Data analysis of TRD beam test

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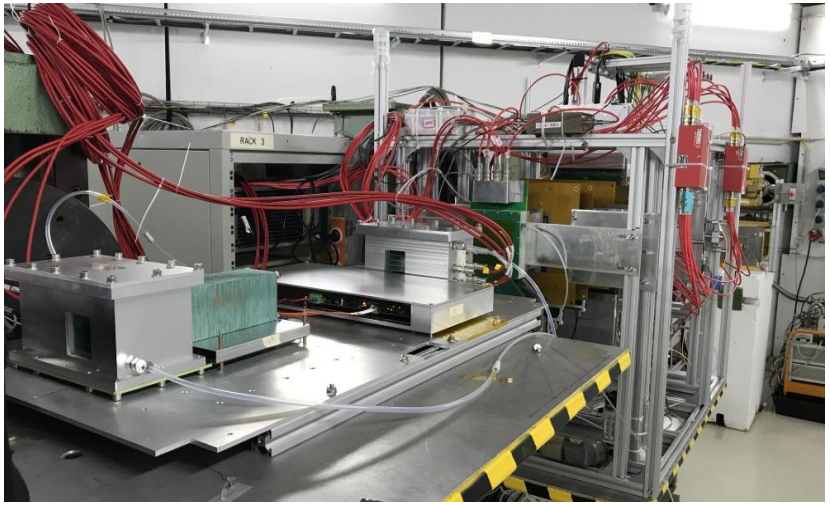
Introduction

- TRD performance changes slowly with time. How to correct TRD performance in orbit?
- Correction by fitting the ionization background peak.
  - to make such a correction based on DESY beam test data.

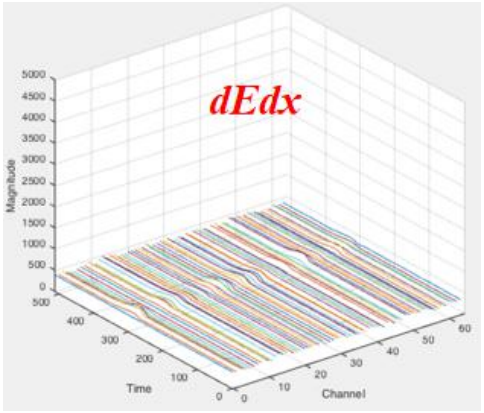
Description of beam test.

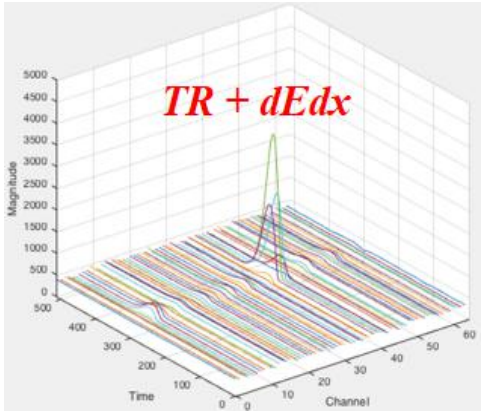
- TRD regular radiator structure:
  - 225 layers of polypropylene(PP) foil with a thickness of 20 microns.
- The sensitive volume:
  - 64-way readout structure, and the thickness is 51.2mm.
  - 11 mm invalid areas on front and back.
  - working gas: 93%Argon + 7%CO_2.
- Beam particle:
  - electrons.
  - energy : 1 – 5.8GeV
  - Lorentz factor : $2\times10^3 \sim 10^4$.

