JADE COMPUTER NOTE 14D

16. MAY 1984 S.YAMADA

ANALYSIS PROGRAM FOR LEAD GLASS (LG) COUNTERS.
(REVISED VERSION OF THE JADE COMP.NOTES 14,14A,14B,14C
BY S.YAMADA AND Y.WATANABE
UPDATED AND MORE INFORMATION IS GIVEN HERE)

A SMALL CHANGE HAS BEEN MADE TO THE LG LIBRALY JADELG.SOURCE/LOAD.
THE NUMBER OF WORDS/CLUSTER IS NOW 16, BUT THERE SHOULD BE NO PROBLEM
AS LONG AS THE RIGHT WORD FOR IT IS USED IN THE PROGRAM.

THIS CHANGE IS TO ACCOMODATE A REQUEST TO INCLUDE UNCORRECTED ENERGY
IN TO THE BANK. FOR MONTE CARLO DATA, THIS WORD CONTAINS UNSMEARED
ENERGY WHEN SMEARING IS DONE AT THE LG ANALYSIS STAGE, WHICH IS
THE NORMAL PRACTICE FROM NOW ON.

THE STRUCTURE OF THE LIBRARY ,SOME DESCRIPTION OF TECHNIQUES USED IN
THE PROGRAM AND THAT OF INPUT/OUTPUT BANKS ARE GIVEN BELOW.

1. THE STRUCTURE OF THE LIBRARY

IT CONSISTS OF BANCH OF SUBROUTINES, WHICH CAN BE DIVIDED INTO 4 GROUPS.
EACH OF THE GROUPS CAN BE REPRESENTED BY ONE SUBROUTINE.

A. SUBROUTINE LGINIT

FUNCTION LOAD IN VARIOUS CONSTANTS AND CUTS.
(IN THE FORM OF BLOCK DATA).
SHOULD BE CALLED AT THE BEGINNING.
THE SET CONSTANTS CAN BE OVERRIDDEN BY
SETTING TO DESIRED VALUES AFTERWARD.

B. SUBROUTINE LGCALB(*)

INPUT BANK 'ALGL'/0 (RAW PULSE HEIGHTS)
OUTPUT BANK 'ALGN'/1 (UNIT IS IN MEV)

FUNCTION CONVERTS ADC PULSE HEIGHTS TO MEV.
SUBTRACT SOME COUNTS FROM SPINNING BLOCKS AND
DELETE BAD AND/OR NON-EXISTING CHANNELS
WHEN THEY FIRE. (LGERSE)
(NOW USES L.H.O'NEILL'S SCHEME OF CONSTANTS)

ERROR RETURN OCCURS IF THE INPUT DATA ARE ABNORMAL.

C. SUBROUTINE LGANAL

INPUT BANK 'ALGN'/1
OUTPUT BANK 'LGCL'/1 (SOME PART IS TO BE FILLED BY LGCDIR)

FUNCTION FINDS CLUSTERS AND STORES THE INFORMATION
IN 'LGCL'/1.
THE BANK 'ALGN'/1 IS REORDERED IN SUCH A WAY
THAT HITS BELONGING TO A CLUSTER ARE GROUPED TOGETHER.

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D. SUBROUTINE LGCDIR(NPPATR,NPALGN,NPLGCL)

WHERE THE ARGUMENTS ARE POINTERS TO THE CORRESPONDING BANKS.

INPUT BANK 'LGCL'/1
OUTPUT BANK 'LGCL'/1 (I.E. JUST MODIFIES THE CONTENTS)
FUNCTION LINKS TRACKS FOUND IN THE JET CHAMBER
TO LG CLUSTERS
PERFORMS ENERGY CORRECTION FOR DATA(J.C.NOTE#35)

AND ENERGY SMEARING FOR MC DATA. (LGESMR)
CALCULATES THE DIRECTION COSINES TAKING
INTO ACCOUNT THE EVENT VERTEX AND SHOWER
DEPTH.

