Status MM paper(s)

Outline:

- paper submitted (first MM time resolution)
- 2010 data (P. Colas editor)
- 2015 data (A. Bellerive editor)
  - status analysis
  - a few plots
  - timescale
- Summary

Paper submitted: small prototype

Time Resolution of a Micromegas TPC using the charge dispersion signal

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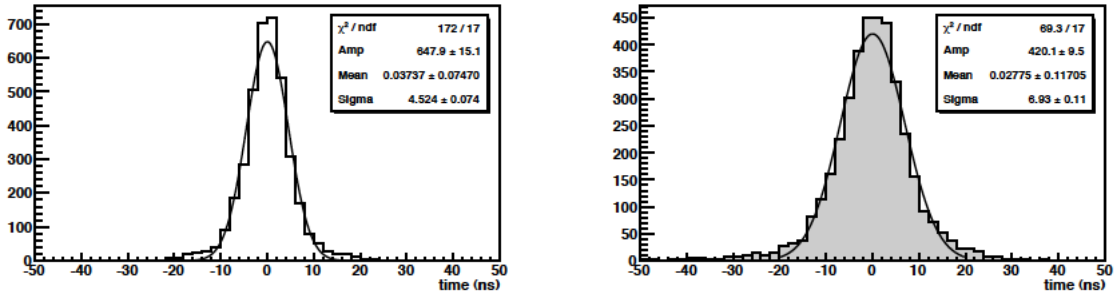
Submitted to NIM

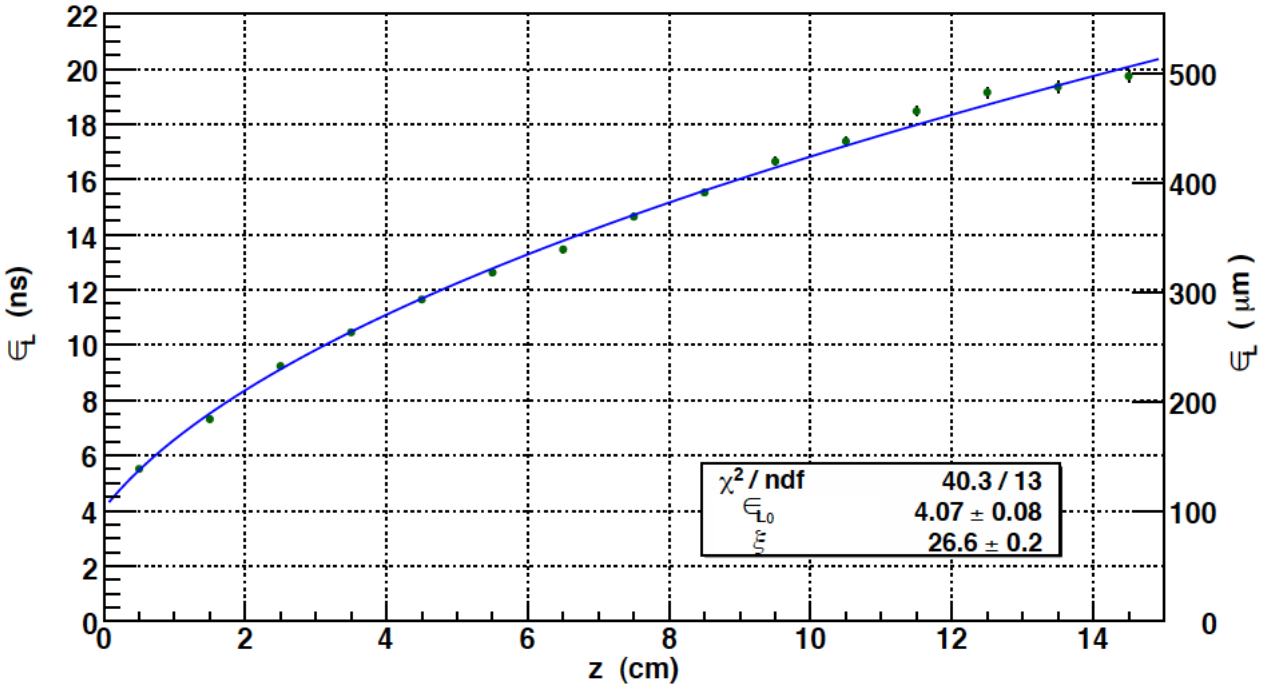
Abstract

The International Linear Collider (ILC) will require a large volume Time Projection Chamber (TPC) with transverse space-point resolution of 100 μm for all tracks over the full 2 m drift region. It has been shown that a conventional readout GEM TPC can achieve this resolution using 1 mm or narrower readout pads, at the expense of detector cost and complexity. A new readout technique using the principle of charge dispersion has demonstrated that the transverse resolution goal can be achieved using 2-3 mm wide pads in both small (COSMo) and large (LCTPC) prototype detectors. However, the effect of this new technique on the time resolution was not a part of these studies. Here we present a re-analysis of a 4 GeV π^+ beam test carried out at KEK, and a high magnetic field cosmic ray test at DESY, of the COSMo TPC with charge dispersion. We find the time resolution comparable to conventional MPGD and wire/pad readout TPCs, and consistent with the ILC z-resolution requirements of 500 and 1400 μm at zero and 2 m drift distances, respectively.

The gas mixture was Ar:C_4H_{10} (95:5), chosen for the low transverse diffusion of 126 $\mu m/\sqrt{cm}$ in the 1 T magnetic field at 70 V/cm. The drift velocity was $\sim$26 μm/ns, and the longitudinal diffusion, D_L, was $\sim$ 479 $\mu m/\sqrt{cm}$, calculated by Magboltz [13]. The transverse resolution, ϵ_T, was measured in the original analysis: at zero drift distance it was found that $\epsilon_{T_0} = 50 \pm 2$ μm, [10].

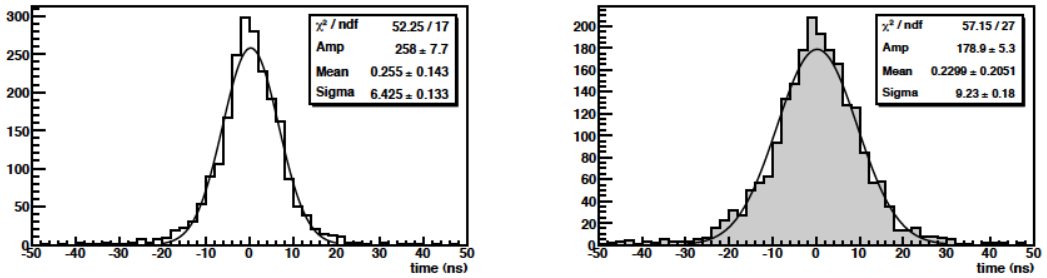


(a) KEK: 0< z <1 cm

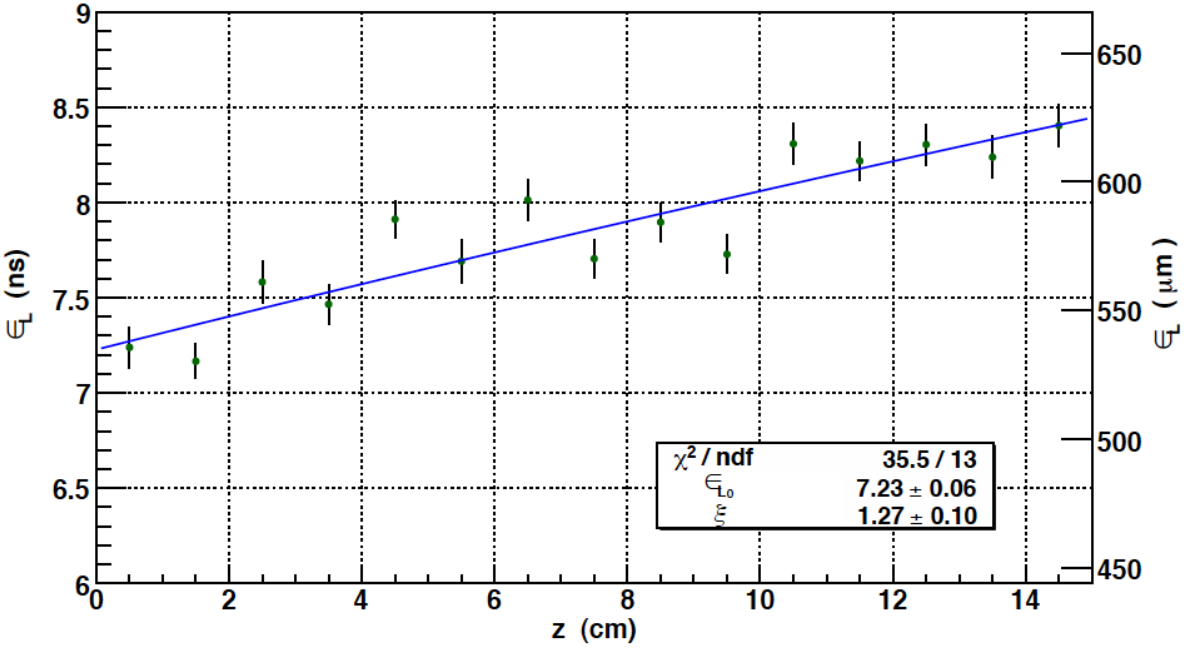


(b)

The gas mixture was the so-called T2K gas, Ar:CF_4:C_4H_{10} (95:3:2), which is considered a possible candidate for the ILC TPC. It has an electron drift velocity of 74 μm/ns at a moderate 200 V/cm electric field, and a large $\omega\tau \sim$ 20 at 5 T, which reduces transverse diffusion to $D_T \simeq 19\ \mu m/\sqrt{cm}$. The resulting longitudinal diffusion was 248 $\mu m/\sqrt{cm}$. Transverse resolution was measured to be independent of z: $\epsilon_T(z)_{[B=5\ T]} \simeq \epsilon_{T_0} \simeq 50\ \mu$m, as can be found in [11].



