DELPHI Collaboration

---

# WWANA
# A standard package for W analysis
# - Version 6.00 -

**R. Chierici**
University of Torino and INFN
**C. Parkes**
CERN
**A. Tonazzo**
University of Milano and INFN

**Abstract**

This note contains an update of the structure of the WWANA program. WWANA is intended as a standard DELPHI package for use in WW physics analysis: it provides information relevant to both W mass measurements and TGC studies. The main output of the package is a column wise ntuple organised in blocks of relevance to particular W decay channels and of more general event information. This document relates to WWANA version 6.00.

# 1 Introduction

WWANA is intended as a standard package for W mass, WW cross section and TGC analyses in DELPHI. The program is written in PATCHY format and uses the SKELANA package to fill the common blocks which contain the information from the DST.

The main program calls several routines which evaluate interesting physics quantities for the event: these include lepton identification, global event variables and jet analysis.

If the user is processing simulation data the event is classified according to its type, and some simulation truth information is retrieved.

For each event WWANA calls different identification routines whose aim is to tag the event. They return a tag flag and, if a kinematic fit is performed, the chi-square of the fit. The subroutine `ww4qid` tags four jet events, the subroutines `ww2qid` and `ww1tid` two jet events with one lepton, while `ww2lid` tags two lepton events. The kinematic fit is not performed on two lepton events. The basic flow diagram of the program is provided as Figure 1.

The main output of the program is a Column-Wise Ntuple. By setting a simple set of logical parameters, the user can choose which blocks of information to include in the ntuple. This choice will be dependent on which analysis and which W decay channels the user is interested in studying.
In what follows a review of users' inputs to WWANA and a complete update of the ntuple structure is given: for a full description of the program flow and for basic information on how to use WWANA see the DELPHI note 96-128 PROG 218, 1996.

# 2 Location of the code

The WWANA program is composed of several PAM files, which are located in the common area for DELPHI LEP200 physics on afs machines:

`//afs/cern.ch/delphi/tasks/lep200/wphysics/wwana`

The core of the program is composed of two PAM files:

- `wwcde.car` contains all the common and parameter declarations useful for the analysis: it also contains the user-defined basic selections.
- `wwana.car` is the main program with all the 'tool subroutines'

Two versions of the main program are stored in this area: a stable version `wwanaxx.car, wwcdexx.car` updated every few weeks, and a development version `wwana.car ,wwcde.car` updated as soon as changes are suggested. WWANA also uses the following files:

- `wwfit.car` contains the routines for the kinematic fit (the PUFITC package, written by N.Kjaer)
- `sprime.car` is the SPRIME package by P.Abreu et al., to calculate the effective centre of mass energy
- `durham.car` contains the routine for the DURHAM jet reconstruction algorithm

- `fixcal.car` contains routines to correct the electromagnetic calorimeter energy in data and monte-carlo for '96 data

A further two files are provided in this area to assist the WWANA user:

- `wwana.cra` contains an example PATCHY cradle file which shows how to use these PAM files

- `wwana.manual` documents the stable version of WWANA

# 3 Inputs and Settings

- **SKELANA interface** WWANA works in SKELANA framework. WWANA handles the flags for the filling of the SKELANA common blocks in the WWINI subroutine, where they should be set to the desired values. The SKELANA LVLOCK array is used inside WWANA for track selection; WWANA re-orders the VECP array so that the locked tracks are at the end.

- **Track selection** The users can perform their own track selection within SKELANA or use the W team track selection within WWANA. The use of the W team track selection criteria, which also include track rescaling, can be done by setting to .TRUE. the logical variable TK SEL in the `.cdes`. The track selection cuts have been studied on 97E3 data, to achieve good agreement with the simulation. For charged tracks cuts are placed on track momenta, impact parameters ($R-\phi$ and $z$), track length and relative momentum error. In addition tracks composed only of ID-VD hits without $z$ information (none in 97E3) and VD only without z are explicitly rejected.Rescaling routines are used to improve electron momentum estimation and recoup rejected tracks. The rescaling routines use the associated calorimeter energy deposits, and TPC track elements. For neutral deposits low energy clusters are rejected with calorimeter energy cuts.

- **Pre-selection** A very loose pre-selection of events can be performed at the beginning of WWANA by setting the corresponding logical variable PRE CUT. This would accelerate the execution of the program. The pre-selection consists of two cuts which require at least one track with momentum over 2 GeV in the event and more than 15 GeV of charged energy in the polar range 10-170 degrees.

