Update for Discrete Readout & MIT Prototype Comparison December Testbeam Analysis

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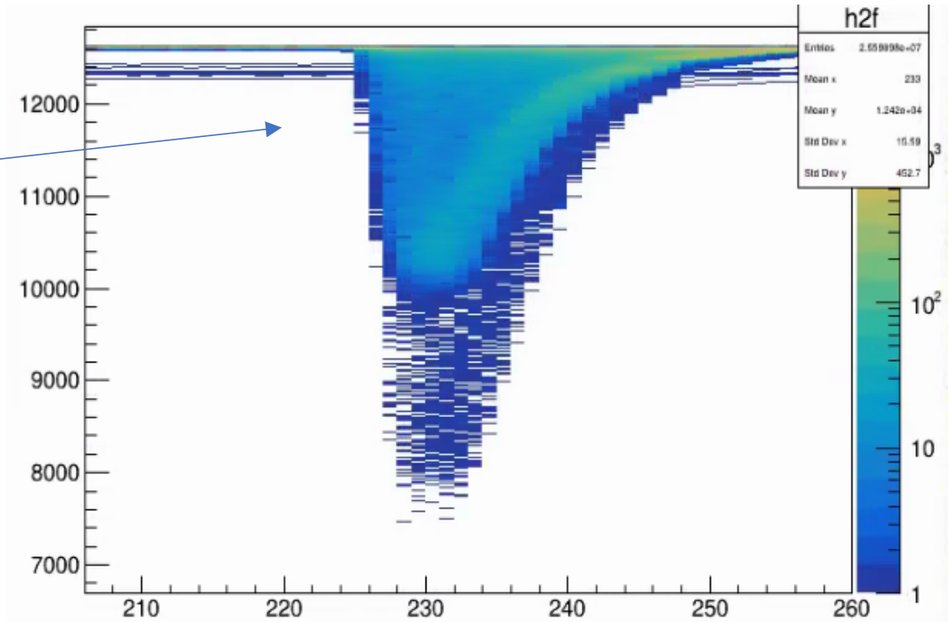
MIT Prototype / data

- Josh(/Doug) sent me/us the MIT Prototype data
- I analyzed it to same point as discrete results shown last wk– results look good!
- Shown here are “all” Waveforms overlaid for one Ebeam = 1 GeV file
- MIT Prototype:
  - Different PbWO Crystals
  - Cooled to -20 Celsius
  - PMT’s (Negative Pulses) – (NPS’s?) (others pls describe)
    - + better “ACTIVE” bases than Feb ‘25
    - Performance normal – i.e. linear response etc.
    - As we will see, other than waveforms being negative, it’s hard to distinguish further extracted data from siPM + discrete readout--all checks so far look similar (albeit lightly checked)

