

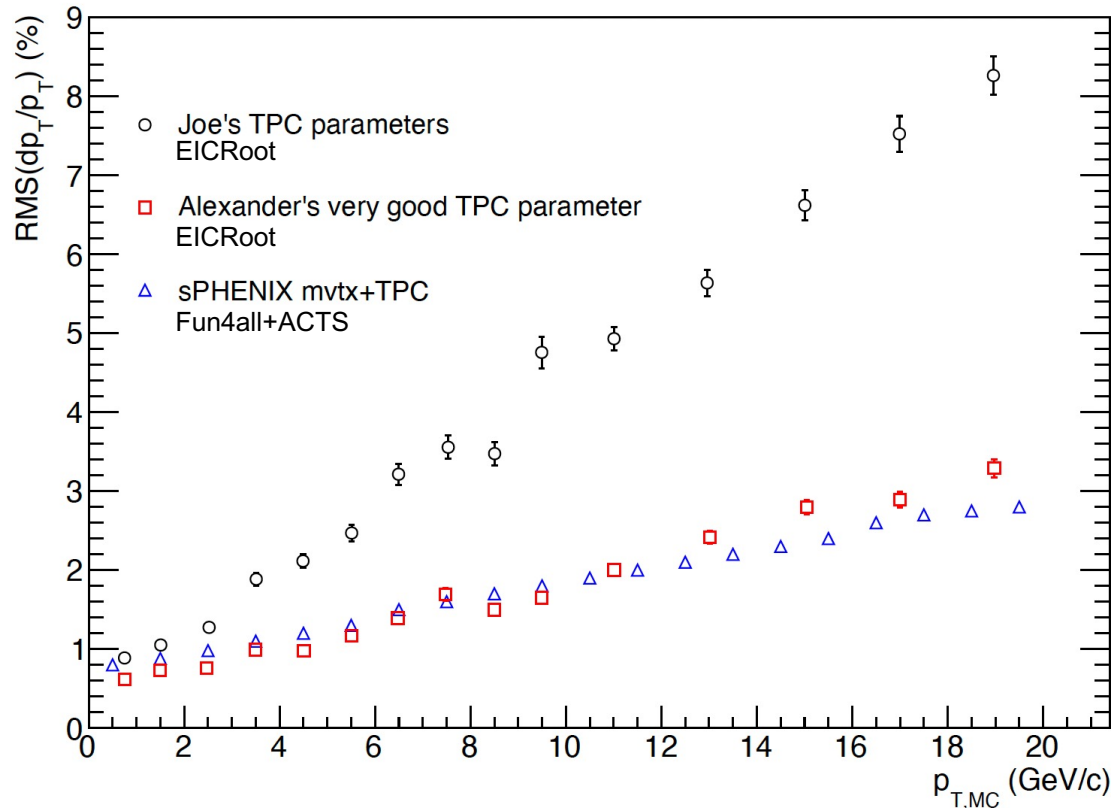
Tracking Simulation in EICRoot

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Last Update

sPHENIX p_T Resolution from EICRoot



	Joe's num.	Alexander's very good TPC
transverse dispersion	53 $\mu\text{m}/\sqrt{\text{cm}}$	15 $\mu\text{m}/\sqrt{\text{cm}}$
longitudinal dispersion	150 $\mu\text{m}/\sqrt{\text{cm}}$	1 $\mu\text{m}/\sqrt{\text{cm}}$
transverse intrinsic resolution	150 μm	200 μm
longitudinal intrinsic resolution	500 μm	500 μm
radial intrinsic resolution	7mm	0mm
GEM vertical pad size	1.16cm	0.5 cm

- Do we have the same definitions for these parameters as Joe?
- Need to apply for a factor of $1/\sqrt{12}$ in some of the parameters?

