```
   ***********************************************************
****                                                      ****
****      J A D E   C O M P U T E R   N O T E    6 6      ****
****                                                      ****
****               INNER DETECTOR SMEARING                ****
****                         AND                          ****
****                 TRIGGER SIMULATION                   ****
****                                                      ****
****             IN JADE MONTECARLO EVENTS                ****
****                                                      ****
   ***********************************************************
```

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This note contains detailed information about the software handling of inner detector resolution and trigger simulation in Monte Carlo events in JADE. It is mainly intended to be a help for those who will have to change or add details in future developments. But it also gives overall information about the structuring of Monte Carlo events and Monte Carlo data files in JADE and should therefore be a useful introduction for the general user. The list of program errors and logical mistakes which is given below, as well as the notes on Muon Monte Carlo and TP-programs should also be of general interest.

The details refer to the proposed new scheme for smearing and trigger simulation, which does away with the many known program bugs which plague the up to now current version. A list of these bugs and the affected routines is provided below and where relevant, commented upon in the text.

The simulation of the JADE detector response is done in so called "TRACKING" programs. For the inner part of the JADE detector, (i.e. inner detector, scintillation counters and lead glass), the general programs reside on F22ELS.JMC.S and F22ELS.JMC.L. For the Muon filter simulation, special programs exist on F22RJB.RLMC.S and F22RJB.RLMC.L. For details of these programs, see JADE COMPUTER NOTES nr 26,40,54 and 55.

Here it is only noted that the input to these tracking programs are 4-vector events in the CPROD-format (see JADE COMPUTER NOTE 10) and the output are simulated JADE events in BOS-format. These output events are often referred to as "TRACKED" events.

For the inner detector, the tracking is done with a fine resolution, typically 20 micron (in recent developments, 5 micron has been used and is proposed for standard use in the new version). This resolution is kept in the output events and for this reason the output events are also known as " UNSMEARED, TRACKED " events. The simulation of the real resolution is known as "SMEARING" and is done when unsmeared events are read as input data. For the understanding of this process, the following general information is needed:

GENERAL INFORMATION:
====================

A file with JADE MC events, fully simulated and in BOS format, always start with two "CALIBRATION and DETECTOR STATUS" events. These two "events" are automatically read and processed by the standard read routine(s), or written out by the standard write routine(s):

    F11LHO.JADEGS(EVREAD)
    F11LHO.JADEGS(EVWRIT)

Thus the normal user never sees these initial events and the first call to EVREAD will return the first simulated JADE event on the file, although this event is only the third logical event on the file.

The tracking programs create these initial CALIBRATION and STATUS events automatically, in the output routine

    F22ELS.JMC.S(WRTMCB)

The logical event nr 1 contains the following banks:

    MTCO:1, MJET:2, MGEO:3.

When written out by subr. WRTMCB, these banks contain:

```
MTCO:     empty
MJET:     first 34 words of COMMON /CJDRCH/
MGEO:     COMMON /CGEO1/  66 words
```

Thus the bank MGEO contains all the geometry constants of the JADE detector (beampipe, pressure vessel,inner detector, counters, magnet, lead glass), which have been used in the tracking process. The bank MJET contains detailed geometry constants for the inner detector (words 1-19) and resolution constants (words 20-34), which were used in the tracking process. Here the information about the fine resolution, e.g. the time bin constants, are kept. The bank MTCO is empty, but will later contain details of smearing and trigger simulation, which are not provided in the tracking program step.

Event nr 2 contains the following banks:

    MUCO, MUCD, MUOV, MFFI, MCFI, MFSU,
    ~~MESU~~, MCEL, MCST, MUFI, MUYO, MUEN.

When written out by subr. WRTMCB, these banks contain various Muon filter information. WRTMCB calls subr. MUCONW for this purpose. Note however that MUCONW takes this information from the COMMON /CALIBR/, which is not properly set in the standard tracking program. Thus these banks have dummy content. Only when the complete Muon filter tracking program is used do these banks contain relevant information (see also the note below on Muon Monte Carlo).

To summarize: WRTMCB creates and writes, on its first call, the two calibration events and then, as the third logical output event, the first simulated event. Subsequent calls to WRTMCB will only write out the corresponding simulated event, in the normal way. All information about the tracking status and resolution is kept in the first two events on the output file.

What happens when reading such an unsmeared, tracked event file? This should be done with the standard routine EVREAD (or any other routine equipped in the same way). A flow chart of EVREAD is provided in Fig.1. Some details were already given in JADE COMPUTER NOTE 25.

EVREAD distinguishes three event types:

```
IEVTP = 0       Real data.
IEVTP = 1       Unsmeared Monte Carlo data.
IEVTP = 2       Smeared Monte Carlo data.
```

The variable IEVTP is set by EVREAD and passed on to other routines via the COMMON /CADMIN/ IEVTP,...   The COMMON /CADMIN/ is BLOCK DATA set in subr. EVREAD.

