Short-range correlations in small systems

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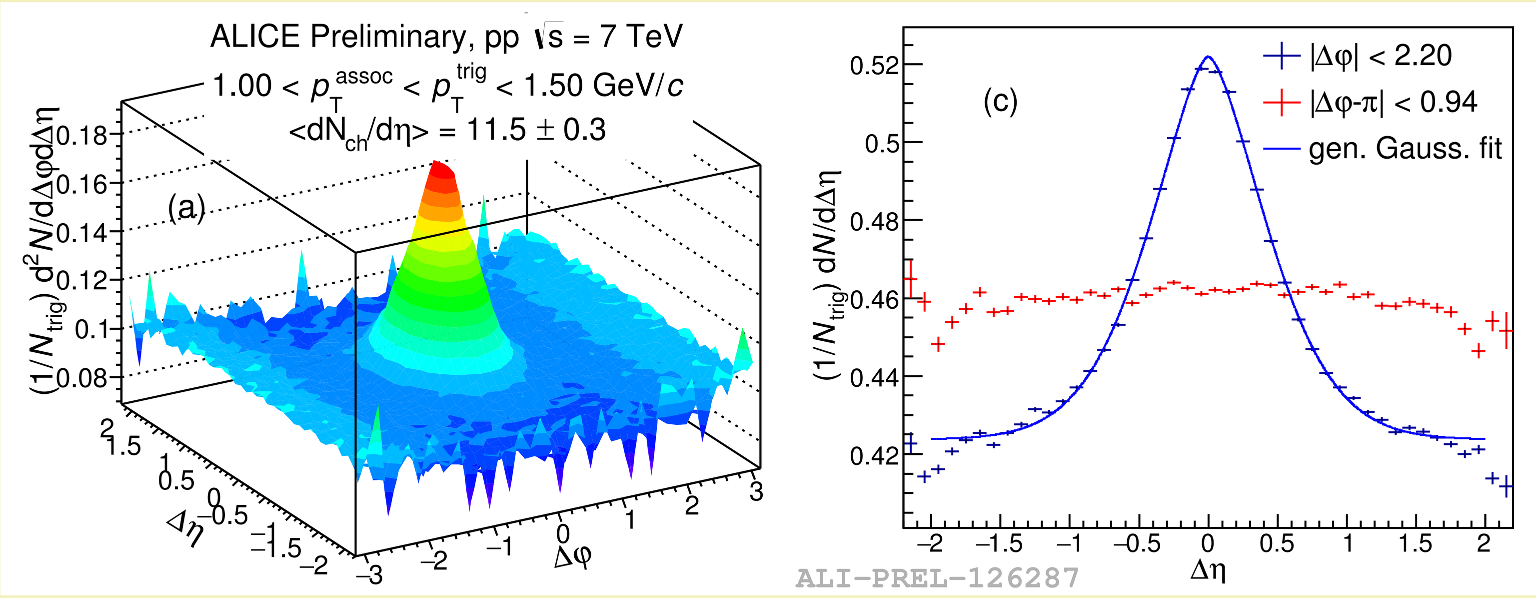
Long range correlations have been studied extensively in small systems, and show indications of collectivity.

Why study short-range correlations?

- ✧ Information about particle production mechanisms, including (mini-)jet fragmentation
- ✧ Important quantitative input to techniques of analyzing long-range correlations

Two-particle correlations



- ✧ construct correlation function between "trigger" and "associated" particles in relative azimuthal angle Δφ and relative pseudorapidity Δη $$C(\Delta\varphi,\Delta\eta) = \frac{1}{N_{\rm trig}}\frac{{\rm d}^2 N}{{\rm d}\Delta\varphi {\rm d}\Delta\eta}$$
- ✧ project on to Δη, fit peak with generalized Gaussian function to obtain per-trigger yield and peak width

How can we remove short-range correlations?