- **Beam energy** For analyses in which the beam energy is important, the BEAM ENERGY option should be used. If you wish to use the BEAM ENERGY option the beam energy file must be provided: for the 96 data the name of the file is `ENERGY96.14AUG97` and for the 97 data this is `ENERGY97.23FEB98`. Both files are in `$DELPHI_DAT` and to be used they must be linked in the `csh` file to `ENERGY.DAT`. This can be done by using the command:
`ln -s $DELPHI_DAT/ENERGY96.14AUG97 ENERGY.DAT`

- **Beam spot** Data that is processed while the data taking period is still continuing will generally not have the correct beamspot defined on the DST. For precision studies the impact parameter cuts in WWTRSE should be defined with respect to the true beamspot, as displacements from the origin can be significant. To correct this the standard DELPHI beamspot routines can be used to read the beamspot file (once one has been produced). To assist a routine WWBSCOR has been included in WWANA that overwrites the SKELANA PSBEAM common. To correct the DST beam spot the following steps must be done:

- In SKELANA USER00 add:
  `CALL READBS(xx)`
- In SKELANA USER02 add, before the call to WWANA:
  `CALL WWBSCOR`
- In your submission script file link the correct beamspot file:
  `setenv ftnxx $DELPHI_DAT/96E1.DB`

where `xx` defines the fortran logical unit.

- **General cuts** The user can set general cuts to be used inside WWANA for the tagging of the different WW decay channels. These cuts are defined inside `+KEEP,WWCUTS.` in `wwcde.car` and are set by default to very loose values in order to maximize the tagging efficiency, thus leaving complete control to the user. The table 1 lists these cuts, their allowed range, and their default value. The numbers in brackets indicate parameter ranges.
- **Settings** The user can set a certain number of parameters which control the logic of the analysis. They are related to the constrained fit options, the lepton identification and the jet clustering algorithm to be used. The full list of the parameters with their allowed values and ranges are reported in table 2.

# 4 Building WWANA ntuple

A Column-Wise Ntuple is used to store all the event information: this choice allows the use of a block structure for the ntuple. The user can therefore decide which of the blocks they want to include in their ntuple in order to meet the individual needs of their analysis. The ntuple output file `ww.ntp` is generated automatically when running the program. The ntuple blocks of WWANA version 6.00 are:

**TITLE BLOCK**
This contains a user defined 'nickname' for the ntuple. It can be used to store information about the ntuple production: e.g. MC generator, clusterization algorithm, etc...

**HEADER BLOCK**
General information about the run.

**MCINFO BLOCK**
Montecarlo information about the event.

**EVENT BLOCK**
General event quantities.

| Input cuts | Variable(s) | Range | Default |
|---|---|---|---|
| Minimum and maximum multiplicity per event ($4q$, $ql\nu$, $qql\nu$, $l\nu l\nu$) | MINMUL4Q, MINMUL2Q, MAXMUL2Q, MAXMUL2L | >0 | 5,5, 150,20 |
| Polar angle of the electrons ($qql\nu$) | THELMIN | (0,180) | 5 (°) |
| Polar angle of the muons ($qql\nu$) | THMUMIN | (0,180) | 5 (°) |
| Polar angle of the tracks ($l\nu l\nu$) | THLLMIN | (0,180) | 5 (°) |
| Minimum momentum of leptons ($qql\nu$) | PMUCUT, PELCUT | >0 | 5,5 (GeV) |
| Minimum momentum of unidentified track ($qq\tau\nu$) | PLPCUT | >0 | 5 (GeV) |
| Minimum momentum of tracks ($l\nu l\nu$) | PLLCUT | >0 | 5 (GeV) |
| Maximum energy in a cone around a lepton... ($qql\nu$) | ENCOMU, ENCOEL | ≥0 | 100, 100 (GeV) |
| ...with following opening angle (lepton id. and $qql\nu$, $l\nu l\nu$) | ANGCONE | >0 | 10 (°) |
| Min. lepton angle from nearest charged track... ($qql\nu$) | ANELMIN, ANMUMIN, ANLPMIN | ≥0 | 0,0,0 (°) |
| ...with at least this momentum | PMINANG | ≥0 | 1 (GeV) |
| Min. angle between jet and lepton ($qql\nu$) | THLEJEMIN | ≥0 | 5 (°) |
| Minimum acollinearity between two selected tracks ($l\nu l\nu$) | THACOLL | ≥0 | 10 (°) |
| Max. number of allowed tagged leptons | MAXLEP | ≤10 | 10 |
| Max. energy in FEMC for candidate electrons (ELMODE = 'C') | EMAXFE | ≥0 | 100 (GeV) |

Table 1: The user defined cuts in `+KEEP, WWCUTS`.

