

CERN T10 Test Beam Simulation

SuperB EMC session

Pasadena

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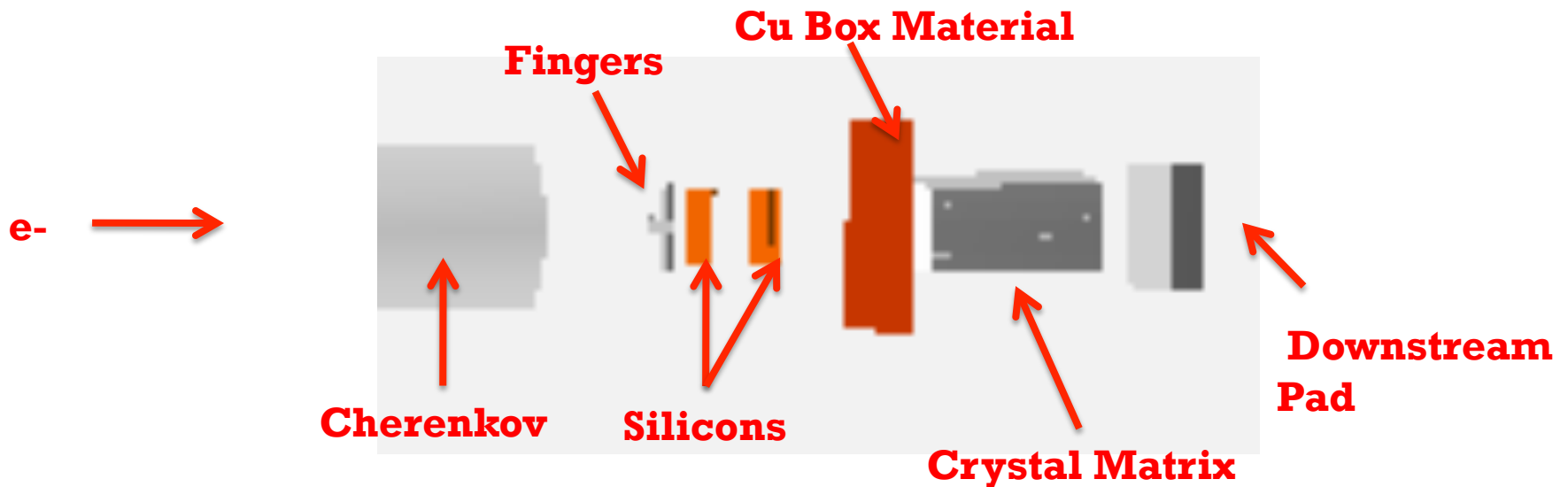
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Intro

- **Aim:**
MC Study on TB matrix resolution effects
- **Beam**
 - 1→4.5 GeV e-
 - 2x2 cm beam on central crystal (12)
- **Strategy:**
 - Try to include all known effects
 - Noise
 - Beam Energy Spread
 - Intercalibration Error
 - Photostatistics
 - Crystals LY non-uniformity
 - Generate ntuples to process TB data and MC with the same code

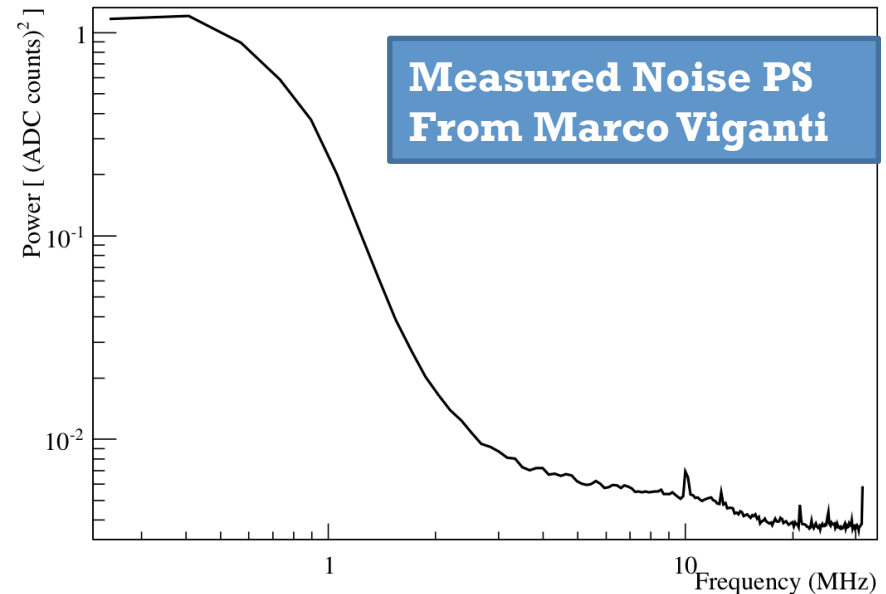
Simulation Geometry

- All elements of the T10 line have been included in the simulation geometry



Simulated Effects

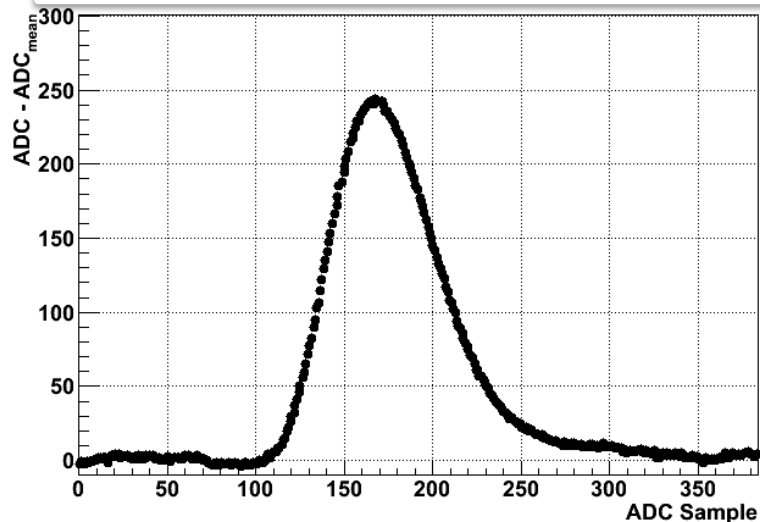
- **Crystals LY non-uniformity**
 - Use Gauss distribution to assign non uniformity from RY measurements
 - Mean = 4.5% RMS = 0.6%
- **Photostatistics**
 - 450 PE/MeV
- **Intercalibration Error**
 - Default is 1% (maybe to small)
 - Need to be estimated correctly
- **Beam Energy Spread**
 - 0.7% from T10 line description
- **Noise and Signal**
 - Use measured noise PS for each crystal (from Marvo Vignati)
 - Use ADC counts/MeV as measured in the data
 - Emulate ADC sampling procedure
 - Add fixed shape Gauss function to random noise according to PS and noise RMS



