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DAFNE program description

Sergio Navas
IFIC, CSIC - Universitat de València, Valencia

Pierpaolo Rebecchi, Andrea Trombini
Université de Paris-Sud, Laboratoire de l'Accélérateur Linéaire, Orsay

Abstract

This note contains a detailed description of the purposes and structure of the DAFNE program. DAFNE is a DELPHI analysis code to classify events according to their physical characteristics. The program reads the DST using the PHDST package and calls different routines which tag the events. There are three groups of tagging routines (*Low level*, *New physics* and *Standard physics*), and each group includes several tagging routines, one for each kind of physical event.

1 Introduction

DAFNE (**D**elphi **A**nalysis code to **F**lag **N**ew **E**vents) has been designed in order to classify in a quick way new physics and standard physics events coming from LEP200, as an input to visual scanning.

DAFNE was first used in the LEP run at $\sqrt{s} \sim 130\ GeV$ (November, 1995).

The program reads the DST using the PHDST package [1] and is written in PATCHY format. The main file (called *dafne.car*) contains the interface to the DST, the filling of general purpose common blocks and the steering routines for initialization, tagging, ending and info output. Additional *tagging routines* classify the events according to their physical characteristics. Many people contributed writing the code of these routines.

Section 2 describes where to find and how to use the files needed to produce the required executable version of DAFNE.

Inputs of DAFNE are: a file containing the event DST information and another one containing the control cards. The outputs are: the same DST file extended by the tagging information written into the Pilot Record [2], and two *scan list files* (ASCII files) with the results of the tags on each event plus the values of some interesting global event variables. Input/Output aspects are treated with detail in Section 3.

Special subsections have been dedicated in Section 4 to a brief overview of the program : description of common blocks, routines called directly from DAFNE and tagging routines.

We say that *a tagging routine has tagged an event* when the event passes the selection criteria required by the routine. An event can be tagged by several routines. It is possible to activate or desactivate a certain tagging routine via control cards. More details on this subject are given in Section 4.4.

2 DAFNE location and usage

DAFNE runs on different platforms: *HP-UX*, *ALPHA/OSF*, *ALPHA/VMS*. There are versions of the DAFNE code on DELSHIFT and VXCERN clusters:

DELSHIFT

shift10:/userd/xx/dafne/phdst/pro	for the currently released version.
shift10:/userd/xx/dafne/phdst/old	for old versions.

The *pro* area contains:

dafne.make	Command file to create the DAFNE executable file, with PATCHY selection of needed modules.
dafne.r	Command file to define control cards.
dafne.b	Command file to submit the job to *delshift* queues.
dafne.car	Main DAFNE program.
t****.car	Tagging routines.

The *old* area contains:

DAFNE******.tar.gz	*Compressed-tar* files with old versions of the files on *pro* area. For example, DAFNE960412.tar.gz should be the 12th May 1996 version of the *pro* area.

VXCERN

DISK$DELPHI1:[DAFNE.PHDST.PRO] for the currently released version.

If you are starting to work with DAFNE, the following instructions should help you:

1. Copy all files above into your own area (DELSHIFT machines recommended),
2. Edit these files: read the headers, define home and scratch directories (*HDIR* and *SCR* environment variables), and include your tagging routine in the PATCHY sequence.
3. Run *dafne.make* to create DAFNE's executable.
4. Define the kind of data to be analysed and set control cards values in *dafne.r*
5. Run *dafne.b* (some input parameters must be specified).

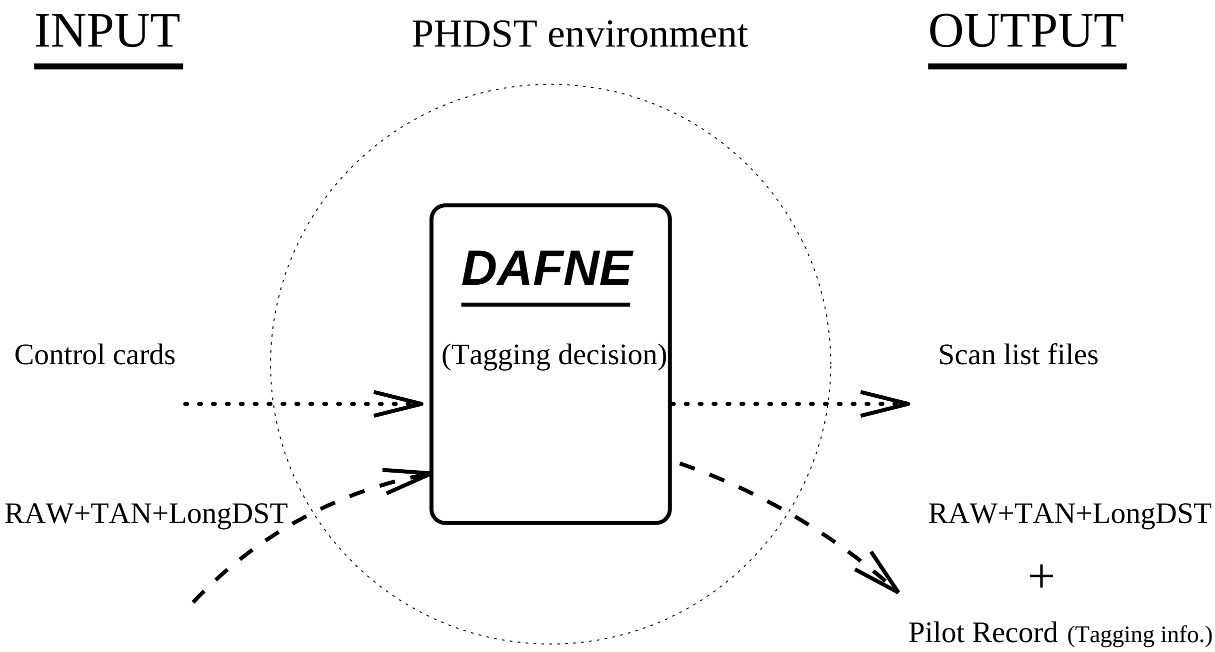

Figure 1: DAFNE Input/Output scheme.

3 DAFNE Input/Output

A diagram of DAFNE's Input/Output procedure is shown in figure 1.

The inputs of DAFNE are:

- A *RAW + TANAGRA + LongDST* file containing the events to analize †.
- A set of *control cards* which are related to the general job control, to the values to be used in the track quality selection, to the level of lepton identification to be used and to the tagging routines to be activated and desactivated (see Section 3.1 for more details).

The outputs of DAFNE are:

- The same *RAW + TANAGRA + LongDST* input file plus the tag information (the output of the tagging routines) written into the *Pilot Record* (see Section 3.2). It is possible to switch off the creation of this file via *DSTOUT* control card.
- Two *scan list files*: the first one is the scan list file for new physics events and the latter is for standard physics events (see Section 3.3).

3.1 DAFNE control cards

Control over a given run is obtained via a set of *control cards*.
In this section we indicate, for each variable, the name (Key), the dimension (N), the Type (I=integer, R=real, L=logical), a short description and the default value.

- **General job control (COMMON/PJCARD/):**

Key	N	Type	Description	Default
NEVMAX	1	I	Maximum number of events to be processed	1
REDATA	1	L	Read REAL data (T) or M.C. (F)	T
IDEGUB	1	L	Printout some general debug information	T
LDBG	1	I	Logical unit to printout general debug info	6
PJLIM	1	R	CPU time limit for ending the job (sec.)	5.
DSTOUT	1	L	Writing events to an output file (T) or not (F)	F

- **Track and shower cuts (COMMON/PJCARD/):**

Key	N	Type	Description	Default
TJKLEN	1	R	Min. track length (cm)	0.001
TJKMIN	1	R	Min. momentum for a track (GeV)	0.001
TJKMAX	1	R	Max. momentum for a track (GeV)	1000.
TJKIMP	1	R	Max. track impact parameter (cm)	50.
TJKZ	1	R	Max. ZP-ZV impact parameter (cm)	50.
TJKANG	1	R	Max. track θ angle ($\|\cos\theta\|$)	.9994
TJRVTX	1	R	Max. distance of closest approach to vertex in XY plane	100.
TJKDPP	1	R	Max. track $\Delta E/E$	1.E20

† DAFNE can also work with only LongDST files.

- **Lepton identification (COMMON/PJCARD/):**

Key	N	Type	Description	Default
IELTAG	1	I	Electron tag: Loose (1) Standard (2) Tight (3)	1
IMUTAG	1	I	Muon tag: Loose (1) Standard (2) Tight (3)	1

- **Tagging routines (COMMON/TAGTOT/):** Activate (T) or desactivate (F).

Key	N	Type	Description	Default
TGTNP	1	L	Switch ON/OFF (T/F) all *low level* and	T
			new physics tagging routines	T
TGTSP	1	L	Switch ON/OFF (T/F) all *standard physics*	T
			tagging routines	T
TNOTA	1	L	"No-tag" tagging routine	T
TEMIS	1	L	Missing energy tagging routine	T
TTOPO	1	L	Topological tagging routine	T
T4JET	1	L	>3 jets tagging routine	T
TCHJL	1	L	$\tilde{\chi}^{\pm}$ jjl channel tagging routine	T
TCHJJ	1	L	$\tilde{\chi}^{\pm}$ jjjj channel tagging routine	T
TCHLL	1	L	$\tilde{\chi}^{\pm}$ ll channel tagging routine	T
TNEUT	1	L	$\tilde{\chi}^0$ tagging routine	T
TSTOP	1	L	$\tilde{t}$ tagging routine	T
TSBOT	1	L	$\tilde{b}$ tagging routine	T
TSTAU	1	L	$\tilde{\tau}$ tagging routine	T
TSINL	1	L	Single lepton tagging routine	T
THNN	1	L	$H\nu\nu$ tagging routine	T
THLL	1	L	Hll tagging routine	T
THH	1	L	H^+H^- tagging routine	T
THA	1	L	hA tagging routine	T
TEXLE	1	L	Excited lepton tagging routine	T
TFFGG	1	L	$ff\gamma\gamma$ tagging routine	T
T2G	1	L	$\geq$ 2 photons tagging routine	T
TCOMP	1	L	Compton tagging routine	T
TGG	1	L	$\gamma\gamma$ tagging routine	T
TRRZ	1	L	Radiative return to Z^0 tagging routine	T
TFF	1	L	$f\overline{f}$ tagging routine	T
TNNG	1	L	ν counting tagging routine	T
TCOSM	1	L	Cosmic tagging routine	T
TGLOS	1	L	"γ lost in a crack" tagging routine	T

3.2 DAFNE and Pilot Record

The output of a tagging routine is an integer number (0 or 1 in most cases). This information is stored at the end of the existing Pilot Record array, in the *standard tagging blocklet*, Identifier = 15.

A detailed description of the DAFNE Pilot Record blocklet structure is given in next table.

