Impact of the Electromagnetic Calorimeter Calibration on Physics Sensitivity

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EM Calorimeter *In Situ* Calibration

Energy Resolution : $\sigma(E)/E = 1.7\% / \mathrm{sqrt}(E) \oplus 0.55\%$

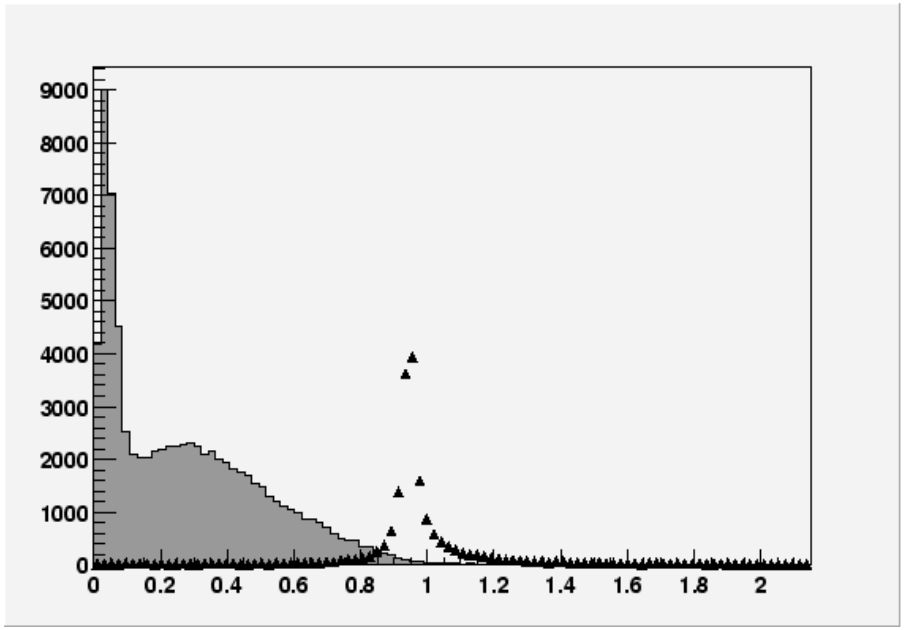
- All contributions into const term must be kept small
- Calibration precision is one significant contribution
- Goal calibration precision 0.2%

- *In Situ* calibration option :
  - → with e^+/e^-
  - → with μ^+/μ^- (?)
- MC study with 10,000 sample of generic B events

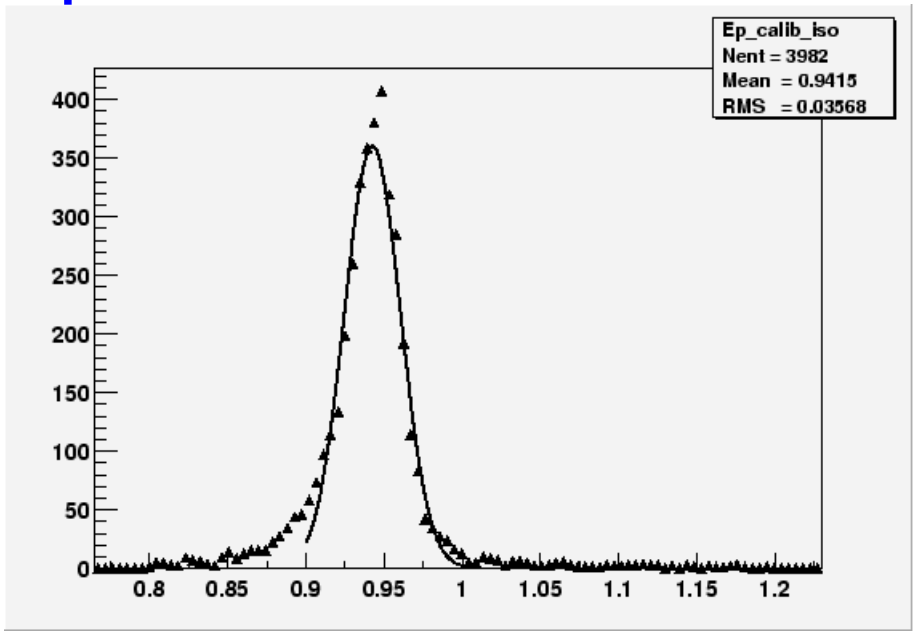
In Situ Calibration with e^+/e^-

- Will rely on E/p and use e's reconstructed momenta to calibrate energy scale

- σ(E/p)=1.9% (for isolated e's with p>3GeV) =>
- 100e's/crystal to achieve 0.2% precision

