JADE Computer Note 69

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Monte Carlo Simulation of Electromagnetic Showers in the Lead-Glass

The standard JADE LG-tracking does not properly simulate electromagnetic showers. In particular the longitudinal and tranversal energy spread is only poorly reproduced. One method to overcome these problems is the well known EGS-algorithm which however is to slow in generating large amounts of MC events as it is required for efficiency calculations.

The scheme being presented in this note is based on a parametrisation of electromagnetic showers in SF5 lead glass (E. Longo et. al.,Nucl. Instr. a. Meth.,128(79),283).

The parametrized energy density function ρ allows to calculate the energy fraction deposited in a single block by

$$F_i = \int_{Block} \rho \cdot dr \cdot d\Theta \cdot d\varphi$$

This integral has to be evaluated in detector coordinates which can only be done with the use of numerical methods. The processing time for an average multihadron event is therefore as large as 5 sec which is to much for an implementation into the standard JADE Monte Carlo chain.

It is however easy to run the new program instead of the standard LG tracking by changing the tracking job according to one of the two following methods.

- insert the source program as a macro

```
%MACRO 'F1IMEI.MCSHOWS(TRLG3)'
```

or

- include the compiled version

```
INCLUDE SYSLIB(TRLG3)
```

The program requires the following additional libraries to be linked

F11MEI.MCSHOWL

F22KAN.LGMTC.L

F22KAN.KZYLIB.LOAD

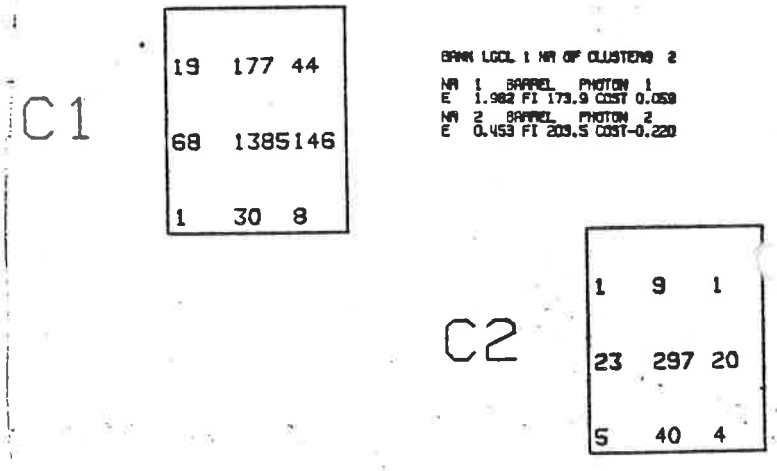
F22KAN.ANAL.L

some remarks

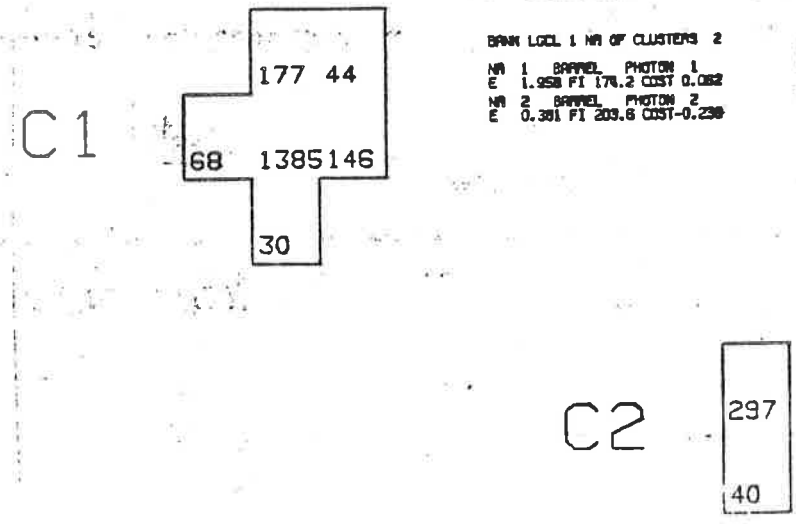
- the program includes the simulation scheme for muon and hadron energy deposition written by Junichi Kanzaki.

