JADE COMPUTER NOTE 22 - ISSUE 3

MU SOFTWARE INFORMATION.

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10/04/81.

THIS INFORMATION IS KEPT ON 'F22ALL.JADEMUS(@MUINFOM)'. IT CONTAINS EXTENSIVE INFORMATION ON THE MUON ANALYSIS AND MONTE CARLO PROGRAMS. IT WAS ISSUED IN JADE COMPUTER NOTE 22 - ISSUE 2 IN MAY 1980. (THIS NOTE REPLACES THAT ISSUE.).

* FURTHER MODIFICATIONS WILL BE RECORDED ON F22ALL.JADEMUS(MUNEWS)
* PRIOR TO A FURTHER RE-ISSUE OF THIS NOTE. WATCH THAT SPACE

* FURTHER INFORMATION ON MUSEFUL PROGRAMS IS KEPT ON
* 'F22ALL.MUSEFULS(@MUSEFUL)'.

? LINES PREFIXED WITH ? INDICATE INTENTION ONLY. FEATURES MARKED IN
? THIS WAY ARE NOT YET IMPLEMENTED. HOPEFULLY THEY WILL BE
? IMPLEMENTED AT SOME TIME AND AN UPDATED NOTE WILL BE ISSUED.

* LINES PREFIXED WITH * INDICATE RECENTLY IMPLEMENTED FEATURES OR
* RECENT INFORMATION.
LAST CHANGE AT 09.51 15/05/80. JOHN ALLISON.
LAST CHANGE AT 08.00 10/04/81. HUGH MCCANN.

Outdated

MONTE CARLO

#MONTE CARLO STATUS AT 10/04/81 :

A NEW MONTE-CARLO HAS BEEN WRITTEN FOR TRACKING PARTICLES THROUGH THE MU-FILTER. DETAILS OF THIS WILL BE MADE AVAILABLE SOON.

MUON ANALYSIS

MUON ANALYSIS STATUS AT 10/04/81 :

THE PHILOSOPHY 1 ROUTINES (MUANAL.MUANAJ) ARE CURRENTLY COMMENTED OUT IN THE STANDARD DRIVING ROUTINE MUANA. 09/04/81.

THE CALLING SEQUENCE IS NOW AS FOLLOWS:

1) CALL MUINI - AT START OF OPERATIONS.
2) FILL MUON CALIBRATION DATA AREAS - BEFORE ANY PROCESSING.
   (THIS CAN BE DONE WITH O'NEILL SYSTEM OR WITH MUCON.)
3) CALL MUREG(IPRINT) (USUALLY IPRINT=0) - DITTO.
4) CALL MUANA(0) IF 'PATR' ABSENT OR
   CALL MUANA(1) IF 'PATR' PRESENT - IN EVENT LOOP.
   (MUANA IS DESCRIBED IN MORE DETAIL BELOW.)
5) CALL MUFINI - AT END.

THE ABOVE ARE INCORPORATED INTO THE STANDARD SUPERVISOR. IF YOU ELECT TO USE IT. THERE EXIST THE FOLLOWING TO ASSIST MU PROGRAM DEVELOPMENT (IN SOURCE/LOAD LIBRARIES F22ALL.MUSEFULS/MUSEFULL) :

1) A SPECIAL VERSION OF USER IN MEMBER MUSER.
2) SUBROUTINE MU0 WHICH IS CALLED AT START OF OPERATIONS. MU0 READS A PARAMETER CARD WHICH (AMONG OTHER THINGS) SPECIFIES THE PRINT PARAMETER IPRINT. WHICH IS USED AS FOLLOWS...
   IPRINT .LE. 0 SUPPRESSES ALL PRINTING. (THIS IS THE NORMAL CASE FOR GRAPHICS. STANDARD ANALYSIS. ETC.)
   IPRINT .GE. 1 TO GET ERROR MESSAGES.
   IPRINT .GE. 2 TO GET NORMAL MUON MESSAGES.
   IPRINT .GE. 4 TO GET PHILOSOPHY 2 RESULTS PRINTING.
   IPRINT .GE. 10 TO GET CALIBRATION DATA PRINTING.
3) SUBROUTINE MU1 WHICH IS CALLED JUST AFTER NEW CALIBRATION DATA HAVE BEEN READ IN AND WHICH WILL READ A PRIVATE SET OF CALIBRATION DATA IF REQUESTED. OR ALTERNATIVELY A SET OF UPDATES.
4) SUBROUTINE MU2 WHICH IS CALLED JUST AFTER THE EVENT HAS BEEN READ AND WHICH ALLOWS EVENT SELECTION.
5) SUBROUTINE MU8 WHICH IS CALLED AFTER MU PROCESSING IS COMPLETE.
6) SUBROUTINE MU99 WHICH IS CALLED AT END.
7) A SPECIMEN SET OF JCL IN MEMBER #MUTEST WHICH USES ALL OF THESE FACILITIES.

NOTE: THE FOLLOWING ARE ALSO AVAILABLE ON F22ALL.MUSEFULS/L :

1) A SOMEWHAT SIMPLIFIED VERSION OF #MUTEST IS TO BE FOUND IN MEMBER #USERA. IT CONTAINS A DATA INPUT FILE. A DATA OUTPUT FILE. AND LARRY'S CALIBRATION DATASETS. ALL THE RELEVENT LOAD LIBRARIES ARE ALREADY LINKED IN.

2) MEMBER USERA CONTAINS A SPECIAL VERSION OF USER. THIS VERSION OF USER CONTAINS THE TIME OF FLIGHT PROGRAMS WHICH PRODUCE THE 'TOFR' RESULTS BANK . CALLS ONLY THOSE PROGRAMS WHICH ARE NEEDED FOR PHIL. 2 AND BYPASSES THE CALL TO MUANA AT LEVEL 8 IN THE SUPERVISOR. (SEE BELOW)

USING THE MUON ROUTINES OUTSIDE OF THE SUPERVISOR IS QUITE SIMPLE.
HERE IS THE BASIC STRUCTURE OF SUCH A PROGRAMME :

```
C-----------------------------------------------------------------
C              MACRO CDATA .... BOS COMMON.
C-----------------------------------------------------------------
      COMMON /BCS/ IDATA(25000)
      DIMENSION HDATA(10),IPNT(50),ADATA(2000)
      EQUIVALENCE (HDATA(1),IDATA(1),ADATA(1)),(IPNT(1),IDATA(55))
      EQUIVALENCE (NWORD,IPNT(50))
C----------------------- END OF MACRO CDATA ----------------------
      - - - -
C---     INITIALIZE BOS.
      - - - -
      CALL MUINI
      - - - -
C---     MAIN EVENT LOOP
C---
      NUNIN=2
    1 CONTINUE
      CALL BSLT
      CALL BDLG
C---
      CALL BREAD(NUNIN,&10,&20)
      CALL KALIBR
C
C FORCE MUON RE-ANALYSIS.
C
      CALL BMLT(2,'MURIMUR2')
      CALL BDLM
C
C---  CALL MU CHAMBER TRACKING.
      IMUARG=1
      CALL MUANA(IMUARG)
      - - - -
  ANALYSE RESULTS
      - - - -
      GO TO 1
      - - - -
      - - - -
      STOP
      END
      BLOCK DATA
  FILL VARIABLES IN MACRO CIOUNI (FOR USE IN KALIBR. SEE JADEGS(SUPERV))
      END
```

MUANA - THE MUON ANALYSIS DRIVER.

```
      CALL MUANA(IJOIN)
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WHERE IJOIN.NE.0 TO GET MUON ROUTINES TO ATTEMPT TO JOIN MUON HITS AND TRACKS TO INNER DETECTOR AND LEAD GLASS TRACKS AND CLUSTERS. I.E. YOU WOULD USUALLY CALL MUANA(1) SAY. (IJOIN=0 SUPRESSES SUCH ATTEMPTS AND THUS CAN BE USED ON MU DATA ALONE WHEN NO OTHER BANKS EXIST.)

MUANA CALLS 4 OTHER DRIVING ROUTINES. WHICH CALL NUMEROUS OTHER ROUTINES.....

1)MUANAC. THIS CONVERTS SIGNALS TO COORDINATES AND CREATES 'MURI' BANKS 0.1.AND 2 (SEE BELOW). IT CALLS THE SIGNAL TO COORDINATE CONVERSION ROUTINE MUCOOR. WHICH USES THE FULL MUON CALIBRATION DATA PREPARED BY MUCON

2)MUANAL. THIS LOOKS FOR 'LINEAR CLUSTERS'. I.E. TRACKS. IN THE MUON FILTER. IT FOLLOWS 'PHILOSOPHY 1'. I.E. GATHERS AS MUCH INFORMATION AS POSSIBLE BY LOOKING IN THE MUON FILTER ALONE. IT USES 'MUR1' BANKS 0.1.& 2. IT UPDATES 'MUR1' BANK 0.1.& 2. IT CREATES 'MUR1' BANKS 3.4.5.6.AND 7 (SEE BELOW).

3)MUANAJ. THIS ATTEMPTS TO JOIN MUON CLUSTERS TO INNER DETECTOR AND LEAD-GLASS CLUSTERS. IT USES THE 'MUR1' BANKS AND UPDATES 'MUR1' BANKS 0 AND 3 (SEE BELOW).

4)MUANAF. THIS ADOPTS 'PHILOSOPHY 2'. I.E. FOLLOWS EACH INNER DETECTOR TRACK OUT THROUGH THE MUON FILTER. CREATES 'MUR2'.
***NOTE : PHILOSOPHY 2 USES THE PATR BANK WITH LOWEST BANK NO. I.E. GENERALLY THE MOST RECENT PATR BANK.

THE ABOVE CAN BE SUMMARISED BY THE FOLLOWING TABLE.

ROUTINE	USES	CREATES	COMMENTS
MUANAC	MUEV	MUR1/0.1.2	SIGNAL TO COORD CONVERSION
MUANAF	PATR.MUR1/0.1.2	MUR2/0.1.2.3.4.5.6	PHILOSOPHY 2
*(MUANAL	MUR1/0.1.2	MUR1/3.4.5.6.7	PHILOSOPHY 1)*
*(MUANAJ			JOINS PHIL1 TO ID.ETC.)*
* MUANAL.MUANAJ NOT CURRENTLY GUARANTEED AND ONLY AVAILABLE ON F22ALL.MUSEFULS/L.			- COMMENTED OUT OF MUANA

----------END OF DESCRIPTION OF MUON ANALYSIS. ----------

NOTE ON GRAPHICS :

IMPORTANT : ANYONE INTERESTED IN LOOKING AT MUONS AT A GRAPHICS TERMINAL MUST READ THIS PARTICULAR SECTION.

TO GET MU RESULTS PROCEED TO INDEX=8.
THE STANDARD JADE GRAPHICS MODULE (FIILHO.GRAPHL(JADEZ)) DISPLAYS THE MUR1 & MUR2 BANKS WHICH EXIST ON THE INPUT FILE. SO. IF THE MUON PROGRAMMES OR CALIBRATION HAVE CHANGED SINCE THE INPUT FILE WAS PRODUCED . YOU WILL NOT HAVE THE MOST UP-TO-DATE ANALYSIS UNLESS YOU EXPLICITLY FORCE REANALYSIS AS FOLLOWS :
MUPT 1 (TO FORCE REANALYSIS)
STVW (OR SIMILAR COMMAND TO GET HITS REDRAWN)
MUPT (AGAIN TO GET MU LINES. MULTIPLE SCATTERING ELLIPSES. ETC.)

FURTHERMORE. THE FOLLOWING ARE USEFUL :
CDTL 9 (TO GET X.Y.Z INSTEAD OF THE DEFAULT R.Z - ESSENTIAL FOR ZX AND ZY VIEWS).
CDTL 24 (TO GET HITS AND ELLIPSES IN FACING FACE - CAN GET MESSY).
CDTL 22 (TO GET MUON HIT NUMBERS).
CDTL 18 (TO GET T3 TRIGGER DISPLAY).
CDTL 6 (TO SPEED JET CHAMBER DISPLAY).
CDTL 26 (TO SPEED JET CHAMBER DISPLAY).

TO JUDGE WHETHER A TRACK IS A MUON AT THE GRAPHICS SCREEN. IT IS ESSENTIAL TO CONSIDER THE STATUS OF INDIVIDUAL CHAMBERS. WHEN A BROKEN LINE (- - - - -) IS DRAWN OVER THE DRIFT WIDTH OF A CHAMBER (SEE FIGURE 1. POINT A). IT MEANS THAT THE CHAMBER WAS NOT SENSITIVE WHEN THIS EVENT WAS RECORDED.
THE COMMAND "MUPT" CAUSES THE PROJECTED TRAJECTORY OF EACH PATREC TRACK TO BE DRAWN ON THE SCREEN. ASSUMING EACH TRACK TO BE A MUON (FIG 1. B). THE EXPECTED RANGE OF THE TRACK IS INDICATED BY THE TRAJECTORY CHANGING FROM A SOLID LINE TO A BROKEN LINE (FIG 1. C). AT EACH INTERSECTED CHAMBER LAYER ALONG THE EXPECTED TRAJECTORY. AN "ERROR BAR" IS DRAWN. INDICATING THE UNCERTAINTY IN THE EXPECTED TRAJECTORY. THIS "ERROR BAR" IS ONE STANDARD DEVIATION LONG ON EACH SIDE OF THE TRACK AND IS CALCULATED FROM THE PATREC ERROR AND THE EXPECTED MULTIPLE SCATTERING DISTRIBUTION (FIG 1. D). IF CDTL 24 IS SWITCHED ON. AN ERROR ELLIPSE IS DRAWN INSTEAD (FIG 2. A).
IF. IN THE VIEWED PROJECTION. A TRACK APPEARS TO GO THROUGH A PARTICULAR CHAMBER LAYER BUT THERE IS NO ERROR BAR DRAWN. THEN THIS IMPLIES THAT THE TRACK DID NOT INTERSECT THIS CHAMBER LAYER IN 3-D. (FIG 1. E).YOU SHOULD THEN LOOK IN THE RELEVANT PROJECTION TO SEARCH FOR FURTHER HITS ALONG THIS TRACK.
WHEN ONE AMBIGUITY OF A HIT IS MARKED "*" (FIG 2.B). INSTEAD OF THE NORMAL "X". THIS MEANS THAT THIS AMBIGUITY OF THIS HIT IS IN THE BEST CHI-SQUARED PERMUTATION FOR A MUON-CANDIDATE TRACK. (SEE THE PHILOSOPHY 2 WRITE-UP FOR THE CRITERIA USED TO DEFINE A MUON-CANDIDATE TRACK.) HITS MARKED WITH A SMALLER THAN USUAL "X" (FIG 2.C) ARE BADLY DIGITISED HITS AND ARE NOT USED IN THE CHI-SQUARED CALCULATION. HOWEVER. IF THERE IS MORE THAN ONE ASSOCIATED HIT IN A PARTICULAR CHAMBER LAYER AND ONE OF THEM IS A "BAD" HIT. THE "BAD" HIT IS USED FOR THE HIT PERMUTATION PROCEDURE. I.E. A "BAD" HIT CAN BE PREFFERED OVER A "GOOD" HIT IF THE CHI-SQUARED/NO. OF DEGREES OF FREEDOM FOR THE BEST L/R AMBIGUITY PERMUTATION THUS OBTAINED IS BETTER THAN THAT OBTAINED WHEN THE "GOOD" HIT IS USED. ANY "BAD" HIT WHICH IS IN THE BEST PERMUTATION OF HITS FOR A MUON CANDIDATE TRACK HAS A CIRCLE DRAWN ROUND IT I.E. IT APPEARS AS "Ⓧ" . THUS A SCANNER CAN SEE EXACTLY WHICH HITS/AMBIBUITIES WERE USED TO CALCULATE THE CHI-SQUARED.
ANY L/R AMBIGUITY OF ANY HIT WHICH IS "ASSOCIATED" WITH A TRACK. BUT IS NOT IN THE BEST CHI-SQUARED PERMUTATION FOR THAT TRACK. HAS A SQUARE DRAWN ROUND IT I.E. IT APPEARS AS "⊠" (SEE THE PHIL2 WRITE-UP FOR THE DEFINITION OF "ASSOCIATED" .) --- PROVIDED THE OTHER AMBIGUITY IS NOT "ASSOCIATED" WITH THE SAME TRACK AND IN THE BEST

DESCRIPTION OF MUON BANKS

RAW DATA BANK 'MUEV':

REAL DATA.....

WORD	TYPE	CONTENTS
1	I=2	) BANK DESCRIPTOR - SEE JADE NOTE 32.
2	I=2	)
3	I=2	MARKER FOR FIRST CRATE (=FON(HEX) = 3840+N FOR CRATE N
.	I=2	REFERENCE SIGNAL (=E00(HEX)+IREF = 3584+IREF) IF REAL HITS FOLLOW.
.	I=2	4=CHAMBER NUMBER + (HIT NUMBER - 1).)THESE
.	I=2	DRIFT TIME)3 WORDS
		OR 2048+SINGLES COUNT.)REPEATED
.	I=2	LONGITUDINAL TIME DIFFERENCE)FOR
		OR 2048+TIME INTERVAL FOR SINGLES COUNT.)EACH
		(TIME INTERVAL IN UNITS OF 0.5 SECS.))HIT.
.		.
.		.
.	I=2	IN CASE OF ERRORS. CRATE MARKER DON(HEX) = 3328+N. FOLLOWED BY....
.	I=2	STATUS WORD.
.		.
.		.
.		.
.	I=2	END OF CRATE MARKER F00(HEX) = 3840.
.	I=2	MARKER FOR NEXT CRATE. ETC.

NOTE : WITHIN A CRATE. CHAMBER NUMBER INCREASES. IF A CHAMBER HAS MORE THAN ONE HIT. THE HITS ARE RECORDED HERE IN REVERSE ORDER I.E. THE LAST PHYSICAL HIT APPEARS FIRST IN THIS BANK.

MONTE CARLO DATA.....

= THE NEW MONTE-CARLO PRODUCES A MUEV BANK WITH THE SAME FORMAT AS THAT
= OF THE REAL DATA.

MUON CALIBRATION DATA BANKS :

THESE ARE KEPT ON DATASETS
(A) F22ALL.MUCALIB.DATA0001 (-0002. ..... .-0016)
AS BOS RECORDS WHICH CAN BE READ BY BREAD :
(B) F22ALL.MUCALIB.NBOS0001 (-0002. ..... .-0016)
AS SINGLE LOGICAL RECORDS OF LENGTH 4185 WORDS.

THE FIRST ONE OF BOTH TYPES IS FOR MONTE CARLO ANALYSIS.
DATASETS (A) ARE PROVIDED FOR THE PURPOSE OF PRIVATE MUON CALIBRATION OUTSIDE THE O'NEILL SYSTEM . ANY CHANGES OR UPDATES ARE PUT ONTO THESE BOS DATASETS . THE CHANGES ARE THEN CHECKED INDEPENDENTLY BEFORE PROVIDING A COPY IN FORMAT (B) FOR THE O'NEILL SYSTEM.

CHANGES AND UPDATES ARE IMPLEMENTED BY ROUTINE MUCONE WHICH IS ACTIVATED BY RUNNING JOB #MUTEST WITH PARAMETER 'LUNE' SET TO THE LOGICAL UNIT NUMBER OF THE INPUT EDIT DATA . IF THIS IS ZERO . NO EDITS ARE CARRIED OUT. THE UPDATED DATASETS CAN ALSO BE OUTPUT BY THE SAME JOB BY SETTING THE PARAMETER 'LUNO' TO THE LOGICAL UNIT NUMBER OF THE OUTPUT DATA SET . ACTIVATING ROUTINE MUCONW AS FOLLOWS :

LUNO=0	==>	NO OUTPUT ;
LUNO < 40 OR =40	==>	MUCONW WRITES ONLY A BOS FORMAT DATA SET ON LOGICAL UNIT NUMBER LUNO ;
40<LUNO<45	==>	MUCONW WRITES BOTH A BOS DATA SET AND A SINGLE LOGICAL RECORD OF LENGTH 4185 WORDS ON LOGICAL UNIT NUMBERS LUNO AND LUNO+1 RESPECTIVELY ;
LUNO > 45 OR =45	==>	MUCONW WRITES ONLY A SINGLE LOGICALRECORD OF LENGTH 4185 WORDS ON LOGICAL UNIT NUMBER LUNO.

ONLY ONE COMMON IS USED BY MUCONE AND MUCONW . NAMELY CMUCALIB.
THE ROUTINES MUCONW & MUCONR WILL SHORTLY BE CHANGED RE LOGICAL UNIT NOS. ETC. (KEEP WATCHING MEMBER MUNEWS)

THE FOLLOWING CALIBRATION DATA HAVE BEEN PROVIDED TO THE O'NEILL SYSTEM :

DATASET NUMBER	RUN NUMBERS	COMMENTS
0004	0000 - 2047	DATA UNRELIABLE : ALL CHAMBERS 'OFF' UP TO 13.00 26.10.79.
0005	2047 - 2185	336 CHAMBERS IN THE BARREL FACES 'ON' 17.09 26.10.79 TO 00.05 03.11.79
0006	2186 - 2402	349 CHAMBERS IN THE BARREL FACES 'ON' 00.18 03.11.79 TO 23.19 18.11.79
0007	2403 - 2746	477 CHAMBERS IN THE BARREL FACES AND THE ENDWALLS 'ON' 23.31 18.11.79 TO 23.59 31.12.79
0008	2747 - 3015	592(OUT OF 622 INSTALLED) CHAMBERS 'ON' 00:00 01.01.80 TO 04.24 10.03.80
0009	3016 - 3316	597/622 CHAMBERS 'ON' 04.51 10.03.80 TO 20.35 03.04.80
0010	3317 - 3584	597/622 CHAMBERS 'ON' 09.30 11.04.80 TO 20.30 13.05.80
0011	3585 - 3614	ALL CHAMBERS OFF WATER LEAK 20.30 13.05.80 TO 22.54 16.05.80
0012	3615 - 3727	586/622 CHAMBERS 'ON' 22.55 16.05.80 TO 18.39 23.05.80
0013	3730 - 4891	592/622 CHAMBERS 'ON' 07.03 17.06.80 TO 23:59 10.09.80
0014	4993 - 5326	575/622 CHAMBERS 'ON' 00:00 11.09.80 TO 23:59 17.10.80
0015	5327 - 5567	578/622 CHAMBERS 'ON' 00:00 18.10.80 TO 23:59 31.10.80
0016	5568 - NOW	576/622 CHAMBERS 'ON' 00:00 01.11.80 TO NOW.

N.B. 'OFF' AND 'ON' REFER TO THE STATE OF A SOFTWARE SWITCH: FOR ANY GIVEN DATASET. THE SET OF CHAMBERS OFF IN THE NW HALL IS A SUBSET OF THOSE SWITCHED 'OFF'. BUT GENERALLY CORRESPONDS FAIRLY CLOSELY. HOLES IN RUN NUMBER SEQUENCE CORRESPOND TO JUNK DATA CALIBRATION RUNS ETC.

BANK NAMES. NUMBERS AND LENGTHS

NAME	NUMBER	LENGTH	CONTENTS
MUCD	0	16	VERSION NUMBER AND DESCRIPTION.
MUOV	0	3	OVERALL JADE UNIT TRANSLATIONS.
MFFI	2	370	FIXED FRAME PARAMETERS.
MCFI	3	318	FIXED CHAMBER PARAMETERS.
MFSU	4	246	'SURVEY' FRAME PARAMETERS.
MCSU	5	634	'SURVEY' CHAMBER PARAMETERS.
MCEL	6	2220	'ELECTRONIC' CHAMBER PARAMETERS.
MCST	7	317	CHAMBER STATUS WORDS.
MUFI	8	36	FILTER (ABSORBER BLOCK) PARAMETERS.
MUYD	9	10	SIDE, TOP AND BOTTOM YOKE PARAMETERS.
MUEN	10	15	YOKE END-PLUG PARAMETERS.

TOTAL LENGTH 4185 WORDS.

MUON RESULTS BANKS 'MURI' (8 BANKS NUMBERED 0-7).

THESE BANKS REPRESENT THE RESULTS OF FOLLOWING 'PHILOSOPHY I'. I.E. OF OBTAINING AS MUCH INFORMATION AS POSSIBLE BY LOOKING AT THE MUON SIGNALS ALONE.

'MURI' BANK 0 - GENERAL INFORMATION.

WORD	TYPE	CONTENTS
1	I*4	NO. OF HITS.
2	I*4	NO. OF CLUSTERS (TRACKS).
3	I*4	NO. OF 2-BYTE WORDS PER HIT IN COORDINATE BANK.
4	I*4	NO. OF 4-BYTE WORDS PER CLUSTER IN CLUSTER BANK.
5	I*4	=1 IF MULINE HAS BEEN CALLED. I.E. IF AN ATTEMPT TO CREATE CLUSTERS HAS BEEN MADE. =0 OTHERWISE.
6	I*4	=1 IF AN ATTEMPT TO JOIN CLUSTERS TO INNER DETECTOR TRACKS HAS BEEN MADE. =0 OTHERWISE.
7	I*4	=1 IF AN ATTEMPT TO JOIN CLUSTERS TO LEAD-GLASS CLUSTERS HAS BEEN MADE. =0 OTHERWISE.
8	I*4	DATE OF VERSION OF SIGNAL-COORDINATE CONVERSION ROUTINE.
9	I*4	CALIBRATION DATA ISSUE. I.E. IDENTIFIER OF CALIB. DATA USED TO PRODUCE COORDINATES.

'MURI' BANK 1 - MUON COORDINATE BANK.
FOR EACH HIT....

WORD	TYPE	CONTENTS
1	I*2	4*CHAMBER NUMBER + (HIT NUMBER -1)
2	I*2	10*LAYER NUMBER + ORIENTATION PARAMETER (I.E. 1, 2 OR 3 ACCORDING TO DIRECTION OF NORMAL OF CHAMBER PLANES. X->1. Y->2. Z->3. SEE CMUINY DESCRIPTION.)
3	I*2	X)
4	I*2	Y) 'LEFT' AMBIGUITY (MM).
5	I*2	Z)
6	I*2	X)
7	I*2	Y) 'RIGHT' AMBIGUITY (MM).
8	I*2	Z)
9	I*2	POINTER TO RAW DATA

MUR1 BANK 2 - MUON HIT STATUS BANK.
FOR EACH HIT A 2-BYTE WORD PACKED AS FOLLOWS...

