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Guide to Running the Detailed ALEPH TPC Simulation Program (TPCSIM) on the CERN VAX and IBM (VM)

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1 Introduction

At present the only way to simulate the TPC digital readout is by means of the stand-alone program, TPCSIM *(ALEPH/TPC note 85-10)*. This code has not been incorporated in GALEPH due to the high memory and CPU requirements imposed by the very detailed treatment of the signal formation, and the practical solution which has been adopted is to use GALEPH to generate the charged track elements in the TPC, which are then re-tracked by TPCSIM if the TPC digitisations are required.

It should be noted that the TPC track elements (bank 'TPTE') are not saved by default, and it is therefore necessary to set ICTPJO(4) = 1 through the appropriate GALEPH runcard.

```
RUNC 'TPC' 0 1 1 1 . .
```

TPCSIM thus accepts as input the standard GALEPH BOS output file, and produces the TPC wire and pad readout (banks TPAD,TWIR,TPDI,TWDI) which are simply appended to the existing BOS structure. If there are simulated coordinate and associated reference banks (TPCO, TPCH, TCRL) on the GALEPH output, they are dropped in TPCSIM as these will be properly reconstructed from the digitisations in JULIA.

The current version of TPCSIM uses native BOS format for both input and output on the VAX, and EPIO on IBM.

2 Run conditions

The run conditions for TPCSIM are given in an ASCII file in a very legible form. An example run condition set is shown in Appendix A. Each parameter is described by two lines:

```
1. Name     ID       Format     Comment
2. Value
```

The parameter name is taken from the actual variable name used in the code. The comment and ID (composed of a group and parameter code) are used to provide nice output printout of the run conditions. Default condition sets exist in GAL:TPRCON.DAT on the VAX, and TPRCON onthe IBM.

3 Job submission on the CERN VAX (VXCRNA/B)

The system is installed in DISK$ALEPH:[GENERAL.GAL]. To submit a TPCSIM job one can simply edit the run condition file (an example file exists in GAL:TPRCON.DAT) as required and use the following DCL:

```
$ASS TPRCON.DAT FOR012
$RUN GAL:TSMAIN
```

For more flexibility, a command procedure (TPCSIM.COM) is provided which features interactive menu-driven definition of run conditions. The procedure also gives the option for the user to create, independently of GALEPH, a file of track elements to be input to TPCSIM.

To install the menu feature, you should copy to your directory the command files GAL:TPCSIM.COM, GAL:TPCRUN.COM and modify the "SET DEF" line to correspond to your directory. To invoke the procedure just type

```
$@TPCSIM
```

The following prompts are issued:

```
INTeractive or OFFline?
```

The normal reply is OFF for submitting a batch job.

```
Make new track elements for this run? (Y or N)?
```

This gives you a choice of creating a file of track elements (TPTE banks) which can be digitised instead of GALEPH output. An associated menu (described below) allows you to produce track elements at any desired position in the TPC.

When running the simulation on GALEPH output, the normal reply is "N".

```
Special(Y) run conditions or default(N)?
```

The run conditions are read by default from the file TPRCON.DAT. The option allows you to select another previously prepared set of conditions.

Following this prompt, the top level menu is presented:

The menu system is based on the old MNPACK package of UALIB. (This should eventually be replaced by a more modern panel system). To select a menu item, you just type the letter identifying it, and you are presented either with another menu or the parameter to be changed. To get out of any menu type "2".

One should normally select option B of the top level menu to see the Input/Output conditions sub-menu. The parameters that will need to be changed will usually be only the names of the input track element file (GALEPH output or private) and the TPCSIM digitisation output file, and the range of event numbers to be processed. Unless you know what you are doing, the "physics" parameters should not be changed.

When you leave the top level menu you will get the prompt:

```
Keep run conditions?(Y or N)
```

If you want to save the conditions in the current state you will be prompted to give file name on which they will be written. This run condition file can be used in subsequent runs to avoid menu sessions for redefining the default parameters.