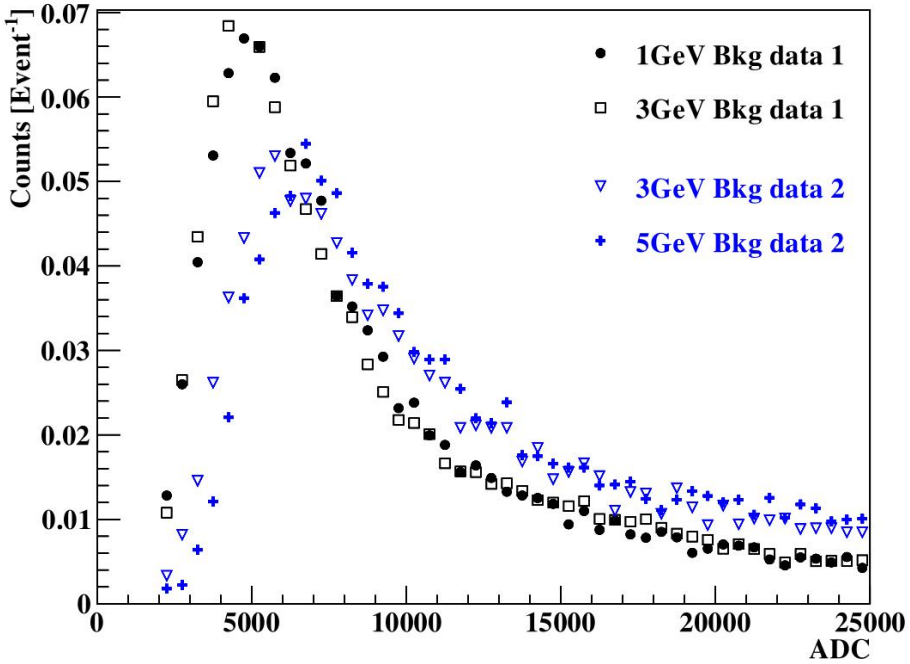


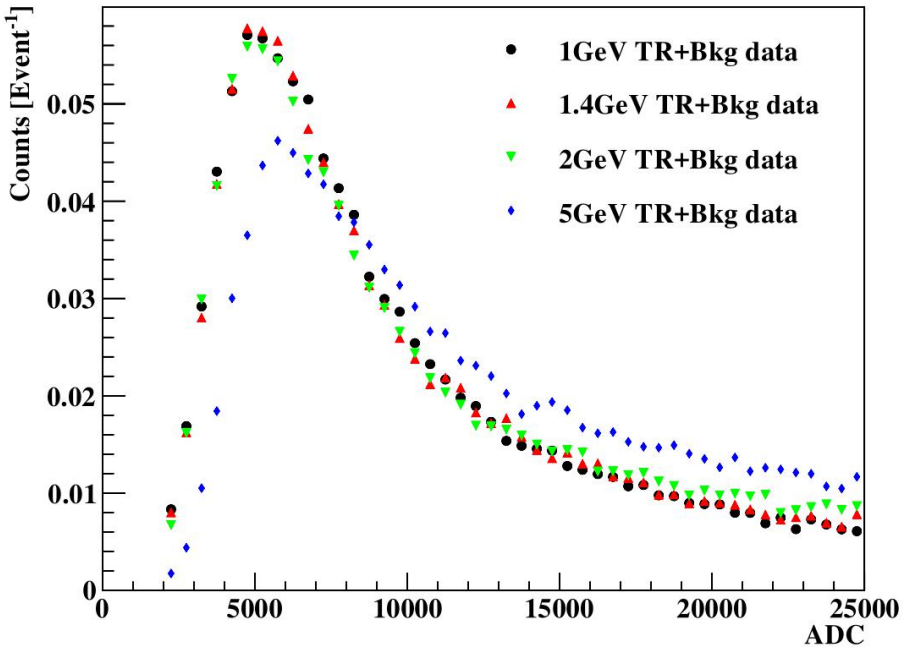
Data acquisition logic

- The data is obtained by selecting the channel with the largest energy deposition in the 64 channels