### QQANA BLOCK

Information about the four jet analysis. The jet combination with the best $\chi^2$ after the constrained kinematic fit has been performed is retained.

### QQ4C BLOCK

Several qqqq analyses require information from kinematic fits performed with two sets of constraints. This block is included to provide 4C fit information.

### QQOTHER BLOCK

Information on the other possible di-jet combinations after the standard (QQANA block) kinematic fit.

### QLANA BLOCK

Information for two jet, one lepton analysis, where the lepton is identified as an electron or a muon.

| **Input cuts** | **Variable(s)** | **Range** | **Default** |
|---|---|---|---|
| Exponent for momentum weighted jet charge | CAPPA | any | 0.5 |
| Number of constraints in kinematic fit ($4q$, $ql\nu$)<br>$4 \rightarrow P_\mu$ conservation<br>$5 \rightarrow P_\mu$ and equal masses<br>$6 \rightarrow P_\mu$ and masses = Mw<br>$7 \rightarrow P_\mu$ and one mass = Mw | NCON4Q, NCON2Q | [4,7] | 5 |
| ISR included in the constrained fit | ISRC4Q, ISRC2Q | 0,1 | 0 |
| Jet broadening included in constr. fit | JBROAD | 0,1 | 0 |
| Clustering algorithm to force 2 or 4 jets<br>PUJ4 → PUJET4: only for 4 jets<br>PUYC → PUYCLU<br>LUCL → iterative PUCLUS with standard LUND $d_{ij}$<br>LUNR → same as LUCL, but particles are not reassigned to jets<br>MINV → PUCLUS with invariant mass cluster, no particle reassignment<br>JADE → PUCLUS with JADE $d_{ij}$<br>DURH → DURHAM algorithm | CLU4, CLU2 | 'PUJ4', 'PUYC', 'LUCL', 'LUNR', 'MINV', 'JADE', 'DURH' | 'LUCL', 'LUCL' |
| Muon id. selection criteria<br>'V' → very loose (MUC)<br>'L' → loose (MUC)<br>'S' → standard (MUC)<br>'T' → standard (MUC)<br>add 'H' → PXHAID tag (HCAL) | MUMODE | 'V'(+'H'), 'L'(+'H'), 'S'(+'H'), 'T'(+'H') | 'V' |
| Electron id. selection criteria<br>'C' → W team criteria<br>'V' → very loose (ELEPHANT)<br>'L' → loose (ELEPHANT)<br>'S' → standard (ELEPHANT)<br>'T' → tight (ELEPHANT) | ELMODE | 'C','V', 'L','S', 'T' | 'C' |
| Clustering algorithm to be used (as for CLU4,CLU2) | CLNJ | 'LUCL', 'LUNR', 'MINV', 'JADE', 'DURH' | 'LUCL' |
| Value of $d_{join}$ or $y_{cut}$ to be used | DCNJ | any | 6.5 |

Table 2: WWANA settings in `+KEEP, WWCUTS.` and `+KEEP, WWJETS.`

| Logical word | Action | Default |
|---|---|---|
| MONTECARLO | to include/exclude MCINFO BLOCK | .TRUE. |
| QQANALYSIS | to include/exclude QQANA BLOCK | .TRUE. |
| QQINFO4C | to include/exclude QQ4C BLOCK | .FALSE. |
| OTHERCOMB | to include/exclude QQOTHER BLOCK | .FALSE. |
| QLANALYSIS | to include/exclude QLANA BLOCK | .TRUE. |
| QTANALYSIS | to include/exclude QTANA BLOCK | .FALSE. |
| FLANALYSIS | to include/exclude FLANA BLOCK | .TRUE. |
| ALLLEPTONS | to include/exclude LEPTON BLOCK | .FALSE. |
| ALLJETS | to include/exclude JETANA BLOCK | .FALSE. |
| BIGNEUTRALS | to include/exclude NEUT BLOCK | .FALSE. |

Table 3: Logical variable for ntuple definition

**QTANA BLOCK**
Information for two jet + one lepton analysis, where the lepton is either an unidentified single charged track, or a narrow low multiplicity jet. Intended for $qq\tau\nu$ channel selection.