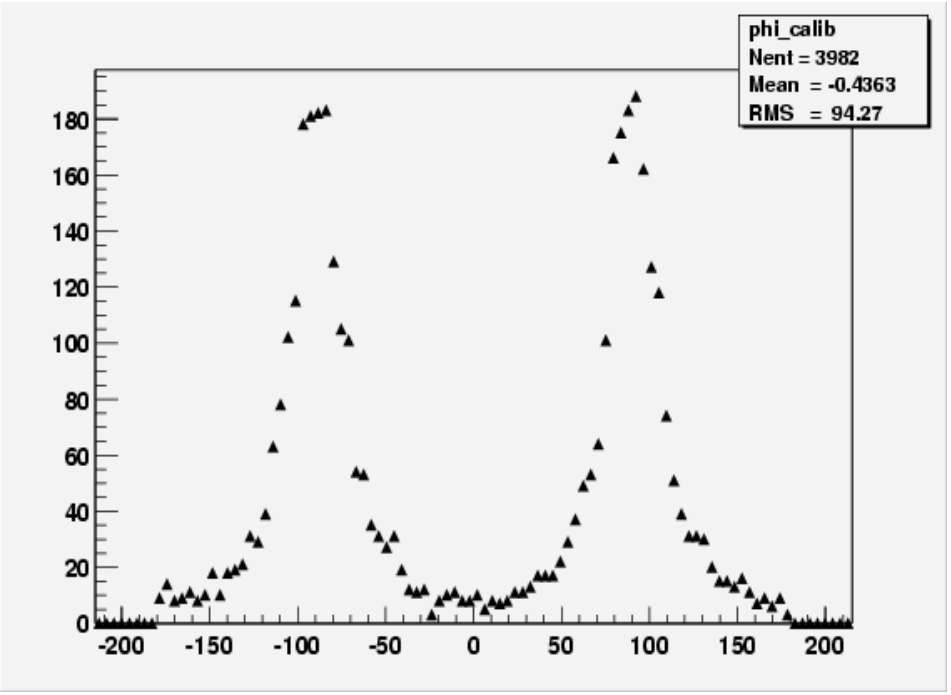


Measured E/p for e's and for other tracks



Measured E/p for isolated e' s

In Situ Calibration with e^+/e^-

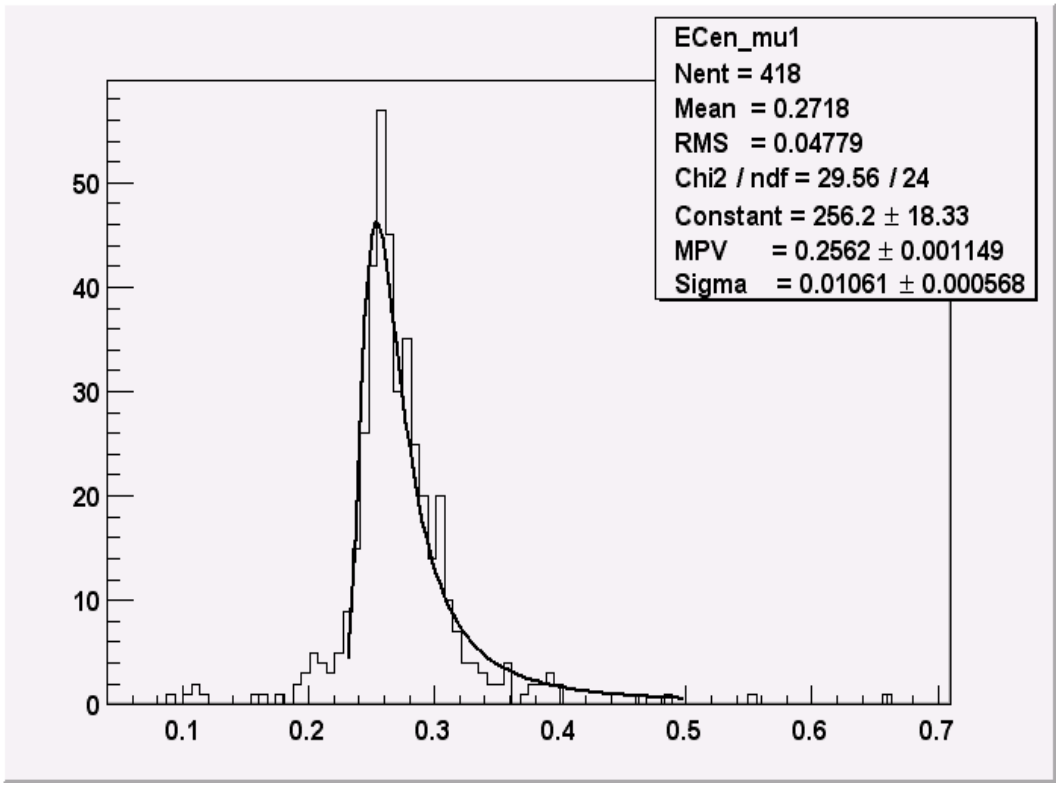


phi-distribution for isolated e' s

- Significant ϕ-asymmetry due to magnetic field (factor~18-20)
- Collection rate :
  - 8% - ~1.7e-04 e's/crystal/evt
  - 14% - ~1.0e-04 e's/crystal/evt
  - 11% - ~5.0e-04 e's/crystal/evt
  - 22% - ~2.0e-05 e's/crystal/evt
  - 45% - $\leq$1.0e-05 e's/crystal/evt
- Good news : even the least covered area can be calibrated every several hours of running

In Situ Calibration with μ^+/μ^- (?)