TPC Digitization Parameters

1. Transverse dispersion
 2. Longitudinal dispersion
 3. Transverse intrinsic resolution
 4. Longitudinal intrinsic resolution
 5. Radial intrinsic resolution
 6. GEM vertical pad size
- In EICRoot, the quadrature sum of parameters 1 and 3 determine the spatial resolution in transverse direction, and the same for parameters 2 and 4
 - Parameter 4 is product of the electronics frequency and drift velocity
 - Parameter 5 is the pad size
 - Parameter 6 depends on the size of the TPC and number of hits, that is $\text{GEM vertical pad size} = (r_{\text{out}} - r_{\text{in}}) / n\text{Hits}$

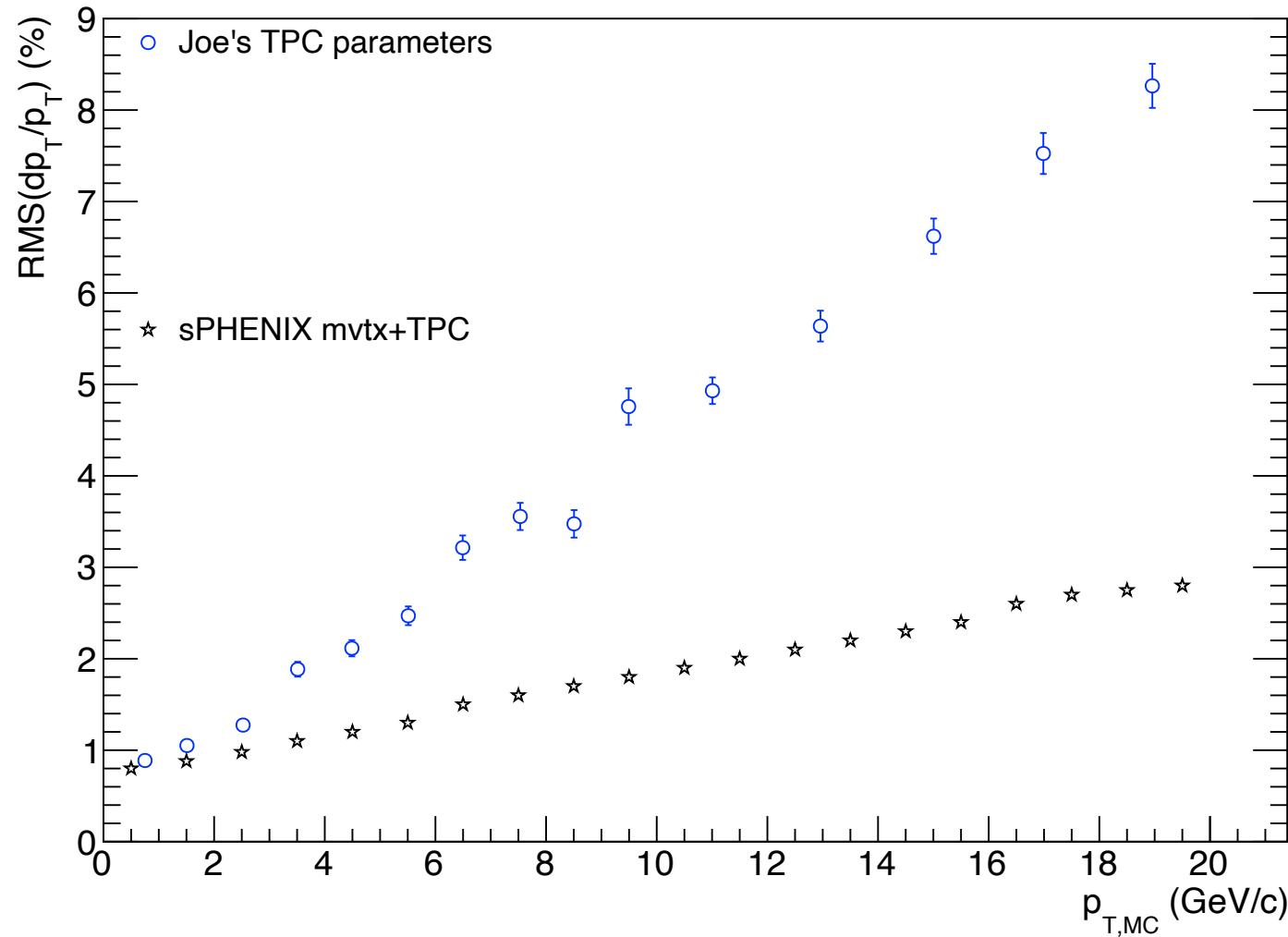
TPC Digitization Parameters

	Joe's number	What I put in
transverse dispersion	$53 \mu\text{m}/\sqrt{\text{cm}}$	$53 \mu\text{m}/\sqrt{\text{cm}}$
longitudinal dispersion	$150 \mu\text{m}/\sqrt{\text{cm}}$	$150 \mu\text{m}/\sqrt{\text{cm}}$
transverse intrinsic resolution	$150 \mu\text{m}$	$150 \mu\text{m}$
longitudinal intrinsic resolution	$500 \mu\text{m}$	$500 \mu\text{m}$
radial intrinsic resolution	5-10mm	7mm (mid-ish value)
GEM vertical pad size	??	$(78\text{cm}-20\text{cm})/50\text{hits}=1.16\text{cm}$