- it is essential to apply a cut on the single block energy to simulate the readout threshold of the LG ADC's. This can be done in the TP-step by changing the variable IPHALG in COMMON /CRDSTA/ to e.g. 28 (MeV).The effect of the readout threshold is demonstrated in the example below.

no readout threshold applied



readout threshold of 28 MeV



L. Becker, G. Heinzelmann 25.1.84

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New dE/dx Calibration

Based on the z calibration P. Dittmann has started to develop a new calibration for the measurement of the energy loss dE/dx. His work has been continued and a final calibration is now available for the period 1979 - 1982.
The resulting overall rms resolution (compared with the old one) is:

	old	new
Bhabhas	9 %	6.5 %
Pions in multi-hadronic events 0.45 < p < 0.6 GeV	11 %	8.0 %

Here, only tracks with more than 36 hits and cos(theta) < 0.75 were taken into account.

For the data of 1983 a preliminary calibration is available.

The old program DEDXBN was replaced by a new one which performs:

a) Calculation of dE/dx and sigma(dE/dx)
b) Comparison with the theoretical value (J.A.J. Skard, K. Ambrus)

The program is on the general library F11LHO.JADEGL and is called by:

```
CALL   DEDXBN
```

The results are stored in the

```
COMMON /CWORK1/ IER,NTR,TRES(10,60).
```

```
IER             =  ERRORFLAG:
                   IER=1000  IF BANK POINTER = 0
                   IER=4000  IF # OF TRACKS .LE. 0
                                OR .GT. 60
NTR             =  # OF TRACKS

ITRES(1,ITR)    =  NHIT
TRES(2,ITR)     =  DEDX
TRES(3,ITR)     =  SIGMA(DEDX)
TRES(4,ITR)     =  CHISQ(ELECTRON)
TRES(5,ITR)     =  CHISQ(PION)
TRES(6,ITR)     =  CHISQ(KAON)
TRES(7,ITR)     =  CHISQ(PROTON)
ITRES(8,ITR)    =  JMIN, NUMBER FOR MINIMUM CHISQUARE
                   1 = P, 2 = K, 3 = PI, 4 = E, 0=NO DEDX
TRES(9,ITR)     =  MOMENTUM (GEV)
TRES(10,ITR)    =  MOMENTUM ERROR
```

The program DEDXBN has to be used in the SUPERVISOR. In this way the dE/dx calibration constants are given automatically by KLREAD from the general calibration files

```
F11LHO.AUPDAT1
```

or

```
F11LHO.BUPDAT0
F11LHO.BUPDAT1
```

The results of DEDXBN can be saved by creating a BOS bank 'DEDX' via:

```
IPATR = IDATA( IBLN('PATR') )
CALL DEDXBK(IPATR)
```

(The bank number is the same as for the 'PATR' bank.)

The 'DEDX' bank contains:

```
(1)  :  IER
(2)  :  NTR

(3)  :  NHIT                    )
(4)  :  DEDX                    )
(5)  :  SIGMA(DEDX)             )
(6)  :  CHISQ(ELECTRON)         )
(7)  :  CHISQ(PION)             )    1. track
(8)  :  CHISQ(KAON)             )
(9)  :  CHISQ(PROTON)           )
(10) :  JMIN                    )
(11) :  MOMENTUM                )
(12) :  MOMENTUM ERROR          )

(13) :  NHIT                    )
(14) :  DEDX                    )
  .        .                    )    2. track
  .        .                    )
(22) :  MOMENTUM ERROR          )

        .
        .
        .
```

If the 'TP' step was performed with this new version of DEDXBN the results are also available from the 'TPTR' banks.

For the use of DEDXBN the data have to be z recalibrated. This is automatically controled by DEDXBN. If the 'z calibration flag' (second half word in the 'JETC' bank) is zero the program does:

```
CALL   ZSFIT(1)
```

Important:
==========

If the user wants in addition the so called 'hit cleaning' together with a z-s fit he has to CALL ZSFIT(0) before CALL DEDXBN. The hit cleaning removes hits if there is a nearby track within a distance of 3 mm. Without 'hit cleaning' the rms resolution for tracks in multihadronic events is 9.0 % instead of 8.0 % .

The new dE/dx version is also available in the graphics package.