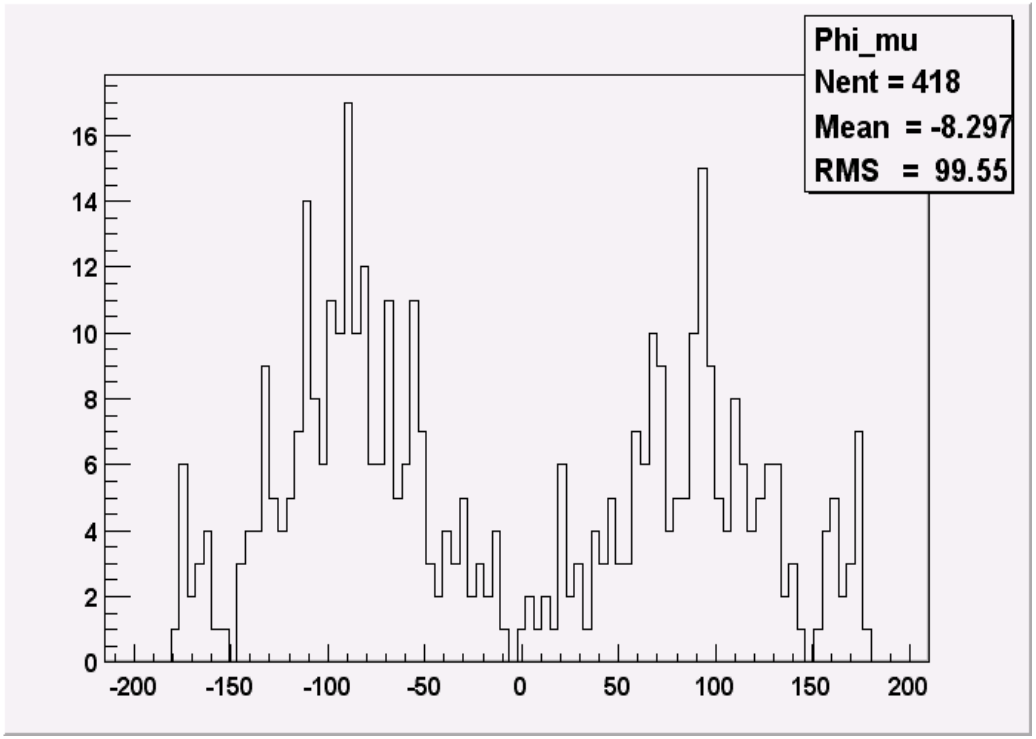
Should we employ this scenario ?



Energy deposition in ”max” crystal, GeV

- **Isolated 1-crystal's showers matched with μ's**
- **Statistical precision of peak position ~0.45% (Landau fit)**
- **~400 ``useful" μ's / 10,000evts**
- **Integral rate ~0.04μ's/evt/ECAL - ~8-10 times lower than e's)**

In Situ Calibration with μ^+/μ^- (?)



phi-distribution for selected μ's

- ϕ-asymmetry within factor~4
- Collection rates :
  - 25% - ~0.8e-05 μ's/crystal/evt
  - 25% - ~0.4e-05 μ's/crystal/evt
  - 50% - ~0.2e-05 μ's/crystal/evt
- Need several hundreds μ's/crystal to achieve 0.2% precision – a couple of days (?)