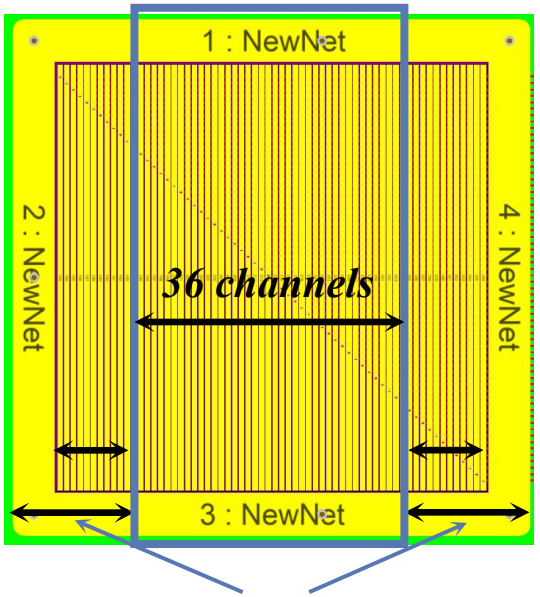
- Reasons for performance changes: Change the gas during the experiment(~18 hours).

Fitting method

Construct the fitting function: *func*

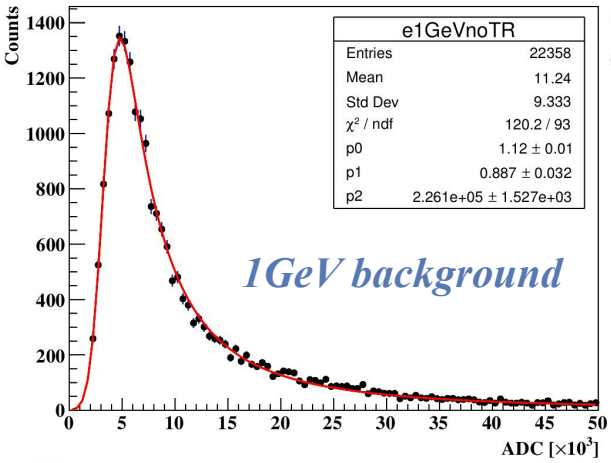
- Generate 36 random numbers distributed by Landau and take the maximum value.
  - Construct truth function: *fLan*

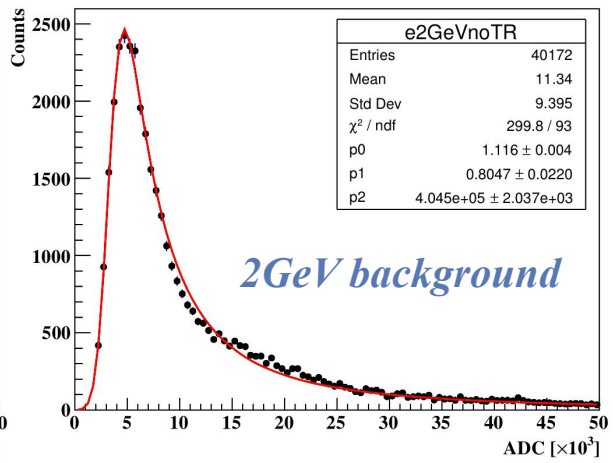
```
for (int i=0;i<EventNum;i++) {
    MaxADC = 0;
    for (int j=0;j<36;j++) {
        ADC[j] = gRandom->Landau(MPV, Width);
        if ( ADC[j] > MaxADC ) {
            MaxADC = ADC[j];
        }
    }
    fLan->Fill(MaxADC);
}
```

