DELPHI Collaboration

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Description of the DELANA Pilot Record and DST Content

Version 3.40

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Foreword

This description is purely technical, it is not a guide for users wanting to read a DST. Several programs exist in DELPHI for this purpose, with their corresponding descriptions.
Users should nevertheless be aware of some conventions used in this description:
• The bit numbering ranges from 1 to 32. This is the so-called offline convention, used here because it is the one of the CERNLIB routines (JBYT, SBYT, ...). It is not the worldwide standard convention followed by online people (numbering from 0 to 31).
• Some bitted words are stored in real numbers, in particular in the extra modules. The user should always use the function NINT to get the original word: IBITWD = NINT(WORD)
• Following DELPHI convention, φ indicates the azimuthal coordinate of a direction, and ϕ the same for a position. It may happen sometimes that this convention is not followed, due to imprecisions in the original descriptions.

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PILOT RECORD

The ZEBRA structure of the DELPHI event data contains a pilot record designed to have general information concerning the event, allowing a first filter. This pilot record consists of **blocklets** from different origins, containing data related to a given step of the processing. The pilot record only has **integer** data words.

BLOCKLET STRUCTURE

A blocklet is a sequence of data words, preceded by three words:

1 Wordcount = NW
2 Blocklet identifier. The last 4 bits contain the identifier, the other bits can have error codes. Usually in the form (hexadecimal)
0 0 0 0 F F 1 i
, with i (from 0 to F) being the identifier
3 Blocklet sub-identifier

, and terminated by the same wordcount:

NW Wordcount = NW

This structure allows a fast scan of the blocklets, in forward and backward directions. Each blocklet contains NW-4 data words. The pilot record is a succession of blocklets, to which a last word **zero** is added: If we note a blocklet $< BKL1 >$, the pilot record has the structure (for example with three blocklets):
PILOT: $< BKL1 >$,$< BKL2 >$,$< BKL3 >$,0
The size of this pilot record is

NWP = NW1 + NW2 + NW3 + 1

where NWi is the size of the blocklet i.

ACCESSING THE PILOT RECORD:

When using UX for reading the data, the pilot record is stored in the array **IUPILT** accessible through the routine UXEVIN which makes the input of the event in memory:

```
 INTEGER NWPMAX,NWPILT,IUPILT
 PARAMETER(NWPMAX=1024)
 CALL VZERO(IUPILT,NWPMAX)
 CALL UXEVIN(NWPMAX,NWPILT,IUPILT)
```

Thus, to access the word M of the blocklet with identifier ID, the typical code sequence would be:

```
*                 Start at the beginning of the pilot record
      IPP = 0
*                      Decode blocklet's header
   10 NWCUR = IUPILT(IPP+1)
      IDCUR = JBYT(IUPILT(IPP+2),1,4)
      IF(IDCUR.EQ.ID) THEN
*                      Blocklet found, access the data
           IWRDM = IUPILT(IPP+M)
```

```
          GO TO 20
      ENDIF
      IPP = IPP + NWCUR
      IF(IPP.GE.NWPILT) THEN
*                     End of pilot record found , no such blocklet
      GO TO ...
*                       Look for next blocklet
      IF(IUPILT(IPP+1).NE.0) GO TO 10
*                     Blocklet not found
      GO TO ...
*                     Blocklet found
   20 CONTINUE
```

LIST OF BLOCKLETS

Type	Name	Created by
0	DAS	DAS
8	DANA	DELANA
9	DPHA	PXDST, (**PH**ysics Analysis)
11	LUMI	SAT and VSAT
12	TRIG	TRIGGER
13	DETECTORS SPECIAL INFO.	DELANA
14	LEP	DELANA

Note: the DJET blocklet (type 10) has been removed from the pilot record since DST version 3.01, and plugged into the DST structure.

DAS BLOCKLET
TYPE 0

1	Wordcount	(12)
2	Identifier	($00000000)
3	Sub-identifier	(0)

4 Type of record:

1	Raw data
2	Simulation
3	Tanagra
4	Intermediate
5	DST
11	Start-of-Run
21	Continue_Run
31	Check_point
41	Pause_Run
51	End-of-Run
81	Abort_Run

*This flag is set by the DAS to n*100+Type in case of DAS transfer error, n being an error index*

5 Experiment Number
6 Run number
7 File sequence number
8 T2 (Trigger level 2) event number
9 Event number
This event number is the sequencial number on the stream, and then depends on it.
The T2 number is the only absolute number.

10	Event date	(Format 'yymmdd')
11	Event time	(Format 'hhmmss')

12	Wordcount	(12)

DANA BLOCKLET
TYPE 8

1	Wordcount	(57)
2	Identifier	($0000FF18)
3	Sub-identifier	(0)

4 DAS status (bits)
Each bit set indicates which detector was in central partition.
The bit number correspond to software module (as in TANAGRA).

5 Reconstruction status (bits):
Each bit set indicates which detector/processor has been processed in DELANA (i.e. was activated by the data cards).
The bit number correspond to software module (as in TANAGRA).

6	bits 0-15: Current number of Z^0had. in the run bits 16-31: Current number of bhabhas in the run	
7	Atmospheric pressure in DELPHI (B4)	(mbar)
8	X coordinate of primary vertex	(μm)
9	Y coordinate of primary vertex	(μm)
10	Z coordinate of primary vertex	(μm)
11	Event topology at primary vertex (packed bytes): NNEUT//NGAMM//NNEGA//NPOSI	
12	Raw data size (number of words)	
13	Energy in Centre of Mass from LEP (in MeV)	
14	Date of processing	(Format 'yymmdd')
15	Time of processing	(Format 'hhmmss')
16	Magnetic field measurement: if bit 25 = 0 magnet power supply current if bit 25 = 1 field	 (Amps) (Gauss)
17	ITIMOD, time flag given by Outer Detector:	

-1	Unknown
0	Event in time with BCO
1	Cosmic (not in time with BCO)

18 DELANA tagging (bits) .
Starting at first bit =1,

1	Hadronic Z^0
2	Leptonic Z^0
3	Ambiguous hadronic/leptonic Z^0
4	Cosmic or beam gas
5	SAT/STC Bhabha
6	Calibration (STP)
7	Calorimetric energy

For calibration events (bit 6):

11	Single electron (including low energy)
12	Compton tag for HPC
13	Track tag in barrel (2 prong event)
14	Electromagnetic tag in barrel (2 prong event)

15 Track tag forward (2 prong event)
16 Electromagnetic tag forward (2 prong event)

Additional tags:

17 Forward e^+/e^-, no tracks
18 additional tau-tau tag
19 'super' hadronic for team 4
20 team 3 tag from Delana
21 gg– ll with SAT/VSAT tag
22 gg– ll no forward tag
23 gg– ll MUB/MUS in ge 1 track
24 gg– ll HAC in ge 1 track
25 bit on if event fails gg filter
26 cancel gg tag for lep2 due to noise

19 Delana correction cradle date
20 ITIMOD, timing data from OD (T^0 offset for cosmics)
21 LEP status
22 LEP collimators status
23 IFLOAD (bits); Indicate status of database and related informations. Bits start at 1:

1 Database available
2 Trigger Partition available
3 Discrepancy in Fill number
4 Discrepancy in LEP status
5 Discrepancy in collimator status
6 Ebeam taken from database
7 Ebeam from first estimate in Trigger Partition
8 Ebeam from final estimate in Trigger Partition
9 Ebeam from data card
10 Magnet current from database
11 Magnet current from Trigger Partition
12 Magnet current from data card

24 to 56 XSTAD(IDET) : Detectors Status words

Each detector gives a status as a bitted word :

bits 0-3 Status flag 1
bits 4-7 Status flag 2
bits 9-31 detector dependent user bits

The status word for detector IDET is given in the word 23+IDET, IDET being basically the TANAGRA index of the detector. But some unused IDET are filled by detectors needing several words:

	IDET	Detector
24	1	MUB
25	2	MUB
26	3	VD
27	4	ID
28	5	TPC
29	6	RIB
30	7	Free
31	8	OD
32	9	HPC
33	10	HPC
34	11	TOF

35	12	HAB
36	13	HAB
37	14	MUB
38	15	MUB
39	16	MUB
40	17	MUB
41	18	VSAT
42	19	HAC
43	20	FCA
44	21	RIF
45	22	HAF
46	23	SAT
47	24	VSAT
48	25	FCB
49	26	EMF
50	27	FCB
51	28	SAT
52	29	HOF
53	30	MUF
54	31	VFT
55	32	VFT
56	33	MUS

57 Wordcount (57)

DANA BLOCKLET
TYPE 8

1	Wordcount	(5)
2	Identifier	($0000FF18)
3	Sub-identifier	(1)
4	Delana processing identifier (format IFROMC('97D '))	
5	Wordcount	(5)

DPHA BLOCKLET
TYPE 9

1	Wordcount		(43)
2	Identifier		($0000FF19)
3	Sub-identifier		(0)
4	Event type (bitted number)		
	bit 0	=1 if type is defined	
	1	=1 for background event	
	2	=1 for cosmic event	
	3	=1 for beam-gas interaction	
	4	=1 for $\gamma\gamma$ or 3 γ candidate	
	5	=1 for $\gamma\nu\bar{\nu}$ candidate	
	6		
	7		
	8	=1 for $\mu^+\mu^-$ candidate	
	9	=1 for e^+e^- candidate	
	10	=1 for $\tau^+\tau^-$ candidate	
	11		
	12		
	13	=1 for $e^+e^-\gamma\gamma$ (2 photons interaction) candidate	
	14		
	15		
	16	=1 for $q\overline{q}$ candidate	
	17	=1 for u ubar or d dbar candidate	
	18	=1 for s sbar candidate	
	19	=1 for c cbar candidate	
	20	=1 for b bbar candidate	
	21	=1 for t tbar candidate	
	22		
	23		
	24	=1 for large missing energy event	
	25	=1 for large sphericity event	
	26	=1 for high energy isolated γ event	
	27	=1 for high energy isolated lepton event	
5	Total reconstructed energy		(MeV)
6	Total reconstructed Px		(MeV/c)
7	Total reconstructed Py		(MeV/c)
8	Total reconstructed Pz		(MeV/c)
9	Sphericity		(multiplied by 1000)
10	Thrust		(multiplied by 1000)
11	Teams tagging word; The number of each bit set gives the team number of each team tagging the event (*This word was not correct for DST produced from version 250 to 260*)		
12	Number of charged tracks from a vertex at R < 4., Z <10.		
13	Energy of charged tracks from a vertex at R < 4., Z <10.		
14	Number of charged tracks from a vertex at R> 4.		
15	Energy of charged tracks from a vertex at R> 4.		
16	Number of charged tracks from a vertex at R<4., Z >10.		
17	Energy of charged tracks from a vertex at R<4., Z>10.		
18	Number of HPC showers associated with charged tracks		
19	Energy in HPC showers associated with charged tracks		
20	Number of neutral HPC showers identified as photon		

21 Energy of neutral HPC showers identified as photon
22 Number of neutral HPC showers not identified as photon
23 Energy of neutral HPC showers not identified as photon
24 Number of HAC showers associated with charged tracks
25 Energy in HAC showers associated with charged tracks
26 Number of neutral HAC showers with E > 1. GeV
27 Total energy of neutral HAC showers with E > 1. GeV
28 Number of neutral HAC showers with E < 1. GeV
29 Total energy of neutral HAC showers with E < 1. GeV
30 Number of EMF showers associated with charged tracks
31 Energy in EMF showers associated with charged tracks
32 Number of neutral EMF showers identified as photon
33 Energy of neutral EMF showers identified as photon
34 Number of neutral EMF showers not identified as photon
35 Energy of neutral EMF showers not identified as photon
36 Number of CCA showers associated with charged tracks
37 Energy in CCA showers associated with charged tracks
38 Number of neutral CCA showers
39 Energy of neutral CCA showers
40 Number of neutral CCA showers identified as charged by HAC
41 Energy of neutral CCA showers identified as charged by HAC
42 Total energy of the event; it is the result of the sum
13 + 15 + 17 + 21 + 27 + 29 + 33 + 35 + 39

43 Wordcount (43)

N.B.: *All energies and momenta (words 5, 6, 7, 8, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 42) are limited to 10,000,000 MeV, and set to this value above.*

LUMI BLOCKLET
TYPE 11
SAT

Differential SAT blocklet (in each event's pilot record)

1	NW, wordcount	(13)
2	Identifier	($0000FF1B)
3	Sub-identifier : 1 for SAT blocklet	
4	Total number of accepted Bhabha events since previous event was written to the output stream.	
5	Number of Bhabha events accepted in BCO number 1 since previous event was written to output strea	
6	Same as 5 for BCO number 2	
7	Same as 5 for BCO number 3	
8	Same as 5 for BCO number 4	
9	Same as 5 for BCO number 5	
10	Same as 5 for BCO number 6	
11	Same as 5 for BCO number 7	
12	Same as 5 for BCO number 8	
13	NW, wordcount	(13)

Accumulated SAT blocklet (in E-O-R pilot record)

Same size and identifiers as the differential one. Each data word refer now to the sum over the run of the differential one

Special SAT E-O-R blocklet

1	NW, wordcount	(17)
2	Identifier	($0000FF1B)
3	Sub-identifier : 1 for SAT blocklet	
4	Integrated luminosity of the run	$(nb^{-1} * 1000000)$
5	Statistical error on luminosity	$(nb^{-1} * 1000000)$
6	Luminosity conversion factor used	$(nb^{-1} * 1000000)$
7	Date of the first event in the run	
8	Time of the first event in the run	
9	Date of the last event in the run	
10	Time of the last event in the run	
11	SAT scaler increment of the run	
12	SAT scaler increment of the run	
13	Number of triggers processed by SATANA with SAT trigger bit on	
14	SAT arms A&C single arm trigger increment (scalers) in the run	
15	SAT scaler increment of the run	
16	SAT Bhabha trigger increment (scalers) in the run	
17	NW, wordcount	(17)

LUMI BLOCKLET
TYPE 11
VSAT

1	NW, wordcount	(24)
2	Identifier	($0000FF1B)
3	Sub-identifier : 2 for VSAT blocklet	(2)

4 Number of Bhabha triggers in arm 1
5 Number of Bhabha triggers in arm 2
6 Total number of Bhabha triggers in both arms

The following words count events above the following threshold:

- Energy deposition in 2 opposite modules >0.8∗Ebeam
- The 2 electrons are in the VSAT fiducial volume.