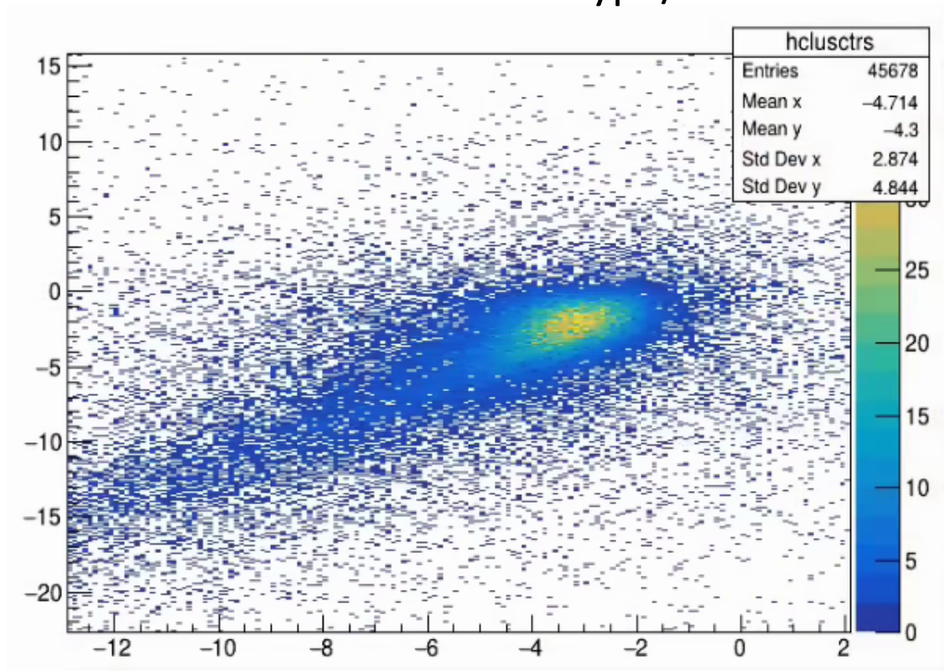


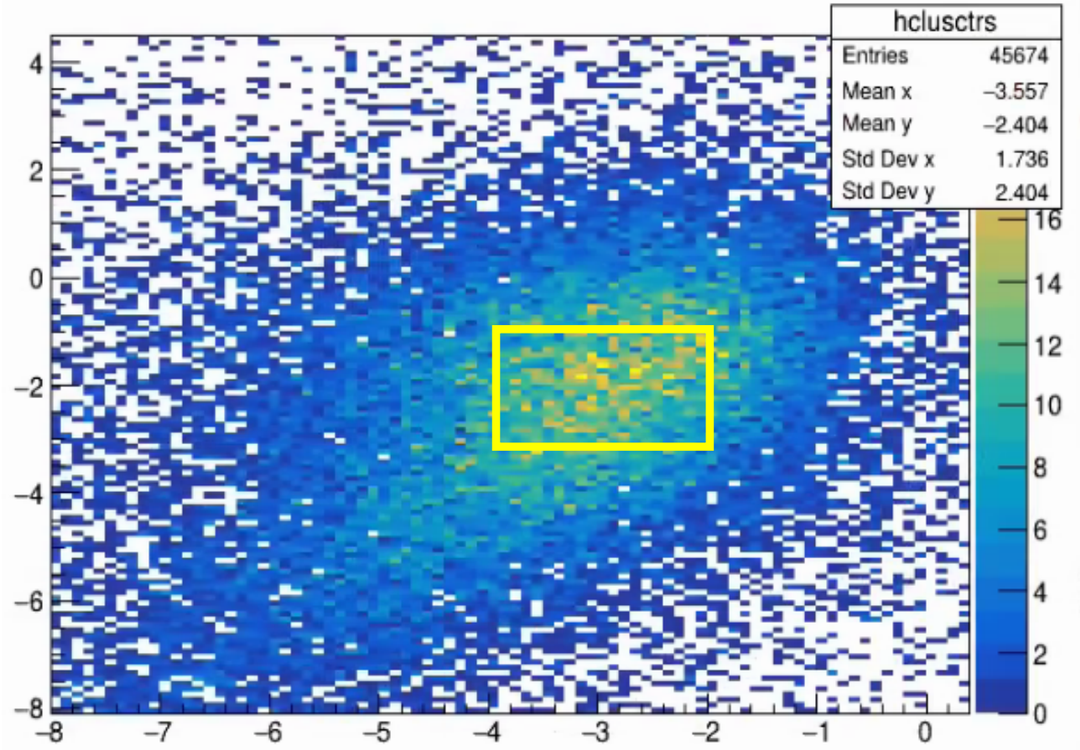
- Digitized by same Caen Modules we later used for siPM/Discrete
- Even waveform timing almost identical
- Used ~exactly the same pedestal subtraction scheme (ped region/integration region) but **ped minus sample** rather than **sample minus ped**.

Same “cluster” E c.o.g. trick to cut collimator low E tail bkg

- Geometric location of shower c.o.g. avg center almost the same different in x by only ~0.5 cm (Q crystal size /spacing ~same)
- Width’s are possibly wider
- Used very similar rectangle box cut to siPM/discrete ana of last wk

