA/ PARQUA(79,7), NQUA, MAXQUA
004484 COMMON /PAR/ PUD, PS1, SIGMA, CX2, EBEG, WFIN, IFLBEG
004485 COMMON /DECPAR/ PUDD, PS10, CND1, CND2, IDB(110)
004486 COMMON /JET/ K(399,2), P(399,5)
004487 COMMON /EDPAR/ ITHROW, PZMIN, PHIN, THETA, PHI, BETA(3)
004488 COMMON /MAXN/ MNBOOK, MNBOOK, MNPART, MNQUA, MNCUE, MNCUE, MNSJO
004489
004490
004491
004492
004493
004494
004495
004496
004497
004498
004499
004500
004501
004502
004503
004504
004505
004506
004507
004508
004509
004510
004511
004512
004513
004514
004515
004516
004517
004518
004519
004520
004521
004522
004523
004524
004525
004526
004527
004528
004529
004530
004531
004532
004533
004534
004535
004536
004537
004538
004539
004540
004541
004542
004543
004544
004545
004546
004547
004548
004549
004550
004551
004552
004553
004554
004555
004556
004557
004558
004559
004560
004561
004562
004563
004564
004565
004566
004567
004568
004569
004570
004571
004572
004573
004574
004575
004576

```

```

C EPS=1.E-7
UEPS=1.+EPS

C IFLBEG=PARQUA(IQ,6)
EBEG=PARQUA(IQ,4)*1000.
PP=SQR(1+PARQUA(IQ,1)**2+PARQUA(IQ,2)**2+PARQUA(IQ,3)**2)
THETA=ACOS(PARQUA(IQ,3)/PP/UEPS)
PTQSQ=PARQUA(IQ,1)**2+PARQUA(IQ,2)**2
IF(PTQSQ.LT.EPS) GO TO 20
PTQ=SQR(PTQSQ)
PHI=ATAN2(PARQUA(IQ,2),PARQUA(IQ,1))
GO TO 21
20 PHI=0
PTQ=0
21 CONTINUE
C CALL JETGEN(N)
IF(N.EQ.0) RETURN
ITHROW=1
CALL EDIT(N)
C DO 25 I=1,N
DO 25 J=1,5
P(I,J)=P(I,J)/1000.
25 RETURN
END
C SUBROUTINE SPECTJ
*****
C-- COMPLETES CURRENT CONTENT OF PARHAD( ,7) WITH SPECTATOR JETS
C-- CONTRIBUTION SO AS TO HAVE 4-MOMENTUM CONSERVATION
CALL HADRON(1,0,1)
RETURN
END
C SUBROUTINE LOOSEH(IH,N)
*****
C-- CARRIES ON DECAY OF HEAVY FLAVOR HADRON STORED IN PARHAD(IH,7)
C-- ALL CASCADE HADRONS (STABLE OR UNSTABLE) ARE STORED IN P( , ) AND
C-- K( , )
C-- TABS(K(I,1)) GIVES ORDER NO. IN THE CASCADE (OF LENGTH N) OF THE
C-- PARENT OF THE HADRON WITH ORDER NO. I
C-- IF K(I,1).LT.0 PARTICLE WITH ORDER NO. I IS UNSTABLE
COMMON/EVENT/NEVENT,ECH,PARHAD(401:7),NPART,HXPART,WEIGHT
COMMON/PAIR/PUO,PSI,SIGMA,CX2,EBEG,WFIN,IFLBEG
COMMON/DECPAR/PUO,PSI,CMD1,CMD2,IDB(110)
COMMON/JET/ K(399,2), P(399,5)
COMMON/HAXSJO/HAXSJO
COMMON/CBROR/CBROR(180),IDBOR(110)
INTEGER IOBC(110)
C DO 100 L=1,110
IDB(L)=IDB(L)
100 IDB(L)=IDBOR(L)
C I=1
DO 202 J=1,5
P(I,J)=PARHAD(IH,J)*1000.
K(I,2)=PARHAD(IH,6)
K(I,1)=1
202 C IPD=0
IPD=IPD+1
IF(IDB(K(IPD,2)).GT.0) CALL DECAY(IPD,I)
IF(IPD.LT.I) GO TO 203
N=I
DO 204 M=1,N
