ECAL performance vs. thresholds

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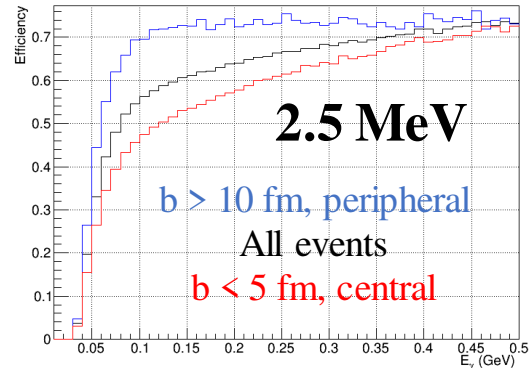
Last time …

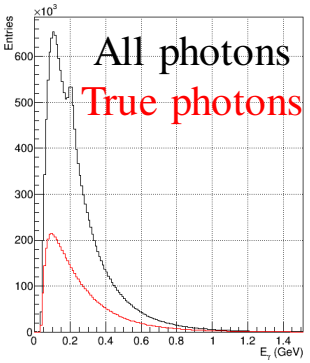
- Last meeting: MPD-DAC follow-up discussion of ECAL performance
- Focus is on relatively small efficiency for registration of soft signals, which dominate at NICA energies
- The main conclusions of the discussion:
  - ✓ ECAL performance is well understood
  - ✓ low efficiency for photons at low energy is caused by E_{seed} = 30 MeV (minimum energy of the local maximum) and cluster splitting
  - ✓ neutral mesons will be reconstructed from near zero momentum

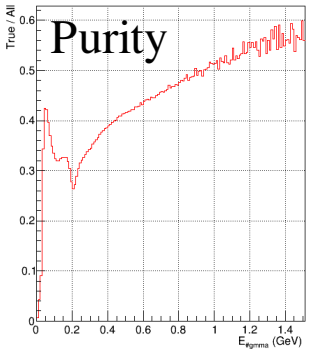
Today

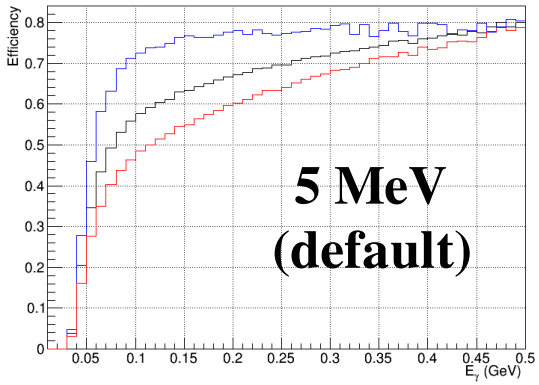
- Achieved ECAl performance was well understood
- The remaining available degrees of freedom:
  - ✓ E_{depth} = 5 MeV (by how much energy of the local maximum should be larger than energies of any of eight neighboring towers) → vary
  - ✓ E_{seed} = 30 MeV (minimum energy of the local maximum) → decrease
- Observables:
  - ✓ single photon efficiency vs. p_T and multiplicity
  - ✓ Single photon purity
  - ✓ π_0 efficiency vs. p_T
  - ✓ quality of reconstructed π_0 peaks at low momentum (0-0.1 GeV/c)
- Calculations are time and resources consuming → only key variations were tried:
  - ✓ E_{depth} = 2.5 MeV, 10 MeV vs. default E_{depth} = 5 MeV
  - ✓ E_{seed} = 15 MeV, 7 MeV vs. default E_{seed} = 30 MeV

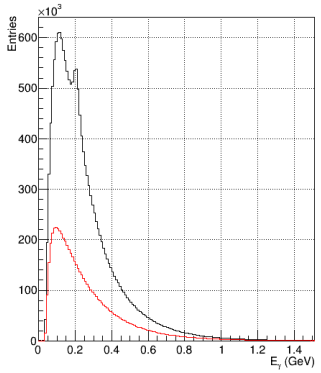
Variation of E_{depth} (E_{seed}=30 MeV): photons

