

Long-range Near-side Ridge Signal in High Multiplicity e^+e^- Collisions with Archived ALEPH Data at 91-209 GeV



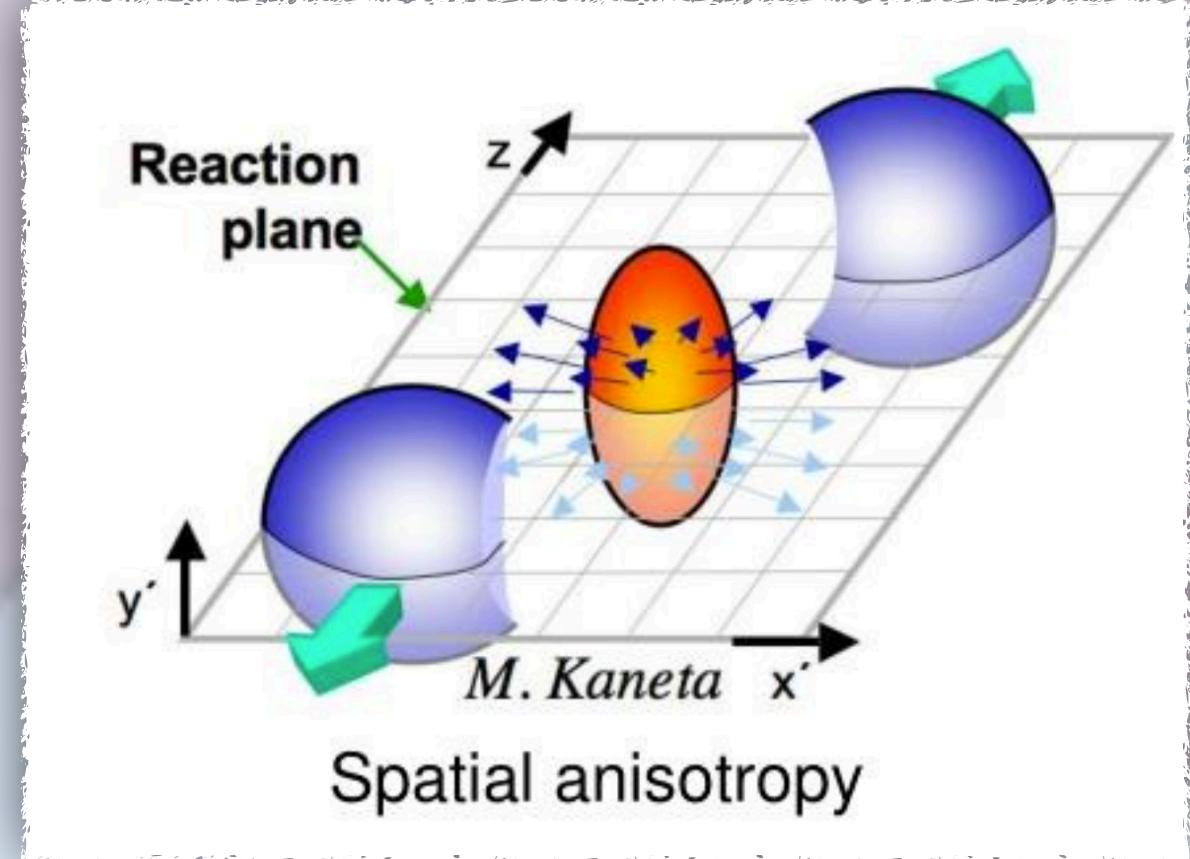
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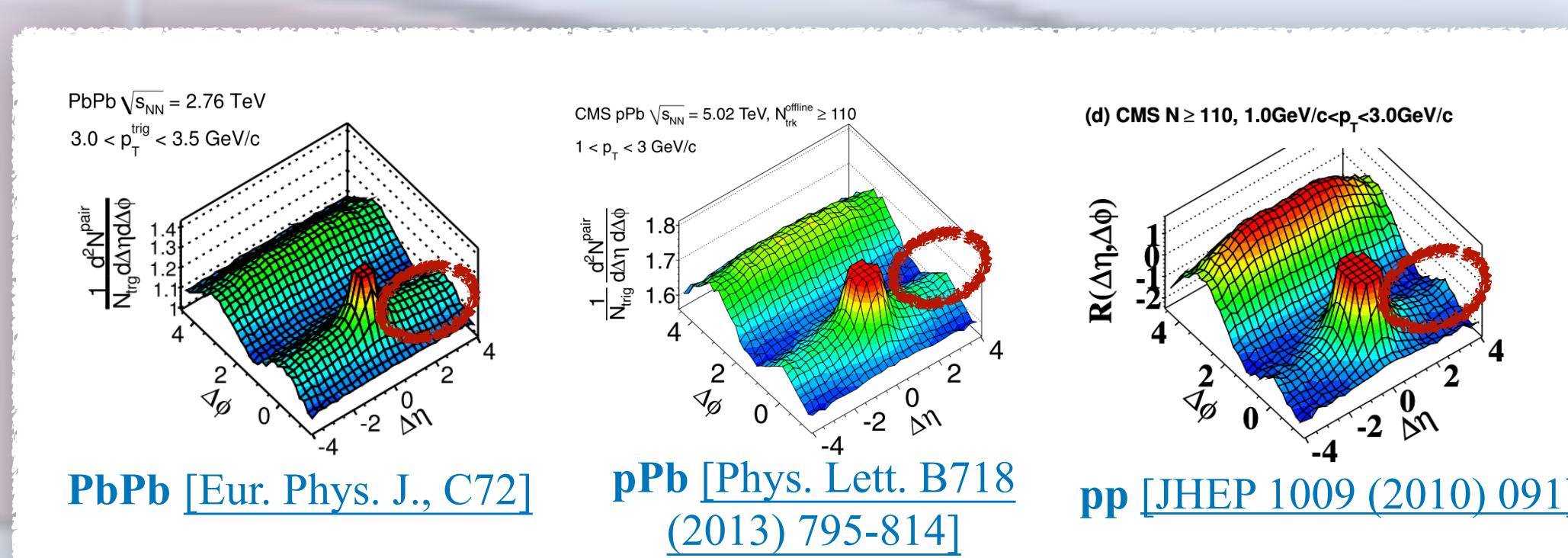
Introduction

