Brookhaven National Laboratory

U.S. DEPARTMENT OF ENERGY

# Tracking Simulation using LDT

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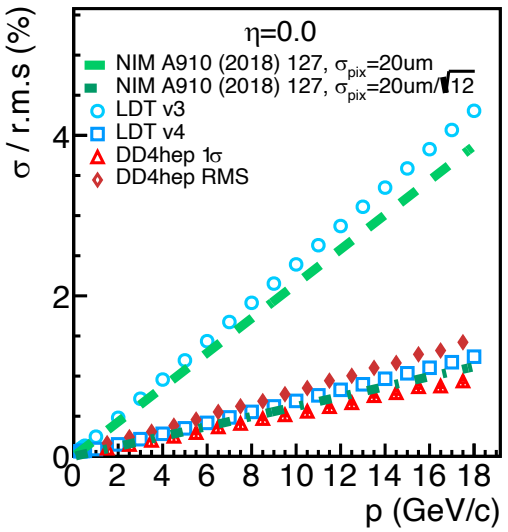
# Momentum Resolutions

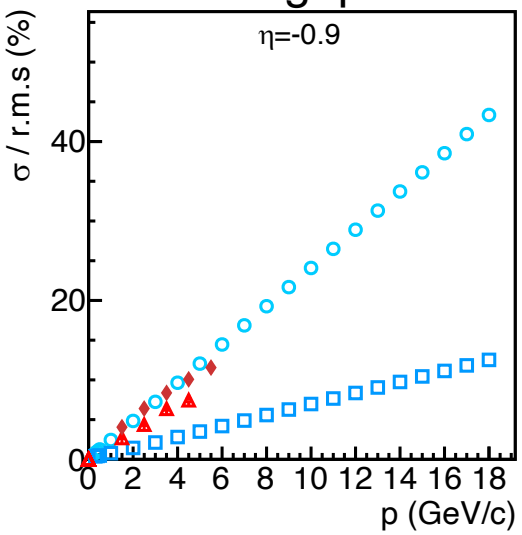
Same as last update with minimal materials

- $\mathbf{dr\phi = 20\ um}$, $\boldsymbol{dz = 20\ um}$, $du = 20$ um, $dv = 20$ um
- $\mathbf{dr\phi = 20/\sqrt{12}\ um}$, $\boldsymbol{dz = 20/\sqrt{12}\ um}$, $du = 20$ um, $dv = 20$ um