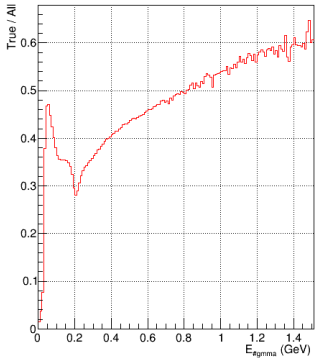


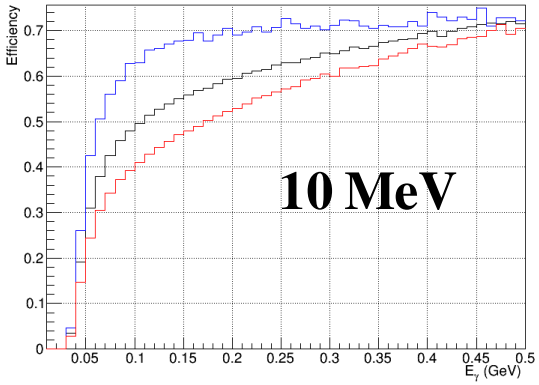


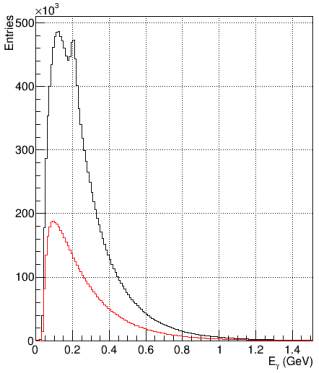


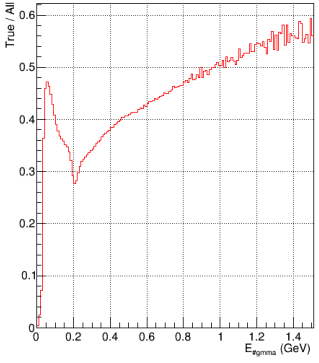












- E_{depth} → 2.5 MeV:

✓ efficiency does not improve

✓ 'all photons' spectrum grows, while 'true photons' spectrum stays the same → purity worsens

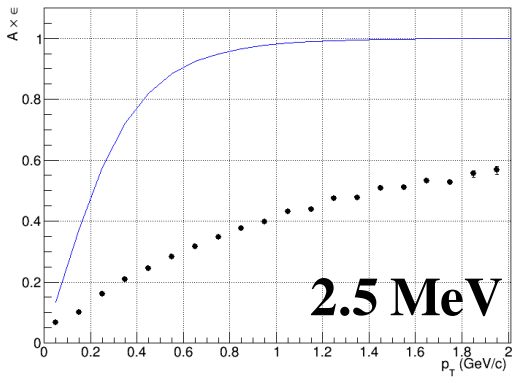
Conclusion: E_{depth} = 5 MeV gives better results

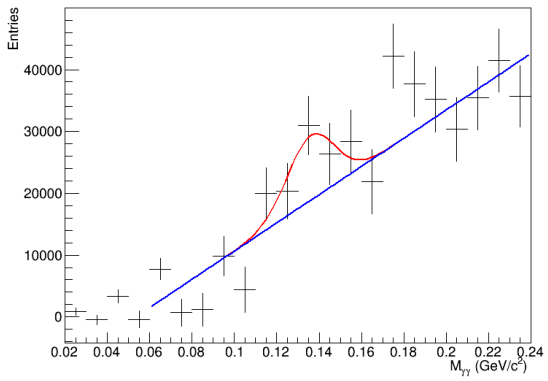
- E_{depth} → 10 MeV:

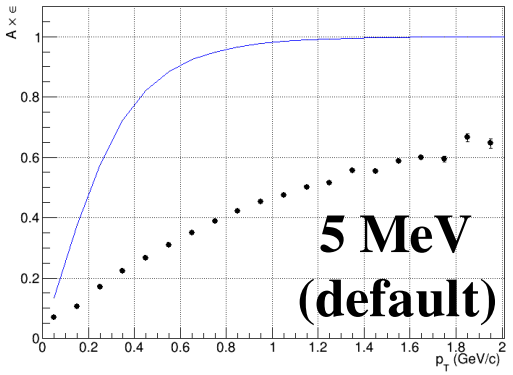
✓ efficiency decreases by 10%

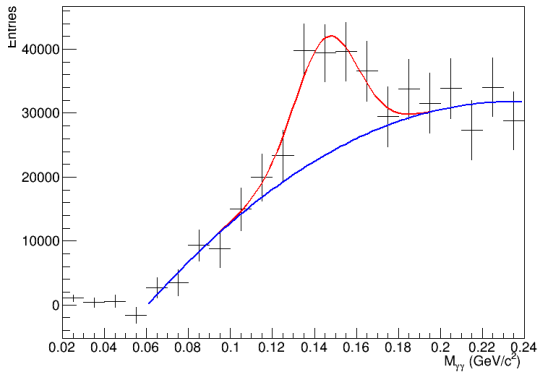
✓ 'all photons' and 'true photons' spectra decrease → purity does not improve