The final prompt asks you which queue you want to submit the job to. Bearing in mind that it takes an average time of 6 minutes of VAX 8650 CPU per LUND event at the Z^0, you will need the VERYLONG option for any sizeable GALEPH run.

3.1 Menu tree

The top level menu provides a path to menus dealing with specific areas of the simulation (General, Input/Output, Debug, Electron transport, Avalanche formation, Coupling of charge to pads, Electronics network characteristics and Digitisation conditions). The options should be self-explanatory, and we shall restrict the discussion to the menu items used in the normal case.

GENERAL RUN CONDITIONS

In the interest of reducing the execution time, it is advisable to turn off option H (Coupling to trigger pads) unless you are interested in the trigger pad signals. At present only the analog signal are simulated for the trigger pads as the final digitisation scheme is not yet known.

INPUT/OUTPUT CONDITIONS

You will normally have to change options B and C (first event and number of events to process) and declare the required track element file (option E) and output file (option O). The digitisation banks added in TPCSIM expand the original GALEPH output by about a factor of 2-3. There are also options to write out the internal analog signal banks, used for special studies.

3.2 Generating special track elements

As mentioned above, there is a facility to generate track elements privately. The system is tailored for resolution studies using the coordinate-measuring pads. When this feature is selected a menu is invoked to allow interactive specification of the track elements, defined relative to the centre of a selected pad (fig 1). Having placed the track elements in the desired TPC sectors, one can generate a file of a given number of events of the same configuration. You must remember this file name to give it as input to TPCSIM later on.

4 Job submission on the CERN IBM (CERNVM)

The program is installed on the TPC minidisk (type GIME TPC to access it). There are two files TPCSIM TPRCON (run conditions) and TPCSIM EXEC (the command file to be submitted) which you have to copy to your disk and to modify according to your needs. You specify the range of event numbers to be processed (NFEVNT and MXEVNT) in TPRCON and the filenames and the run time (a typical LUND event takes about 15 minutes in IBM 168 units) in the EXEC.