**FLANA BLOCK**
Information for the fully leptonic channel analysis.

**LEPTON BLOCK**
Information on all the tagged leptons in the event.

**JETANA BLOCK**
Information on the jets - clusterized according to the selected criteria.

**NEUT BLOCK**
Information on highest energy neutral particles.

The detailed description of each block has been reported in Appendix A. Only the TITLE block, the HEADER block and the EVENT block are always filled, while the other blocks can be excluded (or included) by changing the corresponding logical word in `+KEEP WWNTUP.` in `wwcde.car`. These logical words are listed in table 3, together with their meaning and default value:

The HBOOK file created by WWANA also contains some histograms to give complementary information about track or jet quantities. They are listed in table 4

| Histogram number | Content |
|---|---|
| 210 | Natural jets polar angle distribution |
| 220 | Selected muons polar angle distribution |
| 221 | Selected electrons polar angle distribution |
| 2000 | Generated W mass |
| 2001 | Generated energy of leptons from W |
| 2002 | Generated ISR polar angle |

Table 4: WWANA output Histograms

# 5 Ntuple contents

TITLE BLOCK

| | | |
|---|---|---|
| User defined nickname | WWTITLE | USER |
| Name of generator/data | GENER | DST |

HEADER BLOCK

| | | |
|---|---|---|
| Run number | NRUN | SKELANA |
| Event number | NEVT | SKELANA |
| Bunch number | NBUN | SKELANA |
| Fill number | NFIL | SKELANA |
| Center of mass energy | ECOM | SKELANA |
| Event Date (format yymmdd) | NDATE | SKELANA |
| Event Time (format hhmmss) | NTIME | SKELANA |

MCINFO BLOCK

| | | |
|---|---|---|
| W-, W+ (resp.) mass | GWMAS(2) | MC |
| W-, W+ (resp.) polar angle | GWTHE(2) | MC |
| W-, W+ (resp.) abs. value of momentum | GWMOM(2) | MC |
| Four-momentum of fermion from W- | GFEP1(4) | MC |
| Four-momentum of antifermion from W- | GFEP2(4) | MC |
| Four-momentum of antifermion from W+ | GFEP3(4) | MC |
| Four-momentum of fermion from W+ | GFEP4(4) | MC |
| Lund codes of the four fermions from W | GFECO(4) | MC |
| VECP indices of the leptons from W | GLPAI(2) | MC |
| Type of decay of tau from W | GTAUDEC(2) | MC |
| 11 $\rightarrow$ leptonic decay with electron (sign according to LUND) | | |
| 13 $\rightarrow$ leptonic decay with muon (sign according to LUND) | | |
| 1 $\rightarrow$ any hadronic decay | | |
| ISR four-momentum | GEISR | MC |
| Energy of the hardest ISR photon | GEMAXISR | MC |
| Polar angle of the hardest ISR photon | GTHEISR | MC |
| Bitted word for the event tagging | IGEN | MC |

$\boxed{\text{EVENT BLOCK}}$

| | | |
|---|---|---|
| Total multiplicity | NTMUL | WWANA |
| Charged multiplicity | NCMUL | WWANA |
| Number of natural jets | NJETS | PUCLUS |
| Number of tagged electrons | NELE | WWANA |
| Number of tagged muons | NMUO | WWANA |
| Total visible energy | EVIS | WWANA |
| Transverse energy | ETRANS | WWANA |
| Total charged energy | ECHARG | WWANA |
| Vector missing momentum | PMISS(1:3) | WWANA |
| Absolute value of PMIS | PMISS(4) | WWANA |
| Thrust value | THRUST | VECSUB |
| Thrust axis polar angle | THETHR | VECSUB |
| Sphericity | SPHER | VECSUB |
| Acoplanarity | APLA | VECSUB |
| $\sqrt{S'}$ | SPRM | SPRIME |
| SPRIME quality flag | IFQSPR | SPRIME |
| Bitted word for the event tagging | IDET | WWANA |

$\boxed{\text{QQANA BLOCK}}$

| | | |
|---|---|---|
| Four-momentum of forced jet 1 | QQP1(1:4) | WWANA |
| Four-momentum of forced jet 2 | QQP2(1:4) | WWANA |
| Four-momentum of forced jet 3 | QQP3(1:4) | WWANA |
| Four-momentum of forced jet 4 | QQP4(1:4) | WWANA |
| Total multiplicities of jets | QQTM(1:4) | WWANA |
| Charged multiplicities of jets | QQCM(1:4) | WWANA |
| Momentum weighted charges of 4 jets | QQCH(1:4) | WWANA |
| Electromagnetic energy in jets | QQEM(1:4) | WWANA |
| Hadronic energy in jets | QQHA(1:4) | WWANA |
| Neutral energy in jets | QQNE(1:4) | WWANA |
| Energy of the lowest energy jet | QQEMIN | WWANA |
| Minimum angle between two jets | QQANJJ | WWANA |
| Fitted four-momentum of jet 1 | QQOB1(1:4) | PUFITC |
| Fitted four-momentum of jet 2 | QQOB2(1:4) | PUFITC |
| Fitted four-momentum of jet 3 | QQOB3(1:4) | PUFITC |
| Fitted four-momentum of jet 4 | QQOB4(1:4) | PUFITC |
| Fitted W mass error from PUFITC | QQWMER(1:2) | PUFITC |
| Fitted W masses | QQWM(1:2) | PUFITC |
| Fitted W- polar angle | QQWTH | WWANA |
| Chi square of the 4 jets fit | QQCHI | PUFITC |
| Number of degrees of freedom in the fit | QQDOF | PUFITC |
| Chosen dijet combination | ICOMB | PUFITC |