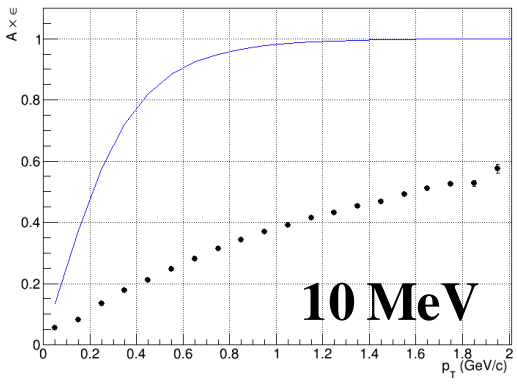
Variation of E_{depth} (E_{seed}=30 MeV): π^0

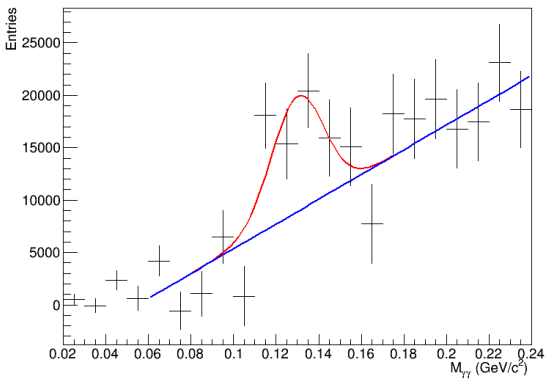






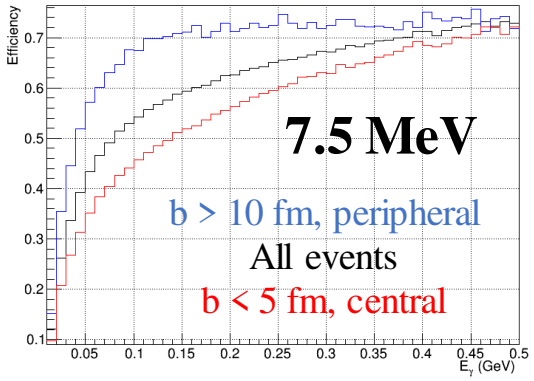


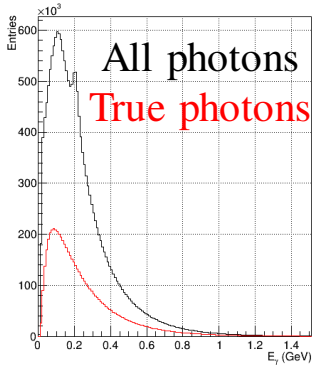


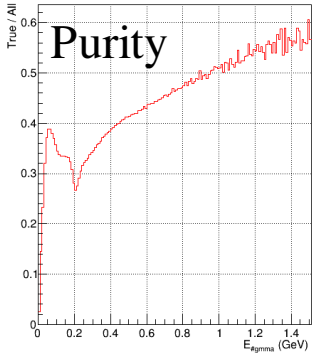


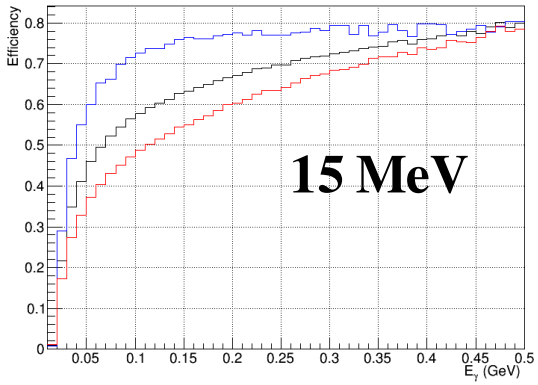
Conclusions: Better efficiency and better signal significance is achieved with E_{depth} = 5 MeV