IF(IDB(K(M,2)).EQ.0) K(M,1)=-K(M,1)
DO 204 J=1,5
P(M,J)=P(M,J)/1000.
204 C IF(N.GT.1) K(1,1)=0
C DO 300 L=1,110
IDB(L)=IDB(L)
300 IDB(L)=IDBC(L)
RETURN
END
C SUBROUTINE STABKP(N)
*****
C-- ELIMINATES UNSTABLE PARTICLES FROM P( , ) AND K( , )
COMMON/JET/ K(399,2), P(399,5)
C IF(N.EQ.0) RETURN
I=0
DO 110 I=1,N
004577 IF(K(I,1).LE.0) GO TO 110
004578 I1=I+1
004579 K(I1,1)=0
004580 K(I1,2)=K(I,2)
004581 DO 100 J=1,5
004582 P(I1,J)=P(I,J)
004583 CONTINUE
004584 N=I1
004585 C RETURN
004586 END
004587 C SUBROUTINE SHOCAS(N)
004588 *****
004589 C-- LISTS CASCADE PARTICLES
004590 COMMON/JET/ K(399,2), P(399,5)
004591 COMMON/DATA3/ CHA1(36), CHA2(110), CHA3(2)
004592 COMMON/CBROR/CBROR(180),IDBOR(110)
004593 PRINT 110
004594 IF(N.EQ.0) RETURN
004595 DO 100 I=1,N
004596 C2=CHA2(K(I,2))
004597 C3=CHA3(I)
004598 IF(IDBOR(K(I,2)).EQ.0) C3=CHA3(2)
004599 PRINT 130,I,K(I,1),C2,C3,(P(I,J),J=1,5)
004600 RETURN
004601 110 FORMAT(/T11,IMI,T17,SMORI,T24,4HPART,T32,4HSTAB,
004602 T44,2HPX,T56,2HPY,T68,2HPZ,T80,1HE,T92,1HM/)
004603 130 FORMAT(8X,I4,2X,IS,2(4X,A4),5(3X,E9.3))
004604 END
004605 C SUBROUTINE FORSLE(HFLA,KEY)
004606 *****
004607 C-- FORCES ELECTRON S.L. DECAY OF HEAVY FLAVORS
004608 C-- (IF KEY.GT.0 -- IF KEY.LT.0 RESTORES ORIGINAL B.R.'S)
004609 COMMON/DATA2/ CBR(180), KOP(180,3), WTCOR(10)
004610 COMMON/CBROR/CBROR(180),IDBOR(110)
004611 COMMON/SPYFOR/SPYQ,SPYB,SPYT,SPYQ,SPYCEL,SPYBEL,SPYTEL
004612 DATA MC,HB,HT/1HC,1HB,1HT/
004613 C CALL SBLOCK
004614 IF(HFLA.EQ.HC) GO TO 40
004615 IF(HFLA.EQ.HB) GO TO 50
004616 IF(HFLA.EQ.HT) GO TO 60
004617 GO TO 500
004618 C C-- CHARM
004619 40 CONTINUE
004620 IF(KEY.LT.0) GO TO 45
004621 SPYCEL=1.
004622 CBR(6)=1.
004623 CBR(9)=1.
004624 CBR(12)=1.
004625 CBR(121)=1.
004626 RETURN
004627 45 CONTINUE
004628 SPYCEL=-1.
004629 CBR(6)=CBROR(6)
004630 CBR(9)=CBROR(9)
004631 CBR(12)=CBROR(12)
004632 CBR(121)=CBROR(121)
004633 RETURN
004634 C C-- BOTTOM
004635 50 CONTINUE
004636 IF(KEY.LT.0) GO TO 55
004637 SPYBEL=1.
004638 CBR(16)=1.
004639 CBR(21)=1.
004640 CBR(26)=1.
004641 CBR(32)=0.
004642 CBR(33)=1.
004643 CBR(126)=1.
004644 RETURN
004645 55 CONTINUE
004646 SPYBEL=-1.
004647 CBR(16)=CBROR(16)
004648 CBR(21)=CBROR(21)
004649 CBR(26)=CBROR(26)
004650 CBR(32)=CBROR(32)
004651 CBR(33)=CBROR(33)
004652 CBR(126)=CBROR(126)
004653 RETURN
004654 C C-- TOP
004655 60 CONTINUE
004656 IF(KEY.LT.0) GO TO 65
004657

```