LGCDIR CAN BE CALLED INDEPENDENT OF LGANAL FOR ONCE
ANALYSED DATA.

2. SHORT DESCRIPTION OF CLUSTER FINDING

A. THE LIST IN 'ALGN'/1 IS ORDERED FROM THE HIGHEST ENERGY

B. TAKE THE BLOCK WITH THE HIGHEST ENERGY AS A PARENT.
CALL THIS BL1. E(BL1) > ITH (DEFAULT IS 45 MEV)

C. LOOK FOR A NEIGHBOR IN THE LIST. IF FOUND MOVE IT TO THE NEXT
TO BL1. CALL THIS BL2 (NEIGHBORS ARE ADJUCENT COUNTERS)

D. FOR EACH BL2, LOOK FOR A NEIGHBOR OF BL2. CALL THIS BL3.

F. INCLUDE BL3 IRRESPECTIVE OF THE ENERGY IF E(BL2) > E(BL1)/5.
IF NOT,INCLUDE BL3 IF E(BL3) < E(BL1)/2 .AND. E(BL3) < E(BL2)*3.
IF INCLUDED TO THE FAMILY, MOVE IT NEXT TO BL2.

G. FIND ALL NEIGHBORS OF BL2 (GO TO C ;BL3 IS NOW BL2)

H. AFTER ALL NEIGHBORS OF BL1 FAMILY IS FOUND, REPEAT ABOVE
FOR UNASSIGNED BLOCKS IN THE LIST (GO TO B)

NOTE. DETECTOR IS DIVIDED INTO 3 PARTS; BARREL, -Z AND +Z
END CAPS, AND CLUSTER SEARCH IS MADE SEPARATELY.
THE THRESHOLDS USED IN THE CLUSTER SEARCH ARE STORED IN THE
COMMON /CLGPRM/ ITH, MAXCLS, IRLTHD, IRLTH2, IRLTH3.
(45MEV) 5 2 3 <--- DEFAULT
THESE VALUES CAN BE CHANGED BY USERS AFTER CALLING LGINIT.

3. CALUCULATION OF CLUSTER POSITION

THE COORDINATES (PHI,Z) FOR BARREL AND (X,Y) FOR END CAP ARE
OBTAINED BY WEIGHTED AVERAGE. THE EXPONENT IN THE WEIGHT
WAS DETERMINED BY R.EICHLER IN ORDER TO OBTAIN THE BEST
PI-0 INVARIANT MASS BY A 3-DIMENSIONAL MONTE CARLO SHOWER
USING THE A.SATO'S SHOWER PROGRAM.

X = SUM (XI*EI**0.33) / SUM(EI**0.33) (SIMILAR FOR PHI)
Y = SUM (YI*EI**0.33) / SUM(EI**0.33) (" " Z)

THEN THE DIRECTION COSINE IS CALUCUATED TAKING THE SHOWER
DEPTH AND THE EVENT VERTEX(IF 'TPVX' IS THERE) INTO ACCOUNT.
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DEPTH = 22.39*LN(E/E0) (MM) E0=4.979MEV FOR E+-,
E0=1.725MEV FOR GAMMA.
OR = HALFWAY THROUGH THE LEAD GLASS
IF E<600 MEV OR E/P < 0.75
("IDENTIFIED" AS A NONSHOWERING CHARGED PARTICLE)

TO OBTAIN THE DIRECTION COSINE, E.G. FOR A BARREL CLUSTER,
THE ADDITIONAL PARAMETER R IS ITTERATIVELY SEARCHED FOR,
FIXING (PHI,Z), UNTIL THE DEPTH REACHES TO THE EXPECTED VALUE.

A FURTHER CORRECTION OF THE DIRECTION IS APPLIED AS A FUNCTION
OF THE HIT POSITION AND THE ENERGY. THE CORRECTION FUNCTION WAS
OBTAINED BY A MONTE CARLO METHOD.