(a) DESY: 0< z <1 cm

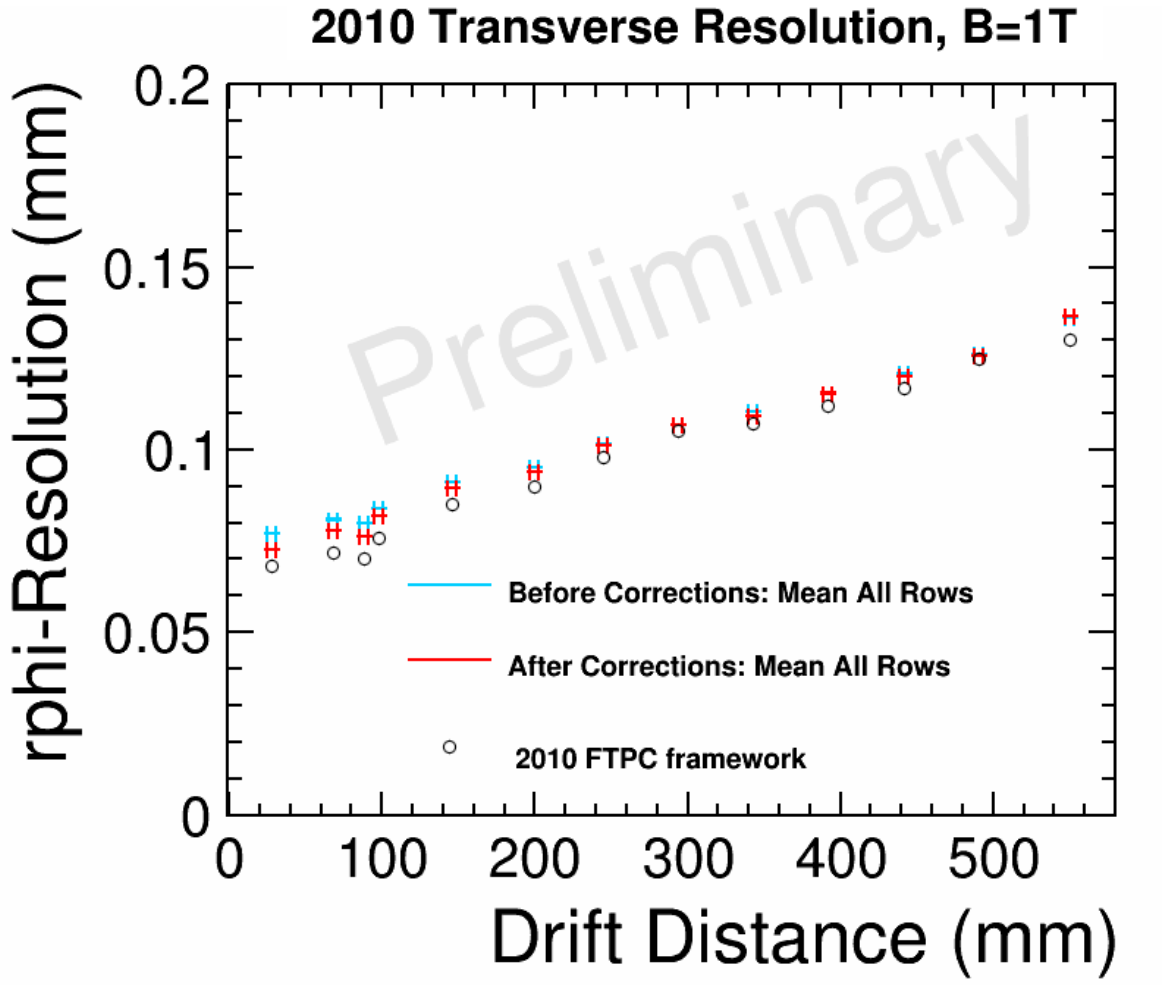


(b)

Paper: 2010 data (ed. P. Colas)

- First LCTPC MM paper!
- Single module
- σ_{xy} vs Z (500 nsec peaking time with Vmesh=380 V and Edrift = 230 V/cm)
- σ_{xy} vs Z (500 nsec peasking time with Vmesh = 360 V or 280 V and Edrift = 230 V/cm or Edrift=140V/cm)
- σ_{xy} for a fixed Z~5cm but different peaking times
- Z resolution (100 nsec and 500 nsec fixed Z~5cm)

2010 data



380V on Mesh
Peaking time= 500 ns
MarlinTPC
Bias corrected
Sum PRF used

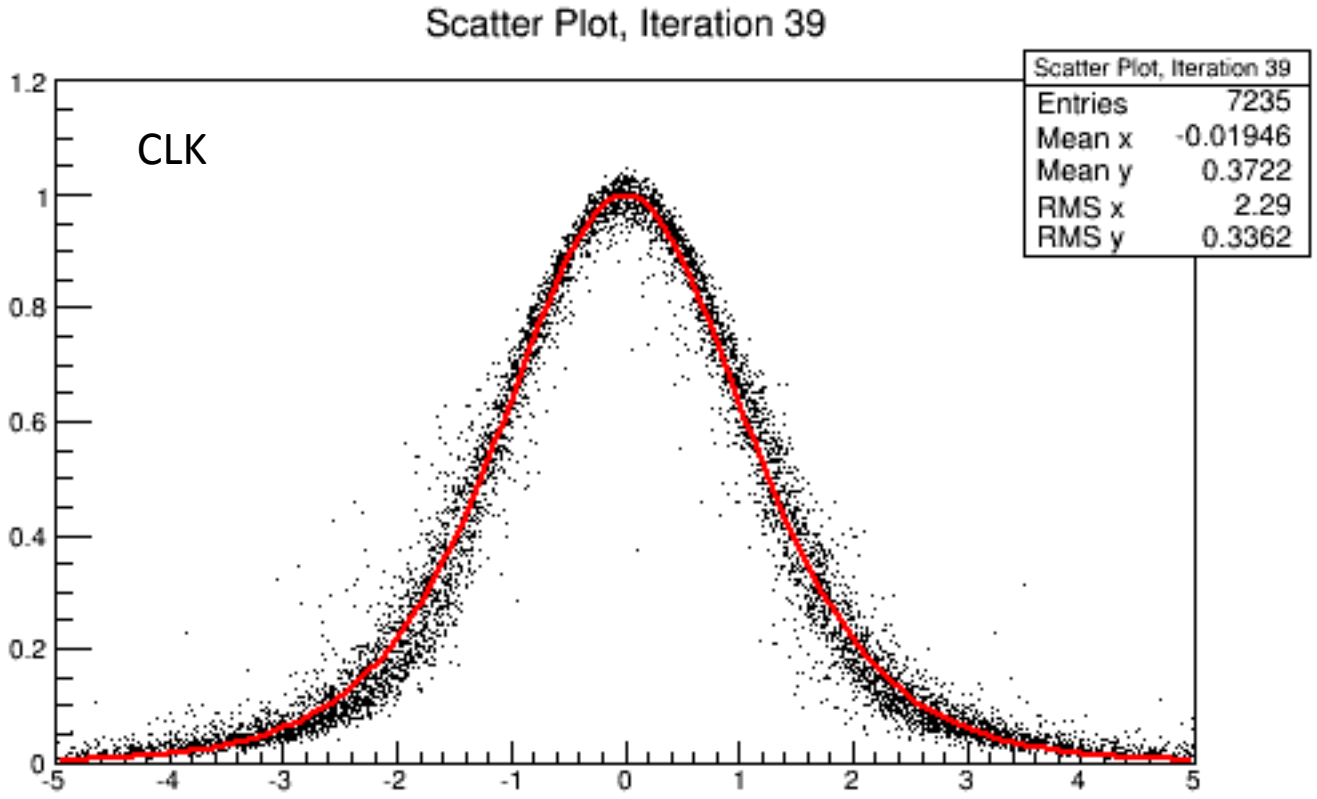
Open circles – Wenxin FTPC
Product PRF

Paper: 2015 data (ed. A. Bellerive)

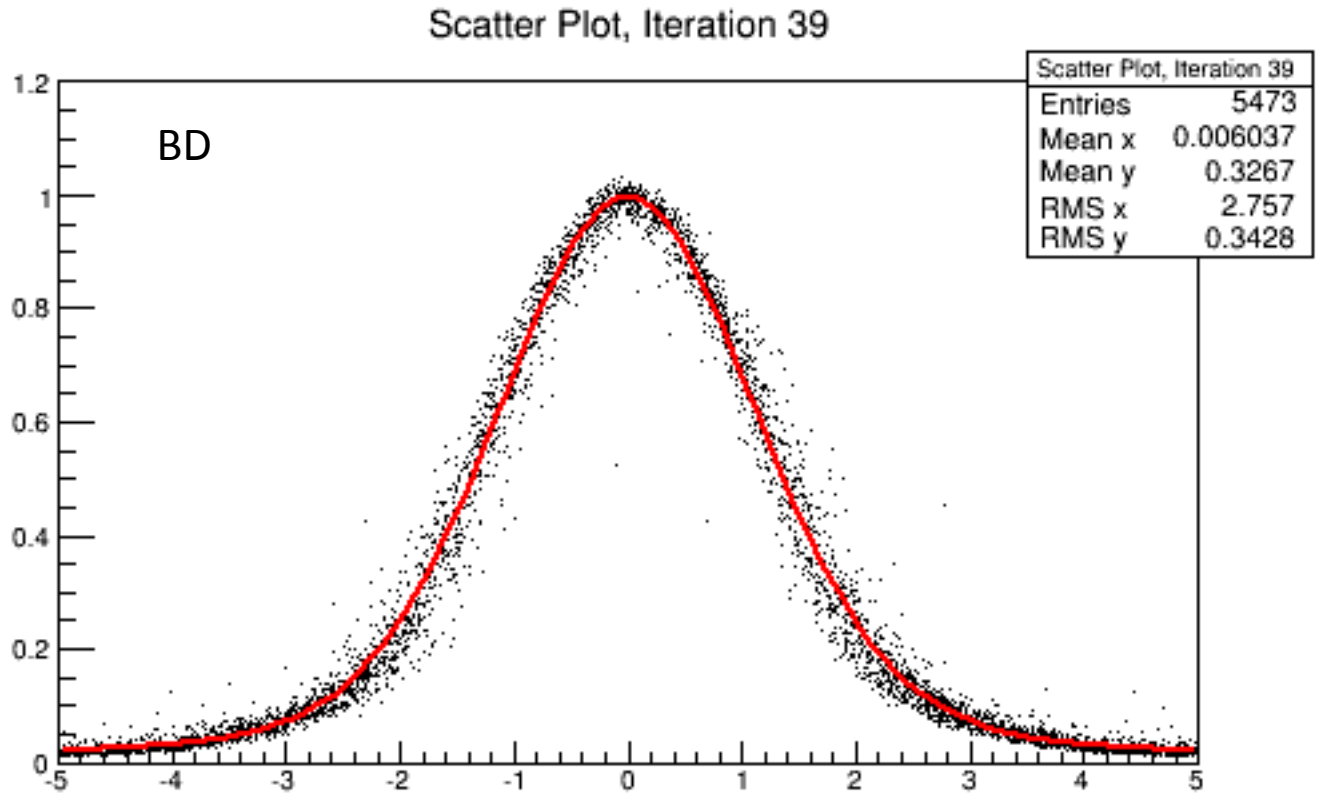
- Straightforward analysis with two different resistive layer: Carbon Loaded Capton (CLK) and Black Diamond (BD)
- Residuals after bias & distortion corrections. Varying threshold to accept pulses in Pulse Finder (mostly noise related issues).
- σ_{xy} vs Z (100 nsec peaking time with Vmesh=380 V and Edrift = 230 V/cm)
- σ_Z vs Z (100 nsec peaking time with Vmesh=380 V and Edrift = 230 V/cm)
- Analysis three (3) modules (alignment then bias & distortion corrections)

PRF Width look up
(for the same shaping time, drift distances, analysis cuts etc.)