(NOTE: The information from the fit on the W- , selected using the jet charge, is stored first)

QQ4C BLOCK

| | | |
|---|---|---|
| 4C fitted fourmomentum of jet 1 | QQP14C(4) | PUFITC |
| 4C fitted fourmomentum of jet 2 | QQP24C(4) | PUFITC |
| 4C fitted fourmomentum of jet 3 | QQP34C(4) | PUFITC |
| 4C fitted fourmomentum of jet 4 | QQP44C(4) | PUFITC |
| Energy of Minimum Energy jet | QQEMIN4C | PUFITC |
| Minimum jet - jet angle | QQANJJ4C | PUFITC |

QQOTHER BLOCK

| | | |
|---|---|---|
| Number of di-jet combinations with the chosen n of constraints | NCOMB | WWANA |
| Fitted four-momentum of 'object' 1 | QQOB1(1:4,1:NCOMB) | PUFITC |
| Fitted four-momentum of 'object' 2 | QQOB2(1:4,1:NCOMB) | PUFITC |
| Fitted four-momentum of 'object' 3 | QQOB3(1:4,1:NCOMB) | PUFITC |
| Fitted four-momentum of 'object' 4 | QQOB4(1:4,1:NCOMB) | PUFITC |
| Fitted W masses | QOWM(1:2,1:NCOMB) | PUFITC |
| Fitted W mass errors | QOWMER(1:2,1:NCOMB) | PUFITC |
| Fitted W polar angle | QOWTH(1:NCOMB) | WWANA |
| Chi square from constrained fit | QOCHI(1:NCOMB) | PUFITC |

QLANA BLOCK

**2 jets + 1 electron**

| | | |
|---|---|---|
| Information on chosen electron for the fit (as PLEPT,see below) | QEPL(1:23) | WWANA |
| Fourmomentum of forced jet 1 | QEP1(1:4) | WWANA |
| Fourmomentum of forced jet 2 | QEP2(1:4) | WWANA |
| Total multiplicities of jets | QETM(1:2) | WWANA |
| Charged multiplicities of jets | QECM(1:2) | WWANA |
| Momentum weighted charges of 2 jets | QECH(1:2) | WWANA |
| Angle electron - closest jet | QEANLJ | WWANA |
| Angle between the two jets | QEANJJ | WWANA |
| Codes of the four fitted 'objects' | QECOD(4) | WWANA |

1 → jet
3 → neutrino
11 → electron (sign according to LUND)
13 → muon (sign according to LUND)

| | | |
|---|---|---|
| Fitted fourmomentum of 'object' 1 | QEOB1(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 2 | QEOB2(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 3 | QEOB3(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 4 | QEOB4(1:4) | PUFITC |
| Fitted hadronic W mass | QEWMH | PUFITC |
| Fitted leptonic W mass | QEWML | PUFITC |
| Fitted hadronic W mass error | QEWMHER | PUFITC |
| Fitted leptonic W mass error | QEWMLER | PUFITC |
| Fitted W polar angle | QEWTH | WWANA |
| Chi square of the 2 jet fit | QECHI | PUFITC |
| Number of deg. of freedom in the fit | QEDOF | PUFITC |
| **2 jets + 1 muon** | | |
| Information on chosen muon for the fit (as PLEPT,see below) | QMPL(1:23) | WWANA |
| Fourmomentum of forced jet 1 | QMP1(1:4) | WWANA |
| Fourmomentum of forced jet 2 | QMP2(1:4) | WWANA |
| Total multiplicities of jets | QMTM(1:2) | WWANA |
| Charged multiplicities of jets | QMCM(1:2) | WWANA |
| Momentum weighted charges of 2 jets | QMCH(1:2) | WWANA |
| Angle muon - closest jet | QMANLJ | WWANA |
| Angle between the two jets | QMANJJ | WWANA |
| Codes of the four fitted 'objects' | QMCOD(4) | WWANA |
| 1 $\rightarrow$ jet | | |
| 3 $\rightarrow$ neutrino | | |
| 11 $\rightarrow$ electron (sign according to LUND) | | |
| 13 $\rightarrow$ muon (sign according to LUND) | | |
| Fitted fourmomentum of 'object' 1 | QMOB1(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 2 | QMOB2(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 3 | QMOB3(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 4 | QMOB4(1:4) | PUFITC |
| Fitted hadronic W mass | QMWMH | PUFITC |
| Fitted leptonic W mass | QMWML | PUFITC |
| Fitted hadronic W mass error | QMWMHER | PUFITC |
| Fitted leptonic W mass error | QMWMLER | PUFITC |
| Fitted W polar angle | QMWTH | WWANA |
| Chi square of the 2 jet fit | QMCHI | PUFITC |
| Number of deg. of freedom in the fit | QMDOF | PUFITC |