```

SPYTEL=1.
CBR(39)=1.
CBR(45)=1.
CBR(50)=1.
CBR(55)=1.
CBR(61)=1.
CBR(130)=1.
RETURN
65 CONTINUE
SPYTEL=-1.
CBR(39)=CBROR(39)
CBR(45)=CBROR(45)
CBR(50)=CBROR(50)
CBR(55)=CBROR(55)
CBR(61)=CBROR(61)
CBR(130)=CBROR(130)
RETURN
C
C-- ABNORMAL EXIT
500 PRINT 501,HFLA
501 FORMAT(1H1,24HINCORRECT CALL TO FORSLR
1 //1X,27HCALLED WITH 1ST ARGUMENT = ,A1
2 //1X,39HONLY C, B AND T (IN HOLLERITH) ACCEPTED
3 //1X,20HEXECUTION TERMINATED)
STOP
END
C
C-----
C-- SECTION (F)
C-- TIME LEFT FOR EXECUTION AND RANDOM NUMBER GENERATOR ROUTINES
C-- TO BE FIXED BY USER DEPENDING ON LOCAL IMPLEMENTATIONS
C
C-----
C SUBROUTINE TIMELEFT(TLE)
C *****
C-- GIVES TIME LEFT FOR EXECUTION
CALL TIMELEFT(TLE)
RETURN
END
C
C FUNCTION RNDH(A)
C *****
C-- UNIFORM RANDOM NUMBER GENERATOR
C-- N.B. RNDH SHOULD NEVER BE EQUAL TO 0. OR 1.
RNDH=FRANF()
RETURN
END
C
C*****
C-- SECTION (F)
C-- THE CONTENTS OF THE FOLLOWING ROUTINES CAN BE ARBITRARILY CHANGED
C-- BY USER
C
C*****
C SUBROUTINE BOOKH
C *****
C-- BOOKS HISTOGRAMS
COMMON//B(3000)
CALL HLIMIT(3000)
C
C-- QUANTA
CALL HBOOK1(1001,10HN QUANTA $,100,0.,100.)
CALL HBOOK1(1002,10HYJX $,50,-2.5,2.5)
CALL HBOOK2(1003,10HYECH-YJX $,50,-2.5,2.5,50,-2.5,2.5)
C
C-- BALANCE
CALL HBOOK1(2001,10HDE/ECM $,100,-1.,1.)
CALL HBOOK1(2002,10HDP/P $,100,0.,1.)
C
C-- BOSON
CALL HBOOK1(1,10HW/Z MASS $,100,75.,100.)
C
C-- PARTICLES
CALL HBOOK1(3001,10HETA CM $,100,-5.,5.)
CALL HBOOK1(3002,10HNCH $,100,0.,200.)
CALL HBOOK1(3003,10HPT CM $,100,0.,10.)
CALL HBOOK1(3004,10HET Y.LT.3 $,100,0.,200.)
CALL HBOOK1(3005,10HET Y.LT.1 $,100,0.,200.)
C
C-- LEADING ELECTRON
CALL HBOOK1(4001,10HPT EL $,60,0.,60.)
CALL HBOOK1(4002,10HYCH EL $,100,-2.5,2.5)
CALL HBOOK2(4003,10HYCH-PT EL $,100,-2.5,2.5,60,0.,60.)
004753 C
004754 CALL HBSTAT(0)
004755 C
004756 RETURN
004757 END
004758 C
004759 SUBROUTINE FILLH
004760 C
004761 *****
004762 C-- FILLS HISTOGRAMS
004763 C-- NOTE ON /HADQN/ - LHADR(M),LCHARG(M),LCHARN(M),LBOTT(M) AND LTOP(M)
004764 C-- GIVE HADRON/LEPTON QUALITY (1/0 RESPECTIVELY), ELECTRIC CHARGE,
004765 C-- CHARM Q.N., BOTTOM Q.N. AND TOP Q.N. (1,-1 OR 0), RESPECTIVELY,
004766 C-- OF PARTICLE WITH CODE NUMBER M (SEE PARTICLE TABLE)
004767 C-- NOTE - WEIGHT IS ALWAYS 1. IN WIZJET
004768 REAL PTOT(4)
004769 COMMON/PARQUA/PARQUA(79,7),NQUA,MAXQUA
004770 COMMON/NEVENT/NEVENT,ECM,PARHAD(401,7),NPART,MPART,WEIGHT
004771 COMMON/BOSON/PBOS(6),ICHDB,IQRKFM
004772 COMMON/HADQN/LHADR(110),LCHARG(110),LCHARN(110),LBOTT(110)
004773 *LTOP(110)
004774 COMMON/TOTMGT/TOTMGT
004775 C
004776 DATA ICALL/0/
004777 C
004778 IF(ICALL.GT.0) GO TO 10
004779 ICALL=1
004780 EPS=1.E-7
004801 FECH=2./ECM
004802 PI=4.*ATAN(1.)
004803 TOTMGT=0.
004804 CONTINUE
004805 C-- QUANTA
004806 ETJX=0.
004807 IF(NQUA.EQ.0) GO TO 16
004808 CALL HFIILL(1001,FLOAT(NQUA)+EPS,0.,WEIGHT)
004809 DO 13 I=1,NQUA
004810 ETSQ=PARQUA(I,1)**2+PARQUA(I,2)**2
004811 ETJ=SQRT(ETSQ)
004812 IF(ETJ.LT.10..OR.ETJ.LT.ETJX) GO TO 13
004813 ETJX=ETJ
004814 YJX=SIGN(-ALOG(TAN(ATAN(ETJX/ABS(PARQUA(I,3)))/2.)),PARQUA(I,3))
004815 CONTINUE
004816 IF(ETJX.GT.1.E-3) CALL HFIILL(1002,YJX,0.,WEIGHT)
004817 CONTINUE
004818 IF(NPART.EQ.0) RETURN
004819 C-- BALANCE OF HADRONIC STATE
004820 DO 21 J=1,4
004821 PTOT(J)=0.
004822 PSUM=0.
004823 DO 22 I=1,NPART
004824 PSUM=PSUM+SQRT(PARHAD(I,1)**2+PARHAD(I,2)**2+PARHAD(I,3)**2)
004825 DO 23 J=1,4
004826 PTOT(J)=PTOT(J)+PARHAD(I,J)
004827 CONTINUE
004828 CONTINUE
004829 EBLNC=(PTOT(4)-ECM)/ECM
004830 PBLNC=SQRT(PTOT(1)**2+PTOT(2)**2+PTOT(3)**2)/PSUM
004831 CALL HFIILL(2001,EBLNC,0.,WEIGHT)
004832 CALL HFIILL(2002,PBLNC,0.,WEIGHT)
004833 C
004834 C-- BOSON
004835 CALL HFIILL(1,PBOS(5),0.,WEIGHT)
004836 C
004837 C-- PARTICLES
004838 IF(NPART.EQ.0) RETURN
004839 TOTMGT=TOTMGT+WEIGHT
004840 NCH=0
004841 ETY3=0.
004842 ETY1=0.
004843 PTEX=0.
004844 DO 91 I=1,NPART
004845 PP=SQRT(PARHAD(I,1)**2+PARHAD(I,2)**2+PARHAD(I,3)**2)
004846 PTSQ=PARHAD(I,1)**2+PARHAD(I,2)**2
004847 PT=SQRT(PTSQ)
004848 ETI=SQRT(PTSQ+PARHAD(I,5)**2)
004849 Y=SIGN(-ALOG(TAN(ATAN(PT/ABS(PARHAD(I,3)))/2.)),PARHAD(I,3))
004850 IPART=PARHAD(I,6)
004851 IF(LCHARG(IPART).NE.0)
004852 * CALL HFIILL(3003,PT,0.,WEIGHT)
004853 IF(LCHARG(IPART).NE.0) CALL HFIILL(3001,Y,0.,WEIGHT)
004854 IF(LCHARG(IPART).NE.0) NCH=NCH+1
004855 C-- ELIMINATE ET CONTRIBUTIONS FROM NEUTRINOS
004856 IF(IPART.EQ.9..OR.IPART.EQ.10..OR.IPART.EQ.13..OR.IPART.EQ.14
004857 *..OR.IPART.EQ.17..OR.IPART.EQ.18) ETI=0.
004858 IF(ABS(Y).LT.3.) ETY3=ETY3+ETI
004859 IF(ABS(Y).LT.1.) ETY1=ETY1+ETI
004860

```