- Soft probes of Quark-Gluon Plasma (QGP) created in Heavy-Ion collisions
- Azimuthal anisotropy** from:
Initial density fluctuation
+
Hydrodynamical expansion of perfect-fluid-like QGP



Two-particle correlation (2PC)

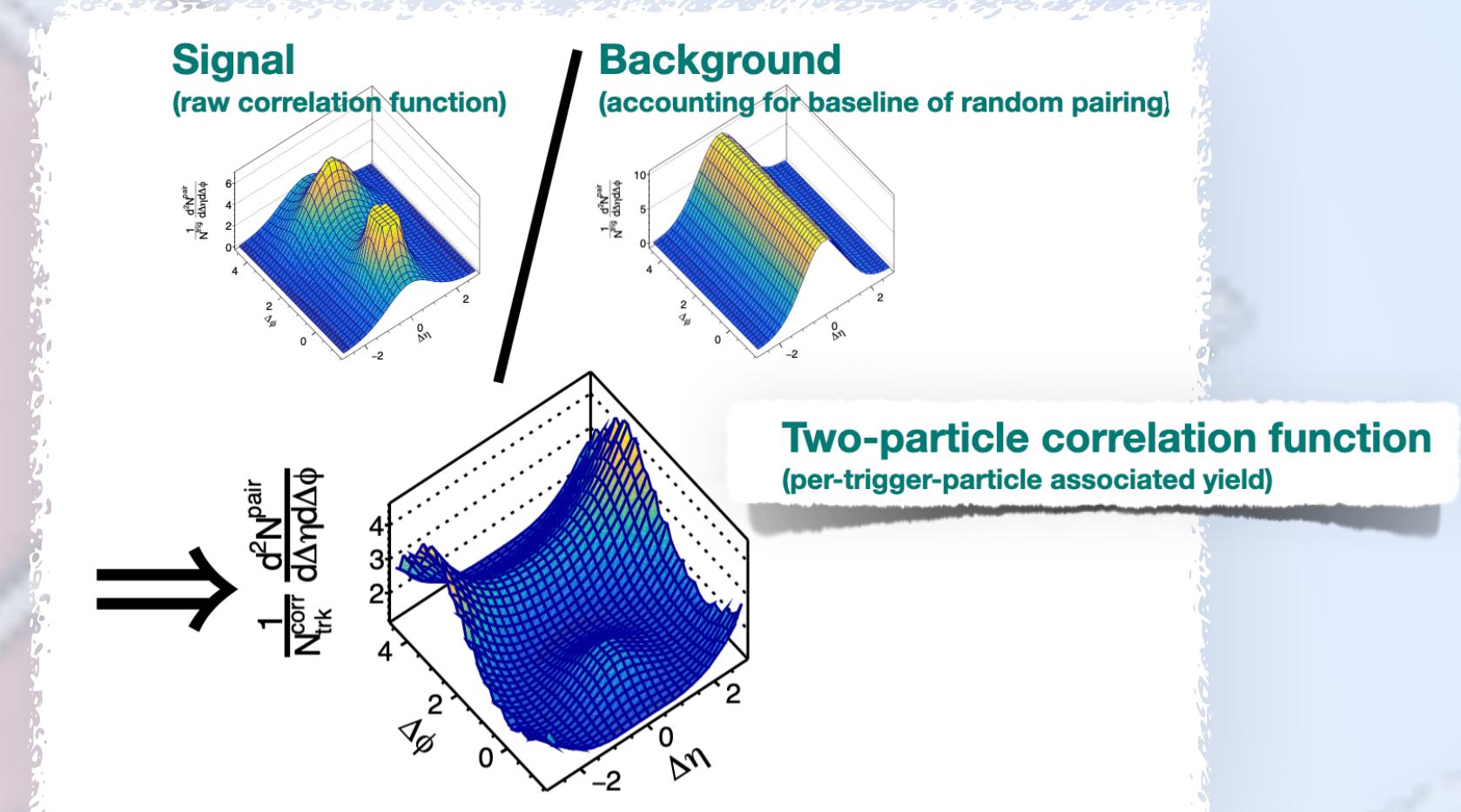
- Ridge-like signals** (azimuthal anisotropy) observed in not only AA, but also pA & pp!