Looks somewhat less promising than the e's scenario

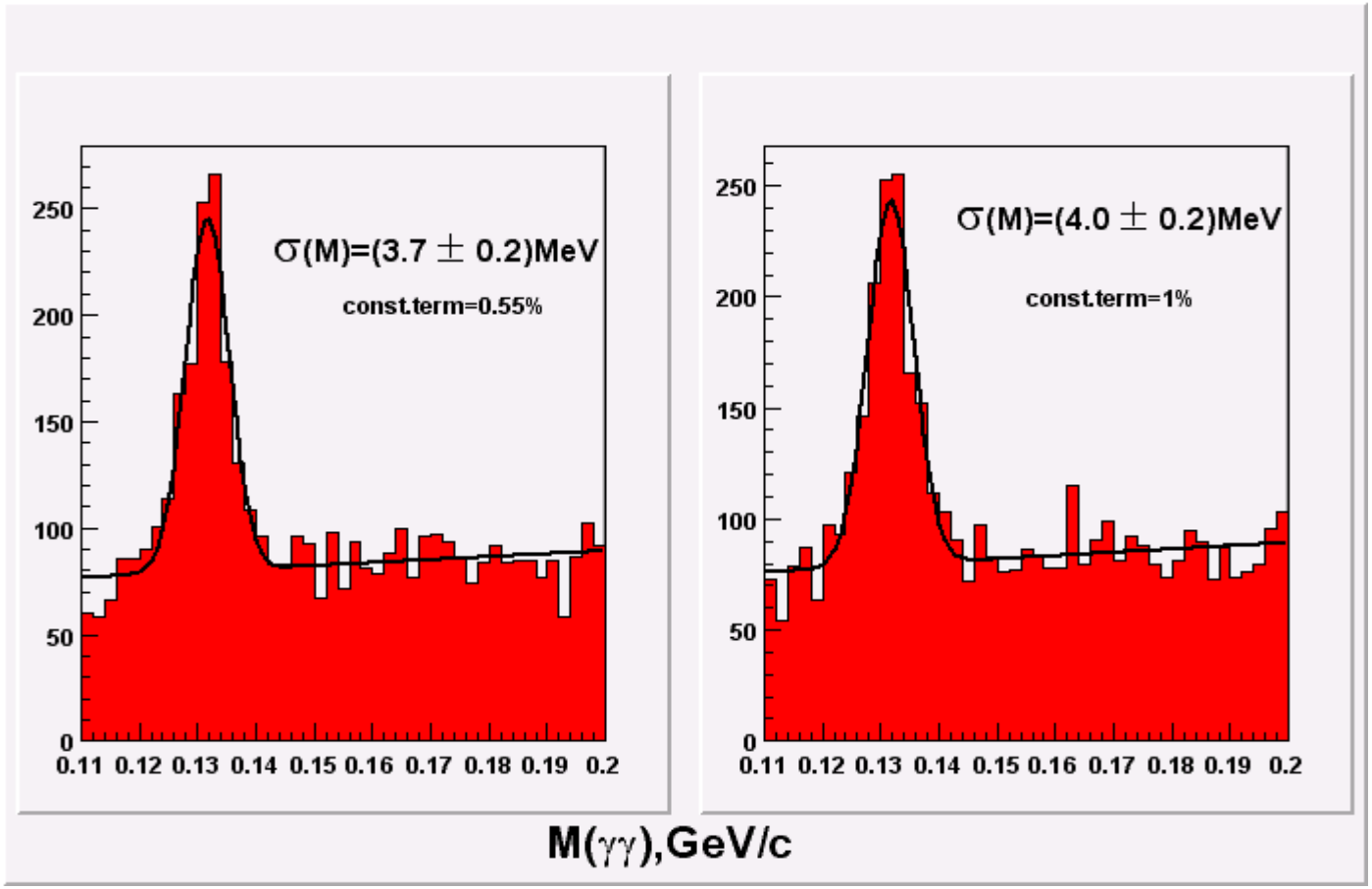
Const term 0.55% vs 1% - Impact on $B^0 \to \rho^+\pi^-$

- Calibration precision 1% is our worst case scenario
- If so, it will translate into const term = 1%
- Wanted to know the impact on physics sensitivities, to test where the limits were
- 50k $B^0 \to \rho^+\pi^-$ processed through BTeV MC, reconstruction, and analysis; with const term=1%

1% Calibration :

Impact on π^0's from B^0 -> $\rho^+\pi^-$

Practically no effect (within errors)