Run5119, 2015 data, Sum Form



Run5119, 2015 data, Sum Form

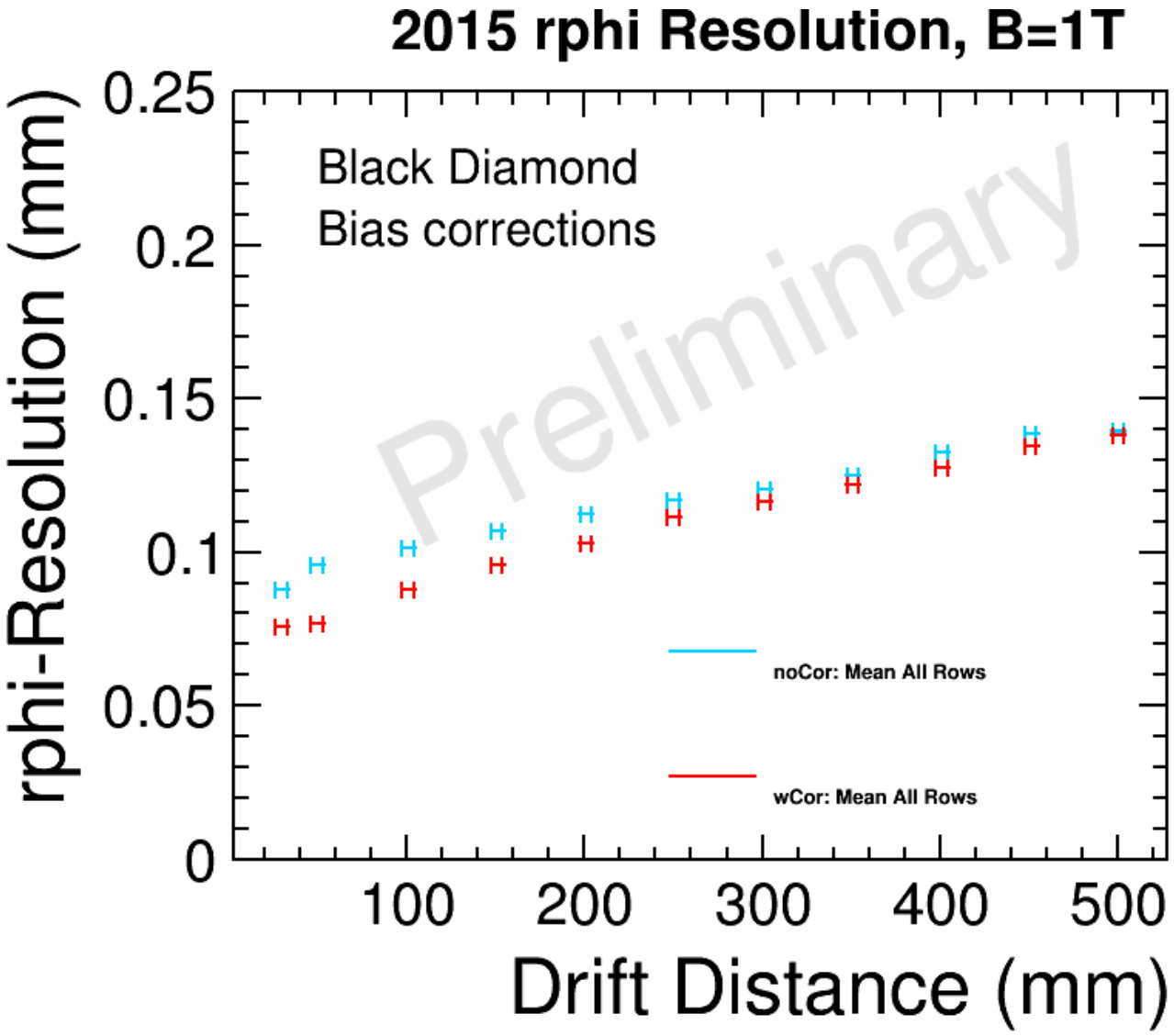


PRF for BD2 appears wider than for CLK, which does make perfect sense.

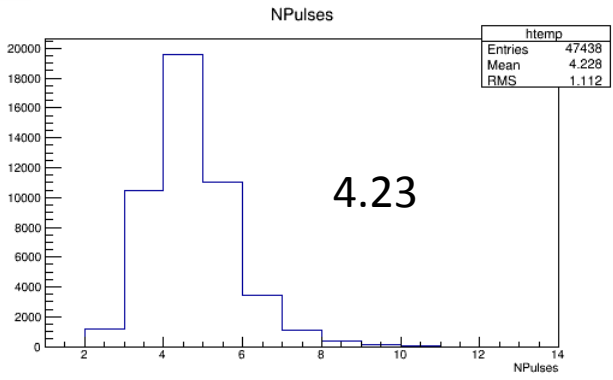
r-phi resolution

Resolution plots (for BD or CLK) with variable ADC threshold for all pulses.