Here it is an example of how to access the tagging information :

```
* - PHDST common blocks.
+CDE, PHCDE.
* -
      IDN1    = 15                  ! TAGGING blocklet identifier.
      IDN2    = 15                  ! DAFNE blocklet sub-identifier.
      IADDR   = IPHPIL(IDN1,IDN2)   ! address of the found blocklet in the Pilot.
* -           Getting info
      NWD     = IPILOT(IADDR+1)     ! wordcount.
      IVER    = IPILOT(IADDR+4)     ! DAFNE version.
      IEM     = IPILOT(IADDR+5)     ! Missing energy.
      ITO     = IPILOT(IADDR+6)     ! Topological.
      IJE     = IPILOT(IADDR+7)     ! >3 jets.
      INP1    = IPILOT(IADDR+8)     ! New physics, first word.
      INP2    = IPILOT(IADDR+9)     ! New physics, second word.
      ISP     = IPILOT(IADDR+10)    ! Standard physics.
* -
      IHA     = JBIT(INP1,10)       ! hA tagging result (first bit).
```

TAGGING BLOCKET

TYPE 15

1	NW, wordcount	(11)
2	Identifier	(cod. 15)
3	Sub-identifier	(cod. 15)

———————————

4 *DAFNE version* (sequential number version + 6 digits date)

5 *Missing Energy* tagging word.

6 *Topological* tagging word.

7 $>$ *3 jets* tagging word.

8 *New physics* , first tagging word (bitted).

bits :

1 - 3	$\tilde{\chi}^{\pm}$ *jjl channel* tag
4 - 6	$\tilde{\chi}^{\pm}$ *jjjj channel* tag
7 - 9	$\tilde{\chi}^{\pm}$ *ll channel* tag
10 - 12	$\tilde{\chi}^{0}$ tag
13 - 15	$\tilde{t}$ tag
16 - 18	$\tilde{b}$ tag
19 - 21	$\tilde{\tau}$ tag
22 - 24	Single lepton tag

9 *New physics* , second tagging word (bitted):

bits :

1 - 3	$H\nu\nu$ tag
4 - 6	Hll tag
7 - 9	$H^{+}H^{-}$ tag
10 - 12	hA tag
13 - 15	Excited lepton tag
16 - 18	$ff\gamma\gamma$ tag
19 - 21	$\geq$ 2 photons tag

10 *Standard physics* tagging word (bitted):

bits :

1 - 3	$\gamma\gamma$ tag
4 - 6	Radiative return to Z^0 tag
7 - 9	$f\overline{f}$ tag
10 - 12	ν counting tag
13 - 15	Cosmic tag
16 - 18	"γ lost in a crack" tag
19 - 21	Compton tag

———————————

11 NW, wordcount (11)

3.3 Scan lists

DAFNE generates at the end of each job two output files, the *scan list* files, containing a summary of the results of the tagging routines.

The two scan lists are:

- *Scan list for new physics events*: is filled with all events tagged either by one or more low level tags or by one or more high level new physics tags. Also the events with no tag at all will go into this file.
- *Scan list for standard physics events*: all events tagged only by one or more high level standard physics tags will go into this file.

Each scan list can be divided in four parts:

1. The first part is the header which reports the scan list type, the DAFNE version in use and the status of all tags ('1' if the tag is active, ' ' if it is inactive).
2. The second part is the event by event information:
   - Run number.
   - File number.
   - Event number.
   - Results of the tags: it is an empty character (' ') if the event has not been tagged by the routine, or an integer number (always different from 0 and 1 in most cases) if the event has been tagged.
   - Global variables: some event variables, computed by DAFNE, after track quality cuts.
3. The third part is the statistics summary of all the tags. It is different for the two kinds of scan lists.
   a. Scan list file for new physics events:
      - Number of read events: total number of events read by DAFNE after track quality cuts.
      - Number of events in this scan list: total number of events appearing in the scan list.
      - T N. Ph : total number of events tagged as new physics. In this case that number is the same as Number of events in this scan list.
      - T NOTA : total number of events with no tag at all. These events are in this file.
      - List of low level tags and new physics high level tags: for each tag there is the total number of events tagged and the percentage. All these events are in this file.
      - List of standard physics high level tags: for each tag there is the total number of events tagged and the percentage. These events are partly in this file and partly in the scan list file for standard physics.

   b. Scan list file for standard physics events:
      - Number of read events: total number of events read by DAFNE after track quality cuts.
      - Number of events in this scan list: total number of events appearing in the scan list.
      - T S. Ph : total number of events tagged as standard physics. In this case that number is the same as Number of events in this scan list.

- List of standard physics high level tags: for each tag there is the total number of events tagged and the percentage. These events are partly in this file and partly in the scan list file for standard physics.

4. The fourth part is the *legend* with all the keywords explanations.

An example of new physics scan list follow. It is the output of DAFNE version (8.050196) running on real LEP1.3 data.

```
*
*
*         SCAN LIST FILE FOR NEW PHYSICS EVENTS
*         DAFNE VERSION =   8.050196
*
* Status of TAG routines (1=ON empty=OFF)
*                  |1|1 |1| |1|1|1| | | | |1|1|1|1|1|1|1| |1|1|1|1|1|1|1|
*________________________________________________________________________________________________________
*....Run n   |Evt n |T|T |T| |T|T|T|T|T|T|T|T|T|T|T|T|T|T|T|T|T|T|T|T|T|T|Mul|Evis |Ptmis|Pmiss|THmis|Mvis |Mmiss|Mhad |
*....  File n|      | |  | | | | | | | | | | | | | | | | | | | | | | | | |   |     |     |     |     |     |     |     |
*....        |      |E|T |4| |C|C|C|N|S|S|S|S|H|H|H|H|E|F|2|C|G|R|F|N|C|G|   |     |     |     |     |     |     |     |
*....        |      |M|O |J| |H|H|H|E|T|B|T|I|N|L|H|A|X|F|G|O|G|R|F|N|O|L|   |     |     |     |     |     |     |     |
*....        |      |I|P |E| |J|J|L|U|O|O|A|N|N|L| | |L|G| |M| |Z| |G|S|O|   |     |     |     |     |     |     |     |
*....        |      |S|O |T| |L|J|L|T|P|T|U|L| | | | |E|G| |P| | | |M|S|   |     |     |     |     |     |     |     |
*------------|------|-|--|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|---|-----|-----|-----|-----|-----|-----|-----|
      64056 1   341| |  | | | | | | | | | | | | | | | | | | | | | | | | |  4|  7.6|  2.8|  6.9|156.4|  3.1|122.6|  3.1|
      64056 1   661| |  | | | | | | | | | | | | | | | | | | | | | | | | |  7| 91.7|  0.2| 50.0|  0.3| 76.8|-31.8| 76.8|
      64056 1  1122|1|  | | | | | | | | | | | | | | | | | |1| |1| | | | | 11| 42.4|  7.7| 23.4|160.9| 35.3| 84.7| 35.3|
      64056 1  1434|1|  | | | | | | | | | | | | | | | | | |1| | | | | | |  8| 22.3|  5.0| 20.0|165.4|  9.9|106.2|  9.9|
      64056 1  1836|1|  | | | | | | | | | | | | | | | | | | | | | | | | |  1| 46.5| 38.7| 46.5| 56.3|  0.1| 69.8|  0.1|
      64056 1  1862| |  | | | | | | | | | | | | | | | | | | | | | | | | |  3| 14.4|  0.5|  3.9|173.2| 13.9|115.8| 13.9|
      64056 1  2376|1|  | | | | | | | | | | | | | | | | | |1| |1| | | | |  5| 79.2| 14.2| 56.0| 14.7| 56.0|-22.7| 56.0|
      64056 1  2384| |  | | | | | | | | | | | | | | | | | | | | | | | | | 44|103.3|  6.9|  7.5| 68.1|103.1| 25.9|103.1|
      64056 1  2402| |  | | | | | | | | | | | | | | | | | | | | | | | | |  4|  5.3|  1.9|  3.0|142.4|  4.4|125.0|  4.4|
      64056 1  2657|1|8 | | | | | | | | | | | | | | | | | | | |1| | | | |  2| 67.5| 16.8| 18.0| 68.5| 65.0| 60.2| 65.0|
      64056 1  3037| |48|1| | | | | | | | | | | | | | | | | | |1| | | | | 62|155.3| 18.1| 31.2| 35.5|152.1|-31.2|150.5|
      64056 1  3407|1|  | | | |1| | | | | | | | | | | | | | | | | | | | | 10| 22.6| 16.8| 16.8| 86.2| 15.0|106.4| 15.0|
      64056 2  3765|1|  | | | | | | | | | | | | | | | | | |1| | | | | | |  7| 61.0| 14.1| 60.0| 13.6| 11.1| 34.8|  9.0|
      64056 2  4064| |  |1| | | | | | | | | | | | | | | | | | |1| | | | | 51|155.3|  6.5|  6.6|102.2|155.2| -6.6|151.2|
      64056 2  4131|1|  | | | | | | | | | | | | | | | | | | | |1| | | | |  7| 63.2| 21.5| 55.1| 23.0| 30.9| 38.5| 30.9|
      64056 2  4194|1|  | | | | | | | | | | | | | | | | | | | | | | | |1|  3| 11.5| 10.1| 10.2| 81.4|  5.4|118.4|  5.4|
      64056 2  4939| |  | | | | | | | | | | | | | | | | | | | | | | | | |  7|116.5| 20.9| 21.9|106.9|114.4|-16.9| 59.5|
      64056 2  5289| |  | | | | | | | | | | | | | | | | | | | | | | | | | 14| 18.3|  2.5| 16.7|  8.7|  7.3|110.8|  7.3|
      64056 2  5354| |8 | | | | | | | | | | | | | | | | | | | | | | | | |  4| 64.3|  0.8| 47.4|  1.0| 43.5| 46.0| 43.5|
      64056 2  5424|1|  | | | | | | | | | | | | | | | | | |1| | | | | | | 28| 33.5|  5.1| 16.6| 17.8| 29.1| 95.3| 29.1|
      64056 2  5496|1|  | | | | | | | | | | | | | | | | | | | | | | | | | 11| 48.8|  9.2| 46.1| 11.5| 16.0| 67.3| 16.0|
      64056 2  5516|1|  | | | | | | | | | | | | | | | | | |1| | | | |1|  5| 69.4|  5.2| 60.2|175.0| 34.6|  8.9| 34.6|
      64056 2  5751| |  |1| | | | | | | | | | | | | | | | | | | | | | |1| 34|102.0| 20.5| 23.7|119.7| 99.2| 15.5| 99.2|
      64056 2  5755|1|  | | | | | | | | | | | | | | | | | | | | | | | | | 15| 65.9| 23.7| 53.8| 26.1| 38.0| 35.6| 38.0|
      64056 2  5919|1|  | | | | | | | | | | | | | | | | | |1| |1| | | | |  5| 53.0|  8.0| 47.2|  9.7| 24.1| 61.2| 24.1|
*____________|______|_|__|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|___|_____|_____|_____|_____|_____|_____|_____|
*
* Number of read events:                 100
* Number of events in this Scan list:     25 ( 25.0 %)
*
* Summary on New Physics Tags:
*_________________________
* TAG channel| TOT  |  %  |
* T N. Ph    |    25| 25.0|
*            |      |     |
* T NOTA     |     7|  7.0|
*            |      |     |
* T EMIS     |    14| 14.0|
* T TOPO     |     3|  3.0|
* T 4JET     |     3|  3.0|
*            |      |     |
```

```
* T CHJL     |      0|  0.0|
* T CHJJ     |      1|  1.0|
* T CHLL     |      0|  0.0|
* T NEUT     |      0|  0.0|
* T STOP     |      0|  0.0|
* T SBOT     |      0|  0.0|
* T STAU     |      0|  0.0|
* T SINL     |      0|  0.0|
* T HNN      |      0|  0.0|
* T HLL      |      0|  0.0|
* T HH       |      0|  0.0|
* T HA       |      0|  0.0|
* T EXLE     |      0|  0.0|
* T FFGG     |      0|  0.0|
* T 2G       |      0|  0.0|
*____________|_______|_____|
*
* Summary on Standard Physics Tags:
*__________________________
* TAG channel| TOT   |  %  |
* T COMP     |      3|  3.0|
* T GG       |     57| 57.0|
* T RRZ      |      1|  1.0|
* T FF       |     34| 34.0|
* T NNG      |      0|  0.0|
* T COSM     |     11| 11.0|
* T GLOS     |     20| 20.0|
*____________|_______|_____|
*
* LEGEND:
*
* Run n  = Run number
* Evt n  = Event number
* File n = File number
*
* T NOTA = Low level tag: NO-tag tag
* T EMIS = Low level tag: Missing Energy > 50 GeV and PTmiss > 5 GeV
* T TOPO = Low level tag: Topological tag
* T 4JET = Low level tag: >= 4 jets
* T CHJL = Chargino JJl  channel tag
* T CHJJ = Chargino JJJJ channel tag
* T CHLL = Chargino ll   channel tag
* T NEUT = Neutralino tag
* T STOP = Stop tag
* T SBOT = Sbottom tag
* T STAU = Stau tag
* T SINL = Single lepton tag
* T HNN  = Hnunu tag
* T HLL  = Hll tag
* T HH   = H+H- tag
* T HA   = hA tag
* T EXLE = Excited lepton tag
* T FFGG = ff gamma gamma tag
* T 2G   = >=2 gamma tag
*
* T COMP = Compton event tag
* T GG   = Gamma-gamma event tag
* T RRZ  = Radiative Return to Z0 tag
* T FF   = Fermion anti-fermion tag
* T NNG  = Neutrino counting tag
* T COSM = Cosmic tag
* T GLOS = Gamma lost in a crack tag
*
* Mul   = Total multeplicity
* Evis  = Total visible energy
* Ptmis = Total transversal missing momentum
* Pmiss = Total missing momentum
* THmis = Theta missing momentum
* Mvis  = Total visible mass
* Mmiss = Total missing mass
* Mhad  = Hadronic mass
```