If the first event on the file contains the bank HEAD, EVREAD assumes that this is Real data, IEVTP = 0 and immediate RETURN is done.

If the first event on the file contains the bank MTCO, MC data is assumed. Smeared on Unsmeared data is decided upon from the value of the Smearing Flag: The latter is contained in the bank MTCO:

    IDATA(IDATA(IBLN('MTCO'))+1)

Its value is 0 for unsmeared, 1 for smeared data. IEVTP is set accordingly. To copy the information in the banks MTCO,MJET and MGEO into the relevant commons, EVREAD calls subr. RDMTCO. A flow-chart of this routine is provided in Fig.2.

"1. Event"
→MTCO

RDMTCO copies the bank MJET into COMMON /CJDRCH/ and the bank MGEO into COMMON/CGEO1/; thus the information on the data file will override the BLOCK DATA setting of these commons. If the file contains already smeared data and if it was written with a modern version of RDMTCO and output routines, the bank MTCO will contain information about smearing and trigger constants. In this case, the second and third words in bank MTCO are non-zero. If so, the information in MTCO is copied by RDMTCO into the relevant commons: /CBIN/, /CTRIGG/ and /CRDSTA/.

If the first event contained the bank MTCO, the second event is expected to contain the bank MUCO. To unpack this Muon filter information, EVREAD calls subr. MUCON.

2. Event "
" → MUCO

The third event should now contain a HEAD bank. After reading this event, EVREAD returns to the calling program and the first simulated event is available in COMMON /BCS/, with corresponding constants in various commons.

3. Event
→ HEAD

RDMTCO prints relevant information when it is called. The sequence MTCO, MUCO and HEAD can be repeated any nr of times and proper updating is always done, with accompanying informing print.

If EVREAD decides that the data are unsmeared, i.e. IEVTP = 1, it will smear them before returning. This is done for each event with a call to subr. RDJETC, which is an entry in RDMTCO. RDJETC calls in turn a number of subroutines to do the smearing of inner detector data in the bank JETC. This process will be described in detail below. RDJETC also calls the subroutines RDTRIG, RDTRG1 and RDTRG2, which simulate the trigger and create the banks LATC, TRIG:1 AND TRIG:2, as well as update the bank HEAD for TRIGGER ACTION and LOGICS CONDITIONS (TALC, HEAD word 22). Details of the trigger simulation will be given below. See also JADE COMPUTER NOTE 55.

Note here that the up to now current version of RDJETC calls the subr. RDTRG instead of RDTRIG. RDTRIG is essentially the same as RDTRG, but fills the COMMON /CTRIGG/ instead of COMMON /CTR123/ and is moreover extended to include 1982 trigger modes. It does not call RDTRG1 and RDTRG2 as RDTRG does, avoiding the logical error described below (see the section ERRORS).

Finally some words about the writing of Monte Carlo data to an output file. For this, the standard subr. EVWRIT should be used (or any other routine equipped in the same way). If called for real data, EVWRIT will only write the event on the output unit. If the event type IEVTP is not 0, EVWRIT will create the two CALIBRATION and STATUS events in the same way as described for WRTMCB above, and it will set the smear flag in the first word of bank MTCO, to the value 1. It creates the banks MJET and MGEO and fills them with the content of COMMONS /CJDRCH/ and /CGEO1/. The bank MTCO is also created and the content of the COMMON /CBIN/ (Smearing constants), as well as the COMMONS /CTRIGG/ and /CRDSTA/ (Trigger constants) is copied into MTCO. For the second event with Muon filter information, the subr. MUCONW is called. Finally, the simulated event is written, as the third logical event on the file. Subsequent calls will only write the MC events, just as is done for real events.

To summarize: EVWRIT will assure that the current smearing parameters are stored on the same file as the output events, keeping the structure of two CALIBRATION and STATUS events preceeding the actual MC events. If unsmeared events were read, the parameters of the just performed smearing are remembered. If smeared events were read, the smearing constants from the input file are transferred to the new output file.

OBS: It is not possible to smear already smeared events.

OBS: If unsmeared data should only be read and written, without smearing, a fast BOS READ and WRITE program should be used, since the use of EVREAD and EVWRIT automatically will invoke smearing and the original fine resolution is then destroyed.

A ready program for such fast READ and WRITE is provided in F22ELS.JMC.S(#COPY).

NOTE: The earlier version of EVWRIT did not copy any information from trigger simulation into MTCO and also not the dead cell status, nr of random hits, double hit resolution or wire efficiencies. Only the smearing variables which are situated in COMMON /CJDRCH/, like the time binning or z-resolution, were properly copied into the bank MJET.