```
                BIT...15 14 13 12 11 10  9  8  7  6  5  4  3  2  1  0
STRUCTURE OF HLUN  0  0  0  0  0  0  0  A  B  C  D  X  Y  Z  T  L
          ......THIS BIT NUMBERING RUNS OPPOSITE TO IBM CONVENTION
                 I.E. MACHINE SEES *L* FLAG IN BIT NO. 15.

        (BIT) (TRUTH VALUE)
HLUN     0      =  0   IF LONGITUDINAL COORDINATE IS *INVALID*
                =  1   IF LONGITUDINAL COORDINATE IS  *VALID*

HLUN     1      =  0   IF TRANSVERSE   COORDINATE IS *INVALID*
                =  1   IF TRANSVERSE   COORDINATE IS  *VALID*
      (I.E. MOD(HLUN,4)= 0 ---> BOTH   COORDS. BAD
                       = 1 ---> LONG. COORD OK ( TRANS. COORD. BAD)
                       = 2 ---> TRANS COORD OK ( LONG.  COORD. BAD)
                       = 3 ---> ALL OK

HLUN     2      =  0   IF Z  COORDINATE IS *INVALID*
                =  1   IF Z  COORDINATE IS  *VALID*

HLUN     3      =  0   IF Y  COORDINATE IS *INVALID*
                =  1   IF Y  COORDINATE IS  *VALID*

HLUN     4      =  0   IF X  COORDINATE IS *INVALID*
                =  1   IF X  COORDINATE IS  *VALID*

HLUN     5      =  0   IF Z  COORDINATE IS NORMAL
                =  1   IF Z  COORDINATE IS EITHER DRIFT OR LONG.

HLUN     6      =  0   IF Y  COORDINATE IS NORMAL
                =  1   IF Y  COORDINATE IS EITHER DRIFT OR LONG.

HLUN     7      =  0   IF X  COORDINATE IS NORMAL
                =  1   IF X  COORDINATE IS EITHER DRIFT OR LONG.

HLUN     8      =  0   IF HIT 1 HAS BEEN LOST (BECAUSE OF HIT 4 )
                =  1   IF ALL OK
                ..... BIT 8 FLAG IS ONLY MEANINGFUL FOR HIT1.

NOTE: THE 1*ST SET BIT(OF 5,6,7) IS ALWAYS THAT FOR  LONG. COORD.

NOTE: ONE CAN USE TBIT. ONE OF THE FORTRAN H SPECIAL FUNCTIONS
  INVOKED BY THE OPTION XL. BUT NOTE THAT THE BIT NUMBERING IN TBIT
  IS THE OTHER WAY ROUND. E.G.
    TBIT(HLUN(IHIT),14) IS TRUE IF DRIFT COORDINATE IS OK.
    TBIT(HLUN(IHIT),15) IS TRUE IF LONGITUDINAL COORDINATE IS OK.
  AN EXAMPLE FROM PUFFLY SETS THE LOGICAL VARIABLE BADL AS FOLLOWS..
    BADL=.NOT.TBIT(HLUN(IHIT),15)
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*MURI* BANK 3 - MUON CLUSTER INFORMATION.  (NOTE. CLUSTER NUMBER IN
   WORD 30.)
FOR EACH CLUSTER...
 WORD   TYPE  CONTENTS
   1     I*4   DATE OF PRODUCTION (E.G. 791010 FOR 10/10/79).
   2     R*4   IDENTIFIER OF PROGRAM WHICH CREATED CLUSTER (A 4 CHAR-
                ACTER ALPHANUMERIC WORD).
   3     I*4   NO. OF HITS IN CLUSTER.
   4     I*4   CLUSTER NUMBER OF ALTERNATIVE CLUSTER (=0 IF NONE).
   5     I*4   =0. ONLY ONE LAYER IN CLUSTER (IF SO WORDS 9-14=0).
   6     R*4   XC )
   7     R*4   YC ) COORDS. OF *CENTRE OF GRAVITY* (MM).
   8     R*4   ZC )
   9     R*4   DX )
  10     R*4   DY ) DIRECTION COSINES OF FITTED LINE.
  11     R*4   DZ )
  12     R*4   D1. DISTANCE TO *FIRST* POINT (MM).
  13     R*4   D2. DISTANCE TO *LAST* POINT (MM).
                NOTE. ALGORITHM TO GET CORDINATES OF FIRST HIT IS...
                   X1=XC+D1*DX
                   Y1=YC+D1*DY
                   Z1=ZC+D1*DZ
                AND SIMILARLY FOR LAST HIT.
  14     R*4   RMS DEVIATION FOR *GOOD* CLUSTER - SEE ALSO WORDS 25,26.
               =0. IF MULINA (AMBIGUITY RESOLVING ROUTINE) NOT CALLED.
               =-1. IF IT FAILS ACCEPTANCE CRITERIA.
               =-2. IF IT HAS MORE THAN 2 ACCEPTABLE AMBIGIUTY
                         PERMUTATIONS.
               =-9999. IF MULINA HAS TAKEN NO ACTION. E.G. IF ONLY 1
                 LAYER. OR TOO MANY AMBIGUITIES. OR ONLY 2 LAYERS AND
                 TOO MANY AMBIGUITIES.
               NOTE THAT IF THIS WORD.LE.0 THEN WORDS 6-11 CONTAIN THE
                 THE RESULTS OF FITTING PRIOR TO CALL TO MULINA. I.E.
                 L AND R HITS OF UNRESOLVED HITS USED WITH EQUAL WEIGHT
                 (ALTHOUGH WITH LOWER WEIGHT THAN RESOLVED HITS).
  15     R*4   INTEGRAL DL (=DISTANCE. MM).                    )(FROM
  16     R*4   INTEGRAL DENSITY*DL (= MATERIAL TRAVERSED.      )(INTER-
                                                               )(ACTION
                GM CM**-2).
  17     R*4   INTEGRAL (-DE/DX)*DL (ENERGY LOSS. MINIMUM      )(POINT TO
                IONISING PARTICLE. GEV).                       )(LAST
  18     R*4   INTEGRAL DL/(ABSORPTION LENGTH) (*NUMBER* OF    )(POINT IN
                ABSORPTION LENGTHS) ASSUMING A PION.           )(CLUSTER.
  19     R*4   MU *GOODNESS* PARAMETER (VERY CRUDE AT THIS STAGE).
  20     R*4   HADRON *LEAK* PROBABILTY. EXP(-(NO. OF ABSN. LENGTHS)).
  21     I*4   ASSOCIATED INNER DETECTOR TRACK NO., IF ANY.
  22     I*4   ASSOCIATED LEAD GLASS CLUSTER NO., IF ANY.
  23     R*4   DISTANCE BETWEEN PROJECTIONS OF THE MU-TRACK AND THE
                INNER DETECTOR TRACK. IF ANY. AT THE POSITION OF THE
                FLUX RETURN YOKE.
  24     R*4   ULTIMATE RANGE OF A MUON WITH MOMENTUM OF INNER DETECTOR
                TRACK. IF ANY (GM CM**-2).
  25     R*4   RMS DRIFT DIRECTION DEVIATION.                  ) IGNORE IF
  26     R*4   RMS LONGITUDINAL (WIRE) DIRECTION DEVIATION.) WD 14.LE.0.
  27     R*4   TOTAL WEIGHT OF X COORDINATES
  28     R*4   TOTAL WEIGHT OF Y COORDINATES
  29     R*4   TOTAL WEIGHT OF Z COORDINATES
  30     I*4   CLUSTER NUMBER.

*MURI* BANK 4 - THE POINTER LIST HCLP.
   HCLP(ICL) POINTS TO START OF INFORMATION IN HCLIST (BANK 5) FOR
     CLUSTER ICL.
   HCLP(NO. OF CLUSTERS +1) POINTS TO WORD AFTER THE LAST.

*MURI* BANK 5 - THE HIT LIST HCLIST.
   THIS GIVES THE HITS BELONGING TO EACH CLUSTER.
   BANKS 4 AND 5 MAY BE USED IN CONJUNCTION TO FIND THE HITS BELONGING
```

MUR1 BANK 2 - MUON HIT STATUS BANK.
FOR EACH HIT A 2-BYTE WORD PACKED AS FOLLOWS...

```
                BIT...15 14 13 12 11 10  9  8  7  6  5  4  3  2  1  0
STRUCTURE OF HLUN  0  0  0  0  0  0  0  A  B  C  D  X  Y  Z  T  L
                .....THIS BIT NUMBERING RUNS OPPOSITE TO IBM CONVENTION
                      I.E. MACHINE SEES *L* FLAG IN BIT NO. 15.

        (BIT) (TRUTH VALUE)
HLUN     0      =  0   IF LONGITUDINAL COORDINATE IS *INVALID*
                =  1   IF LONGITUDINAL COORDINATE IS  *VALID*

HLUN     1      =  0   IF TRANSVERSE   COORDINATE IS *INVALID*
                =  1   IF TRANSVERSE   COORDINATE IS  *VALID*
      (I.E. MOD(HLUN,4)= 0 ---> BOTH  COORDS. BAD
                       = 1 ---> LONG. COORD OK ( TRANS. COORD. BAD)
                       = 2 ---> TRANS COORD OK ( LONG.  COORD. BAD)
                       = 3 ---> ALL OK

HLUN     2      =  0   IF Z  COORDINATE IS *INVALID*
                =  1   IF Z  COORDINATE IS  *VALID*

HLUN     3      =  0   IF Y  COORDINATE IS *INVALID*
                =  1   IF Y  COORDINATE IS  *VALID*

HLUN     4      =  0   IF X  COORDINATE IS *INVALID*
                =  1   IF X  COORDINATE IS  *VALID*

HLUN     5      =  0   IF Z  COORDINATE IS NORMAL
                =  1   IF Z  COORDINATE IS EITHER DRIFT OR LONG.

HLUN     6      =  0   IF Y  COORDINATE IS NORMAL
                =  1   IF Y  COORDINATE IS EITHER DRIFT OR LONG.

HLUN     7      =  0   IF X  COORDINATE IS NORMAL
                =  1   IF X  COORDINATE IS EITHER DRIFT OR LONG.