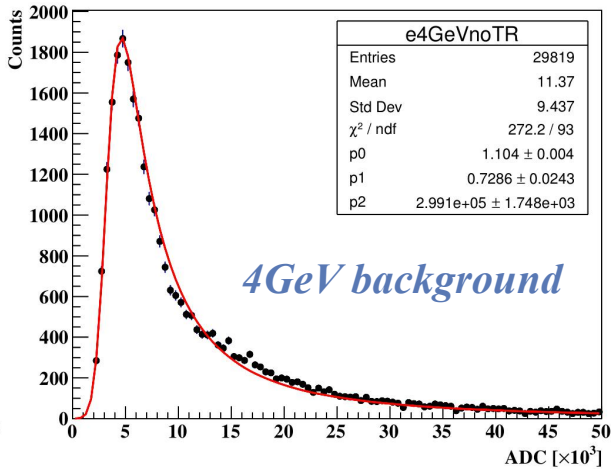


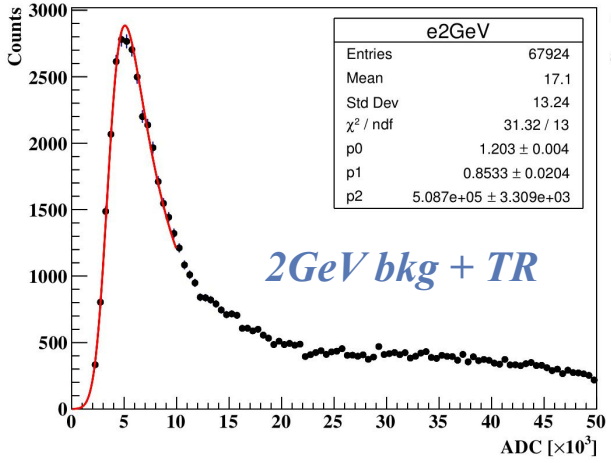
- Then the sampled function is convolved with a Gaussian function.
  - Truth function convolution Gaussian: *Func = fLan * gaus(Mean,Sigma)*
- *func*->fitTo(data)