Figure 2: Example of new physics scan list.

4 DAFNE program structure

Figure 3 shows the outline of the main DAFNE program structure. Its routines can be divided into three groups:

- PHDST routines: needed to link DAFNE and the PHDST package. They appear with generic names USERxx and have been marked with a double box in the text. They are integrated into the *dafne.car* file.
- DAFNE routines: DST reading, COMMON blocks filling and steering of tagging routines are made here. They are also integrated into the *dafne.car* file.
- Tagging routines: written by tagging experts. They appear with generic names TIxxxx, Txxxx, TExxxx (**I**nitialization, **T**agging and **E**nding respectively) integrated into *t****.car* files. They have been marked with a thick box in the figure.

Appart from PHDST, DAFNE links to three external libraries:

- *ELEPHANT* [3]: This is the electron and photon identification package. It will be called by DAFNE only when reading data on *FullDST* format.
- *HERLIB* [4]: This package is very useful to get the information of the hermeticity taggers (40^0 , 90^0 and ϕ taggers).
- *HACCOR* [5]: This is a program to reassociate hits in the hadronic calorimeter to charged tracks and to recover neutrals mis-associated to charged particles on the DST. It will be called by DAFNE only when reading data on *FullDST* format.

DAFNE has beed designed to read and store on internal arrays the required information from all this libraries.

The next sections are dedicated to describe in detail the contents of the main COMMON blocks and the task of all routines used in the program.

4.1 COMMON blocks description

+KEEP, PHYCOM.	Number of particles before quality cuts.

COMMON/PHYCOM/

NPCHRG	I	Number of reconstructed charged particles before track quality cuts.
NPNEUT	I	Number of reconstructed neutral particles before quality cuts.

+KEEP, RHCOML.	DST information for each particle.

PARAMETER (NWCANE = 25, NCANMX = 100)
PARAMETER (NWPTRK = 65, MXPRNG = 100)
COMMON/RHVECT/

NCANMX	I	Max. number of stored neutrals.
MXPRNG	I	Max. number of stored charged tracks.
PTRK(65,NTRACK)	R	DST information on charged tracks.

PCANEU(25,NNEUTR)	R	DST information on neutral tracks.
PBAD(65,NTRKS)	R	Tracks which do not pass the quality cuts.

NPRONG	I	Number of charged tracks in the event (before track quality cuts).
NTRACK	I	Number of charged tracks which pass the quality cuts.
NPBAD	I	Number of tracks rejected by track quality cuts.
NCANEU	I	Number of neutral particles in the event (before quality cuts).
NNEUTR	I	Number of neutral particles which pass the quality cuts.
NNBAD	I	Number of neutral particles rejected by quality cuts.

Information on *charged tracks*: **PTRK(65,NTRKS)**

Track parameters : 1 $\rightarrow$ 19 (from DST Standard Module)

1 $\longrightarrow$ P, momentum.
2 $\longrightarrow$ θ direction (radians).
3 $\longrightarrow$ ϕ direction (radians).
4 $\longrightarrow$ Error on E.
5 $\longrightarrow$ Track length.
6 $\longrightarrow$ Charge.
7 $\longrightarrow$ Track type: 1=MUB, 2=MUF, 3=HOLE.
8 $\longrightarrow$ DST mass code.
9 $\longrightarrow$ R Polar coordinates
10 $\longrightarrow$ ϕ $\Longrightarrow$ of the first measured point
11 $\longrightarrow$ Z on the track.
12 $\longrightarrow$ X Cartesian coordinates
13 $\longrightarrow$ Y $\Longrightarrow$ of the point of closest distance of approach
14 $\longrightarrow$ Z to the vertex.
15 $\longrightarrow$ Impact parameter at perigee.
16 $\longrightarrow$ Z impact parameter.
17 $\longrightarrow$ Hemisphere (1 if $Z > 0$; 2 if $Z < 0$).
18 $\longrightarrow$ Number of VD hits associated to this track.
19 $\longrightarrow$ Detectors used in the reconstruction (bitted word).

Electromagnetic energy : 20 $\rightarrow$ 29 (from EMCA module)

20 $\longrightarrow$ Number of electromagnetic (EM) clusters associated to the track.
21 $\longrightarrow$ Total EM energy associated to the track (sum of all showers).
22 $\longrightarrow$ X
23 $\longrightarrow$ Y
24 $\longrightarrow$ Z $\Longrightarrow$ of first EM shower.
25 $\longrightarrow$ θ
26 $\longrightarrow$ ϕ
27 $\longrightarrow$ Total EM energy in 15^0 cone around track.
28 $\longrightarrow$ EMCA detector module (HPC=9, FEMC=26, STIC=18).
29 $\longrightarrow$ Free.

Hadronic energy : 30 $\rightarrow$ 39 (from HCAL module)

30 $\longrightarrow$ Number of layers for first HCAL shower.
31 $\longrightarrow$ Number of HCAL clusters associated to track.
32 $\longrightarrow$ Total hadronic energy associated to track (sum all showers).

33 $\longrightarrow$ X
34 $\longrightarrow$ Y $\Longrightarrow$ of first HCAL shower.
35 $\longrightarrow$ Z
36 $\longrightarrow$ Total HCAL energy in 15^0 cone around track.
37 $\longrightarrow$ HCAL pattern (not implemented).
38 $\longrightarrow$ HCAL energy of first shower.
39 $\longrightarrow$ HCAL energy per layer, corrected for theta dependence.

Muon identification : 40 $\rightarrow$ 43 (from MUC module)
40 $\longrightarrow$ Muon identification in HCAL (from PXHAID).
41 $\longrightarrow$ Number of hits in MUC blocklet.
42 $\longrightarrow$ Muon identification in HCAL by $\frac{E(HCAL)}{layer} < 5\ GeV + HP > 3$.
43 $\longrightarrow$ MUC hit pattern.

TPC information : 44 $\rightarrow$ 48 (from MTPC module)
44 $\longrightarrow$ dE/dx (from GETDEDX).
45 $\longrightarrow$ Number of pads points in the track.
46 $\longrightarrow$ Sigma of the Landau distribution.
47 $\longrightarrow$ Number of wires used for dE/dx.
48 $\longrightarrow$ Error on dE/dx.

Particle identification : 49 $\rightarrow$ 51
49 $\longrightarrow$ Muon identification (from MUCALL):
1 = Not a muon
3 = Loose muon tag
4 = Standard muon tag
5 = Tight muon tag
50 $\longrightarrow$ Electron identification (from ELEPHANT) = ITAG + IVETO $\cdot$ 10
ITAG :
0 = Not an electron.
1 = Loose.
2 = Standard.
3 = Tight.
IVETO :
0 = Not from γ conversion.
1 = Loose
2 = Standard
3 = Tight
51 $\longrightarrow$ Free

Particle PA Link in DST : 52 $\rightarrow$ 53
52 $\longrightarrow$ LPA of this particle.
53 $\longrightarrow$ Matching simulated PA, or matching reconstructed PA for PA of the simulation (attached to the PV of LDTOP-2). Computed as IQ(LPA-2).

Electron/Muon identification from ELMACO/MUCALL infos :
54 $\longrightarrow$ *True* Mass Code (code of the simulated particle), valid only for M.C. data.
60 $\longrightarrow$ Mass code after ELMACO/MUCALL (*LUND convention*).

Information on *neutrals*: **PCANEU(25,NTRKS)**

Neutral parameters : 1 $\rightarrow$ 4 (from DST Standard Module)

1 $\longrightarrow$ P, momentum.
2 $\longrightarrow$ θ direction (radians).
3 $\longrightarrow$ ϕ direction (radians).
4 $\longrightarrow$ Hemisphere (1 if $Z > 0$, 2 if $Z < 0$).

Electromagnetic energy : 5 $\rightarrow$ 11 (from EMCA or STIC modules)

5 $\longrightarrow$ Energy.
6 $\longrightarrow$ X
7 $\longrightarrow$ Y
8 $\longrightarrow$ Z $\Longrightarrow$ of first EM shower.
9 $\longrightarrow$ θ
10 $\longrightarrow$ ϕ
11 $\longrightarrow$ Detector module (9=HPC, 18=STIC, 26=EMF, 240+i=VSAT module i).

Hadronic energy : 12 $\rightarrow$ 18 (from HCAL module)

12 $\longrightarrow$ Energy.
13 $\longrightarrow$ X
14 $\longrightarrow$ Y
15 $\longrightarrow$ Z $\Longrightarrow$ of first HCAL shower.
16 $\longrightarrow$ θ
17 $\longrightarrow$ ϕ
18 $\longrightarrow$ Detector module (13=HAC).