HLUN     8      =  0   IF HIT 1 HAS BEEN LOST (BECAUSE OF HIT 4 )
                =  1   IF ALL OK
                ..... BIT 8 FLAG IS ONLY MEANINGFUL FOR HIT1.

NOTE: THE 1*ST SET BIT(OF 5,6,7) IS ALWAYS THAT FOR  LONG. COORD.

NOTE: ONE CAN USE TBIT. ONE OF THE FORTRAN H SPECIAL FUNCTIONS
  INVOKED BY THE OPTION XL. BUT NOTE THAT THE BIT NUMBERING IN TBIT
  IS THE OTHER WAY ROUND. E.G.
    TBIT(HLUN(IHIT),14) IS TRUE IF DRIFT COORDINATE IS OK.
    TBIT(HLUN(IHIT),15) IS TRUE IF LONGITUDINAL COORDINATE IS OK.
  AN EXAMPLE FROM PUFFLY SETS THE LOGICAL VARIABLE BADL AS FOLLOWS..
    BADL=.NOT.TBIT(HLUN(IHIT),15)
```

MUON RESULTS BANKS 'MUR2' (7 BANKS NUMBERED 0-6).

THESE BANKS REPRESENT THE RESULTS OF FOLLOWING 'PHILOSOPHY 2'. I.E. OF FOLLOWING INNER DETECTOR TRACKS OUT. SEE JADE NOTES 47 & 68 FOR SOME DETAILS OF THE METHODS USED.

'MUR2' BANK 0 - GENERAL INFORMATION.

WORD	TYPE	CONTENTS
1	I*4	NO. OF INNER DETECTOR TRACKS ACCORDING TO BANK 'PATR'.
2	I*4	NO. OF 4-BYTE WORDS PER TRACK IN BANK 1.
3	I*4	NTPH. NO. OF TRACKS PER HIT ALLOCATED IN BANKS 2 AND 3.
4	I*4	NPL.NO. OF STORED POINTS PER EXTRAPOLATED TRACK(SET TO 5)

'MUR2' BANK 1 - MUON INFORMATION FOR EACH INNER DETECTOR TRACK.

GENERAL TERMS.....

'ASSOCIATED'. MEANS A HIT WITHIN 3 STANDARD DEVIATIONS OF THE EXTRAPOLATED INNER DETECTOR TRACK.

'STANDARD DEVIATION' IS THE COMBINATION OF
A) INNER DETECTOR TRACK FITTING ERRORS.
B) MULTIPLE COULOMB SCATTERING.
C) MU CHAMBER MEASURING ERRORS.

'INEFFICIENT LAYER' IS ONE IN WHICH THERE ARE NO ASSOCIATED MUON HITS AND NO DEAD CHAMBERS WITHIN 3 STANDARD DEVIATIONS. (THE CHAMBERS INSIDE THE YOKE COUNT AS ONE LAYER.)
IF, IN THE DRIFT DIRECTION, THE EXPECTED TRAJECTORY GOES WITHIN 3 SIGMA OF THE EDGE OF THE SENSITIVE REGION OF A LAYER, AND NO ASSOCIATED HIT IS FOUND, THE LAYER IS NOT CALLED INEFFICIENT.
(FOR THIS PURPOSE , SIGMA IS TAKEN FROM PATREC + MULTIPLE SCATTERING ERRORS ONLY.)

'CHI-SQUARED' IS CALCULATED FROM THE DEVIATIONS OF THE 'ASSOCIATED' MUON HITS. THE CORRELATIONS OF DEVIATIONS ARE TAKEN INTO ACCOUNT. IN THE CASE OF THE END-WALLS, THE CORRELATION BETWEEN DRIFT AND LONGITUDINAL DEVIATIONS IS ALSO TAKEN INTO ACCOUNT. (THIS ARISES BECAUSE OF THE CYLINDRICAL SYMMETRY OF THE INNER DETECTOR VIS-A-VIS THE RECTANGULAR SYMMETRY OF THE MUON DETECTOR.) BAD COORDINATES ARE GIVEN 'MAXIMUM' MEASURING ERRORS.

'DRIFT CHI-SQUARED' IS CALCULATED USING ONLY THE DRIFT COORDINATES AS FOLLOWS : ONLY ONE ASSOCIATED HIT PER CHAMBER LAYER IS USED IN THIS CALCULATION - - - IF A TRACK HAS MORE THAN ONE ASSOCIATED HIT IN A CHAMBER LAYER, ALL PERMUTATIONS OF HITS ARE TRIED. WITHIN EACH HIT PERMUTATION, THE LEFT/RIGHT AMBIGUITIES ARE PERMUTED TO FIND THE FIND THE BEST L/R PERMUTATION. 'DRIFT CHI-SQUARED' IS THAT OF THE BEST HIT/(L/R) PERMUTATION .

'LONGITUDINAL CHI-SQUARED' IS THE CHI-SQUARED OF THE BEST LEFT/RIGHT DRIFT DEVIATIONS AND LONGITUDINAL DEVIATIONS TOGETHER.

CHI-SQUARED IS CALCULATED ONLY FOR THOSE TRACKS WHICH PASS THE FOLLOWING BASIC CRITERIA :
A) 2 OR MORE LAYERS WITH ASSOCIATED HITS OUTSIDE THE YOKE ;
B) NOT MORE THAN 1 INEFFICIENT LAYER WITHIN THE RANGE OF THE MUON, INCLUDING INEFFICIENCY OF THE LAYER INSIDE THE YOKE (WHICH IS CONSIDERED AS ONLY ONE LAYER). (THE MUON RANGE IS CALCULATED FROM DE/DX. DEAD CHAMBERS ARE ALLOWED FOR.)

TRACKS WHICH PASS THESE CRITERIA ARE CONSIDERED TO BE MUON CANDIDATES. FOR PHYSICS ANALYSIS WE ALSO REQUIRE THAT THE TRACK DOES NOT HAVE AN INEFFICIENCY IN THE LAST INTERCEPTED LAYER ...SEE WORD 6 OF MUR2/1 BELOW.

```
      TO EACH CLUSTER AS FOLLOWS...
     NCLS = NO. OF CLUSTERS (WORD 2 OF BANK 0).
     NWHIT = NO. OF WORDS PER HIT (WORD 3 OF BANK 0).
     NWCL = NO. OF WORDS PER CLUSTER (WORD 4 OF BANK 0).
     IPCL = IP3. WHERE IP3 IS POINTER TO BANK 3.
     IP11 = 2*IP1. WHERE IP1 IS POINTER TO BANK 1.
     IP44 = 2*IP4. WHERE IP4 IS POINTER TO BANK 4.
     IP55 = 2*IP5. WHERE IP5 IS POINTER TO BANK 5.
C BEGIN LOOP 1 - LOOP OVER CLUSTERS                    **** START LOOP 1
      DO 1000 ICL=1,NCLS
C FIND HITS FOR THIS CLUSTER.  TO GET HITS OF SECONDARY CLUSTER USE
C   THE POINTERS OF PRIMARY CLUSTER.
      JCL=ICL
      IALT=IDATA(IPCL+4)
      IF(IALT.NE.0.AND.IALT.LT.ICL)JCL=IALT
      LP=HDATA(IP44+JCL)
      LPNEXT=HDATA(IP44+JCL+1)
C START LOOP 2.                                        ***** START LOOP2.
 2000 CONTINUE
      IHIT=HDATA(IP55+LP)
      IP=NWHIT*(IHIT-1)
C NOW YOU CAN FIND HITS. ADD IP TO IP11 TO GET START OF COORDINATE DATA.
C  (DON'T FORGET TO USE APPROPRIATE INFORMATION E.G. AMBIGUITY FLAGS.
C   FOR SECONDARY CLUSTERS. I.E. IF(JCL.LT.ICL) ).
      ....
      ....
C END LOOP 2.                                          ***** END LOOP 2.
 2001 CONTINUE
      LP=LP+1
      IF(LP.LT.LPNEXT)GO TO 2000
C END LOOP 1.                                          ***** END LOOP 1.
 1001 CONTINUE
      IPCL=IPCL+NWCL
 1000 CONTINUE

C *MUR1* BANK 6 - THE L/R AMBIGUITY OF HITS IN PRIMARY CLUSTERS
C FOR EACH HIT....
C  WORD   TYPE   CONTENTS
C     1   I*2    = -1. *LEFT* AMBIGUITY SELECTED.
C     .    .       +1. *RIGHT* AMBIGUITY SELECTED.
C     .    .        0.  BOTH AMBIGUITIES EQUALLY ACCEPTABLE.
C     .    .

C *MUR1* BANK 7 - THE L/R AMBIGUITY OF HITS IN SECONDARY CLUSTERS
C FOR EACH HIT....
C  WORD   TYPE   CONTENTS
C     1   I*2    = -1. *LEFT* AMBIGUITY SELECTED.
C     .    .       +1. *RIGHT* AMBIGUITY SELECTED.
C     .    .        0.  BOTH AMBIGUITIES EQUALLY ACCEPTABLE.
C     .    .
```

```
 13   I*2   NUMBER OF TRACKS WITH SHARED HITS INSIDE MAGNET YOKE.
               (IF >3 SEE *MUR2* BANK 2 FOR DETAILS.)
 14   I*2   TRACK NUMBER OF 1ST TRACK WITH SHARED HITS INSIDE YOKE.
 15   I*2   TRACK NUMBER OF 2ND TRACK WITH SHARED HITS INSIDE YOKE.
 16   I*2   TRACK NUMBER OF 3RD TRACK WITH SHARED HITS INSIDE YOKE.
 17   I*2   NUMBER OF TRACKS WITH SHARED HITS OUTSIDE MAGNET YOKE.
               (IF >3 SEE *MUR2* BANK 2 FOR DETAILS.)
 18   I*2   TRACK NUMBER OF 1ST TRACK WITH SHARED HITS OUTSIDE YOKE.
 19   I*2   TRACK NUMBER OF 2ND TRACK WITH SHARED HITS OUTSIDE YOKE.
 20   I*2   TRACK NUMBER OF 3RD TRACK WITH SHARED HITS OUTSIDE YOKE.
 11   R*4   CHI-SQUARED PROBABILITY OF BEING MUON.  (ONLY FILLED IF
               IF THE QUALITY FLAG (WORD 6) IS .GT.0.)
 12   R*4   INTEGRAL DL (=DISTANCE. MM).                    )(FROM
 13   R*4   INTEGRAL DENSITY*DL (= MATERIAL TRAVERSED.      )(VERTEX
               GM CM**-2).                                  )(TO
 14   R*4   INTEGRAL (-DE/DX)*DL (ENERGY LOSS. ASSUMING     )(LAST
               PARTICLE IS A MUON. GEV).                    )(ASSOC'D
 15   R*4   INTEGRAL DL/(ABSORPTION LENGTH) ('NUMBER' OF    )(HIT.
               ABSORPTION LENGTHS) ASSUMING A PION.         )(
 16   R*4   ENERGY AT LAST HIT ASSUMING MUON (GEV).
 17   R*4   INTEGRAL DL (=DISTANCE. MM).                    )(FRO
 18   R*4   INTEGRAL DENSITY*DL (= MATERIAL TRAVERSED.      )(VERTEX TO
               GM CM**-2).                                  )(END OF
 19   R*4   INTEGRAL (-DE/DX)*DL (ENERGY LOSS. ASSUMING     )(TRACK.I.E.
               PARTICLE IS A MUON. GEV).                    )(STOPPING
 20   R*4   INTEGRAL DL/(ABSORPTION LENGTH) ('NUMBER' OF    )(POINT OR
               ABSORPTION LENGTHS) ASSUMING A PION.         )(EDGE OF
                                                            )(DETECTOR.
 21   R*4   PROBABILTY OF PI->MU DECAY BEFORE          )(
               PION-NUCLEAR INTERACTION.                )(
 22   R*4   PROBABILTY OF PION PENETRATION. I.E.       )( AT
               PROBABILTY OF NO PION-NUCLEAR INTER-     )( LAST
               ACTION AND NO PI-> MU DECAY.             )( ASSOC-
 23   R*4   PROBABILTY OF PION 'PUNCHTHROUGH'.I.E.     )( IATED
               PROBABILTY OF PION INTERACTION AND       )( HIT
               SUBSEQUENT DETECTION OF SECONDARIES.     )(
               (IF P.GE.5 GEV/C THEN 0.01 ELSE 0).      )(
 24   R*4   PROBABILTY OF K->MU DECAY.                  )(
 25   R*4   PROBABILTY OF BEING A MUON.
               IF (WORD 6) .GT. 0 .AND .LT.100. PROBABILITY = 1.
                 (I.E. CLEAN OR INEFFICIENT. PROVIDED THE INEFFICIENCY
                 IS NOT IN THE LAST LAYER. IT'S 'GOOD'.)
               IF (WORD 6) .GT. 100. PROBABILTY = 0.05 (A NOMINAL
                 INNEFICIENCY TO ACCOUNT FOR THE POSSIBILITY OF A
                 FURTHER CHAMBER FIRING). BECAUSE INEFFICIENCY IS IN
                 LAST LAYER.
               IF DIRTY (MOD(WORD 6.10).GE.5). MULTIPLY BY A FACTOR
?                .LT.1. BECAUSE IT MAY BE A NUCLEAR INTERACTION.
?
 26   R*4   PROBABILTY OF BEING A PION.
               = (WORD 22) + (WORD 23) + (WORD 21)
               IF DIRTY. MULTIPLY BY A FACTOR .GT. 1 BECAUSE IT MAY
?                BE A NUCLEAR INTERACTION.
?
? 27   I*4   CLUSTER NUMBER OF ASSOCIATED MUON CLUSTER RECORDED IN
?             MUON RESULTS BANKS 'MUR1'. (=-1 IF MORE THAN 1 CLUSTERS
?             ARE ASSOCIATED.  IN THIS CASE SEE 'MUR2' BANK 2 AND
?             'MUR1' BANK 2.)
? 28   I*4   NO. OF HITS EXTRA TO ASSOCIATED CLUSTER.)(=0 FOR
? 29   I*4   NO. OF HITS IN ASSOCIATED CLUSTER BUT    )(COMPLETE
?             NOT FOUND HERE.                        )(CORRESPONDENCE.
?
```

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FOR EACH INNER DETECTOR TRACK...
 WORD  TYPE  CONTENTS
   1    I*4   INNER DETECTOR TRACK NUMBER.
   2    R*4   IDENTIFIER OF PROGRAM WHICH CREATED THIS INFORMATION (A
               4-CHARACTER ALPHANUMERIC WORD).
   3    I*4   DATE OF VERSION OF MUFFLE WHICH CREATED MUR2 BANKS.
   4    I*4   HIT INFORMATION FOR THIS TRACK :
              VIZ. 10000 * INEFF   (INEFF=NO. OF INEFFICIENT LAYERS
                                    ON THIS TRACK.ACCORDING TO PHIL2
                                    DE/DX -- NOT COUNTING "DEAD" CHAMS)
                 + 100 * NHLAYR    (NHLAYR IS RELATED TO THE NO. OF
                                    LAYERS WITH ASSOCIATED MU HITS
                                    AS FOLLOWS :
                                    NHLAYR=2*NO. OF SUCH LAYERS OUTSIDE
                                           THE YOKE
                                           +1 IF LAYER INSIDE YOKE HAS
                                              ASSOCIATED HIT(S)    )
                   +       NTHIS    (NTHIS IS THE NO. OF MU HITS WHICH
                                     ARE ASSOCIATED WITH THIS TRACK)
             E.G. 10304 ==> INEFF=1 , NHLAYR=3 , NTHIS=4
             I.E. ONE LAYER DID NOT HAVE A HIT CORRESPONDING TO
                  THIS TRACK WHEN PHIL2 SAYS IT HAS NOT RANGED OUT YET;
                  NHLAYR BEING ODD ==> THERE WAS AN INNER LAYER HIT
                  ASSOCIATED , ALSO THERE WAS ONE OUTER LAYER WITH
                  ASSOCIATED HIT(S);
                  NTHIS=4 ==> THERE WERE A TOTAL OF 4 HITS ASSOCIATED
?  5    I*4   ACCEPTANCE FLAG. =0. SAFELY IN ACCEPTANCE.
?                             =1. NEAR EDGE OF ACCEPTANCE.
?                             =2. DEFINITELY OUTSIDE MUON ACCEPTANCE.
   6    I*4   QUALITY FLAG.
              = -3. TRACK HAS "ERROR CODE FROM MUREGY" . IGNORE.
              = -2. TRACK HAS POOR FIT IN INNER DETECTOR .
                    THEREFORE , TRACK IGNORED.
              = -1. TRACK HAS SUCH LOW MOMENTUM THAT IT CURLS BACK
                    TOWARDS INTERACTION POINT , OR , ABS(TRANSVERSE
                    MOMENTUM) < 0.1 GEV/C .  TRACK IGNORED.
              =  0. NOT PASSING THE ACCEPTANCE CRITERIA (A) & (B) ABOVE
              =1. CLEAN MUON. I.E. A CLEAN LINE OF HITS. THE LAST
                    OF WHICH CORRESPONDS TO AN AMOUNT OF
                    PENETRATED MATERIAL NOT MORE THAN THE
                    ULTIMATE RANGE OF A MUON WITH THE MOMENTUM
                    OF THIS INNER DETECTOR TRACK. THE DRIFT
                    CHI-SQUARED PROBABILTY IS GREATER THAN 0.10.
              =2. AS =1. BUT THE DRIFT CHI-SQUARED PROBABILTY IS LESS
                    THAN 0.10.
              =3. AS =1. BUT THE HITS ARE SHARED WITH ANOTHER TRACK.
?             =4. AS =2. BUT THE HITS ARE SHARED WITH ANOTHER TRACK.
?             =5.6.7.8. DIRTY MUON. I.E. AS =1.2.3.4 BUT MORE THAN 1
?                   ASSOCIATED HITS IN AT LEAST 1 LAYER.
              +10. I.E. ADD 10 IF THERE IS AN INEFFICIENT LAYER WITHIN
                    THE RANGE OF THETRACK AND NOT IN THE LAST LAYER
              +100. I.E. ADD 100 IF THERE IS AN INEFFICIENCY IN THE
                    LAST LAYER. ALLOWING FOR RANGE-OUT WHERE
                    APPLICABLE.
```

MUR2 BANK 2 - MUON HIT - INNER DETECTOR TRACK CORRELATION.
NTPH I*2 WORDS PER HIT. (NTPH IS THE NUMBER OF TRACKS PER HIT ALLOCATED IN THIS BANK. AND IS GIVEN IN WORD 3 OF BANK 0.)
FOR EACH MUON HIT....