7 Same as 4 for events above the threshold
8 Same as 5 for events above the threshold
9 Same as 6 for events above the threshold

The false Bhabha events refer to background events: 2 electrons (not Bhabha) in coincidence in 2 opposite modules.

10 Number of **false** Bhabha triggers in arm 1
11 Number of **false** Bhabha triggers in arm 2
12 Total number of **false** Bhabha triggers in both arms

13 Number of **fals**e Bhabha triggers in arm 1, above the threshold
14 Number of **false** Bhabha triggers in arm 2, above the threshold
15 Total number of **false** Bhabha triggers in both arms, above the threshold

16 Corrupted Bhabha events in arm 1 (Hardware problems)
17 Corrupted Bhabha events in arm 2 (Hardware problems)
18 Corrupted **false** Bhabha events in arm 1
19 Corrupted **false** Bhabha events in arm 2
20 Corrupted **DELPHI** events : one **DELPHI** event can contain one or more VSAT events)
21 Not identified **false** Bhabha event
22 Total number of corrupted Bhabha events
23 Not used

24	NW, wordcount	(24)

TRIGGER BLOCKLET
TYPE 12

1	NW, wordcount	(69)
2	Identifier	($0000FF1C)
3	Sub-identifier	(0)
4	B1 triggers (from scalers)	
5-8	PYTHIA first level	
9-10	Output from A module; first level	
11-12	Output from A/B module; first level	
13	Forward majority triggers (from scalers)	
14-17	PYTHIA second level	
18-19	Output from A module; second level	
20-21	Output from A/B module; second level	
22	Input module C ; first level	
23	Result from C ; first level	
24	Result from C post mask; first level	
25	Result from C post scaling; first level	
26-29	Trigger pattern ; first level	
30-31	Majority pattern ; first level	
32	Input module C ; second level	
33	Result from C ; second level	
34	Result from C post mask; second level	
35	Result from C post scaling; second level	
36-39	Trigger pattern ; second level	
40-41	Majority pattern ; second level	
42	B1 pattern	
43-46	Internal T3 trigger pattern	
47-48	Internal T3 majority pattern	
49	Internal T3 DF pattern	
50-53	Output T3 trigger pattern	
54-55	Output T3 majority pattern	
56	Output T3 DF pattern	
57	TPC T3 tagging	
58	Bunch number from VSAT	
59	Bunch number from UNG_CLK_BCO	
60	Vernier Scan	
61-64	First level Prescaling factors	
65-68	Second level Prescaling factors	
69	NW, wordcount	(69)

T4 BLOCKLET

1	NW, wordcount	(7)
2	Identifier	($0000FF1C)
3	Sub-identifier	(1)
4	T4 tagging word: -1 if no T4 info found by DELANA in raw data 0 if T4 rejected the event	

bit 1:T4 HPC
bit 5:T4 EMF
bit 9:T4 TPC
bit 13:T4 STC
bit 17:Team tag
bit 21:T3 tag
bit 24:T4 pass
bit 29:T4 Delana

5 T3 single gamma:
-1 if no T3 info found by DELANA in raw data
bit 2:Bhabha
bits 15-16:single gamma

6 T3 TPC tag:
-1 if no T3 info found by DELANA in raw data
bits 1-8 :HAD tag
bits 9-16:LEP tag
bits 17-24:LLB tag
bits 25-32:TPC tag

7 NW, wordcount (7)

DETECTORS SPECIAL BLOCKLET
TYPE 13

1	NW, wordcount	(16)
2	Identifier	($0000FF1D)
3	Sub-identifier: Detector identifier (TANAGRA index) for which the transformation matrix is given.	

Transformation matrix:

4 to 15	transformation matrix to go from the detector reference frame to the general DELPHI reference frame. The numbers are multiplied by 1000000 before being stored as integers.	
16	NW, wordcount	(16)

DETECTORS SPECIAL BLOCKLET
TYPE 13

1	NW, wordcount	(NW)
2	Identifier	($0000FF1D)
3	Sub-identifier: 1000*Detector identifier (TANAGRA index)	
NW	NW, wordcount	(NW)

Currently used: ID (NW=70), TPC (NW=7)

LEP BLOCKLET
TYPE 14

1	NW, wordcount	(44)
2	Identifier	($0000FF1E)
3	Sub-identifier	(0)

4	Date of last update	(Format 'yymmdd')
5	Time of last update	(Format 'hhmmss')
6	Fill number	
7	LEP status as given by the machine (from 1 to 9)	
8	LEP status derived from current, energy and collimator: (DELPHI evaluation) = 1 No beam = 2 Setup = 3 Physics = 4 End of fill = 5 Unknown	

9	Time of last change to LEP status	(Format 'hhmmss')

10	Collimators setting: = 0 Unknown = 1 Open = 2 Coarse = 3 Fine	
11	Number of positron bunches in the machine	
12	Actual ring energy, in MeV. For 1990 this is a rough estimate, given even during ramping For 1991 beam energy, with significance given by next word	
13	For 1990: flip coil energy if available (precision 10**-4), -1 if not available -1 Energy unreliable or unavailable. 1 Rough estimate (2% precision) 2 Flip coil value	

14	Current in the main coil	(Amps)
15	Field in mids-**NMR** probe	(Gauss)
16	Horizontal (X) beta value	(mm)
17	Vertical (Y) beta value	(mm)

18 to 23 Beam spot used by Delana:

x
y
z
σ_x
σ_y
σ_z

24 to 27 Positron stack currents (μA)

28 to 31 Electron stack currents (μA)

N.B.: For 8-bunches running, each value is the sum of currents in bunches n and $n+4$(i.e. : 1+5, 2+6, 3+7, 4+8)

32 Interacting bunch number, used by DELANA
33 Bunch number given by ID
34 Bunch number given by FCB
35 Bunch number given by FCA
36 Bunch number given by TOF
37 Bunch number given by OD
38 Bunch number given by HOF
39 Bunch number given by STC
40 Bunch number given by STW
41 Number of wagons from LEP (not used in Delana)
42 Distance in RF buckets from LEP (not used in Delana)
43 Number of clock BCOs from Zeus

or:(when running in cosmic mode)

33 Time measured by TOF
34 Time measured by OD
35 Time measured by FCB
36 Time measured by HOF
37 Time measured by STW
38 0
39 0
40 0
41 0
42 0
43 0

44 NW, wordcount (44)

TAGGING BLOCKLET
TYPE 15

1	NW, wordcount	(NW)
2	Identifier	($0000FF1F)
3	Sub-identifier = number of teams	(NTEAM)

4 to NTEAM+3	Tagging words for teams 1 to NTEAM	
4+NTEAM	Bitted word: each bit set indicates a team tagging effectively run	
5+NTEAM	Bitted word: each bit set indicates a team accepted for output even if not confirmed by DELANA or other team	
NW	NW, wordcount	(NW)

DST CONTENT

TOP BANK

43	Structural links
0	Reference link
5 or 35	data (4I-1B)

Link LDTOP

LINKS

-1	PV banks (from reconstruction)	
-2	PV banks from simulation (if any)	
-3	SH bank (from simulation)	
-4	Initial e^+e^- system	
-5	e^+e^- system after gamma radiation	
-6	$l\bar{l}$ or $q\bar{q}$ system before gluon radiation	
-7	TE information	
-8	Trigger information	
-9	Vertex Detector TD information	
-10	Unassociated TE information	
-11	OD timing information	
-12	VSAT result bank	(*since version 2.54*)
-13	AMBiguous shower(s) information bank(s)	(*since version 2.65*)
-14	HPC trigger bank	(*since version 2.62*)
-15	CCA bank	(*since version 2.69*)
-16	Unassociated HPC clusters	(*since version 2.81*)
-17	DJET blocklet, swapped from pilot record	(*since version 3.01*)
-18	HCAL cathode read-out information bank	(*since version 3.14*)
-19	Straw tubes information bank	(*since version 3.17*)
-20	STIC trigger bank	(*since version 3.16*)
-21 to -40	Reserved for Long/Short DST extensions	
-41	Forward RICH photon banks	(*since version 3.30*)
-42	VFT pixel cluster bank	(*since version 3.34*)
-43	VFT strip cluster bank	(*since version 3.34*)

DATA CONTENT

+1	Date of processing	(format yymmdd)
+2	Time of processing	(format hhmm)
+3	IVERS, version number of PXDST (multiplied by 100: for version 2.51, IVERS = 251) N.B. :*In PXDST, the sequence PXCVER contains a parameter IVERS, which is not the currently read DST version, but the program version.*	

+4	Laboratory identifier (See TANAGRA manual)
+5	List of activated Extra Modules: bitted word, each bit correspond to a module.

Up to 20, the bit number attributed to a module corresponds to the extra-module identifier, if any. This is no more the case after 21, due to the ShortDST developpement.

Maximum number of modules: 23

List of modules:

1 = CCA	Combined Calorimetry
2 = EMF	Forward Electromagnetic calorimeter
3 = HCA	Hadronic calorimeter
4 = MU	Muons chambers (Barrel and forward)
5 = EL	Electron identification
6 = MRIC	RICH informations
7 = MTPC	TPC informations (dE/dx)
8 = TRAC	Tracking parameters of the track
9 = TOF	Time of flight information
10= VD	VD informations
11= TDHA	Points of Hadronic Calorimeter
12= TEID	Tracks from ID
13= TETP	Tracks from TPC
14= TEOD	Tracks from OD
15= TEFA	Tracks from FCA
16= TEFB	Tracks from FCB
17= TDID	Drift times in ID
18= SAT	SAT informations
19= STIC	STIC informations
20= TRAX	Track extrapolation points on defined surfaces
21= TERF	Forward RICH informations
22= VFT	Very Forward Tracker informations
23= TEST	Straw tubes informations

Since version 3.36, only for Simulation :

+6	Incoming electromagnetic energy for HPC
+7	Outgoing electromagnetic energy for HPC
+8	Incoming energy of mu+, mu- for HPC
+9	Outgoing energy of mu+, mu- for HPC
+10	Incoming hadronic energy for HPC
+11	Outgoing hadronic energy for HPC
+12	Incoming electromagnetic energy for EMF
+13	Outgoing electromagnetic energy for EMF
+14	Incoming energy of mu+, mu- for EMF
+15	Outgoing energy of mu+, mu- for EMF
+16	Incoming hadronic energy for EMF
+17	Outgoing hadronic energy for EMF
+18	Incoming electromagnetic energy for COI
+19	Outgoing electromagnetic energy for COI
+20	Incoming energy of mu+, mu- for COI
+21	Outgoing energy of mu+, mu- for COI
+22	Incoming hadronic energy for COI
+23	Outgoing hadronic energy for COI
+24	Incoming electromagnetic energy for HAB
+25	Outgoing electromagnetic energy for HAB

+26 Incoming energy of mu+, mu- for HAB
+27 Outgoing energy of mu+, mu- for HAB
+28 Incoming hadronic energy for HAB
+29 Outgoing hadronic energy for HAB
+30 Incoming electromagnetic energy for HAF
+31 Outgoing electromagnetic energy for HAF
+32 Incoming energy of mu+, mu- for HAF
+33 Outgoing energy of mu+, mu- for HAF
+34 Incoming hadronic energy for HAF
+35 Outgoing hadronic energy for HAF

STATUS BITS IQ(LDTOP) : 2 bits

Those bits are set by PXTAG since version 3.13 :

bit 1 = 1 if a D^* candidate has been tagged in the event, in the channel
$D^* \to D^0\pi, D^0 \to K\pi$

bit 2 = 1 if the event contains a $(K\pi)\pi$ background combination to D^*

bit 3 = 1 if a D^0 candidate has been tagged in the event, in the channel
$D^0 \to K\pi$

bit 4 = 1 if the event contains a $K\pi$ background combination to D^0

bit 5 = 1 if a loose D_s candidate has been tagged in the event, in the channel
$D_s \to K^+K^-\pi$

bit 6 = 1 same as bit 5, but for a tight D_s

PV BANK

1	Structural link
1	Reference link
14	data (3B-F)

Link LQPV = LQ(LDTOP-1)

LINKS

0	Next vertex bank
-1	PA of outgoing particles
-2	PA of incoming particles

DATA CONTENT

+1	TANAGRA identifier of the TV bank
+2	Number of outgoing particles
+3	Number of degrees of freedom
+4	Mass code of the origin particle Special cases: 0. for primary vertex 999. for dummy vertex
+5	X |
+6	Y | –> Coordinates of the vertex
+7	Z |
+8	χ^2 of the vertex fit
+9	xx |
+10	xy |
+11	yy | –> Error matrix
+12	xz |
+13	yz |
+14	zz |

since version 3.13 :

When tracks attached to this vertex are found by PXTAG to form a D^* or only a D^0 candidate:

+15	$(K\pi)$ mass for D^0 candidate
+16	$(K\pi\pi - K\pi)$ mass difference for D^* candidate

When tracks attached to this vertex are found by PXTAG to form a D_s candidate:

+15	(K^+K^-) mass for Φ candidate
+16	$(K^+K^-\pi)$ mass for D_s candidate

STATUS BITS IQ(LQPV) : 5 bits

bit 1 = 1 if dummy vertex
bit 2 = 1 if secondary vertex
bit 3 = 1 if secondary hadronic vertex
bit 4 = 1 if vertex with simulation data

Since version 3.13 :

if a D^0 or D^* is flagged:
bit 5 = 1 if a K from a D^0 is linked to this vertex
if a D_s is flagged:
bit 5 = 1 if a K from a Φ is linked to this vertex

PA BANK

0	Structural link
4	Reference links
n	data (3B,(n+1)I,-F)

Link LQPA = LQ(LQPV-1)

LINKS

0	Next PA bank	
-1	PV bank of end vertex (if any)	
-2	Matching simulated PA (if any), or matching reconstructed PA, for PA of the simulation (attached to the PV of LDTOP-2)	
-3	PA containing extra-module CCA with ambiguous shower also associated to this track. for simulation PA (hanging to PV from LDTOP-2), this link points to the SH bank (simulation has no ambiguities).	(*since version 2.68*)
-4	CCA bank associated to this PA	(*since version 2.69*)