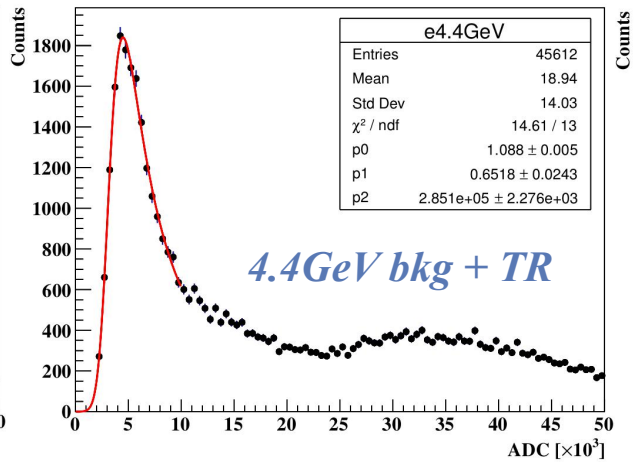
Fitting Results

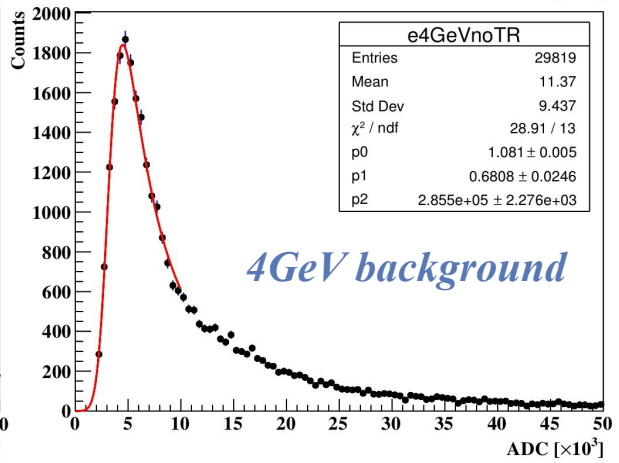








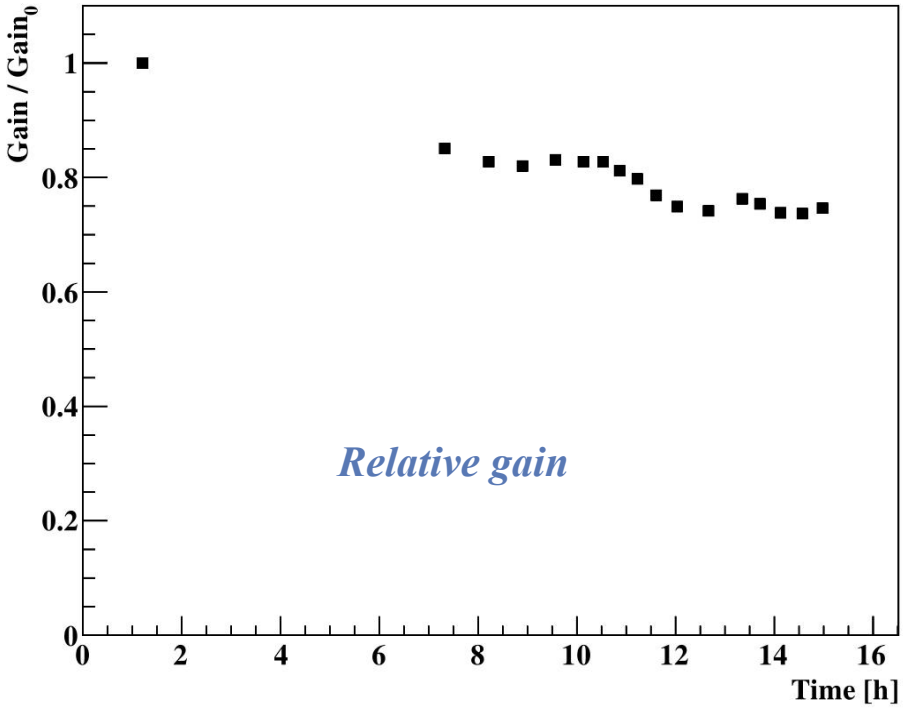


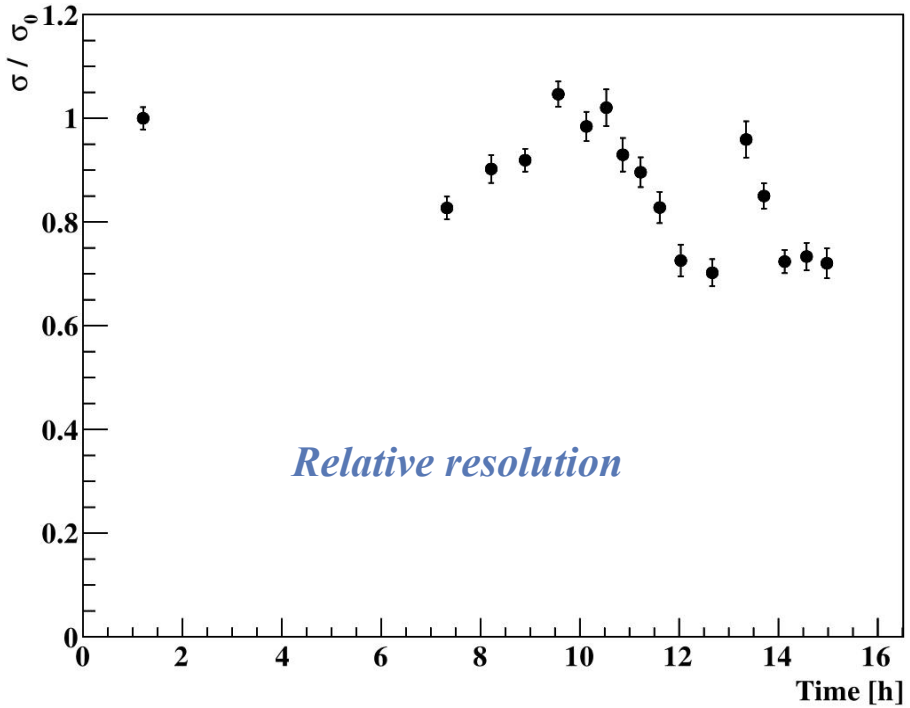


- The fitting parameter par[0](*Mean*) reflects the gain of the detector.
- The fitting parameter par[1](*Sigma*) reflects the resolution of the detector.