Particle identification : 19 $\rightarrow$ 21

19 $\longrightarrow$ γ/π^0 identification (from PXGECO).
20 $\longrightarrow$ DST mass code.
21 $\longrightarrow$ CALCON usage flag (for calculation of EM energy in a 15^0 cone around some charged track).

Particle PA Link in DS : 22 $\rightarrow$ 23

22 $\longrightarrow$ LPA of this particle.
23 $\longrightarrow$ Matching simulated PA, or matching reconstructed PA for PA of the simulation (attached to the PV of LDTOP-2). Computed as IQ(LPA-2).

Electron/Muon identification from ELMACO/MUCALL infos :

24 $\longrightarrow$ *True* Mass Code (code of the simulated particle, valid only for MC samples).
25 $\longrightarrow$ Detectors used in the reconstruction (bitted word).

+KEEP, MUCRUN.

COMMON/MUCRUN/

IPXVER	I	PHDST version
LDFLAG	I	Run over Reconstructed DST bank (1) or Simulated DST bank (2).
		controled via DATACARDS :
ISCAN	L	Printout info of events which pass user cuts.
LSCAN	I	Logical unit for user statistics printout.
LSTAT	I	Logical unit to printout final statistics

+KEEP, GENSTAT. General event counter.

COMMON/GENSTAT/

NUMEVT(1)	I	Number of events read in DST.
NUMEVT(2)	I	Number of events with more than 0 tracks (before track quality cuts).
NUMEVT(3)	I	Number of events with more than 0 tracks (after track quality cuts).

+KEEP, PUCQQQ. VECSUB and LINKPA arrays.

MTRACK	I	Maximum number of tracks stored in VECP (def. = 300).
VECP(1,I)	R	Px (from DST).
VECP(2,I)	R	Py (from DST).
VECP(3,I)	R	Pz (from DST).
VECP(4,I)	R	Energy = $\sqrt{P^2 + M^2}$.
VECP(5,I)	R	Mass.
VECP(6,I)	R	Momentum (from DST).
VECP(7,I)	R	Charge (from DST).
VECP(8,I)	R	Total electromagnetic energy.
VECP(9,I)	R	Total hadronic energy.
VECP(10,I)	I	Link to Standard Module.
LINKPA(1,I)	I	LPA = DST Link for this particle.
LINKPA(2,I)	I	Link to Standard Module.
LINKPA(3,I)	I	TANAGRA identifier of the track PA (IQ(LPA+1)).

+KEEP, PJCARD. Control cards. See Section 3.1 for more details.

+KEEP, XMUO. Muon identification.

COMMON/XMUO/

NMUL	I	Number of muons (*Loose* identification).
NMUS	I	Number of muons (*Standard* identification).
NMUT	I	Number of muons (*Tight* identification).
LMUONL(I)	I	LPA of the particles tagged as *loose* muons.
LMUONS(I)	I	LPA of the particles tagged as *standard* muons.
LMUONT(I)	I	LPA of the particles tagged as *tight* muons.

+KEEP, NTUPLE.

COMMON/GVC/ Global variables (computed after track quality cuts):

NNEVT	I	Event number.
NNRUN	I	Run number.
IFNUM	I	File number.
NEVTOT	I	Event sequence number.
ICHA(I)	I	* not used *
ITRIG	I	* not used *
ICUT	I	* not used *
DBIT	I	DELANA word (from DANA blocklet)
NTOT	I	Total multiplicity.
NCHA	I	Total number of charged particles.
NNEU	I	Total number of neutral particles.
EVIS	R	Visible energy.
MVIS	R	Visible mass.
MHAD	R	Hadronic mass.
MMISS	R	Missing mass.
ELEN	R	Total EMCA energy.
HAEN	R	Total HCAL energy.
PMISSP(I)	R	Missing momentum (POLAR coordinates) : (RANGE [0,4]) PMISSP(1) = $\lvert P_{missing} \rvert$, module of missing momentum. PMISSP(2) = θ direction of missing momentum (degrees). PMISSP(3) = ϕ direction of missing momentum (degrees). PMISSP(4) = P_t, missing transverse momentum.
PMISSC(I)	R	Missing momentum (CARTESIAN coordinates) : (RANGE [0,4]) PMISSC(1) = missing Px. PMISSC(2) = missing Py. PMISSC(3) = missing Pz. PMISSC(4) = missing Energy. PMISSC(5) = $\sqrt{s} - M_{missing}$
ACOP	R	Acoplanarity, computed from jet information and only for two jets events (all particles are involved).

ACOL	R	Acollinearity, computed from jet information and only for two jets events (all particles are involved).
ACOPJ	R	Acoplanarity, computed without the most isolated lepton.
ACOLJ	R	Acollinearity, computed without the most isolated lepton.
NJR	I	Number of reconstructed jets (from LUCLUS).
PTMAX	R	Pt value of the particle with highest Pt in the event.
THRUST(I)	R	Thrust axis (CARTESIAN coordinates): (RANGE [0,4]) THRUST(1) = thrust x direction. THRUST(2) = thrust y direction. THRUST(3) = thrust z direction. THRUST(4) = thrust value.
ECONE(I)	R	Total energy in a barrel cone: (RANGE [0,10]) ECONE(1) = energy in $5^0 < \theta < 175^0$ cone. ECONE(2) = energy in $10^0 < \theta < 170^0$ cone. ECONE(3) = energy in $15^0 < \theta < 165^0$ cone. ... . ECONE(J) = energy in $5 \cdot J^0 < \theta < (180 - 5 \cdot J)^0$ cone.
PISOLEP(I)	R	Most isolated lepton information : (RANGE [0,7]) PISOLEP(1) = momentum of iso. lepton. PISOLEP(2) = θ direction of isolated lepton (degrees). PISOLEP(3) = ϕ direction of isolated lepton (degrees). PISOLEP(4) = flavor of iso. lepton. PISOLEP(5) = Isolation angle with respect to nearest jet axis (degrees). PISOLEP(6) = Position on */CTC/* common block (+KEEP, NTUPLE). PISOLEP(7) = Position on */ISOLEP/* common block (+KEEP, NTUPLE).

COMMON/CTC/ Charged particles information: (RANGE [0,10])

NTC	I	Number of charged tracks.
PC(I)	R	Momentum times charge (±).
THC(I)	R	θ direction at the vertex (degrees).
PHC(I)	R	ϕ direction at the vertex (degrees).
EMC(I)	R	Electromagnetic energy in 15^0 cone.
HEC(I)	R	Hadronic energy in 15^0 cone.
EMA(I)	R	Electromagnetic energy associated to the track.
NHMV(I)	I	Number of hits in μVertex.
ACC(I)	R	Isolation angle to the nearest charged PA.
ANC(I)	R	Isolation angle to the nearest neutral PA.
DMC(I)	I	Detector module (TANAGRA convention, bitted word).
NHMC(I)	I	Number of hits in muon chamber.
HPMC(I)	I	Hits pattern in muon chamber.
MUIC(I)	I	BIT word for muon identification: bit 0 = 1 IF [muon id in HCAL by PXHAID)] bit 1 = 1 IF [muon id in HCAL by $\frac{E(HCAL)}{layer} < 5\ GeV + HP > 3$.
IPXYC(I)	R	Impact paramenter in XY plane.
IPZC(I)	R	Impact parameter in Z plane.
TRKLEN(I)	R	Track length.
DPC(I)	R	ΔP.

DEDXC(I)	R	dE/dx from TPC.
NWIREC(I)	I	Number of wires used in dE/dx.
DEERC(I)	R	Error on dE/dx.
DEXEL(I)	R	Expected dE/dx value for electron hypothesis.
DEXMU(I)	R	Expected dE/dx value for muon hypothesis.
DEXPI(I)	R	Expected dE/dx value for pion hypothesis.
MTAC(I)	I	Muon tag = 1 = Not a muon 3 = Loose 4 = Standard 5 = Tight
ETAC(I)	I	Electron tag (+10 if from gamma conversion) = 1 = Not an electron 2 = Very loose 3 = Loose 4 = Standard 5 = Tight
LPASTRK(I)		LPA of the asociated track in the recons/simul bank (LQ(LPA-2)).

COMMON/CTN/ Neutral particles information: (RANGE [0,5])

NTN	I	Number of neutral tracks.
PN(I)	R	Momentum.
THN(I)	R	θ direction at the vertex (degrees).
PHN(I)	R	ϕ direction at the vertex (degrees).
EMN(I)	R	Electromagnetic energy in 15^0 cone.
HEN(I)	R	Hadronic energy in 15^0 cone.
ACN(I)	R	Isolation angle to the nearest charged PA.
ANN(I)	R	Isolation angle to the nearest neutral PA.
DMN(I)	I	Detector module (bitted word: 9=HPC,13=HAC,23=SAT,26=EMF, 9+13=HPC+HAC,13+26=HAC+EMF,240+i=VSAT+i module).
DTHN(I)	R	$\Delta\theta$ between particle direction and line going from the shower to the primary vertex (for HPC only).
DPHN(I)	R	$\Delta\phi$ between particle direction and line going from the shower to the primary vertex (for HPC only).
PTAN(I)	I	Photon tag (PXPHOT code)
LPARNEU(I)	I	LPA of this particle.
LPASNEU(I)	I	LPA of the asociated particle in the recons/simul bank (IQ(LPA-2)).

COMMON/CJE/ Jets information: (RANGE [0,4])

NJE	I	Number of jets.
EJ(I)	R	Energy of jet I.
ECJ(I)	R	Charged energy.
PJ(I)	R	Momentum.
THJ(I)	R	θ direction (degrees).
PHJ(I)	R	ϕ direction (degrees).
NJ(I)	I	Number of particles.

NCJ(I)	I	Number of charged particles.
AMJ(I)	R	Maximum opening angle.
AWJ(I)	R	Weighted opening angle.

Info. jets excluding lepton J in calculations

NJL(J)	I	Number of jets.
EJJ(J,I)	R	Energy of jet I.
PJJ(J,I)	R	Momentum of jet I.
THJJ(J,I)	R	θ direction (degrees).
PHJJ(J,I)	R	ϕ direction (degrees).
NNJ(J,I)	I	Number of particles.

Lepton and photon information: (RANGE [0,3])

COMMON/ISOLEP/ , Lepton information:

NLEP	I	Number of leptons in the event.
NISOL	I	Position in /ISOLEP/ common block of the most isolated lepton.
NL(I)	I	Position in VECP array of the most isolated lepton.
PL(I)	R	Momentum of lepton I.
THEL(I)	R	θ direction of lepton I (degrees).
PHEL(I)	R	ϕ direction of lepton I (degrees).
AISO(I)	R	Isolation angle between lepton I and the closest jet axis.
NFLAV(I)	I	Flavor of lepton I (after identification).
NFLAVD(I)	I	DST mass code of lepton I.
NFLAVT(I)	I	*True* mass code (valid only for MC samples).

COMMON/PHOTON/ ,Most energetic photon in the event:

IPHOT	I	Position of the most energetic photon in VECP array.
EPHOT	R	Energy.
THPHOT	R	θ direction (degrees).
PHPHOT	R	ϕ direction (degrees).