DATA CONTENT

+1	TANAGRA identifier of the track PA, or Label, for simulated track.	
+2	Detectors used in the reconstruction. (2nd word of the TK, 1 bit for each detector, as defined in TANAGRA manual, appendix B)	
+3	Mass ambiguity code. (not yet implemented)	
+4	n, number of information modules (standard plus extra) = N+1 , N being the number of extra modules.	
+5	Length of standard module	(N1=27 *up to version 3.32,* N1=32 *after*)
+6	Length of first extra module	(N2)
⋮		
+n+4	Length of Nth extra module	
+n+5	First word of standard module	
+n+5+N1	First word of first extra module	
+n+5+N1+N2	First word of 2nd extra module	
⋮	⋮	

STATUS BITS IQ(LQPA) : 17 bits

bit 1 = 1 if the track is discarded
bit 2 = 1 if the correlation matrix is given
bit 3 = 1 if the track has an unresolved te
bit 4 = 1 if the track is made with overlapping showers
bit 5 = 1 if the track contains results from cca.
bit 6 = 1 if the track is given by the forward combined fit.
bit 7 = 1 if the energy is obtained from substraction in calorimeters

bits 8 to 12 concern simulated data only

bit 8 = 1 if good match with simulated track
bit 9 = 1 if match ok, ambiguity solved
bit 10 = 1 if match with showers
bit 11 = 1 if unmatched track
bit 12 = 1 if remaining TER from calorimeters.
bit 13 = 1 for remaining TER from OD, not associated to a TKX.
(This track is attached to a dummy vertex)

since version 3.04:

bit 14 = 1 when multiple scattering from first measured point to perigee is included, 0 if not.
bit 15 = 1 for a track flagged as V^0 branch candidate by the TPCANA algorithm.

since version 3.13 :

if a D^0 or D^* is flagged:

bits 16-17 = 1 if the track is a K candidate from a $D^0 \to K\pi$
2 if the track is a π candidate from a $D^0 \to K\pi$
3 if the track is a π candidate from a $D^* \to D^0\pi$

if a D_s is flagged:

bits 16-17 = 1 if the track is a K^+ candidate from a $\Phi \to K^+K^-$
2 if the track is a K^- candidate from a $\Phi \to K^+K^-$
3 if the track is a π candidate from a $D_s \to \Phi\pi$

PA MODULES
STANDARD MODULE (0)

LENGTH: 27 words. *since 3.32 :* 32 words

CONTENT (at address IPS = 5+IQ(LPA+4))

IPS +0	Label of the module	(= 0)
+1	Particle mass	
+2	Px |	
+3	Py | > At the closest distance approach to the vertex	(GeV/c)
+4	Pz |	
+5	E , energy *Since 3.15 :* For the neutrals in HPC, this energy is corrected for non-linearities and crack losses.	(GeV)
+6	P , momentum	(GeV/c)
+7	Charge : 0=neutral; 1. = positive; 2. = negative; 3. = undefined, + or -	
+8	Track length (negative for incoming particle)	
+9	Mass code	
+10	Impact parameter, rp (with sign): If VC is the distance of the vertex to the center of curvature and R the radius of curvature, with the sign opposite to the charge sign, then rp = sign(R) *(|R|)-VC)	
+11	Error on impact parameter	
+12 to +17	Error matrix on Px,Py, Pz, computed at the inner face of the beam pipe	
+18	Error on E	
+19	Z impact parameter = ZP - ZV ; ZP is the z coordinate of the extrapolation of the track at the closest distance approach to the vertex in the R-Rϕ plane	
+20	Error on ZP	
+21	Azimuthal angle of the point of closest distance approach to the vertex, PHIP. The routine **PXPOSC**(LPA,XP,YP,ZP) calculates the cartesian coordinates of the point of closest distance approach to the vertex, for the track pointed to by LPA.	
+22	X |	
+23	Y |> Coordinates of the first measured point on the track	(cm)
+24	Z |	
+25	χ^2 of the fit of the TK	
+26	Number of degrees of freedom *Since version 3.32 :*	
+27	Track origin	
+28	Track type	
+29	Reserved for DSTANA extra information	
+30	Reserved for DSTANA extra information	
+31	Reserved for DSTANA extra information	

PA MODULES
LIST OF THE EXTRA MODULES

Each track contains extra information from given detector/processor (called module), in the form of a block of floating point data in defined format.

The creation of the modules is activated by data card; they are identifiable by their DST identifier.

LIST OF MODULES:

Module	**data card**	**subroutine**	**DST ID**
Combined calorimetry	CCAL	PXCCAL	1.
E.M. calorimetry	EMCA	PXEMCA	2.
Hadron calorimetry	HCAL	PXHCAL	3.
Muon identification	MU	PXMU	4.
Electron identification	EL	PXEL	5.
RICH mass identification	MRIC	PXMRIC	6.
TPC mass identification	MTPC	PXMTPC	7.
Track information	TRAC	PXTRAC	8.
Time of flight	TOF	PXTOF	9.
TD from HAC	TDHA	PXTDHA	11.
TE from ID	TEID	PXTEAM(4)	12.
TE from TPC	TETP	PXTEAM(5)	13.
TE from OD	TEOD	PXTEAM(8)	14.
TE from FCA	TEFA	PXTEAM(20)	15.
TE from FCB	TEFB	PXTEAM(25)	16.
TD from ID	TDID	PXTDID	17.
SAT information	SAT	PXSAT	18.
STIC information	STIC	PXSTIC	19.
Track extrapolation	TRAX	PXTRAX	20.
TE from Forward RICH	TERF	PXTEAM(21)	21.
TE from Straw tubes	TEST	PXTEAM(41)	41.
TE from VFT	VFT	PXTEAM(42)	42.

The following modules, concerning the full event and not one track only, are put as an extra bank hanging to LDTOP. They are nevertheless activated in the same way as the other extra modules:

Vertex Detector	VD	PXTDVD	LDTOP-9
Since version 3.34			
VFT information	VFT	PXVFT	LDTOP-42/-43

(The VFT creates both an extramodule and additionnal banks)

er

The modules are activated by the data card PXMODU at the creation of the DST.

NOTE :

If the module 'CCAL' is activated, it triggers automatically the activation of 'EMCA' and 'HCAL'.

If the module 'MU ' is activated, it triggers automatically the activation of 'EMCA', 'HCAL', and 'CCAL'.

PA MODULES
CCAL MODULE (1)

LENGTH : variable, = 2 + 9*NS words, NS being the number of associated showers.

CONTENT (at address IP)

IP	+ 0	Label of the module	(= 1)
	+ 1	Number of associated showers, NS	

Then for each shower,
at address J = IP + 1 + 9*(n-1) , n being the shower number (from 1 to NS):

J	+ 1	Length of this shower information block	(= 9)
	+ 2	Detector Identifier : 31 = CCA	
	+ 3	Energy	
	+ 4	X	
	+ 5	Y	
	+ 6	Z	
	+ 7	Mass identifier from DELANA	
	+ 8	ϑ	
	+ 9	φ	

PA MODULES
EMCA MODULE (2)

LENGTH: variable, = 2 + NS*(11+2*NLAY) words, NS being the number of associated showers, and NLAY the number of layers.

CONTENT (at address IP)

IP	+ 0	Label of the module	(= 2)
	+ 1	Number of associated showers, NS	

Then for each shower, at address J, the first shower being at J = IP + 1 :

J	+ 1	Length of this shower information block	(= 11+2*NLAY) *since 2.63 for HPC :* (= 11+3*NCLU)
	+ 2	Detector Identifier: 9 = HPC , 26 = EMF	
	+ 3	Energy *Since 3.15 for HPC :* This energy is **not** corrected for non-linearities in the HPC. For the neutrals, the energy given in the standard module is corrected for non-linearities and crack losses.	
	+ 4	X	
	+ 5	Y	
	+ 6	Z	
	+ 7	Mass identifier from DELANA	
	+ 8	ϑ	
	+ 9	φ	

Layer information *(Up to version 2.62 for HPC)*

+10 NLAY = Number of layer hit in this shower

+11 Layer pattern. This is a bitted word: each bit set indicates a layer hit; bit n correspond to layer n. Layers range from 1 to 10

Then for each layer (nl is the layer number):

+11+2*(nl-1)+1 Energy deposited in the layer

+11+2*(nl-1)+2 1000*nl + number of channels active in the layer

Since version 2.53, for HPC (ID=9)

+11+2*(nl-1)+1 Packed Energy (E) and width (DZ): float (1024*int(10.*E) + int(10.*DZ))

+11+2*(nl-1)+2 Packed coordinates of the layer hit: float (1024*int(10.*Z) + int(100*ϕ)

Layer information (*Since version 2.63 for HPC*)

+10 NCLU = Number of clusters recorded for this shower. This may be larger than the number of layers involved in the shower. For version before 2.81, this was always less than or equal to the number of layers in the HPC.

+11 NWDCL = Number of words describing each cluster. This is currently 3, but may be extended.

Then for each cluster (nc is the cluster number):

Up to version 2.69 :

+11+NWDCL*(nc-1)+1 Packed Energy (GeV) and layer number. A layer may

	appear more than once, if there is more than one cluster in this layer:
	64*(100*E) + NL
+11+NWDCL*(nc-1)+2	Packed X and Y coordinates (cm) of the cluster maximum:
	1024*(X+260) + (Y+260)
+11+NWDCL*(nc-1)+3	Packed Z (cm) coordinate and width (cm) in Z:
	1024*(Z+260) + 10*W

Since version 2.70:

+11+NWDCL*(nc-1)+1	Packed Energy (GeV) and layer number. A layer may appear more than once, if there is more than one cluster in this layer:	
	64*NINT(1000*E) + NL	(E limited to 16.383)
+11+NWDCL*(nc-1)+2	Packed R (cm) and ϕ (rad) coordinates of the cluster maximum:	
	4096*NINT(5*(R-205)) + NINT(512*ϕ)	(R limited to 256.)
+11+NWDCL*(nc-1)+3	Packed Z (cm) coordinate and width (cm) in Z:	
	256*NINT(8*(Z+260)) + NINT(10*W)	(Z limited to 252.)

NB: X, Y (for the first version) and Z are offset by 260 cm, so they are positive.

A routine **PXHGET**(PACK,E,N,X,Y,Z,W) is provided for the unpacking of the 3 packed words stored in PACK(1) to PACK(3).

NL is the layer number, set to -1 in case of error; it ranges from 1 to 10, 4 being the trigger gap.

PA MODULES
HCAL MODULE (3)

LENGTH: variable, = 2 + NS*(12+2*NLAY+2*NTOW) words, NS being the number of associated showers, NLAY the number of layers and NTOW the number of towers hit.

CONTENT (at address IP)

IP	+ 0	Label of the module	(= 3)
	+ 1	Number of associated showers, NS	

Then for each **shower**, at address J, the first shower being at J= IP + 1:

J	+ 1	Length of this shower information block	(= 12+2*(NLAY+NTOW))
	+ 2	Detector Identifier: 13 = HAB/HAF	
	+ 3	Energy	
	+ 4	X	
	+ 5	Y	
	+ 6	Z	
	+ 7	Mass identifier from DELANA	
	+ 8	ϑ	
	+ 9	φ	

Layer (i.e. tower) information:

+10 Number of layers hit in this shower, NLAY

+11 Layer pattern. This is a bitted word: each bit set indicates a layer hit; bit n correspond to layer n. Layers range from 1 to 4

Then for each layer hit (nh is the hit number, from 1 to NLAY):

+11+2*(nh-1)+1 Energy deposited in the tower

+11+2*(nh-1)+2 Number of channels active in the tower, +1000*nl (layer number)

Since version 2.66, TD information of the tower:

+11+2*NLAY+1 Number of towers hit, NTOW

For each tower *it*=1,NTOW:

+11+2*NLAY+2*(*it*-1)+1 Energy in the tower (GeV)

+11+2*NLAY+2*(*it*-1)+2 Tower coordinate (packed):
10000*Layer number
+ 1000*JU (cell number along ϑ)
+ 10*JV (cell number along ϕ)

PA MODULES
MU MODULE (4)

LENGTH: variable, = 18+10*NLAY+11 words, NLAY being the number of layers.
35+10*(NLAY1+NLAY2)+2*11 words in case MUS overlaps with MUB or MUF.

CONTENT (at address IP)

IP	+ 0	Label of the module	(= 4)
	+ 1	Detector ID : 14 = MUB , 30 = MUF , 17 = MUS	
	+ 2	Number of associated layers, NLAY	
	+ 3	Number of degrees of freedom	
	+ 4	Global χ^2	
	+ 5	X coordinate in the first layer	
	+ 6	Y coordinate in the first layer	
	+ 7	Expected hit pattern (MUB only)	
	+ 8	χ^2 for MU chambers alone	
	+ 9	X (extrap-fitted)	
	+ 10	Y (extrap-fitted)	
	+ 11	ϑ (extrap-fitted)	
	+ 12	φ (extrap-fitted)	
	+ 13	error on X (extrap-fitted)	
	+ 14	Error on Y (extrap-fitted)	
	+ 15	Error on ϑ (extrap-fitted)	
	+ 16	Error on φ (extrap-fitted)	
	+ 17	Hit pattern for layers: each bit set indicates a layer hit, starting at bit 1 for layer 1.	

LAYER INFORMATION: 10 words per layer, at address J = IP+17+10*(nl-1), nl being the layer number. The format considers the measured values, and is different for MUB and MUF:

Format for **MUB** (and **MUS** *since version 3.13*):

J	+ 1	Submodule ID : TER(2)
	+ 2	χ^2 of the layer
	+ 3	R measured
	+ 4	Rϕ (fit)-Rϕ(meas)
	+ 5	Z(fit)-Z(meas)
	+ 6	Error on Rϕ
	+ 7	Error on **Z**
	+ 8	Rϕ measured
	+ 9	Z measured
	+ 10	Status of the TER bank after EMMASS: 0 = deactive , 1 = active.

Format for **MUF**:

J	+ 1	*Up to version 3.01*: Submodule ID: 100*TER(2) + TER(36) *Since version 3.02*: (new definition of submodule ID in MUFANA) Submodule ID: TER(2)
	+ 2	χ^2 of the layer
	+ 3	**X**fit-Xmeas.
	+ 4	**Y**fit-Ymeas.

	+ 5	**Z** measured
	+ 6	Error on **X**
	+ 7	Error on **Y**
	+ 8	**X** measured
	+ 9	**Y** measured
	+ 10	Status of the TER bank after EMMASS: 0 = deactive , 1 = active.