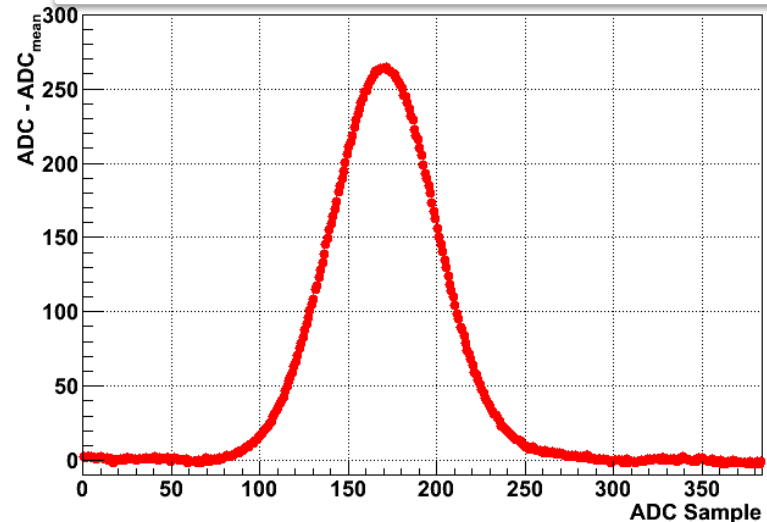
Noise + Signal simulation

Signal Amplitude = Peak height

Noise + signal example
from DATA



Noise + signal example
from PS+Gauss

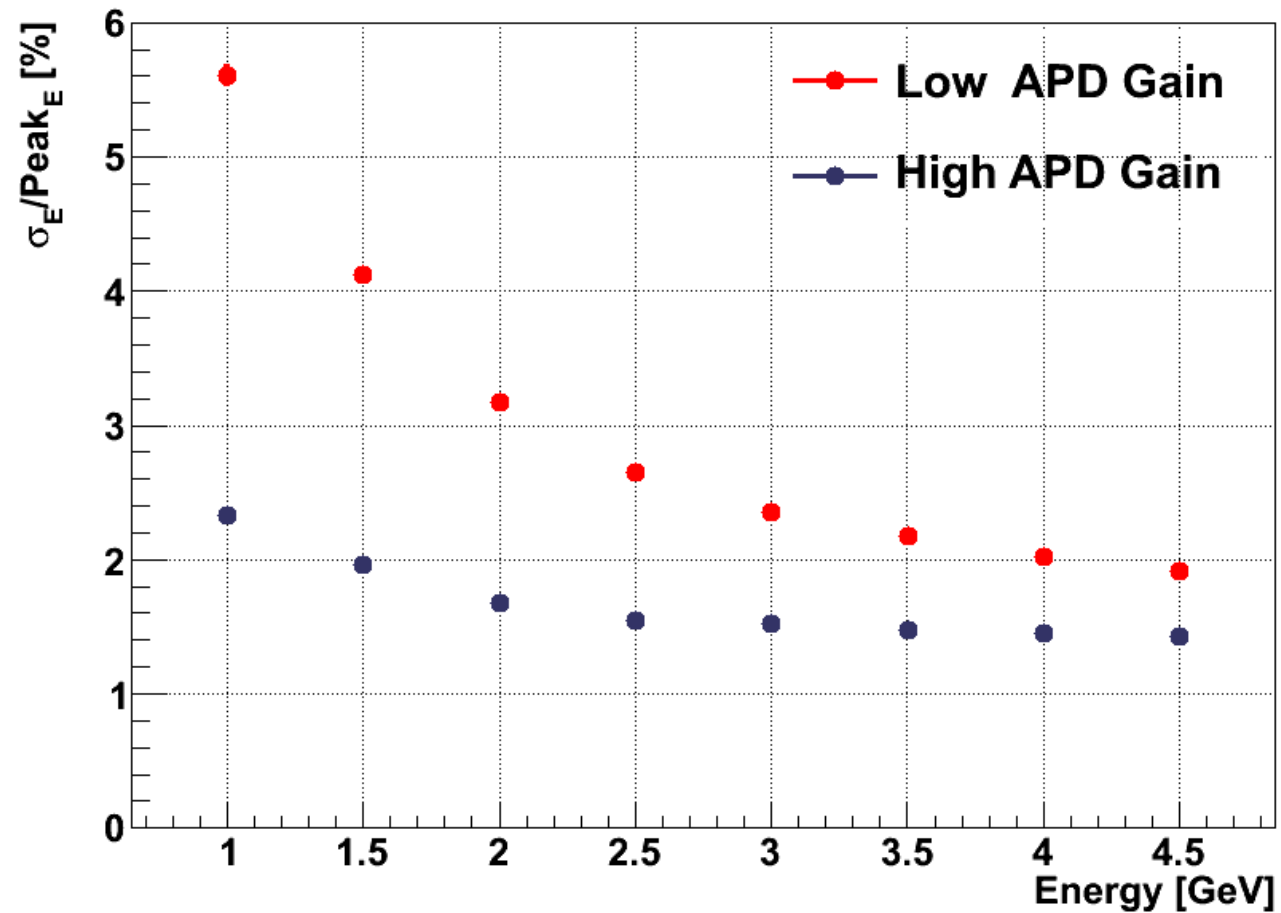


Thresholds:

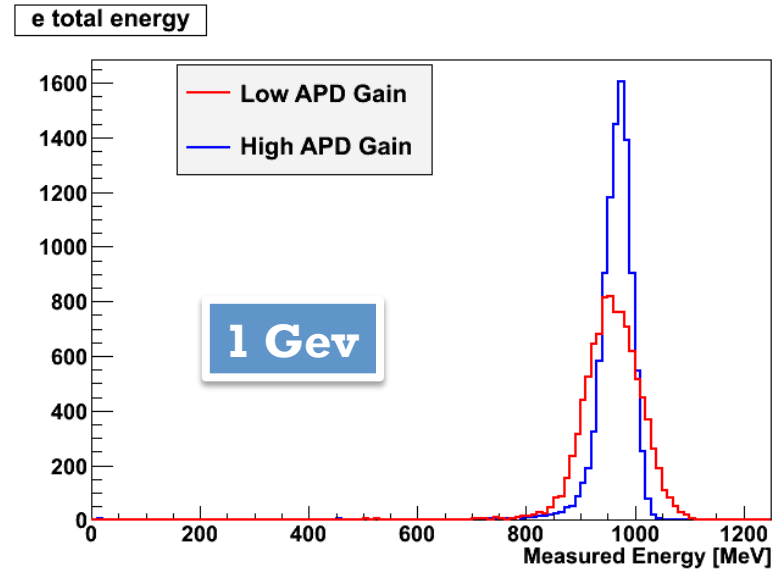
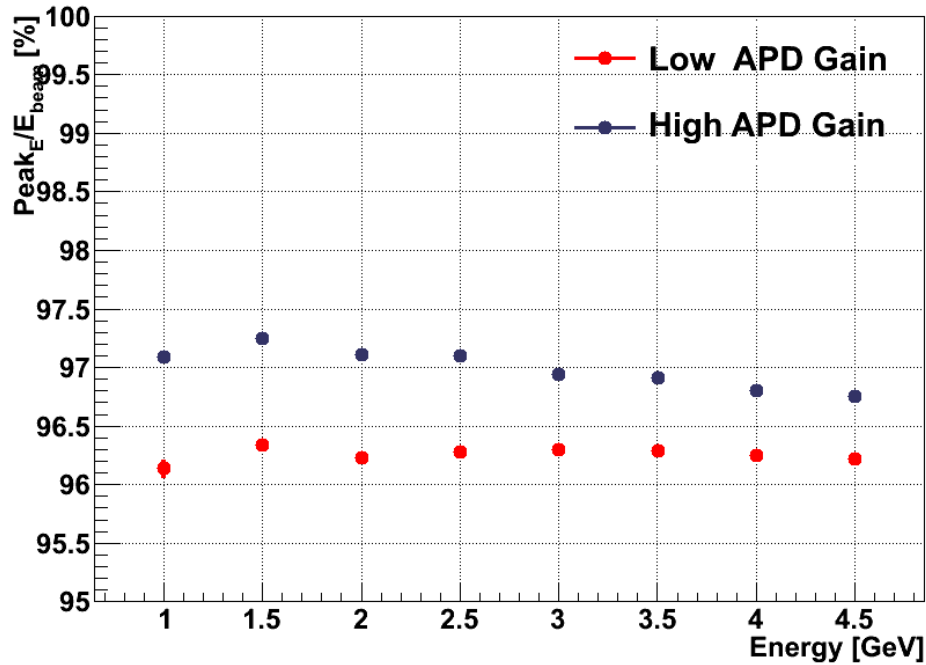
- Low Gain \rightarrow 2 Noise RMS (~ 16 MeV)
 - Very High : default value in SuperB FullSim is 1 MeV
- High Gain \rightarrow 3 Noise RMS (~ 7 MeV)
 - Still quite high (default value in SuperB FullSim is 1 MeV)

Resolution vs Energy

Resolution from Crystal Ball function fit (FWHM/2.36)