(NOTE: The information from the fit on the W- , selected using the lepton charge, is stored first)

QTANA BLOCK

**2 jets + 1 prong**

| | | |
|---|---|---|
| Information on chosen track for the fit | Q1PL(1:15) | WWANA |
| abs.value of momentum | Q1PL( 1) | |
| theta of momentum | Q1PL( 2) | |
| phi of momentum | Q1PL( 3) | |
| VECP index | Q1PL( 4) | |
| mass code of simulated PA | Q1PL( 5) | |
| charge | Q1PL( 6) | |
| electron 'bitted word' (KELID(1,i)) | Q1PL( 7) | |
| muon 'bitted word' (KMUID(1,i)) | Q1PL( 8) | |
| gamma conversion (KELID(2,i)) | Q1PL( 9) | |
| energy in a cone of given opening angle | Q1PL(10) | |
| angle from nearest charged track with a given min. energy | Q1PL(11) | |
| HAC energy | Q1PL(12) | |
| HAC hit pattern | Q1PL(13) | |
| Emag energy (HPC+FEMC+STIC) | Q1PL(14) | |
| skelana style lvlock | Q1PL(15) | |
| Fourmomentum of forced jet 1 | Q1P1(1:4) | WWANA |
| Fourmomentum of forced jet 2 | Q1P2(1:4) | WWANA |
| Total multiplicities of jets | Q1TM(1:2) | WWANA |
| Charged multiplicities of jets | Q1CM(1:2) | WWANA |
| Momentum weighted charges of 2 jets | Q1CH(1:2) | WWANA |
| Angle track - closest jet | Q1ANLJ | WWANA |
| Angle between the two jets | Q1ANJJ | WWANA |
| Codes of the four fitted 'objects' | Q1COD(4) | WWANA |
| $1 \rightarrow$ jet | | |
| $3 \rightarrow$ neutrino | | |
| $15 \rightarrow$ tau (sign according to LUND) | | |
| Fitted fourmomentum of 'object' 1 | Q1OB1(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 2 | Q1OB2(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 3 | Q1OB3(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 4 | Q1OB4(1:4) | PUFITC |
| Fitted hadronic W mass | Q1WMH | PUFITC |
| Fitted leptonic W mass | Q1WML | PUFITC |
| Fitted hadronic W mass error | Q1WMHER | PUFITC |
| Fitted leptonic W mass error | Q1WMLER | PUFITC |
| Fitted W polar angle | Q1WTH | WWANA |
| Chi square of the 2 jet fit | Q1CHI | PUFITC |
| Number of deg. of freedom in the fit | Q1DOF | PUFITC |

**2 jets + 1 narrow jet**

| | | |
|---|---|---|
| Information on chosen narrow jet for the fit (as PJT,see below) | QTPL(1:23) | WWANA |
| Fourmomentum of forced jet 1 | QTP1(1:4) | WWANA |
| Fourmomentum of forced jet 2 | QTP2(1:4) | WWANA |
| Total multiplicities of jets | QTTM(1:2) | WWANA |
| Charged multiplicities of jets | QTCM(1:2) | WWANA |
| Momentum weighted charges of 2 jets | QTCH(1:2) | WWANA |
| Angle narrow jet - closest jet | QTANLJ | WWANA |
| Angle between the two jets | QTANJJ | WWANA |
| Codes of the four fitted 'objects' | QTCOD(4) | WWANA |
| 1 → jet | | |
| 3 → neutrino | | |
| 11 → electron (sign according to LUND) | | |
| 13 → muon (sign according to LUND) | | |
| Fitted fourmomentum of 'object' 1 | QTOB1(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 2 | QTOB2(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 3 | QTOB3(1:4) | PUFITC |
| Fitted fourmomentum of 'object' 4 | QTOB4(1:4) | PUFITC |
| Fitted hadronic W mass | QTWMH | PUFITC |
| Fitted leptonic W mass | QTWML | PUFITC |
| Fitted hadronic W mass error | QTWMHER | PUFITC |
| Fitted leptonic W mass error | QTWMLER | PUFITC |
| Fitted W polar angle | QTWTH | WWANA |
| Chi square of the 2 jet fit | QTCHI | PUFITC |
| Number of deg. of freedom in the fit | QTDOF | PUFITC |