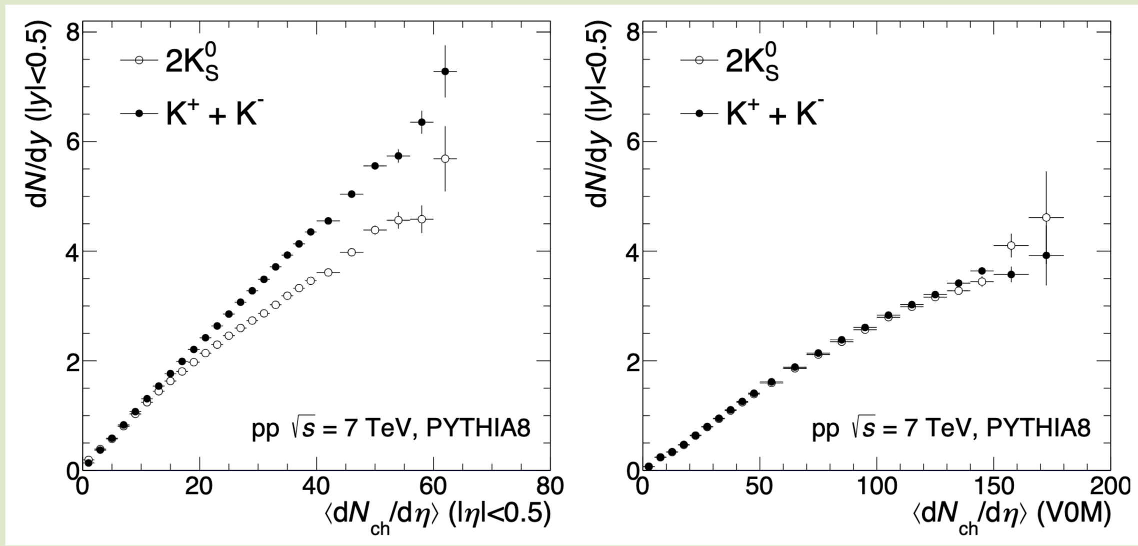
- ✧ look at correlations between pairs of particles that are separated in pseudorapidity (large Δη)
  → need to quantitatively define "long-range"
- ✧ subtract correlations in low-multiplicity events from high-multiplicity events, template fitting
  → assumes that short-range correlations are independent of multiplicity
- ✧ multi-particle correlations
  → depends on relative multiplicities of collective and non-collective components

Experimental aside: Multiplicity selection

Typically, determine high- and low-multiplicity events from the number of particles detected, or energy deposited, in a detector in a certain region of phase space.

→ can lead to biases, "you get what you ask for"

Example:



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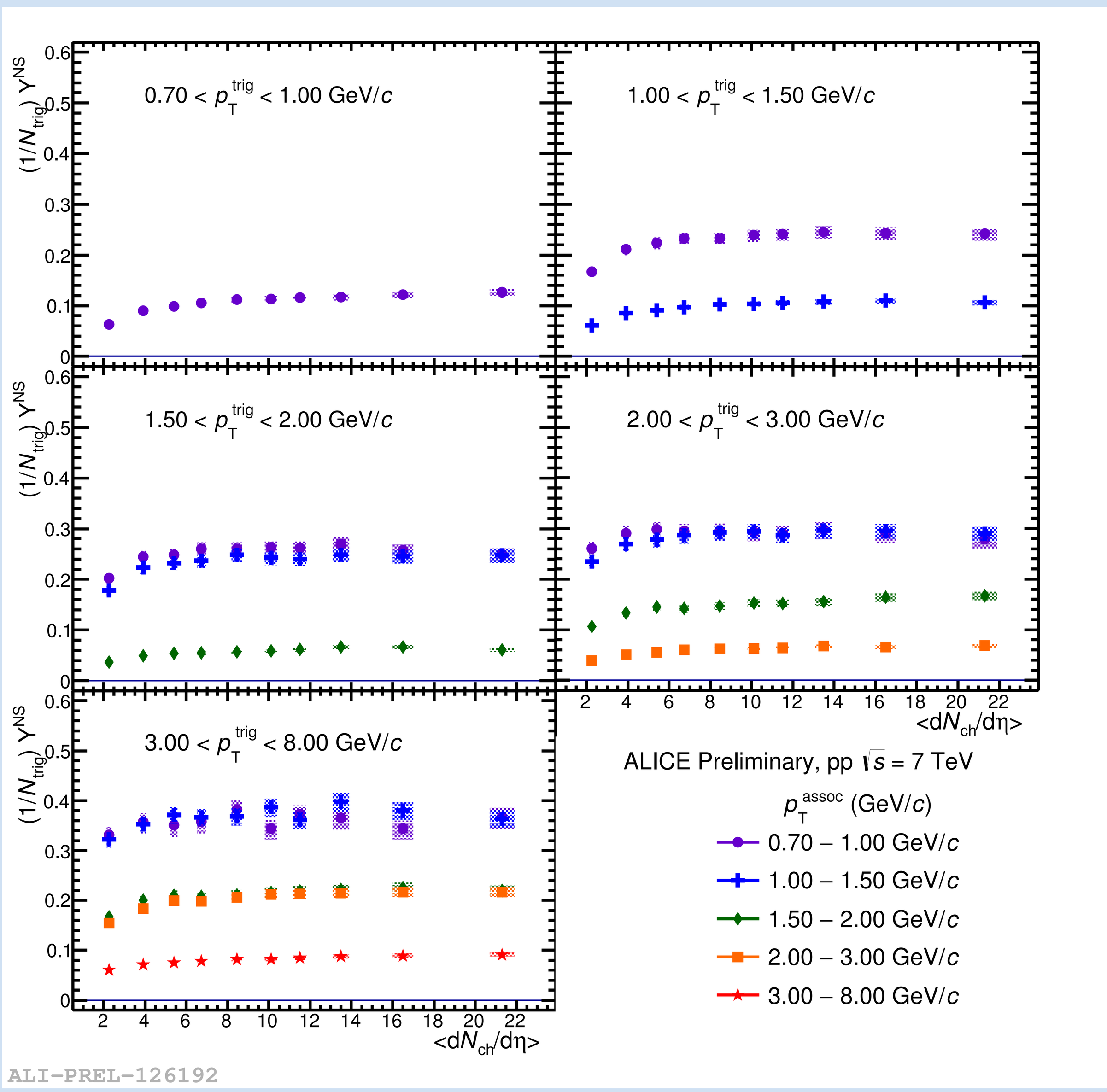
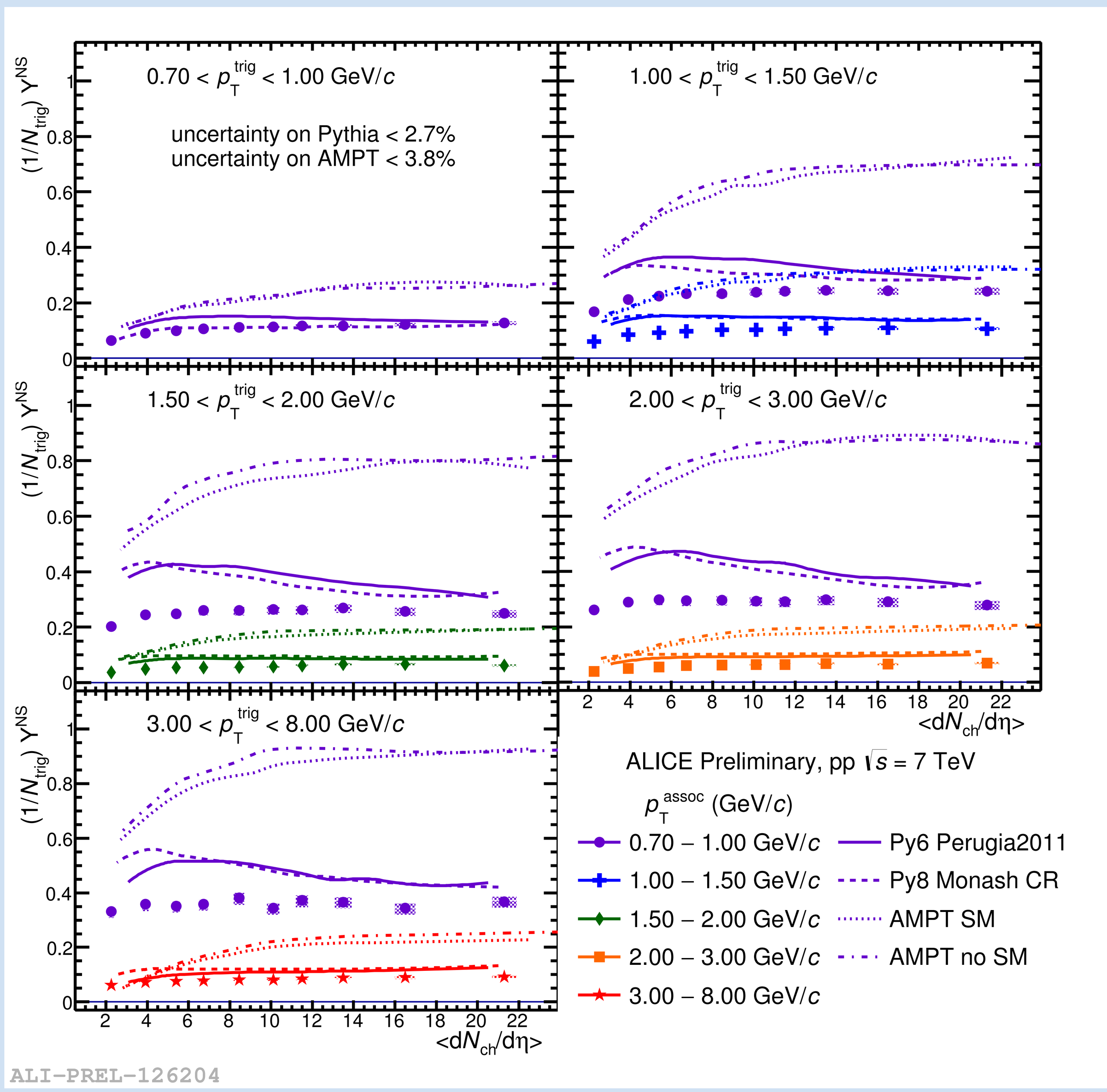
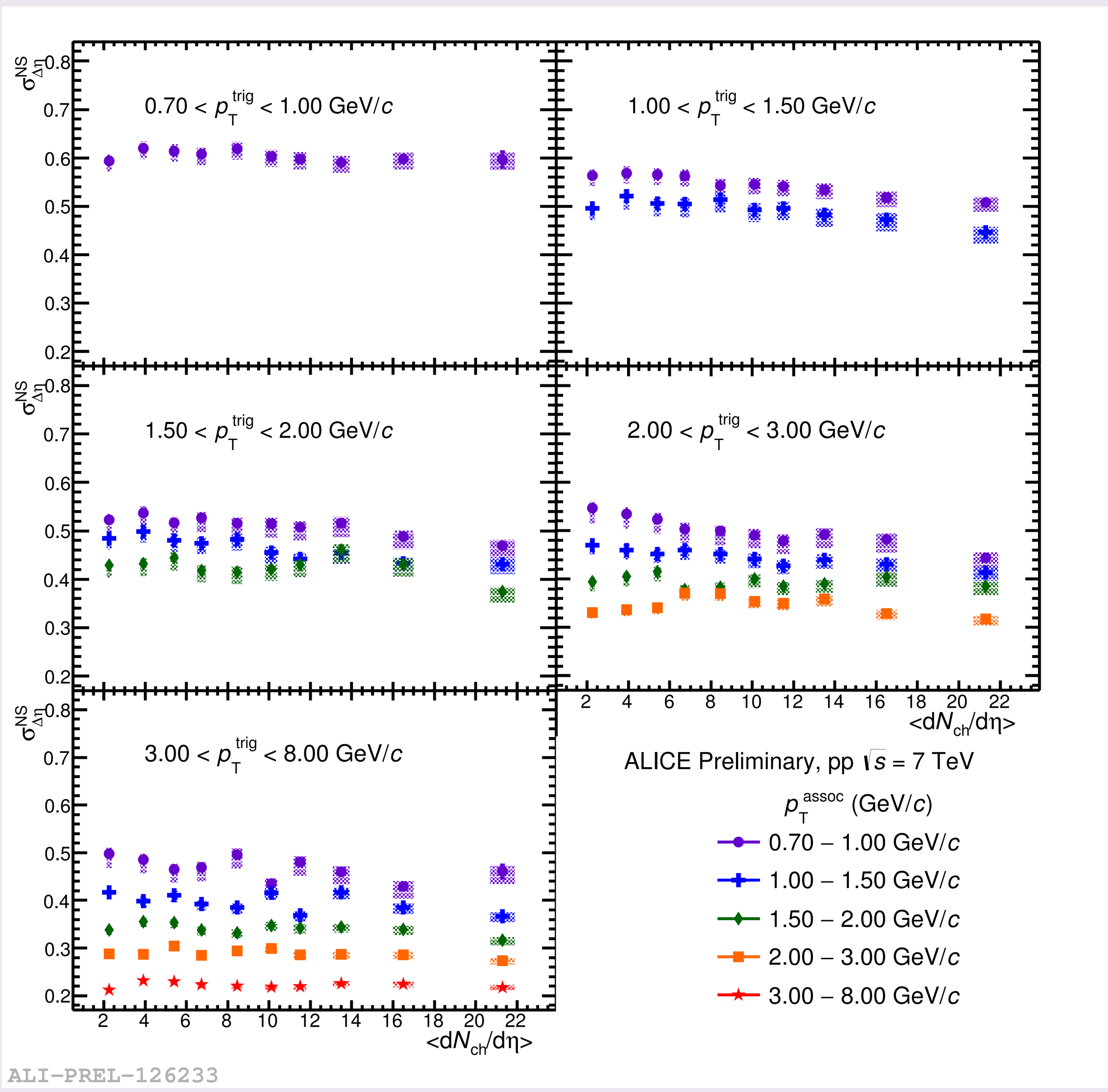
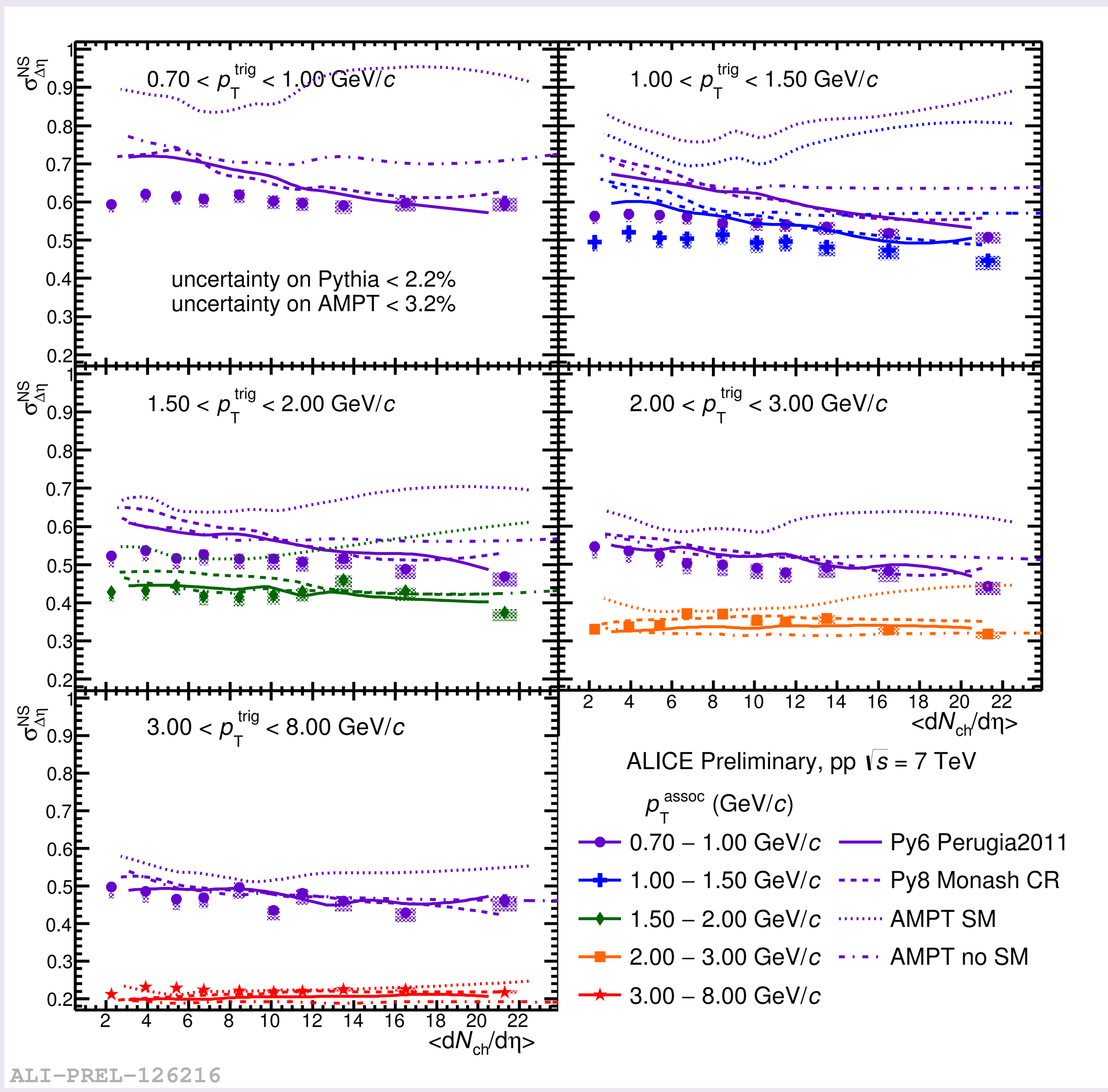




Nearside peak per-trigger associated yields

- ✧ yields depend on multiplicity for $\langle dN_{ch}/d\eta\rangle < 5$
  → simple high-low subtraction will leave residual peak yield
- ✧ MC largely overpredicts yields for $p_T < 1$ GeV/c
- ✧ PYTHIA gives decent description at higher p_T, AMPT does not





Nearside peak Δη widths

- ✧ widths also depend slightly on multiplicity
  → template fits will be imperfect
- ✧ widths decrease with increasing p_T
- ✧ for $p_T > 1$ GeV/c, widths are consistently < 0.55
  → 95% of the peak yield is within $|\Delta\eta| < 1.1$
- ✧ sets the scale for studying long-range correlations