DETAILS OF SMEARING:
=====================

The purpose of smearing is to worsen the fine resolution provided in the tracking program, so as to obtain a resolution matching the real data. The resolution in the real data depends on the intrinsic resolution as well as on a number of more or less well understood systematic effects, like chamber position uncertainties, field inhomogeneities, etc.. Most of these systematic effects are not simulated in MC events and the resolution has to be artificially imposed in other ways. In earlier versions of the smearing routines, worsening of resolution beyond the intrinsic resolution has been involuntarily obtained by the presence of several program bugs. In the momentum determination of high energy tracks these bugs cause severe systematic effects, which are not seen in real data. The removal of these bugs therefore necessitates a better and controllable smearing of the resolution. In the following, a method for such smearing is presented and suggested for standard use. First however, a short introduction to the flow of subr. RDJETC:

```
RDJETC
  ---> RDHEAD          (Save date, HEAD words 6-8, into words 96-98)
  ---> RDTRIG          (Set version date with call to RDDATE,       )
                       (set /CTRIGG/ and /CRDSTA/ accordingly.      )
  ---> RDRESO          (Smear time and Z-coordinate values.         )
  ---> RDMODN
           ---> RDRDMH (Generate random hits.                       )
           ---> RDMERG (Merge random hits into JETC data.           )
           ---> RDINEF (Kill some hits, acc. to wire inefficiency.  )
           ---> RDDOUB (Kill hits too close, double hit resolution.)
           ---> RDDDCL (Kill hits in dead cells.                    )
           ---> RDPOIN (Adjust pointers and data in JETC bank.      )
  ---> RDPATR          (Adjust some values in bank PATR:12.         )
  ---> RDTRG1          (Create banks LATC and TRIG:1.               )
  ---> RDTRG2          (Create bank TRIG:2.                         )
  ---> RDALGN          (Delete LG-blocks below readout threshold,   )
                       (specified by parameter IPHALG, default 0.   )
```

Here RDTRIG sets the COMMON /CRDSTA/ with information about dead cells in the inner detector. This information is used in the subsequent smearing (subr. RDDDCL). In an earlier version of RDJETC, which called subr. RDTRG after the smear routines, the first event was treated with a sometimes wrongly set COMMON /CRDSTA/.
After the proper smearing the hardware trigger is simulated in subr. RDTRG1 and RDTRG2. Relevant constants have been set by RDTRIG in COMMON /CTRIGG/.

The constants used in the smearing are stored in COMMON /CBIN/:

```
  COMMON/CBIN/TIME(6),ZOF,ZRS,ZL,ZSC,EPSI(3),DOUB(3),IRN(3),
 *  BINDL8(6),RJITT
```

TIME: Bin width for drift time in mm, wires are put together in groups of 8.
ZOF: Offset in z-coordinate, in mm.
ZRS: Standard deviation for z resolution, in mm.
ZL: Effective wire length in mm.
ZSC: Scaling factor for z amplitudes.
EPSI: Wire efficiency in each ring.
DOUB: Double track resolution in mm in each ring.
IRN: Nr of random hits inserted in each ring.

```
C---------- BINDL8 and RJITT are used in the new RDRESO for smearing.

          BINDL8:  Bin width for drift time in mm.
          RJITT:   Standard smearing of the drift coordinate.

   Default values are (BLOCK DATA set in RDMTCO):

      DATA TIME / 6*0.380/
      DATA ZOF, ZRS, ZL, ZSC / -10., 20., 2687., 1. /
      DATA EPSI / 3*.98 /
      DATA DOUB / 3*7.5 /
      DATA IRN  / 20, 20, 20 /

      DATA BINDL8 / 6*0.380/
      DATA RJITT / .270 /
```

The array BINDL8 is actually a help array and used together with the array TIME; it holds the actual binning used in the smearing, i.e. the values stored in time. This help array has been introduced to keep backward compatibility.

OBS: The TIME and RJITT values are designed to simulate the actual momentum resolution in real data. The values should not be directly compared to the space resolution in the real data.

RDRESO:

Drift-times and amplitudes are smeared in RDRESO. The drift-time, here called IDRI, is originally given in units of fine resolution, BINMC = .02 mm (or .005 mm). It is treated as follows:

```
      DRIFT = FLOAT(IDRI)*BINMC
      IDRIFT = IFIX(DRIFT/BINDL8)
      DRIINT = (FLOAT(IDRIFT) + .4999)*BINDL8
C-----------------------------------------------------------------------
C          SMEAR DRIFT COORDINATE
C
      Z1 = RN(DUM)
      SQLOG=SQRT(-2.*ALOG(RN(DUM)))
      G1=SIN(PI*2.*Z1)*SQLOG
C G1 IS RANDOM AND GAUSSIAN
      DRIINT = DRIINT + G1*RJITT
C-----------------------------------------------------------------------
      IDRI  = IFIX(DRIINT/BINMC)
```

Thus all smearing beyond the pure binning is governed by the parameter RJITT. The smeared coordinate is returned in units of the fine binning BINMC.