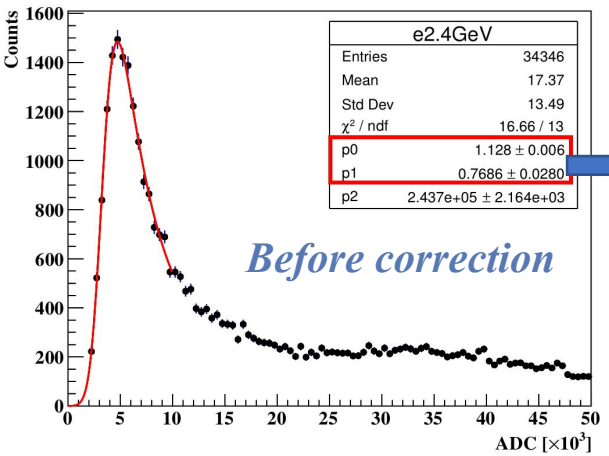
Relative gain and relative resolution

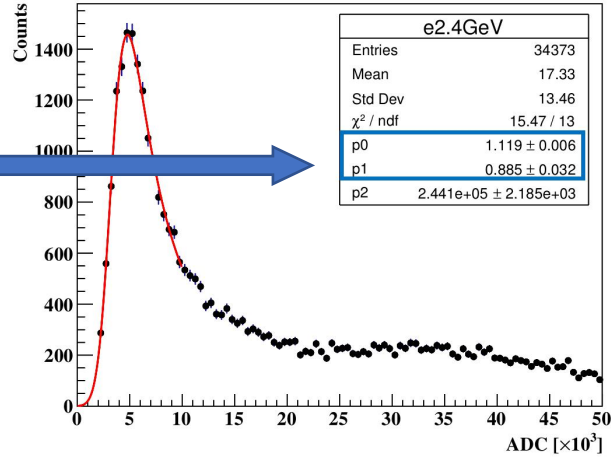
- Data :
  - 16 TR signals data.
  - and 5 ionization backgrounds.
  - beam test time : around 22 hour.
  - the relative gain and resolution of e5.2GeV, 5.4GeV and 5.6GeV-1 vary greatly