Clarifications from Joe

- Transverse resolution is 150um
→ transverse intrinsic resolution should be smaller than 150um, but the difference should be small
- Radial intrinsic resolution is between 6mm and 12 mm, actually
→ Again, it is not a big different than what I put in
- The Inner radius of TPC is 30cm instead of 20cm
→ GEM vertical pad size should be 0.96cm

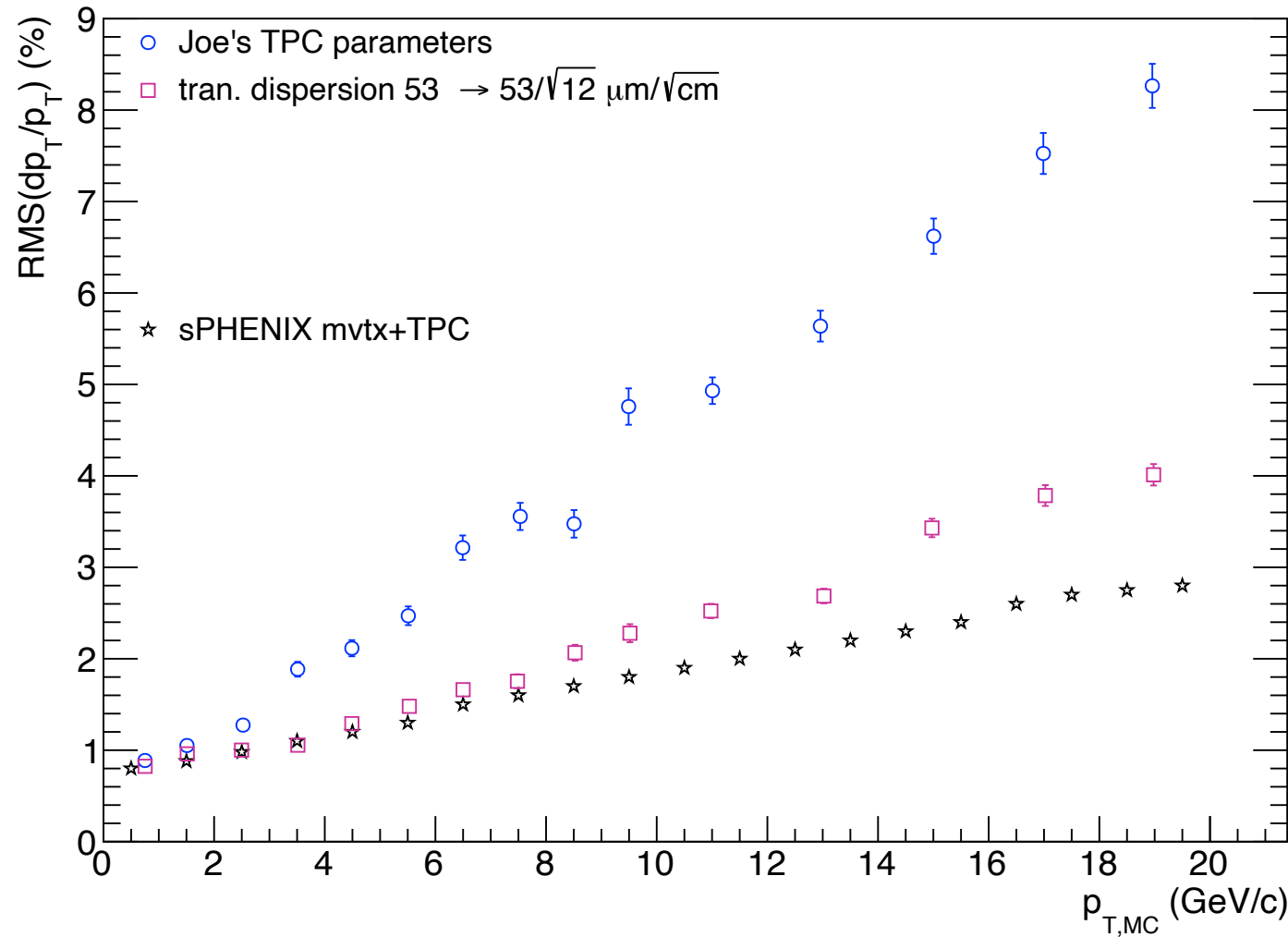
Testing Different TPC Digitization Parameters