The difference between the old smearing scheme and the new one given by the above code, is shown schematically in Fig.3. Note the serious systematic error in the old scheme, coming from the adding of half a time bin to the drift coordinate. This bug gives rise to strong systematic effects for high momentum tracks. For lower momenta the effect is a worsening of resolution, which agrees roughly with the real data resolution. See also below in the section ERRORS; the errors in subr. JINIT and BLDAT also contribute to the artificial worsening of resolution in Monte Carlo data.

It is clear that in the proposed new scheme there is an interplay between the TIME bin width and the smear parameter RJITT. Several different combinations could be envisaged, that would give a similar momentum resolution in the data.

To change momentum resolution of the inner detector, the variables TIME(1-6) and RJITT should be changed. The present default values correspond approximately to a resolution dpt/pt = .02 * pt, with pt being the transverse momentum. A larger RJITT value means a worse momentum resolution. For RJITT < .1 mm, also the array TIME should

be changed to smaller values, to avoid binning effects. The following table may serve as a rough guide to such changes.

TIME (micron)	RJITT (micron)	dpt/(pt**2) (%)
380	270	2.1
380	100	1.7
200	200	1.5
150	150	1.0
80	80	0.7

For the z-resolution, the following algorithm is used:

```
      IAL = HDATA(J+1)
      XL = FLOAT(IAL)
      CALL NVERT( ZRS, XL, XLL )
      XL = XLL / ZL
      IAR = HDATA(J+2)
      XR = FLOAT(IAR)*ZSC
      HDATA(J+2) = IFIX((XL+.5)*XR)
      HDATA(J+1) = IFIX((-XL+.5)*XR)
```

Thus the first amplitude, which contains the true z-coordinate to 1 mm precision, is rescaled in terms of the second amplitude, which contains the dE/dx pulse height. The chosen algorithm assures that the z-coordinate calculation agrees with the calculation used for real data in various analysis routines.

The treatment of the z-coordinate has not changed, but in the earlier version the offset of 10 mm, ZOF, was subtracted before smearing. This subtraction was not compensated in later reconstruction of the z-coordinate, giving rise to a systematic shift of 10 mm in z-coordinates in MC data. In the new version, the z offset parameter is not used.

RDMODN:

RDMODN and the subroutines it calls are all concerned with adding or removing hits. The /CBIN/ variables to steer these actions are EPSI (wire efficiencies), DOUB (double hit resolution) and IRN (nr of random hits, e.g. from synchrotron radiation or electronic noise). The dead cell hit removal was already mentioned above. These routines are all straight forward and need no special comment. One change has been made in the new version: RDRDMH gives in the new version only random hits with coordinates inside the corresponding cell. The earlier version allowed maximum drifttimes everywhere and hits could have coordinates in the next or overnext cell.

NOTE: In the early versions of RDMTCO an elaborate scheme for changing COMMON /CBIN/ was foreseen, using the argument HOPT in

CALL RDMTCO(HOPT).

The sense of this has since been lost and the smearing occurs with the parameters in /CBIN/, independent of HOPT='DE' or HOPT='SE'. The argument in RDMTCO is kept however, for backward compatibility.

DETAILS OF TRIGGER SIMULATION:
==============================

There are many different triggers in the JADE detector and their conditions vary over the years. Some of these triggers are directly linked with the status of the inner detector (dead cells, random hits) and the software simulation of trigger conditions is therefore done together with the smearing of MC data. This simulation is an important aspect in some physics analyses, e.g. 2-photon physics, where trigger efficiencies may vary considerably.

The routines for trigger simulation have also developed over the years, with the addition of new triggers or modification of existing

ones. The routines to be discussed below are the most complete so far, in that trigger conditions for 1982 and later are included (the so far standard versions only include conditions for 1979-1981) and in addition several bugs have been removed. The scheme however follows closely the earlier scheme described in JADE COMPUTER NOTE 55.