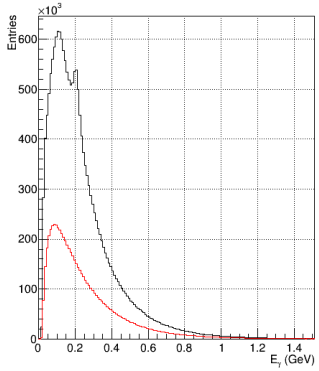
Variation of E_{seed} (E_{depth}=5 MeV): photons

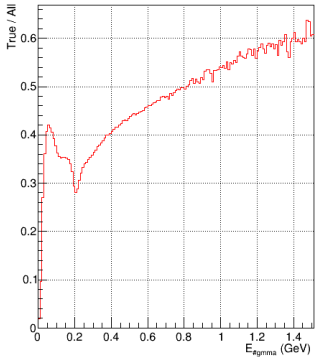


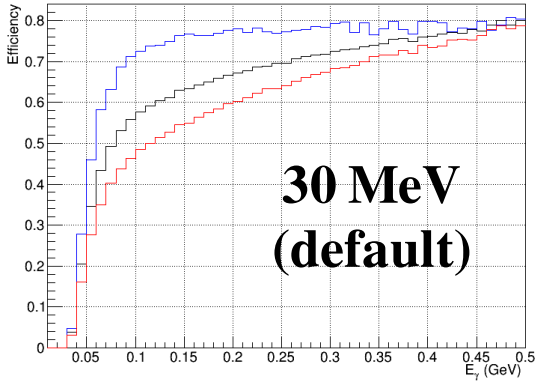


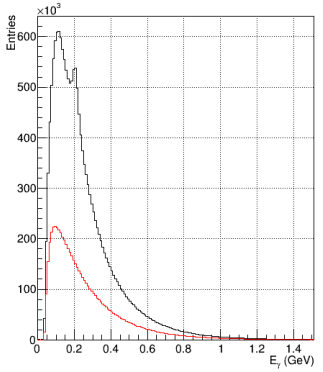


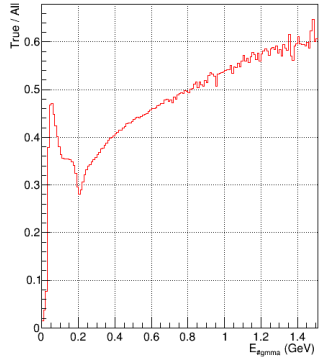








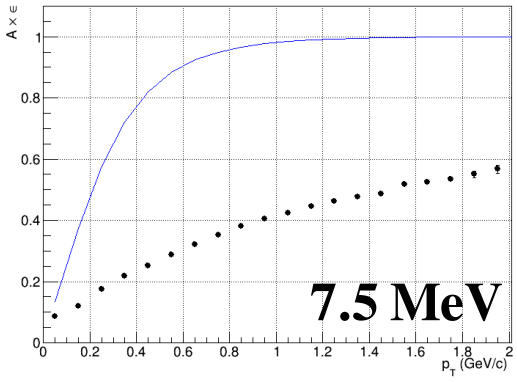


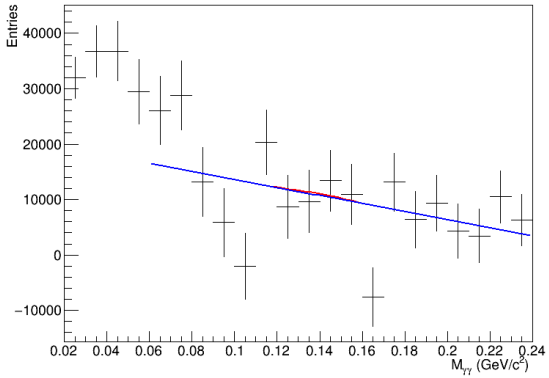


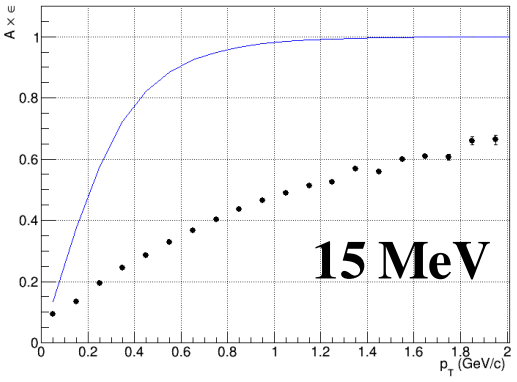
- 15 MeV → 7.5 MeV:
  - ✓ modest increase of efficiency at low energy
  - ✓ purity decreases
- 30 MeV → 15 MeV:
  - ✓ big increase of efficiency at low energy
  - ✓ purity decreases