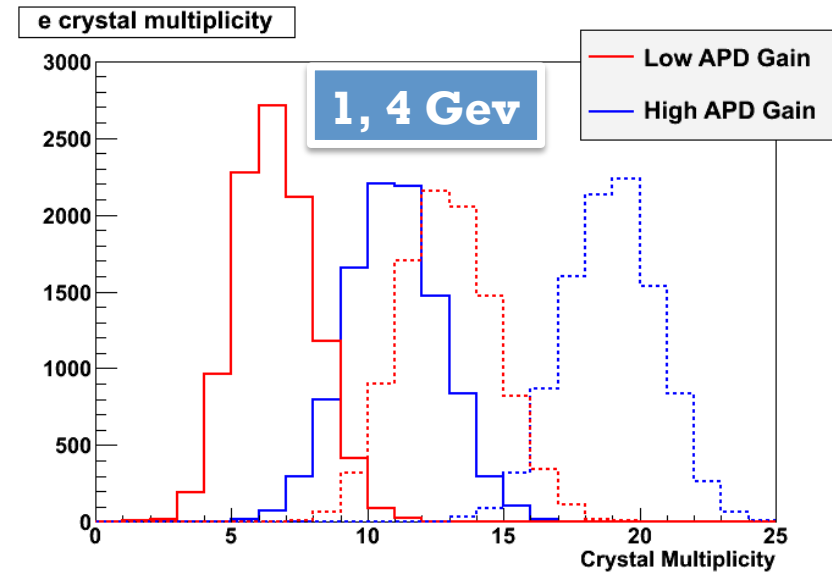
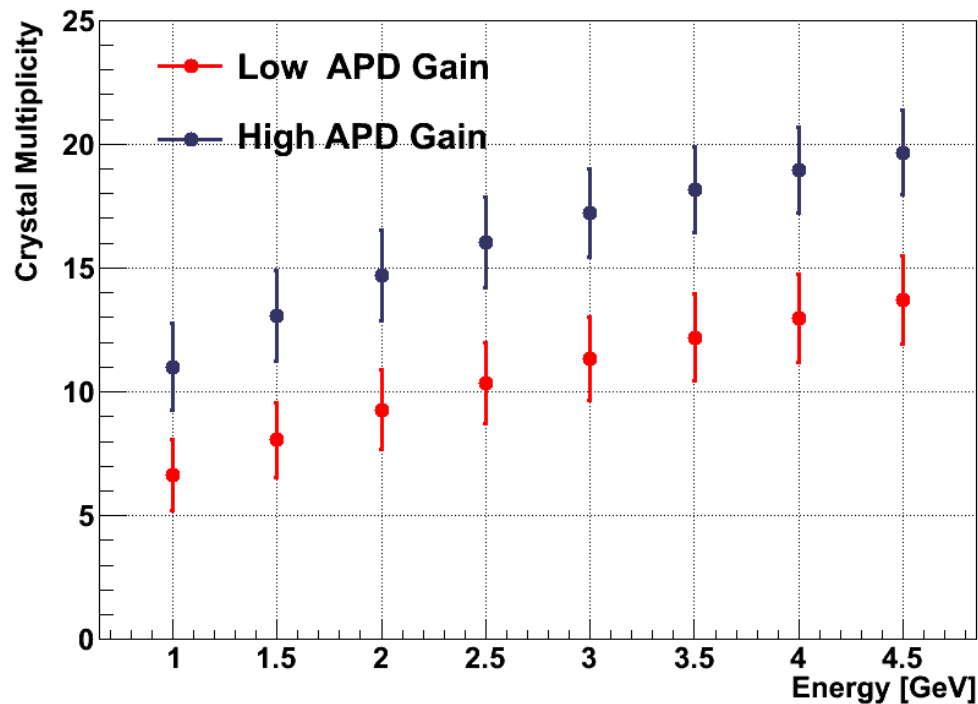


Peak Position vs Energy



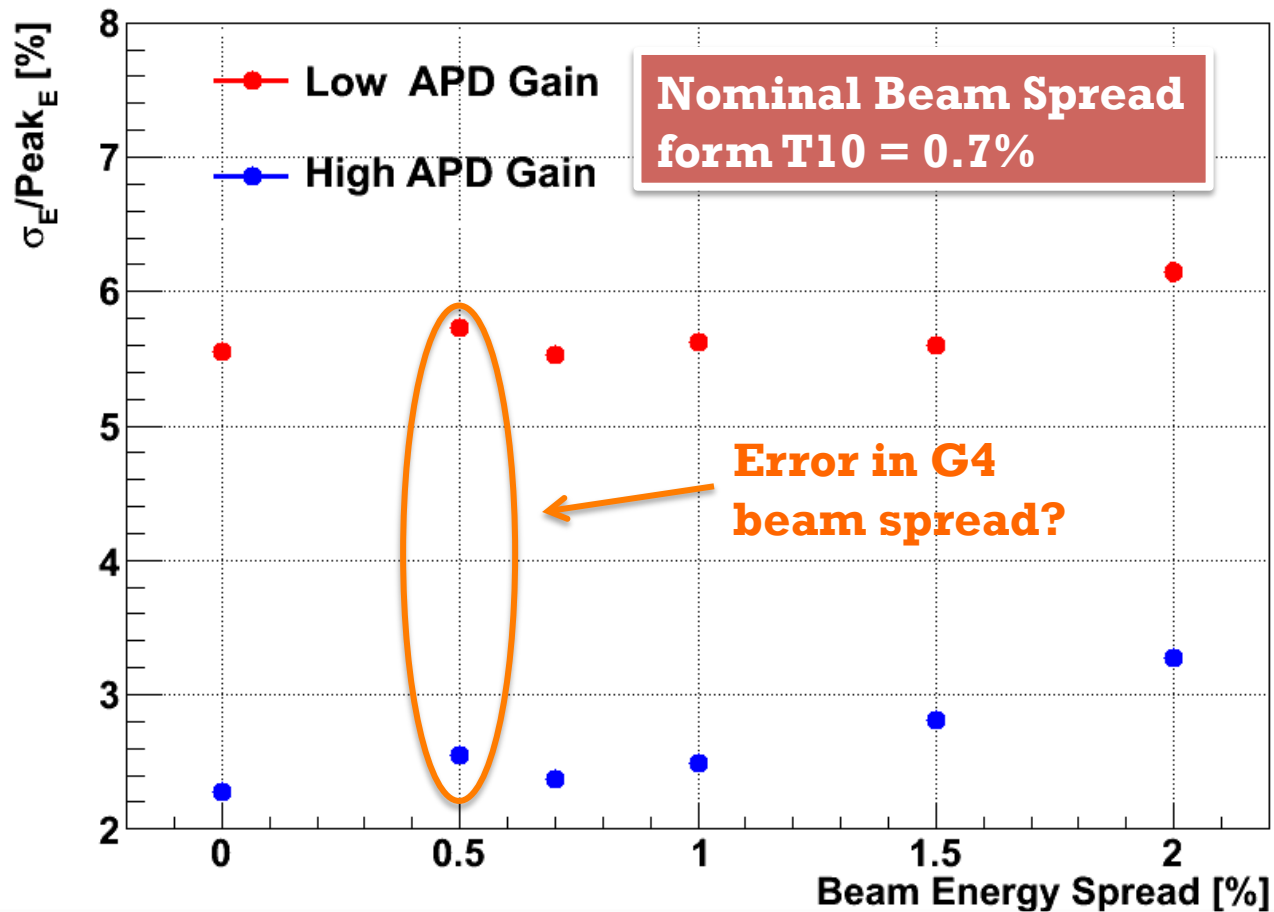
- Peak position is different between Low and High APD gain configurations
- Small dependence of $E_{\text{peak}}/E_{\text{beam}}$ with beam energy