COMMON/PRIMVTX/ DST generation bank (primary vertex): (RANGE [0,2])

Leptons :

IEV	I	Number of leptons.
PLVTX(I)	R	Momentum of lepton I.
THLVTX(I)	R	θ direction of lepton I (degrees).
PHLVTX(I)	R	ϕ direction of lepton I (degrees).
NFLAVTX(I)	I	Flavor of lepton I.

Photons:

EGVTX(I)	R	Energy of photon I.
THGVTX(I)	R	θ angle of photon I (degrees).
PHGVTX(I)	R	ϕ angle of photon I (degrees).

Hermeticity information:

TEs from *40^0 taggers*, COMMON/TE40/ : (RANGE [0,10])

NTE40	I	Number of TEs found.
NT40(I)	I	Number of taggers for TE I.

PH40(I)	R	ϕ position of TE I.
TH40(I)	R	θ position of TE I.
DPH40(I)	R	ϕ size of TE I.
DTH40(I)	R	θ size of TE I.
SI40(I)	R	Significance in pedestal sigmas of TE I.
AC40(I)	R	Isolation angle to the nearest charged PA and the TE I.
AN40(I)	R	Isolation angle to the nearest neutral PA and the TE I.
NC40(I)	I	Number of charged tracks in a cone around the tagger I.

TEs from *ϕ taggers*, COMMON/TEPH/ (RANGE [0,10])

NTEPH	I	Number of TEs found.
NTPH(I)	I	Number of taggers for TE I.
PHPH(I)	R	ϕ position of TE I.
THPH(I)	R	θ position of TE I.
DPHPH(I)	R	ϕ size of TE I.
DTHPH(I)	R	θ size of TE I.
SIPH(I)	R	Significance in pedestal sigmas of TE I.
ACPH(I)	R	Isolation angle to the nearest charged PA and the TE I.
ANPH(I)	R	Isolation angle to the nearest neutral PA and the TE I.
NCPH(I)	I	Number of charged tracks in a cone around the tagger I.

TEs from *90^0 taggers*, COMMON/TE90/ (RANGE [0,10])

NTE90	I	Number of TEs found.
NT90(I)	I	Number of taggers for TE I.
PH90(I)	R	ϕ position of TE I.
TH90(I)	R	θ position of TE I.
DPH90(I)	R	ϕ size of TE I.
DTH90(I)	R	θ size of TE I.
SI90(I)	R	Significance in pedestal sigmas of TE I.
AC90(I)	R	Isolation angle to the nearest charged PA and the TE I.
AN90(I)	R	Isolation angle to the nearest neutral PA and the TE I.
NC90(I)	I	Number of charged tracks in a cone around the tagger I.

TEs from *TOF detector*, COMMON/TOFH/ (RANGE [0,10])

NTOFH	I	Number of TOF clusters.
PHT(I)	R	Mean ϕ angle of cluster I.
DPHT(I)	R	Half width of cluster I.
NTET(I)	I	Number of TEs in the cluster I.
IAT(I)	I	0 = Not associated, otherwise is the number of the track in the ntuple associated to that cluster.
NCTOF(I)	I	Number of charged TEs associated to the cluster I.
NCNTOF(I)	I	Number of neutral TEs associated to the cluster I. in the cone around the HPC crack.

Smoking gun information, COMMON/SMGUN/ (RANGE [0,3])

NTESG	I	Number of Smoking Gun TEs.
PHSG(I)	R	ϕ position of the TE I.
THSG(I)	R	θ position of the TE I.
DPHSG(I)	R	ϕ size of TE I.

DTHSG(I)	R	θ size of TE I.
NHSG(I)	R	Number of unassociated FCB hits (TE) in the SG TE.
ACSG(I)	R	Isolation angle to the nearest charged PA and the TE I.
ANSG(I)	R	Isolation angle to the nearest neutral PA and the TE I.

COMMON/PILREC/ Pilot Record information: (bitted words)

DAS Blocklet:
IRTYP(4) R Type of record (4th word).
DANA Blocklet:
DTAGG(18) R Delana Tagging (18th word).
DPHA Blocklet:
DETYP(4) R Event type (4th word).
DESTAT(24) R Detectors Status words (24th word).
TAGGING Blocklet:
TAGTEAM R Indicates that a team tagging effectively ran.

+KEEP, WRPILOT. See Section 3.2 for more details.

COMMON/WRPILOT/

NWTAG	I	Number of *tagging words* in the Blocklet.
IDBLK	I	Blocklet identifier.
IDBLKS	I	Blocklet sub-identifier.
IWEMIS	I	Missing Energy tagging word.
IWTOPO	I	Topological tagging word.
IW4JET	I	Number of jets tagging word.
IWNEW1	I	First New physics tagging word.
IWNEW2	I	Second New physics tagging word.
IWSPHY	I	Standard physics tagging word.

+KEEP, TAGTOT. Tagging statistics.

PARAMETER (MAXTAGT = 100)	Maximum number of tagging routines.
PARAMETER (NTAGT = 28)	Number of tags.
PARAMETER (ITGTNP = 1)	**.OR.** of new physics tags.
PARAMETER (ITNOTA = 2)	"No-tag" tag.
PARAMETER (ITEMIS = 3)	Missing energy low level tag.
PARAMETER (ITTOPO = 4)	Topological low level tag.
PARAMETER (IT4JET = 5)	$>$ 3 jets low level tag.
PARAMETER (ITCHJL = 6)	$\tilde{\chi}^{\pm}$ JJl channel tag.
PARAMETER (ITCHJJ = 7)	$\tilde{\chi}^{\pm}$ JJJJ channel tag.
PARAMETER (ITCHLL = 8)	$\tilde{\chi}^{\pm}$ ll channel tag.
PARAMETER (ITNEUT = 9)	$\tilde{\chi}^{0}$ tag.

PARAMETER (ITSTOP	= 10)	$\tilde{t}$ tag.
PARAMETER (ITSBOT	= 11)	$\tilde{b}$ tag.
PARAMETER (ITSTAU	= 12)	$\tilde{\tau}$ tag.
PARAMETER (ITSINL	= 13)	Single lepton tag.
PARAMETER (ITHNN	= 14)	$H\nu\nu$ tag.
PARAMETER (ITHLL	= 15)	Hll tag.
PARAMETER (ITHH	= 16)	H^+H^- tag.
PARAMETER (ITHA	= 17)	hA tag.
PARAMETER (ITEXLE	= 18)	Excited lepton tag.
PARAMETER (ITFFGG	= 19)	$ff\gamma\gamma$ tag.
PARAMETER (IT2G	= 20)	$\geq$ 2 photons tag.
PARAMETER (ITGTSP	= 21)	**.OR.** of standard physics tags.
PARAMETER (ITCOMP	= 22)	Compton tag.
PARAMETER (ITGG	= 23)	$\gamma\gamma$ tag.
PARAMETER (ITRRZ	= 24)	Radiative return to Z^0 tag.
PARAMETER (ITFF	= 25)	$f\bar{f}$ tag.
PARAMETER (ITNNG	= 26)	ν counting tag.
PARAMETER (ITCOSM	= 27)	Cosmic tag.
PARAMETER (ITGLOS	= 28)	"γ lost in a crack" tag.

COMMON/TAGTOT/

For each tagging routine ...

ITAGR	I	Counter: total number of tags.
ITAGT	I	Counter: total tagged events.
LTAG	L	*Active tag* (T) or *inactive tag* (F), from control cards.
ITAGCR	I	All tags results in the event.

+KEEP, CORHAC. Infromation given by HACCOR routines.

COMMON/VECPCP/
COMMON/VECPNCP/

NHACH	I	Number of charged particles stored in VECP by HACCOR.
NHANE	I	Number of neutral particles stored in VECP by HACCOR.
VHAC(I,J)	R	Copy of VECP array filled by HACCOR routines.
VHNEU(I,J)	R	Copy of VECP array of new neutrals (only) created by HACCOR.

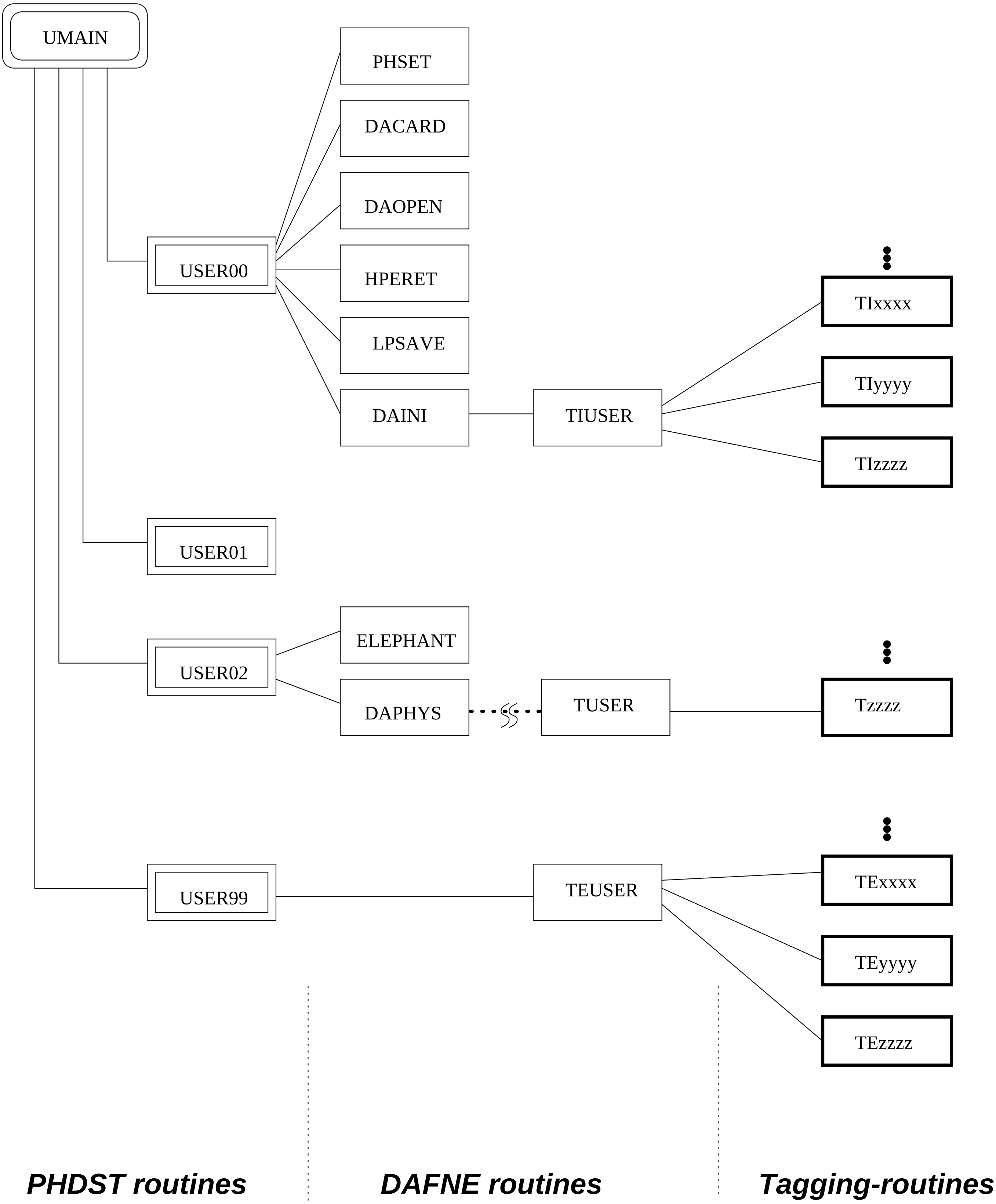

Figure 3: DAFNE program diagram.