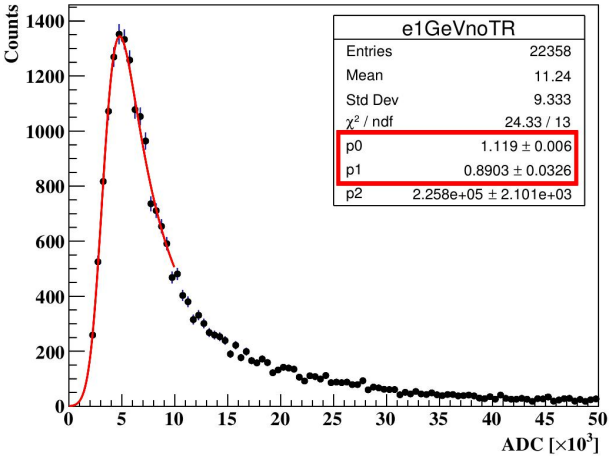


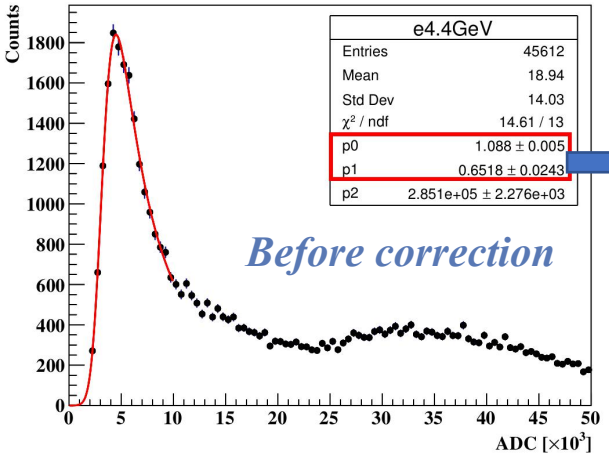


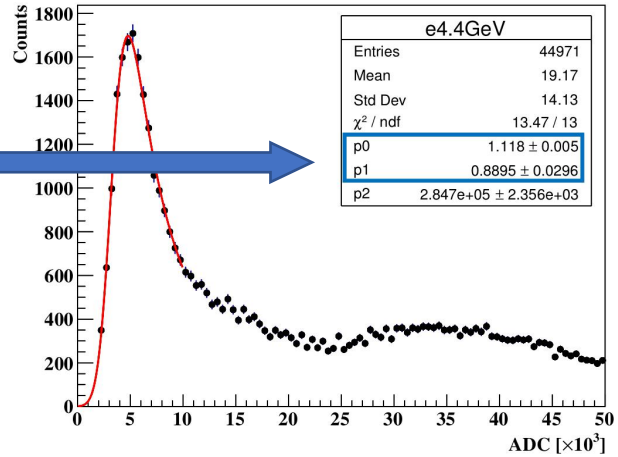
Adjust the data to be consistent







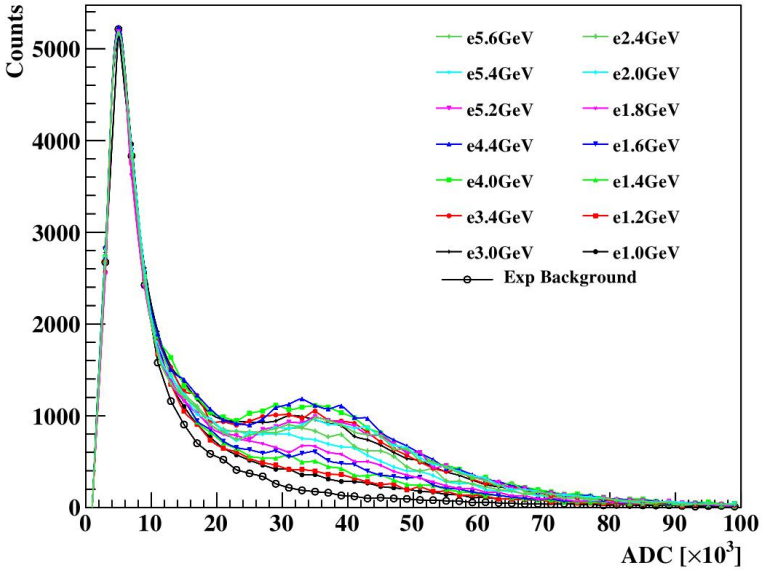


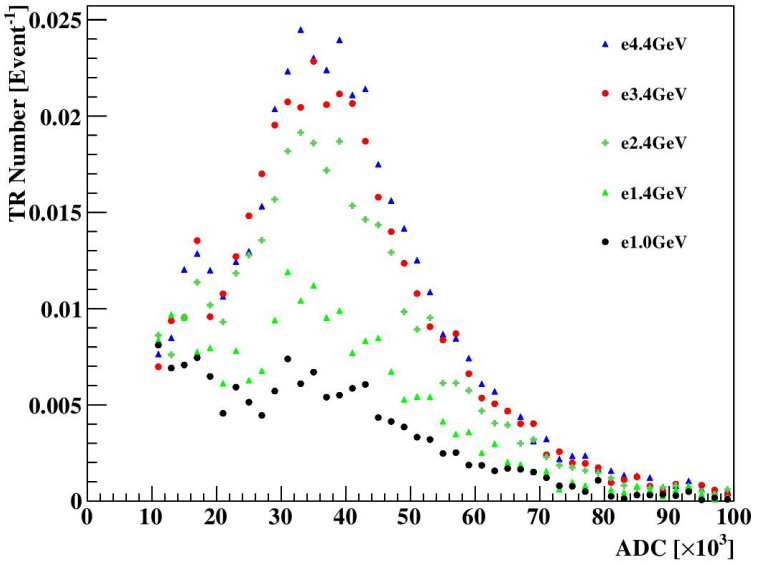


- Adjust the gain of the data: according to the fitting parameter par[0]
- Adjust the resolution of data: according to the fitting parameter par[1]