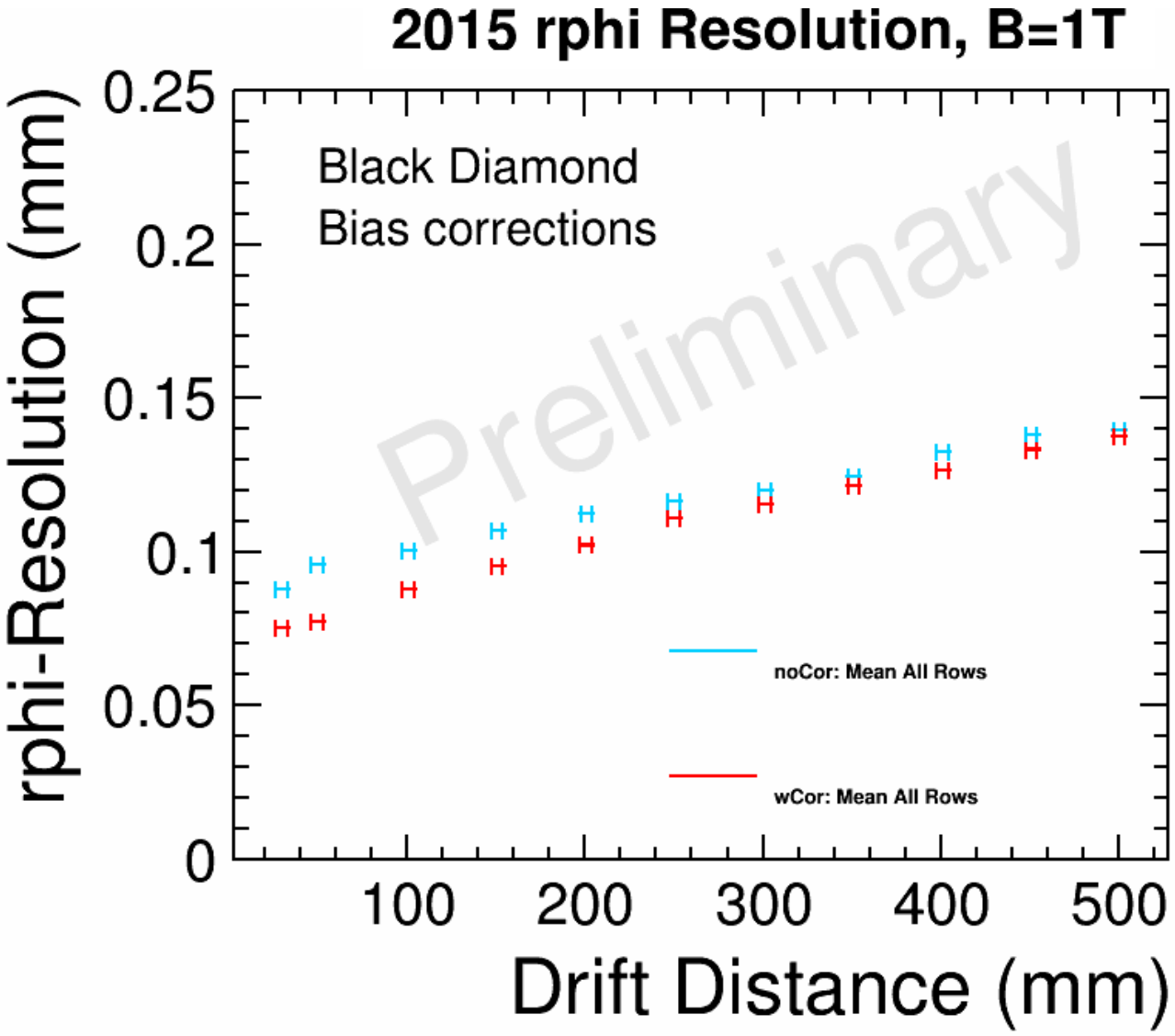
Pulse Threshold: 12 ADC for all pulses



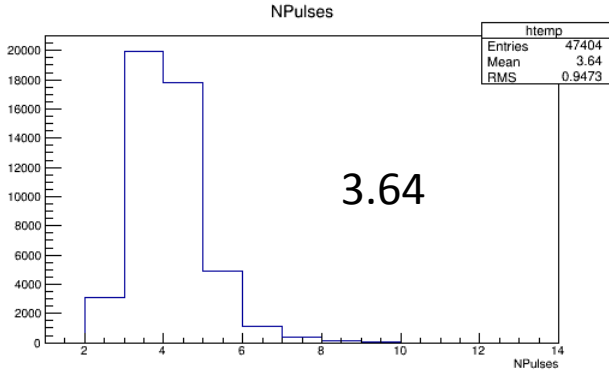
One BD module



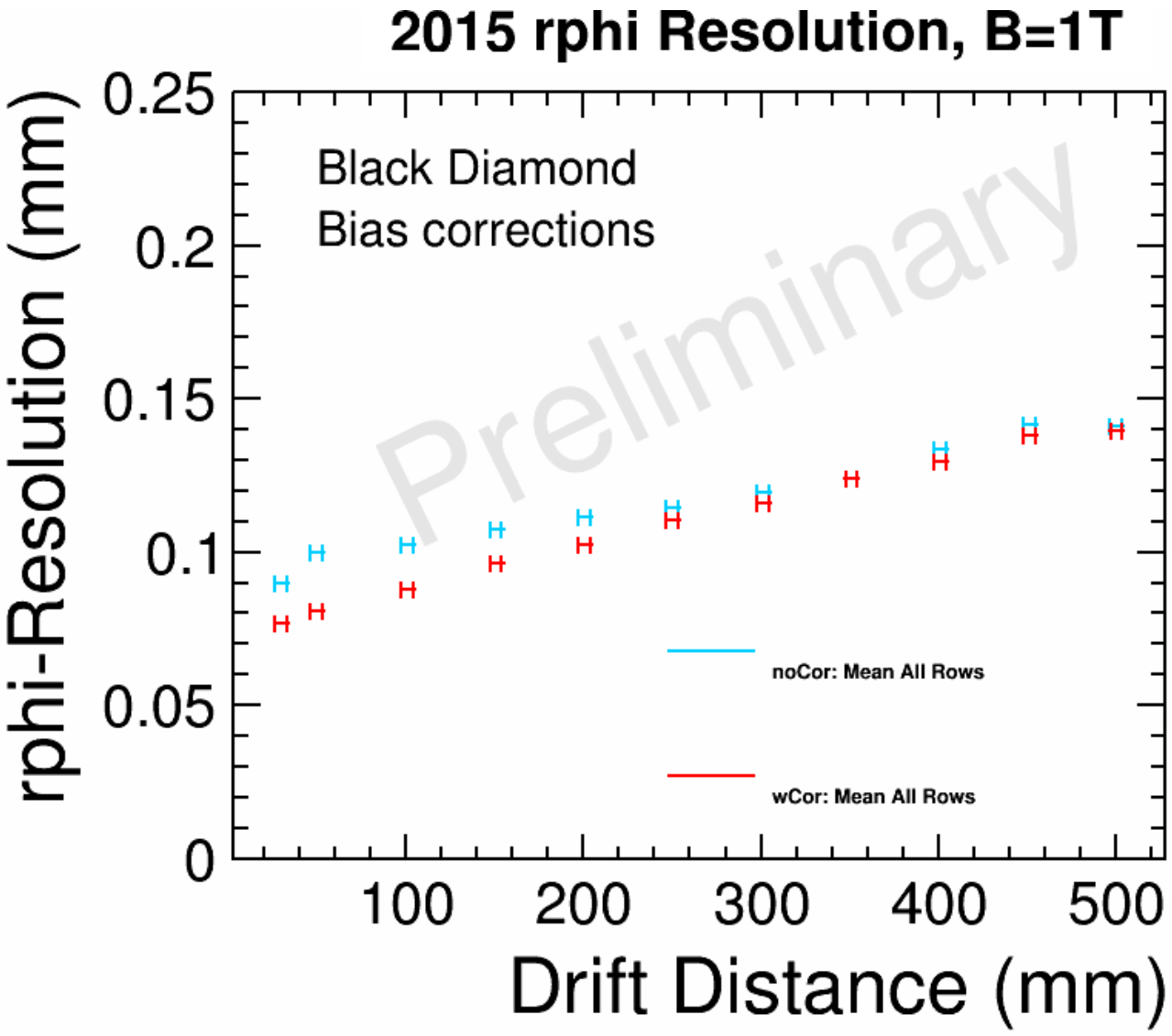
Pulse Threshold 30 ADC (“standard”).



