CDF/ELECTRON/ANAL/CDFR/1086

Fiducial Cuts for Electrons

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April 18, 1990

1 Introduction

This note defines a set of fiducial cuts relevant for electron analysis in all 3 electromagnetic calorimeters. The cuts were chosen to satisfy the following criteria: first, the efficiency of the fiducial region should be reasonably high; second, any region where the efficiency is difficult to measure should be excluded. The routine, C$ELE:FIDELE.CDF, makes these fiducial cuts on electron candidates and is described in appendix A.

This note also describes 2 additional routines used in electron analysis, C$ELE:BADRUN and C$ELE:BADTOW. BADRUN excludes runs based on PEM dead channels, $\not\!\!E_T$ problems, or luminosity problems. BADTOW excludes central towers based on their E/p response. These routines are descibed in appendix B and C.

2 Fiducial Cuts

The following regions are excluded by the fiducial cuts:

- Central EM calorimeter:

  1. Tower 9. This tower is shaped differently from the other CEM towers and the electron response varies significantly with the z position in the tower.

2. Tower 7 of the chimney module. The chimney module has only 7 EM towers. Larry Nodulman says excluding this tower is the moral equivalent of excluding tower 9.
3. $|z| < 9$ cm. This excludes the 90° crack region. This cut is made using the strip chamber position. The strip chamber extends to $z = 6.2$ cm, and the active region of the calorimeter extends to $z = 4.2$ cm.
4. Local wedge $x > 21$ cm. This excludes the ϕ cracks between wedges. This cut is made using the strip chamber position. The strip chamber extends to $x = 22.5$ cm, and the active region of the calorimeter extends to $x = 23.1$ cm.

- Plug EM calorimeter:

1. Outer 2 η annuli (31-32 and 53-54). In **TOWE** tower type language, these are tower types 3-4. This is a cut on the seed tower of the cluster.
2. Inner 2 η annuli (19-20 and 65-66). In **TOWE** tower type language, these are tower types 7 and 8. This is a cut on the seed tower of the cluster.
3. $5° - \phi$ border of each quadrant. In the plug 5° is one ϕ pad, so this cut excludes the 8 ϕ towers - 0,17,18,35,36,53,54,and 71. This is a cut on the seed tower of the cluster.

- Forward EM calorimeter:

1. Inner 5 η annuli (1-5 and 80-84). This is a cut on the seed tower of the cluster.
2. $5°-\phi$ border of each quadrant. In the forward calorimeter 5° is one ϕ pad, so this cut excludes the 8 ϕ towers - 0,17,18,35,36,53,54,and 71. This is a cut on the seed tower of the cluster.

3 Bad Run Cuts

The routine BADRUN makes cuts on the event run number to exclude runs with problems which could bias electron analysis. The run numbers excluded

along with the problem are given in the table below:

Run Number	Problem
16785	Large $\not\!\!E_T$ mean and sigma in minbias data
17469,17475,17512	Large number of PEM
18869-18947	dead channels
17512-17516	Luminosity problems

Minimum bias runs were studied to determine the mean and sigma of $\not\!\!E_T$ projections in 2 directions, MET_x and MET_y [1]. Several runs were flagged as having $\not\!\!E_T$ offsets or large sigmas. The results for run 16785 were significantly worse than other runs and worrisome enough to remove from data samples.

Some channels in the PEM calorimeter were dead for part or all of the run. Several runs had greater than 30 dead channels. Rather than excluding these channels for all runs using the routine FIDELE or using the database to access the run and channel numbers, we chose to exclude these runs from all samples. The integrated luminosity for these "dead runs" is 170 nb^{-1} or roughly 3.4% of the data.

Studies of trigger rates versus luminosity and run number were done to understand any possible bias in event selection as a function of instantaneous luminosity [2]. The runs 17512-17516 have much higher rates than the norm. Although we don't know what caused this effect, and electron selection may be unbiased, we chose to exclude these runs.

4 Bad Central Towers

Calibration studies of central EM towers using E/p found certain towers had means significantly different from the average. There are 5 towers where the E/p calibration correction was large enough that both the correction and the original calibration were mistrusted. These towers are:

Wedge	Tower
5E	0
17W	9
1E	0
22E	9
23E	5

Two of these are tower 9 which is excluded in FIDELE.

5 Acknowledgments

I would like to thank Pekka Sinervo for writing the first draft of FIDELE. Satoru Ogawa suggested the PEM cuts and determined the PEM dead channels. Finally, Ed Kearns suggested the FEM cuts.

References

[1] W. Trischuk and L. Nodulman, **CDF948** 1988-1989 Missing E_T Centering and Resolution.

[2] Carla Grosso-Pilcher, Private communication.