WORD	TYPE	CONTENTS
1	I*2	1ST INNER DETECTOR TRACK NUMBER TO WHICH THIS HIT IS *ASSOCIATED* (=0 IF NONE).
2	I*2	2ND INNER DETECTOR TRACK NUMBER ETC. (=0 IF NONE).
.		.
NTPH	I*2	NTPH*TH INNER DETECTOR TRACK NUMBER ETC. (=0 IF NONE. = -(TRACK NUMBER) IF MORE THAN NTPH TRACKS ASSOCIATED WITH THIS HIT).

MUR2 BANK 3 - MUON HIT AMBIGUITY FLAGS. FOR EACH ENTRY IN BANK 2 THERE IS AN ENTRY HERE. THE AMBIGUITY FLAG IS...
0/-1/+1. BOTH/LEFT/RIGHT AMBIGUITY IS *ASSOCIATED* WITH THE TRACK
-2/+2. LEFT/RIGHT AMBIGUITY IS *ASSOCIATED* WITH THE TRACK AND ALSO IN THE BEST HIT/(L/R) PERMUTATION :
*3. BAD HIT WHICH IS *ASSOCIATED* WITH THE TRACK AND ALSO IN THE BEST HIT/(L/R) PERMUTATION .

MUR2 BANK4 -- X.Y.Z COORDINATES OF 5 POINTS ON EXTRAPOLATED TRACK
IE R*4 WORDS FOR EACH INNER DETECTOR TRACK
THE POINTS ARE AS FOLLOWS :

WORDS	POINT
1 . 2 . 3	LAST POINT ON INNER DETECTOR FIT
4 . 5 . 6	POINT WHERE TRACK INTERSECTS COIL OR LEAVES MAGNETIC FIELD
7 . 8 . 9	POINT WHERE TRACK LEAVES YOKE OR END PLUG
10 . 11 . 12	POINT WHERE TRACK STOPS -- IF IT STOPS BEFORE LEAVING DETECTOR
13 . 14 . 15	POINT WHERE TRACK LEAVES THE DETECTOR . OR . IN THE CASE OF A STOPPING TRACK . THE POINT WHERE IT WOULD HAVE LEFT DETECTOR . HAD IT NOT STOPPED

MUR2 BANK 5 - PARAMETERS OF ERROR ELLIPSES ON FACES OF INTERCEPTED MUON CHAMBER PLANES. (GET THE NUMBER OF WORDS FROM THE BANK HEADER.)

WORD	HALF-WORD	DESCRIPTION
1.2.3		X.Y.Z OF CENTRE OF ELLIPSE.
4		INNER DETECTOR TRACK NUMBER.
5		ORIENTATION OF CHAMBER PLANE. =1.2.3 FOR NORMALS IN X.Y.Z DIRECTIONS RESPECTIVELY.
6		VT. VARIANCE IN DRIFT DIRECTION.
7		VL. VARIANCE IN LONGITUDINAL DIRECTION.
		CTL. COVARIANCE.

FOR AN EXAMPLE OF CODE USED TO RECONSTRUCT ELLIPSES FROM THIS INFORMATION SEE *F22ALL.JADEMUS(MULDSP)*.

MUR2 BANK 6 - IS A LIST OF BAD CHAMBERS IN I*2 WORDS.

END OF BANK DESCRIPTIONS.

30	R*4	PI	) WORDS 30-33 ARE THE PROBABILITY THAT THIS TRACK
31	R*4	K	) FAKING A MUON WITH QUALITY FLAG (WORD 6) .LT. 100
32	R*4	P	) ON THE ASSUMPTION THAT IT IS A PION. KAON. PROTON.
33	R*4	PBAR	) AND ANTI-PROTON RESPECTIVELY.
34	R*4	PI	)
35	R*4	K	) WORDS 34-37 ARE SIMILAR TO WORDS 30-33. BUT FOR
36	R*4	P	) FAKING A MUON OF ANY QUALITY .GT. 0.
37	R*4	PBAR	)
38	R*4	MOMENTUM OF THIS TRACK AS MEASURED BY INNER DETECTOR. I.E. EFFECTIVELY AT INTERACTION POINT.	

NOTE: MANY OTHER PARAMETERS ARE CALCULATED IN THE MUON PHILOSOPHY 2 ANALYSIS. WHICH ARE AVAILABLE IN /CWORK/ AND WHICH MAY BE ADDED TO THIS RESULTS BANK. FOR DETAILS. SEE 'F22ALL.JADEMUS(CMUFWORK)'.
NOTE ALSO: A DUMMY SUBROUTINE MUFFLZ IS CALLED FOR EACH 'GOOD' MUON TRACK. EVEN MORE INFORMATION IS AVAILABLE THERE. THE USER MAY MODIFY IT FOR HIS OWN USE.

```
      HMCELE(4440)                                          2220 WORDS
      DIMENSION HMCELE(4440)
      EQUIVALENCE ( HMCELE(1),MUCAL(1588) )
C ********** N.B. HMCELE IS JUST A 'FILLER' . **********
      DIMENSION HDTP(634),HLTP(634),HLSF(4,634),HVDRFT(634)
      EQUIVALENCE (HMCELE(1),HVDR),(HMCELE(2),HDTP(1)),
     *            (HMCELE(636),HLTP(1)),(HMCELE(1270),HLSF(1,1)),
     *            (HMCELE(3806),HMCEDM),(HMCELE(3807),HVDRFT(1))
-----------------------------------------------------3807 WORDS SO FAR

      HMCSTA(634)                                           317 WORDS
      DIMENSION HMCSTA(634)
      EQUIVALENCE ( HMCSTA(1),MUCAL(3808) )
-----------------------------------------------------4124 WORDS SO FAR

      HFILDA(72)                                             36 WORDS
      DIMENSION HFILDA(72)
      EQUIVALENCE ( HFILDA(1),MUCAL(4125) )
      INTEGER*2 HBLLO(6),HBLHI(6),HBTLO(6),HBTHI(6),HBNLIM(36)
      INTEGER*4 IFCIND(6)
      INTEGER*2 HFILDA
      EQUIVALENCE (HBLLO(1),HFILDA(1)),(HBLHI(1),HFILDA(7)),
     *            (HBTLO(1),HFILDA(13)),(HBTHI(1),HFILDA(19)),
     *            (HBNLIM(1),HFILDA(25)),(IFCIND(1),HFILDA(61))
-----------------------------------------------------4160 WORDS SO FAR


      HYKNMI(4),HYKNMO(4),HYKLDM(4),HYKTDM(4),BYOKE, 10 WORDS
      IYKIND
      DIMENSION HYKNMI(4),HYKNMO(4),HYKLDM(4),HYKTDM(4)
      INTEGER*2 HYKTDM,HYKLDM,HYKNMI,HYKNMO
      EQUIVALENCE ( HYKNMI(1),MUCAL(4161) ),
     *            ( HYKNMO(1),MUCAL(4163) ),
     *            ( HYKLDM(1),MUCAL(4165) ),
     *            ( HYKTDM(1),MUCAL(4167) ),
     *            ( BYOKE,MUCAL(4169) ),( IYKIND,MUCAL(4170) )
-----------------------------------------------------4170 WORDS SO FAR


    IZEII,IZEIO,IREP1,IREP2,IREP3,IREP4,IXYEP5,      15 WORDS
    IZOEP1,IZOEP2,IZOEP3,IZOEP4,IZOEP5,CAEP2,
    IEPIND,IEPSCT

      EQUIVALENCE ( IZEII,MUCAL(4171) ),( IZEIO,MUCAL(4172) ),
     *            ( IREP1,MUCAL(4173) ),( IREP2,MUCAL(4174) ),
     *            ( IREP3,MUCAL(4175) ),( IREP4,MUCAL(4176) ),
     *            ( IXYEP5,MUCAL(4177) ),( IZOEP1,MUCAL(4178) ),
     *            ( IZOEP2,MUCAL(4179) ),( IZOEP3,MUCAL(4180) ),
     *            ( IZOEP4,MUCAL(4181) ),( IZOEP5,MUCAL(4182) ),
     *            ( CAEP2,MUCAL(4183) ),( IEPIND,MUCAL(4184) ),
     *            ( IEPSCT,MUCAL(4185) )
-----------------------------------------------------4185 WORDS SO FAR


  NVERSN              VERSION NUMBER.
  DESCRP              DESCRIPTION.

  HOVALL(IUNIT)       OVERALL TRANSLATION OF EACH UNIT ALONG RAILS.
                        IUNIT=1 - FAR SIDE (-X) WALL.
                        IUNIT=2 - NEAR SIDE (+X, RUCKSACK) WALL.
                        IUNIT=3 - MAGNET  (ALL TRANSLATIONS ARE RELATIVE TO
                                  THIS SO HOVALL(3) SHOULD ALWAYS BE ZERO.)
                        IUNIT=4 - FAR SIDE (-X) ARCH.
                        IUNIT=5 - NEAR SIDE (+X) ARCH.
```

COMMON DESCRIPTIONS.

```
      COMMON /CALIBR/ LARRY(100),MUCAL(4185)


                NVERSN
      DIMENSION DESCRP(15),HOVALL(6)
                                                          19 WORDS

      EQUIVALENCE ( NVERSN,MUCAL(1) ),( DESCRP(1),MUCAL(2) ),
     *            ( HOVALL(1),MUCAL(17) )
-----------------------------------------------------------19 WORDS SO FAR

      HMFFIX(740)                                        370 WORDS
      DIMENSION HMFFIX(740)
      EQUIVALENCE ( HMFFIX(1),MUCAL(20) )
      DIMENSION HFACE(82),HSECT(82),HLAYER(82),HNORM(82),HLONG(82),
     *          HTRANS(82),HAC(82),HAL(82),HUNIT(82)
      EQUIVALENCE (HMFFIX(1),NFRAMS),(HMFFIX(3),HFACE(1)),
     *            (HMFFIX(85),HSECT(1)),(HMFFIX(167),HLAYER(1)),
     *            (HMFFIX(249),HNORM(1)),(HMFFIX(331),HLONG(1)),
     *            (HMFFIX(413),HTRANS(1)),(HMFFIX(495),HAC(1)),
     *            (HMFFIX(577),HAL(1)),(HMFFIX(659),HUNIT(1))
-----------------------------------------------------------389 WORDS SO FAR

      HMCFIX(636)                                        318 WORDS
      DIMENSION HMCFIX(636)
      EQUIVALENCE ( HMCFIX(1),MUCAL(390) )
      DIMENSION HFR(634)
      EQUIVALENCE (HMCFIX(1),NCHAMS),(HMCFIX(3),HFR(1))
-----------------------------------------------------------707 WORDS SO FAR

      HMFSUR(492)                                        246 WORDS
      DIMENSION HMFSUR(492)
      EQUIVALENCE ( HMFSUR(1),MUCAL(708) )
      DIMENSION HDIST(82),HANG(82),HCLLO(82),HCLHI(82),HCTLO(82),
     *          HCTHI(82)
      EQUIVALENCE (HMFSUR(1),HDIST(1)),(HMFSUR(83),HANG(1)),
     *            (HMFSUR(165),HCLLO(1)),(HMFSUR(247),HCLHI(1)),
     *            (HMFSUR(329),HCTLO(1)),(HMFSUR(411),HCTHI(1))
-----------------------------------------------------------953 WORDS SO FAR

      HMCSUR(1268)                                       634 WORDS
      DIMENSION HMCSUR(1268)
      EQUIVALENCE ( HMCSUR(1),MUCAL(954) )
      DIMENSION HD1(634),HCTW(634)
      EQUIVALENCE (HMCSUR(1),HCTW(1)),(HMCSUR(635),HD1(1))
-----------------------------------------------------------1587 WORDS SO FAR
```

```
     -DINATES RELATIVE TO THE CHAMBER AS FOLLOWS..
   ICT=(HVDR*(ITD-HDTP))/1000
   ICL=(HLSF*(ITL-HLTP))/100
     WHERE ICT.ICL ARE COORDINATES IN MM.
     ITD IS DRIFT TIME IN TRANS. CLOCK UNITS. AND
     ITL IS LONG. TIME DIFF. IN LONG. CLOCK UNITS.

STATUS DATA FOR THE CHAMBERS

HMCSTA(ICHAM)     =0 IF CHAMBER OK
                  .NE.0 IF CHAMBER U/S FOR ANY REASON.
```

```
MACRO CMUTNY
  /CMUTNY/

CONDENSED MU-FILTER PAARAMETERS FOR USE BY APPROXIMATE SIGNAL TO
  COORDINATE CONVERSION SUBROUTINE MUTINY.

HPLANS      NO. OF CHAMBER PLANES.
HVDRAV      AVERAGE DRIFT VELOCITY.
HDTPAV      AVERAGE DRIFT TIME PEDESTAL.
HLTPAV      AVERAGE LONGITUDINAL TIME DIFFERENCE PEDESTAL.
HLSFAV      AVERAGE LONGITUDINAL SCALING FACTOR.

FOR EACH CHAMBER PLANE...

HLY         LAYER NUMBER.
HOR         ORIENTATION PARAMETER:
            =1. WIRES PARALLEL TO BEAM. AND NORMAL PARALLEL TO
                X-AXIS - FACES 1(-X) AND 2(+X).
            =2. WIRES PARALLEL TO BEAM. AND NORMAL PARALLEL TO
                Y-AXIS - FACES 3(-Y) AND 4(+Y).
            =3. WIRES VERTICAL. AND NORMAL PARALLEL TO Z-AXIS -
                FACES 5(-Z) AND 6(+Z).
HCI         FIRST CHAMBER NUMBER.
HCNO        NORMAL       )
HCLO        LONGITUDINAL ) COORDINATE OF 'ORIGIN' OF CHAMBER PLANE.
HCTO        TRANSVERSE   )
HSP         AVERAGE SPACING OF CHAMBERS.

  (THE 'ORIGIN' IS AT ONE END OF THE WIRE OF THE FIRST CHAMBER IN THE
PLANE.  THE END IS THAT WITH THE LOWEST LONGITUDINAL COORDINATE.)

    COMMON /CMUTNY/HPLANS,HVDRAV,HDTPAV,HLTPAV,HLSFAV,
   * HLY(48),HOR(48),HCI(48),HCNO(48),HCLO(48),HCTO(48),HSP(48)
```

```
IFRAME          FRAME NUMBER.
ICHAM           CHAMBER NUMBER.
NFRAMS          NUMBER OF FRAMES.
NCHAMS          NUMBER OF CHAMBERS.

FIXED DATA FOR EACH FRAME....

HFACE(IFRAME)     1-6 FOR -X,+X,-Y,+Y,-Z,+Z RESPECTIVELY.
                  =0 IF FRAME NOT PRESENT.
HSECT(IFRAME)     SECTION NUMBER OF SECTION TO WHICH FRAME BELONGSH
HLAYER(IFRAME)    1-5 NUMBERING FROM THE INTERACTION POINT OUTWARDSH
                    =1. INSIDE RETURN YOKE
                    =2-5 FOR LAYERS ON CONCRETE.
HNORM(IFRAME)     =1.NORMAL OF PLANE PARALLEL TO X-AXIS
                  =2.NORMAL OF PLANE PARALLEL TO Y-AXIS
                  =3.NORMAL OF PLANE PARALLEL TO Z-AXIS
HLONG(IFRAME)     =1.WIRE NOMINALLY PARALLEL TO X-AXIS
                  =2.WIRE NOMINALLY PARALLEL TO Y-AXIS
                  =3.WIRE NOMINALLY PARALLEL TO Z-AXIS
HTRANS(IFRAME)    =1.DRIFT FIELD PARALLEL TO X-AXIS
                  =2.DRIFT FIELD PARALLEL TO Y-AXIS
                  =3.DRIFT FIELD PARALLEL TO Z-AXIS
HAC(IFRAME)       CHAMBER NUMBER OF FIRST CHAMBER IN FRAME.
HAL(IFRAME)       CHAMBER NUMBER OF LAST CHAMBER IN FRAME.
HUNIT(IFRAME)     UNIT TO WHICH THIS FRAME BELONGS.

SURVEY DATA FOR EACH FRAME....

HDIST(IFRAME)       THE COORDINATE OF THE CENTRAL PLANE WHERE THE AXIS
                    SPECIFIED BY HNORM(IFRAME) CUTS THE PLANE.(UNITS MM
HANG(IFRAME)        THE ANGLE BETWEEN THE WIRE AND THE AXIS SPECIFIED BY
                    HLONG(IFRAME)  (UNITS 1/10 MR)
HCLLO(IFRAME)       LOWER LOGITUDINAL COORDINATE LIMIT
HCLHI(IFRAME)       UPPER LOGITUDINAL COORDINATE LIMIT
HCTLO(IFRAME)       LOWER TRANSVERSE COORDINATE LIMIT
HCTHI(IFRAME)       UPPER TRANSVERSE COORDINATE LIMIT
                    THE ABOVE 4 VARIABLES APPLY TO TOTAL SENSITIVE AREA
                      OF PLANE.THEY ARE IN MM

FIXED DATA FOR EACH WIRE....

HFR(ICHAM)          FRAME NUMBER FOR THIS CHAMBER.

SURVEY DATA FOR EACH WIRE....

HDI(ICHAM)          AMOUNT TO BE ADDED TO HDIST(IFRAME) TO GET TO
                      COORDINATE OF THE CHAMBER.   (UNITS MM)
HCTW(ICHAM)         TRANVERSE COORDINATE OF EACH IRE.  (UNITS MM)

ELECTRONIC DATA FOR CHAMBERS...

HDTP(ICHAM)         DRIFT TIME PEDESTAL (TRANS. CLOCK UNITS. CA. 60 NS.)
HLTP(ICHAM)         LONGITUDINAL TIME PEDESTAL (IN LONG. CLOCK UNITS.
                      CA. 0.5 NS. OR 50 MM.)
HLSF(J,ICHAM)       LONG. SCALE FACTOR FOR J*TH HIT
                      (UNITS (1/100MM)/LONG. CLOCK UNIT)
HVDRFT(ICHAM)       DRIFT VELOCITY (MICRONS PER CLOCK UNIT (50 NS)).

                    THE ABOVE DATA ARE USED TO CONVERT SIGNALS TO COOR-
```