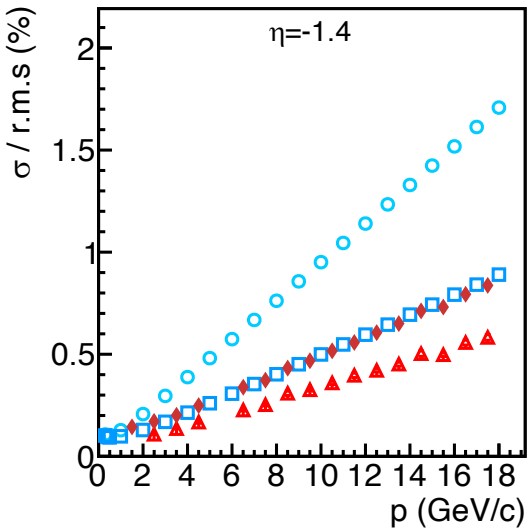
All barrel hits



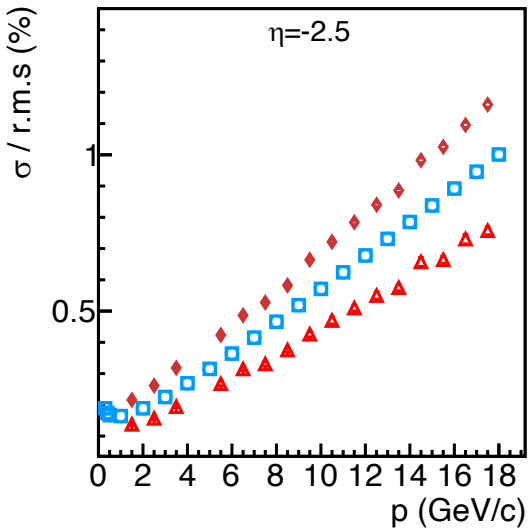

The gap




2 barrel + 3 disk hits




All disk hits

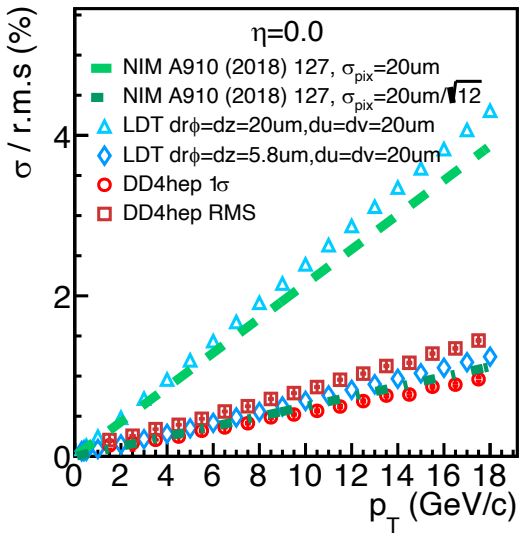


# Transverse Momentum Resolutions

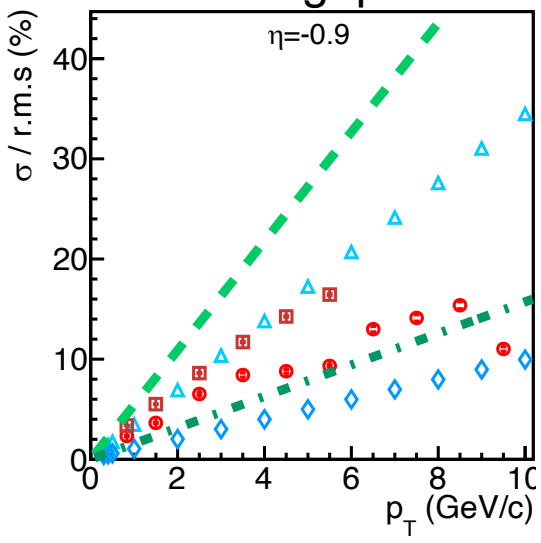
Same as last update with minimal materials

- $\mathbf{dr\phi = 20\ um}$, $\boldsymbol{dz = 20\ um}$, $du = 20$ um, $dv = 20$ um
- $\mathbf{dr\phi = 20/\sqrt{12}\ um}$, $\boldsymbol{dz = 20/\sqrt{12}\ um}$, $du = 20$ um, $dv = 20$ um