FLANA BLOCK

| | | |
|---|---|---|
| Information on the four most energetic tracks in the event | FLPL(1:16,1:4) | WWANA |
| P cartesian components | FLPL(1:3,i) | |
| energy | FLPL( 4,i) | |
| simulated mass code | FLPL( 5,i) | |
| index in VECP array | FLPL( 6,i) | |
| mass code of the simulated PA | FLPL( 7,i) | |
| charge | FLPL( 8,i) | |
| electron 'bitted word' | FLPL( 9,i) | |
| muon 'bitted word' | FLPL(10,i) | |
| gamma conversion | FLPL(11,i) | |
| energy in cone | FLPL(12,i) | |
| angle from nearest charged track | FLPL(13,i) | |
| impact parameter wrt primary vtx | FLPL(14,i) | |
| jet number | FLPL(15,i) | |
| electron best est. energy | FLPL(16,i) | |
| Accoll. of two highest p tracks | FLANLL | WWANA |
| Four momentum of forced jet 1 | FL2P1(1:4) | WWANA |
| Four momentum of forced jet 2 | FL2P2(1:4) | WWANA |
| Charged multiplicity of jet 1,2 | FLLCM(1:2) | WWANA |
| Total multiplicity of jet 1,2 | FLLTM(1:2) | WWANA |

**LEPTON BLOCK**

| | | |
|---|---|---|
| Number of leptons selected | NLEPT | WWANA |
| Track info of the selected leptons: | PLEPT(1:23,1:MAXLEP) | WWANA |
| abs.value of momentum | PLEPT( 1,i) | |
| theta of momentum | PLEPT( 2,i) | |
| phi of momentum | PLEPT( 3,i) | |
| tag flag (ELTAG+10*MUTAG, each tag being 0 or 1) | PLEPT( 4,i) | |
| simulated LUND mass code (if link exists) | PLEPT( 5,i) | |
| VECP index | PLEPT( 6,i) | |
| mass code of simulated PA | PLEPT( 7,i) | |
| charge | PLEPT( 8,i) | |
| electron 'bitted word' (KELID(1,i)) | PLEPT( 9,i) | |
| muon 'bitted word' (KMUID(1,i)) | PLEPT(10,i) | |
| gamma conversion (KELID(2,i)) | PLEPT(11,i) | |
| energy in a cone with a given op. angle | PLEPT(12,i) | |
| angle from nearest charged track with a given min. energy | PLEPT(13,i) | |
| impact parameter wrt primary vtx | PLEPT(14,i) | |
| number of the jet the lepton belongs to | PLEPT(15,i) | |
| ptin wrt 'natural' jets | PLEPT(16,i) | |
| ptout wrt 'natural' jets | PLEPT(17,i) | |
| best estimate for electron energy at vertex (fixed e.m. energy) | PLEPT(18,i) | |
| HAC energy | PLEPT(19,i) | |
| HAC hit pattern | PLEPT(20,i) | |
| Emag energy (HPC+FEMC+STIC) | PLEPT(21,i) | |
| MU ID (14 MUB,17 MUS, 30 MUF, +100 HCAL) | PLEPT(22,i) | |
| skelana style lvlock | PLEPT(23,i) | |

JETANA BLOCK

| | | |
|---|---|---|
| Number of 'natural' jets | NJT | WWANA |
| Jet info: | PLEPT(1:13,1:NJT) | WWANA |
| Four-momenta of the jets | PJT(1:4,i) | |
| Total Multiplicities of jets | PJT(5,i) | |
| Charged multiplicities of jets | PJT(6,i) | |
| Jet charge of the jet | PJT(7,i) | |
| p weighted Spread of the jet | PJT(8,i) | |
| Angle from the nearest charged track not belonging to the jet | PJT(9,i) | |
| Electromagnetic energy of jet | PJT(10,i) | |
| Hadronic energy of jet | PJT(11,i) | |
| Neutral energy of jet | PJT(12,i) | |
| Angular spread | PJT(13,i) | |
| Djoin for transition from I+1 to I+2 jets with LUCLUS | DJONJ(3) | WWANA |
| Ymin for transition from I+1 to I+2 jets with DURHAM | YMINJ(3) | WWANA |