Since version 2.68:
INFORMATIONS FOR REFIT: 11 words, giving the covariance matrix of the TKX at the reference surface closest to the interaction point.
(T1/T2 stands for Rϕ/Z (MUB), or X/Y (MUF))
At address K = IP + 17 + 10*NLAY:

K	+ 1	T3 fit	|
	+ 2	dT1dT1	|
	+ 3	dT1dT2	|
	+ 4	dT2dT2	|
	+ 5	dT1dϑ	|
	+ 6	dT2dϑ	|→ Covariance matrix of
	+ 7	dϑdϑ	| TKX at closest reference
	+ 8	dT1dφ	| surface to interaction point
	+ 9	dT2dφ	|
	+ 10	dϑdφ	|
	+ 11	dφdφ	|

Since version 3.13 :
Overlapping MUS informations

Then, in event of track having MUB and MUS associated hits, or MUF and MUS associated hits (never MUB and MUF), MUS information follows in the above format, starting at address IS = K+11

IS + 1 Detector ID (same at IP+1)

⋮

PA MODULES
EL MODULE (5)

LENGTH: variable.

This module contains extra informations for EMF and HPC which are not foreseen in the standard calorimetry format. They are intended mainly to help for electron identification.

CONTENT (at address IP)

IP + 0 Label of the module (= 5)

+ 1 NW1 + 100*ID
NW1 is the number of words following,
ID is a detector identifier, 9 = HPC , 26 = EMF

For EMF (NW1 = 10 , format up to version 2.55):

+ 2 Address of the central counter of the shower
+ 3 Energy deposited in the first block.
+ 4 to + 11 Energy in the blocks 2 to 9
The blocks are arranged in the order (in standard X-Y view):

3	2	1
6	5	4
9	8	7

For EMF (new format since version 2.56):
This format allows for up to 3 showers be associated to the track.

+ 2 Shower number + 10.*NWi
NWi is the length of the information which follows for this shower (10 or 19)
+ 3 Address of the central counter of the shower
+ 4 Energy deposited in the first block or ERROR FLAG
+ 5 to + 12 Energy in the blocks 2 to 9 or ERROR FLAG
The blocks are arranged in the order (in standard X-Y view):

3	2	1
6	5	4
9	8	7

ERROR FLAG	- 9999.	Not existing glass
	- 999.	Dead glass
	- 998.	EMFANA killed the glass
	1000.+E	Noisy glass

If NWi>10, there is a second external frame of glasses whose deposited energy are given. The energies are packed as follow:

+13 Unused
+14 E1*1000 + E2
+15 E3*1000 + E4
+16 E5*1000 + E6
+17 E7*1000 + E8
+18 E9*1000 + E10
+19 E11*1000 + E12
+20 E13*1000 + E14
+21 E15*1000 + E16
This second array of blocks are arranged in the following order (in standard X-Y view):

	5	4	3	2	1
	7				6
	9				8
	11				10
	16	15	14	13	12
+2+NWi	As from word +2, for the following shower, if any.				

For HPC (NW1 = 5) :

Up to version 3.12 (approximatively) :

+ 2 "Clara word" = 100*IEL90 + 200*IEL80 + 300*IEL70
(IELn is set to 1 if the particle pass the cut which keeps n% of electrons.
Only the lowest n is set, the others are 0:
100 = loose electron cut
300 = strict cut)

Since version 2.51 (but wrong for versions 2.81 to 2.87):

+ 3 Shower history
+ 4 Mass selection flag
+ 5 Canonical variable for π/e separation
+ 6 χ^2 probability for e identification

From version 3.13 (approximatively) :

+ 2 NINT(α*1000.) + NINT(XMASS)*1000
Where α is the rotation angle of the transverse charge distribution tensor,
XMASS the calculated shower mass
+ 3 Shower history
+ 4 Mass selection flag (γ or π^0 for neutrals, π^+ for charged)
+ 5 NINT(EIG1*10.)*1000. + NINT(XMASS)*1000
Where EIG1 and EIG2 are the eigenvalues of the transverse charge deposition
+ 6 (ILOMAX+10.*ILOSAV)*1000
Where ILOSAV and ILOMAX are the total and accepted local maxima

N.B. A routine PXHPIO in the ELEPHANT package can be used to unpack these words.

PA MODULES
MRIC MODULE (6)

<u>FORMAT UP TO VERSION 2.51</u>:

LENGTH: 23 words

CONTENT (at address IP)

IP + 0 Label of the module (= 6)

Words 1 to 6 for the first radiator

+ 1 Bitted word:
  - bit 1: 0 for Barrel RICH, 1 for Forward RICH
  - bit 2: 0 for liquid, 1 for gas radiator
  - bits 3 to 8: sector number (from 1 to 48)
  - bits 9 to 11: first mirror number (from 1 to 6)
  - bits 12 to 22: Qualification number
+ 2 Bitted word:
  - bits 1 to 7: Electron probability
  - bits 8 to 14: Muon probability
  - bits 15 to 21: Pion probability
+ 3 Bitted word:
  - bits 1 to 7: Kaon probability
  - bits 8 to 14: Proton probability
  - bits 15 to 21: Total number of ?
+ 4 Sum of absolute probabilities
+ 5 Bitted word:
  - bits 1 to 5: Expected number of ? for the best hypothesis (from 0 to 31)
  - bits 6 to 10: Observed number of ? for the best hypothesis (in 3 sigmas)
  - bits 11 to 22: Fited background for the best hypothesis (from 0 to 4095)
+ 6 Mean theta (mrad) + 1000*sigma (1/10 mrad) for the best hypothesis

Words 7 to 12 for the second radiator

+ 7 Bitted word:
  - bit 0: 0 for Barrel RICH, 1 for Forward RICH
  - bit 1: 0 for liqid, 1 for gas radiator
  - bits 3 to 8: sector number (from 1 to 48)
  - bits 9 to 11: first mirror number (from 1 to 6)
  - bits 12 to 22: Qualification number
+ 8 Bitted word:
  - bits 1 to 7: Electron probability
  - bits 8 to 14: Muon probability
  - bits 15 to 21: Pion probability
+ 9 Bitted word:
  - bits 1 to 7: Kaon probability
  - bits 8 to 14: Proton probability
  - bits 15 to 21: Total number of ?
+10 Sum of absolute probabilities
+11 Bitted word:
  - bits 1 to 5: Expected number of ? for the best

hypothesis (from 0 to 31)
bits 6 to 10: Observed number of ? for the best hypothesis (in 3 sigmas)
bits 11 to 22: Fitted background for the best hypothesis (from 0 to 4095)

+12 Mean theta (mrad) + 1000*sigma (1/10 mrad) for the best hypothesis

Track parameters at the entry of RICH
(R=123cm for RIB)

+ 13 Rϕ
+ 14 Z
+ 15 ϑ
+ 16 φ
+ 17 1/P
+ 18 Error on Rϕ
+ 19 Error on Z
+ 20 Error on ϑ
+ 21 Error on φ
+ 22 Error on 1/P

FORMAT FOR VERSION 2.70 UP TO VERSION 2.85:

This format is not to be found anymore.

FORMAT FOR VERSION 2.86 UP to VERSION 3.30:

LENGTH: variable = 1+18 words for gas or/and liquid RICH, +14 words of track information, +1 or 6 words of extension for gas and liquid, +1+3 words per photon in liquid, +1+3 words per photon in gas, +2 words per photon (*since version 3.06*), +2 words (*since version 3.12*)

CONTENT (at address IP)

IP + 0 Label of the module, = 6

Liquid radiator info:

+ 1 Bitted word:
bit 1: 0 for Barrel RICH, 1 for Forward RICH
bit 2: 0 for liquid, 1 for gas radiator
bits 3 to 8: sector number (from 1 to 48 for BRICH, 15° sectors)
(from 1 to 24 for FRICH, 30° sectors)
bits 9 to 11: BRICH: 0 , not used
FRICH: liquid radiator number, from 1 to 3
bits 12 to 22: Qualification number
17 words for liquid radiator follow. If no liquid (bit1=1), those words are skipped.

+ 2 Sum of absolute probabilities (before normalization)
+ 3 Bitted word:
bits 1 to 11: Total number of photons between e and p rings (in $\pm 3\sigma$)
bits 12 to 22: Fitted background for the best hypothesis
+ 4 Bitted word:
bits 1 to 10: $<\theta_c>$ (mrad) for **electron** hypothesis
bits 11 to 20: σ_c (units 0.1 mrad)
+ 5 Bitted word:
bits 1 to 7: Number of photoelectrons within $\pm 3\ \sigma$ (σ =.015)
bits 8 to 14: Number of expected photoelectrons

bits 15 to 22: electron probability (1.%)

+ 6 Bitted word:
bits 1 to 10: Deri. of average Cerenkov angle in mrad/cm+1000
bits 11 to 20: Deri. log prob (.1%) per cm (1000.*DP/P/cm) + 1000

+ 7 Bitted word:
bits 1 to 10: $< \sigma_c >$ (mrad) for **muon** hypothesis
bits 11 to 20: σ_c (units 0.1 mrad)

+ 8 Bitted word:
bits 1 to 7: Number of photoelectrons within $\pm 3\,\sigma$ (σ =.015)
bits 8 to 14: Number of expected photoelectrons
bits 15 to 22: muon probability (1.%)

+ 9 Bitted word:
bits 1 to 10: Deri. of average Cerenkov angle in mrad/cm+1000
bits 11 to 20: Deri. log prob (.1%) per mm (10.*DP/P/cm) + 1000

+10 Bitted word:
bits 1 to 10: $< \theta_c >$ (mrad) for **pion** hypothesis
bits 11 to 20: σ_c (units 0.1 mrad)

+11 Bitted word:
bits 1 to 7: Number of photoelectrons within $\pm 3\,\sigma$ (σ =.015)
bits 8 to 14: Number of expected photoelectrons
bits 15 to 22: pion probability (1.%)

+12 Bitted word:
bits 1 to 10: Deri. of average Cerenkov angle in mrad/cm+1000
bits 11 to 20: Deri. log prob (.1%) per mm (10.*DP/P/cm) + 1000

+13 Bitted word:
bits 1 to 10: $< \theta_c >$ (mrad) for **kaon** hypothesis
bits 11 to 20: σ_c (units 0.1 mrad)

+14 Bitted word:
bits 1 to 7: Number of photoelectrons within $\pm 3\,\sigma$ (σ =.015)
bits 8 to 14: Number of expected photoelectrons
bits 15 to 22: kaon probability (1.%)

+15 Bitted word:
bits 1 to 10: Deri. of average Cerenkov angle in mrad/cm+1000
bits 11 to 20: Deri. log prob (.1%) per mm (10.*DP/P/cm) + 1000

+16 Bitted word:
bits 1 to 10: $< \theta_c >$ (mrad) for **proton** hypothesis
bits 11 to 20: σ_c (units 0.1 mrad)

+17 Bitted word:
bits 1 to 7: Number of photoelectrons within $\pm 3\,\sigma$ (σ =.015)
bits 8 to 14: Number of expected photoelectrons
bits 15 to 22: proton probability (1.%)

+18 Bitted word:
bits 1 to 10: Deri. of average Cerenkov angle in mrad/cm+1000
bits 11 to 20: Deri. log prob (.1%) per mm (10.*DP/P/cm) + 1000

Gas radiator info:

At address N0 = IP+18 if liquid info is there,
N0 = IP+ 1 if no liquid (see IP+1)

N0 + 1 Bitted word:
bit 1 : 0 for Barrel RICH, 1 for Forward RICH
bit 2 : 0 for liquid, 1 for gas radiator
bits 3 to 8 : sector number (from 1 to 48 for BRICH, 15° sectors)
(from 1 to 24 for FRICH, 30° sectors)

bits 9 to 11 : first mirror number (from 1 to 6 for BRICH)
(from 1 to 5 for FRICH)
bits 12 to 22 : Qualification number

17 words for gas radiator follow. If no liquid (bit1=1), those words are skipped.

+ 2 Sum of absolute probabilities (before normalization)

+ 3 Bitted word:
bits 1 to 11 : Total number of photons between e and p rings (in $\pm 3\sigma$)
bits 12 to 22 : Fitted background for the best hypothesis

+ 4 Bitted word:
bits 1 to 10 : $< \theta_c >$ (mrad) for **electron** hypothesis
bits 11 to 20 : σ_c (units 0.1 mrad)

+ 5 Bitted word:
bits 1 to 7 : Number of photoelectrons within $\pm 3\ \sigma$ (σ =.005)
bits 8 to 14 : Number of expected photoelectrons
bits 15 to 22 : Electron probability (1.%)

+ 6 Bitted word:
bits 1 to 10 : Deri. of average Cerenkov angle in mrad/cm+1000
bits 11 to 20 : Deri. log prob (.1%) per mm (10.*DP/P/cm) + 1000

+ 7 Bitted word:
bits 1 to 10 : $< \theta_c >$ (mrad) for **muon** hypothesis
bits 11 to 20 : σ_c (units 0.1 mrad)

+ 8 Bitted word:
bits 1 to 7 : Number of photoelectrons within $\pm 3\ \sigma$ (σ =.005)
bits 8 to 14 : Number of expected photoelectrons
bits 15 to 22 : muon probability (1.%)

+ 9 Bitted word:
bits 1 to 10 : Deri. of average Cerenkov angle in mrad/cm+1000
bits 11 to 20 : Deri. log prob (.1%) per mm (10.*DP/P/cm) + 1000

+10 Bitted word:
bits 1 to 10 : $< \theta_c >$ (mrad) for **pion** hypothesis
bits 11 to 20 : σ_c (units 0.1 mrad)

+11 Bitted word:
bits 1 to 7 : Number of photoelectrons within $\pm 3\ \sigma$ (σ =.005)
bits 8 to 14 : Number of expected photoelectrons
bits 15 to 22 : pion probability (1.%)

+12 Bitted word:
bits 1 to 10 : Deri. of average Cerenkov angle in mrad/cm+1000
bits 11 to 20 : Deri. log prob (.1%) per mm (10.*DP/P/cm) + 1000

+13 Bitted word:
bits 1 to 10 : $< \theta_c >$ (mrad) for **kaon** hypothesis
bits 11 to 20 : σ_c (units 0.1 mrad)

+14 Bitted word:
bits 1 to 7 : Number of photoelectrons within $\pm 3\ \sigma$ (σ =.005)
bits 8 to 14 : Number of expected photoelectrons
bits 15 to 22 : kaon probability (1.%)