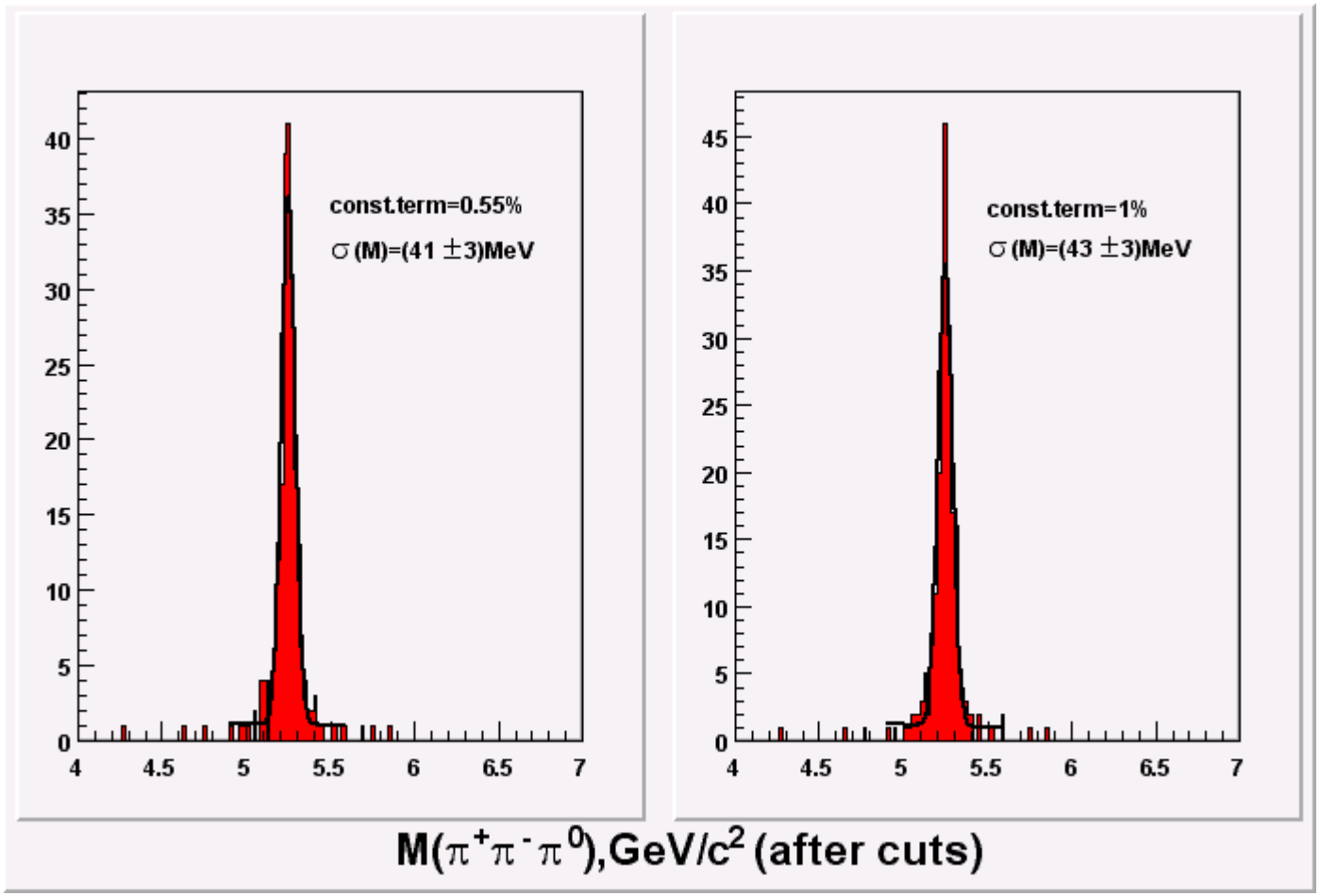


- $E(\gamma)$ > 1GeV
- Isolation 2cm
- $E(\pi^0)$ > 5GeV
- $pt(\pi^0)$ > 0.75GeV

1% Calibration :

Impact on $B^0 \to \rho^+\pi^-$

Practically no effect (within errors)



Summary

- MonteCarlo study of the EM Calorimter *In Situ* calibration with particles produced in physics events has been done
- EM calorimeter can be calibrated with e^+/e^- to the 0.2% precision every several hours of running
- Even in the worst case scenario of 1% calibration precision impact on physics sensitivity is minimal, as has been demonstrated with the $B^0 \rightarrow \rho^+\pi^-$ decay