3225 6065 26
IDHITS 1117
ELGTOT 11856
MUHITS 35
LGCYL 11683
LGCAPS 0 173
FWCAPS 0 0

BEAM 17.570 GEV MAG.FIELD -4.531 KG
TRIG 0201 TALC 00F9

DATE 09/04/81
TIME 23.43.52

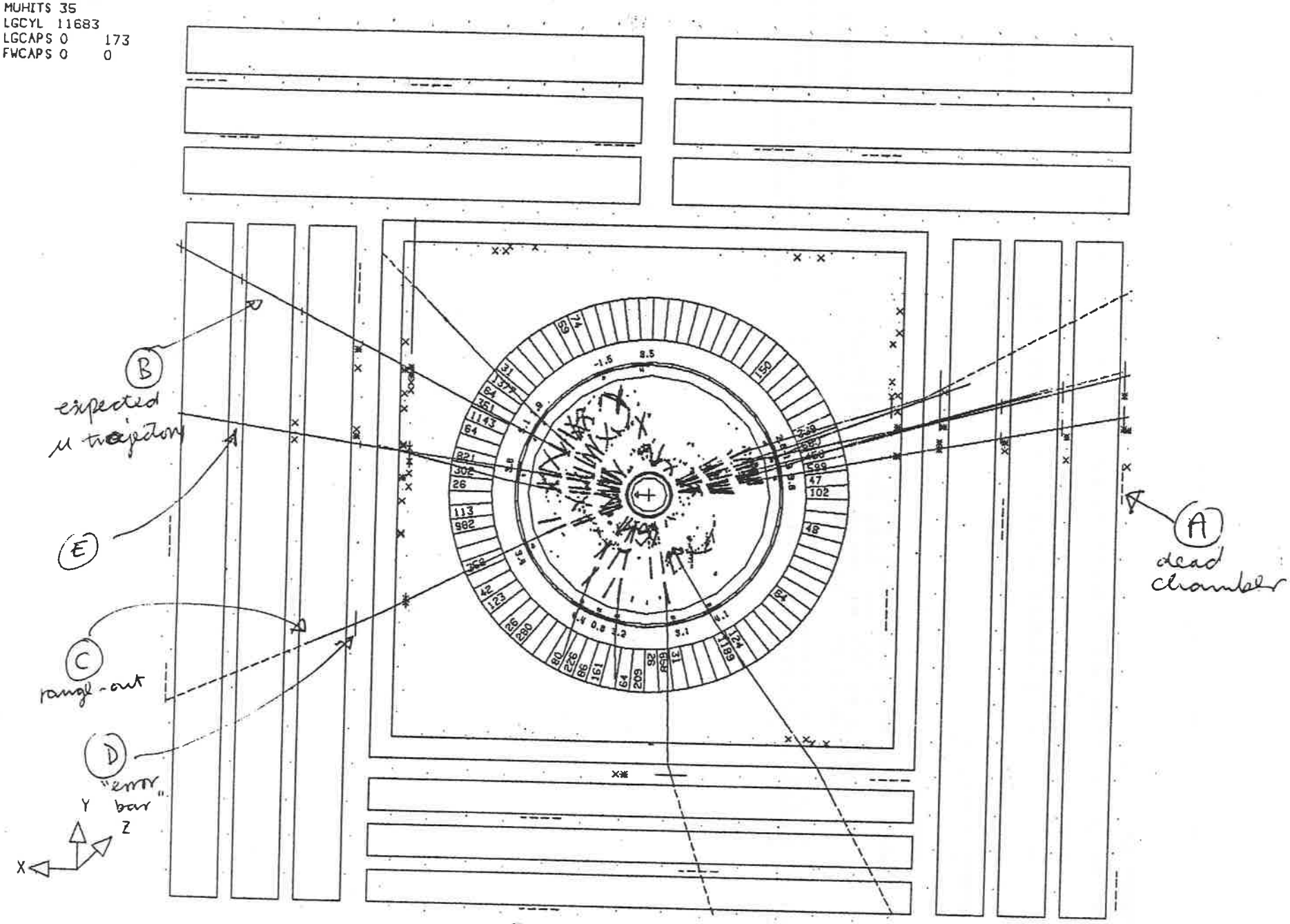

FIGURE 1.

MACRO CMUANP.

MU ANALYSIS PARAMETERS FILLED BY BLOCK DATA AFTER MUINI.

```
      COMMON/CMUANP/IMUANP(30)
      DIMENSION AMUANP(30),HMUANP(60)
      EQUIVALENCE (IMUANP(1),AMUANP(1),HMUANP(1))
```

COMMON /CMUPRN/.

```
      COMMON /CMUPRN/MUPRIN

      MUPRIN=0 TO SUPPRESS ALL PRINTING OF MU MESSAGES.
            .GE.1 TO GET MU ERROR MESSAGES.
            .GE.2 TO GET MU INFORMATION MESSAGES.
            .GE.10 TO GET FULL MU CALIBRATION PRINTOUT (ABOUT 10 PAGES).
```

END OF COMMON DESCRIPTIONS.

DSN F22KIN.MUONS JADE R-FI [redacted] BEAM 17.570 GEV MAG.[redacted] -4.531 KG
TRIG [redacted] TALC 00F9
DATE 09/04/81
TIME 23.45.49

3225 6065 26
IDHITS 1117
ELGTOT 11856
MUHITS 35
LGCYL 11683
LGCAPS 0 173
FWCAPS 0 0

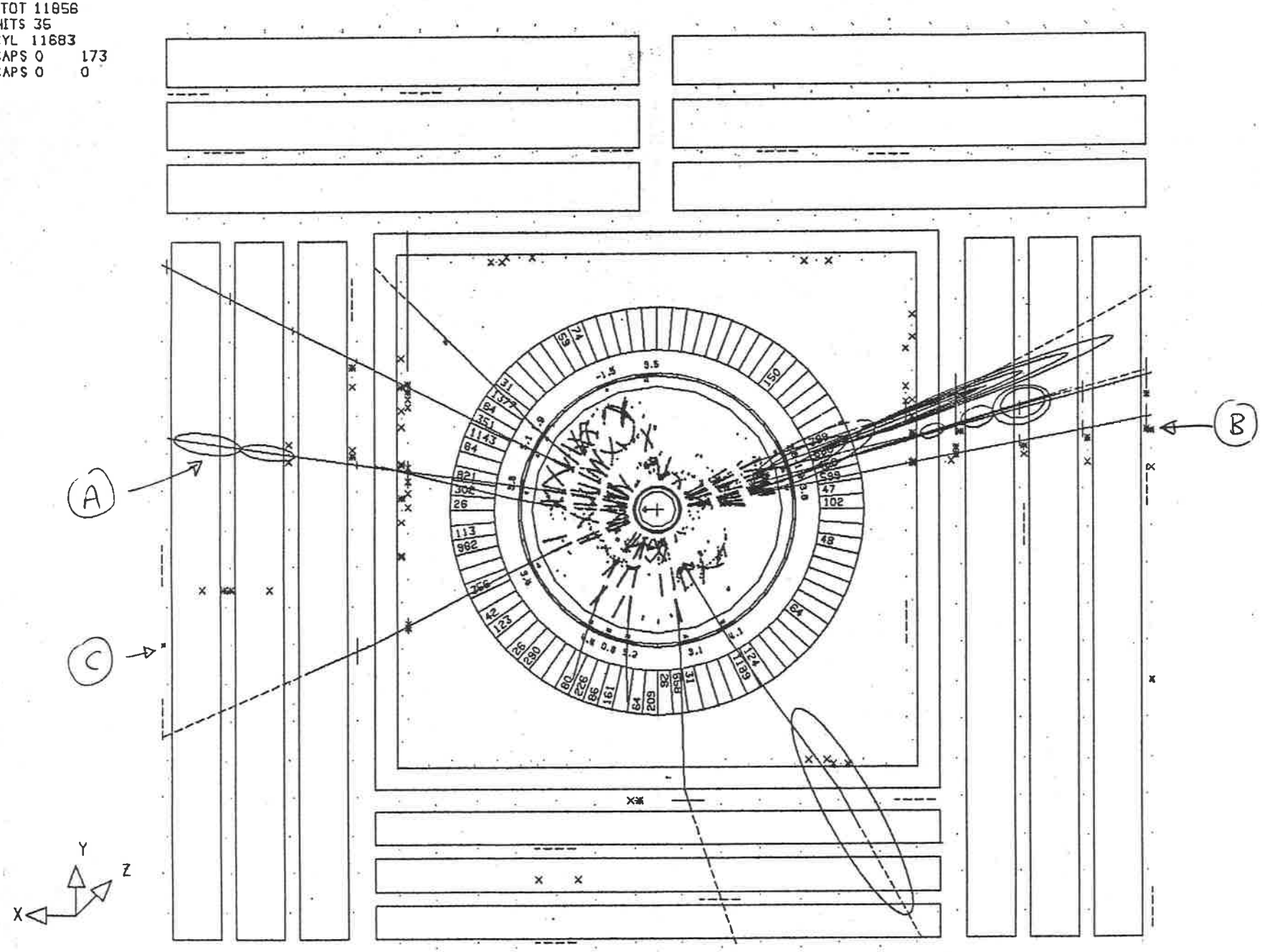

FIGURE 2

NEW DATA FORMAT - MONTE CARLO AND RAW DATA - FROM MARCH 1979.

BANK NAME 'MUEV'
BANK NUMBER =0, RAW DATA,
=10, MONTE CARLO.

WORD	TYPE	CONTENTS
1	I*2	BANK DESCRIPTOR - SEE JADE NOTE 32.
2	I*2	
3	I*2	4*CHAMBER NUMBER + (HIT NUMBER - 1).)THESE 3 WORDS
4	I*2	DRIFT TIME.)REPEATED FOR
5	I*2	LONGITUDINAL TIME DIFFERENCE.)EACH HIT.

OLD MONTE CARLO DATA FORMAT - UP TO END OF FEB 1979.

'MUEV', BANK 10

WORD	TYPE	CONTENTS	
1	I*2	POINTER TO START OF FACE 1	ALL THESE POINTERS
2	I*2	POINTER TO START OF FACE 2	REFER TO INTEGER*2
3	I*2	POINTER TO START OF FACE 3	WORDS RELATIVE TO
4	I*2	POINTER TO START OF FACE 4	WORD 9. I.E. POINTER
5	I*2	POINTER TO START OF FACE 5	=1 MEANS WORD 9.
6	I*2	POINTER TO START OF FACE 6	
7	I*2	POINTER TO WORD AFTER LAST.	
8	I*2	0	
9	I*2	4*CHAMBER NUMBER + (HIT NUMBER - 1).	)THESE 3 WORDS
10	I*2	DRIFT TIME.	)REPEATED FOR
11	I*2	LONGITUDINAL TIME DIFFERENCE.	)EACH HIT.

MUON RESULTS BANKS 'MUR1' (6 BANKS NUMBERED 0-5).
THESE BANKS REPRESENT THE RESULTS OF FOLLOWING 'PHILOSOPHY 1', I.E. OF OBTAINING AS MUCH INFORMATION AS POSSIBLE BY LOOKING AT THE MUON SIGNALS ALONE.

'MUR1' BANK 0 - MUON GENERAL INFORMATION BANK.

WORD	TYPE	CONTENTS
1	I*4	NO. OF HITS.
2	I*4	NO. OF CLUSTERS (TRACKS).
3	I*4	NO. OF 2-BYTE WORDS PER HIT IN COORDINATE BANK.
4	I*4	NO. OF 4-BYTE WORDS PER CLUSTER IN CLUSTER BANK.
5	I*4	=1 IF MULINE HAS BEEN CALLED, I.E. IF AN ATTEMPT TO CREATE CLUSTERS HAS BEEN MADE. =0 OTHERWISE.
6	I*4	=1 IF AN ATTEMPT TO JOIN CLUSTERS TO INNER DETECTOR TRACKS HAS BEEN MADE. =0 OTHERWISE.
7	I*4	=1 IF AN ATTEMPT TO JOIN CLUSTERS TO LEAD-GLASS CLUSTERS HAS BEEN MADE. =0 OTHERWISE.

'MUR1' BANK 1 - MUON COORDINATE BANK.
FOR EACH HIT....

WORD	TYPE	CONTENTS
1	I*2	4*CHAMBER NUMBER + (HIT NUMBER -1)
2	I*2	10*LAYER NUMBER + ORIENTATION PARAMETER (I.E. 1, 2 OR 3 ACCORDING TO DIRECTION OF NORMAL OF CHAMBER PLANES. X->1, Y->2, Z->3. SEE CMUTNY DESCRIPTION.)
3	I*2	X)
4	I*2	Y) 'LEFT' AMBIGUITY (MM).
5	I*2	Z)
6	I*2	X)
7	I*2	Y) 'RIGHT' AMBIGUITY (MM).
8	I*2	Z)

J. Olsson

THIS MEMBER CONTAINS INFORMATION ON THE MUON ANALYSIS AND MONTE CARLO PROGRAMS.

F22ALL.MUANAL.S (@MUINFOM)

DRAFT JADE COMPUTER NOTE 22.

9/3/79

MONTE CARLO. STATUS AT 9/1/79.
WRITTEN LARGELY BY DEREK STORK, UPDATED SOMEWHAT BY JOHN ALLISON, WHO NOW HOLDS DEREK STORK'S FILES. NOW FULLY INCORPORATED INTO THE JADE MONTE CARLO ON 'F11BAR.JADE.SOURCE' AND '.LOAD', AND MAINTAINED BY WOLFFIN BARTEL AND ECKHARD ELSEN.
THERE ARE SOME MUON MONTE CARLO PRINTING ROUTINES ON 'F22ALL.MUMC.S' AND '.L' WHICH CAN BE CALLED FOR DIAGNOSTIC PURPOSES AND FOR OBTAINING FULL INFORMATION ABOUT THE TRACKS IN THE MUON FILTER AS GENERATED. SEE, E.G., 'F11BAR.JADE.SOURCE(ITEST8)' WHERE THE APPROPRIATE STATEMENTS ARE COMMENTED OUT, OR 'F22ALL.MUMC.S(MUGEN)' WHERE THEY ARE OPERATIONAL. THE CORRESPONDING JCL IS IN 'F22ALL.MUMC.S(#MUGEN)'.

MUON ANALYSIS. STATUS AT 9/1/79.
UNDER INTENSIVE DEVELOPMENT BY JOHN ALLISON AND HARRY PROSPER.

THE ANALYSIS CHAIN CONSISTS OF 4 SUBROUTINES (WHICH CALL NUMEROUS OTHER SUBROUTINES).

1) MUANAC. THIS CONVERTS SIGNALS TO COORDINATES AND CREATES 'MUR1' BANKS 0 AND 1 (SEE BELOW). IT CALLS 1 OF 2 SIGNAL TO COORDINATE CONVERSION ROUTINES...
MUTINY, WHICH USES A CONDENSED SET OF CALIBRATION DATA PREPARED BY MUCONT (FOR MONTE CARLO OUTPUT - SEE READMC), WHICH CALLS A VERSION OF MUCOWN.
MUCOOR, WHICH USES THE FULL MUON CALIBRATION DATA PREPARED BY MUCON (FOR MONTE CARLO OUTPUT - SEE READMC).

2) MUANAL. THIS LOOKS FOR 'LINEAR CLUSTERS', I.E. TRACKS, IN THE MUON FILTER. IT FOLLOWS 'PHILOSOPHY 1', I.E. GATHERS AS MUCH INFORMATION AS POSSIBLE BY LOOKING IN THE MUON FILTER ALONE. IT USES 'MUR1' BANKS 0 AND 1. IT UPDATES 'MUR1' BANK 0. IT CREATES 'MUR1' BANKS 2,3,4 AND 5 (SEE BELOW).

3) MUANAJ. THIS ATTEMPTS TO JOIN MUON CLUSTERS TO INNER DETECTOR AND LEAD-GLASS CLUSTERS. IT USES THE 'MUR1' BANKS AND UPDATES 'MUR1' BANKS 0 AND 1 (SEE BELOW).

4) MUANAF. THIS ACCEPTS 'PHILOSOPHY 2', I.E. FOLLOWS EACH INNER DETECTOR TRACK OUT THROUGH THE MUON FILTER. CREATES 'MUR2'.

AN EXAMPLE OF A CALLING SEQUENCE IS AS FOLLOWS....