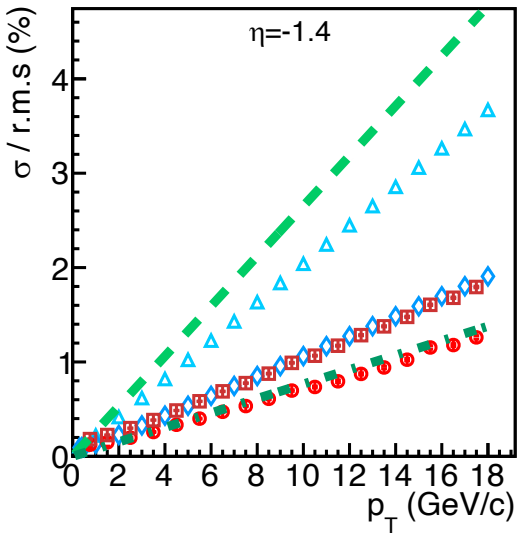
All barrel hits



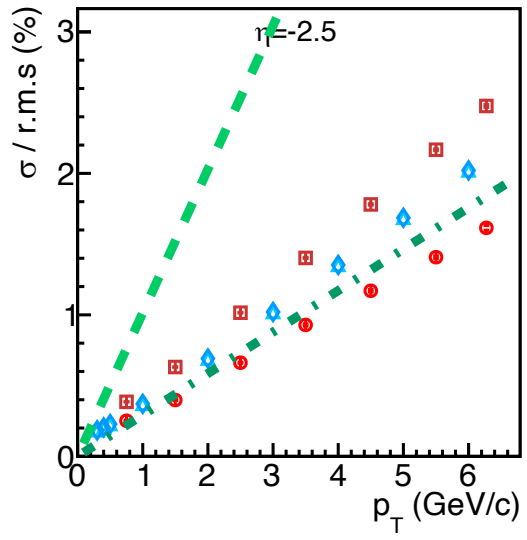

The gap




2 barrel + 3 disk hits




All disk hits



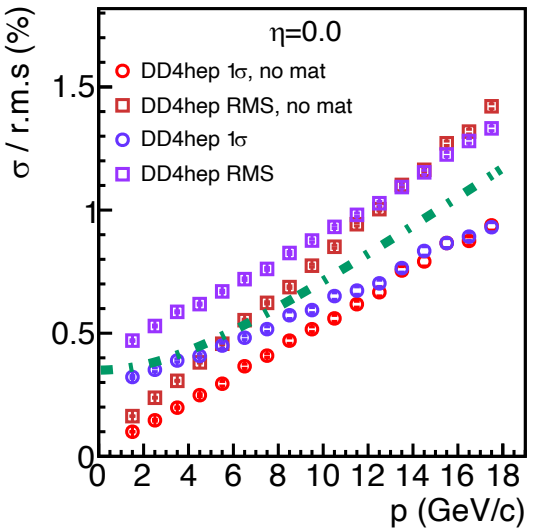

- The analytical calculation suggests that pixel errors are treated differently between barrel and backward trackers in LDT?
- Analytical calculation prefers the Gaussian $\sigma$ resolution from DD4hep at $\eta = -0.9, -1.4, -2.5$