Crystal Multiplicity vs Energy



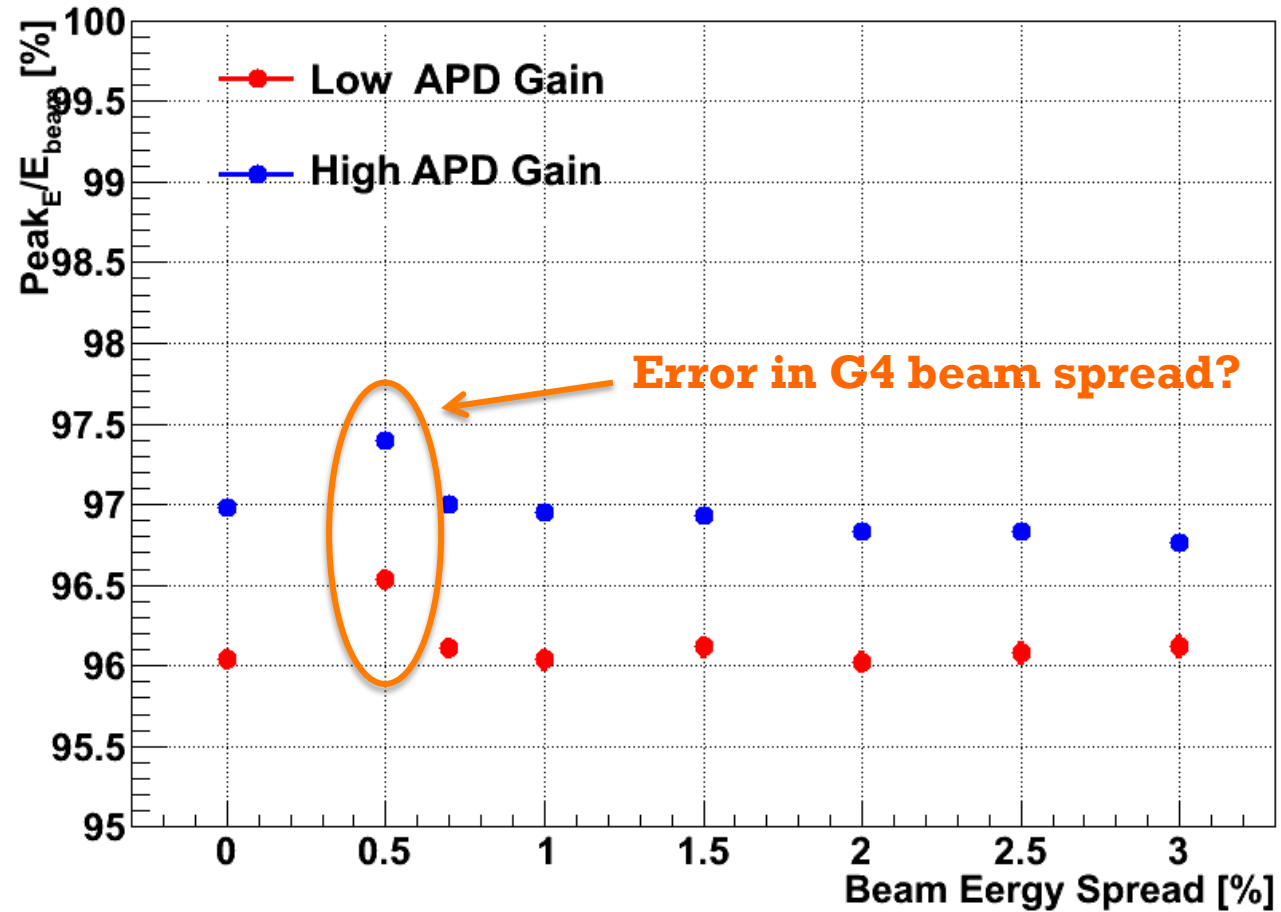
- Peak position is different between Low and High APD gain configurations
- Small dependence of $E_{\text{peak}}/E_{\text{beam}}$ with beam energy

Resolution vs Beam Energy Spread

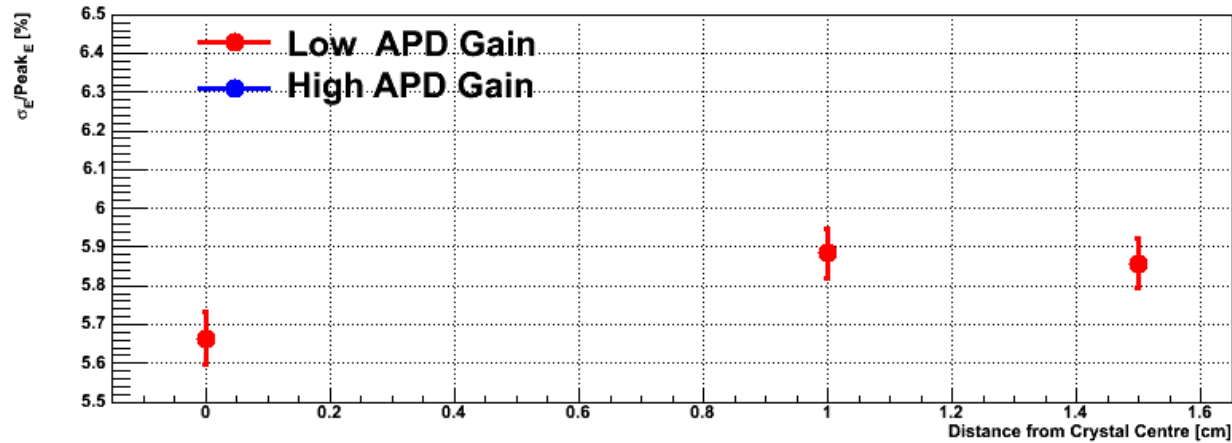


- Significant dependence of resolution on beam energy spread
- To have a significant impact at Low Gain the spread should be more than twice the nominal one
- Beam spread knowledge may be an issue for High Gain simulation accuracy