4.2 PHDST environment routines

DAFNE reads DST and Pilot Record information using the PHDST package. In this sense, DAFNE works as a standard PHDST user. This interface forces to use a particular set of COMMON blocks and a special program architecture.

In this section we describe the format and contents of those routines needed to interface PHDST and DAFNE (marked with a double box in the text).

PROGRAM UMAIN

Main user program. Initialization and run of PHDST package.

CALL USER00

PHDST user initialization - called once per run from PHINIT.

Structure :

- ▷ Change some PHDST default values (CALL PHSET).
- ▷ Read DAFNE control cards (CALL DACARD).
- ▷ Open text output files (CALL DAOPEN).
- ▷ Read hermeticity pedestals information (CALL HPERET).
- ▷ Backup of PYTHIA common blocks (CALL LPSAVE).
- ▷ Initialize general DAFNE variables (CALL DAINI).

Description :

- For more details on the PHSET routine, consult [1].
- For more details on the control cards used by DAFNE, see 3.1.
- The call to some routines which initialize the HACCOR package is also done in DACARD routine.
- For more details on the hermeticity package, consult [4].
- PYDATA and LUDATA common blocks are saved in special arrays when the job starts (default values) and they are restored before calling each tagging routine.
- DAINI subroutine: initializes general DAFNE counting variables and user tagging counting variables (CALL TIUSER).

CALL TIUSER

Steering of tagging routines initialization - called once per run from DAINI.

Structure :

- ▷ Initialization of all tagging user routines (CALL TIxxxx).

▷ The *scan lists headers* are written here.

Description :

- There is one call for each *active* team. It is possible to activate or desactivate a particular tagging routine using control cards. These routines have the names of the form TIxxxx, where xxxx is the particular extension which characterizes each tagging routine (TICOSM could be the initialization routine for *cosmic tag*, for example).

CALL TIxxxx

"xxxx"-tag initialization - called once per run from TIUSER.

Description :

- There is not a defined structure of what this routine should be. The experts on this tag should initialize here all variables they use in their own code. Reading of user control cards (if any) should be done also here.

CALL USER01(NEED)

Check the event - called on an event by event basis from PHNEED.

Output :

⇐ NEED, flag to accept or reject the event (see [1] for details).

Structure :

▷ Check CPU time (CALL TIMEL).
▷ Check the number of processed events.
▷ Printout some event information.
▷ Accept or reject the event (via NEED value).

CALL USER02

Start DST data analysis - called once per run from PHPROC.

Structure :

▷ Call the lepton and photon identification package (CALL ELEPHANT).
▷ Call the tagging code for general analysis (CALL DAPHYS), see 4.3.

▷ Call the PHDST routine to write events to an output stream (CALL PHOUT).

Description :

- The call to ELEPHANT is done only when reading data on *FullDST* format. For more details on ELEPHANT package, consult [3].
- The call to PHOUT is controled via the logical variable DSTOUT, defined in the control card list. For more details on the PHOUT routine, consult [1].

CALL USER99

PHDST user end of job - called once per job from PHEND.

Structure :

▷ Call the tagging end user code (CALL TEUSER).

CALL TEUSER

Tagging routines ending - called once per run from USER99.

Structure :

▷ Ending of all tagging user routines (CALL TExxxx).
▷ The *scan lists summary and statistics* are written here.

Description :

- There is one call for each *active* team. It is possible to activate or desactivate a particular tagging routine using control cards. These routines have the names of the form TExxxx, where xxxx is the particular extension which characterizes each tagging routine (TECOSM could be the ending routine for *cosmic tag*, for example).

CALL TExxxx

"xxxx"-tag ending - called once per run from TEUSER.

Description :

- There is not a defined structure of what this routine should be. The experts on this tag should end here the run (write event statistics, close logical units, for example).

CALL LPSAVE

Copy COMMON LUDAT, PYINT $\longrightarrow$ COMMON LUDATxx, PYINTxx at the beggining of the job.

Description :

- This routine makes a security copy of the JETSET and PYTHIA COMMON blocks into other common blocks : LUDAT1XX, LUDAT2XX, LUDAT3XX, LUDAT4XX, LUDATRXX, PYSUBSXX, PYPARSXX, PYINT1XX, PYINT2XX, PYINT3XX, PYINT4XX, PYINT5XX, PYINT6XX, PYINT7XX.

CALL DAOPEN

Open text output files - called once per run from USER00.

Description :

- Open *scan list* (Standard physics and New physics) files (CALL PHOPEN). File names are given by means of environment variables (CALL GETENV).

4.3 Analysis routines

Figure 4 shows the four USERxx routines (needed to link DAFNE and PHDST) and the outline of the DAPHYS routine contents. DST reading and event analysis are done in this routine on an event by event basis.

Figure 5 shows the logical stream diagram of the DAPHYS routine.

For DAFNE users it is very useful to check the correct working of their tagging routines on Monte Carlo samples of events in order to detect and correct possible bugs. This is why DAFNE has been designed for reading both reconstruction and simulation DST banks. Two loops inside the DAPHYS routine (reading first DST reconstruction bank and DST simulation bank later) are done if the logical control card REDATA is selected equal to *false*. Only one (reading DST reconstrucion bank) if REDATA is *true*.

General information on each particle is stored in the VECP array. This array is first filled in the PHVDST routine and updated in DATRSEL, after track quality cuts. The list of particles is ordered by charge and by energy (NTRACK charged followed by NNEUTR neutrals).

Thrust, major and minor axes are computed in DANAL routine (using all particles) and stored in positions VECP(J,261)-VECP(J,263). Thrust directions and module are also stored in the vector THRUST(I) (COMMON/GVC/).

Jet reconstruction is made in the JETA routine, using the LUCLUS algorithm with all particles involved in the calculation. The event is forced to be reconstructed with $NJR = 2$ jets. Jets information is stored in positions VECP(J,271)-VECP(J,271+NJR) and in the COMMON/JETS/.

In the JETA routine we also look for leptons (electrons or muons). Once a lepton is found, LUCLUS is called again excluding the lepton from the jet calculation. Jets information is stored in positions VECP(J,291)-VECP(J,291+NJL(1)) and in the COMMON/JETS/. The lepton is restored into its old position in VECP, and the isolation angle of the lepton with respect to the closest jet axis is computed.

This operation is repeated for the rest of the leptons found and all reconstructed jets are stored sequentially in VECP.

Finally, the most isolated lepton is selected and the thrust axis is computed excluding this lepton from the calculation. The result is stored in VECP(J,281)-VECP(J,283).

A general overview of the VECP array contents is shown in Figure 6.

CALL DAPHYS

DST data analysis - called on an event by event basis from USER02.

Structure :

- ▷ Event initialization (CALL DAEVINI).
- ▷ Read the *DST generation bank* (CALL PJVTX), only for Monte-Carlo data.
- ▷ Read the Pilot Record information (CALL READ_PIL).
- ▷ Call HACCOR package routines (CALL COREVT(IER)).
- ▷ Fill and order the VECP array (CALL PHVDST).
- ▷ Dump DST information into PTRK/PCANEU array (CALL RDDST).
- ▷ Apply the track quality selection and update the arrays VECP, PTRK/PCANEU (CALL DATRSEL).
- ▷ Call DELPHI hermeticity routines (CALL HERMETIC).
- ▷ Compute some general event variables from DST information (CALL DANAL).
- ▷ Call the *tagging routines* (CALL TUSER).
- ▷ Write the tagging results into the Pilot Record (CALL WRITE_PIL).

Description :

- Information from the Pilot Record is stored into COMMON/PILREC/ (inside +KEEP, NTUPLE.).
- The call to COREVT routine will be done only when reading data on *FullDST* format.

CALL DAEVINI

Event initialization - called on an event by event basis from DAPHYS.

Description :

- Set the default value of all variables at the beginning of the event.
- Call routine HCLFIX to read DST FIXES (DSTPGE and HACFIX).

CALL PJVTX

Read information from DST simulation bank.

Description :

- Called only for Monte-Carlo data (REDATA=.TRUE.). Reads the simulation bank (LDTOP-2). Looks for I.S.R. photons and leptons at the primary vertex. The COMMON/PRIMVTX/ is filled in this routine.

CALL READ_PIL

Read Pilot Record information - called on an event by event basis from DAPHYS.

Description :

- Read information from blocklets: DAS, DPHA, DANA and TAGGING (CALL PILOT).
- Store this information into COMMON/PILREC/ (+KEEP, NTUPLE).

CALL HACINFO

Read HACCOR information - called on an event by event basis from DAPHYS only if HACCOR package is used.

Description :

- Read results of HACCOR package, only when reading data on *FullDST* format.
- Copy current VECP array (filled by HACCOR routines) into VHAC array.
- Copy VECP positions of new neutrals created by HACCOR into VHNEU array.
- Set VECP array to zero.

CALL PHVDST

Fill and order the VECP array - called on an event by event basis from DAPHYS.

Structure :

▷ Fill COMMON/XMUO/ with muon identification information (CALL MUCALL).
▷ Loop on DST bank structure: reconstruction bank (ldflag=1) or simulation bank (ldflag=2) ...
▷ Take information from stable particles and reject tracks coming from unstable/radiative particles (useful for M.C. data analysis).

- ▷ Fill VECP array with remaining particles: *charged tracks* (ordered by energy) + *neutral particles* (ordered by energy).
- ▷ Update VECP array appending new neutrals created by HACCOR (if any). Order VECP array again (CALL ORDER) and replace previous hadronic energy by the one computed by HACCOR (CALL HACEN).
- ▷ Calculation of the sum of some general variables, for testing only (CALL PHVSUM).
- ▷ Printout of these variables, for testing only (CALL PHVPRT).

CALL RDDST(IOVFLW)

Dump of DST information into the PTRK/PCANEU array - called on an event by event basis from DAPHYS.

Output :

$\Leftarrow$ IOVFLW = 1 if max. number of particles reached (default=0).

Structure :

- ▷ Loop on charged particles (fill PTRK array) ...
- ▷ Read DST Standard-Module.
- ▷ Lepton identification (CALL ELMACO).
- ▷ Read Extra-Modules information (using LPHPA function).
- ▷ Loop on neutral particles (fill PCANEU array) ...
- ▷ Read DST Standard-Module.
- ▷ Read Extra-Modules information (using LPHPA function).

Description :

- For more details on the PTRK/PCANEU array, see Section 4.1.
- When reading the *reconstruction bank*, it takes information from Extra-Modules. When reading the *simulation bank*, it takes information only from DST Standard-Module.