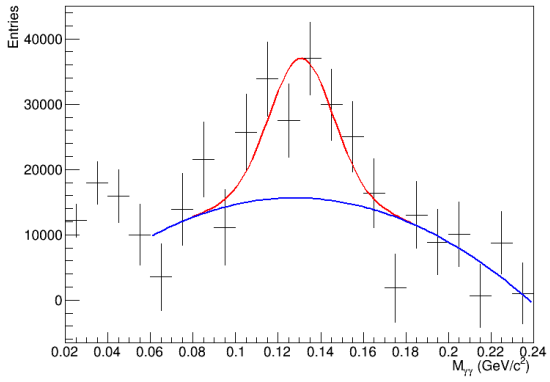
- Conclusions:
  - ✓ only qualitative
  - ✓ 30 MeV → 15 MeV: significant increase of efficiency, purity is worse but not dramatically
  - ✓ 15 MeV → 7.5 MeV: further improvements are quite modest, 7.5 MeV is dangerously close to noise limit

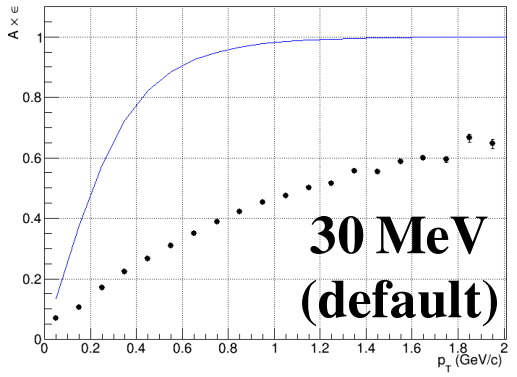
Variation of E_{seed} (E_{depth}=5 MeV): π^0

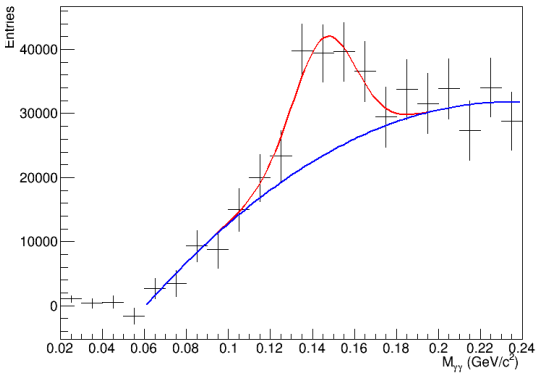












Conclusions:

- ✓ better efficiency and better signal significance is achieved with E_{seed} = 15 MeV
- ✓ improvements are not dramatic