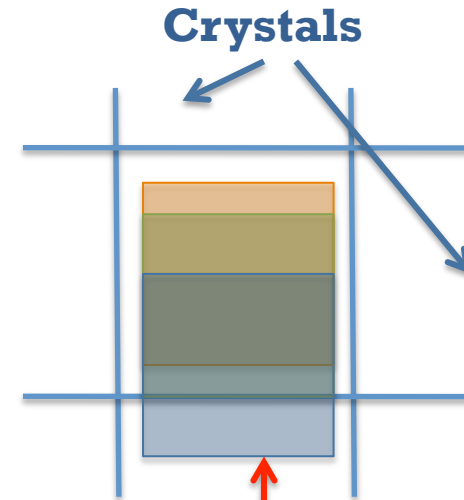
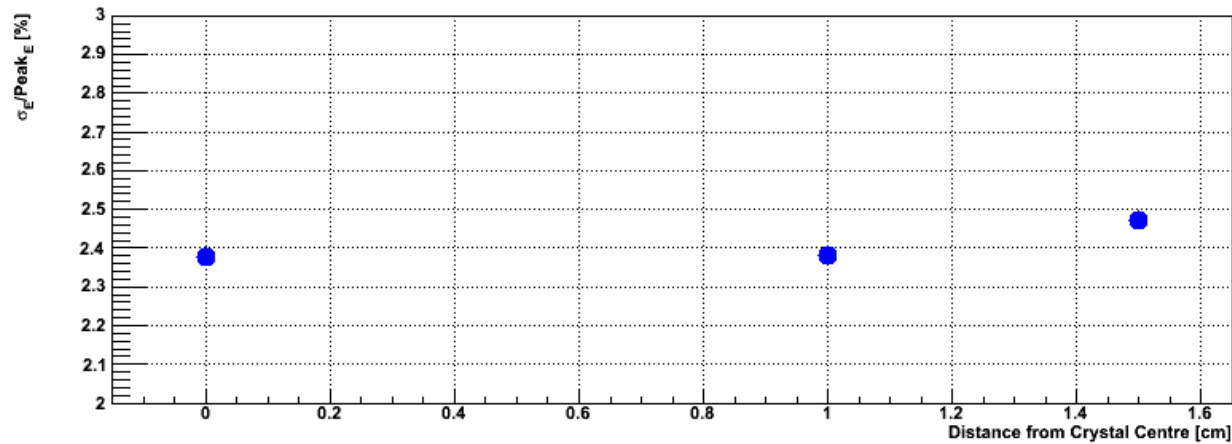
Peak Position vs Beam Energy Spread



Resolution vs Beam Position



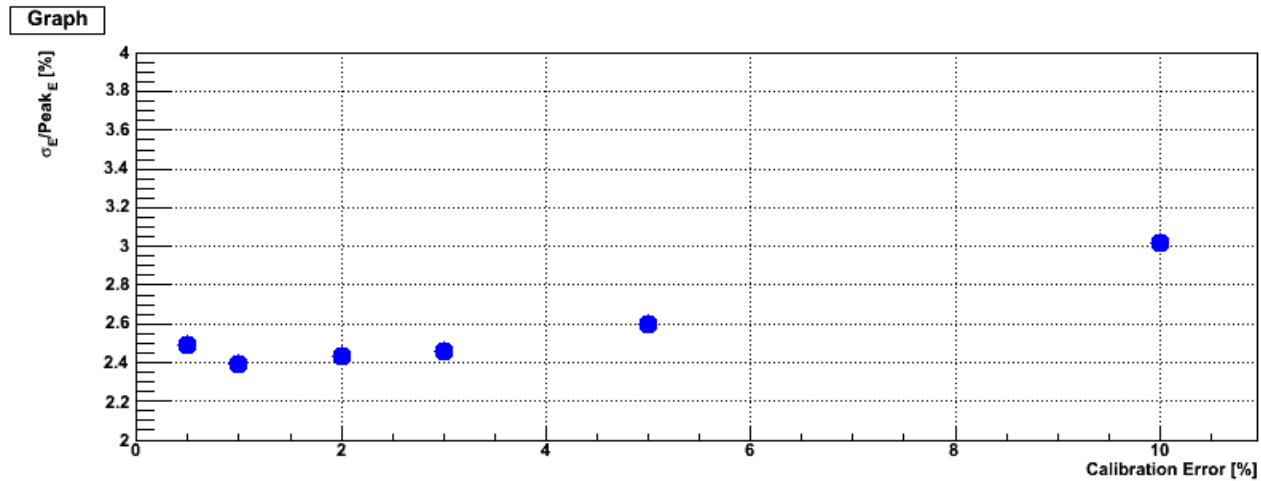
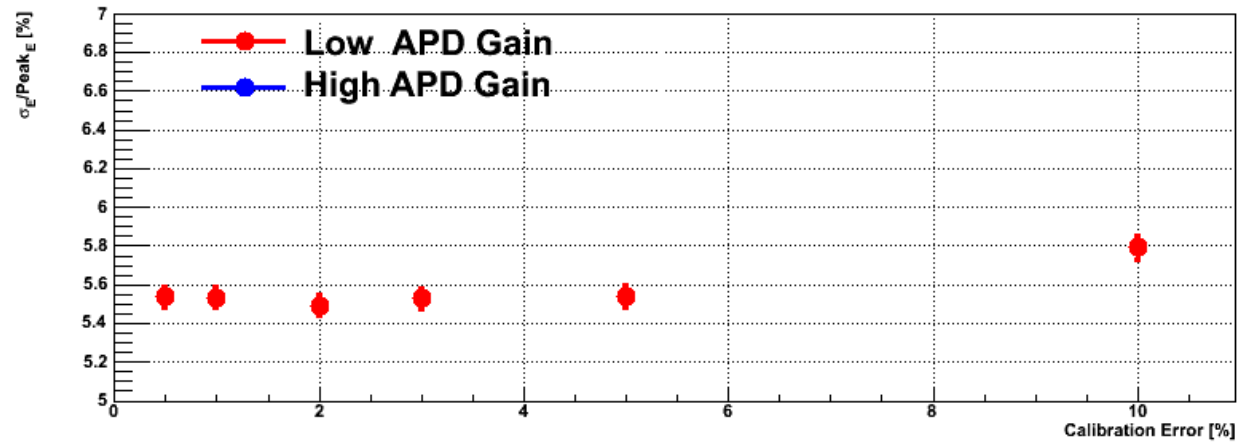
Graph