CONVERT MUON SIGNALS TO COORDINATES.
```
CALL MUANAC(IDATA(IPMU+1),IDATA(IPML))
```

FIND MUON LINES - PHILOSOPHY 1 MUON PATTERN RECOGNITION.
```
CALL MUANAL
```

ATTEMPT TO JOIN MUON CLUSTERS TO INNER DETECTOR TRACKS. & TO LEAD GLASS CLUSTERS.
```
CALL MUANAJ
```

FOLLOW EACH INNER DETECTOR TRACK OUT (PHILOSOPHY 2).
```
CALL MUANAF
```

Outdated!

```
  24    R*4   ULTIMATE RANGE OF A MUON WITH MOMENTUM OF INNER DETECTOR
                TRACK, IF ANY (GM CM**-2).
  25    R*4   RMS DRIFT DIRECTION DEVIATION.                ) IGNORE IF
  26    R*4   RMS LONGITUDINAL (WIRE) DIRECTION DEVIATION.) NO 14.LE.0.
  27    I*4   CLUSTER NUMBER.

'MUR1' BANK 4 - THE POINTER LIST HCLP.
   HCLP(ICL) POINTS TO START OF INFORMATION IN HCLIST (BANK 5) FOR
     CLUSTER ICL.
   HCLP(NO. OF CLUSTERS +1) POINTS TO WORD AFTER THE LAST.

'MUR1' BANK 5 - THE HIT LIST HCLIST.
   THIS GIVES THE HITS BELONGING TO EACH CLUSTER.
   BANKS 4 AND 5 MAY BE USED IN CONJUNCTION TO FIND THE HITS BELONGING
     TO EACH CLUSTER AS FOLLOWS...
    NCLS = NO. OF CLUSTERS (WORD 2 OF BANK 0).
    NWHIT = NO. OF WORDS PER HIT (WORD 3 OF BANK 0).
    NWCL = NO. OF WORDS PER CLUSTER (WORD 4 OF BANK 0).
    IPCL = IP3, WHERE IP3 IS POINTER TO BANK 3.
    IP11 = 2*IP1, WHERE IP1 IS POINTER TO BANK 1.
    IP44 = 2*IP4, WHERE IP4 IS POINTER TO BANK 4.
    IP55 = 2*IP5, WHERE IP5 IS POINTER TO BANK 5.
BEGIN LOOP 1 - LOOP OVER CLUSTERS                    **** START LOOP 1
    DO 1000 ICL=1,NCLS
FIND HITS FOR THIS CLUSTER.  TO GET HITS OF SECONDARY CLUSTER USE
  THE POINTERS OF PRIMARY CLUSTER.
    JCL=ICL                    IDATA
    IALT=IQ(IPCL+4)
    IF(IALT.NE.0.AND.IALT.LT.ICL)JCL=IALT
    LP=HQ(IP44+JCL)
    LPNEXT=HQ(IP44+JCL+1)
START LOOP 2.                                        ***** START LOOP2.
2000 CONTINUE              HDATA
    IHIT=HQ(IP55+LP)
    IP=1+NWHIT*(IHIT-1)
NOW YOU CAN FIND HITS. ADD IP TO IP11 TO GET START OF COORDINATE DATA.
  (DON'T FORGET TO USE APPROPRIATE INFORMATION,E.G. AMBIGUITY FLAGS,
   FOR SECONDARY CLUSTERS, I.E. IF(JCL.LT.ICL) ).
    ....
    ....
END LOOP 2.                                          ***** END LOOP 2.
2001 CONTINUE
    LP=LP+1
    IF(LP.LT.LPNEXT)GO TO 2000
END LOOP 1.                                          ***** END LOOP 1.
1001 CONTINUE
    IPCL=IPCL+NWCL
1000 CONTINUE
```

```
MUON RESULTS BANKS 'MUR2' (3 BANKS NUMBERED 0-2).
   THESE BANKS REPRESENT THE RESULTS OF FOLLOWING 'PHILOSOPHY 2', I.E.
     OF FOLLOWING INNER DETECTOR TRACKS OUT.

'MUR2' BANK 0 - MUON GENERAL INFORMATION BANK.
 WORD   TYPE   CONTENTS
   1    I*4   NO. OF INNER DETECTOR TRACKS ACCORDING TO BANK 'PATR'.
   2    I*4   NO. OF 4-BYTE WORDS PER TRACK IN BANK 1.
```

3 NO of Track/hit

(3)

'MUR1' BANK 2 - MUON CLUSTER ASSIGNMENT BANK.
FOR EACH HIT A 2-BYTE WORD PACKED AS FOLLOWS... Designed to be same as for inner detector

```
 NAME              F  E   D   C   B   A
 LAYOUT  M.S. I---I-I-----I-I-----I-I LEAST SIGNIFICANT END.
 NO. OF BITS     3  1   5   1   5   1
```

NAME	BITS	CONTENTS
A	15 (L.S.)	=0 IF LONGITUDINAL MEASUREMENT DOUBTFUL,. =1 IF LONGITUDINAL MEASUREMENT IS OK.
B	10-14	PRIMARY CLUSTER ASSIGNMENT (=0 IF UNASSIGNED).
C	9	=0 LEFT AMBIGUITY) (PRIMARY CLUSTER). =1 RIGHT AMBIGUITY)
D	4-8	SECONDARY CLUSTER ASSIGNMENT (=0 IF UNASSIGNED).
E	3	=0 LEFT AMBIGUITY) (SECONDARY CLUSTER). =1 RIGHT AMBIGUITY)
F	0-2 (M.S.)	FREE.

'MUR1' BANK 3 - MUON CLUSTER INFORMATION. (NOTE. CLUSTER NUMBER IN WORD 27.)
FOR EACH CLUSTER...

WORD	TYPE	CONTENTS
1	I*4	DATE OF PRODUCTION (E.G. 790110 FOR 10/1/79).
2	I*4	IDENTIFIER OF PROGRAM WHICH CREATED CLUSTER (A 4 CHARACTER ALPHANUMERIC WORD).
3	I*4	NO. OF HITS IN CLUSTER.
4	I*4	CLUSTER NUMBER OF ALTERNATIVE CLUSTER (=0 IF NONE).
5	I*4	=0, ONLY ONE LAYER IN CLUSTER (IF SO WORDS 9-14=0).
6	R*4	XC)
7	R*4	YC) COORDS. OF 'CENTRE OF GRAVITY' (MM).
8	R*4	ZC)
9	R*4	DX)
10	R*4	DY) DIRECTION COSINES OF FITTED LINE.
11	R*4	DZ)
12	R*4	D1, DISTANCE TO 'FIRST' POINT (MM).
13	R*4	D2, DISTANCE TO 'LAST' POINT (MM). NOTE. ALGORITHM TO GET COORDINATES OF FIRST HIT IS... X1=XC+D1*DX Y1=YC+D1*DY Z1=ZC+D1*DZ AND SIMILARLY FOR LAST HIT.
14	R*4	RMS DEVIATION FOR 'GOOD' CLUSTER - SEE ALSO WORDS 25,26. =0. IF MULINA (AMBIGUITY RESOLVING ROUTINE) NOT CALLED. =-1. IF IT FAILS ACCEPTANCE CRITERIA, =-2. IF IT HAS MORE THAN 2 ACCEPTABLE AMBIGUITY PERMUTATIONS. =-9999. IF MULINA HAS TAKEN NO ACTION, E.G. IF ONLY 1 LAYER, OR TOO MANY AMBIGUITIES, OR ONLY 2 LAYERS AND TOO MANY AMBIGUITIES. NOTE THAT IF THIS WORD.LE.0 THEN WORDS 6-11 CONTAIN THE THE RESULTS OF FITTING PRIOR TO CALL TO MULINA, I.E. L AND R HITS OF UNRESOLVED HITS USED WITH EQUAL WEIGHT (ALTHOUGH WITH LOWER WEIGHT THAN RESOLVED HITS).
15	R*4	INTEGRAL DL (=DISTANCE, MM).) (FROM
16	R*4	INTEGRAL DENSITY*DL (= MATERIAL TRAVERSED, GM CM**-2).) (INTERACTION
17	R*4	INTEGRAL (-DE/DX)*DL (ENERGY LOSS, MINIMUM IONISING PARTICLE, GEV).) (POINT TO LAST
18	R*4	INTEGRAL DL/(ABSORPTION LENGTH) ('NUMBER' OF ABSORPTION LENGTHS) ASSUMING A PION.) (POINT IN CLUSTER.
19	R*4	MU 'GOODNESS' PARAMETER (VERY CRUDE AT THIS STAGE).
20	R*4	HADRON 'LEAK' PROBABILTY, EXP(-(NO. OF ABSN. LENGTHS)).
21	I*4	ASSOCIATED INNER DETECTOR TRACK NO., IF ANY.
22	I*4	ASSOCIATED LEAD GLASS CLUSTER NO., IF ANY.
23	R*4	DISTANCE BETWEEN PROJECTIONS OF THE MU-TRACK AND THE INNER DETECTOR TRACK, IF ANY, AT THE POSITION OF THE FLUX RETURN YOKE.

L12	R*4	INTEGRAL DL (=DISTANCE, MM).	)(FROM (6)
L13	R*4	INTEGRAL DENSITY*DL (= MATERIAL TRAVERSED, GM CM**-2).	)(~~INTER~~-)(~~ACTIC~~TRACK VERTEX
L14	R*4	INTEGRAL (-DE/DX)*DL (ENERGY LOSS, ASSUMING PARTICLE IS A MUON, GEV).	)(~~POIN~~T TO)(LAST
L15	R*4	INTEGRAL DL/(ABSORPTION LENGTH) ('NUMBER' OF ABSORPTION LENGTHS) ASSUMING A PION.	)(HIT.)(
L16	R*4	ENERGY AT LAST HIT ASSUMING MUON (GEV).	
L17	R*4	INTEGRAL DL (=DISTANCE, MM).	)(FROM TRACK
L18	R*4	INTEGRAL DENSITY*DL (= MATERIAL TRAVERSED, GM CM**-2).	)(~~INTER~~ VERTEX)(~~ACTION~~
L19	R*4	INTEGRAL (-DE/DX)*DL (ENERGY LOSS, ASSUMING PARTICLE IS A MUON, GEV).	)(~~POINT~~ TO)(POSSIBLE
L20	R*4	INTEGRAL DL/(ABSORPTION LENGTH) ('NUMBER' OF ABSORPTION LENGTHS) ASSUMING A PION.	)(FURTHER)(HIT. (SAME AS 12-15 IF NO POSSIBLE FURTHER HIT)
L21	R*4	PROBABILITY OF PI->MU DECAY.	
L22	R*4	PROBABILITY OF NO NUCLEAR INTERACTION, ASSUMING A PION.	
L23	R*4	PROBABILITY OF PION PUNCHTHROUGH. ?<-?	

'MUR1' BANK 2 — TRACK NO. - HIT NO. CORRELATION.

END OF BANK DESCRIPTIONS.

24 Prob K-decay

25 " to be µ

26 " " hadron

'MUR2' BANK 1 - MUON INFORMATION FOR EACH INNER DETECTOR TRACK. (IN (5)
THE FOLLOWING DESCRIPTION, 'MULTIPLE SCATTERING CIRCLE' MEANS AN
ELLIPSE IN THE PLANE OF A MUON CHAMBER WITH MAJOR AXIS PARALLEL
TO THE WIRE. THE SEMI-MAJOR/MINOR AXIS HAS A LENGTH DMAJOR/DMINOR.

DMAJOR=F*SQRT(DSRMS**2+DLRES**2),

DMINOR=F*SQRT(DSRMS**2+DRES**2),

WHERE DSRMS IS THE RMS MULTIPLE SCATTERING DEFLECTION EXPECTED AT
THE CHAMBER,

DLRES IS THE LONGITUDINAL (I.E. PARALLEL TO WIRE) RESOLUTION
EXPRESSED AS A STANDARD DEVIATION,

DRES IS THE DRIFT DISTANCE RESOLUTION, ALSO A STANDARD DEVN.

F IS A FACTOR, SAY 3., TO COLLECT HITS WITHIN 3 STANDARD
DEVIATIONS. F IS ADJUSTABLE.

FOR EACH INNER DETECTOR TRACK...

IORD	TYPE	CONTENTS
1	I*4	TRACK NUMBER.
2	R*4	IDENTIFIER OF PROGRAM WHICH CREATED THIS INFORMATION (A 4-CHARACTER ALPHANUMERIC WORD).
3	I*4	DATE OF PRODUCTION, E.G. 79067 FOR 7TH MARCH 1979.
16	I*4	QUALITY FLAG =0, NO HITS AND NO HITS EXPECTED FOR A MUON.

ALSO extra word (4) — NUMBER OF ASSOCIATED MUON CHAMBER HITS.

=-2 NO CHAMBERS ALONG PROJECTED INNER DETECTOR TRACK, I.E. OUT OF ACCEPTANCE.

=-1, IF CLOSE TO EDGE OF 'SAFE' REGION

=0, in 'safe" fiducial region

extra word (5) ACCEPTANCE FLAG

=1, CLEAN MUON, I.E. A CLEAN LINE OF HITS, THE LAST OF WHICH CORRESPONDS TO AN AMOUNT OF PENETRATED MATERIAL NOT MORE THAN THE ULTIMATE RANGE OF A MUON WITH THE MOMENTUM OF THIS INNER DETECTOR TRACK AND THERE ARE NO CHAMBERS BEYOND THE LAST HIT WHICH FIRE.

=2, AS =1, BUT THE HITS USED ARE SHARED WITH ANOTHER TRACK, I.E. THERE IS AN AMBIGUITY.

=3, DIRTY MUON, I.E. AS =1, BUT MORE THAN 1 HITS WITHIN MULTIPLE SCATTERING CIRCLE IN AT LEAST ONE MUON CHAMBER LAYER.

+10, I.E. ADD 10 IF THE HITS STOP SHORT OF WHAT WOULD BE EXPECTED FOR A MUON, I.E. THERE EXIST CHAMBERS BEYOND THE LAST WHICH WOULD FIRE.

+100, I.E. ADD 100 IF THE HITS EXTEND TOO FAR, I.E. THE LAST HIT CORRESPONDS TO AN AMOUNT OF MATERIAL PENETRATED WHICH IS SIGNIFICANTLY GREATER THAN THE EXPECTED RANGE.

7	I*4	TRACK NUMBER OF TRACK WITH SHARED HITS, IF ANY. (=-1 IF MORE THAN 1 OTHER TRACKS SHARE HITS. IN THIS CASE SEE 'MUR2' BANK 2.)
8	I*4	CLUSTER NUMBER OF ASSOCIATED MUON CLUSTER RECORDED IN MUON RESULTS BANKS 'MUR1'. (=-1 IF MORE THAN 1 CLUSTER IS ASSOCIATED. IN THIS CASE SEE 'MUR2' BANK 2 AND 'MUR1' BANK 2.)
9	I*4	NO. OF HITS EXTRA TO ASSOCIATED CLUSTER.) (=0 FOR
10	I*4	NO. OF HITS IN ASSOCIATED CLUSTER BUT) (COMPLETE NOT FOUND HERE.) (CORRESPONDENCE.
11	R*4	CHI-SQUARED PROBABILITY OF BEING MUON. THIS HAS MEANING ONLY IF FLAG (WORD 4) IS .LT. 10. THE CHI-SQUARED IS THE SUM (D/SD)**2 FOR EACH DIRECTION FOR EACH HIT, WHERE D IS THE DISTANCE OF THE HIT FROM THE EXTRAPOLATION OF THE INNER DETECTOR TRACK, IN THE DRIFT DIRECTION OR WIRE DIRECTION, SD IS THE CORRESPONDING STANDARD DEVIATION, WHICH IS THE RMS MULTIPLE SCATTERING DISPLACEMENT AND THE CHAMBER RESOLUTION ADDED IN QUADRATURE.

MONTE CARLO.

MONTE CARLO STATUS AT 9/1/79.

WRITTEN LARGELY BY DEREK STORK, UPDATED SOMEWHAT BY JOHN ALLISON, WHO NOW HOLDS DEREK STORK'S FILES. NOW FULLY INCORPORATED INTO THE JADE MONTE CARLO ON 'F11BAR.JADE.SOURCE' AND '.LOAD', AND MAINTAINED BY WULFRIN BARTEL AND ECKHARD ELSEN.

THERE ARE SOME MUON MONTE CARLO PRINTING ROUTINES ON 'F22ALL.MUMC.S' AND '.L' WHICH CAN BE CALLED FOR DIAGNOSTIC PURPOSES AND FOR OBTAINING FULL INFORMATION ABOUT THE TRACKS IN THE MUON FILTER AS GENERATED. SEE, E.G., 'F11BAR.JADE.SOURCE(ITEST8)' WHERE THE APROPRIATE STATEMENTS ARE COMMENTED OUT, OR 'F22ALL.MUMC.S(MUGEN)' WHERE THEY ARE OPERATIONAL. THE CORRESPONDING JCL IS IN 'F22ALL.MUMC.S(#MUGEN)'.

MUON ANALYSIS.

MUON ANALYSIS STATUS AT 02/07/79.

THE ANALYSIS CAN BE INVOKED BY 3 DRIVING ROUTINES AS FOLLOWS:

CALL MUINI BEFORE THE EVENT LOOP.

CALL MUANA IN THE EVENT LOOP TO ANALYSE DATA.

CALL MUFINI AFTER PROCESSING TO GET STATISTICS, ETC.

THESE SUBROUTINES ARE DESCRIBED BELOW.

I)MUINI - THE MUON INITIALISATION ROUTIINE.

CALL MUINI(LUNC,LUNE,IPRINT,&98)

WHERE LUNC IS THE LOGICAL UNIT NUMBER OF THE MUON CALIBRATION DATA SET (THE DATASET IS F22ALL.MUCALIB.DATAXXXX WHERE XXXX IS A SEQUENCE NUMBER, PRESENTLY 0001, AND IS PLATENFEST.) USUALLY LUNC=8. IF LUNC=0, MUINI ASSUMES THE DATA IS ALREADY IN BANKS IN /BCS/ AS THOUGH READ BY BREAD.

LUNE IS THE LOGICAL UNIT NUMBER OF THE UPDATE DATA SET. (THE DATASET IS F22ALL.MUCALIB.UPDATEXX WHERE XX IS A SEQUENCE NUMEER, PRESENTLY 01, AND IS PLATENFEST.) USUALLY LUNE=9. IF LUNE=0, MUINI ASSUMES THERE ARE NO UPDATES TO BE MADE.

IPRINT=0 TO SUPPRESS PRINTING, OTHERWISE YOU GET ABOUT 10 PAGES OF MUON CAALIBRATION DATA.

&98 IS AN ERROR RETURN LABEL.

Allison

MU INFORMATION AT 14.22 04/07/79. PAGE 1

Computer
JADE NOTE 22.

MU INFORMATION.

JOHN ALLISON

4/7/79.

THIS INFORMATION IS KEPT ON 'F22ALL.JADEMUS(@MUINFOM)'. IT WAS LAST UPDATED AT 21.15 ON 02/07/79. IT CONTAINS EXTENSIVE INFORMATION ON THE MUON ANALYSIS AND MONTE CARLO PROGRAMS. IT WAS ISSUED IN JADE COMPUTER NOTE 22 IN JULY 1979.

? LINES PREFIXED WITH ? INDICATE INTENTION ONLY. FEATURES MARKED IN
? THIS WAY ARE NOT YET IMPLEMENTED. HOPEFULLY THEY WILL BE
? IMPLEMENTED AT SOME TIME AND AN UPDATED NOTE WILL BE ISSUED.

The libraries

'F22ALL.JADEMUS' (source)

and 'F22ALL.JADEMUL' (load)

are now standard JADE libraries. To process muon data and produce muon results banks, concatenate this library on LKED.SYSLIB before 'F22LH0.JADEGL'. Observe the calling sequence on page 2.

ja.

outdated!

DESCRIPTION OF MUON BANKS.