The trigger simulation involves a number of thresholds for latch settings and limits for various veto conditions. Over the years these thresholds and limits have been given in commons with varying names and lengths. The version described here introduces the COMMON /CTRIGG/ which is structured in a logical way and has additional dummy variables for later extensions. COMMON /CTRIGG/ is set by subr. RDTRIG and has the following content:

```
      COMMON /CTRIGG/ IHIST(3),NBPTFW,IDUM1(5),HDUM1,
     *  HLGBRT,HLGBST,HLGQT,HLGTOT(4,2),HECAPT(4),HLGTL,HLGTH,HDUM2(10),
     *                IWIDBS,NRNBSL,NRNBSH,NTOFBS,IDUM2(10),
     *                NTOFC,NTOFC1,NTOFC2,NTBGC,NTBGC1,NTBGC2,
     *                IWCOLL,IWCOLN,IWMPRG,HFMPRL,HFMPRH,HWCOLN,HMPRON,
     *                IWCTBG,NTFCOL,NTFCLN,IDUM3(10),
     *  HITCLL(3),HITWLL(3),HITSUM(3),HCHAMB(3),HMASK(16,3),HDEADC(10),
     *  HACC1,HACC2,HACC3,HACC4,HACCM,HDUM6,IWIDT2,IDUM4(10)
C
C DATE OF VERSION
      DATA IHIST /1,1,1982/
C
C NBPTFW = WIDTH OF BP-TOF MATRIX; OBSOLETE, NEVER USED IN TRIGGER
      DATA NBPTFW / 6 /
C
C DUMMY SPARE VARIABLES
      DATA IDUM1 /5*-1/, HDUM1/-1/, HDUM6/-1/
      DATA IDUM2 /10*-1/, HDUM2/10*-1/
      DATA IDUM3 /10*-1/, IDUM4/10*-1/
C
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     ****   THRESHOLDS FOR LATCHES ****
C
C     BARREL GROUPS,        BARREL SEPTANCES, ENDCAP QUADRANTS
      DATA HLGBRT/ 80/,        HLGBST/180/,        HLGQT/50/
C                      TOTAL ENERGY                      BARREL ENERGY
      DATA HLGTOT/ 6000,2500,2000,1500,       6000,2500,2000,1500/
C                      ENDCAP ENERGY
      DATA HECAPT/ 4000,1000, 500, 300/
C                      TAGGING ENERGIES
      DATA HLGTL/ 1500/,     HLGTH /6000/
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     ****   DATA FOR T1 ACCEPT  ****
C
C           NEUTRAL COPLANAR TRIGGER
      DATA NRNBSL/2/,  NRNBSH/3/, IWIDBS/3/, NTOFBS/1/
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     ****   DATA FOR T1 POSTPONE   ****
C
C           COPLANAR TOF TRIGGER
      DATA IWCOLL/3/, NTFCOL/5/
C           NARROW COPLANAR TOF TRIGGER     HWCOLN=1 --> TRIGGER ACTIV
      DATA IWCOLN/1/, NTFCLN/7/, HWCOLN/1/
C           MULTIPRONG TRIGGER              HMPRON=1 --> TRIGGER ACTIV
      DATA IWMPRG/6/, HFMPRL/3/, HFMPRH/6/, HMPRON/0/
C           COPLANAR TBG TRIGGER
      DATA IWCTBG/2/

C           LIMITS FOR NR OF TOF'S IN POSTPONE TRIGGERS
C           NTOFC  =  LIMIT FOR NTOF IN TOTAL ENERGY TRIGGER
C           NTOFC1 =  LIMIT FOR NTOF IN ENDCAP TOTAL ENERGY TRIGGER
C           NTOFC2 =  LIMIT FOR NTOF IN NRTOFBG-NS TRIGGER
      DATA NTOFC/2/,NTOFC1/2/, NTOFC2/7/

C           LIMITS FOR NR OF TBG'S IN POSTPONE TRIGGERS
C           NTBGC  =  LIMIT FOR NTBG IN TAG TRIGGERS
C           NTBGC1 =  LIMIT FOR NTBG IN BARREL ENERGY TRIGGER
```



```
C           NTBGC2 =  LIMIT FOR NTBG IN NRTOFBG-NS TRIGGER
      DATA NTBGC/0/,NTBGC1/0/, NTBGC2/2/
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     ****    T2 DATA     ****
C
      DATA HITCLL/8,7,8/,  HITWLL/2,2,2/  ,HITSUM/10,9,10/
      DATA HCHAMB/24,24,48/,  HMASK/16*1,16*1,16*1/,HDEADC/10*0/
C
C  HACC1:  NR OF ALL TRACKS IN T1 POSTPONE: TOTAL LG ENERGY + TOF
C  HACC2:  NR OF ALL TRACKS IN T1 POSTP.82: TBGNS + TOF
C  HACC2:  NR OF FAST TRACKS IN T1 POSTP.79-81: WIDE COPLANAR TOFS
C  HACC3:  NR OF FAST TRACKS IN T1 POSTP.82: TOTAL LG ENERGY AND TBG
C  HACC3:  NR OF ALL TRACKS IN T1 POSTP.79-81: TAG
C  HACC4:  NR OF FAST TRACKS IN T1 POSTP.82: TAG + TBG
C  HACC4:  NR OF FAST TRACKS IN T1 POSTP.79-81: NARROW COPLANAR TOFS
C  HACCM:  NR OF ALL TRACKS IN T1 POSTPONE: MULTIPRONG COPLANAR TOFS
C
      DATA HACC1/2/,  HACC2/2/,  HACC3/1/, HACC4/1/, HACCM/3/
C   IWIDT2 GIVES WIDTH OF T2 COPLANARITY
      DATA IWIDT2 /4/
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
C     WIRE DISABLE SECTION FOR JETC BANK
C
      COMMON / CRDSTA / NDEAD, NCDEAD, HITD(10), HCELLD(10), IPHALG
C
C                                        DEAD WIRES
      DATA NDEAD / 0 /
      DATA HITD / 10*0 /
C                                        DEAD CELLS
      DATA NCDEAD / 0 /
      DATA HCELLD / 10*0 /
C
C                    LEAD GLASS BLOCK READOUT THRESHOLD
      DATA IPHALG / 0 /
C
```