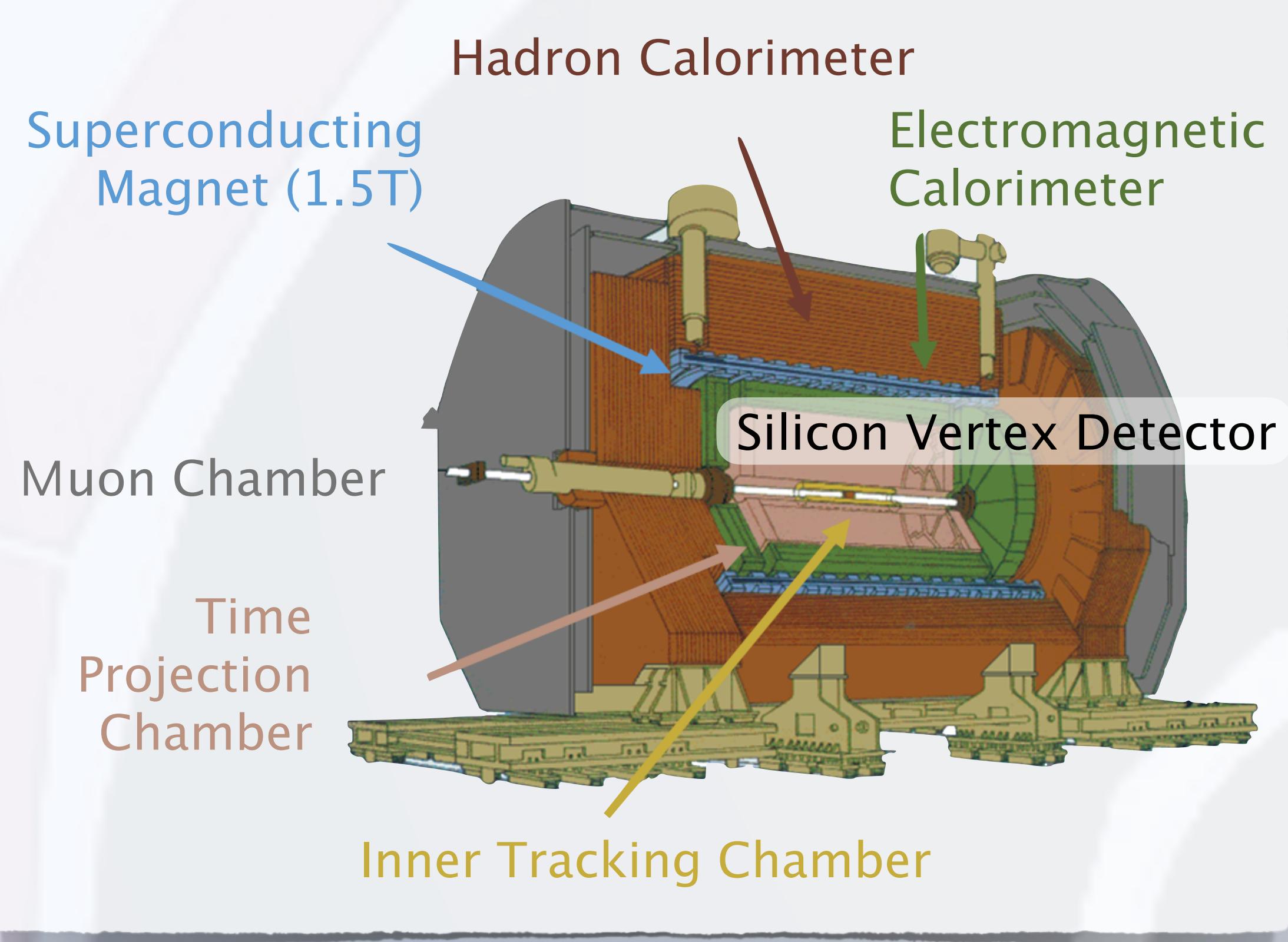
Methodology

- Correlations in terms of track pairs' pseudorapidity and azimuthal angle differences
To compare with pp, pA and AA, using the thrust axis as the reference axis
- Random combination effects are factored out

$$\frac{1}{N_{\text{trk}}^{\text{corr}}} \frac{d^2 N_{\text{pair}}}{d\Delta\eta d\Delta\phi} = B(0,0) \times \frac{S(\Delta\eta, \Delta\phi)}{B(\Delta\eta, \Delta\phi)}$$