EICRoot with Joe's TPC parameters

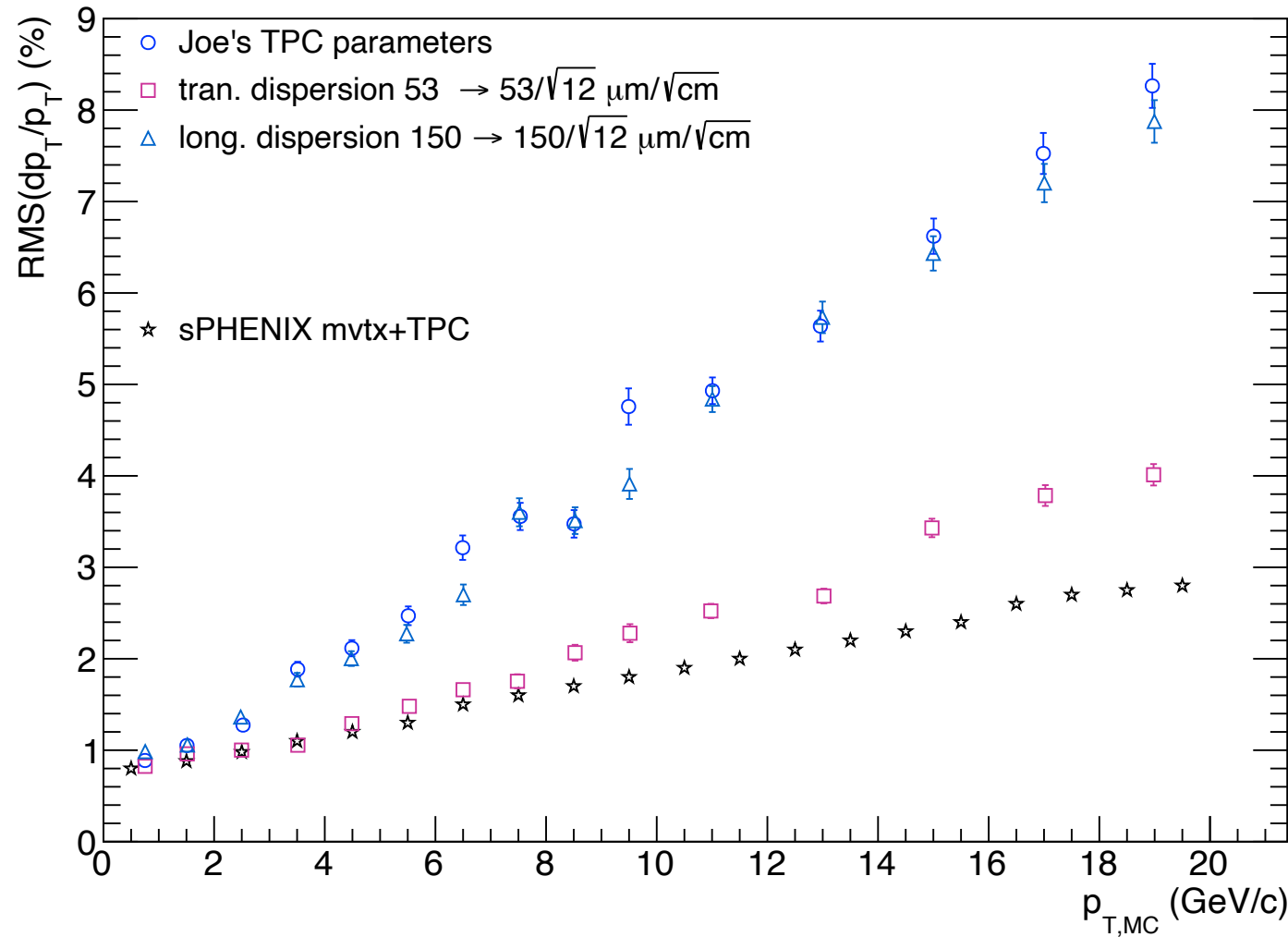
Fun4all +ACTS

Testing Different TPC Digitization Parameters