NEUT BLOCK

| | | |
|---|---|---|
| Total energy of shower | ENEUT(1,1:3) | WWANA |
| Theta of most energetic shower | ENEUT(2,1:3) | WWANA |
| Phi of most energetic shower | ENEUT(3,1:3) | WWANA |
| Error on energy (from TRAC module) | ENEUT(4,1:3) | WWANA |
| Particle identification code (not for STIC) | NNEUT(1,1:3) | WWANA |
| Bitted word for detector | NNEUT(2,1:3) | WWANA |
| E.m. Energy in 15 deg. cone around beam pipe | EBC | WWANA |

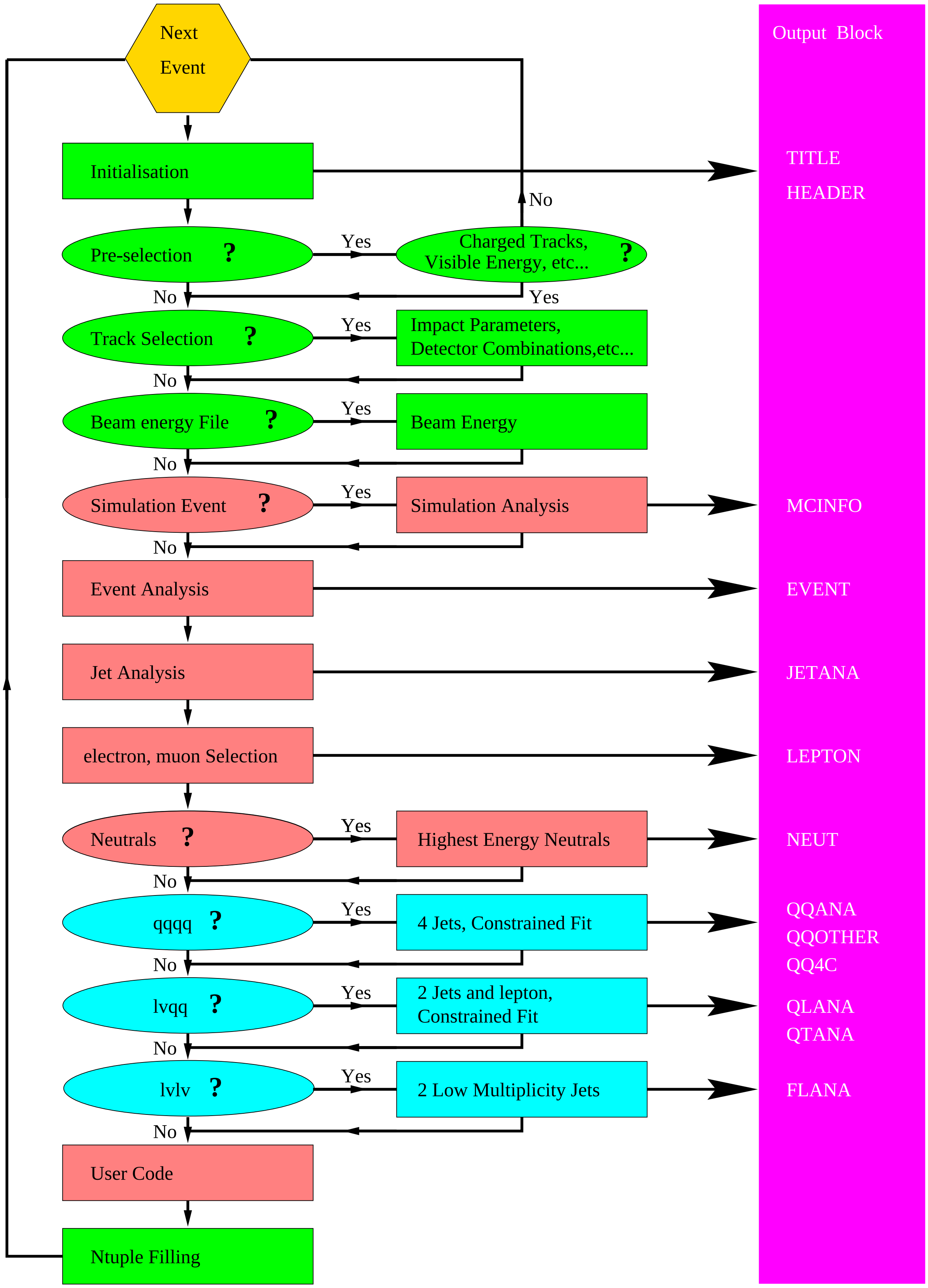


Figure 1: Basic flow diagram for the WWANA package