PLOTS ARE FROM MIT Prototype/PMT



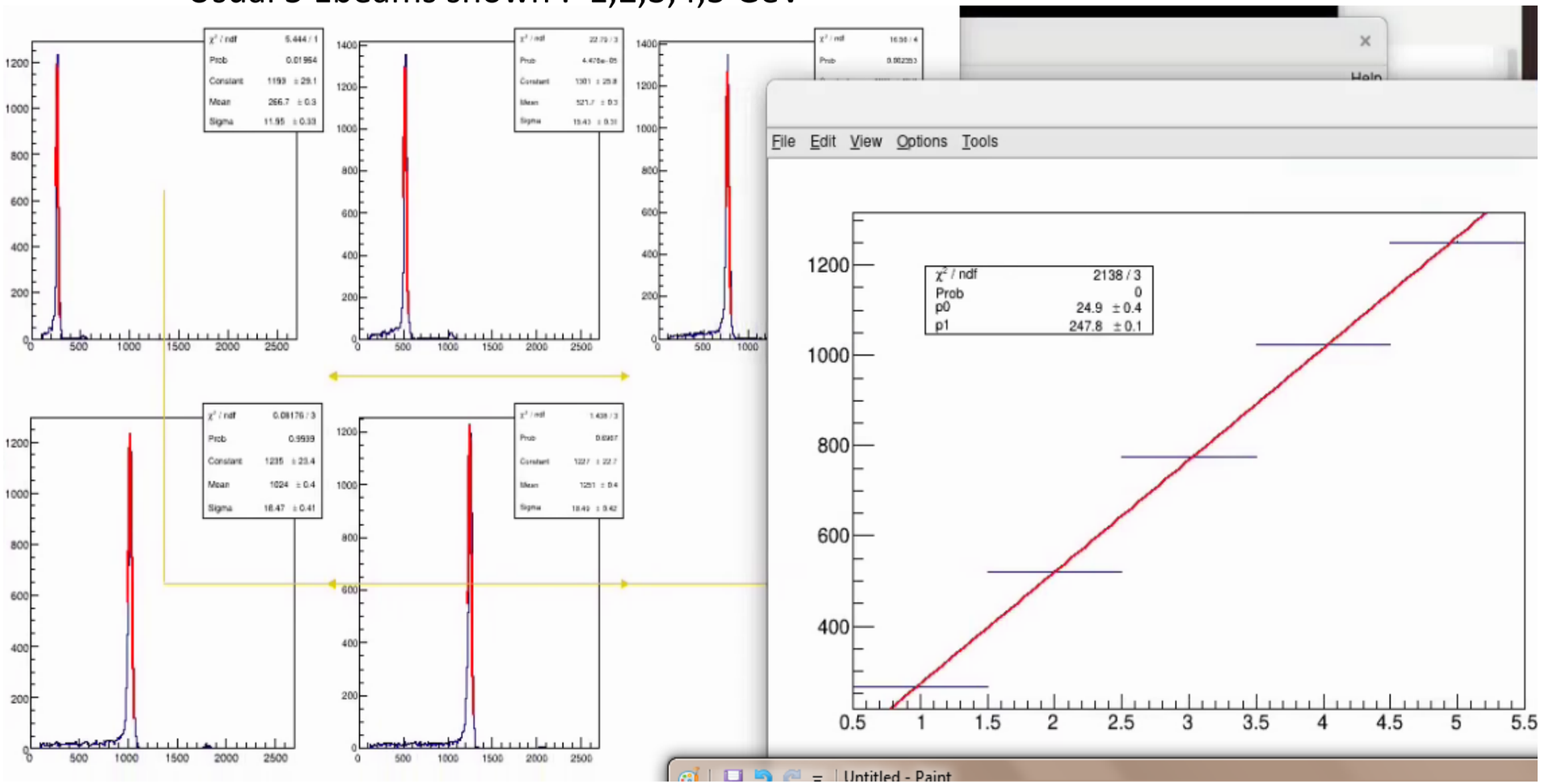


zoomed

Results 1 : Active bases – linearity good

Shown are pulse amplitude distrib's for the full MIT prototype 5x5 sum