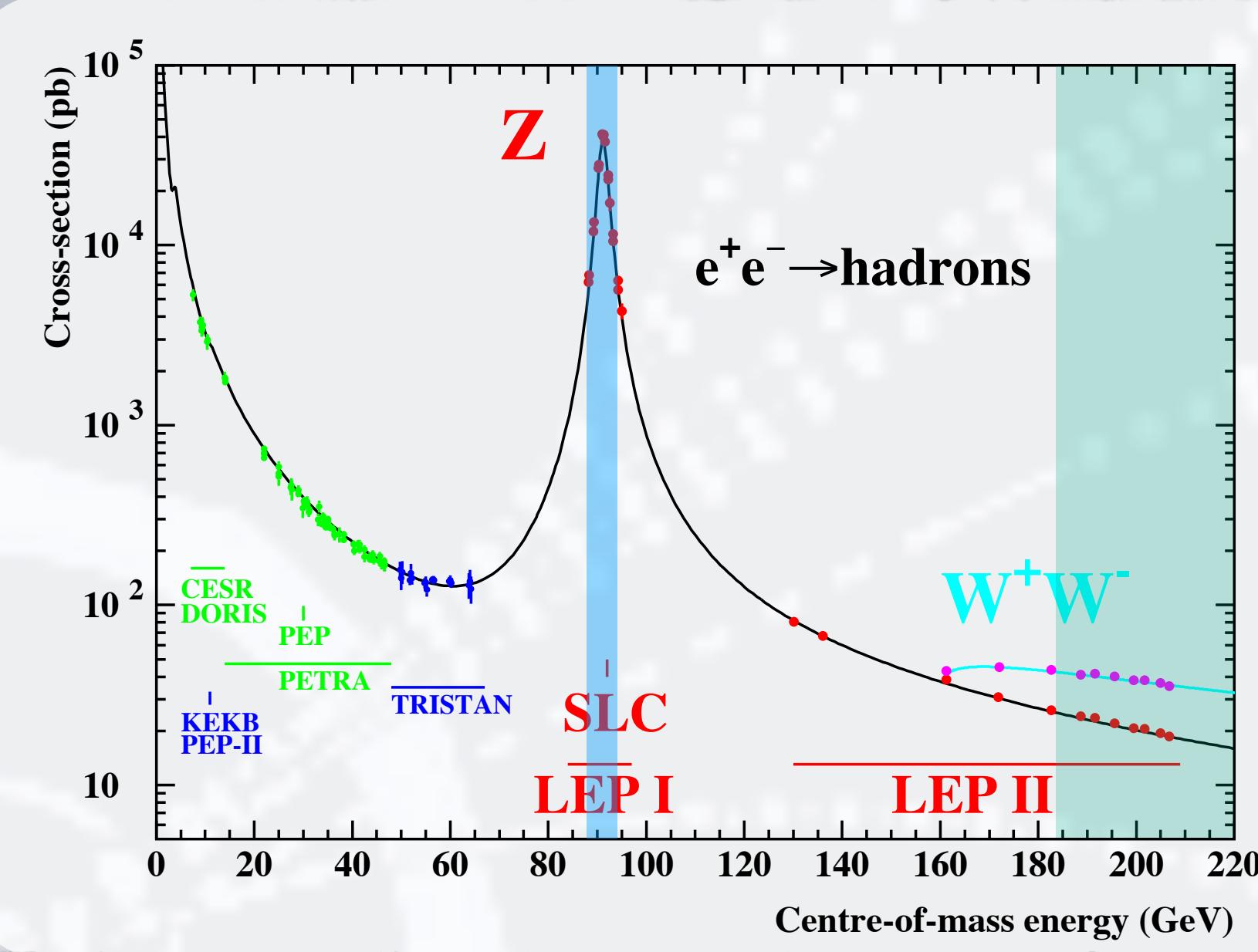


ALEPH Detector



e^+e^- collisions

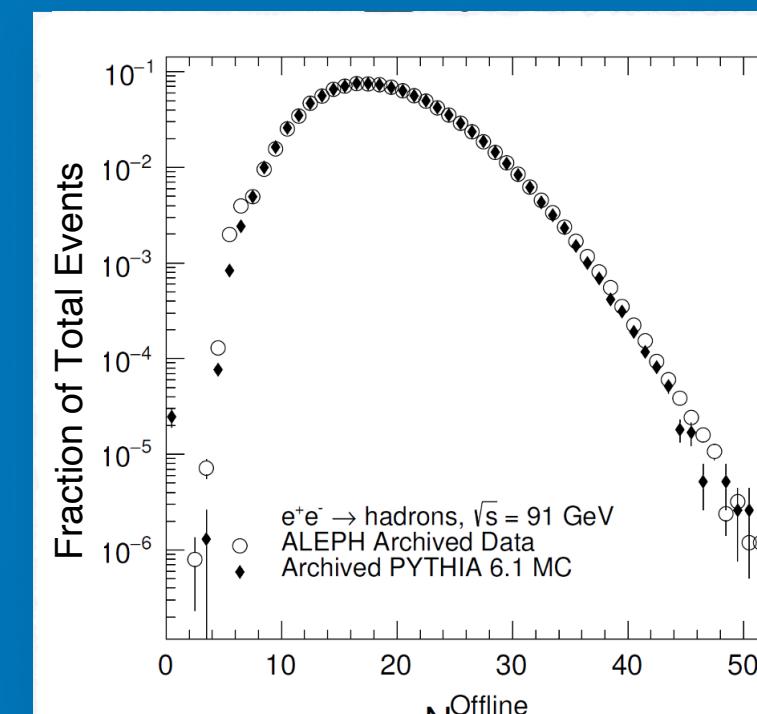
- Re-analyze ALEPH archived data using MIT Open Data format
- ALEPH archived Pythia6 MC: for corrections and the comparison baseline



