## For each channel in plane subtract pedestals, calculated from the revious 100 events. Find pad with maximum signal (after pedestal subtraction) in the plane. Calculate average signal (name it cmn\_shift) and RMS from the rest of the channels in the plane. If the RMS is less than the RMS from the previous 100 events then we have the Common-Mode-Noise There are two cases of CMN correction when calculating the sum of the signals on the plane: 1) total sum. Sum of all channels with subtracted pedestals and subtracted cmn shift. In this case the pedestal peak tend to be distorted: all small signals by definition have smal RMS and therefore will give perfect zero in the sum. 2) central\_sum. Sum of only 4 central pads with subtracted pedestals and subtracted cmn\_shift. In this case there will be no distrortion of the pedestal peak. **Naming conventions** On all histograms the X axis corresponds to the global pad number GPN. Plane 0. GPN 0:15, ADC0 16:31, Plane 1. GPN ADC1. Disconnected. Plane 2. GPN 32:47, ADC2. In MIP run 28-29 ADC2 was not terminated, therefore was showing twice higher numbers Plane 3. GPN 48:63, ADC3. 63:79, ADC3. Channel 6 dead Plane 4. GPN 80:95, ADC3. Plane 5. GPN Plane 6. GPN 96:111, ADC3. Plane 7. GPN 112:127, ADC3. No negative signals. Pad numbering: 4 8 12 16 3 7 11 15 2 6 10 14 9 11 **Overall structure:** W(2.5mm), Si, W(2.5mm), Si, W(2.5mm), Si, ..... Total: 3\*5 layers, +2\*(W(15mm),Si,W(15mm),Si, W (15mm),Si) Prerequisites. Raw data. Protons 70 GeV, runs 46&54, Raw data. © 0 8 File Edit View Options Inspect Classes <u>H</u>elp tADC 3000 **hADC** 10<sup>6</sup> Entries 4.52096e+08 2500 Mean x 64 Mean y 297.5 RMS x 36.95 10<sup>5</sup> 2000 RMS y 271.1 1500 10<sup>4</sup> 1000 10<sup>3</sup> 500 10<sup>2</sup> 0 10 -500 Fig. 1 Protons 70 GeV, runs 46&54, Pedestals subtracted. © 0 8 <u>File Edit View Options Inspect Classes</u> <u>H</u>elp ADC 3000 **hADC** 1.10592e+08 **Entries** 10<sup>6</sup> 2500 Mean x 64 Mean y 14.81 RMS x 36.95 10<sup>5</sup> 2000 RMS y 195.8 1500 10<sup>4</sup> 1000 10<sup>3</sup> 500 10<sup>2</sup> 0 10 -500 -1000 20 80 120 Fig 2 Protons 70 GeV, runs 46&54, Pedestals subtracted, Common-Mode-Noise corrected (total\_cmn). © 🗈 😸 File Edit View Options Inspect Classes <u>H</u>elp ADC **hADC** 1.10592e+08 3000 69.71 Mean y 13.3 2500 RMS x 36 10<sup>5</sup> RMS y 2000 10<sup>4</sup> 1500 10<sup>3</sup> 1000 500 10<sup>2</sup> 10 -500 1000 20 60 100 120 Fig 3 Positrons. Run 38. Wide front trigger. CMN-corrected (total\_cmn) ♥ 🗈 😸 File Edit View Options Inspect Classes ADC 3000 10<sup>5</sup> **hADC** 2500 **Entries** 1.1776e+07 Mean x 69.71 Mean y 7.682 2000 10<sup>4</sup> RMS x 36 RMS y 1500 10<sup>3</sup> 1000 500 10<sup>2</sup> 10 -1000<sub>0</sub> 20 60 80 100 120 Fig 4 Positrons 10 GeV, Runs 28-29. MIP run. Beam absorber in front of the detector, Pass-through trigger. Pedestal subtracted, Common-Mode-Noise corrected. Note. Values of ADC2 should be divided by 2 because the cable was not terminated. File Edit View Options Inspect Classes <u>H</u>elp ADC 3000 10<sup>5</sup> hADC **Entries 6144000** 2500 Mean x 69.71 Mean y 10<sup>4</sup> 0.3615 2000 RMS x 36 RMS y 1500 10<sup>3</sup> 1000 10<sup>2</sup> 500 10 -500 100 20 60 120 40 80 Fig 5 The same run. Total histogram of ADC0 channel 0. This is how pedestals looks like. <u>File Edit View Options Inspect Classes</u> ADC **Entries** 213 10<sup>5</sup> Mean 0.06618 RMS 6.012 10<sup>4</sup> 10<sup>3</sup> 10<sup>2</sup> 600 Fig 6 Common-Mode-Noise rejection (total\_cmn). How it works root [106] run\_ihep("../data/raw\_runs\_28-29\_MIP/",0) File Edit View Options Inspect Classes <u>H</u>elp detector sum **Entries** 