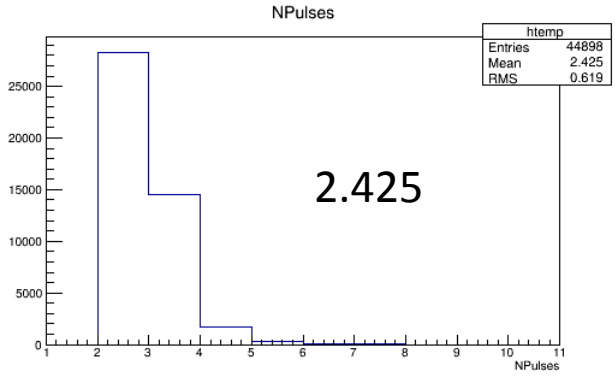
One BD module



Pulse Threshold: 70 ADC for all pulses

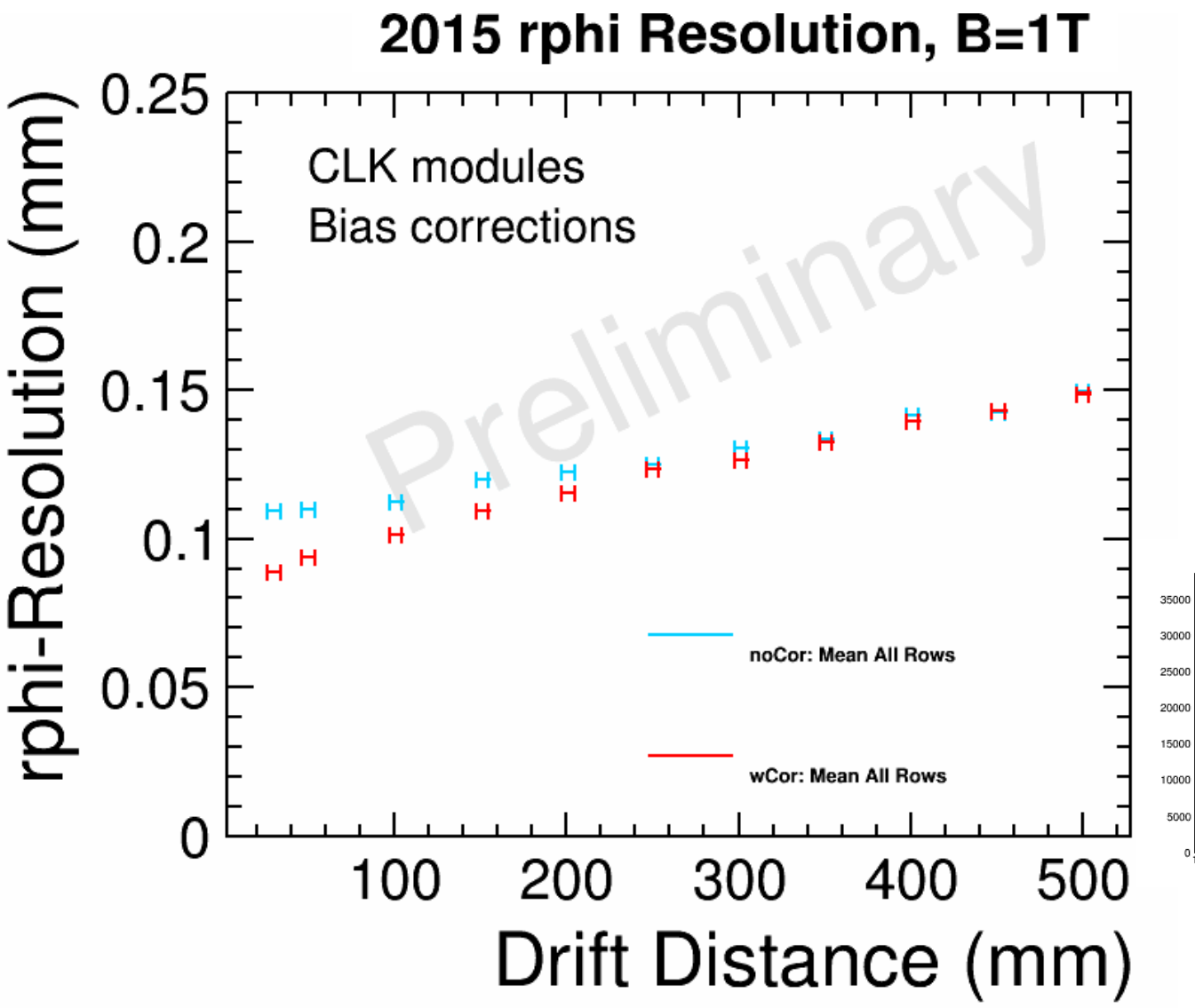


One BD module

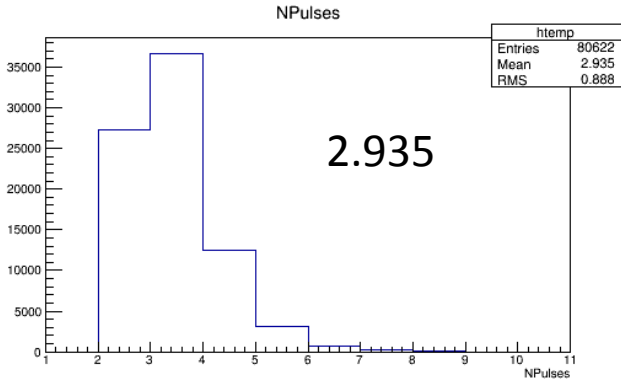


Slight degradation at short drifts

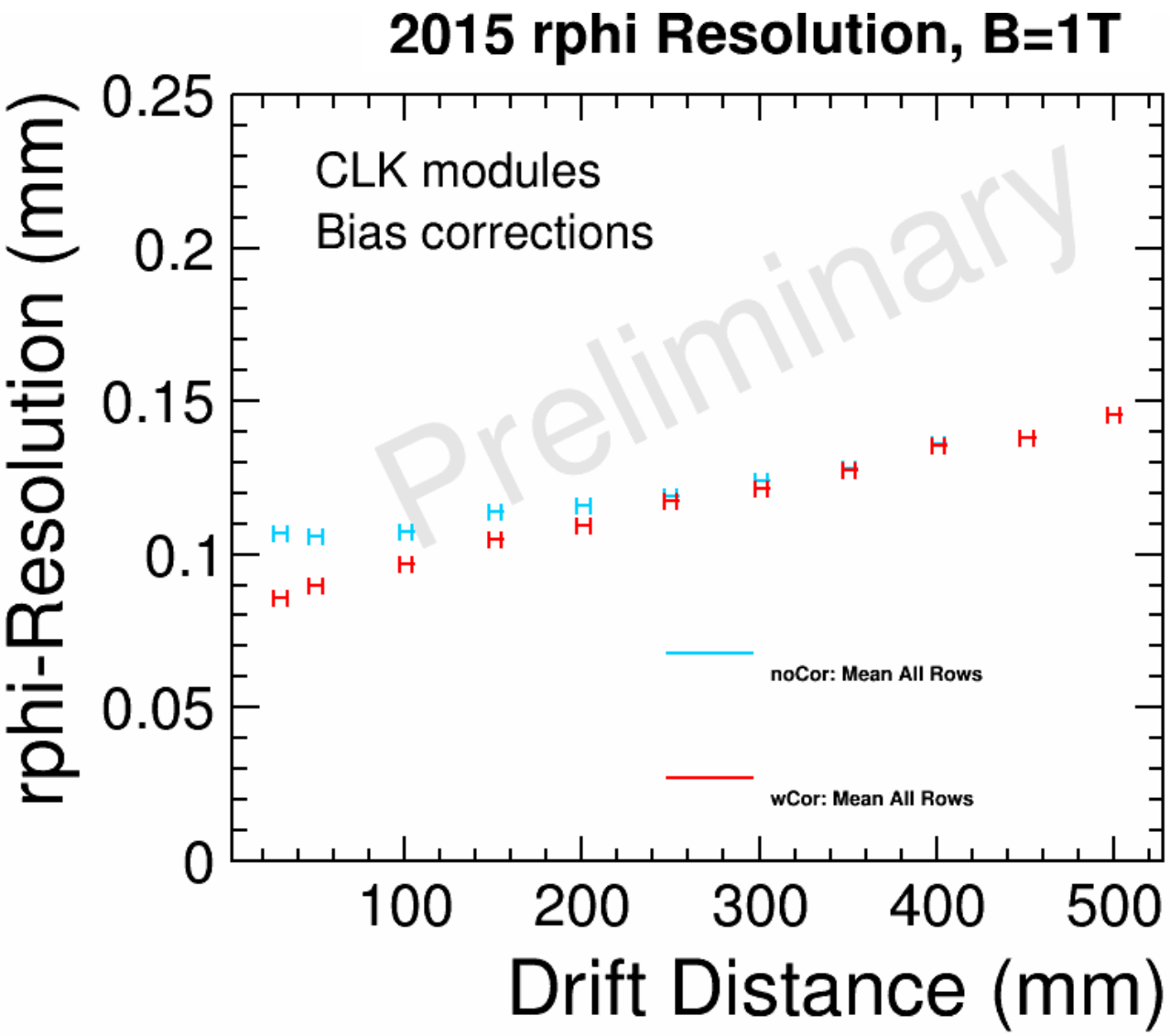
Pulse Threshold: 12 ADC for all pulses



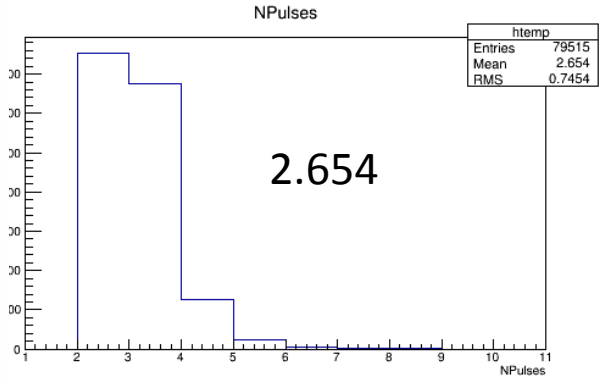
Two CLK modules



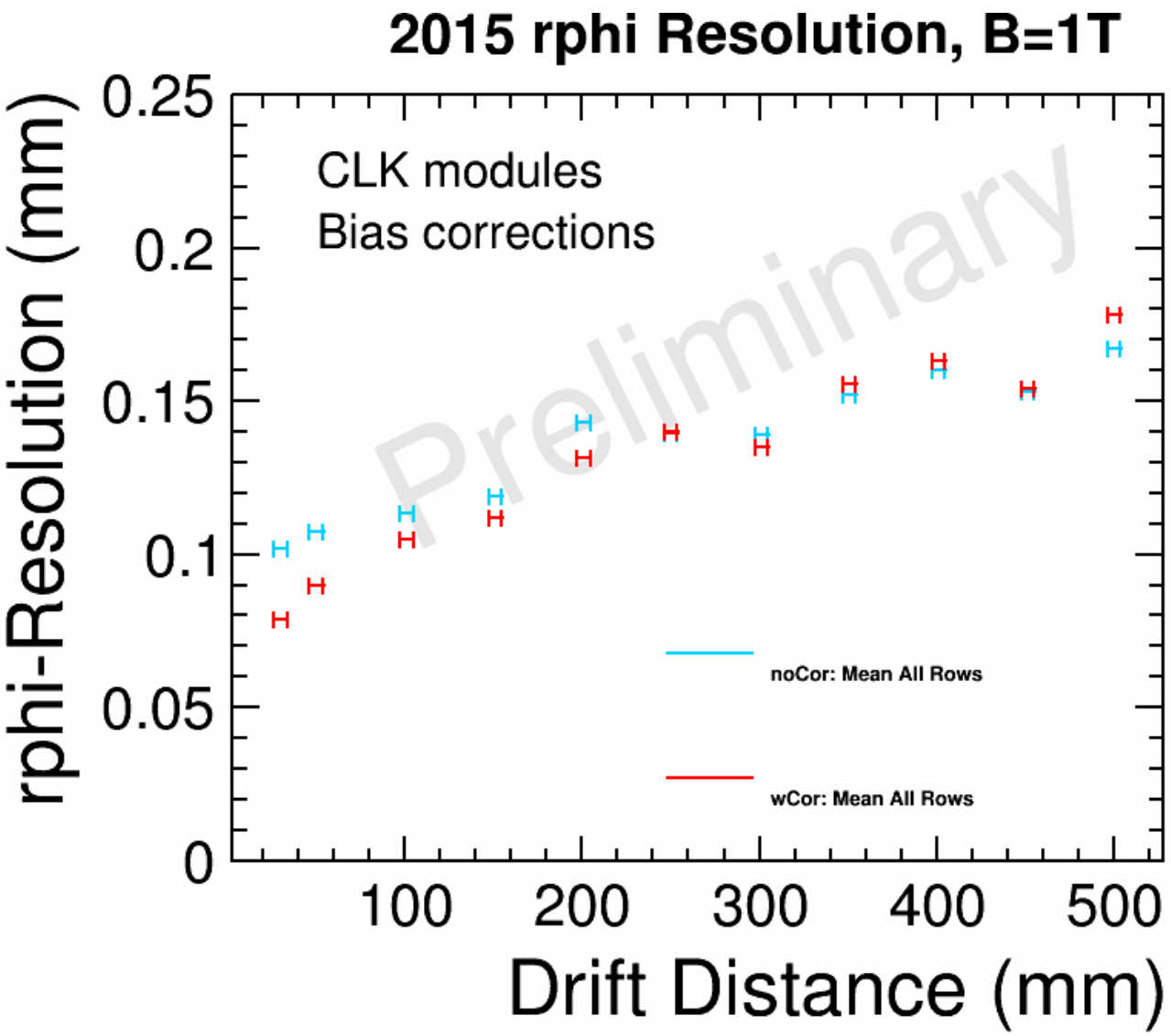
Pulse Threshold 30 ADC (“standard”).