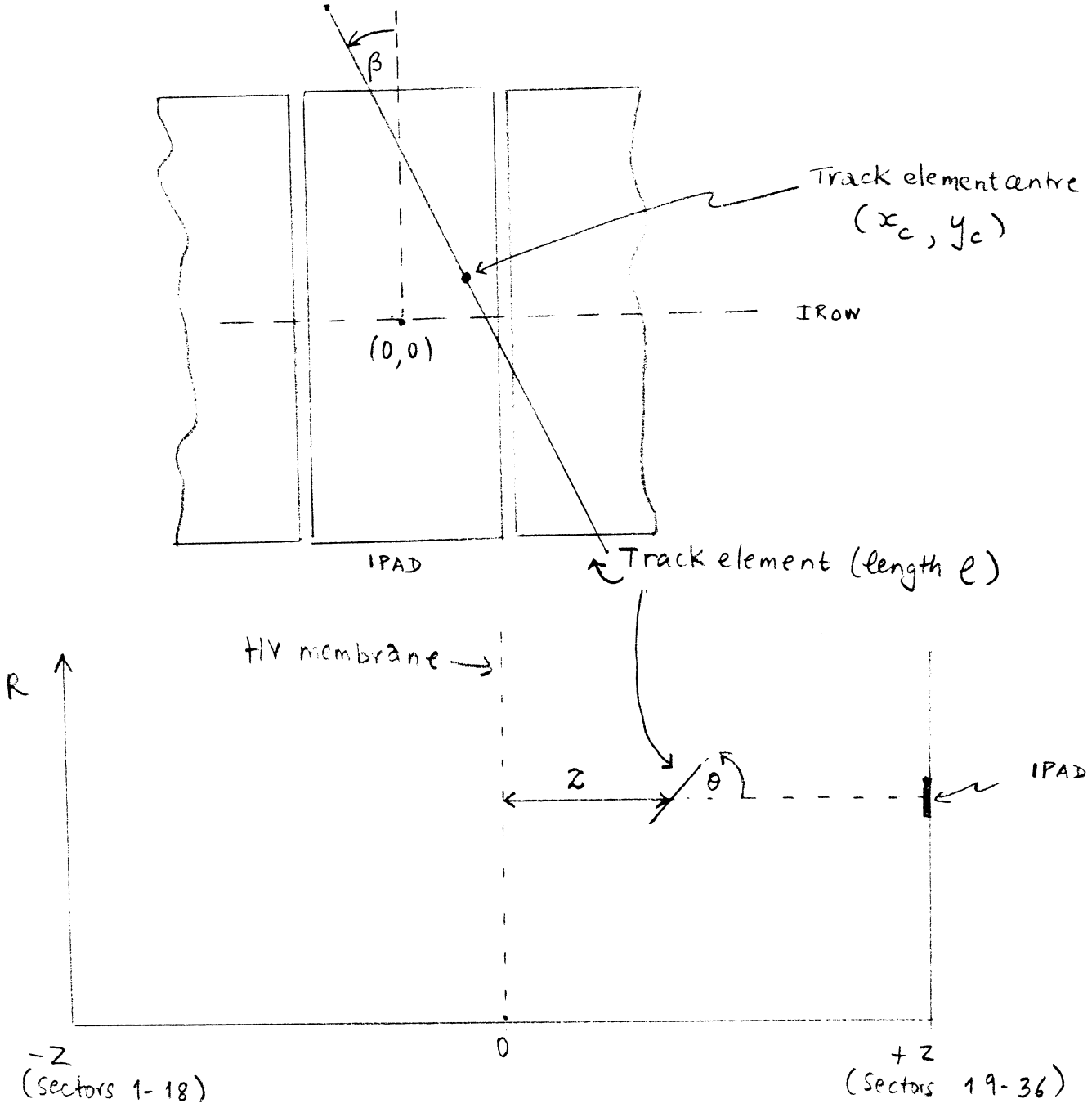
Appendix A

Example Run Condition file for TPCSIM

```
NTPCDD      301       (I10)    Debug level for dE/dx
         1
NCALDD      302       (I10)    # calls before dE/dx debug 0
      5000
NTPCDT      303       (I10)    Debug level for transport
         1
NCALDT      304       (I10)    # calls before transport debug 0
      5000
NTPCDA      305       (I10)    Debug level for avalanche
         1
NCALDA      306       (I10)    # calls before avalanche debug 0
      5000
NTPCDC      307       (I10)    Debug level for coupling to pads
         1
NCALDC      308       (I10)    # calls before coupling debug set to 0
      5000
NTPCDS      309       (I10)    Debug level for signal summing
         1
NCALDS      310       (I10)    # calls before signal summing debug 0
      5000
NTPCDI      311       (I10)    Debug level for digitizing
         2
NCALDI      312       (I10)    # calls before digitization debug 0
      5000
NTPCDE      313       (I10)    Debug level for track elements
         1
NCALDE      314       (I10)    # calls before track element debug 0
       100
NTPCSA      315       (I10)    Debug level for shaping/amplification
         2
NCALSA      316       (I10)    # calls before shape/amplify debug 0
      5000
NTPCDR      317       (I10)    Debug level for coupling to trigger pads
         1
NCALDR      318       (I10)    # Calls before t-pad coupling debug 0
      1000
NUMRUN      201       (I10)    Run number
         1
NFEVNT      202       (I10)    First event to process
         1
MXEVNT      203       (I10)    Number of events to process
         1
LHISST      209       (L10)    Save histograms produced
         F
LTPCSA      211       (L10)    Print circuit response documentation
```

```
        T
TRKFIL     212      (A50)    Name of track element file used
ALEPHDATA:MCLUN180.NATIVE
DETFIL     213      (A50)    Name of processed track element file
TSTDET
DIGFIL     214      (A50)    name of digitizations file
MCDIG180.NATIVE
HISFIL     215      (A50)    File name for histograms output
TSTHIS
INSEED     101      (Z8)     First random number
8773D89B
NRSEED     102      (I10)    Reset code
        0
LDETEC     104      (L10)    Process track elements
        T
LTWANL     105      (L10)    Generate wire analog signals
        T
LTPANL     106      (L10)    Do coupling to long pads
        T
LTTANL     107      (L10)    Do coupling to trigger pads
        F
MXTRAN     403      (I10)    Max e transported individually/cluster
       10
DRFVEL     404      (F10.5)  Drift velocity in transport (cm/nanosec)
   0.00505
SIGMA      405      (F10.5)  Sigma for longit. diffusion cm/(cm)**.5
   0.04000
SIGTR      406      (F10.5)  Sigma for transverse diffusion cm/(cm)**.5