+15 Bitted word:
bits 1 to 10 : Deri. of average Cerenkov angle in mrad/cm+1000
bits 11 to 20 : Deri. log prob (.1%) per mm (10.*DP/P/cm) + 1000

+16 Bitted word:
bits 1 to 10 : $< \theta_c >$ (mrad) for **proton** hypothesis
bits 11 to 20 : σ_c (units 0.1 mrad)

+17 Bitted word:
bits 1 to 7 : Number of photoelectrons within $\pm 3\ \sigma$ (σ =.005)

bits 8 to 14 : Number of expected photoelectrons
bits 15 to 20 : proton probability (1.%)

+18 Bitted word:
bits 1 to 10 : Deri. of average Cerenkov angle in mrad/cm+1000
bits 11 to 20 : Deri. log prob (.1%) per mm (10.*DP/P/cm)+ 1000

Track parameters at the entry of RICH

At address N1 = N0+18 if gas info is there,
N1 = N0+ 1 if no gas (see N0+1)

Either Barrel-RICH (R=123.cm):

N1	+ 1	Rϕ
	+ 2	Z
	+ 3	ϑ
	+ 4	φ
	+ 5	1/P
	+ 6	Squared error on Rϕ, $\sigma^2_{R\phi}$
	+ 7	Squared error on Z, σ^2_z
	+ 8	Squared error on ϑ, σ^2_θ
	+ 9	Squared error on φ, σ^2_φ
	+ 10	Squared error on 1/P, $\sigma^2_{1/p}$
	+ 11	X coordinate (from extrapolation)
	+ 12	Y coordinate (from extrapolation)
	+ 13	Z coordinate (from extrapolation)
		Up to version 3.02:
	+ 14	Same Z as in (N1+13), but coming from RICH dE/dx
		Since version 3.03:
	+ 14	Same X as in (N1+11), but coming from RICH dE/dx
	+ 15	Same Y as in (N1+12), but coming from RICH dE/dx
	+ 16	Same Z as in (N1+13), but coming from RICH dE/dx

Or forward-RICH (|Z| = 172.cm):

N1	+ 1	X
	+ 2	Y
	+ 3	ϑ
	+ 4	φ
	+ 5	1/P
	+ 6	Squared error on X, σ^2_x
	+ 7	Squared error on Y, σ^2_y
	+ 8	Squared error on ϑ, σ^2_θ
	+ 9	Squared error on φ, σ^2_φ
	+ 10	Squared error on 1/P, $\sigma^2_{1/p}$
	+ 11	X coordinate when leaving the drift tube (X_track)
	+ 12	Y coordinate when leaving the drift tube (Y_track)
	+ 13	Z coordinate when leaving the drift tube (Z_track)
	+ 14	unused
		Since version 3.03:
	+ 15	unused
	+ 16	unused

DST extension, global part

Liquid radiator part

	At address N2 = N1+14 (or N1+16 since version 3.03)	
N2 + 1	Refractive index for liquid (0 if no liquid information)	
+ 2	Number of expected photons, e hypothesis	
+ 3	Number of expected photons, μ hypothesis	
+ 4	Number of expected photons, π hypothesis	
+ 5	Number of expected photons, K hypothesis	
+ 6	Number of expected photons, p hypothesis	

Gas radiator part

	At address N3 = N2+6 if liquid, else N3 = N2+1	
N3 + 1	Refractive index for gas (0 if no gas information)	
+ 2	Number of expected photons, e hypothesis	
+ 3	Number of expected photons, μ hypothesis	
+ 4	Number of expected photons, π hypothesis	
+ 5	Number of expected photons, K hypothesis	
+ 6	Number of expected photons, p hypothesis	

Up to version 3.05, and since version 3.12:

	At address N4 = N3+7 if gas, else N4 = N3+2	
N4 + 0	Number of points around the track in a cylinder of 2 cm. (only for use of barrel RICH)	
	Since version 3.06, and up to 3.11:	
	At address N4 = N3+6 if gas, else N4 = N3+1	

DST extension, photon first part

	At address N4	
N4 + 1	NPL, number of photons from the liquid radiator	
	Then for each photon IPL (IPL=1,NPL), at address NL= N4+IPL+1	
NL + 0	Bitted word:	
	bits 1 to 10 : Cerenkov angle θ_C	(mrad)
	bits 11 to 16 : Error on the Cerenkov angle: $2 \times \sigma_\theta$	(mrad)
	bits 17 to 22 : Position of the photon on the Cerenkov ring $10\times$ ϕ_C	(rad)
	At address N5 = N4+NPL+1	
N5 + 1	NPG, number of photons from the gas radiator	
	Then for each photon IPG (IPG=1,NPG), at address NG = N5+IPG+1	
NG + 0	Bitted word:	
	bits 1 to 10 : Cerenkov angle per photon θ_C	(mrad)
	bits 11 to 16 : Error on the Cerenkov angle: $2 \times \sigma_\theta$	(mrad)
	bits 17 to 22 : Position of the photon on the Cerenkov ring: $10\times$ ϕ_C	(rad)

Since version 3.06:

DST extension, photon second part

	At address N6 = N5+NPG+1	
	For each photon from liquid,IPL (IPL=1,NPL), at address NL= N6+IPL	
NL + 0	Bitted word:	
	bits 1 to 10 : Photon identification : ID= 5*IDsec + Dsec + 2	
	(IDsec = unique identifier in a 15° sector,	
	Dsec = sector number relative to the track entry point)	
	bits 11 to 17 : Conversion probability	(%/cm)
	bit 18 (for BRICH) : Member of a $R\phi$ cluster	
	bit 19 (for BRICH) : at least 2 other hits are close to this hit	

At address N7 = N6+NPL+1
For each photon from Gas, IPG (IPG=1,NPG), at address NG = N7+IPG

NG + 0 Bitted word:
bits 1 to 10 : Photon identification : ID= 5*IDsec + Dsec + 2
(IDsec = unique identifier in a 15° sector,
Dsec = sector number relative to the track entry point)
bits 11 to 17 : Conversion probability (%/cm)
bit 18 (for BRICH) : Member of a $R\phi$ cluster
bit 19 (for BRICH) : at least 2 other hits are close to this hit

Since version 3.12:

DST extension, selected volume in the detector

At address N8 = N7+NPG

N8 + 1 Volume selected for the liquid analysis
+ 2 Volume selected for the gas analysis

FORMAT SINCE VERSION 3.30:

LENGTH: variable = 1 + 4 words for gas or/and 4 words for liquid RICH, +17 words of track information.

CONTENT (at address IP)

IP + 0 Label of the module, = 6

Liquid radiator info:

+ 1 Refractive index
If no liquid radiator info, this word is =0, and N_{liq}=1, else N_{liq}=4
+ 2 Sum of absolute probabilities
+ 3 Selected volume in the drift box
+ 4 **BRICH**:R of the emission point; **FRICH**:Z of the emission point

Gas radiator info:

At address IP2 = IP+N_{liq}:

IP2 + 1 Refractive index
If no gas radiator info, this word is =0, and N_{gas}=1, else N_{gas}=4
+ 2 Sum of absolute probabilities
+ 3 Selected volume in the drift box
+ 4 **BRICH**:R of the emission point; **FRICH**:Z of the emission point

Track parameters at RICH entry

At address IP3 = IP2 + N_{gas}

Either Barrel-RICH (R=123.cm):

IP3 + 1 Rϕ
+ 2 Z
+ 3 ϑ
+ 4 φ
+ 5 1/P
+ 6 Squared error on Rϕ, $\sigma^2_{R\phi}$

	+ 7	Squared error on Z, σ_z^2
	+ 8	Squared error on ϑ, σ_ϑ^2
	+ 9	Squared error on φ, σ_φ^2
	+ 10	Squared error on 1/P, $\sigma_{1/p}^2$

Or forward-RICH (|Z| = 172.cm):

IP3	+ 1	X
	+ 2	Y
	+ 3	ϑ
	+ 4	φ
	+ 5	1/P
	+ 6	Squared error on X, σ_x^2
	+ 7	Squared error on Y, σ_y^2
	+ 8	Squared error on ϑ, σ_θ^2
	+ 9	Squared error on φ, σ_φ^2
	+ 10	Squared error on 1/P, $\sigma_{1/p}^2$

Track coordinates at exit of the sensitive volume

IP3	+ 11	X (from extrapolation)
	+ 12	Y (from extrapolation)
	+ 13	Z (from extrapolation)
	+ 14	X (from ionization)
	+ 15	Y (from ionization)
	+ 16	Z (from ionization)
	+ 17	Number of hits from ionization

PA MODULES
MTPC MODULE (7)

LENGTH: variable

CONTENT (at address IP)

IP + 0	Label of the module , = 7	
+ 1	dE/dx measured in the TPC: Mean value of the 80% lowest amplitudes, normalised to 1. for Minimum Ionizing Particles. (Computed with maximum amplitudes)	
+ 2	Sigma of the Landau distribution	

The following two words are there only for historical reason.

+ 3	Flag telling if the track has seen a shower in the OD	
+ 4	"HPC flag" (last word of HPC TER)	
+ 5	NEXTPC, number of words (including this wordcount) in the TER extension of the TPC, dedicated to dE/dx.	(14)
+ 6	Number of pad points in the track + 100*TPC sector number of the start of the track + 10000*TPC sector number of the end of the track	
+ 7	*Up to version 304:* Number of wires crossed by the track *Since version 305:* 1000*Number of wires crossed by the track + number of hit wires	
+ 8	Number of wires used in the dE/dx	
+ 9	Number of saturated hits inside the truncation	

Up to version 304:

+ 10	Mean width of the time clusters	
+ 11	65% dE/dx (Integrated amplitudes)	
+ 12	80% dE/dx (Integrated amplitudes)	
+ 13	Average gap	
+ 14	R.m.s. of the gaps	
+ 15	Mean sin^2 of the angle of the track with the wires.	
+ 16	Mean distance to sector edge. *Since version 2.52*:	
+ 17	Mean drift distance of the track	
+ 18	TPC pressure.	

From version 3.05 up to version 3.31:

+ 10	Average gap	(cm)
+ 11	Average distance of the track to the edges of the sector, in Rϕ plane.	(cm)
+ 12	TPC pressure	(mbar)
+ 13	Normalization factor used to convert the integrated amplitude measurement to normalized dE/dx	(around 200.-250.)
+ 14	Ratio between normalization factors used for the integrated amplitude (given in +13) and for the maximum amplitude measurement	
+ 15	Number of wires used in the Z fit of the track	
+ 16	χ^2 of the Z fit	
+ 17	80% dE/dx (Integrated amplitudes) (*wrong (=0.) up to version 3.15*)	
+ 18	Track bit pattern : Bits 1-16 : pad rows hit by the track (row A =bit 1, ..., row P = bit 16) Bits 17-20 : For flagged V^0: Number of the first hit pad row 0 means no V^0 detected with this track	(1-15)

Since version 2.60:

Two user routines are provided in PXDST first, then in HADIDENT, to cope with different versions of dE/dx analysis on the DST:

PXDMTP(IP,DEDX,SIGM,NWIR) returns the DEDX normalised value (Minimum Ionising particles at 1.), the sigma of the distribution and the number of wires (-1 if not available) used in the analysis, for DELANA_D processing of '91 data (production with version $<$ 2.68).

PXDEDX(P,M,DEDX,DSURP) returns the expected DEDX normalised value for a given mass M and momentum P, together with the derivative of DEDX with respect to P.

Since version 2.83:

PXEMTP(IP,DEDX,SIGM,NWIR,ERROR) returns the DEDX normalised normalised value (Minimum Ionising particles at 1.), the sigma of the distribution and the number of wires (-1 if not available) used in the analysis, for DELANA_E processing of '91 data (production with version $\geq$ 2.68). The error flag (0.=OK) is set to -1 if it is called for an older version of DST.

This routine is called by PXDMTP for the DST produced by 91'DELANA_E.

FORMAT SINCE VERSION 3.32:

IP	+ 0	Label of the module	(7)
	+ 1	dE/dx measured in the TPC: Mean value of the 80% lowest amplitudes, normalised to 1. for Minimum Ionizing Particles. (Computed using maximum amplitudes of the clusters)	
	+ 2	Sigma of the 80% truncated Landau distribution	
	+ 3	Same as +1, with truncation to 65 %	
	+ 4	Same as +2, with truncation to 65 %	
	+ 5	Same as +1, but using integrated amplitudes of the clusters	
	+ 6	Number of pad points in the track + 100*TPC sector number of the start of the track + 10000*TPC sector number of the end of the track	
	+ 7	Number of wires crossed by the track + 1000*number of hit wires, with a "close cluster" + 1000000*method (1=good hit only, 2=include hits from the edge)	
	+ 8	Total number of wires used +1000*number of usable hits at the TPC edge	
	+ 9	Number of wires with saturated amplitude (before truncation) +1000*number of empty hits kept	
	+ 10	Average gap (after 80 % truncation)	
	+ 11	Mean distance to the sector edge (after 80 % truncation)	
	+ 12	Number of wire hits used in the Z fit of the track	
	+ 13	χ^2 of the Z fit	
	+ 14	Track bit pattern for V^0: Bits 1-16 : pad rows hit by the track (row A =bit 1, . . . , row P = bit 16) Bits 17-20 : For flagged V^0: Number of the first hit pad row 0 means no V^0 detected for this track	(1-15)
	+ 15	Average distance in Z between the wire clusters	
	+ 16	Mean dE/dx associated to the empty hits (maximum amplitudes)	
	+ 17	First and last wire seen by the track, with the sector number (non empty wires, selected or not) : bits 1- 8 : first wire	

bits 9-13 : first sector
bits 14-21 : last wire
bits 22-26 : last sector
\+ 18 Average undershoot correction (for the full Landau distribution)

Then follow informations needed to compute all moments up to the 3rd order of the full Landau distribution, calculated with maximum amplitudes.