```

      IF(PY.LY.PTEX) GO TO 91
      IOR=PARMAD(1,7)
      IF(IOR.LE.0) GO TO 91
      IF(IPART.NE.7.AND.IPART.NE.8) GO TO 91
      YE=Y*FLOAT(LCHARG(IPART))
      PTE=PT
      PTEX=PTE
91    CONTINUE
C
      CALL HFILL(3002,FLOAT(NCH)*1.E-5,0.,WEIGHT)
      CALL HFILL(3004,ETY3,0.,WEIGHT)
      CALL HFILL(3005,ETY1,0.,WEIGHT)
C-- LEADING ELECTRON
      IF(PTEX.GT.1.E-4) CALL HFILL(4001,PTE,0.,1.)
      IF(PTEX.GT.1.E-4) CALL HFILL(4002,YE,0.,1.)
      IF(PTEX.GT.1.E-4) CALL HFILL(4003,YE,PTE,1.)
      IF(PTEX.GT.1.E-4.AND.ETJX.GT.1.E-3) CALL HFILL(1003,YE,YJX,WEIGHT)
C
C
      RETURN
      END
C
      SUBROUTINE OUTH
      *****
C-- OUTPUTS HISTOGRAMS
      COMMON/TOTMGT/TOTMGT
C
      IF(TOTMGT.LT.1.E-5) GO TO 100
C
      DO 10 L=3001,3005
10     CALL HOPERA(L,1N+,L,L,1./TOTMGT,0.)
C
100    CONTINUE
      CALL HIST00
C
      RETURN
      END

```

```

004929
004930
004931
004932
004933
004934
004935
004936
004937
004938
004939
004940
004941
004942
004943
004944
004945
004946
004947
004948
004949
004950
004951
004952
004953
004954
004955
004956
004957
004958
004959
004960
004961
004962
004963
004964
004965

```