A Fiducial cut routine – FIDELE

This section desribes how to use the routine **C$ELE:FIDELE.CDF** which makes the fiducial cuts discussed above. A typical calling sequence for **FIDELE** is shown below:

```
C
C               Get fiducial cut information
C               bkeles   - ELES bank number for electron candidate
C               lunit    - logical unit to get debug dump
C                          (if lunit = 0, no dump)
C               lfiduc   - fiducial cut logical
C                          (true - electron passed cuts
C                          (false - electron failed cuts)
C               failed   - bit pattern indicating which cuts failed
C
                lfiduc = .false.
                lunit = 0
                status = fidele(bkeles,lunit,lfiduc,failed)
                if(lfiduc) then                    electron passed fiducial cut
                    ...
```

Below is the documentation found in the file C$ELE:FIDELE.CDF. The meaning of the bits in the integer word **FAILED** is given below.

```
      INTEGER FUNCTION FIDELE(ELESBN, LUNIT, LFIDUC, FAILED)
C
C Description:
C
C This function determines whether the electron candidate specified
C in the ELES bank with bank number ELESBN falls within the
C fiducial region of the electromagnetic calorimeters.
```

C
C The portions of the CEM that are not allowed are:
C
C i) local wedge x > ±21.0 cm from tower center
C ii) | z | of track impact < 9 cm (avoid the 90° crack)
C iii) Tower 9
C iv) Tower 7 of chimney module
C
C The portions of the PEM that are not allowed are:
C
C i) outer 2 η annuli
C ii) inner 2 η annuli
C iii) 5° border of each quadrant (1 ϕ pad)
C iv) 16 dead channels
C
C The portions of the FEM that are not allowed are:
C
C i) inner 5 η annuli
C ii) 5° border of each quadrant (1 ϕ pad)
C
C Preconditions necessary before call:
C
C **ELES** bank present.
C
C Input Arguments:
C
C ELESBN (Integer*4) ELES/CALS bank number of cluster.
C LUNIT (Integer*4) Debug dump written to unit LUNIT if
C LUNIT>0
C
C Output Arguments:
C
C LFIDUC (Logical) True if electron is in fiducial region.
C FAILED (Integer*4) Bit pattern of cuts that fail.
C 0 CEM failed ϕ crack cut
C 1 CEM failed 90° crack cut

```
C                                        2  CEM failed tower 9 cut
C                                        3  CEM No 3D track
C                                        4  CEM Failed tower 7 chimney
C                                        5  PEM outer eta annuli
C                                        6  PEM inner eta annuli
C                                        7  PEM phi cut
C                                        8  PEM dead channel
C                                        9  PEM bad run
C                                        10 FEM inner eta annuli
C                                        11 FEM phi cut
C
C Function Return Value:
C
C       ERSUCC                           Normal execution
C       ERWARN                           ELES bank not found
C                                        or illegal region (< 0 or > 2)
C
```

B Bad Run Routine – BADRUN

Badrun is called without input arguments. The 2 output arguments give information about whether the run is bad and, if so, why it is flagged as bad. Documentation from the routine is given below:

```
      INTEGER FUNCTION BADRUN(LRUN, FAILED)
C
C Description:
C
C This function determines whether the run number of the current
C event is a bad run.
C
C The bad runs are determined from the following sources:
C       Source                           Run Numbers
C       ------                           -----------
C       Large MET means or sigmas
```

```
C       found from Min Bias data                16785
C
C       Large number of PEM dead                17469,17475,17512
C       channels (> 30)                         18869-18947
C
C       Problems with luminosity                17512-17516
C
C Preconditions necessary before call:
C
C       None
C
C Input Arguments:
C
C       None
C
C Output Arguments:
C
C LRUN (Logical)                    True if run is NOT a bad run.
C FAILED (Integer*4)                Bit pattern of cuts that fail.
C                                   0 failed MET bad run
C                                   1 failed PEM channel bad run
C                                   2 failed luminosity bad run
C
C Function Return Value:
C
C ERSUCC                            Normal execution
C
```

C Bad Tower Routine – BADTOW

Documentation form the routine BADTOW is given below:

```
      SUBROUTINE BADTOW(TOWIND,WEDGE,TOWER,EOW,IERR)
C
C Description:
```

```
C
C Given the cluster TOWE index, this routine returns the wedge
C number, tower number, east or west detector index, and
C flags bad central towers as determined by the E/p calibration.
C
C The bad towers are: 5E0, 17W9, 1E0, 22E9, 23E0 where the
C first number is the phi, the letter indicates east or west,
C and the last number is the tower number.
C
C Preconditions necessary before call:
C
C       None
C
C Input Arguments:
C
C TOWIND (integer)          The TOWE index from the ELES bank.
C
C Output Arguments:
C
C WEDGE (integer)           Wedge number (phi)
C TOWER (integer)           Tower number
C EOW (integer)             Indicates east or west
C                           0 - east, 1 - west
C IERR (intger)             (0) good tower
C                           (-1) bad tower
```