Beam Spot Position change

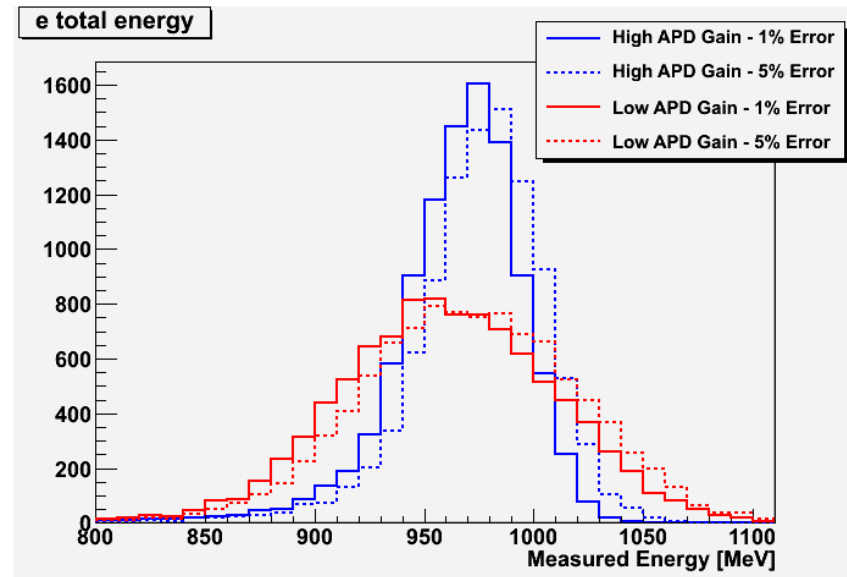
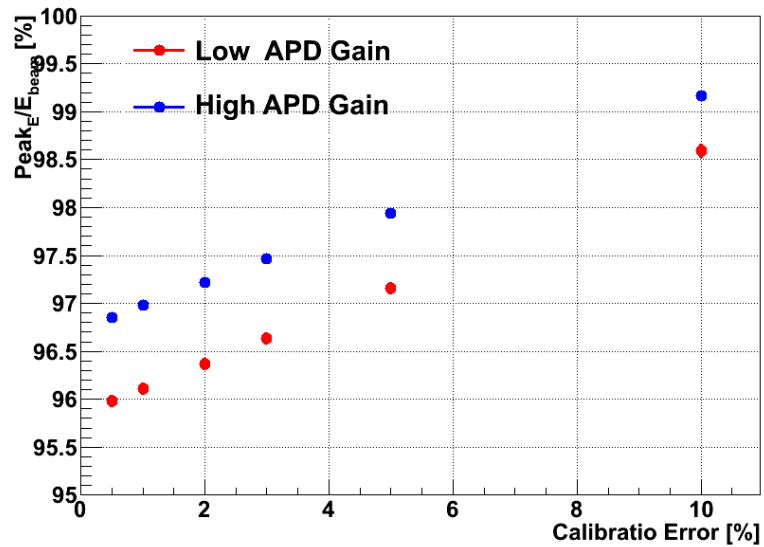
- Small dependence of resolution on beam position
- Need to tune exactly the position according to TB data
- Position may change between different runs at the same energy

Resolution vs Intercalibration Error



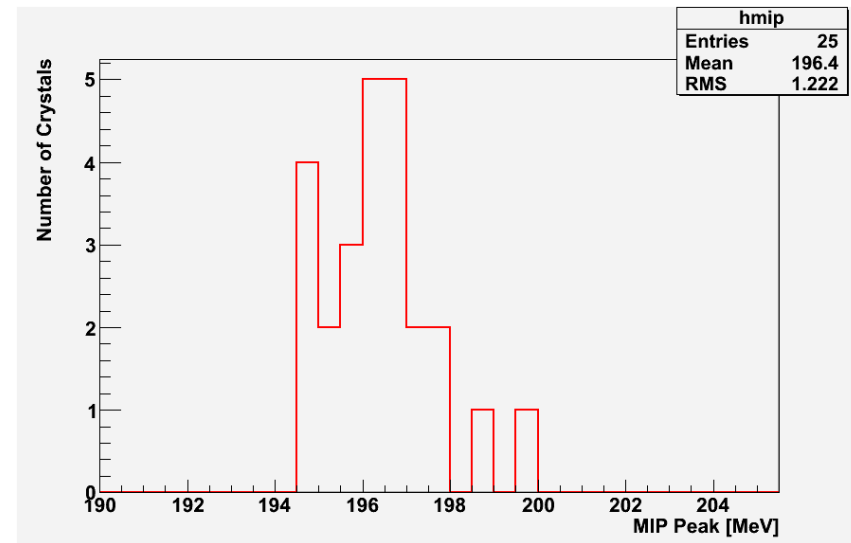
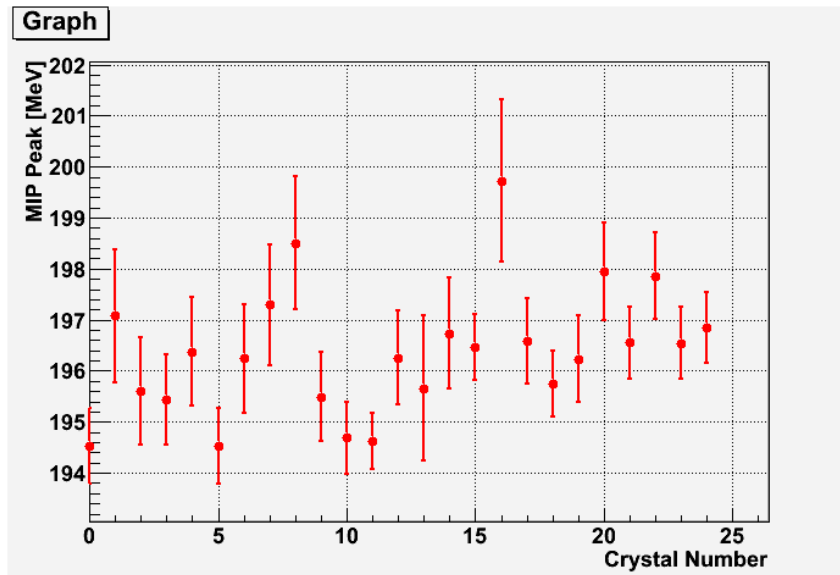
Precise Intercalibration Error estimate may be an issue for High APD gain