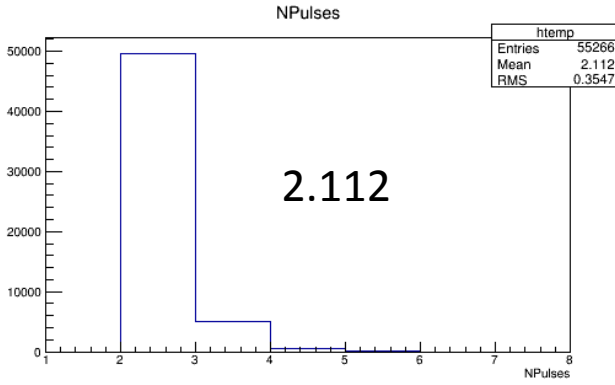
Two CLK modules



Pulse Threshold: 70 ADC for all pulses

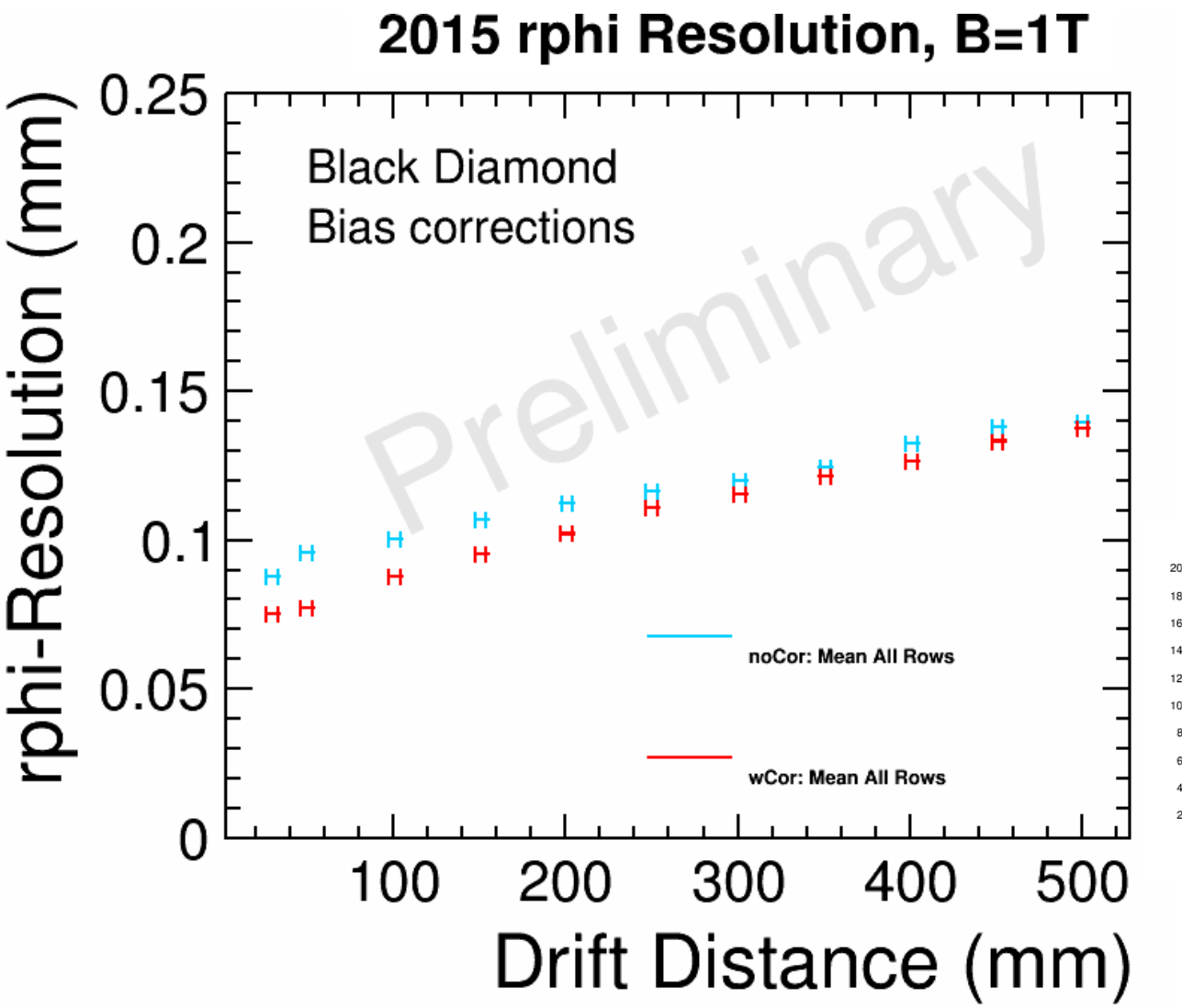


Two CLK modules

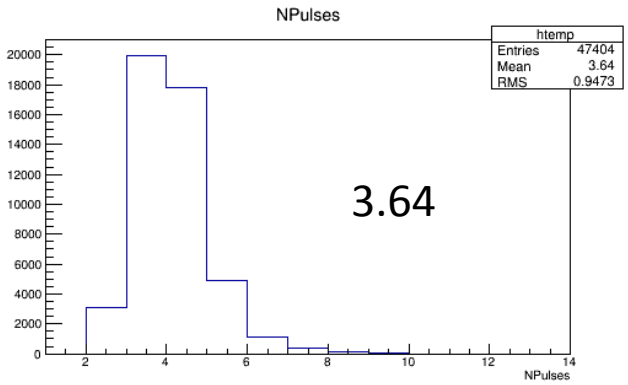


Resolution plots (for BD or CLK) with variable ADC threshold for Max Pulse

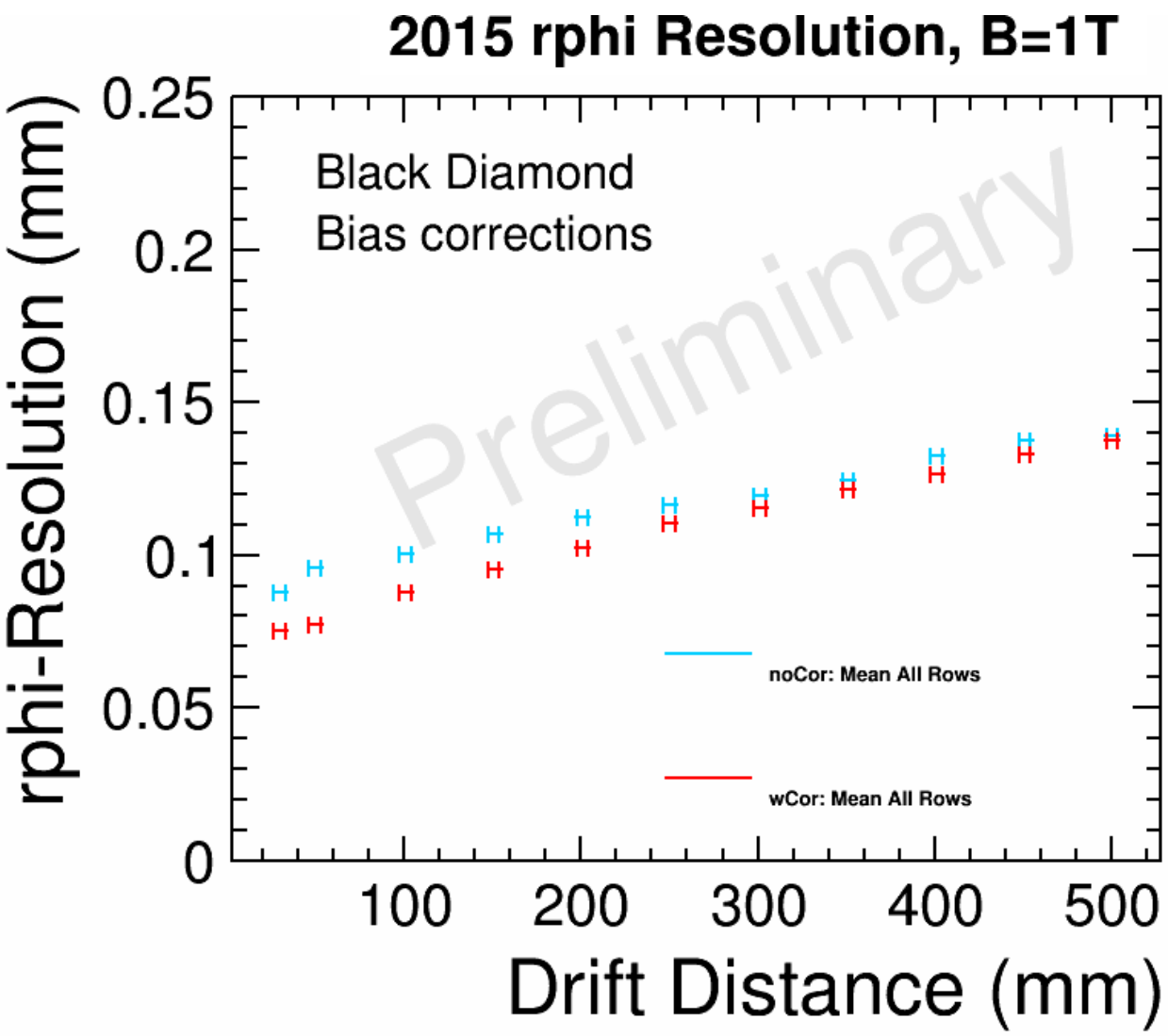
Hit Threshold 50 ADC (“standard”).