\+ 19 $< dEdx/corgap >$
\+ 20 $< dEdx/\sqrt{corgap} >$
\+ 21 $< dEdx^2/corgap >$
\+ 22 $< dEdx/corgap^{1/3} >$
\+ 23 $< dEdx^2/corgap^{2/3} >$
\+ 24 $< dEdx^3/corgap >$

The words 25 to 28 are there only when overlapping between two tracks occur.
A check on the blocklet size is needed to ensure their presence.
Two possible meanings are possible for words +25 to +27, depending on the sign of the word +28:

If word +28 is positive:

\+ 25 Number of hits kept which are common to two tracks
+1000*number of saturated hits in the full Landau
\+ 26 dE/dx of the full Landau using the hits common to two tracks
\+ 27 Sigma of the full Landau using the hits common to two tracks

If word +28 is negative:

\+ 25 Average gap of the clusters contributing to the 80% lowest amplitudes
\+ 26 dE/dx of the 80% truncated distribution of the hits common to two tracks
\+ 27 Sigma of the 80% truncated distribution of the hits common to two tracks

\+ 28 (Current track index
+1000*index of the track with hits common to the current one)
*(+1 or -1), depending on the meaning to attribute to words +25 to +27

PA MODULES
TRAC MODULE (8)

LENGTH: 21 words

This module is needed for the use of the routine PXFVRT which compute the intersection point of a given number of tracks.

CONTENT (at address IP)

IP	+ 0	Label of the module , =8
	+ 1 to 5	Parameters of the track at the perigee
	+ 6 to 20	Weight matrix for those parameters

PA MODULES
TOF MODULE (9)

LENGTH : 9 words

CONTENT (at address IP)

IP + 0 Label of the module , = 9
+ 1 Detector identifier
+ 2 Counter number
+ 3 Rϕ coordinate
+ 4 Z coordinate
+ 5 Time of flight
+ 6 Error on Time of flight
For data before 1995:
+ 7 =External TDC + 256*(external ADC)
+ 8 =Internal TDC + 256*(internal ADC)
For data since 1995:
+ 7 =External TDC + 8192*(external ADC)
+ 8 =Internal TDC + 8192*(internal ADC)
Since version 2.55:
+ 9 Extrapolated Z coordinate

Since version 2.67:
+10 Time of flight measured with TDC multihit
+11 Third level trigger information (T3 level):
1. = Cosmic
2. = Unknown
3. = Z^0

Since version 2.82:
+10 TOF quality flag
+11 *For data before 1995:*
=(TOF measurement with MultiHit TDC) + 1024*(T3 level)
For data since 1995:
Codification of the second hit in the TDC-MH channel
= (TDCext(1st hit) - TDCext(2nd hit))
+ 8192*(TDCint(1st hit) - TDCint(2nd hit))
(This word is there if a second hit not later than 100 ns after the first one is detected in a given channel.)

PA MODULES
TDHA MODULE (11)

LENGTH: variable

This module contains individual TD info for hadronic calorimeter data associated to an isolated track. It is specially intended for a better identification of muons.

The coordinates given in this module are either at constant R, for Barrel, or at constant Z, for End-caps.

CONTENT (at address IP)

IP	+ 0	Label of the module, = 11
	+ 1	NLAY , number of layers in HCAL
		For each layer, the first at address JL = IP+1:
JL	+ 1	Length of the data block for this layer = 9+4*NTD
	+ 2	Layer number
	+ 3	Location: 0. = Barrel , 1. = End-cap
	+ 4	X/R |
	+ 5	Y/Rϕ |
	+ 6	Z | –> For the extrapolated track
	+ 7	ϑ |
	+ 8	φ |
	+ 9	NTD, number of associated TD's in this layer
		For each associated TD: the first at address JT= JL+9:
JT	+ 1	X/R
	+ 2	Y/Rϕ
	+ 3	Z
	+ 4	E

PA MODULES

TEID MODULE (12)
TETP MODULE (13)
TEOD MODULE (14)
TEFB MODULE (16)
TERF MODULE (21)
TEST MODULE (41)
TEVF MODULE (42)

LENGTH : variable.

Those modules contains extra informations from the TER's associated to the TK of the track.

CONTENT (at address IP)

IP	+ 0	Label of the module, =12 for Inner Detector	
		13 for T.P.C.	
		14 for Outer Detector	
		15 for F.C.A.	
		16 for F.C.B.	
		21 for Forward RICH	(*since version 3.18*)
		41 for Straw tubes	(*since version 3.34*)
		42 for Very Forward Tracker	(*since version 3.36*)
		Since version 2.87: to this label is added the quantity 0.1*stage, where stage is 1 or 2, defining the stage at which the TE was created. A particular case is for ID: stage 1 (label 12.1) means jet chamber TE, and stage 2 (label 12.2) means trigger layer TE.	
	+ 1	Data descriptor of the TE + Measurement code	
	+ 2	Coordinate 1	<TER(10)>
	+ 3	Coordinate 2	<TER(11)>
	+ 4	Coordinate 3	<TER(12)>
	+ 5	ϑ	<TER(13)>
	+ 6	φ	<TER(14)>
	+ 7	1/P or 1/Pt at reference point	<TER(15)>
	+ 8 to m+7	Error matrix on the measured quantities. The number of elements depends on what is measured, as given by the measurement code	
		Since version 2.51:	
	m+ 8	Number of degrees of freedom	
	m+ 9	χ^2	
	m+10	Length of the track	

PA MODULES
TDID MODULE (17)

LENGTH: 24 words

This module is filled for tracks useful for the Inner Detector calibration: momentum above 2. GeV/c, TE in TPC and in ID jet part.
This module is introduced *since version 2.64*

CONTENT (at address IP)

IP	+ 0	Label of the module , = 17
	+ 1	I.D. jet sector number, which contains the track. The sign of this number is related to the drift direction: + for clockwise, - for anti-clockwise. Then for each wire iw (1 to 24):
	+ 1+iw	Raw drift time for the wire. If this time is not available in the TD, a "scaled" drift time is given, with a minus.sign.

PA MODULES
SAT MODULE (18)

LENGTH: variable, = 2 +NS*(2+3*NDET) , where:
NS is the number of associated showers
NDET is the number of SAT detector in each shower.
(This number is shower dependent, then the total length is in fact: 2 + NS(2+3*NDET(is)), is being the shower index)

This module is introduced since version 2.84

CONTENT (at address IP)

IP	+ 0	Label of the module, = 18
	+ 1	NS, number of associated showers

Then for each shower, the first at address J=IP+1

J	+ 1	Length of this shower information block
	+ 2	Z coordinate of the shower
	+ 3	R coordinate of detector 1 contributing to the shower
	+ 4	Rϕ coordinate of detector 1 contributing to the shower
	+ 5	Energy in detector 1 contributing to the shower
	⋮	
	+ 3*(IDET-1) + 3	R coordinate of detector IDET contribution
	+ 3*(IDET-1) + 4	Rϕ coordinate of detector IDET contribution
	+ 3*(IDET-1) + 5	Energy in detector IDET contribution

PA MODULES
STIC MODULE (19)

LENGTH: variable, $= 3 + \sum_{i=1}^{NS}(9 + NASS_i + 2 * NH_i)$, $i = 1, NS$ being the shower index.
Since version 3.18: Length $= 3 + \sum_{i=1}^{NS}(10 + NASS_i + 2 * NH_i + 17)$

Where $NASS_i$ is the length of associated showers list;
NH_i is the number of hits for i-th shower;
NS is the total number of showers detected.

This module is introduced since version 3.07

CONTENT (at address IP)

IP +0 Label of the module, = 19
+1 Number of showers detected, NS
+2 STIC trigger bits (packed word):
Bhabha + 4*Single arm forward + 16*Single arm backward +
64*Multiplicity bits forward + 256*Multiplicity bits backward

Then for each shower, at address J, the first shower being at J = IP + 2:

J +1 Length of this shower information block: $9 + (NA_i - 1)/2 + 1 + 2 * NH_i$
Since version 3.18: $10 + (NA_i - 1)/2 + 1 + 2 * NH_i + 4$
+2 Sub-detector identifier:
1 for calorimeter part for positive Z and 2 for negative;
3 for first silicon layer for positive Z and 4 for second layer;
5 for first silicon layer for negative Z and 6 for second layer;
7 for veto detector for positive Z and 8 for negative.

Then shower descriptor (two packed words):
+3 $FLOAT(IS_i + 1000 * NH_i)$
IS_i is the shower identifier (it is an integer value from 1 to 999);
NH_i is the number of hits for this shower.
+4 $FLOAT(IQ_i + 1000 * NA_i)$
IQ_i is the quality flag for this shower:
0 - for good (separated) shower, 1 - for cluster, 2 - for bad shower.
NA_i is number of showers from another sub-detectors associated with the current one.

+5 Energy of this shower (GeV)
+6 R (cm)
+7 $R * \phi$ (cm * radian)
+8 Z (cm)
+9 Mass identifier from DELANA
Since version 3.18:
+10 Charge identifier from the Veto Counter:
0=neutral; 3=positive or negative; 4=no Veto identification

Then for this shower: List of showers from another sub-detectors associated with the current one. The size of this list is $NASS_i = \mathrm{INT}((\mathrm{NA_i} - 1)/2 + 1)$ word(s). $NASS_i$ is zero if no associated shower exists.
Each word is packed in the following way:
At address JS=J+9 (*since version 3.18*, JS=J+10):

JS +1 $FLOAT(IS_1 + 1000 * IS_2)$ where IS_1 and IS_2 are identifiers of associated showers;

+2 (if exists) $FLOAT(IS_3 + 1000 * IS_4)$ where IS_3 and IS_4 are identifiers of associated showers.

and so on for IS_i going from 1 to NA_i.

Then for each calorimeter hit for this shower ($nc = 1, NH_i$ being the hit index):

JS $+NASS_i + 2 * (nc - 1)$+1 Energy deposited for this hit (GeV);

+2 $IPHI + ITHE * 100$ for this hit, where $IPHI$ is this hit ϕ number and $ITHE$ is this hit θ number (tower units).

SINCE VERSION 3.18:

The Veto counter and silicon strips data are added:

Then the Veto counter data for this shower, at address K = JS + 2 * NH_i:

$K + 1$ Numbers of three Veto counters(in the 1-st Veto plane) which are associated to the current calorimeter shower. These numbers are packed in the following way: $N_{left} + 100. * N_{center} + 10000. * N_{right}$. Here N_{center} is the number of the central Veto counter which corresponds to the given calorimeter shower. N_{left} and N_{right} are the numbers of it's neighbours. This word is zero if no Veto counter information is available.

Then Veto counter signals (after a pedestal subtraction and 3σ cut) for six sectors: three sectors from each plane ($S^1_{left}, S^1_{center}, S^1_{right}$ for the first plane and $S^2_{left}, S^2_{center}, S^2_{right}$ for the second one); to put two signals into one word all data are limited at the level of 999 ADC counts.

$K + 2$ 1000. * S^1_{left} + S^1_{center}
3 1000. * S^1_{right} + S^2_{left}
4 1000. * S^2_{center} + S^2_{right}

Then 5 data words from additional Veto counter sub-detectors (Small veto counter and the second ADC). This information is absent at the DST for 1994-95 data taking (for runs < 64800).

$K + 5$ $1000. * S^1_{small} + S^2_{small}$ signals from the Small veto counter in the correspondent arm for the 1-st ADC (data are limited at the level of 999 ADC counts)
6 1000. * S^1_{left} + S^1_{center} for the 2-nd Veto ADC
7 1000. * S^1_{right} + S^2_{left} for the 2-nd Veto ADC
8 1000. * S^2_{center} + S^2_{right} for the 2-nd Veto ADC
9 $1000. * S^1_{small} + S^2_{small}$ for the 2-nd Veto ADC

Then the silicon strips data for two clusters associated with this calorimeter shower, at address S = K + 4 or K+9:

$S+1$	Silicon reconstruction flag: $N_1 + 100 \times N_2$. Here N_1 is the total number of silicon clusters in the 1-st silicon plane associated with the current calorimeter shower and N_2 is the same number for the 2-nd silicon plane.
then	(if $N_1 > 0$ or $N_2 > 0$) for the most energetic silicon cluster associated with the calorimeter shower:
$+2$	θ angle reconstructed by the 1-st silicon plane
$+3$	φ angle reconstructed by the 1-st silicon plane
$+4$	Maximum signal in the 1-st silicon plane cluster
$+5$	θ angle reconstructed by the 2-nd silicon plane
$+6$	φ angle reconstructed by the 2-nd silicon plane
$+7$	Maximum signal in the 2-nd silicon plane cluster
then	(if $N_1 > 1$ or $N_2 > 1$) for the second energetic silicon cluster associated with the calorimeter shower:
$+8$	θ angle reconstructed by the 1-st silicon plane
$+9$	φ angle reconstructed by the 1-st silicon plane
$+10$	Maximum signal in the 1-st silicon plane cluster
$+11$	θ angle reconstructed by the 2-nd silicon plane
$+12$	φ angle reconstructed by the 2-nd silicon plane
$+13$	Maximum signal in the 2-nd silicon plane cluster

PA MODULES
TRAX MODULE (20)

LENGTH: variable

This module contains some informations from track extrapolation:
- at first measured point
- the extrapolation surface directly in front of it
- on the named detectors

Points are arranged in the order of increasing R (barrel) or $\mid Z \mid$ (endcap), with barrel points first

This module is introduced since version 3.31

CONTENT (at address IP)

IP +0 Label of the module, = 20
+1 Number of extrapolated surfaces on which a point is given (NSURFX)
Then at address JPNT1 = IP+2:
JPNT1 +0 Number of following words for the first point, NDAT1 (=8 or 23)
+1 ID of the corresponding detector
+2 Coordinate system flag, IBAR: 1 for R-Rϕ-Z, 0 for X-Y-Z
+3 R (or X) coordinate
+4 Rϕ (or Y) coordinate
+5 Z coordinate
+6 θ of the track
+7 φ of the track
+8 signed 1/P
+9 to +18 : 15 words of covariance matrix for MUB/MUF/MUS, only if there is any associated signal in MU detectors.
Then at address JPNT2 = JPNT1+NDAT1+1:
JPNT2 +0 Number of following words for the second point, NDAT2 (=8 or 23)
+1 ID of the corresponding detector
⋮
JPNTL +0 Number of following words for the last point, NDATL (=8 or 23)
⋮
JPNTL+NDATL+1 = 0, end of the point list

SH BANK

0 Structural link
n Reference link
N data

Link LQSH = LQ(LDTOP-3)

DATA CONTENT

This bank contains the complete SH structure (Simulation History) from the simulation. See the DELSIM manual for a complete description.