The BLOCK DATA setting (in RDTRIG) corresponds to 1982 trigger conditions. To get the status for earlier years or periods, the date in the HEAD bank has to be overwritten. This is done by the call to subr. RDDATE, which then has to be provided by the user. The original date in bank HEAD, which is of some interest, since it tells the date of the original tracking (and thereby the program version), is lost here; therefore a copy of this original date is done in subr. RDHEAD. Thus the date in words 6-8 in HEAD is copied into words 96-98 in HEAD.

According to the date in HEAD words 6-8, RDTRIG decides which status version to use; if it is different from the default of 1982, the corresponding updates in /CTRIGG/ and /CRDSTA/ are made:

```
C                                        **********************
C                                        *  CHANGES 1979-81   *
C                                        **********************
            HLGTOT(1,1) = 4000
            HLGTOT(2,1) = 2000
            HLGTOT(3,1) = 1000
            HLGTOT(4,1) = 500
            HACC1 = 1
C                                        **********************
C                                        *  CHANGES 1979-80   *
C                                        **********************
            HWCOLN = 0
            HITCLL(1) = 12
            HITCLL(2) = 11
            HITCLL(3) = 12
            HITWLL(1) = 1
            HITWLL(2) = 1
            HITWLL(3) = 1
            HITSUM(1) = 12
            HITSUM(2) = 12
            HITSUM(3) = 12
```

```
C                                   ************************
C                                   *  CHANGES 1979 ONLY   *
C                                   ************************
            HDEADC(1) = 17
            NCDEAD = 1
            HCELLD(1) = 17
C                                   *************************
C                                   *  CHANGES 1980 ONLY    *
C                                   *  PERIOD 1: JAN.-MAR.  *
C                                   *************************
            NCDEAD = 8
            HCELLD(1) = 17
            HCELLD(2) = 37
            HCELLD(3) = 65
            HCELLD(4) = 66
            HCELLD(5) = 73
            HCELLD(6) = 74
            HCELLD(7) = 81
            HCELLD(8) = 82
C                                   *************************
C                                   *  CHANGES 1980 ONLY    *
C                                   *  PERIOD 2: APR.- DEC. *
C                                   *************************
            NCDEAD = 6
            HCELLD(1) = 17
            HCELLD(2) = 37
            HCELLD(3) = 65
            HCELLD(4) = 66
            HCELLD(5) = 81
            HCELLD(6) = 82
C                                   ********************
C                                   *  CHANGES 1981    *
C                                   ********************
            HACC3 = 2
            HACC4 = 2
```

After smearing the inner detector data, the trigger banks are set up in the calls to subr. RDTRG1 and RDTRG2.

Note: If you want 1979 trigger conditions, use a date after 1.7.1979, since an earlier date is not accepted by subr. KLREAD, in later reading of the smeared data.

RDTRG1:

Bank LATC is first created and filled, according to the thresholds given for the period in /CTRIGG/. Then bank TRIG:1 is created. T1 ACCEPT and T1 POSTPONE conditions are checked and set in the corresponding words in TRIG:1. In the subr. RDTRG2 the track situation in the inner detector is simulated, with help of the nr of hit wires (in bank JETC) and the arrays HITCLL,HITWLL and HITSUM. Dead cells which are permanently on in the track trigger are given by array HDEADC. The bank TRIG:2 is created and filled with corresponding T2 information.
The actual nr of "fast" and "all" tracks (JADE NOTE 31) are compared to the requirements of the various T1 POSTPONE conditions and the "TRIGGER ACTION and LOGIC CONDITION" (TALC) word (HEAD bank word 22) is filled accordingly.

Since a major change in trigger conditions occurred between 1981 and 1982, with different structuring of the trigger banks, separate subroutines are used for the trigger simulation in 1979-81 and 1982 - : RDTRG1 <--> RD82T1 and RDTRG2 <--> RD82T2, respectively. The 82 versions are called from RDTRG1 and RDTRG2; this is regulated by the value of IHIST(3), which gives the year of the status version.