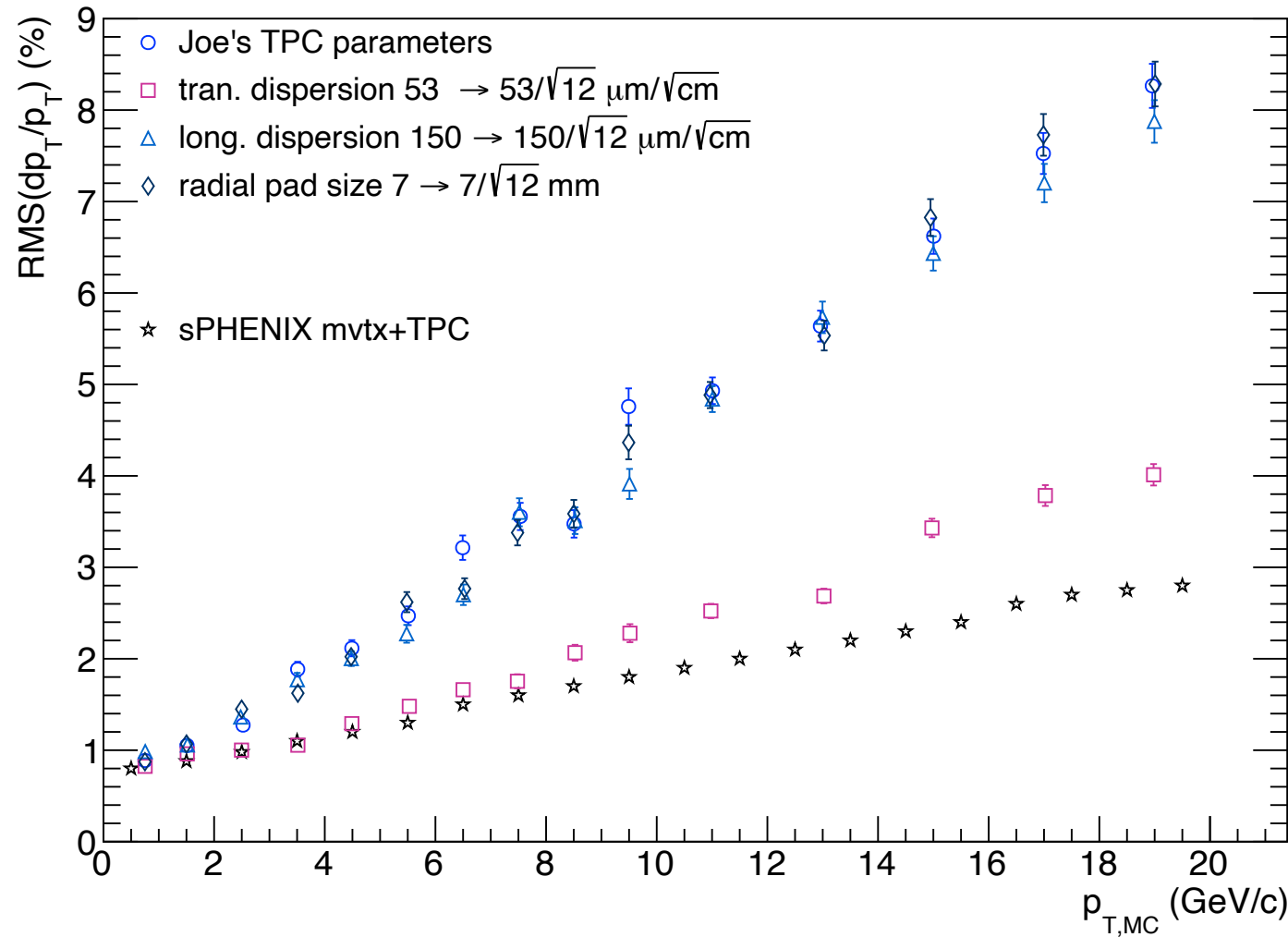
- p_T resolution is **sensitive** to the transverse dispersion