# Put in the Materials

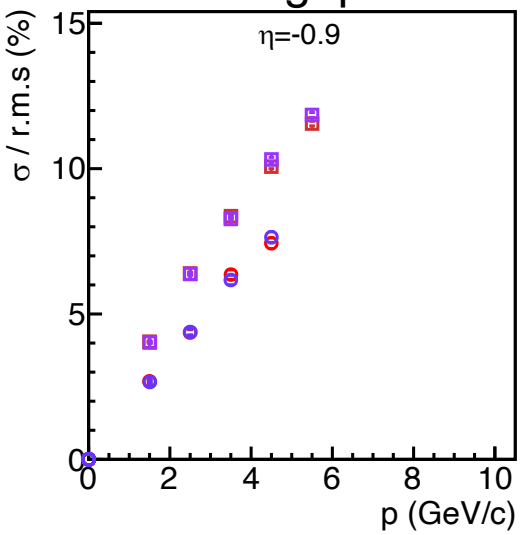
# Momentum Resolutions from DD4hep

- No beam pipe

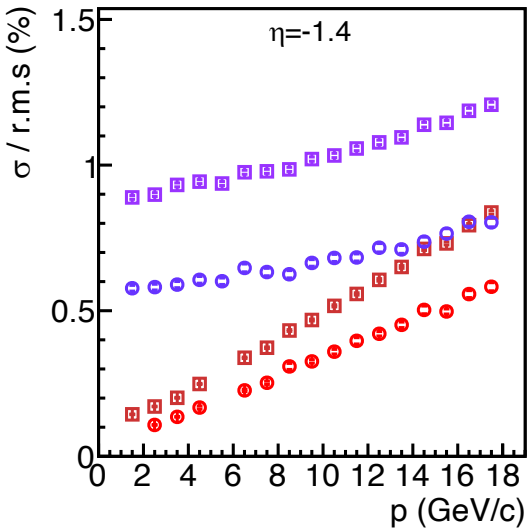
All barrel hits



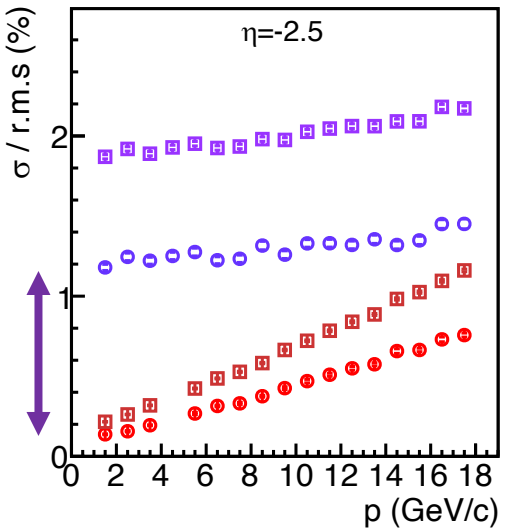

The gap




2 barrel + 3 disk hits




All disk hits

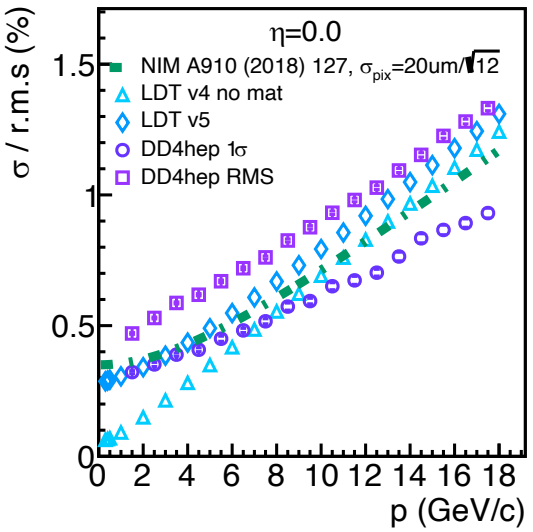



Backward region is more sensitive to material budget at low momentum

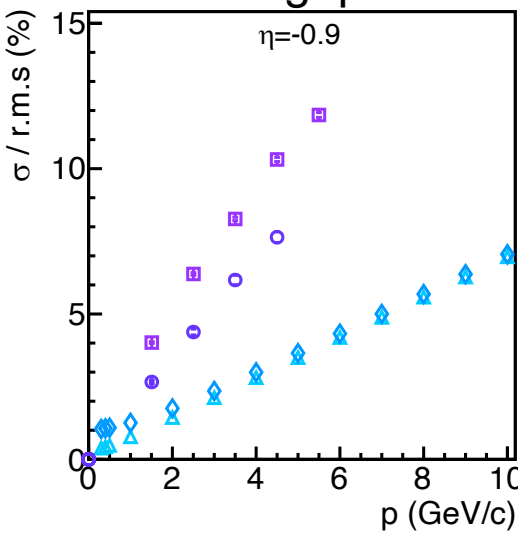
# Momentum Resolutions

- No beam pipe
- V4: $\mathrm{d}r\phi = 20/\sqrt{12}$ um, $dr\phi = 20/\sqrt{12}$ um, $\mathrm{d}u = 20$ um, $\mathrm{d}v = 20$ um, **minimal materials**
- V5: $\mathrm{d}r\phi = 20/\sqrt{12}$ um, $dr\phi = 20/\sqrt{12}$ um, $\mathrm{d}u = 20$ um, $\mathrm{d}v = 20$ um, **proper materials**