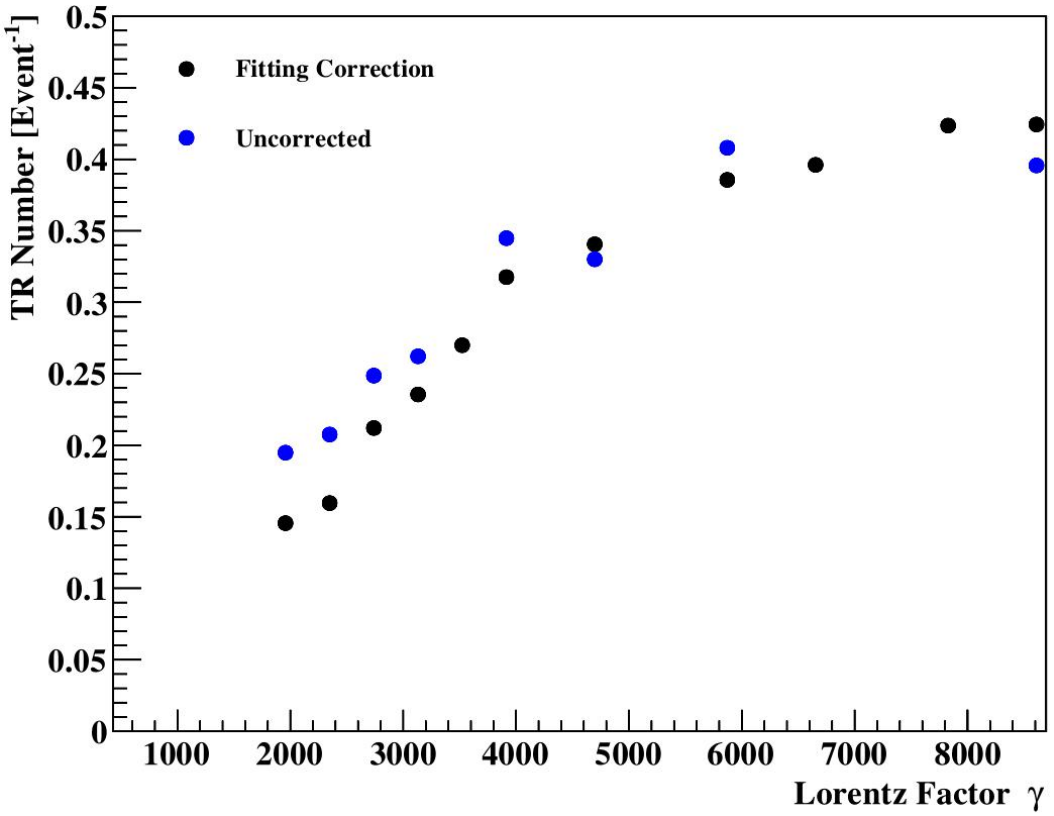
- All data with TR signal are corrected to be consistent with the background data of 1GeV

Corrected result





- All energy data after correction
- Remove the background TR signal after correction
- TR count without correction and after correction



Summary and Plan

Summary:

- According to the acquisition logic of the experimental data, the fitting function is constructed.
- Fit the ionization background peak through the constructed fitting function to obtain real-time detector performance.
- Different data can be corrected by fitting parameters, and all data was corrected to be consistent.

Next:

- Coonsider the error transmission, and to fit another set of data.
- Proofread in this way by fitting the results of a single-channel data.