RAW DATA BANK 'MUEV'.

REAL DATA.....

WORD	TYPE	CONTENTS
1	I*2	) BANK DESCRIPTOR - SEE JADE NOTE 32.
2	I*2	)
3	I*2	MARKER FOR FIRST CRATE (=F0N(HEX) = 3840+N FOR CRATE N
.	I*2	REFERENCE SIGNAL (=E00(HEX)+IREF = 3584+IREF).
.	I*2	4*CHAMBER NUMBER + (HIT NUMBER - 1).)THESE
.	I*2	DRIFT TIME)3 WORDS
		OR 2048+SINGLES COUNT.)REPEATED
.	I*2	LONGITUDINAL TIME DIFFERENCE)FOR
		OR 2048+TIME INTERVAL FOR SINGLES COUNT.)EACH
		(TIME INTERVAL IN UNITS OF 0.5 SECS.))HIT.
.		.
.	I*2	MARKER FOR NEXT CRATE, ETC.

MONTE CARLO DATA.....

AS REAL DATA, WITHOUT MARKERS AND REFERENCE SIGNAL WORDS. (REFERENCE SIGNAL ASSUMED ZERO.)

MUON RESULTS BANKS 'MUR1' (6 BANKS NUMBERED 0-5).

THESE BANKS REPRESENT THE RESULTS OF FOLLOWING 'PHILOSOPHY 1', I.E. OF OBTAINING AS MUCH INFORMATION AS POSSIBLE BY LOOKING AT THE MUON SIGNALS ALONE.

'MUR1' BANK 0 - GENERAL INFORMATION.

WORD	TYPE	CONTENTS
1	I*4	NO. OF HITS.
2	I*4	NO. OF CLUSTERS (TRACKS).
3	I*4	NO. OF 2-BYTE WORDS PER HIT IN COORDINATE BANK.
4	I*4	NO. OF 4-BYTE WORDS PER CLUSTER IN CLUSTER BANK.
5	I*4	=1 IF MULINE HAS BEEN CALLED, I.E. IF AN ATTEMPT TO CREATE CLUSTERS HAS BEEN MADE. =0 OTHERWISE.
6	I*4	=1 IF AN ATTEMPT TO JOIN CLUSTERS TO INNER DETECTOR TRACKS HAS BEEN MADE. =0 OTHERWISE.
7	I*4	=1 IF AN ATTEMPT TO JOIN CLUSTERS TO LEAD-GLASS CLUSTERS HAS BEEN MADE. =0 OTHERWISE.
8	I*4	DATE OF PRODUCTION OF COORDINATE BANK.
9	I*4	CALIBRATION DATA ISSUE, I.E. IDENTIFIER OF CALIB. DATA USED TO PRODUCE COORDINATES.

II)MUANA - THE MUON ANALYSIS DRIVING ROUTINE.

CALL MUANA(IJOIN)

WHERE IJOIN.NE.0 TO GET MUON ROUTINES TO ATTEMPT TO JOIN MUON HITS AND TRACKS TO INNER DETECTOR AND LEAD GLASS TRACKS AND CLUSTERS, I.E. YOU WOULD USUALLY CALL MUANA(1) SAY. (IJOIN=0 SUPRESSES SUCH ATTEMPTS AND THUS CAN BE USED ON MU DATA ALONE WHEN NO OTHER BANKS EXIST.)

MUANA CALLS 4 OTHER DRIVING ROUTINES, WHICH CALL NUMEROUS OTHER ROUTINES.....

1)MUANAC. THIS CONVERTS SIGNALS TO COORDINATES AND CREATES 'MUR1' BANKS 0 AND 1 (SEE BELOW). IT CALLS 1 OF 2 SIGNAL TO COORDINATE CONVERSION ROUTINES...
MUTINY, WHICH USES A CONDENSED SET OF CALIBRATION DATA PREPARED BY MUCONT (FOR MONTE CARLO OUTPUT - SEE READMC), WHICH CALLS A VERSION OF MUCOWN.
MUCOOR, WHICH USES THE FULL MUON CALIBRATION DATA PREPARED BY MUCON (FOR MONTE CARLO OUTPUT - SEE READMC).

2)MUANAL. THIS LOOKS FOR 'LINEAR CLUSTERS', I.E. TRACKS, IN THE MUON FILTER. IT FOLLOWS 'PHILOSOPHY 1', I.E. GATHERS AS MUCH INFORMATION AS POSSIBLE BY LOOKING IN THE MUON FILTER ALONE. IT USES 'MUR1' BANKS 0 AND 1. IT UPDATES 'MUR1' BANK 0. IT CREATES 'MUR1' BANKS 2,3,4 AND 5 (SEE BELOW).

3)MUANAJ. THIS ATTEMPTS TO JOIN MUON CLUSTERS TO INNER DETECTOR AND LEAD-GLASS CLUSTERS. IT USES THE 'MUR1' BANKS AND UPDATES 'MUR1' BANKS 0 AND 3 (SEE BELOW).

4)MUANAF. THIS ADOPTS 'PHILOSOPHY 2', I.E. FOLLOWS EACH INNER DETECTOR TRACK OUT THROUGH THE MUON FILTER. CREATES 'MUR2'.

AN EXAMPLE OF A CALLING SEQUENCE IS AS FOLLOWS....

CONVERT MUON SIGNALS TO COORDINATES.
CALL MUANAC

FOLLOW EACH INNER DETECTOR TRACK OUT (PHILOSOPHY 2). AT THE MOMENT MUANAF AND MUANAL ARE COMPLETELY INDEPENDENT.
CALL MUANAF

FIND MUON LINES - PHILOSOPHY 1 MUON PATTERN RECOGNITION.
CALL MUANAL

ATTEMPT TO JOIN MUON CLUSTERS WITH INNER DETECTOR TRACKS AND WITH LEAD GLASS CLUSTERS. ALSO CORRELATE RESULTS OF PHILOSPHY 1 AND 2.
CALL MUANAJ

III)MUFINI - THE MUON 'FINISHING OFF' ROUTINE.

CALL MUFINI AFTER PROCESSING ALL DATA.

END OF DESCRIPTION OF MUON ANALYSIS.

```
 'MUR1' BANK 1 - MUON COORDINATE BANK.
 FOR EACH HIT....
  WORD   TYPE  CONTENTS
    1    I*2   4*CHAMBER NUMBER + (HIT NUMBER -1)
    2    I*2   10*LAYER NUMBER + ORIENTATION PARAMETER  (I.E. 1, 2 OR 3
                 ACCORDING TO DIRECTION OF NORMAL OF CHAMBER PLANES.
                 X->1, Y->2, Z->3.  SEE CMUTNY DESCRIPTION.)
    3    I*2   X )
    4    I*2   Y ) 'LEFT' AMBIGUITY (MM).
    5    I*2   Z )
    6    I*2   X )
    7    I*2   Y ) 'RIGHT' AMBIGUITY (MM).
    8    I*2   Z )

? 'MUR1' BANK 2 - MUON CLUSTER ASSIGNMENT BANK.
? FOR EACH HIT A 2-BYTE WORD PACKED AS FOLLOWS...
?  NAME                F  E   D   C   B   A
?  LAYOUT  M.S. I---I-I-----I-I-----I-I LEAST SIGNIFICANT END.
?  NO. OF BITS     3  1   5   1   5   1
?  NAME  BITS          CONTENTS
?   A     15 (L.S.)   =0 IF LONGITUDINAL MEASUREMENT DOUBTFUL..
?                     =1 IF LONGITUDINAL MEASUREMENT IS OK.
?   B  10-14          PRIMARY CLUSTER ASSIGNMENT (=0 IF UNASSIGNED).
?   C      9          =0 LEFT AMBIGUITY  ) (PRIMARY CLUSTER).
?                     =1 RIGHT AMBIGUITY )
?   D     4-8         SECONDARY CLUSTER ASSIGNMENT (=0 IF UNASSIGNED).
?   E      3          =0 LEFT AMBIGUITY  ) (SECONDARY CLUSTER).
?                     =1 RIGHT AMBIGUITY )
?   F     0-2 (M.S.)  FREE.

 'MUR1' BANK 3 - MUON CLUSTER INFORMATION.   (NOTE. CLUSTER NUMBER IN
    WORD 27.)
 FOR EACH CLUSTER...
  WORD   TYPE  CONTENTS
    1    I*4   DATE OF PRODUCTION (E.G. 790110 FOR 10/1/79).
    2    R*4   IDENTIFIER OF PROGRAM WHICH CREATED CLUSTER (A 4 CHAR-
                 ACTER ALPHANUMERIC WORD).
    3    I*4   NO. OF HITS IN CLUSTER.
    4    I*4   CLUSTER NUMBER OF ALTERNATIVE CLUSTER (=0 IF NONE).
    5    I*4   =0, ONLY ONE LAYER IN CLUSTER (IF SO WORDS 9-14=0).
    6    R*4   XC )
    7    R*4   YC ) COORDS. OF 'CENTRE OF GRAVITY' (MM).
    8    R*4   ZC )
    9    R*4   DX )
   10    R*4   DY ) DIRECTION COSINES OF FITTED LINE.
   11    R*4   DZ )
   12    R*4   D1, DISTANCE TO 'FIRST' POINT (MM).
   13    R*4   D2, DISTANCE TO 'LAST' POINT (MM).
                 NOTE. ALGORITHM TO GET CORDINATES OF FIRST HIT IS...
                   X1=XC+C1*DX
                   Y1=YC+C1*DY
                   Z1=ZC+C1*DZ
                 AND SIMILARLY FOR LAST HIT.
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14	R*4	RMS DEVIATION FOR 'GOOD' CLUSTER - SEE ALSO WORDS 25,26. =0. IF MULINA (AMBIGUITY RESOLVING ROUTINE) NOT CALLED. =-1. IF IT FAILS ACCEPTANCE CRITERIA. =-2. IF IT HAS MORE THAN 2 ACCEPTABLE AMBIGIUTY PERMUTATIONS. =-9999. IF MULINA HAS TAKEN NO ACTION, E.G. IF ONLY 1 LAYER, OR TOO MANY AMBIGUITIES, OR ONLY 2 LAYERS AND TOO MANY AMBIGUITIES. NOTE THAT IF THIS WORD.LE.0 THEN WORDS 6-11 CONTAIN THE THE RESULTS OF FITTING PRIOR TO CALL TO MULINA, I.E. L AND R HITS OF UNRESOLVED HITS USED WITH EQUAL WEIGHT (ALTHOUGH WITH LOWER WEIGHT THAN RESOLVED HITS).
15	R*4	INTEGRAL DL (=DISTANCE, MM).)(FROM
16	R*4	INTEGRAL DENSITY*DL (= MATERIAL TRAVERSED, GM CM**-2).)(INTER-)(ACTION
17	R*4	INTEGRAL (-DE/DX)*DL (ENERGY LOSS, MINIMUM IONISING PARTICLE, GEV).)(POINT TO)(LAST
18	R*4	INTEGRAL DL/(ABSORPTION LENGTH) ('NUMBER' OF ABSORPTION LENGTHS) ASSUMING A PION.)(POINT IN)(CLUSTER.
19	R*4	MU 'GOODNESS' PARAMETER (VERY CRUDE AT THIS STAGE).
20	R*4	HADRON 'LEAK' PROBABILTY, EXP(-(NO. OF ABSN. LENGTHS)).
21	I*4	ASSOCIATED INNER DETECTOR TRACK NO., IF ANY.
22	I*4	ASSOCIATED LEAD GLASS CLUSTER NO., IF ANY.
23	R*4	DISTANCE BETWEEN PROJECTIONS OF THE MU-TRACK AND THE INNER DETECTOR TRACK, IF ANY, AT THE POSITION OF THE FLUX RETURN YOKE.
24	R*4	ULTIMATE RANGE OF A MUON WITH MOMENTUM OF INNER DETECTOR TRACK, IF ANY (GM CM**-2).
25	R*4	RMS DRIFT DIRECTION DEVIATION.) IGNORE IF
26	R*4	RMS LONGITUDINAL (WIRE) DIRECTION DEVIATION.) WD 14.LE.0.
27	I*4	CLUSTER NUMBER.

'MUR1' BANK 4 - THE POINTER LIST HCLP.
HCLP(ICL) POINTS TO START OF INFORMATION IN HCLIST (BANK 5) FOR CLUSTER ICL.
HCLP(NO. OF CLUSTERS +1) POINTS TO WORD AFTER THE LAST.

'MUR1' BANK 5 - THE HIT LIST HCLIST.
THIS GIVES THE HITS BELONGING TO EACH CLUSTER.
BANKS 4 AND 5 MAY BE USED IN CONJUNCTION TO FIND THE HITS BELONGING

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      SDL**2=DSRMS**2+DLRES**2+DPERRL**2,
      SDD**2=DSRMS**2+DRES**2+DPERRD**2,
    WHERE DSRMS IS THE RMS MULTIPLE SCATTERING DEFLECTION EXPECTED AT
                THE CHAMBER,
          DLRES IS THE LONGITUDINAL (I.E. PARALLEL TO WIRE) RESOLUTION
                EXPRESSED AS A STANDARD DEVIATION,
          DRES IS THE DRIFT DISTANCE RESOLUTION, ALSO A STANDARD DEVN.
          DPERRL/D ARE THE PROJECTION ERRORS IN THE WIRE/DRIFT
                DIRECTIONS,
          F IS A FACTOR, SAY 3., TO COLLECT HITS WITHIN 3 STANDARD
                DEVIATIONS.  F IS ADJUSTABLE.
FOR EACH INNER DETECTOR TRACK...
 WORD  TYPE  CONTENTS
   1   I*4   TRACK NUMBER.
   2   R*4   IDENTIFIER OF PROGRAM WHICH CREATED THIS INFORMATION (A
               4-CHARACTER ALPHANUMERIC WORD).
   3   I*4   DATE OF PRODUCTION, E.G. 790307 FOR 7TH MARCH 1979.
   4   I*4   NUMBER OF ASSOCIATED MUON HITS.
?  5   I*4   ACCEPTANCE FLAG, =0, SAFELY IN ACCEPTANCE,
?                             =1, NEAR EDGE OF ACCEPTANCE,
?                             =2, DEFINITELY OUTSIDE MUON ACCEPTANCE.
   6   I*4   QUALITY FLAG,
             =0, NO ASSOCIATED MUON CHAMBER HITS AND NONE EXPECTED.
             =1, CLEAN MUON, I.E. A CLEAN LINE OF HITS, THE LAST
                    OF WHICH CORRESPONDS TO AN AMOUNT OF
                    PENETRATED MATERIAL NOT MORE THAN THE
                    ULTIMATE RANGE OF A MUON WITH THE MOMENTUM
                    OF THIS INNER DETECTOR TRACK AND THERE ARE
                    NO CHAMBERS BEYOND THE LAST HIT WHICH FIRE.
?            =2, AS =1, BUT THE HITS USED ARE SHARED WITH ANOTHER
?                    TRACK, I.E. THERE IS AN AMBIGUITY.
?            =3, DIRTY MUON, I.E. AS =1, BUT MORE THAN 1 HITS
?                    WITHIN MULTIPLE SCATTERING CIRCLE IN AT LEAST
?                    ONE MUON CHAMBER LAYER.
             +10, I.E. ADD 10 IF THE HITS STOP SHORT OF WHAT
                    WOULD BE EXPECTED FOR A MUON, I.E. THERE EXIST
                    CHAMBERS BEYOND THE LAST WHICH WOULD FIRE.
?            +100, I.E. ADD 100 IF THE HITS EXTEND TOO FAR, I.E.
?                    THE LAST HIT CORRESPONDS TO AN AMOUNT OF
?                    MATERIAL PENETRATED WHICH IS SIGNIFICANTLY
?                    GREATER THAN THE EXPECTED RANGE.
  13   I*2   NUMBER OF TRACKS WITH SHARED HITS INSIDE MAGNET YOKE.
               (IF >3 SEE 'MUR2' BANK 2 FOR DETAILS.)
  14   I*2   TRACK NUMBER OF 1ST TRACK WITH SHARED HITS INSIDE YOKE.
  15   I*2   TRACK NUMBER OF 2ND TRACK WITH SHARED HITS INSIDE YOKE.
  16   I*2   TRACK NUMBER OF 3RD TRACK WITH SHARED HITS INSIDE YOKE.
  17   I*2   NUMBER OF TRACKS WITH SHARED HITS OUTSIDE MAGNET YOKE.
               (IF >3 SEE 'MUR2' BANK 2 FOR DETAILS.)
  18   I*2   TRACK NUMBER OF 1ST TRACK WITH SHARED HITS OUTSIDE YOKE.
  19   I*2   TRACK NUMBER OF 2ND TRACK WITH SHARED HITS OUTSIDE YOKE.
  20   I*2   TRACK NUMBER OF 3RD TRACK WITH SHARED HITS OUTSIDE YOKE.
?  11   R*4   CHI-SQUARED PROBABILITY OF BEING MUON.  THIS HAS MEANING
?             ONLY IF THE QUALITY FLAG (WORD 6) IS .LT. 10.
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      TO EACH CLUSTER AS FOLLOWS...
     NCLS = NO. OF CLUSTERS (WORD 2 OF BANK 0).
     NWHIT = NO. OF WORDS PER HIT (WORD 3 OF BANK 0).
     NWCL = NO. OF WORDS PER CLUSTER (WORD 4 OF BANK 0).
     IPCL = IP3, WHERE IP3 IS POINTER TO BANK 3.
     IP11 = 2*IP1, WHERE IP1 IS POINTER TO BANK 1.
     IP44 = 2*IP4, WHERE IP4 IS POINTER TO BANK 4.
     IP55 = 2*IP5, WHERE IP5 IS POINTER TO BANK 5.
BEGIN LOOP 1 - LOOP OVER CLUSTERS                    **** START LOOP 1
      DO 1000 ICL=1,NCLS
FIND HITS FOR THIS CLUSTER.  TO GET HITS OF SECONDARY CLUSTER USE
  THE POINTERS OF PRIMARY CLUSTER.
      JCL=ICL
      IALT=IDATA(IPCL+4)
      IF(IALT.NE.0.AND.IALT.LT.ICL)JCL=IALT
      LP=HDATA(IP44+JCL)
      LPNEXT=HDATA(IP44+JCL+1)
START LOOP 2.                                        ***** START LOOP2.
2000  CONTINUE
      IHIT=HDATA(IP55+LP)
      IP=NWHIT*(IHIT-1)
NOW YOU CAN FIND HITS. ADD IP TO IP11 TO GET START OF COORDINATE DATA.
 (DON'T FORGET TO USE APPROPRIATE INFORMATION,E.G. AMBIGUITY FLAGS,
  FOR SECONDARY CLUSTERS, I.E. IF(JCL.LT.ICL) ).
      ....
      ....
END LOOP 2.                                          ***** END LOOP 2.
2001  CONTINUE
      LP=LP+1
      IF(LP.LT.LPNEXT)GO TO 2000
END LOOP 1.                                          ***** END LOOP 1.
1001  CONTINUE
      IPCL=IPCL+NWCL
1000  CONTINUE
```

MUON RESULTS BANKS 'MUR2' (4 BANKS NUMBERED 0-3).