The links from SH to PA and reverse have been re-established *since version 2.68*

LQ(LQSH-4) points to the simulated PA bank
LQ(LQPA-3) points to the generated SH bank (LQPA is a simulated PA)

INITIAL e^+e^- BANK
FINAL e^+e^- BANK
$l\bar{l}/q\bar{q}$ BANK

0 Structural link
0 Reference link
9 data

Link LQINEE = LQ(LDTOP-4)
Link LQFIEE = LQ(LDTOP-5)
Link LQFFB = LQ(LDTOP-6)

DATA CONTENT

Each of those banks contains 9 words directly copied from words 3 to 11 of the SI banks (Simulation Initial state).

LQ...	+ 1	= PX
	+ 2	= PY
	+ 3	= PZ
	+ 4	= E
	+ 5	= P
	+ 6	= $\cos(\vartheta)$
	+ 7	= φ
	+ 8	= Code for particle 1
	+ 9	= Code for particle 2

TE BANK

0	Structural link
4	Reference link
19	data (I)

Link LQDETE = LQ(LDTOP-7)

DATA CONTENT

Each (integer) word contains the number of TE's reconstructed by each detector/ module in the event:

+ 1	VD
+ 2	ID
+ 3	TPC
+ 4	RIB
+ 5	OD
+ 6	HPC
+ 7	TOF
+ 8	HAC
+ 9	MUB
+ 10	FCA
+ 11	RIF
+ 12	HAF
+ 13	SAT
+ 14	LUM
+ 15	FCB
+ 16	EMF
+ 17	HOF
+ 18	MUF
+ 19	CCA

TRIGGER BANK

0	Structural link
0	Reference link
N	data

Link LQTR = LQ(LDTOP-8)

DATA CONTENT

This bank is a copy of the trigger block pending in the Raw Data structure. The creation of this bank is activated by the data card :

TRIGG TRUE

No description of the block is available yet.

VD points BANK

0	Structural link
4	(*up to version 2.51*), or 1 (*after 2.51*) Reference link
	or NHIT (*since 2.85*) reference links
N	data,
	or (*since 2.85*) 10*NHIT data (I-9F)
	or (*since 3.11*) 13*NHIT data (I-12F)

Link LQTDVD = LQ(LDTOP-9)

FORMAT UP TO VERSION 2.51:

LINKS:

0	Next TD point
-1	PA bank associated to the TDR (if word 3 is equal to 2)
-2 to -4	Other associated TD points (if word 4 is not equal to 0.)

LQTDVD points to a linear chain of banks, each bank containing data from one active TDR

DATA CONTENT

+ 1	Submodule identifier = 4000 + 100*layer + sector	<TDR(2)>
+ 2	TANAGRA identifier of the TDR bank	
+ 3	Type of link in which this TDR is involved: 0 = The TDR is not connected to any other link 1 = The TDR is associated to at least 1 other TDR in a TE not associated to a charged track 2 = The TDR is associated to a charged track	
+ 4	NTD-1, Number of other TDR associated to this TDR	
+ 5	R coordinate	<TDR(11)>
+ 6	Rϕ coordinate with the sign of Z	<TDR(12)>
+ 7	Error on R	<TDR(14)>
+ 8	Error on Rϕ	<TDR(15)>
+ 9	Pulse height	<TDR(17)>
+10	Local coordinate value	<TDR(18)>
+11	NST, Number of strips in the cluster. (up to 11)	<TDR(19)>
+12	First strip number (from 2 to 1152).	<TDR(20)>
+13	to N: One packed word for each strip of the cluster. There is NST such words. If some strips are missing, they are attributed the word -99999. Content: 32*(ADC count) + (Noise)/1000. The value of Noise is limited to 999. and has the sign of (ADC count)	

FORMAT SINCE VERSION 2.52 UP TO VERSION 2.84

LINKS:

0 Next TD point
-1 PA bank associated to the TDR (if word 4 is greater or equal to 0)

LQTDVD points to a linear chain of banks, each bank containing data from one active TDR

DATA CONTENT

+ 1 Submodule identifier = 5000 + 100*layer + sector <TDR(2)>
+ 2 TANAGRA identifier of the TDR bank
+ 3 Packed word : 10000*NST + NFST
NST is the number of strips above the threshold in the cluster <TDR(7)>
NFST is the channel number of the first strip in the cluster <TDR(9)>
+ 4 Number of other TDR's associated with this one via a TK.
Special cases: = 0 if the TDR is associated with a TK as single hit.
=-1 if no TK is associated
The following coordinates are taken from the TE if
there is an associated TK, else it is taken from the
TDR (in this case Z is put at the center of the module).
+ 5 R coordinate
+ 6 Rϕ coordinate with the sign of Z
+ 7 Z coordinate
+ 8 Error on Rϕ <TDR(15)>
+ 9 Signal/noise ratio for the cluster <TDR(17)>
+10 Local X-coordinate value <TDR(18)>
+11 NSTRIP Number of strips in the cluster <TDR(19)>
+12 Depletion voltage <TDR(8)>
Individual strip informations (2 words per strip):
+13 to 12+NSTRIP:
Packed PH (Pulse Height) and Noise:
= SIGN(PH)*(ABS(PH) + MIN(Noise,999)/1000)
+13 +NSTRIP to 12+2*NSTRIP :
Packed pedestal PE and strip status STA:
= IFIX(PE) + MIN(STA+1.,99.)/100.

<u>*FORMAT SINCE VERSION 2.85*</u>:

LINKS:

- NH PA bank, if any (else 0) associated to the hit number NH

LQTDVD points to a single bank containing 10 data words for each active TDR. The number of hits is given by NHIT = (IQ(LQTDVD-1)-1)/NWPH
Informations concerning Z are present since version 3.11

DATA CONTENT

LQTDVD+ 1 (VD version number)*1000 + NWPH (number of words per hit,
= 10 up to version 3.10, 13 since 3.11)

Then for hit NH, (NH= 1 to NHIT), at address LTH=LQTDVD+1+(NH-1)*NWPH:
LTH + 1 INTEGER: 1000*(DSP channel number of first strip) + Module number (with sign of Z)
+ 2 R coordinate (from TE if associated);
the sign indicates Rϕ (+), or RZ (-) hit.
+ 3 Rϕ coordinate with sign of Z (from TE if associated, or estimated if not associated)

+ 4 Z coordinate (from extrapolation if associated hit, otherwise from module);
since 3.11: same comment as for Rϕ.
+ 5 Error on Rϕ or Z (from TE if associated)
+ 6 Local X (or Z) coordinate <TDR(18)>
In case of multiplexed area, local Z of the associated hit (if associated),
otherwise local Z corresponding to the smallest |Z| in DELPHI frame.

Strip information.

Up to version 3.11: Up to 4 strips are given: the strip with maximum pulseheight (PH), its highest neighbour and the two adjacent ones.

Since version 3.11: Up to 7 strips are given: the strips above threshold plus 1 neighbour on each side. If more than 5 strips are above threshold, the 7 around maximum PH (-3,+3) are given.

The strip pulses are given in the read-out order.

If less than 4/7 strips are given the unused words contain 99999.0 .

+ 7 Packed PH (Pulse Height) and Noise: <TDR(19+2+3*N)>
+ 8 Packed PH (Pulse Height) and Noise: <TDR(19+2+3*N)>
+ 9 Packed PH (Pulse Height) and Noise: <TDR(19+2+3*N)>
+10 Packed PH (Pulse Height) and Noise: <TDR(19+2+3*N)>

Since version 3.11:
+11 Packed PH (Pulse Height) and Noise: <TDR(19+2+3*N)>
+12 Packed PH (Pulse Height) and Noise: <TDR(19+2+3*N)>
+13 Packed PH (Pulse Height) and Noise: <TDR(19+2+3*N)>

Unassociated TE BANK

15 Structural links
0 Reference link
0 data

Link LQTEAD = LQ(LDTOP-10)

LINKS:

-1 to -15 Linear chain of banks for each detector.
14 links are presently defined; they point to the following detectors:

1	ID
2	TPC
3	TPC
4	OD
5	TOF
6	MUB
7	FCA
8	RIF
9	FCB
10	MUF
11	HOF
12	MUS
13	STRAWS
14	VFT

Each bank contains information from active TER not associated to a TK. For MU chambers the deactivated TER are also kept. For ID, only the TER from jet chamber are considered, and only if they are validated by the trigger part. For VFT, only TER containing more than one space point are written here.

Content of the banks (see note for TOF, HOF and VFT):

n + 13 data (4I-F)

LINKS

0 Next TE

DATA CONTENT

+ 1	Module identifier (as in TANAGRA)	
+ 2	Submodule identifier	
+ 3	0 or,*since version 2.87*: Stage at which the TE was created (1 or 2)	
+ 4	Data descriptor + measurement code	<TER(4)>
+ 5	Coordinate 1	<TER(10)>
+ 6	Coordinate 2	<TER(11)>
+ 7	Coordinate 3	<TER(12)>

+ 8 ϑ <TER(13)>
+ 9 φ <TER(14)>
+10 1./P or 1./Pt <TER(15)>
+11 to +m+10 Error matrix (TANAGRA format)
Since version 2.51:
+m+11 Number of degrees of freedom
+m+12 χ^2
+m+13 Length of the Track Element

NOTE:

A special format is used for TOF:

+10 Time-of-flight measurement
up to version 2.81:
+11 Error on Rϕ
+12 0.
+13 Error on Z
+14 Error on TOF

since version 2.82:
For data before 1995:
+11 External TDC + 256*(external ADC)
+12 Internal TDC + 256*(internal ADC)
For data since 1995:
+11 External TDC + 8192*(external ADC)
+12 Internal TDC + 8192*(internal ADC)

+13 TOF quality flag
+14 Multihit info + 1024*(T3 level)
since version 3.35:
+14 *For data before 1995:*
Multihit info + 1024*(T3 level)
For data since 1995:
Codification of the second hit in the TDC-MH channel
= (TDCext(1st hit) - TDCext(2nd hit))
+ 8192*(TDCint(1st hit) - TDCint(2nd hit))

and for HOF:
since version 2.84:
+10 Time-of-flight measurement
+11 Error on X ((SizeX/2)**2/3)
+12 0.
+13 Error on Y ((SizeY/2)**2/3)
+14 Error on time (1.0)

and for VFT:
since version 3.40:
+m+14 NTDBK, number of TDR banks for this TER
+m+14+i TANAGRA identifier of TDR i (i=1,NTDBK)

OD timing BANK

0 Structural link
0 Reference link
N data (I)

Link LQTIOD = LQ(LDTOP-11)

This bank contains a special OD block of integer words. Its size is limited to 400 words.
IQ(LTIOD+1) = N, total number of words in this block. A special value N = 4 is set when the OD timing information is not there.

VSAT result BANK

0	Structural link
0	Reference link
28	data (F)

Link LQVSAT = LQ(LDTOP-12)

This bank is introduced since version 2.54

DATA CONTENT

This bank contains the TE data for the 4 modules of the VSAT:

	Module 1:	
+ 1	Energy deposited in the fads of the module.	
+ 2	X1 coordinate reconstructed from the first strip plane.	
+ 3	Y coordinate reconstructed from the second strip plane.	
+ 4	Z coordinate distance along the beam from the interaction point.	
+ 5	X2 coordinate reconstructed from the second strip plane.	
+ 6	ϑ, polar angle	(range 0. - 180.^{0})
+ 7	ϕ, azimuthal angle	(range 0. - 360.^{0})
	Module 2:	
+ 8 to +14	Same as 1-7 for module 2	
	Module 3:	
+ 15 to +21	Same as 1-7 for module 3	
	Module 4:	
+ 22 to +28	Same as 1-7 for module 4	

Ambiguous shower BANK

0 Structural link
NL Reference link
ND data (I)

Link LQAMB = LQ(LDTOP-13)

This bank is introduced since version 2.65

LINKS

0 Next ambiguous shower Bank

There is one link for each PA bank associated to the ambiguous shower. The first link, LQ(LQAMB-1), points to the PA actually containing the shower information

-1 First PA associated to the shower
-2 Second PA associated to the shower
. . .
-NL Last PA associated to the shower

DATA CONTENT

+ 1 Bank type of the ambiguous shower: 1 for CCA, 2 for HCAL
+ 2 NCONN, number of PA's connected to this shower
+ 3 Internal count of PA processed
+ 4 Tanagra identifier of the CCA or HAC TER (according to word 1)
+ 5 Tanagra identifier of the TK of the first PA
+ 6 Pointer to the corresponding extra-module (CCA or HAC) in the first PA; it means this pointer is equal to J+1 in the description of module 3
+ 7 NEM, number of e.m. TE's in the CCA. (=0 for type 2)
+ 8 NHAC, number of HAC TE's in the shower (=1 for type 2)

For CCA (type 1) :

+ 9 to 8+NEM Tanagra identifiers of the e.m. TE's
+ 9 +NEM to 8+NEM+NHAC Tanagra identifiers of the HAC TE's
+ 9 +NEM+NHAC to 8+NEM+NHAC+NCONN : Tanagra identifiers of the associated PA's

For HAC (type 2):

+ 9 Tanagra identifiers of the HAC TE's
+ 10 to 9+NCONN : Tanagra identifiers of the associated PA's

HPC trigger BANK

0	Structural link
0	Reference link
2*N+2	data (I)

Link LQTHPC = LQ(LDTOP-14)

This bank is introduced since version 2.62

The bank is not written on DST if none of the scintillators is above the threshold. The ADC contents given are pedestal-substracted.

IMPORTANT: For some 1991 runs, the scintillators were not taking data, resulting in LQTHPC = 0, as in empty event. A list of such runs is available.

Module numbers range from 1 to 144 for HPC scintillators, 145 to 168 for 90^0 counters, -11 to 0 for spare channels.

Each 90^0 counter module covers 15^0 in ϕ. The ϕ coverage of each module is the following:

	Module	Range in ϕ (in degrees)		
	145	262.5	-	277.5
	146	277.5	-	292.5
⋮	151	352.5	-	7.5
	152	7.5	-	22.5
⋮	168	247.5	-	262.5

DATA CONTENT

+ 1	Global word count
+ 2	N, Number of modules with data

Then for each module 2 data words are given.
The Nth module with data is described by :

+ 2*N+1	Module number
+ 2*N+2	A.D.C. content of that module

CCA BANK

0	Structural link
NL	Reference links
ND	data (2*I-F)

Link LQNCCA = LQ(LDTOP-15)

This bank is introduced since version 2.69, together with CCA version 4.00

LINKS

The link area contains references to the tracks contributing to the CCA structure. This bunch of tracks is associated to the bunch of calorimeter showers.