CALL DATRSEL

Track quality selection - called on an event by event basis from DAPHYS.

Structure :

- ▷ Charged track selection.
- ▷ No neutral particle selection is done.
- ▷ Update of the arrays VECP and PTRK.

Description :

- Only the tracks which pass the quality cuts are stored in the arrays VECP and PTRK.

- The values of the cuts for charged tracks are specified (COMMON/PJCARD/) via control cards (see Section 3.1).

CALL HERMETIC

Read DELPHI hermeticity information - called on an event by event basis from DAPHYS.

Structure :

- ▷ Read information from the 40^0 taggers (CALL HTE40T).
- ▷ Read information from the ϕ taggers (CALL HTEPHT).
- ▷ Read information from the 90^0 taggers (CALL HTE90T).
- ▷ Read information from the TOF detector (CALL RFCLST).
- ▷ Read information from the Smoking gun code (CALL HTESMG).

Description :

- Store hermeticity information into COMMON/TE40/, COMMON/TEPH/, COMMON/TE90/, COMMON/TOFH/, COMMON/SMGUN/ (+KEEP, NTUPLE.).
- For more details on the hermeticity package, consult [4].
- Additional routines are: CALL TAGCONE, CALL MINISO.

CALL DANAL

Event analysis - called on an event by event basis from DAPHYS.

Structure :

- ▷ Tag muon candidates (CALL TAGMUON).
- ▷ Compute electromagnetic and hadron energy in 15^0 cone around track (CALL CALCON).
- ▷ Compute total electromagnetic (EMCA) and hadronic (HCAL) energies, using charged and neutral particles (CALL GETENE).
- ▷ Fill the LUND common using VECP, PTRK/PCANEU information (CALL VECTOLUND).
- ▷ Loop on charged and neutral particles ...
- ▷ Compute general event variables and look for most energetic photon.
- ▷ Jet analysis (CALL JETA).

Description :

- This routine is called on an event by event basis and makes the event analysis. It computes the most interesting event variables: multiplicity, visible energy , missing transverse momentum, visible mass, jet reconstruction ...

- The variables in COMMONs /GVC/, /CTC/, /CTN/, /PHOTON/ are filled in this routine.

CALL JETA

Jet analysis - called on an event by event basis from DANAL.

Structure :

▹ Jet reconstruction, charged + neutral (CALL PUCLUS).
▹ Compute and store jet properties.
▹ Look for most isolated lepton with respect to the jet axis.
▹ Take out the most isolated lepton and reconstruct jets again.
▹ Recompute and store jet properties again.

Description :

- Fix values for *two jet* reconstruction: maximum distance djoin, below which it is allowed to merge two clusters into one (PARU(44)=40.) and Minimum number of clusters to be reconstructed (MSTU(47)=2).
- Acollinearity and acoplanarity are computed from jet vectors.
- The variables in COMMON/CJE/, COMMON/ISOLEP/ are filled in this routine.

CALL TUSER

Start tagging decision - called once per run from DAPHYS.

Structure :

▹ For each tagging routine ...
▹ Restore default values of PYTHIA and LUDATA COMMON blocks (CALL LPREST).
▹ Call tagging routine(s).
▹ Fill some vectors to compute tagging statistics.
▹ Write the two *scan list* files.

Description :

- Each tagging-routine gives an output (a number): the result of the tag. This result is written in the *scan list* files on an event by event basis.

CALL LPREST

Copy COMMON LUDATxx, PYINTxx $\longrightarrow$ COMMON LUDAT, PYINT immediately before calling a tagging routine.

Description :

- This routine restores the JETSET and PYTHIA COMMON blocks to the default values: LUDAT1, LUDAT2, LUDAT3, LUDAT4, LUDATR, PYSUBS, PYPARS, PYINT1, PYINT2, PYINT3, PYINT4, PYINT5, PYINT6, PYINT7.

CALL WRITE_PIL

Write tagging information into Pilot Record - called on an event by event basis from DAPHYS.

Structure :

▷ Write the tagging results into special words (CALL SBIT1).
▷ Fill IPILOT vector.

Description :

- For *low level tagging* routines: writes the result of the tag into a special word. For the rest: writes the result of the tag (1 or 0) into a bit of a word.
- For more details on the Tagging Blocklet structure, see 3.2.

CALL PILOT(CTYPE,M,IWRDM)

Input :

⇒ CTYPE = (A) name of the blocklet. (DANA, ...)
⇒ M = (I) position of the word inside the blocklet.

Output :

⇐ IWRDM = (I) word content.

Description :

- This routine accesses the word in Mth position inside the blocklet with name identifier CTYPE, using the IPHPIC function (PHDST).

CALL CATOPO(XCAR,XPOL)

$X,Y,Z \longrightarrow R,\theta,\phi$

Input :

⇒ XCAR(3) = (R) cartesian coordinates (3 dimensional vector).

Output :

⇐ XCYL(3) = (R) polar coordinates (3 dimensional vector, angles in radians).

Description :

- This routine converts a cartesian vector into a polar vector.

| CALL POTOCA(XPOL,XCAR) |

$R,\theta,\phi \longrightarrow X,Y,Z$

Input :

⇒ XCAR(3) = (R) polar coordinates (3 dimensional vector, angles in radians).

Output :

⇐ XCYL(3) = (R) cartesian coordinates (3 dimensional vector).

Description :

- This routine converts a polar vector into a cartesian vector.

| CALL CATOCY(XCAR,XCYL) |

$X,Y,Z \longrightarrow R,\phi,Z$

Input :

⇒ XCAR(3) = (R) cartesian coordinates (3 dimensional vector).

Output :

⇐ XCYL(3) = (R) cylindrical coordinates (3 dimensional vector, angles in radians).

Description :

- This routine converts a cartesian vector into a cylindrical vector.

| CALL TAGCONE(VC,SIZEC,IFLAGC) |

Input :

⇒ VC(3) = (R) Position of the cone barycenter (degrees).
⇒ SIZEC = (R) Size of the cone (degrees).

Output :

⇐ IFLAGC = (I) number of charged particles in the cone, or = 0 if there are no charged particles.

Description :

- Giving a point in the detector (VCEN) and a cone size (SIZEC) this routine scans if there are charged particles in the cone

CALL MINISO(TH,PH,MP,IPA,ALPHAC,ALPHAN)

Input :

$\Rightarrow$ TH = (R) θ of the unitary input vector.
$\Rightarrow$ PH = (R) ϕ of the unitary input vector.
$\Rightarrow$ MP = (R) Minimal momentum required on the PA.
$\Rightarrow$ IPA = (I) LPA to exclude from the computation.

Output :

$\Leftarrow$ ALPHAC = (R) Isolation angle of the nearest charged LPA.
$\Leftarrow$ ALPHAN = (R) Isolation angle of the nearest neutral LPA.

Description :

- Computes the angle between the (TH,PH,1) vector and the nearest PA, looping on all the PAs.

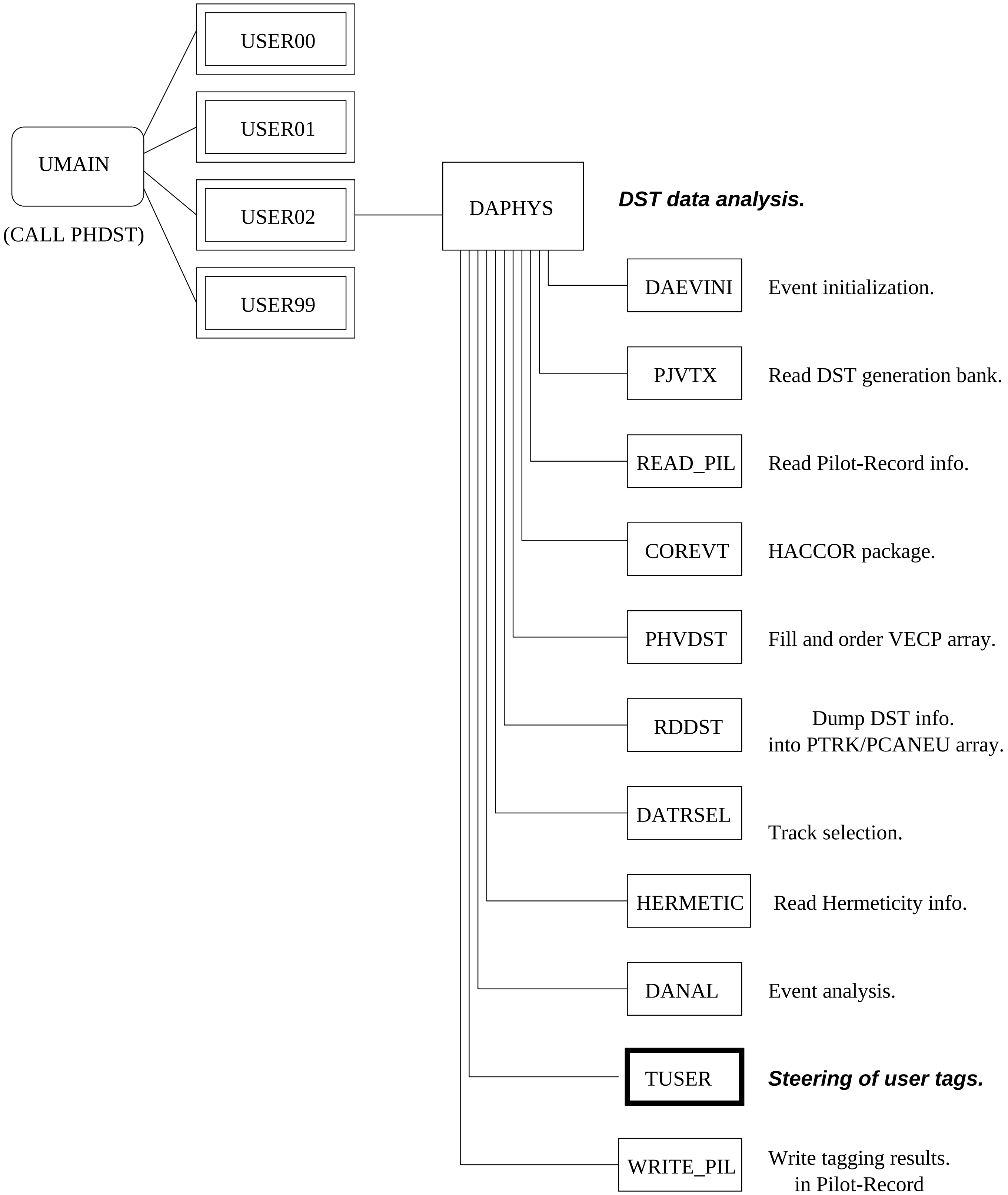

Figure 4: DAFNE program diagram.