Not all triggers in 1982 are simulated however; the following are not yet provided:

```
   T1 ACCEPT:
     FWMU(COPL+-1) * ECAP(COLLIN.)                     Trigger bit 4
```



```
     "ZORN" TRIGGER: >= 1 SEPT. * TOF<1 * TAG           Trigger bit 15
     RANDOM TRIGGER                                     Trigger bit 16

   T1 POSTPONE:
     FWMU(5) * 3 TRACKS(ID) * 1 MUTRACK(FORW.)          Trigger bit 8
```

NOTE: The forward muon scintillation counters have so far not been included in the detector simulation.
Tagging simulation uses the counter set up from 1979-80 and the conditions for 1981-82 and the present set up for 83, have not yet been simulated.
The dimensions and positions of tagging counters which are used in the tracking program, are not saved in any way on the output data set, since they are not included in the COMMON /CGEO1/.

WARNING: ALL TRIGGERS WHICH INVOLVE THE LEAD GLASS ENERGY THRESHOLDS are treated as step functions, i.e. the LG energy is either below or above a fixed threshold. In reality the threshold behaviour of energy triggers is more complicated and requires careful study, mostly involving shower program calculations of energy deposits.

WARNING: Earlier versions of RDTRG1 and RDTRG2 have bugs. These are described below, in section ERRORS.

RDALGN:

RDJETC finally calls subr. RDALGN. The tracking programs register all energy deposits in lead glass blocks down to 1 MeV. The read out threshold in the real data is however higher (25-30 MeV) and varies for different periods. RDALGN provides the possibility to kill all LG blocks in the bank ALGN (there is no bank ALGL in Monte Carlo), which have energies below a specified threshold, given by the variable IPHALG. Default value is zero, however, no killing.

Note in this connection that the really preferrable procedure is to transform the block energy into digitized counts, each count corresponding to 5-6 MeV, and then kill blocks which are below the read out threshold (5-6 counts in hardware read out). Finally remaining blocks should be transformed back into MeV values again. This really means that the energy is measured in units of 5-6 MeV and such a procedure would come closest to a realistic simulation. This is not yet active in the standard smearing process.

Note also that RDALGN is called after trigger simulation. The energy sums which determine the trigger are not dependent on the read out threshold.

ERRORS:
=======

It follows below a list of known errors in the earlier versions of the smearing and trigger simulation routines. These errors are all corrected in the new versions presented in this note. For the sake of completeness, also errors in the tracking routines are listed. The correction of the latter is proposed to take place simultaneously with the instalment of the new smearing and trigger simulation routines.

RDRESO: .5 time-bin added to drift-time value; causes large systematic errors.
10 mm offset subtracted from z-coordinate, never corrected for in later software reconstruction.

RDRDMH: Random hits outside cell boundary possible.

RDTRG: First event will have dead cells in accordance with default values and not according to specification.

RDTRG1: TOF veto in wide coplanar trigger <=3 instead of <=4.

RDTRG2: Coplanarity in T2 tracks wrong.

RDMTCO: Copying of trigger constants and smear status into bank MTCO meaningless, since MTCO is deleted before reading the next event (with Muon constants). See however the note below, concerning TP-programs. To keep compatibility with those programs, the new version of RDMTCO still does the copying of COMMONS /CTRIGG/,/CRDSTA/ and CBIN/ into the bank MTCO.

EVWRIT: Creates MTCO bank and writes it out without filling it.

JINIT: Radius of radial-symmetric electric field at signal wires is different to radius used in later reconstruction programs. Systematic errors <= 200 micron in hit positions may result.

BLDAT: Following DATA values should be changed. Note that they are also BLOCK DATA set in subr. SUPERV, on F11LHO.JADEGS.

	VARIABLE	NEW VALUE	OLD VALUE
COMMON /CJDRCH/	YSUSPN	0.0	0.070
	TIMDEL	0.005	0.020
	DRIDEV	-0.349066	0.349066
	DRISIN	-0.342020	0.342020
COMMON /CJIONI/	POTBEA	160.3	213.0
	POTIVE	160.3	213.0
	POTOVE	160.3	213.0
	POTVES	160.3	213.0
	POTZJL	160.3	213.0
	POTZJR	160.3	213.0
COMMON /CGEO1/	RITNK	167.0	165.0
	DZJM	-30.0	-5.0
	DZJP	30.0	5.0
	XRZJM	0.337	0.060
	XRZJP	0.337	0.060
	ZTKM	-1350.	-1470.
	ZTKP	1350.	1470.
	DZTKM	-74.	-7.
	DZTKP	74.	7.
	XRZTKM	0.832	0.080
	XRZTKP	0.832	0.080

EVTINI, JIPATR: Call ro subr. DAY2 made for every tracked particle. the corrected versions make one call per event.

MCJADE: Event count sometimes wrong by one unit. This error will be taken care of later, it is not vital to the other changes discussed here.