Testing Different TPC Digitization Parameters



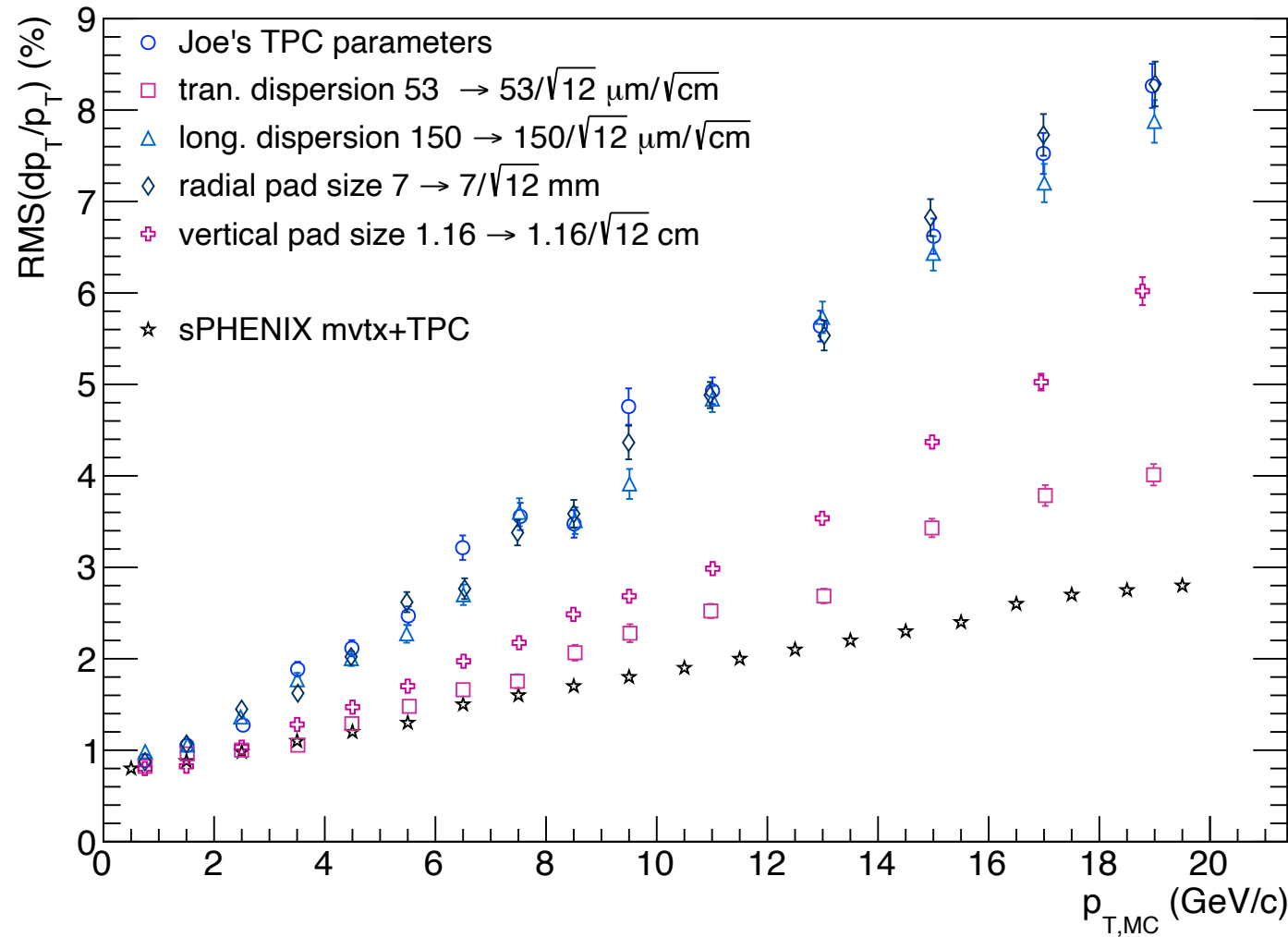
- p_T resolution is **sensitive** to the transverse dispersion
- p_T resolution is **insensitive** to the longitudinal dispersion