4. 'ALGN'/1 BANK

WORD TYPE CONTENTS

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     0    I*4  THE LENGTH OF THE BANK
     1#   I*2  >100
          I*2  10003 FOR DATA .
               FOR MONTE CARLO DATA, 1=ENERGY UNSMEARED, 2=SMEARED
               AT THE GENERATION STAGE.  ADD 4 IF SMEARING IS DONE
               BY LGESMR IN LGCDIR.
     2    I*2  POINTER=1
          I*2  POINTER TO ADDRESS OF THE DATA ( -Z END CAP)
     3    I*2  POINTER TO ADDRESS OF THE DATA ( +Z END CAP)
          I*2  POINTER TO THE LAST WORD+1
     4    I*2  ADC CHANNEL NUMBER (0 THROUGH 2879)
          I*2  THE PULSE HEIGHT IN MEV.
     5    I*2  ADC CHANNEL NUMBER (0 THROUGH 2879)
          I*2  THE PULSE HEIGHT IN MEV.
           "        "
           "        "

           ( ALL NONZERO BLOCKS
               IN THE ORDER OF THE BLOCK NUMBERS (AFTER LGCALB)
               IN FAVOR OF CLUSTERS FOUND        (AFTER LGANAL)

AN EXAMPLE  FOR THE DATA LOOK AS FOLLOWS,

   ADC  MEV   ADC  MEV   ADC  MEV   ADC  MEV   ADC  MEV
   912 4886   880  540   913  194   911  162   944  113
   881   81   879   71 /2257 3879  2289 1227  2256   92
  2225   38  2290   86  2288   76 /2400   15//2715 1661
  2720 1370//2810   76 /2800   15

 POINTERS(WORD#2-5) HAVE THE VALUES OF  1,29,33,37
       ( // INDICATES THE BOUNDARY OF DETECTOR PARTS )
       ( / INDICATES THE BOUNDARY OF CLUSTERS IN ONE PART. )
       ( IN TOTAL 6 CLUSTERS ARE FOUND )
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5. 'LGCL'/1 BANK

   THE FORMAT OF THE BANK IS GIVEN BELOW FOR CONVENIENCE.IT IS
   ESSENTIALLY THE SAME AS THE ONE DESCRIBED IN J.C.NOTE 14 - 14B.

  WORD   TYPE  CONTENTS

     0    I*4  THE LENGTH OF THE BANK
     1     "   IP1= 5;THE POINTER TO THE GENERAL INFORMATION
     2     "   IP2=26;THE POINTER TO THE CLUSTER MAP
     3     "   IP3   ;THE POINTER TO THE CLUSTER INFORMATION(NCLST+27)
     4     "   IP4   ;THE POINTER TO THE LAST WORD +1


  /GENERAL INFORMATION/

  WORD   TYPE  CONTENTS

  IP1     I*4  VERSION# OF THE PROGRAM.
  IP1+ 1   "   THE DATE AND TIME OF THE BANK GENERATION.
  IP1+ 2   "   #CLUSTERS     TOTAL (NCLST)
  IP1+ 3   "        "        BARREL
  IP1+ 4   "        "        Z<0 ENDCAP
  IP1+ 5   "        "        Z>0 ENDCAP
  IP1+ 6  R*4  SHOWER ENERGY TOTAL
  IP1+ 7   "        "        BARREL
  IP1+ 8   "        "        Z<0 ENDCAP
  IP1+ 9   "        "        Z>0 ENDCAP
  IP1+10  I*4  #PHOTONS
  IP1+11  R*4  PHOTON ENERGY TOTAL
  IP1+12   "        "        BARREL
  IP1+13   "        "        Z<0 ENDCAP
  IP1+14   "        "        Z>0 ENDCAP
  IP1+15  I*4  ERROR FLAG. 0=NO ERROR, 1=NOT CALIBRATED, 2=NOT ENOUGH
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               SPACE TO COPY INPUT DATA,1024=FORMAT CONVERSION NOT DONE
               ADD 10 IF TOO MANY CLUSTERS FOUND
               ADD 100 IF NOT ENOUGH SPACE IN /BCS/
  IP1+16   "   THE STAGE OF ANALYSIS 1=LGANAL, 2=LGCDIR.
  IP1+17   "   THE VERSION # FOR THE ENERGY CORRECTION.
  IP1+18   "   1 IF TRACK CONNECTION IS DONE.
  IP1+19   "   FLAG=HDATA(2*NPVRTX+2) SEE J.C.NOTE FOR TP.
  IP1+20#  "   #WORDS/CLUSTER (NWPCL=16 CHANGED FROM 15)
       # INDICATES MODIFICATION