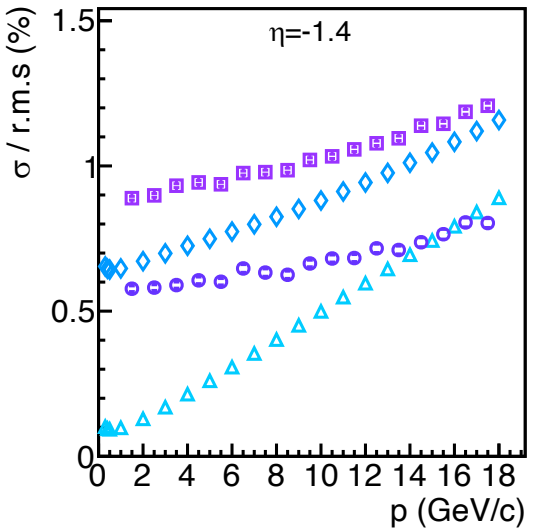
All barrel hits



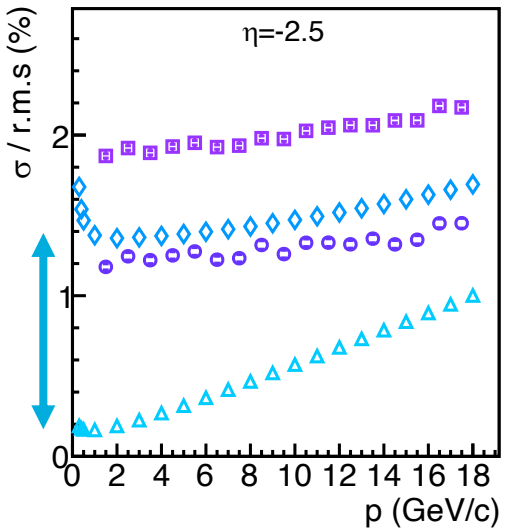

The gap




2 barrel + 3 disk hits



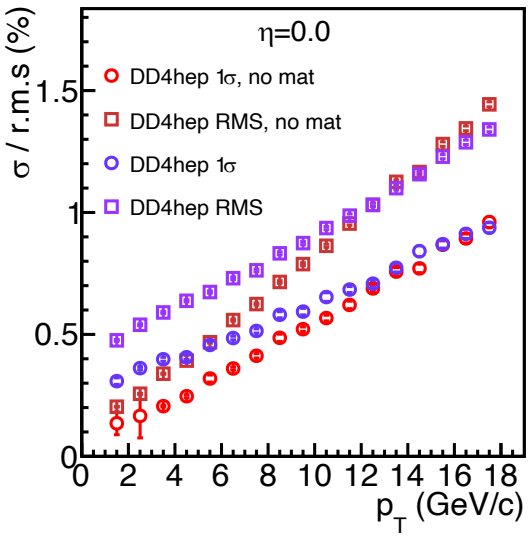

All disk hits



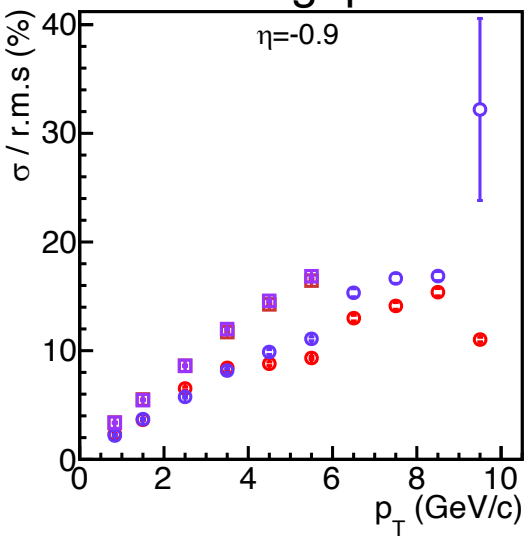
# Transverse Momentum Resolutions from DD4hep