   0.00820
ITRCON     407      (I10)    Gating grid configuration used
        2
NPOLYA     504      (I10)    Max number of electrons to use Polya
       10
AMPLIT     503      (E10.5)  Mean number of electrons in avalanche
.10000E+05
CUTOFF     603      (F10.8)  Cutoff on coupling strength to pads
0.00050000
NCPAD      604      (I10)    # pads tested on each side of avalanche
        2
EFFCP      605      (F10.5)  Maximum coupling constant to pads
   0.21600
SIGW       606      (F10.5)  Sigma for coupling along pad width (cm)
   0.32000
SIGH       607      (F10.5)  Sigma for coupling along pad length (cm)
   0.32000
HAXCUT     608      (F10.5)  Half-length of flat P.R.F. (cm)
   1.20000
TREFCP     703      (F10.5)  Maximum coupling constant for trigger pads
```

```
   0.21600
TCSCUT     704      (F10.5)  Minimum coupling strength for trigger pads
   0.00050
SIGR       705      (F10.5)  Sigma for t-pad coupling, radial direction
   0.32000
SIGARC     706      (F10.5)  Sigma for t-pad coupling along arc length
   0.32000
RAXCUT     707      (F10.5)  Half-length of flat P.R.F., radial dir.
   0.01500
TPDGBN     901      (F10.5)  Length of time bin, digitized signal (ns)
 100.00000
PEDDEF     904      (F10.5)  Pedestal (millivolts)
   0.00000
SPEDEF     905      (F10.5)  Sigma for pedestal variation (millivolts)
   1.00000
SGADEF     906      (F10.5)  Sigma for gain variation (%)
   0.02000
SDIDEF     907      (F10.5)  Sigma for differential nonlinearity (LSB)
   0.00000
WIRNRM     804      (F10.5)  Wire charge normalization
   1.00000
PADNRM     805      (F10.5)  Pad charge normalization
   1.00000
TRGNRM     806      (F10.5)  Trigger pad charge normalization
   1.00000
LWANSV     204      (L10)    Save wire analog signals
         F
LPANSV     205      (L10)    Save pad analog signals
         F
LTANSV     206      (L10)    Save trigger pad analog signals
         F
LTWDIG     110      (L10)    Digitize wire signals
         T
LTPDIG     111      (L10)    Digitize pad signals
         T
LTTDIG     112      (L10)    Digitize trigger pad signals
         F
LTHRSH     908      (I10)    Threshold for zero-suppresion
         5
NPRESP     909      (I10)    No of pre-samples accepted in pulse
         2
NPOSTS     910      (I10)    No of post-samples accepted in pulse
         2
MINLEN     911      (I10)    Minimum number of samples above thresh.
         2
*END
```



Private track element definition

IROW	= Row number (Menu option D)
IPAD	= PAD number in row (Option E)
l	= Track element length (Option K)
β	= azimuth angle with respect to pad axis (Option G)
x_c	= Offset of centre of track element along pad width (Option I)
y_c	= Offset of centre of track alement along radius (Option J)
θ	= Polar angle at pad crossing (Option H)

Fig 1