-1	First origin PA associated to the CCA shower
-2	Second origin PA associated to the CCA shower
	. . .
-NL	Last origin PA associated to the CCA shower

DATA CONTENT

The data area is organised in modules, in order to allow reassociation or better energy measurement:

- CCA result module
- Charged tracks extrapolation module (at HCAL surface)
- TOF hits module

+ 1	Tanagra ID of the CCA bank
+ 2	reserved (0)
+ 3	NC = number of CCA modules (at least 1)
+ 4	LP1 , pointer to first module
+ 5	LP2 , pointer to second module
+ 6	LP3 , pointer to third module
	. . .
+ 3+NC	LPNC, pointer to NCth module

Each module is identified through its first word: CCA results module:

+ LP1	CCA result code = 1000*Nemf + 100*Nhpc + 10*Nhac + Nchr
+ LP1+1	E
+ LP1+2	X
+ LP1+3	Y
+ LP1+4	Z
+ LP1+5	ϑ
+ LP1+6	φ
	CCA extrapolation module:
+ LPi	ID = 8
+ LPi+1	Nex, number of extrapolations given in the module; for each extrapolation Iex (from 1 to Nex), 7 words

	are given:
+ LPi+7*	(Iex-1)+2 Sequential number of the charged track (as given in CCA links)
+ LPi+7*(Iex-1)+3	X
+ LPi+7*(Iex-1)+4	Y
+ LPi+7*(Iex-1)+5	Z
+ LPi+7*(Iex-1)+6	ϑ
+ LPi+7*(Iex-1)+7	φ
+ LPi+7*(Iex-1)+8	P
	TOF hits module:
+ LPi	ID = 9
+ LPi+1	**Nf**, number of TOF hits given in the following words; for each hit **If** (from 1 to **Nf**), 5 words are given:
+ LPi+5*(If-1)+2	X
+ LPi+5*(If-1)+3	Y
+ LPi+5*(If-1)+4	Z
+ LPi+5*(If-1)+5	External counters : 256.*ADC + TDC
+ LPi+5*(If-1)+6	Internal counters : 256.*ADC + TDC

Unassociated HPC clusters BANK

0	Structural link
0	Reference links
3N+2	data (I)

Link LQUHPC = LQ(LDTOP-16)

This bank is introduced since version 2.81:

DATA CONTENT

+ 1	Global word count
+ 2	N, number of unassociated HPC clusters
	Then for each cluster 3 data words are given.
	The Nth cluster is described by :
+3*N + 0	Packed Energy (GeV) and layer number.
+3*N + 1	Packed R (cm) and ϕ (rad) of the cluster.
+3*N + 2	Packed Z coordinate and σ_Z of the cluster.

As for extra-module 2, those three words can be unpacked with the user routine PXHGET

Jet informations bank

0	Structural link	
0	Reference links	
NWJET data (I)		

Link LQJET = LQ(LDTOP-17)

This bank is introduced since version 3.01, its content was before in the Pilot Record.

DATA CONTENT

1	NWJET , wordcount	(variable)
2	Identifier	($0000FF1A)
3	Sub-identifier	(0)

FIXED PART

4	NJET	, number of jets reconstructed
5	NEL	, number of electrons with energy >2. GeV
6	NMU	, number of muons with energy > 3. GeV
7	NGAM	, number of gammas with energy > 8. GeV
8	NPI	, number of charged pions with energy > 8. GeV
9	NKCH	, number of K^{+-} with energy > 5. GeV
10	NPAP	, number of $p/\overline{p}$ with energy >5. GeV
11	NKS	, number of K^o_S with energy > 5. GeV
12	NNAN	, number of $n/\overline{n}$ or K^o_L with energy > 10. GeV
13	NVSEC	, number of secondary vertices
14	JPJET	, pointer to the JET area
15	JPTKR	, pointer to the TRACK area
16	JPVTX	, pointer to the VERTEX area

JET PART
(4 words per jet)

JPJET+ 0	Effective mass of the jet number 1	(MeV/c^2)
1	Px |	(MeV/c)
2	Py |→ of jet 1	(MeV/c)
3	Pz |	(MeV/c)
4	Effective mass of the jet number 2	
5	etc... for the NJET jets	

TRACK PART
(6 words per track)

JPTRK+ 0	Mass code of the track
1	Px |
2	Py |→ of track 1
3	Pz |
4	Parent jet number
5	Mass identification code (1 byte per mass assignement)

6	etc... for all tracks; the total number of tracks is NTR=NEL+NMU+NGAM+NPI+NKCH+NPAP+NKS+NNAN	
	VERTEX PART (6 words per vertex)	
JPVTX+ 0	Mass code of the origin track	
1	X	
2	Y → of vertex 1	
3	Z	
4	Distance to the primary vertex	
5	Error on the distance	
6	etc... for the NVSEC vertices	
NWJET	Wordcount	(variable)

HCAL cathode readout bank

0 Structural link
0 Reference links
ND data (I)

Link LQTUB = LQ(LDTOP-18)

This bank is introduced since version 3.14.
It contains the packed informations of individual HCAL tubes cathode readout. There are 600 tubes, only those which are hit are given.

DATA CONTENT

+1 Bank identifier (3)
+2 NTUB
Then NTUB/2 words follow, with informations packed in 16 bits per tube, two tubes per word :
+3 bitted word for the first two hit tubes:

bits 1-4 :	Tube number	|
bits 5-9 :	Plane number	|→ first tube
bits 10-16 :	Module number	|
bits 17-20 :	Tube number	|
bits 21-25 :	Plane number	|→ second tube
bits 26-32 :	Module number	|

+4 bitted word for the following two hit tubes:
⋮

Straw tube timing bank

0	Structural link
0	Reference links
ND	data (I)

Link LQTIST = LQ(LDTOP-19)

This bank is introduced since version 3.17.
It contains the straw tube timing data in a packed format.

DATA CONTENT

LQTIST +1	Number of words N_w	
+2	bits 1-16:	T_0 to be used in the straw analysis
	bits 17-32:	Nominal time value of BCO signal expected in straws
+3	bits 1-16:	Actual time value of BCO signal in straws for this event
+4	Number of hits N_h	

Then for each hit i, (i=1,N_h) :

+4+i	bits 1-13:	10*(Drift time + 1450), after T_0 and pedestal substraction
	bits 14-19:	Unused
	bit 20:	Tag bit
	bits 21-32:	Sector number + 20*(Cell+32*Layer)

⋮

STIC trigger bank

0	Structural link
0	Reference links
15	data (I)

Link LQSTT1 = LQ(LDTOP-20)

This bank is introduced since version 3.18. The 14-th word with the STIC "neutral trigger" information can be used for 1995 P3 data and later. The 15-th word with the Small veto trigger data can be used for 1996 data and later.

This bank contains the STIC calorimeter and the Veto counter trigger information.

DATA CONTENT

+1	General trigger description: 0 - no problem detected 1 - no Calorimeter LTS_DB trigger blocklet 2 - no Veto counter VDB trigger blocklet 3 - both trigger blocklets are absent
+2	Side C low threshold hitpatterns for the Calorimeter
+3	Side C high threshold hitpatterns for the Calorimeter
+4	Side A low threshold hitpatterns for the Calorimeter
+5	Side A high threshold hitpatterns for the Calorimeter
+6	Side A 1-st Veto counter plane: 1-16 bits for the 1-st wagon 17-32 bits for the 2-nd wagon
+7	Side A 1-st Veto counter plane: 1-16 bits for the 3-rd wagon 17-32 bits for the 4-th wagon
+8	Side A 2-nd Veto counter plane: 1-16 bits for the 1-st wagon 17-32 bits for the 2-nd wagon
+9	Side A 2-nd Veto counter plane: 1-16 bits for the 3-rd wagon 17-32 bits for the 4-th wagon
+10	Side C 1-st Veto counter plane: 1-16 bits for the 1-st wagon 17-32 bits for the 2-nd wagon
+11	Side C 1-st Veto counter plane: 1-16 bits for the 3-rd wagon 17-32 bits for the 4-th wagon
+12	Side C 2-nd Veto counter plane: 1-16 bits for the 1-st wagon 17-32 bits for the 2-nd wagon
+13	Side C 2-nd Veto counter plane: 1-16 bits for the 3-rd wagon 17-32 bits for the 4-th wagon
+14	1-16 bits: neutral trigger from the arm A 17-32 bits: neutral trigger from the arm C
+15	1-8 bits: Small veto counter trigger bits

RICH photon banks

0	Structural link
0	Reference link
ND	data (I)

Link LQRICH = LQ(LDTOP-41)

This bank is introduced since version 3.30.
LQRICH links to RICH individual photon informations stored in up to 4 banks, in a linear structure. Each bank corresponds to one RICH subdetector, the identifiers are *'RIFA'*, *'RIBA'*, *'RIBC'* and *'RIFC'*. Subdetectors which were not crossed by tracks are skipped.

DATA CONTENT

LQRICH	+ 1	Bitted word:	
		bits 1-2	Subdetector identifier (0 for $RIFA$, 1 for $RIBA$, 2 for $RIBC$, 3 for $RIFC$)
		bits 3-12	Number of tracks (N_{track})
	+ 2	TANAGRA identifier of 1st track	
	⋮		
	+ i+1	TANAGRA identifier of ith track	
	⋮		
	+ N_{track}+1	TANAGRA identifier of last track	

Then for each track / radiator, at address LR=LQRICH+N_{track}+1 for the first track:
General Information / Radiator

LR	+ 1	bit 1	Radiator identifier (liq.rad.=0, gas rad.=1)
		bits 2-11	Track index in the list of track identifiers
		bits 12-21	Number of photons following (N_{ph})
		bits 22-32	Number of photons before background rejection
	+ 2	bits 1-6	Sector number for liquid radiator / mirror
		bits 7-9	Liquid radiator (BRICH: 0)/ mirror number
		bits 10-20	Quality word
		bits 21-31	Fitted background for best hypothesis

Then for each of the 5 hypothesis (i=1,5):

	+ 2+i	bits 1-15	Expected number of photons (in units of 0.001)
		bits 16-22	Fitted probability (in units of 0.01)

Single Photon Information for Photon number i
At address LR2 = LR+7+3*(i-1)

LR2	+ 1	bit 1-12	θ_C	(in units of 0.25mrad for liq.rad., 0.025mrad for gas rad.)
		bits 13-22	ϕ_C	(in units of $\pi/512$)
		bits 23-32	Conversion probability	(in units of 0.00125)
	+ 2	bits 1-8	σ_C	(in units of 0.125mrad)

	bits 9-22	Photon identifier
	bits 23-27	Photon quality word
+ 3	bits 1-10	$\log Jacobian$
	bits 11-21	$d\theta/dx_{loc}$ (derivatives w.r.t. track position)
	bits 22-32	dy_{loc} (in units of mrad/mm)

VFT pixel bank

0	Structural link
0	Reference links
ND	data (I)

Link LQVFT = LQ(LDTOP-42)

This bank is introduced since version 3.34.
It contains the VFT pixel data, cluster by cluster.

DATA CONTENT

LQVFT	+1	NPC, number of pixel clusters
		First cluster, at LC1 = LQVFT+1
LC1	+1	1000*crown number + raquette number
	+2	10000*X, in DELPHI frame
	+3	10000*Y, in DELPHI frame
	+4	10000*Z, in DELPHI frame
	+5	10000*X, in local frame
	+6	10000*Z, in local frame
	+7	TANAGRA IDentifier of the TK or TE
	+8	100*(Truth label) + m, number of pixels in the cluster
	+8+1	pixel number of the 1st pixel in the cluster
	+8+2	pixel number of the 2nd pixel in the cluster
		⋮
	+8+m	pixel number of the last pixel in the cluster
		Second cluster, at LC2 = LC1+8+m
LC2	+1	1000*crown number + raquette number
	⋮	

Since version 3.36 :

	+7	10000*dX, in local frame
	+8	10000*dZ, in local frame
	+9	TANAGRA IDentifier of the TK or TE
	+10	100*(Truth label) + m, number of pixels in the cluster
	+10+1	pixel number of the 1st pixel in the cluster
	+10+2	pixel number of the 2nd pixel in the cluster
		⋮
	+10+m	pixel number of the last pixel in the cluster
		Second cluster, at LC2 = LC1+10+m
LC2	+1	1000*crown number + raquette number
	⋮	

Since version 3.40 :

	+7	10000*dX, in local frame
	+8	10000*dZ, in local frame
	+9	TANAGRA IDentifier of the TK or TE
	+10	100*(Truth label) + m, number of pixels in the cluster
	+11	TANAGRA IDentifier of the TDR
	+11+1	pixel number of the 1st pixel in the cluster
	+11+2	pixel number of the 2nd pixel in the cluster
		⋮
	+11+m	pixel number of the last pixel in the cluster
		Second cluster, at LC2 = LC1+11+m
LC2	+1	1000*crown number + raquette number
	⋮	

VFT ministrip bank

0	Structural link
0	Reference links
ND	data (I)

Link LQVFT = LQ(LDTOP-43)

This bank is introduced since version 3.34.
It contains the VFT ministrip data, cluster by cluster.

DATA CONTENT

LQVFT	+1	NSC, number of ministrip clusters
		First cluster, at LC1 = LQVFT+1
LC1	+1	Module number
	+2	10000*X, in local frame
	+3	10000*dX, in local frame
	+4	TANAGRA IDentifier of the TK or TE
	+5	100*(Truth label) + m, number of strips in the cluster
	+6	First strip number in the cluster
	+6+1	1024*(4*signal) + (4*noise) of 1st strip
	+6+2	1024*(4*signal) + (4*noise) of 2st strip
	⋮	
	+6+m	1024*(4*signal) + (4*noise) of last strip
		Second cluster, at LC2 = LC1+6+m
LC2	+1	Module number
	⋮	

Since version 3.40 :

	+6	TANAGRA IDentifier of the TDR
	+7	First strip number in the cluster
	+7+1	1024*(4*signal) + (4*noise) of 1st strip
	+7+2	1024*(4*signal) + (4*noise) of 2st strip
	⋮	
	+7+m	1024*(4*signal) + (4*noise) of last strip
		Second cluster, at LC2 = LC1+7+m
LC2	+1	Module number
	⋮	