THESE BANKS REPRESENT THE RESULTS OF FOLLOWING 'PHILOSOPHY 2', I.E. OF FOLLOWING INNER DETECTOR TRACKS OUT.

'MUR2' BANK 0 - GENERAL INFORMATION.

WORD	TYPE	CONTENTS
1	I*4	NO. OF INNER DETECTOR TRACKS ACCORDING TO BANK 'PATR'.
2	I*4	NO. OF 4-BYTE WORDS PER TRACK IN BANK 1.
3	I*4	NTPH, NO. OF TRACKS PER HIT ALLOCATED IN BANKS 2 AND 3.

'MUR2' BANK 1 - MUON INFORMATION FOR EACH INNER DETECTOR TRACK. (IN THE FOLLOWING DESCRIPTION, 'MULTIPLE SCATTERING CIRCLE' MEANS AN ELLIPSE IN THE PLANE OF A MUON CHAMBER WITH MAJOR AXIS PARALLEL TO THE WIRE. THE SEMI-MAJOR/MINOR AXIS HAS A LENGTH DMAJOR/DMINOR.

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  DMAJOR=F*SDL,
  DMINOR=F*SDD,
WHERE
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COMMON DESCRIPTIONS.

MACRO CMUFRCH.

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----------START OF MACRO CMUFRCH----------

/CMUCDV/,/CMUNIT/,/CMFFIX/,/CMFSUR/,/CMCFIX/,/CMCSUR/,/CMCELE/,/CMCSTA/
   ARE DESCRIBED ON 'F22ALL.JADEMUS(@MUINFOM)'. THEY CAN BE READ FROM
   THE APPROPRIATE MU CALIBRATION DATA EOS RECORD, E.G.,
   'F22ALL.MUCALIB.DATACC01' USING BREAD AND MUCON.

      COMMON /CMUCDV/NVERSN,DESCRP(15)

      COMMON /CMUNIT/HOVALL(6)

      COMMON/CMFFIX/HMFFIX(740)
      DIMENSION HFACE(82),HSECT(82),HLAYER(82),HNORM(82),HLONG(82),
     *          HTRANS(82),HAC(82),HAL(82),HUNIT(82)
      EQUIVALENCE (HMFFIX(1),NFRAMS),(HMFFIX(3),HFACE(1)),
     *            (HMFFIX(85),HSECT(1)),(HMFFIX(167),HLAYER(1)),
     *            (HMFFIX(249),HNORM(1)),(HMFFIX(331),HLONG(1)),
     *            (HMFFIX(413),HTRANS(1)),(HMFFIX(495),HAC(1)),
     *            (HMFFIX(577),HAL(1)),(HMFFIX(659),HUNIT(1))

      COMMON/CMFSUR/HMFSUR(492)
      DIMENSION HDIST(82),HANG(82),HCLLO(82),HCLHI(82),HCTLO(82),
     *          HCTHI(82)
      EQUIVALENCE (HMFSUR(1),HDIST(1)),(HMFSUR(83),HANG(1)),
     *            (HMFSUR(165),HCLLO(1)),(HMFSUR(247),HCLHI(1)),
     *            (HMFSUR(329),HCTLO(1)),(HMFSUR(411),HCTHI(1))

      COMMON/CMCFIX/HMCFIX(636)
      DIMENSION HFR(634)
      EQUIVALENCE (HMCFIX(1),NCHAMS),(HMCFIX(3),HFR(1))

      COMMON/CMCSUR/HMCSUR(1268)
      DIMENSION HD1(634),HCTW(634)
      EQUIVALENCE (HMCSUR(1),HCTW(1)),(HMCSUR(635),HC1(1))

      COMMON/CMCELE/HMCELE(4440)
      DIMENSION HDTP(634),HLTP(634),HLSF(4,634),HVDRFT(634)
      EQUIVALENCE (HMCELE(1),HVDR),(HMCELE(2),HDTP(1)),
     *            (HMCELE(636),HLTP(1)),(HMCELE(1270),HLSF(1,1)),
     *            (HMCELE(3806),HMCEDM),(HMCELE(3807),HVDRFT(1))

      COMMON/CMCSTA/HMCSTA(634)

----------END OF MACRO CMUFRCH----------

NVERSN              VERSION NUMBER.
DESCRP              DESCRIPTION.

HOVALL(IUNIT)       OVERALL TRANSLATION OF EACH UNIT ALONG RAILS.
                      IUNIT=1 - FAR SIDE (-X) WALL,
                      IUNIT=2 - NEAR SIDE (+X, RUCKSACK) WALL,
                      IUNIT=3 - MAGNET  (ALL TRANSLATIONS ARE RELATIVE TO
                                THIS SO HOVALL(3) SHOULD ALWAYS BE ZERO.)
                      IUNIT=4 - FAR SIDE (-X) ARCH,
                      IUNIT=5 - NEAR SIDE (+X) ARCH.
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   12    R*4    INTEGRAL DL (=DISTANCE, MM).                          )(FROM
   13    R*4    INTEGRAL DENSITY*DL (= MATERIAL TRAVERSED,            )(VERTEX
                  GM CM**-2).                                        )(TO
   14    R*4    INTEGRAL (-DE/DX)*DL (ENERGY LOSS, ASSUMING           )(LAST
                  PARTICLE IS A MUON, GEV).                          )(HIT.
   15    R*4    INTEGRAL DL/(ABSORPTION LENGTH) ('NUMBER' OF          )(
                  ABSORPTION LENGTHS) ASSUMING A PION.               )(
   16    R*4    ENERGY AT LAST HIT ASSUMING MUON (GEV).
   17    R*4    INTEGRAL DL (=DISTANCE, MM).                          )(FROM
   18    R*4    INTEGRAL DENSITY*DL (= MATERIAL TRAVERSED,            )(VERTEX TO
                  GM CM**-2).                                        )(POSSIBLE
   19    R*4    INTEGRAL (-DE/DX)*DL (ENERGY LOSS, ASSUMING           )(FURTHER
                  PARTICLE IS A MUON, GEV).                          )(HIT.  SAME
   20    R*4    INTEGRAL DL/(ABSORPTION LENGTH) ('NUMBER' OF          )(AS 12-15
                  ABSORPTION LENGTHS) ASSUMING A PION.               )(IF NONE.
?  21    R*4    PROBABILITY OF PI->MU DECAY.
?  22    R*4    PROBABILITY OF NO NUCLEAR INTERACTION, ASSUMING A PION.
?           (THIS IS JUST EXP(-WORD 20).)
?  23    R*4    PROBABILTY OF PION PUNCHTHROUGH.
?  24    R*4    PROBABILTY OF K->MU DECAY.
?  25    R*4    PROBABILTY OF BEING A MUON.
?             IF CLEAN (WORD 6.LT.10), = CHI-SQUARED PROB. (WORD 11),
?             IF STOPS SHORT (WORD 6.GT.10 AND .LT.100), MULTIPLY
?               BY INNEFICIENCY OF POSSIBLE FURTHER
?               CHAMBER FIRING,
?             IF DIRTY (MOD(WORD 6,10).EQ.3), MULTIPLY BY A FACTOR
?               .LT.1. BECAUSE IT MAY BE A NUCLEAR INTERACTION.
?  26    R*4    PROBABILTY OF BEING A HADRON.
?             = SUM OF WORDS 22 AND 23, PLUS THE DECAY
?               PROBABILTIES (WORDS 21 OR 24) WEIGHTED IN SOME WAY
?               ACCORDING TO THE RELATIVE PROBABILITIES DEDUCED
?               FROM TIME OF FLIGHT OR DE/DX MEASUREMENT.
?             IF DIRTY, MULTIPLY BY A FACTOR .GT.1. BECAUSE IT MAY
?               BE A NUCLEAR INTERACTION.
?  27    I*4    CLUSTER NUMBER OF ASSOCIATED MUON CLUSTER RECORDED IN
?             MUON RESULTS BANKS 'MUR1'. (=-1 IF MORE THAN 1 CLUSTERS
?             ARE ASSOCIATED.  IN THIS CASE SEE 'MUR2' BANK 2 AND
?             'MUR1' BANK 2.)
?  28    I*4    NO. OF HITS EXTRA TO ASSOCIATED CLUSTER.)(=0 FOR
?  29    I*4    NO. OF HITS IN ASSOCIATED CLUSTER BUT    )(COMPLETE
?             NOT FOUND HERE.                           )(CORRESPONDENCE.

'MUR2' BANK 2 - MUON HIT - INNER DETECTOR TRACK CORRELATION.
    NTPH I*2 WORDS PER HIT.  (NTPH IS THE NUMBER OF TRACKS PER HIT
    ALLOCATED IN THIS BANK, AND IS GIVEN IN WORD 3 OF BANK 0.)
 FOR EACH MUON HIT....
 WORD   TYPE   CONTENTS
   1     I*2   1ST INNER DETECTOR TRACK NUMBER (=0 IF NONE).
   2     I*2   2ND INNER DETECTOR TRACK NUMBER (=0 IF NONE).
   .           .
  NTPH   I*2   NTPH'TH INNER DETECTOR TRACK NUMBER (=0 IF NONE,
                 = -(TRACK NUMBER) IF MORE THAN NTPH TRACKS
                 ASSOCIATED WITH THIS HIT).

'MUR2' BANK 3 - MUON HIT AMBIGUITY FLAGS.  FOR EACH ENTRY IN BANK 2
    THERE IS AN ENTRY HERE.  THE AMBIGUITY FLAG IS...
       -1, LEFT AMBIGUITY SELECTED,
       +1, RIGHT AMBIGUITY SELECTED,
        0, BOTH AMBIGUITIES EQUALLY ACCEPTABLE.

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END OF BANK DESCRIPTIONS. -----------------------------------------
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   -DINATES RELATIVE TO THE CHAMBER AS FOLLOWS..
 ICT=(HVDR*(ITD-HDTP))/1000
 ICL=(HLSF*(ITL-HLTP))/100
   WHERE ICT,ICL ARE COORDINATES IN MM,
   ITD IS DRIFT TIME IN TRANS. CLOCK UNITS, AND
   ITL IS LONG. TIME DIFF. IN LONG. CLOCK UNITS.

STATUS DATA FOR THE CHAMBERS

HMCSTA(ICHAM)     =0 IF CHAMBER OK
                  .NE.0 IF CHAMBER U/S FOR ANY REASON.
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MACRO CMUTNY.

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  /CMUTNY/

CONDENSED MU-FILTER PARAMETERS FOR USE BY APPROXIMATE SIGNAL TO
  COORDINATE CONVERSION SUBROUTINE MUTINY.

HPLANS        NO. OF CHAMBER PLANES.
HVDRAV        AVERAGE DRIFT VELOCITY.
HDTPAV        AVERAGE DRIFT TIME PEDESTAL.
HLTPAV        AVERAGE LONGITUDINAL TIME DIFFERENCE PEDESTAL.
HLSFAV        AVERAGE LONGITUDINAL SCALING FACTOR.

FOR EACH CHAMBER PLANE...

HLY           LAYER NUMBER.
HOR           ORIENTATION PARAMETER:
              =1, WIRES PARALLEL TO BEAM, AND NORMAL PARALLEL TO
                    X-AXIS - FACES 1(-X) AND 2(+X).
              =2, WIRES PARALLEL TO BEAM, AND NORMAL PARALLEL TO
                    Y-AXIS - FACES 3(-Y) AND 4(+Y).
              =3, WIRES VERTICAL, AND NORMAL PARALLEL TO Z-AXIS -
                    FACES 5(-Z) AND 6(+Z).
HC1           FIRST CHAMBER NUMBER.
HCN0          NORMAL      )
HCL0          LONGITUDINAL )  COORDINATE OF 'ORIGIN' OF CHAMBER PLANE.
HCT0          TRANSVERSE  )
HSP           AVERAGE SPACING OF CHAMBERS.

  (THE 'ORIGIN' IS AT ONE END OF THE WIRE OF THE FIRST CHAMBER IN THE
PLANE.  THE END IS THAT WITH THE LOWEST LONGITUDINAL COORDINATE.)

    COMMON /CMUTNY/HPLANS,HVDRAV,HDTPAV,HLTPAV,HLSFAV,
   * HLY(48),HOR(48),HC1(48),HCN0(48),HCL0(48),HCT0(48),HSP(48)
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IFRAME              FRAME NUMBER.
ICHAM               CHAMBER NUMBER.
NFRAMS              NUMBER OF FRAMES.
NCHAMS              NUMBER OF CHAMBERS.

FIXED DATA FOR EACH FRAME....

HFACE(IFRAME)       1-6 FOR -X,+X,-Y,+Y,-Z,+Z RESPECTIVELY.
                    =0 IF FRAME NOT PRESENT.
HSECT(IFRAME)       SECTION NUMBER OF SECTION TO WHICH FRAME BELONGS
HLAYER(IFRAME)      1-5 NUMBERING FROM THE INTERACTION POINT OUTWARDSH
                      =1, INSIDE RETURN YOKE
                      =2-5 FOR LAYERS ON CONCRETE,
HNORM(IFRAME)       =1,NORMAL OF PLANE PARALLEL TO X-AXIS
                    =2,NORMAL OF PLANE PARALLEL TO Y-AXIS
                    =3,NORMAL OF PLANE PARALLEL TO Z-AXIS
HLONG(IFRAME)       =1,WIRE NOMINALLY PARALLEL TO X-AXIS
                    =2,WIRE NOMINALLY PARALLEL TO Y-AXIS
                    =3,WIRE NOMINALLY PARALLEL TO Z-AXIS
HTRANS(IFRAME)      =1,DRIFT FIELD PARALLEL TO X-AXIS
                    =2,DRIFT FIELD PARALLEL TO Y-AXIS
                    =3,DRIFT FIELD PARALLEL TO Z-AXIS
HAC(IFRAME)         CHAMBER NUMBER OF FIRST CHAMBER IN FRAME.
HAL(IFRAME)         CHAMBER NUMBER OF LAST CHAMBER IN FRAME.
HUNIT(IFRAME)       UNIT TO WHICH THIS FRAME BELONGS.

SURVEY DATA FOR EACH FRAME....

HDIST(IFRAME)         THE COORDINATE OF THE CENTRAL PLANE WHERE THE AXIS
                       SPECIFIED BY HNORM(IFRAME) CUTS THE PLANE.(UNITS MM
HANG(IFRAME)          THE ANGLE BETWEEN THE WIRE AND THE AXIS SPECIFIED BY
                       HLONG(IFRAME)  (UNITS 1/10 MR)
HCLLO(IFRAME)         LOWER LOGITUDINAL COORDINATE LIMIT
HCLHI(IFRAME)         UPPER LOGITUDINAL COORDINATE LIMIT
HCTLO(IFRAME)         LOWER TRANSVERSE COORDINATE LIMIT
HCTHI(IFRAME)         UPPER TRANSVERSE COORDINATE LIMIT
                       THE ABOVE 4 VARIABLES APPLY TO TOTAL SENSITIVE AREA
                         OF PLANE.THEY ARE IN MM

FIXED DATA FOR EACH WIRE....

HFR(ICHAM)            FRAME NUMBER FOR THIS CHAMBER.

SURVEY DATA FOR EACH WIRE....

HD1(ICHAM)            AMOUNT TO BE ADDED TO HDIST(IFRAME) TO GET TO
                        COORDINATE OF THE CHAMBER.   (UNITS MM)
HCTW(ICHAM)           TRANVERSE COORDINATE OF EACH IRE.  (UNITS MM)

ELECTRONIC DATA FOR CHAMBERS...

HDTP(ICHAM)           DRIFT TIME PEDESTAL (TRANS. CLOCK UNITS, CA. 60 NS.)
HLTP(ICHAM)           LONGITUDINAL TIME PEDESTAL (IN LONG. CLOCK UNITS,
                        CA. 0.5 NS. OR 50 MM.)
HLSF(J,ICHAM)         LONG. SCALE FACTOR FOR J'TH HIT
                        (UNITS (1/100MM)/LONG. CLOCK UNIT)
HVDRFT(ICHAM)         DRIFT VELOCITY (MICRONS PER CLOCK UNIT (50 NS)).

                      THE ABOVE DATA ARE USED TO CONVERT SIGNALS TO COOR-
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MACRO CMUFIL.

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      INTEGER*2 HBLLO(6),HBLHI(6),HBTLO(6),HBTHI(6),HBNLIM(36)
      INTEGER*4 IFCIND(6)
      INTEGER*2 HFILDA
      COMMON/CMUFIL/HFILDA(72)
      EQUIVALENCE (HBLLO(1),HFILDA(1)),(HBLHI(1),HFILDA(7)),
     *            (HBTLO(1),HFILDA(13)),(HBTHI(1),HFILDA(19)),
     *            (HBNLIM(1),HFILDA(25)),(IFCIND(1),HFILDA(61))
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MACRO CMUYOK.

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      INTEGER*2 HYKTDM,HYKLDM,HYKNMI,HYKNMO
      COMMON/CMUYOK/HYKNMI(4),HYKNMO(4),HYKLDM(4),HYKTDM(4),EYOKE,
     *              IYKIND
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MACRO CMUENP.

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      COMMON/CMUENP/IZEII,IZEIO,IREP1,IREP2,IREP3,IREP4,IXYEF5,
     *              IZOEP1,IZOEP2,IZOEP3,IZOEP4,IZOEP5,CAEP2,
     *              IEPIND,IEPSCT
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END OF COMMON DESCRIPTIONS.