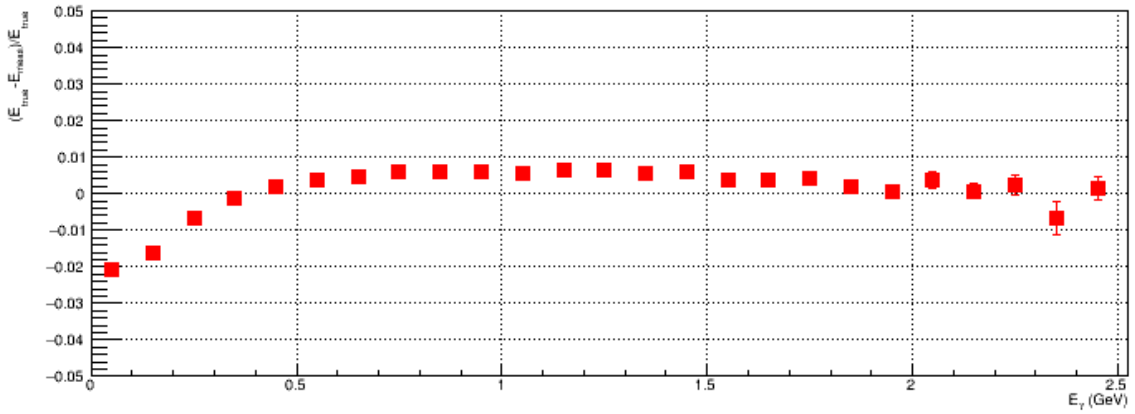
Conclusions

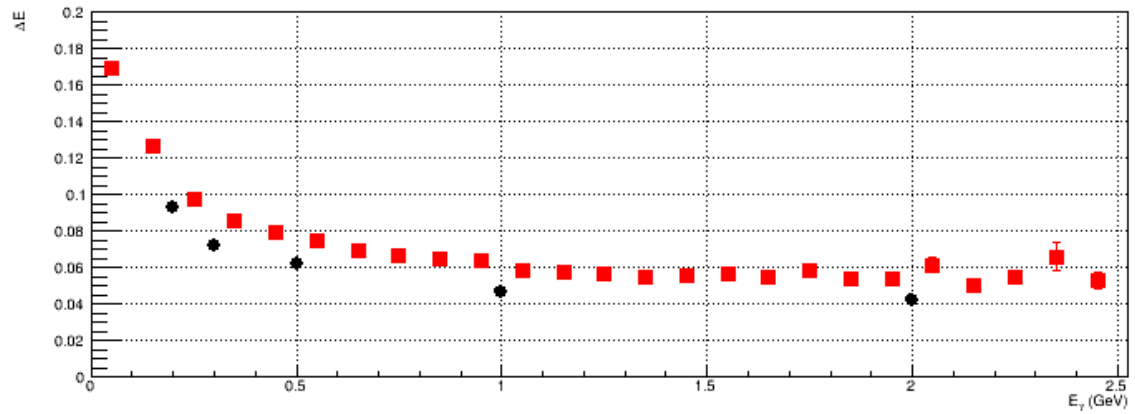
- Noticeable improvements for reconstruction of low-E signals, first of all photons, can be achieved by lowering the E_{seed} to 15 MeV
- Improvements are not going to be dramatic, except for photons with E < 50 MeV
- Nothing changes for electron identification, where ECAL steps in at p_T ~ 200 MeV/c

BACKUP

Energy resolution: MPD-ECAL

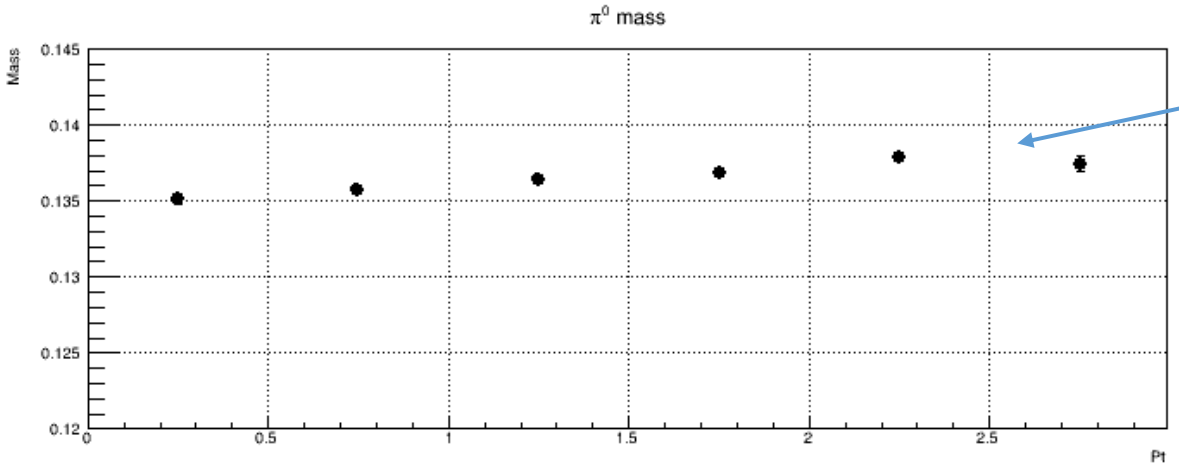
- Black markers – single photons (one per event) , realistic vertex distribution
- Red markers – UrQMD, minbias AuAu@11, realistic vertex distribution
- Non-linearity < 2% → can be corrected
- Energy resolution is significantly affected by multiplicity (constant term?)