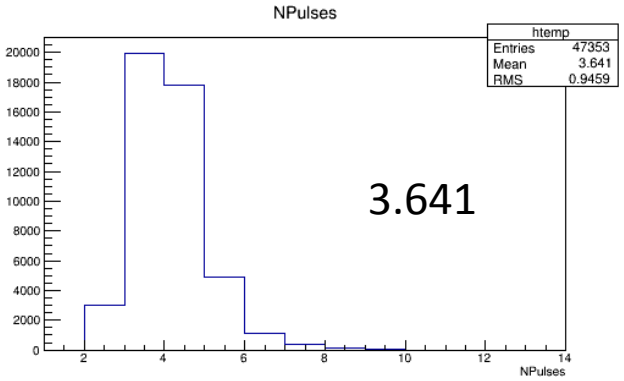
One BD module



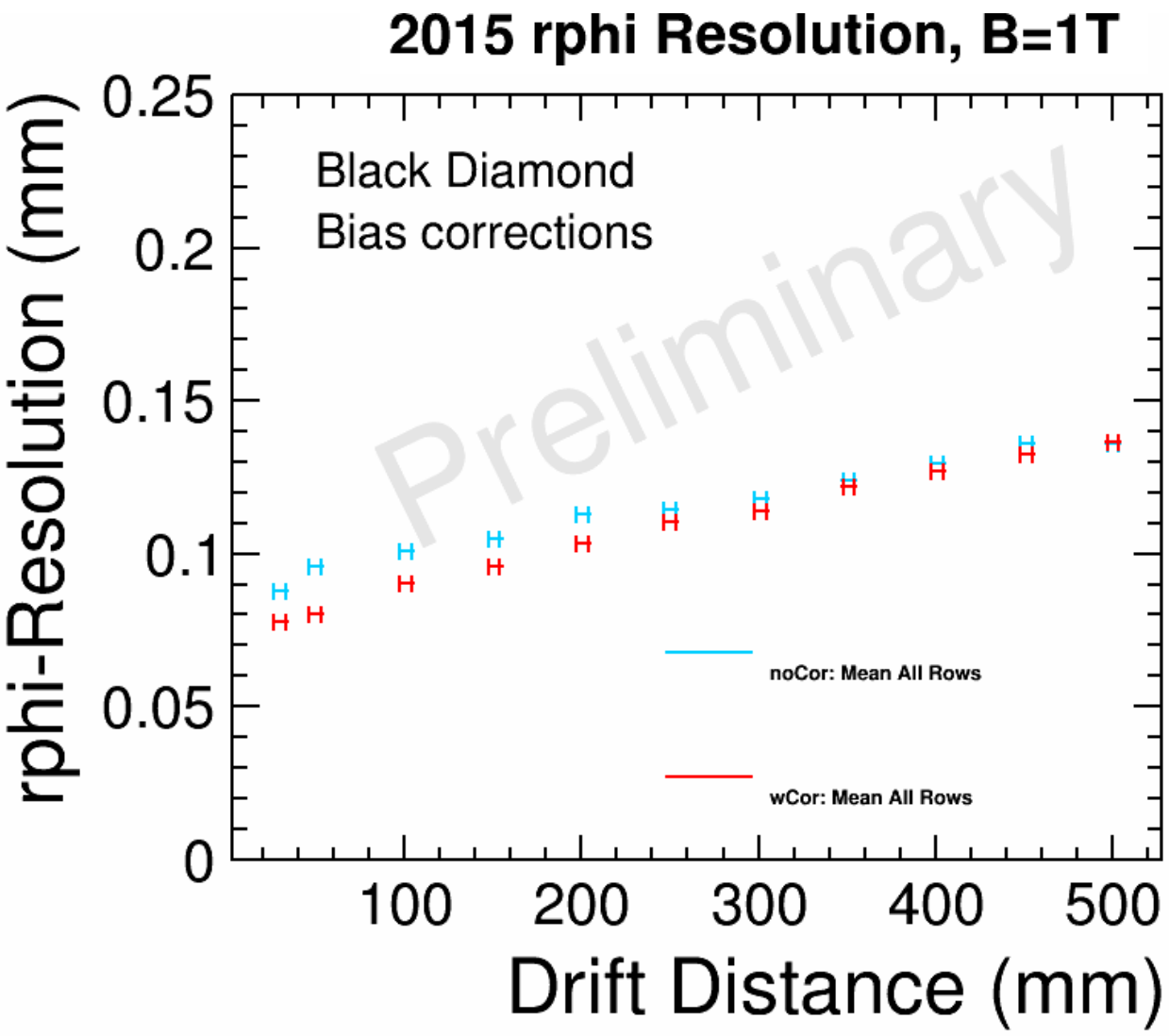
Hit Threshold of 150 ADC



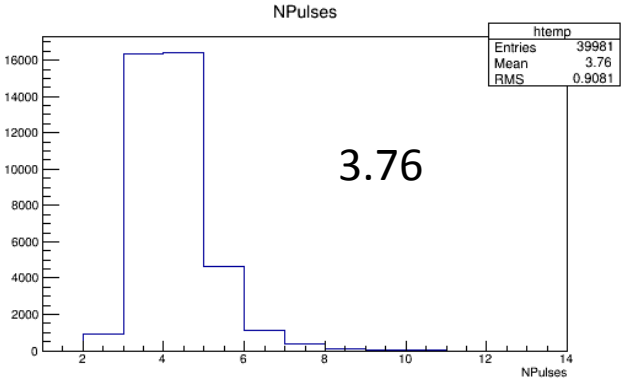
One BD module



Hit Threshold of 600 ADC

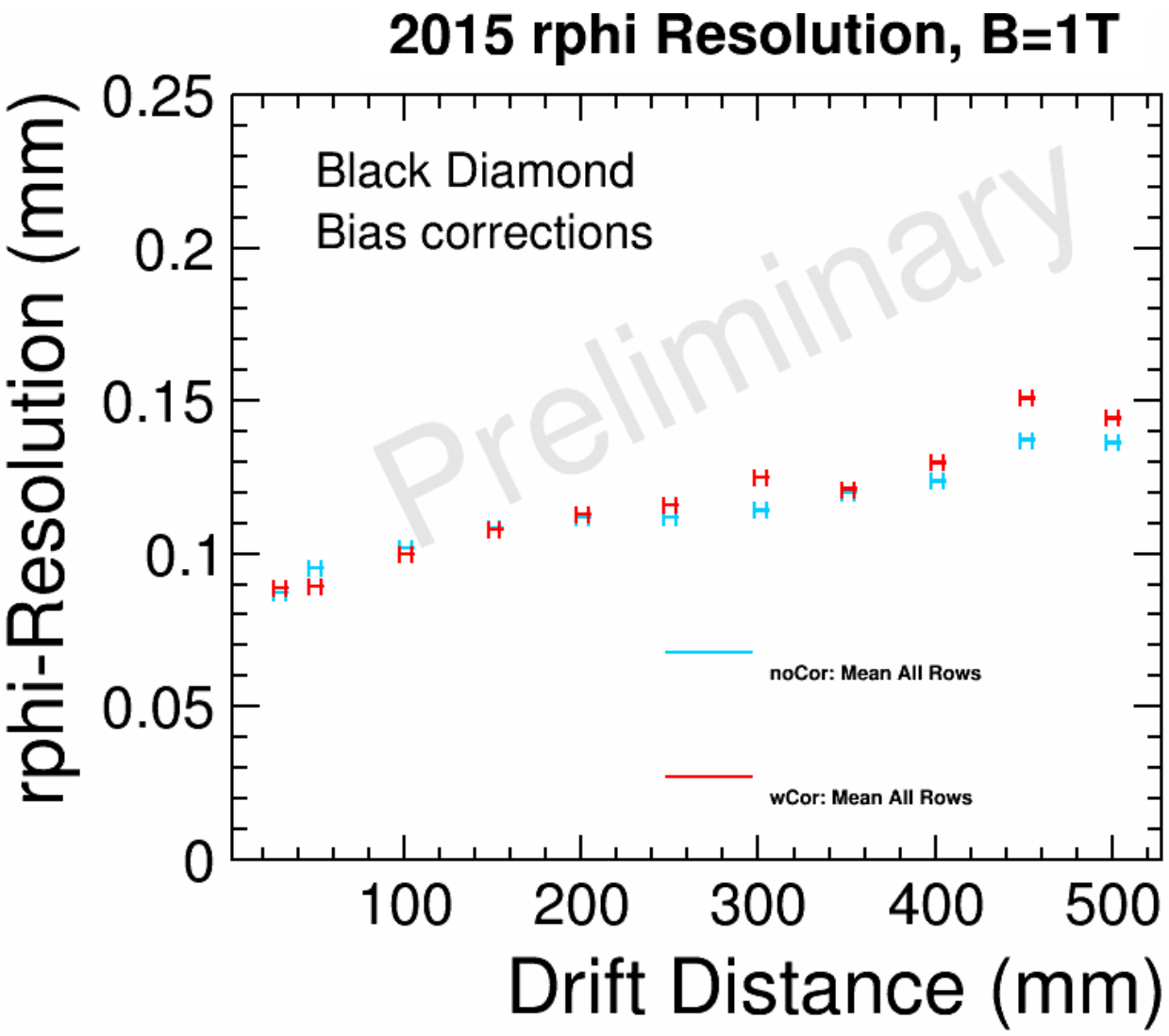


One BD module

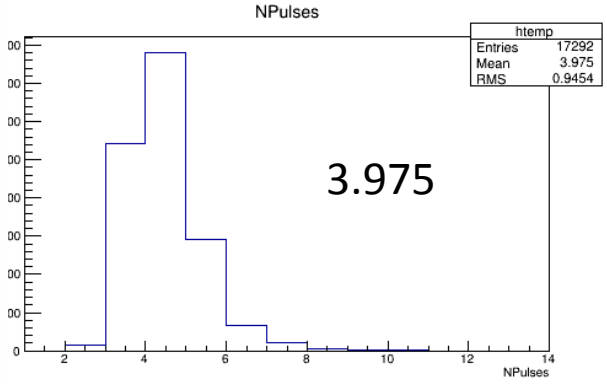


Difference with 150 ADC threshold: worse at low drifts, better at large drifts

Hit Threshold of 1000 ADC

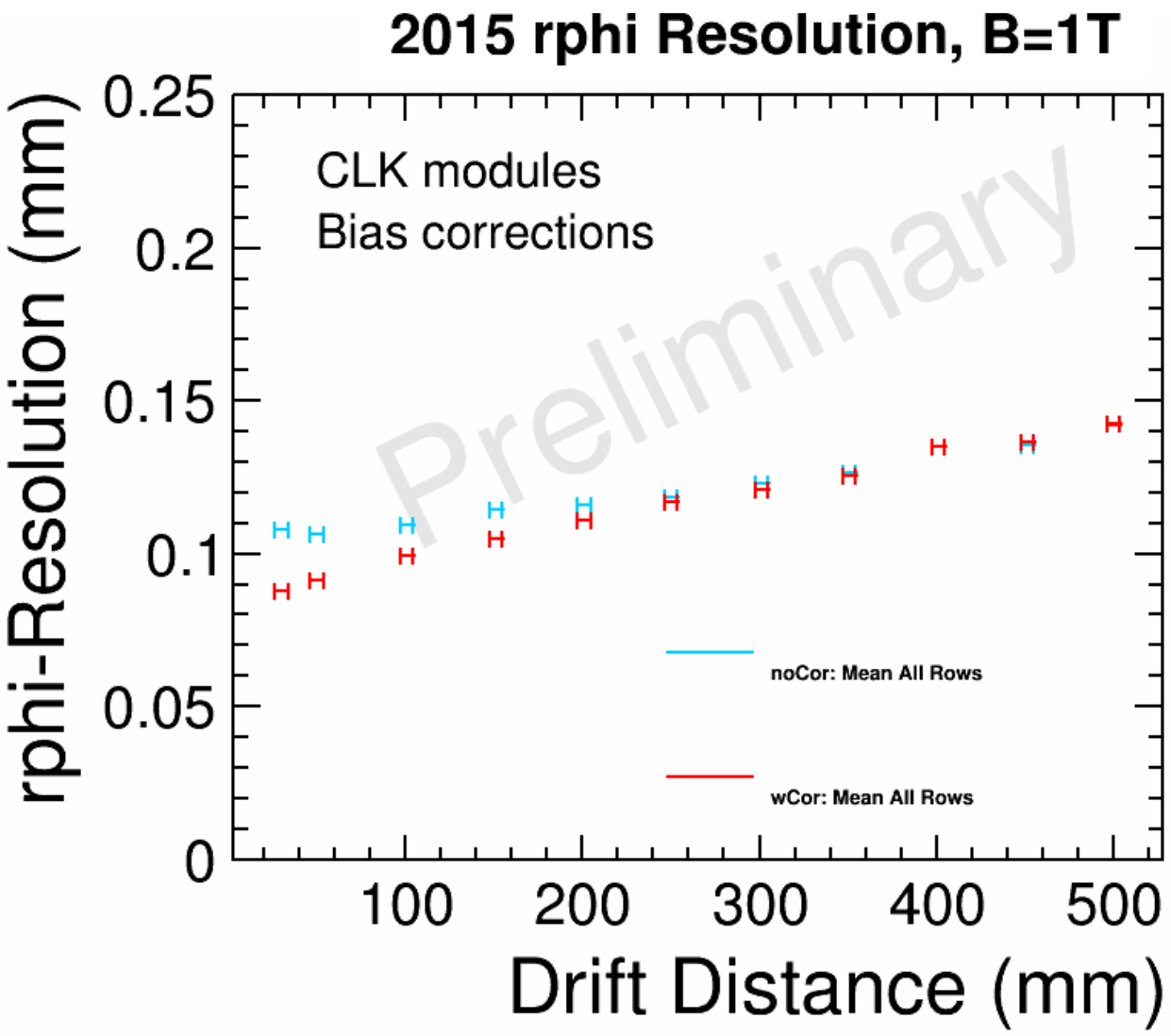


One BD module

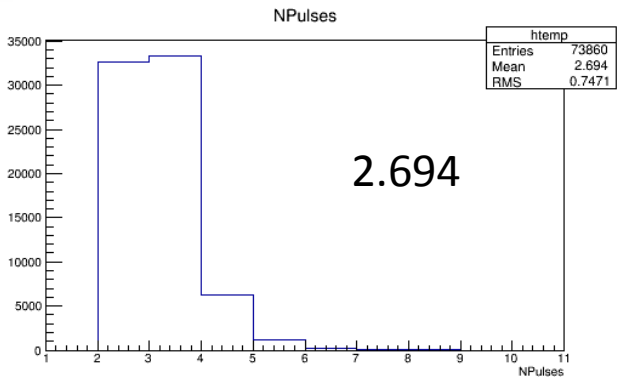


Difference with previous thresholds: better w/o corr.
Bias corr. work opposite way.

Hit Threshold of 50 ADC (“standard”)