Usual 5 Ebeams shown : 1,2,3,4,5 GeV



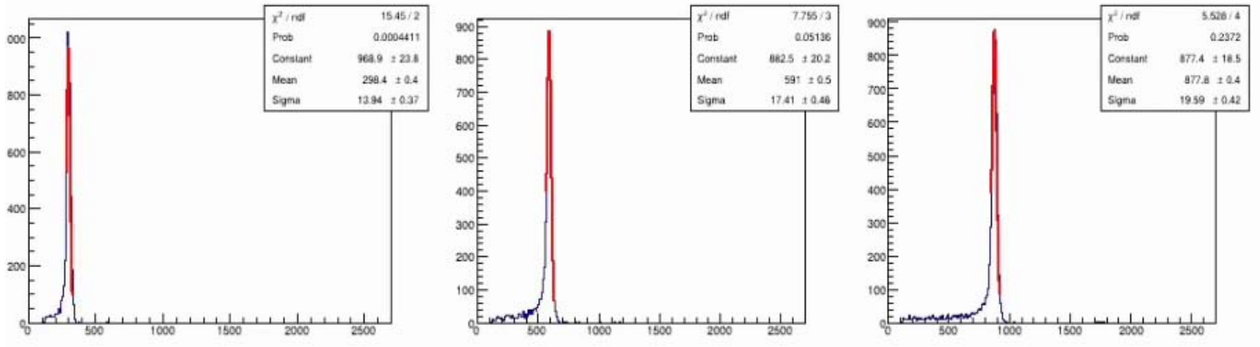
All looks good
nice and linear– active bases worked well!

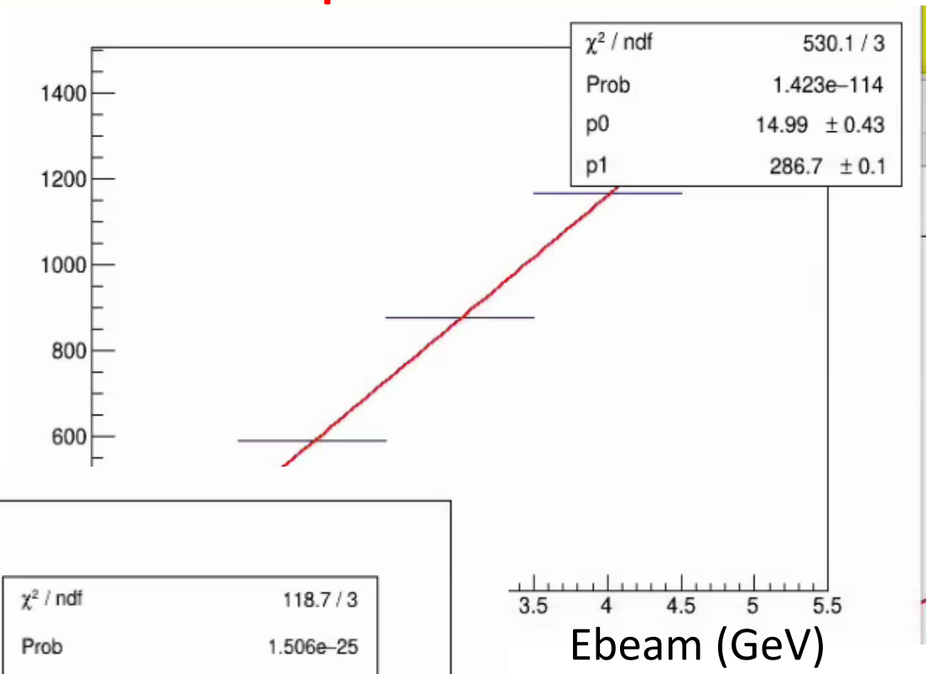
Peaks look VERY similar to siPM/discrete peaks