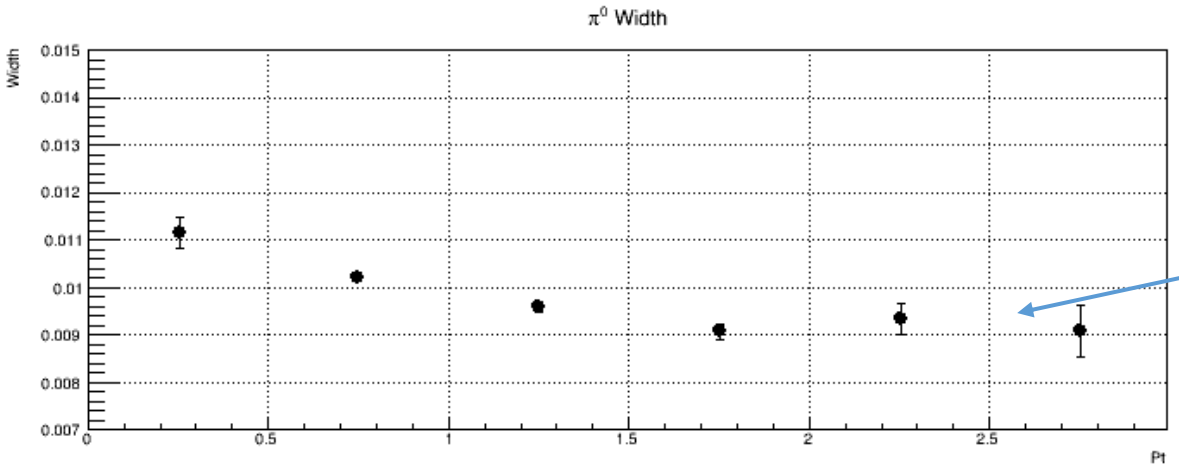


Detector performance: π^0

- UrQMD, ***minbias*** AuAu@11, realistic vertex distribution
- Mass and width



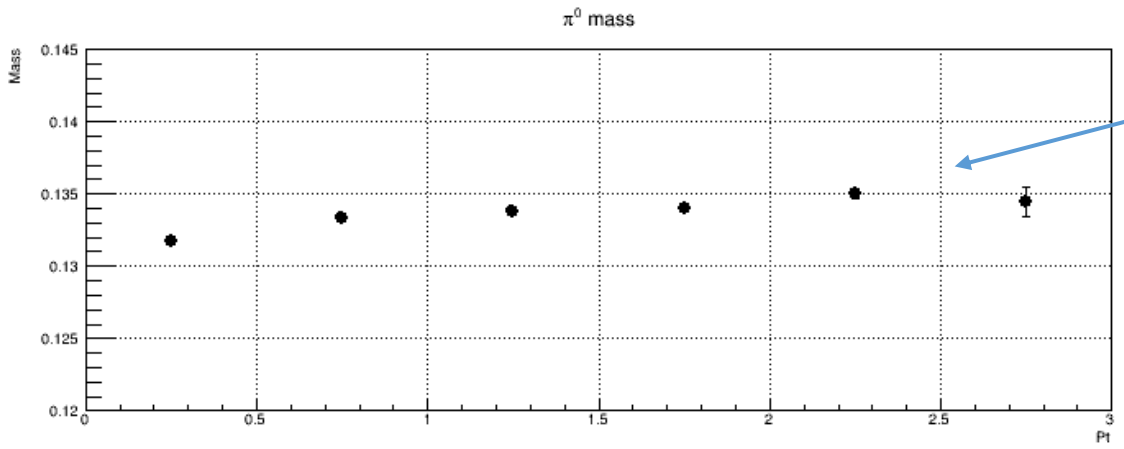
~ 137 MeV/c^2



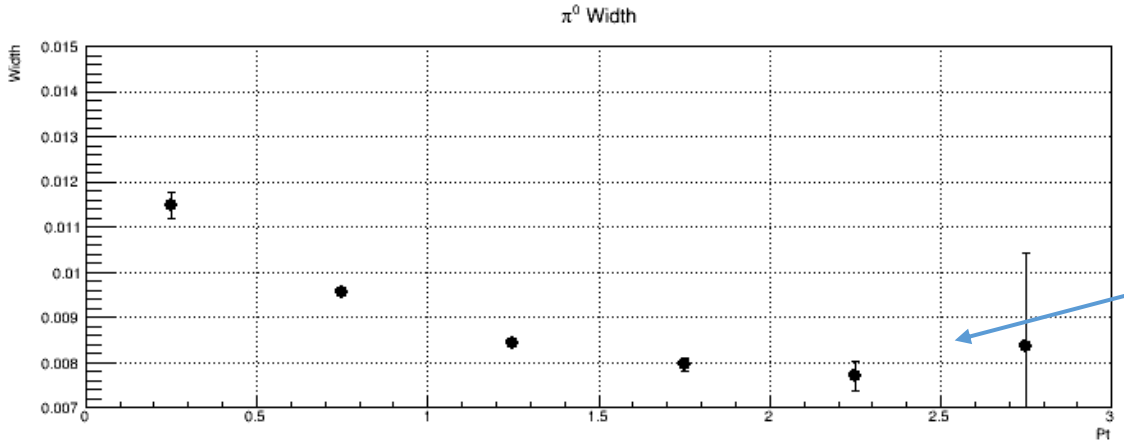
~ 9 MeV/c^2

Detector performance: π^0