Peak Position vs Intrecalibration Error



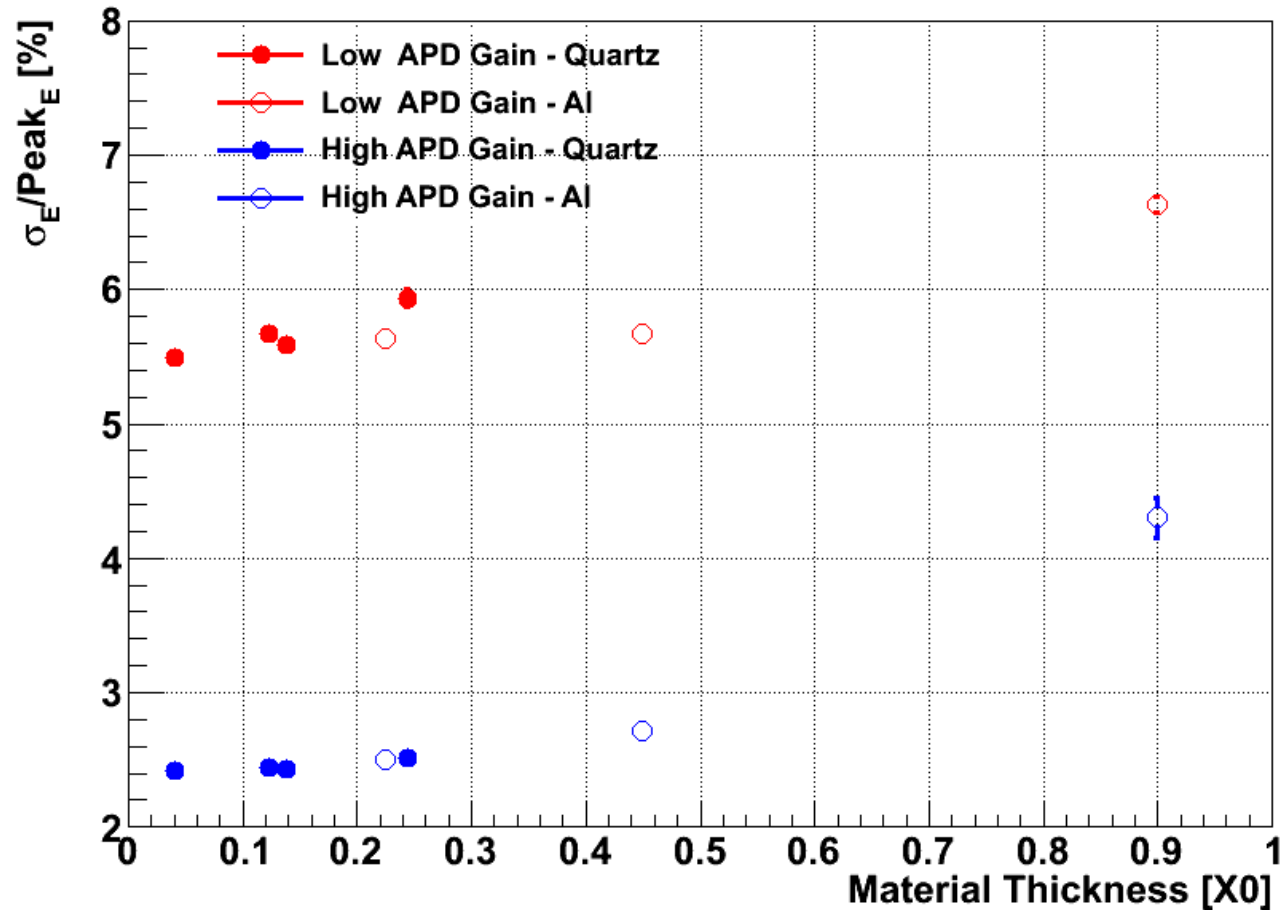
Peak Position is largely affected by intercalibration error

Pions MIP Peak vs Crystal



Intrinsic MIP peak spread seems not to be an issue

Resolution vs Upstream Material X0



- Results with Quartz and Al seem to be consistent
- Need to compare results with TB data

Conclusions

- Noise oscillations, intercalibration error and beam energy spread have not negligible effect on resolution especially for High APD gain
 - Precise estimate of intercalibration error is needed
- See MC-Data comparisons in Alessandro's Talk