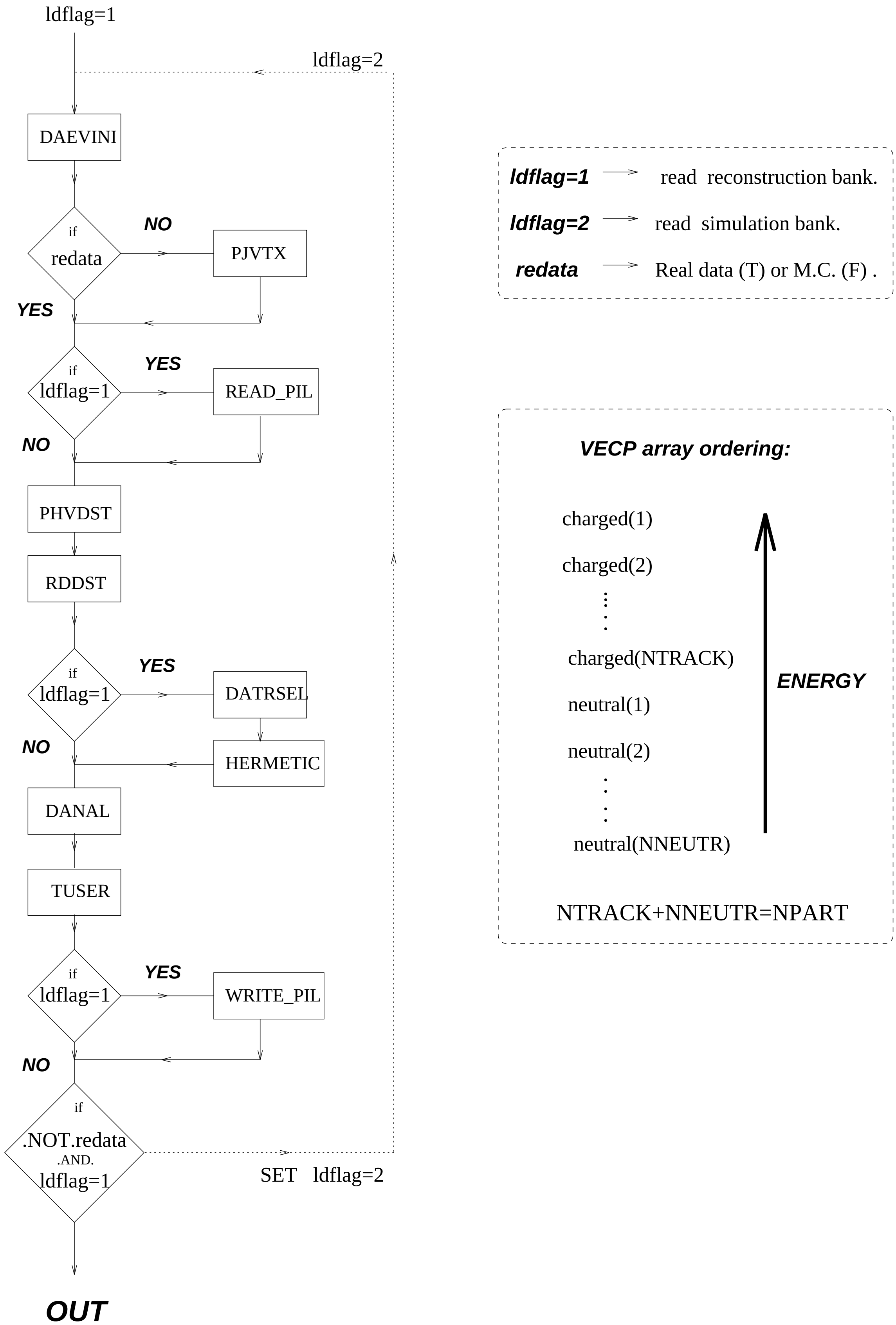

Figure 5: DAPHYS routine logic.

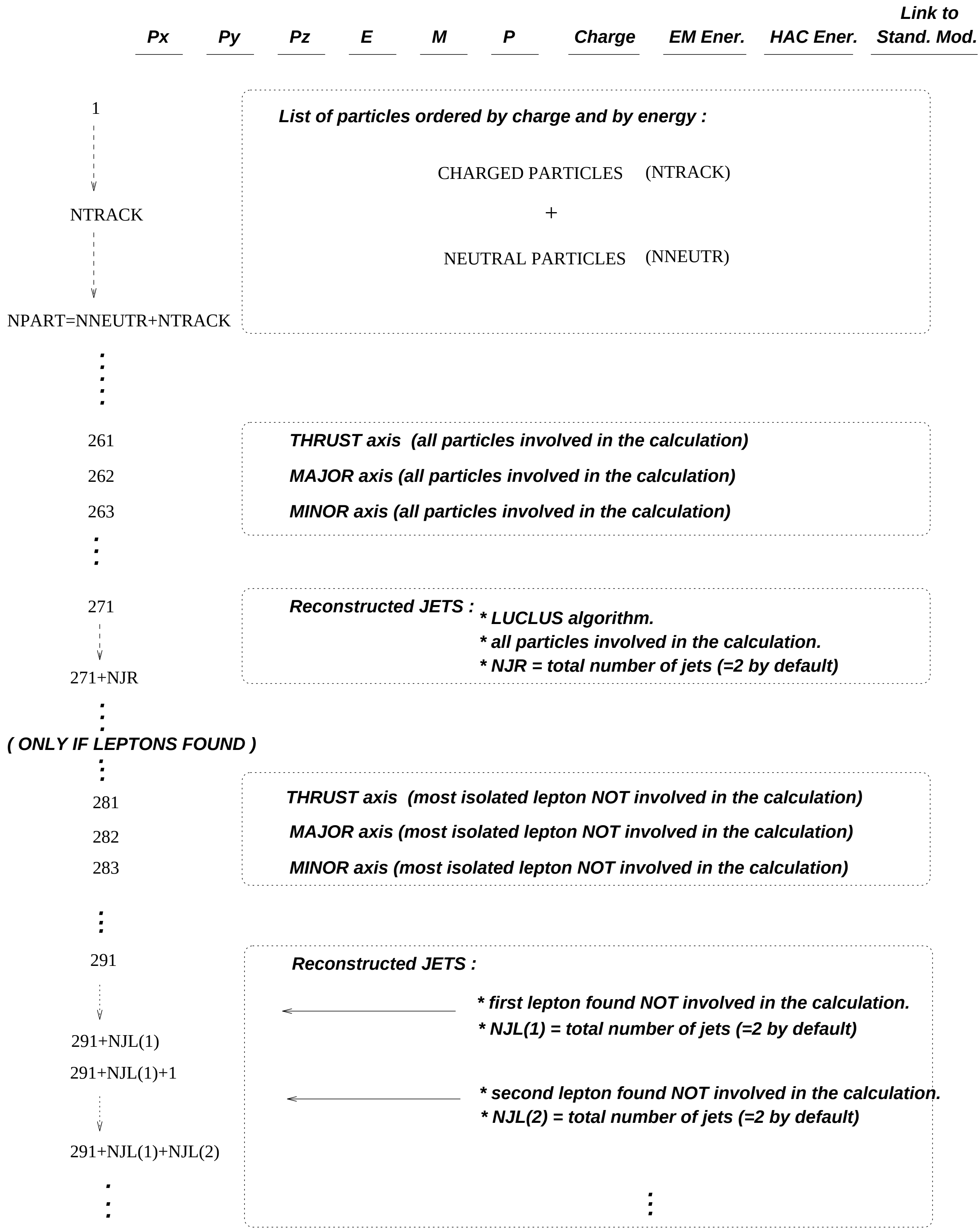

Figure 6: VECP array contents. VECP(8,I) to VECP(10,I) are zero for jets info. , thrust, major and minor axes.

4.4 Tagging routines

The tagging routines are divided into three groups:

- *Low level* : These routines use missing quantities (energy, transverse momentum) and topological characteristics of the events to tag loosely events which might correspond to new physics.
- *New physiscs* : The aim of these routines is to tag events coming from new physics (Supersymmetry, for example), selecting specific processes.
- *Standard physics* : The aim is to classify events coming from standard processes.

There are some important points that DAFNE users should know when starting to prepare a new tagging routine:

1. No Ntuple is stored on disk. The outputs of DAFNE are: the same *LongDST* input file plus the tagging information written into the Pilot Record, and two scan lists files.
2. DAFNE users should write a *.car* file containing the following tagging subroutines:
   - *Txxxx(ITAG)*, where *xxxx* is the identifier of the tagging routine (no more than four characteres). It is called on an event by event basis. The output, *ITAG*, is an integer number related with the result of the tag (=0 if the event is not tagged).
   - *TIxxxx*, tagging routine initialization (called once per job).
   - *TExxxx*, tagging routine ending (called once per job).

   Of course, additional subroutines can be included in the *.car* file if they are necessary for the tag, but the main DAFNE code, *dafne.car*, should not be modified by users.
3. In order to avoid possible interferences between different tagging routines, DAFNE users should restore, after each event, the external arrays it used (DAFNE or PYTHIA common blocks, for example), in the same status they had at the beginning.
4. DAFNE users should test their tagging code (on real and Monte Carlo data) with the current DAFNE version in order to detect and correct possible bugs, checking that everything is consistent. The final version of the tagging routine will be implemented into the following version of DAFNE.

During the end of 1995, tagging experts wrote detailed descriptions of the characteristics of their own tagging routines. This description does not contain only information refered to the fortran code itself but also information on the physical features of the different events they are interested in (topologies under study, cross sections ...), main sources of background, list of cuts used in the analysis, postscript files with typical events, etc.

All this information has been included on the *WWW* pages, address:

URL http://delwww.cern.ch:8010/physics/delphip3/www/scan_bible.html

In table 1 there is a list of the current tagging routines implemented in DAFNE.

Tagging routines:		
Low level	**New physics**	**Standard physics**
▷ No-tag	▷ $\tilde{\chi}^{\pm}$ *jjl channel*	▷ $\gamma\gamma$
▷ Missing enery	▷ $\tilde{\chi}^{\pm}$ *jjjj channel*	▷ Radiative return to Z^0
▷ Topological	▷ $\tilde{\chi}^{\pm}$ *ll channel*	▷ $f\overline{f}$
▷ $>$ 3 jets	▷ $\tilde{\chi}^0$	▷ ν counting
	▷ $\tilde{t}$	▷ Cosmic
	▷ $\tilde{b}$	▷ γ lost in a crack
	▷ $\tilde{\tau}$	
	▷ Single lepton	
	▷ $H\nu\nu$	
	▷ Hll	
	▷ H^+H^-	
	▷ hA	
	▷ Excited lepton	
	▷ $ff\gamma\gamma$	
	▷ $\geq$ 2 photons	

Table 1: Classification of tagging routines.

References

[1] V. Perevozchikov, N. Smirnov, "PHDST Package Description and VZD-Viewer of Zebra Data for DELPHI user's Manuals".
DELPHI 92-118 PROG 189 Rev.3 .

[2] Y.Sacquin, "DELPHI PILOT RECORD DESCRIPTION".
DELPHI 91-90 PROG 177

[3] DELPHI Collab., "DSTANA Library Write-up".

[4] DELPHI Collab., "HERLIB Library Write-up".

[5] Consult WWW address:
http://infodan.in2p3.fr/delphi/analysis/haccor/haccor.html

[6] T. Sjöstrand, PYTHIA 5.6 and JETSET7.3, Physics and Manual,
CERNLIB W5035/W5044, CERN-TH-6488/92.