  /CLUSTER MAP/

  WORD      TYPE  CONTENTS

  IP2       I*2   H(1);THE START ADDRESS OF CLUSTER 1 IN RESHUFFLED
                    'ALGN'/1 BANK.
             "    H(2);THE LAST  ADDRESS
  IP2+1      "     . . . . . . . . . .
   .         "     . . . . . . . . . .
   .         "     . . . . . . . . . .
  IP2+NCLST  "    H(1);POINTS TO THE LAST ADC DATA +1

  FOR THE ABOVE EXAPMLE, THE VALUES OF H(1),... ARE
    1,7, 8,13, 14,16, 17,17, 19,0   RESPECTIVELY
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  /CLUSTER INFORMATION/

   IB = IP3 + (N-1) * NWPCL - 1 (ADD ABSOLUTE POINTER TO THIS)

  WORD   TYPE  CONTENTS

  IB+ 1   I*4  DETECTOR PART; 0=BARREL, +/-1=+/1 Z END CAP
  IB+ 2   R*4  CLUSTER ENERGY IN GEV.
  IB+ 3    "   EXPECTED SIGMA OF THE ENERGY
  IB+ 4    "   PHI/X FOR BARREL/ENDCAP (RAD./MM)
  IB+ 5    "   Z  /Y FOR BARREL/ENDCAP (IN MM)
  IB+ 6    "   SIGMA(PHI)/SIGMA(X) FOR BARREL/ENDCAP (IN MM)
  IB+ 7    "   SIGMA(  Z)/SIGMA(Y) FOR BARREL/ENDCAP (IN MM)
  IB+ 8#  I*4  (#CONNECTED TRACKS)*100+1ST TRACK#, 0= A PHOTON
  IB+ 9   R*4  DX
  IB+10    "   DY  FROM EVENT VERTEX (SHOWER DEPTH CONSIDERED)
  IB+11    "   DZ
  IB+12    "   EW(2)/EW(1)                    (SIGX**2   SIGXY)
  IB+13    "   EW(2)+EW(1)  EIGEN VALUES OF   (SIGXY   SIGY**2)
  IB+14    "   THE ANGLE OF EIGEN VECTOR
  IB+15    "   THE FRACTION OF ENERGY IN THE EDGE BLOCKS.
               (IF IT IS >0.5, SAY, THE ENERGY OF THE CLUSTER COULD
                BE GROSSLY UNDERESTIMATED)
  IB+16#   "   THE ENERGY OBTAINED BY ADDING THE BLOCKS.
                (I.E. UNCORRECTED ENERGY FOR DATA, AND UNSMEARED FOR MC)

       # INDICATES MODIFICATION.
          (IN THE PATR BANK OF THE SMALLEST NR, 40TH WORD NOW CONTAINS
           THE CLUSTER NUMBER THAT IS CONNECTED TO THE TRACK.
           THIS CONNECTION IS DEFINED TO BE UNIQUE.)

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 6  DUMP UTILITIES

      THE BOS BANK /ALGL/,/ALGN/ AND /LGCL/ CAN BE PRINTED
      BY SUBROUTINES  PRALGN AND PRLGCL.


    SUBROUTINE PRALGN(LORN,J,MM)
      DUMP THE LEAD GLASS ADC BANK('ALGN') TO LP

    ARGUMENTS (ALL ARE INPUT)
      LORN=0  FOR 'ALGL'/0,  LORN=1 FOR 'ALGN'/1
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NCLST+1!