NOTE ON MUON MONTE CARLO:
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A complete tracking program, which includes the Muon filter simulation, exists on F22RJB.RMLC.S and L. It is described in JADE COMPUTER NOTE 54 and more details are given in another note, which will soon be distributed by R. Barlow. In connection with the present note the following should be stressed:

The program decides upon which detector status to use in a similar fashion as described above, with the user providing a date. The proper detector status parameters are taken from the COMMON /CALIBR/, which is first filled by a call to subr. KALIBR (and KLREAD). This also means that in this program, the second event on the file, with the muon constants banks, really contains relevant information. Note also that the tracked events will contain an already "smeared" and realistic simulation of resolution as fas as the muon filter is concerned. This is because the geometry constants also involve the

varying positions of the muon filter with respect to the inner detector. For this reason the tracked events can not be used for simulation of different muon filter status in different periods, which is possible for the inner detector, as described in the present note. Thus the program produces tracked events which have "smeared" Muon filter but "unsmeared" inner detector data. Smearing of the inner detector occurs as soon as the events are read again, and it occurs with the detector status as specified by the user in subr. RDDATE.

------------>>>>>>>>>> obs obs obs obs obs <<<<<<<<<<<-------------

It is the responsibility of the user to assure that the inner detector status and the muon filter status agree, since all combinations are possible. There are no programs which will notice inconsistencies and print warnings.......

------------>>>>>>>>>> obs obs obs obs obs <<<<<<<<<<<-------------

Note also that the action of subr. RDHEAD in this case will be to save the version date of the Muon filter status, into HEAD words 96-9800082800 before HEAD words 6-8 are overwritten by subr. RDDATE, with the date of the specified inner detector status.

NOTE ON MONTE CARLO TP PROGRAMS:
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A version of the TP program is available on the tracking library:

F22ELS.JMC.S(#TPMAINC and @TPMAIN)

The main program @TPMAIN contains an event loop which does not use the subr. EVREAD and EVWRIT, but calls instead directly the BOS routines BREAD and BWRITE. The handling of MTCO and MUCO events is done directly in this loop. After the calls to subr. RDMTCO or MUCON, respectively, the MTCO and MUCO events are written out immediately on the output file. In this case the copying of trigger and status commons into the bank MTCO, which is listed as logical error above, makes sense; the stored information is really written out on the output file and not immediately deleted, as is the case when using subr. EVREAD. Unfortunately this copying and writing out takes place before the first event has been read and before the first call to RDJETC has taken place. Thus all the updates of the status commons, which will be done by RDTRIG (or RDTRG in the old version) will never be registered on the output file.

This is of course a logical error and people who used the TP-program in this way should be aware that there is no guarantee that the smeared events agree in status commons content and HEAD bank date.

The new version of subr. RDMTCO still does the copying of /CTRIGG/, /CRDSTA/ and /CBIN/ into MTCO, to keep compatibility with the present TP-program. It prints also a warning, to be aware of the nonsense. But for the future it should be considered to change the TP-program to the use of EVREAD and EVWRIT and get rid of the logical errors in the present version.

NOTE ON THE TRACKING PROGRAM:
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Minor changes are also being made to the tracking program. These changes are only local and should not affect anybody. Such changes are e.g.

WRTMCB: A new bank HITL is created in the output events. It will be used in connection with the new scheme for hit-track association in the later history of the event. This will be described in a later computer note.

WRTMCB,TRCDET,JHITIN,EVTINI,JSPOIN,JRING,..... The present capacity for registering inner detector hits, 1500, will be extended to 4000. This means enlarging a common, occuring in the above routines.

$HISTORY: This member holds the history of the library

F22ELS.JMC.S and it should be consulted for more information on these minor changes to the tracking program.

CONCERNING INSTALMENT OF NEW ROUTINES ON F22ELS.JMC.S AND L:
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The instalment of the corrections is proposed to take place in two steps:

Step 1 starts with the issue of this note; a complete version of the new tracking, smearing and trigger simulation routines is prepared on the libraries:

F22ELS.JMC.S1 and L1.

In order to get hold of any remaining incompatibilities with existing programs or datasets, all MC users and producers are urged to replace the present library F22ELS.JMC.L in their programs with the new version F22ELS.JMC.L1, and see if anything unusual or undesirable happens. Note that the corrected version of EVWRIT is situated on F22ELS.JMC.L1 and therefore this library should be linked before the standard F11LHO.JADEGL.

Step 2: After a successful Step 1 (estimated time c:a 20 days) a renaming will take place:

```
F22ELS.JMC.S    ----->  F22ELS.JMC.S0
F22ELS.JMC.L    ----->  F22ELS.JMC.L0
F22ELS.JMC.S1   ----->  F22ELS.JMC.S
F22ELS.JMC.L1   ----->  F22ELS.JMC.L
```

Simultaneously EVWRIT and RDMTCO on the standard libraries F11LHO.JADEGS and JADEGL will be updated.

Step 2 will take place at a fixed time which will be announced before.

* * * * * * * * * * *

This note can be printed by submitting the member

JADEPR.TEXT(JBJCN66)

An addendum is found in the member JADEPR.TEXT(JBJCN66A)

Figs.1,2 and 3 can be obtained from Mrs. Platz or from J. Olsson.