- No beam pipe

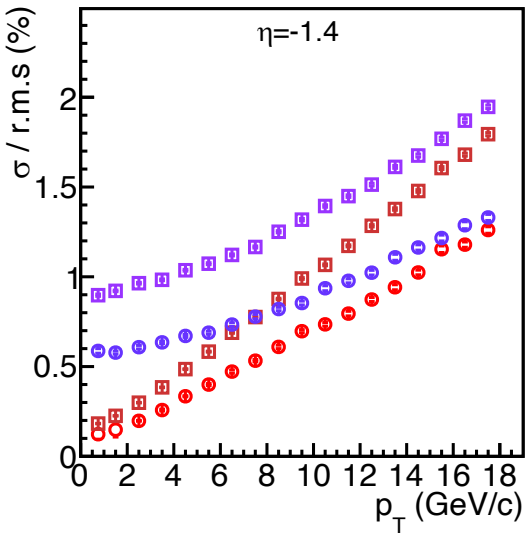
All barrel hits



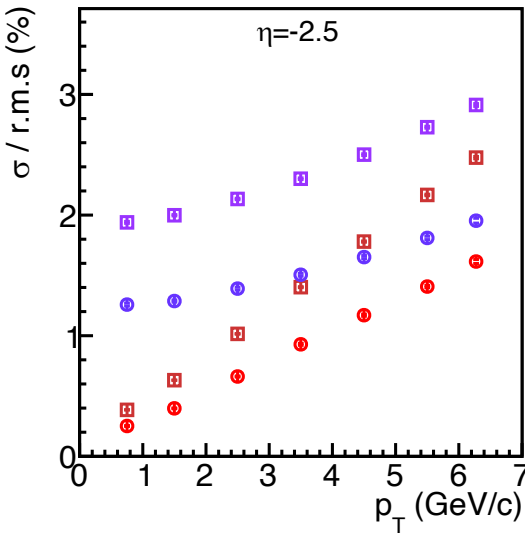

The gap




2 barrel + 3 disk hits



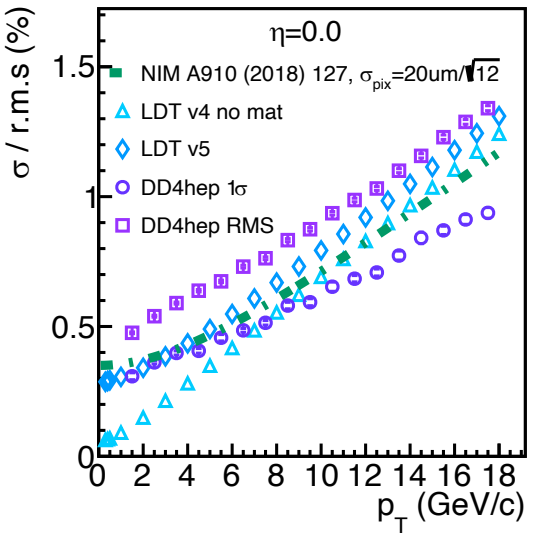

All disk hits



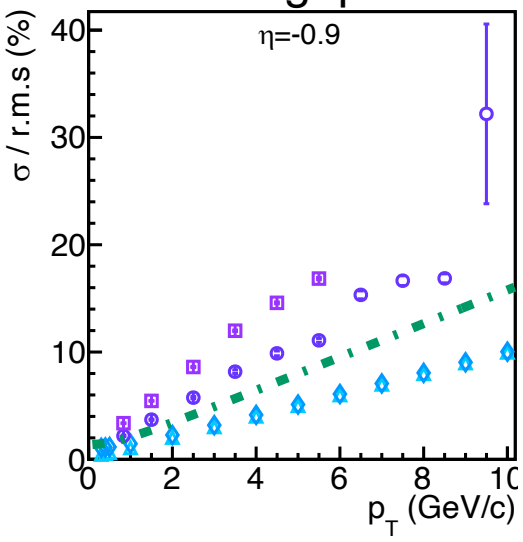
# Transverse Momentum Resolutions

- No beam pipe
- V4: $\mathrm{d}r\phi = 20/\sqrt{12}$ um, $dr\phi = 20/\sqrt{12}$ um, $\mathrm{d}u = 20$ um, $\mathrm{d}v = 20$ um, **minimal materials**
- V5: $\mathrm{d}r\phi = 20/\sqrt{12}$ um, $dr\phi = 20/\sqrt{12}$ um, $\mathrm{d}u = 20$ um, $\mathrm{d}v = 20$ um, **proper materials**

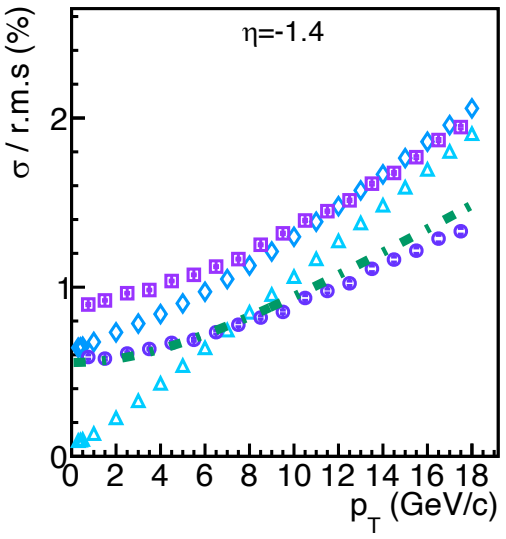
All barrel hits



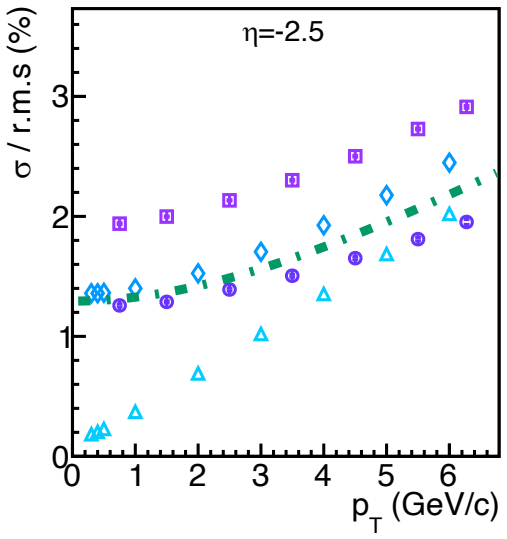

The gap




2 barrel + 3 disk hits




All disk hits

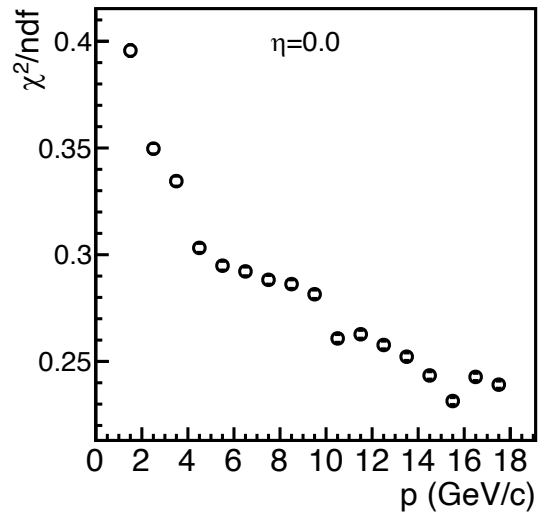



- Analytical calculation prefers the Gaussian $\sigma$ resolution from DD4hep at $\eta = -0.9, -1.4, -2.5$