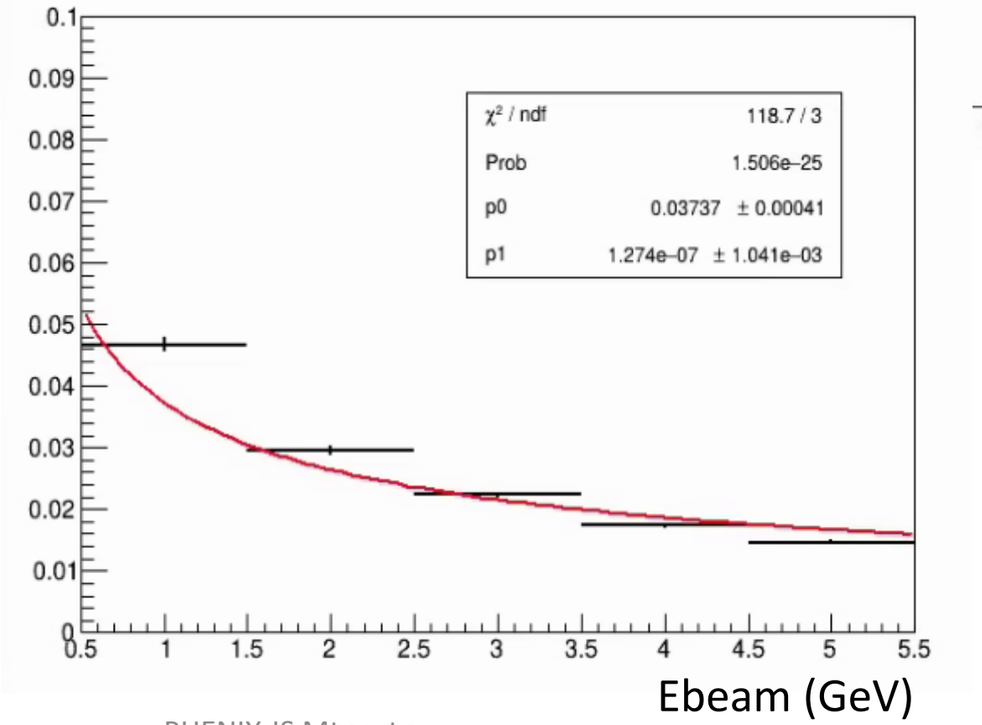
Not at EXACTLY the same locations – ~20% lower amplitudes

NO RELATIVE TbT CALIBRATION APPLIED YET !!!!

LAST WK SLIDE: New siPM DISCRETE data, using only same Ebeam values as February – for comparison







(Values from discrete from last week)

Reso 1GeV :0.0467
Reso 2GeV :0.0295
Reso 3GeV :0.0223
Reso 4GeV :0.0174
Reso 5GeV :0.0146

Discuss fit later

Comparison of Peak Widths

MIT Prototype/PMT	Orsay Prototype/ siPM/Discrete
Reso 1GeV :0.0448	Reso 1GeV :0.0467
Reso 2GeV :0.0296	Reso 2GeV :0.0295
Reso 3GeV :0.0234	Reso 3GeV :0.0223
Reso 4GeV :0.0180	Reso 4GeV :0.0174
Reso 5GeV :0.0148	Reso 5GeV :0.0146

Preliminary statements:

- **RESULTS ARE IDENTICAL WITHIN STATISTICAL ERRORS (*stat error checked once was +/- ~0.002 for one of above numbers)**
- **Presumably puzzling rise at low Ebeam is due to intrinsic DESY beam resolution ? – source of 1/E term need in resolution fits previously**
- **Alt way to say it?: We have same resolution as MIT/PMT readout ? (previously verified to what ? (I will guess ~2-3%/sqrt(E) + ~0-1% const term?))**
- **We still have other beam energy data points in discrete dataset we can use , constrain fit further , e.g. without lowest pt points, maybe fix 1/E term based on MIT Prototype**

One more thing: More realistic ePIC performance

- All previous results (MIT/PMT and siPM/Discrete) are sampling at the full rate of the Caen v1725's → 250 MHz (every 4 ns)
- For DISCRETE: Use only 1 out of every 5 samples (50 MHz) as first model of realistic ePIC performance w/ flash ADC/discrete type option
  - Each channel/event randomly chooses which starting sample within 5 samples of starting sample (start for previous full 250 MHz results) then uses every 5th sample from there. Pedestal AND Integral BOTH have sampling reduced
- Results (Red) : <= 0.5% worsening
- Note PEDESTAL Calc probably still too good ? (using ~80 samples now 16)

Reso 1GeV :0.0467
Reso 2GeV :0.0295
Reso 3GeV :0.0223
Reso 4GeV :0.0174
Reso 5GeV :0.0146

Reso 1GeV :0.0504
Reso 2GeV :0.0305
Reso 3GeV :0.0227
Reso 4GeV :0.0177
Reso 5GeV :0.0153