220979 600 Mean 49.22 **RMS** 196.4 500 400 300 200 100 -600 -400 200 400 600 Fig 7 MIP run run\_ihep("../data/raw\_runs\_28-29\_MIP/",1) © 🗈 😣 File Edit View Options Inspect Classes hsd detector sum 220979 **Entries** Mean 44.37 4500 E 111.7 4000 3500 3000 2500 2000 1500 1000 500 -1000 1000 -500 Fig 8 12/02/05 03:21:01 pm © 🗈 😣 File Edit View Options Inspect Classes <u>H</u>elp hsd detector sum **Entries** 220979 Mean 49.69 **RMS** 165.2 1000 800 600 400 200 -1000 -800 -600 1000 -400 -200 200 400 600 800 Fig 9 12/02/05 04:47:41 pm Effect of CMN correction on plane sums On all figures below are 9 histograms. From left to right, top to bottom: 1. Central sum of the plane 0 2. All amplitudes after CMN correctios 3. Sum of the plane 2 4. Sum of the plane 3 5. Sum of the plane 4 6. Sum of the plane 5 7. Sum of the plane 6 8. Sum of all 7 planes 9. Total sum of all 7 planes No CMN correction. run\_ihep("../data/raw\_runs\_38-01\_e\_wide\_adc\_-50\_50/",0) 6 cl\_n2 <u>E</u>dit <u>F</u>ile View Options Inspect plane sum ADC 264 Fig. $\overline{10}$ CMN condition if((plane\_rms < gADCrms[adc]) TFile \*ff = new TFile("hists/total\_120201\_14\_11\_05\_05\_07\_50.038.root") © 0 8 File Edit View Options Inspect Classes ADC Entries ADC Entries ADC Entries 0 0 160 267 168.9 Mean RMS Mean RMS 308.9 Entries 248 Entries Entries 176.4 158.3 368.6 RMS ADC Entries 93 18.8 RMS Fig 11 CMN condition if((vmax > gADCrms[adc]) && (plane\_rms < gADCrms[adc])) TFile \*ff = new TFile("hists/total\_120216\_14\_11\_05\_05\_07\_50.038.root") 📵 cl\_n2 © 🗈 😣 Edit View Options Inspect Classes <u>H</u>elp plane sum Entries 342.4 212.8 Mean RMS RMS Entries Entries 190 Entries 256 Mean RMS Mean Mean RMS detector sum Entries 95 19.57 Mean RMS Fig 12 12/04/05 11:17:32 am Results. CMN correction: central sum. On all figures below are 9 histograms. From left to right, top to bottom: 1) Central sum of the plane 0 2) All amplitudes after CMN correctios 3) Central sum of the plane 2 4) Central sum of the plane 3 5) Central sum of the plane 4 6) Central sum of the plane 5 7) Central sum of the plane 6 8) Central sum of all 7 planes 9) Total sum of all 7 planes MIP run run\_ihep("../data/raw\_runs\_28-29\_MIP/",1,29) ( cl © 0 8 <u>File Edit View Options Inspect Classes</u> ADC ADC 459 Entrie ADC ADC 401 Mean 0.8189 RMS 10.95 0.366 8.614 0.2234 7.834 ADC hscd Entries 220979 detector sum Entries 0.1202 4.35 RMS 52.49 Fig 13 © 🗈 😸 File Edit View Options Inspect Classes detector central sum hscd 220979 **Entries** Mean 2.352 8000 RMS 26.19 7000 6000 5000 4000 3000 2000 1000 -900 -50 100 Fig. 14 Positron 10 GeV run run ihep("../data/raw runs 38-01 e wide adc -50 50/",1,38) cl\_n2 © 🗈 😸 File Edit View Options Inspect Classes Entries 1567 Entries 1920 55.01 90.19 Mean RMS RMS Entries 2035 1497 Entries 1768 Entries Mean 90.79 44.13 43.31 ADC Entries Mean Fig 15 cl\_n3 © 🗈 😣 File Edit View Options Inspect Classes Help hscd detector central sum 452901 **Entries** 390.5 Mean 500 **RMS** 970.3 400 300 200 100 -1000 -500 3000 3500 500 1000 1500 2000 2500 x=2541.67, y=580.985 c1\_n3 Fig 16 Pedestal peak at -260, right peak at 1670. Proton 70 GeV run run\_ihep("../data/raw\_runs\_46-54\_p\_narrow\_adc\_-25\_25/",1,50); © 🗈 😸 <u>E</u>dit Inspect Classes View Options Help 218.9 622 3502 310.5 763.8 190 562 360.8 817.6 detector central sum plane central sum 312.1 743.2 Fig 17 © 0 8 <u>File Edit View Options Inspect Classes</u> <u>H</u>elp hscd detector central sum **Entries 4301401** 1380 Mean 1200 **RMS** 2645 1000 800 600 400 200 -2000 0 2000 4000 6000 8000 10000 Fig 18 Peak at -892

Analysis of the Test Beam Run at IHEP.

**Common-Mode-Noise Correction Algorithm**