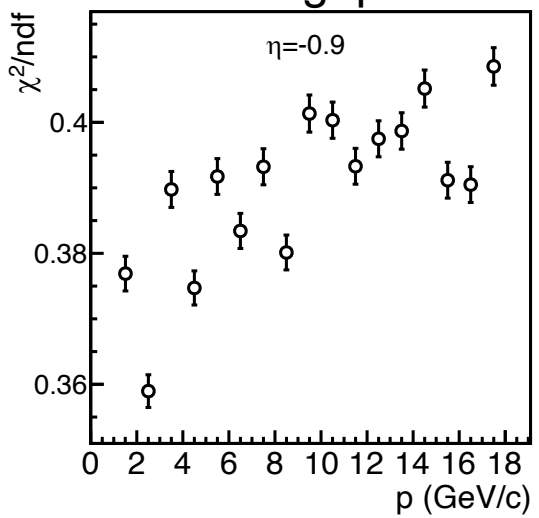
# $\chi^2$/ndf of the Fits from DD4hep

- No beam pipe

All barrel hits

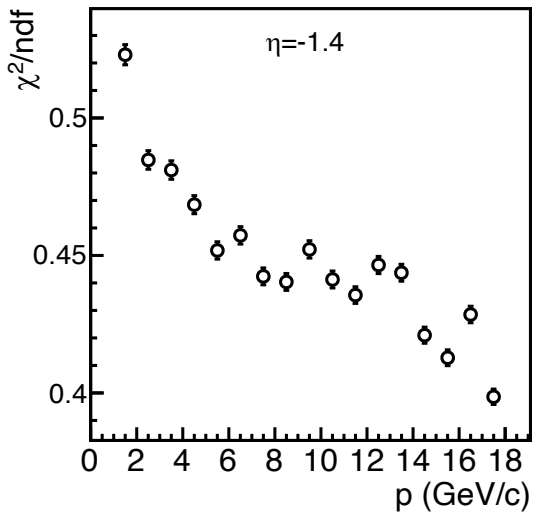



The gap

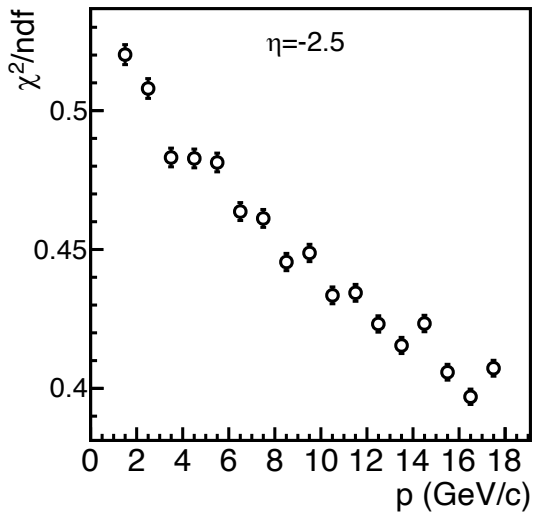



Don't take this bin too seriously. The $\chi^2$/ndf distributions are jumpy in this bin

2 barrel + 3 disk hits




All disk hits



# Moving Forward

1. Settle on the pixel resolutions/size in LDT, and then move forward to TPC implementation
   - Barrel: $\mathrm{d}r\phi = 20/\sqrt{12}$ um, $\mathrm{d}z = 20/\sqrt{12}$ um
   - Backward: $\mathrm{d}u = 20$ um, $\mathrm{d}v = 20$ um

   *cannot implement TPC in the endcap in LDT*
2. Implementation of gas detector in DD4hep? Modify the MPGD?
3. Use sPHENIX/STAR TPC as baseline
4. PHENIX Drift chamber in Fun4all
5. Ask IDEA about their drift chamber simulation in DD4hep?