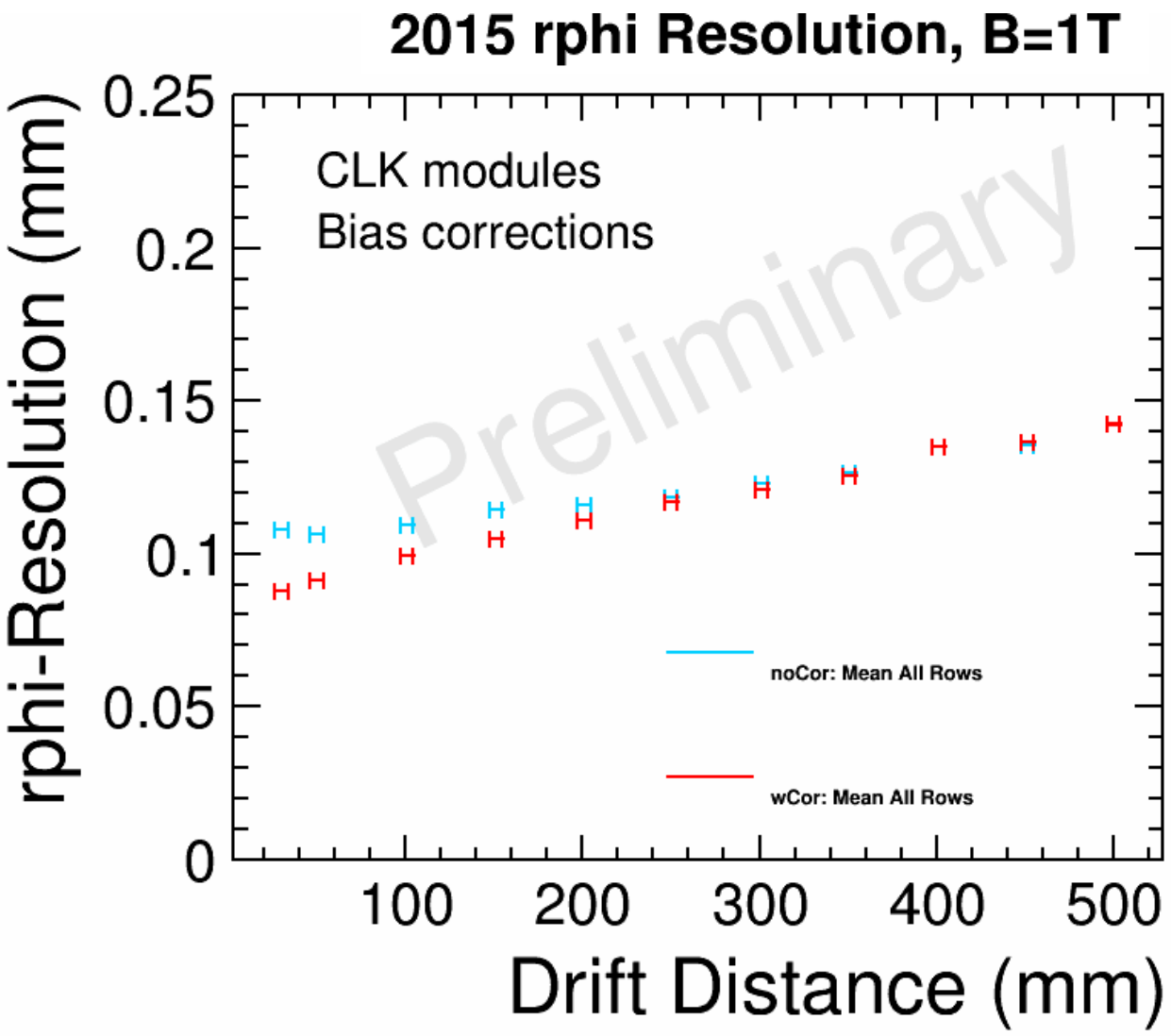


Two CLK modules

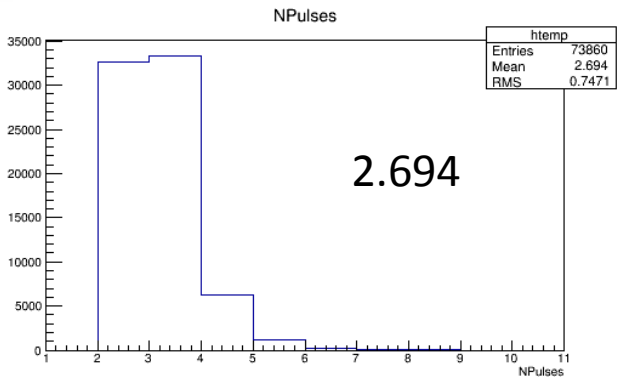


Difference with previous thresholds: worse at both ends.

Hit Threshold of 300 ADC

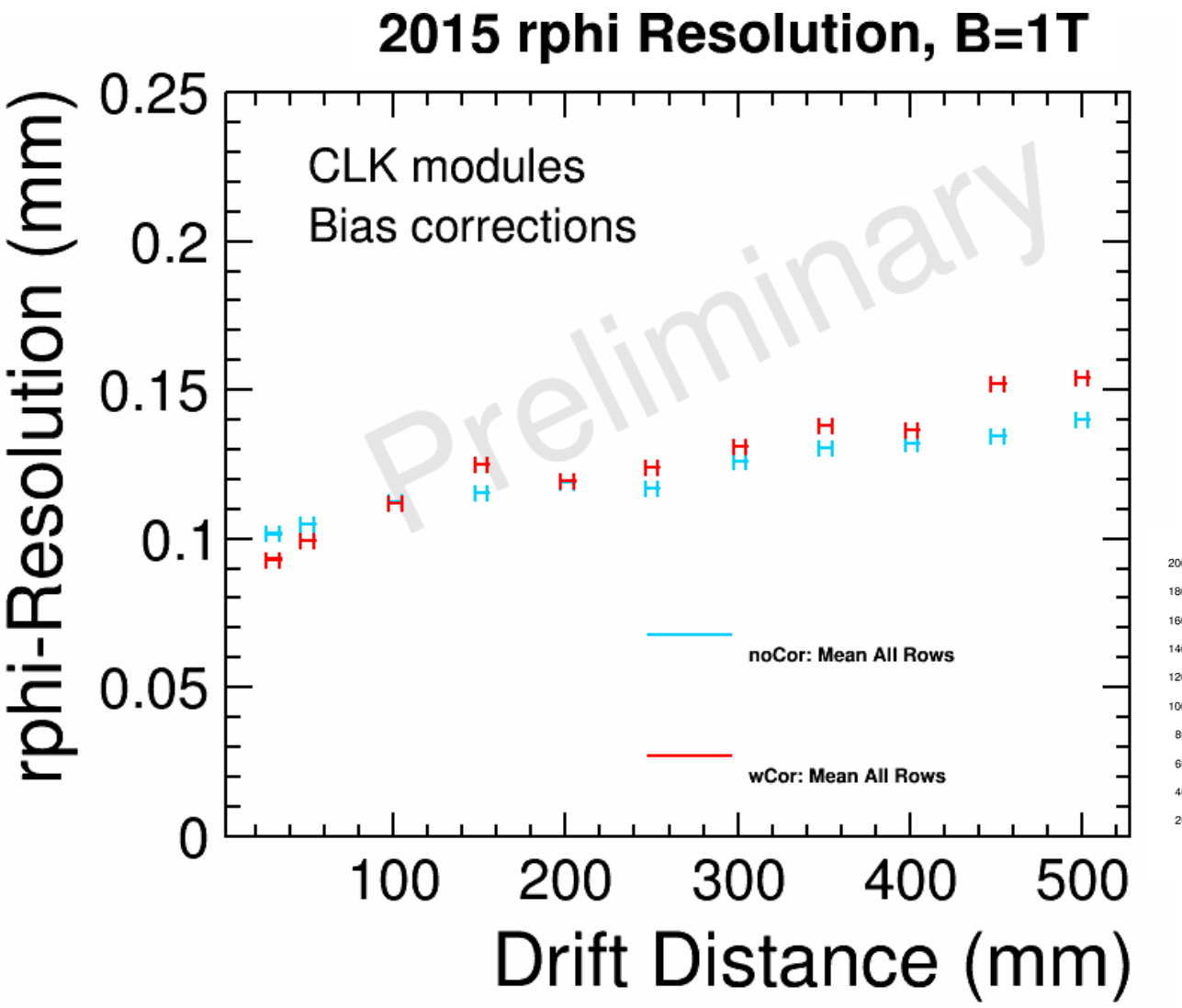


Two CLK modules

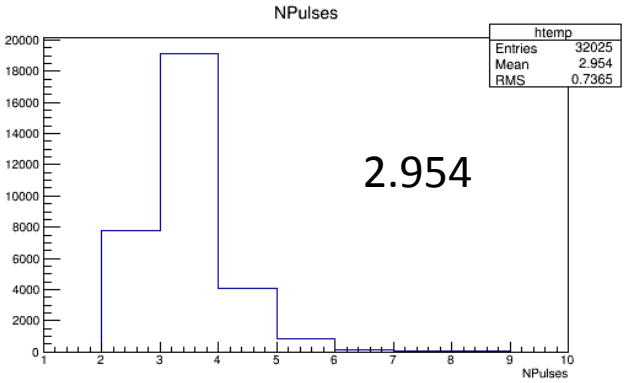


Difference with previous thresholds: worse at both ends.

Hit Threshold of 600 ADC



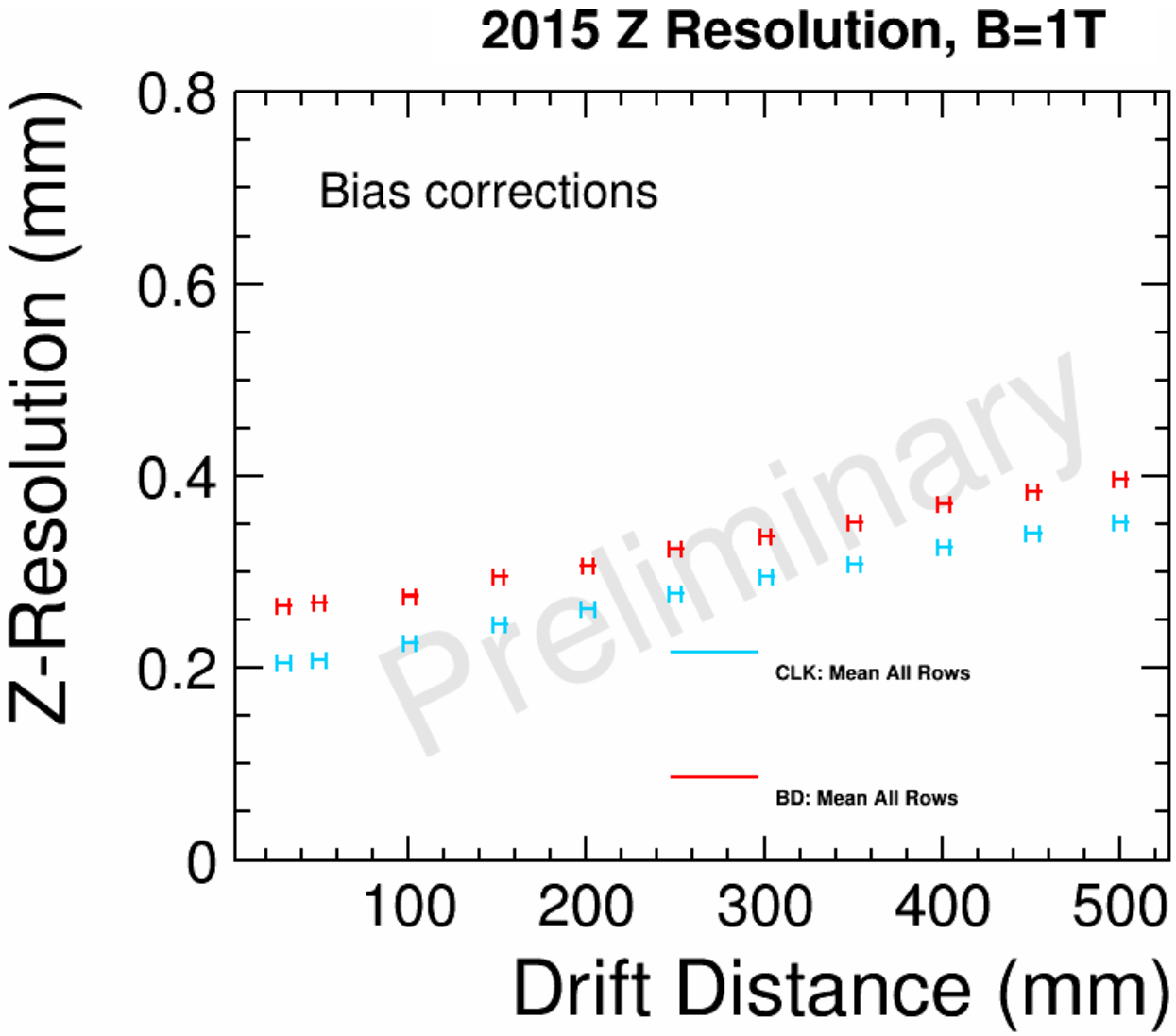
Two CLK modules



Difference with previous thresholds: blue points (no corr) better.

Z resolution

Z resolution 2015



BD2 performs worse than CLK in Z-resolution because lower RC

Summary

- Old time (Z) resolution analysis submitted!

- 2010 and 2015 papers ongoing
  Signed by LCTPC collaboration