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      THE ADDRESS PART IS DECODED ACCORDING TO THE INPUT J
      J=0, NO DECODING
      J=1,FOR INPUT CODE I.E. CRATE-SLOT-SUBADDRESS
      J=2,FOR POSITION CODE I.E. IPHI-IZ FOR THE BARREL PART
                           I.E. TOP/BOTTOM-NUM FOR THE ENDCAP
      MM IS NO. OF DATA TO BE PRINTED IN A LINE. (5--10 ARE RECOMENDED)
      THIS ARGUMENT IS PREPARED TO USE THE SUBROUTINE BOTH FOR
      LP AND OTHER DISPLAY DEVICES.


      SUBROUTINE PRLGCL

      PRINT THE BANK /LGCL/.
      THE CLUSTER HIT MAP, GENERAL INFORMATION AND EACH CLUSTER DATA
      ARE PRINTED.

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 6. COMMON /CWORK/

    THE SUBROUTINE LGANAL USES THE COMMON /CWORK/, WHICH IS COPIED INTO
    THE BOS BANK /LGCL/. THE SUBROUTINE LGCDIR USES THE COMMON
    AGAIN IN LINKING THE INNER CHAMBER TRACK TO THE LG CLUSTERS.
    TO MAKE THE LINK, ALL INNER CHAMBER TRACKS ARE EXTENDED TO THE
    LEAD GLASS COUNTERS AND HIT BLOCKS ARE LISTED. POSSIBLE CLUSTERS
    DUE TO CHARGED TRACKS ARE GENERATED AND MATCHING OF THE COUNTERS
    BETWEEN THE OBSERVED CLUSTERS ARE EXAMINED. AFTER THE ANALYSIS
    THE EXPECTED LG HITS BY CHARGED TRACKS AND
    THE LINK TABLES BETWEEN THE OBSERVED LG CLUSTERS AND CHARGED TRACKS
    ARE KEPT IN THE WORK COMMON, WHICH CAN BE USED IMMEDIATELY AFTER
    THE LGCDIR-CALL IF DETAILED LINK INFORMATION IS REQUIRED.

      THE STRUCTURE OF THE COMMON
                 (  USED IN LGCDIR PART OF ANALYSIS )
      COMMON /CWORK/ NCHCLS,NPOINT,MAPCCL(101),HCLADR(1600),
     $               NCHCL2,HCLIST(4,100),  NCLST2,HCLLSO(4,80)

       NCHCLS   NUMBER OF EXPECTED CLUSTERS DUE TO CHARGED PARTICLES.
       NPOINT   TOTAL NUMBER OF HIT COUNTERS
       MAPCCL   MAP OF THE CHARGED TRACK CLUSTERS, ONLY START ADDRESS
                IS STORED.
       HCLADR   COUNTER ADDRESSES
       NCHCL2   =NCHCLS
       HCLIST(1,K)     NUMBER OF CONNECTED CLUSTERS FOR THE K-TH TRACK
              (2-4,K)  THE CLUSTER NUMBERS OF THE OBSERBED CLUSTERS
                       WHICH ARE LINKED TO THE K-TH TRACK.
       NCLST2   =NCLST
       HCLLSO(1,L)     NUMBER OF LINKED TRACKS FOR THE L-TH CLUSTER
              (2-4,L)  THE TRACK NUMBERS OF THE TRACKS WHICH ARE
                       LINKED TO THE CLUSTER

       UP TO 3 LINKS ARE STORED IN THE TABLE
       NOTE THAT IN THE /LGCL/ ONLY ONE OF THEM (THE HIGHEST ENERGY
       CLUSTER) IS STORED.
       THIS TABLE CAN BE PRINTED BY SUBROUTINE PRITOL.

           SUBROUTINE PRITOL(MODE)

       MODE=1, HIT MAP AND ADDRESS ONLY
           =2, LINK TABLES ONLY
           >2, BOTH
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