- UrQMD, ***peripheral*** AuAu@11 (ip > 10 fm), realistic vertex distribution
- Mass and width



~ 135 MeV/c^2

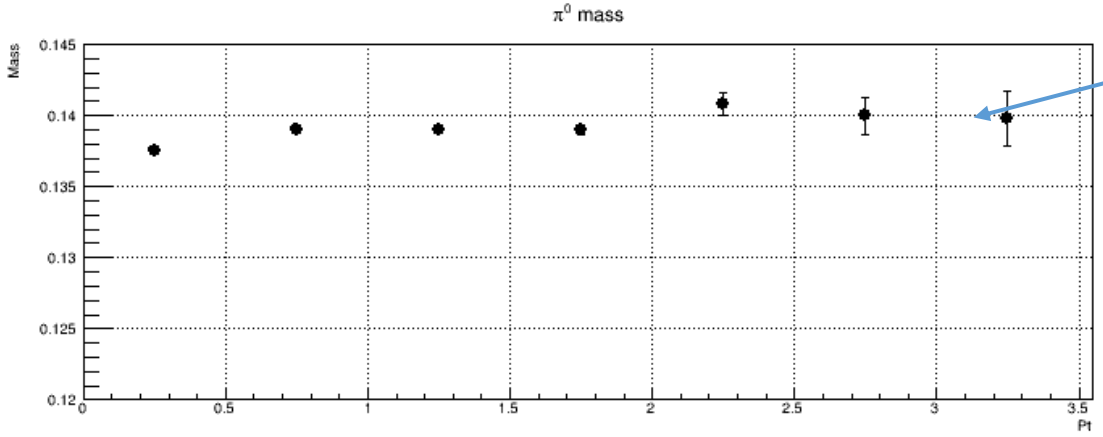


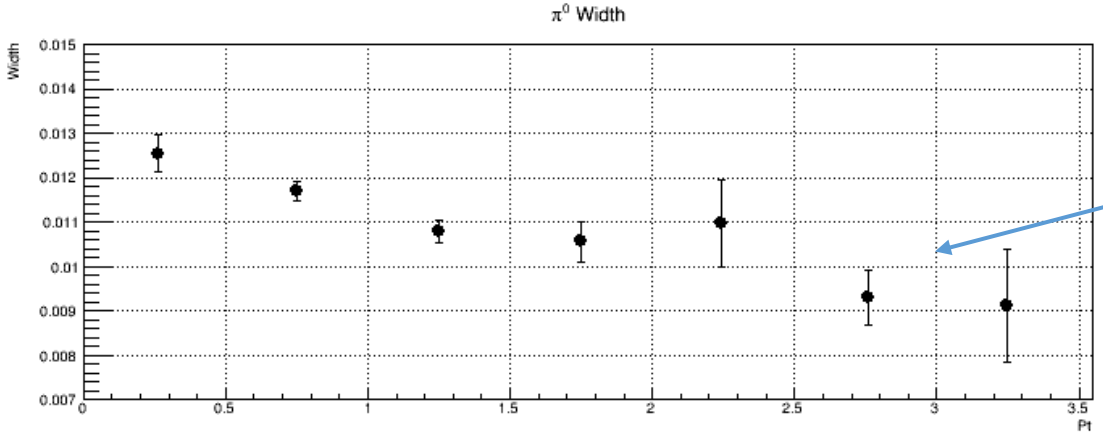
~ 7.5-8 MeV/c^2

Detector performance: π^0

- UrQMD, ***central*** AuAu@11 (ip < 5 fm), realistic vertex distribution
- Mass and width

~ 140 MeV/c^2





~ 10 MeV/c^2