Testing Different TPC Digitization Parameters



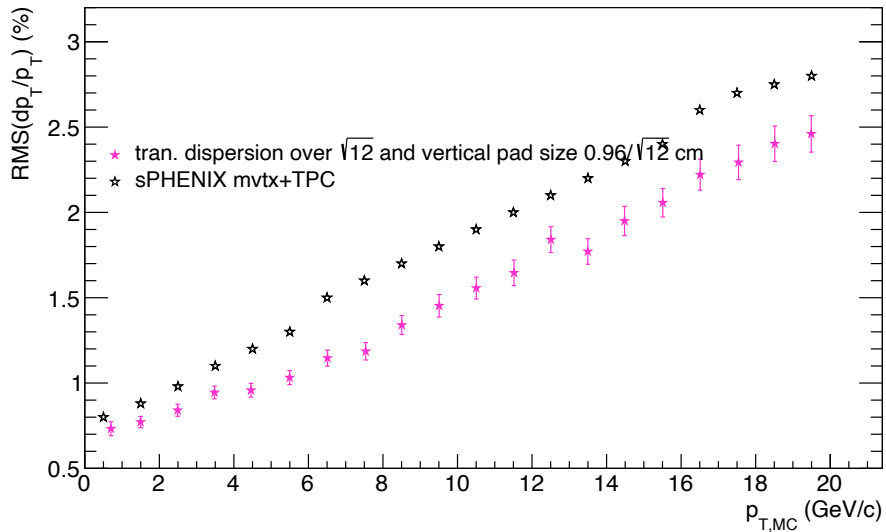
- p_T resolution is **sensitive** to the transverse dispersion
- p_T resolution is **insensitive** to the longitudinal dispersion and the radial pad size

Testing Different TPC Digitization Parameters



- p_T resolution is **sensitive** to the transverse dispersion and GEM vertical pad size
- p_T resolution is **insensitive** to the longitudinal dispersion and the radial pad size

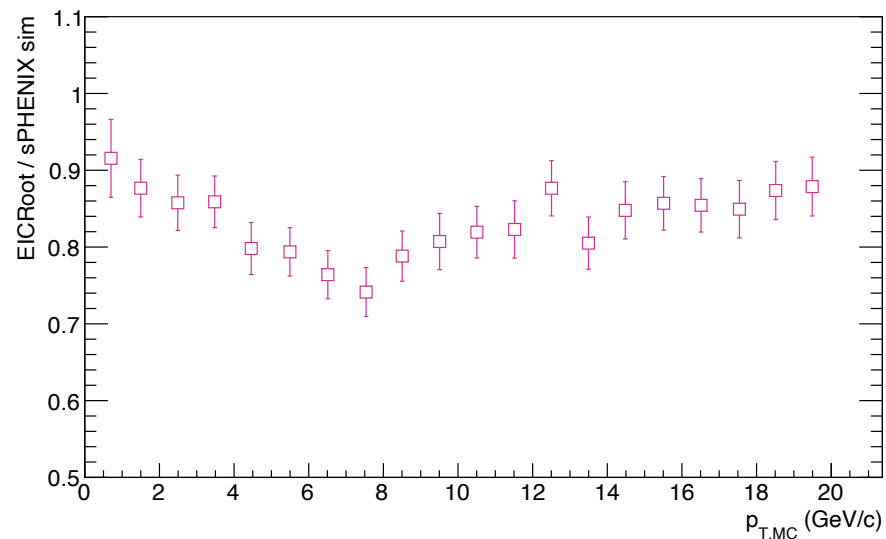
Combined All the Changes



Black markers: Fun4all + ACTS

Pink markers: EICRoot

- Reduce the TPC size from $20 < r < 78$ cm to $30 < r < 78$ cm
- Reduce the transverse dispersion from $53 \mu\text{m}/\sqrt{\text{cm}}$ to $53/\sqrt{12} \mu\text{m}/\sqrt{\text{cm}}$
- Reduce GEM vertical pad size from $(78\text{cm}-20\text{cm})/50$ hits = 1.16 cm to $(78\text{cm}-30\text{cm})/50$ hits/ $\sqrt{12}$ = $0.96/\sqrt{12}$ cm
- Now the p_T resolution from EICRoot is better than the sPHENIX simulation by ~20%-ish
- The discrepancy may also be stemmed from lacking realistic materials, like the INTT between the MVTX and the TPC, or supporting/cooling structure



Alexander's Comments

- Double check the digitization parameters of the MVTX
- Alexander will check the TPC code for better understanding of the TPC digitization parameters
- Check with Joe of the dispersion parameters
- Check material budgets

Summary

- Clarification for TPC digitization parameters
- Received corrected digitization parameters from Joe but there is no significant differences of the parameters
- p_T resolution is **sensitive** to the transverse dispersion and GEM vertical pad size
- Reducing the transverse dispersion and GEM vertical pad size by $\sqrt{12}$ makes the EICRoot simulation comparable to the Fun4all+ACTS simulation
- I will continue to work with Alexander to understand the EICRoot simulations.