Datasets

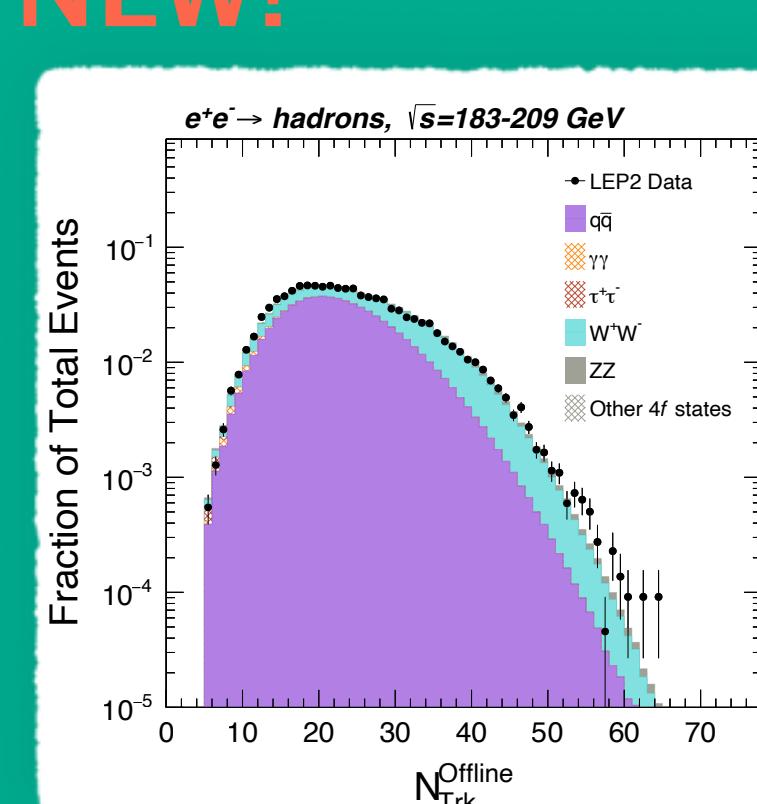
LEP-I Z-resonance dataset

- $\sqrt{s} = 91.2$ GeV
- Dominant by $e^+e^- \rightarrow \gamma^*/Z \rightarrow f\bar{f}$
- Suppressed bkg. at Z-pole



LEP-II high-energy dataset NEW!

- $\sqrt{s} = 183-209$ GeV
- Different physics processes above W^+W^- threshold (160 GeV)
- Higher multiplicity reach!



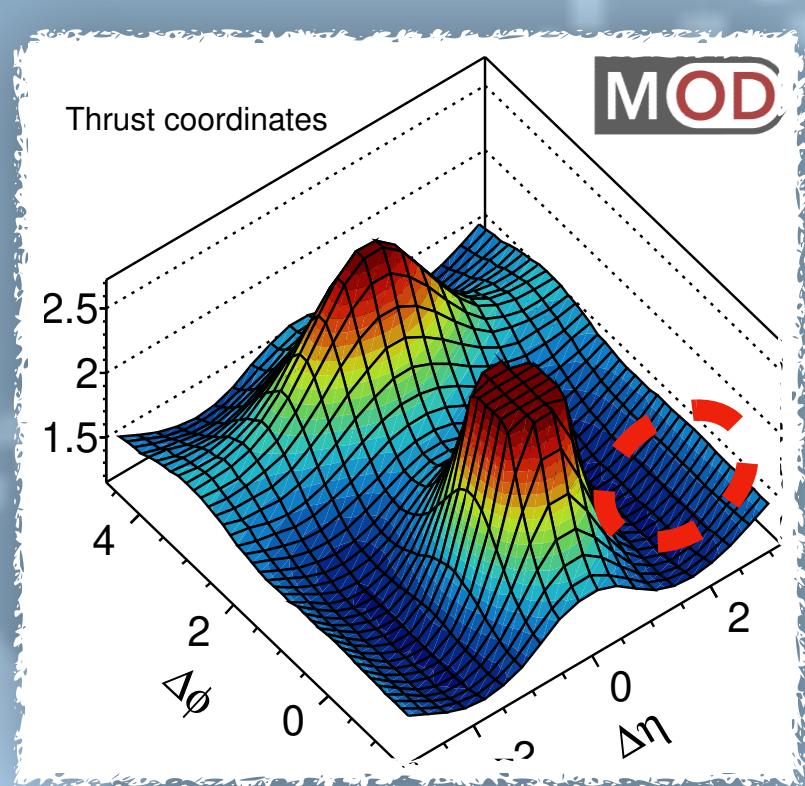
* There are also Z-resonance events in LEP2 sample

LEP-I ($\sqrt{s} = 91.2$ GeV)

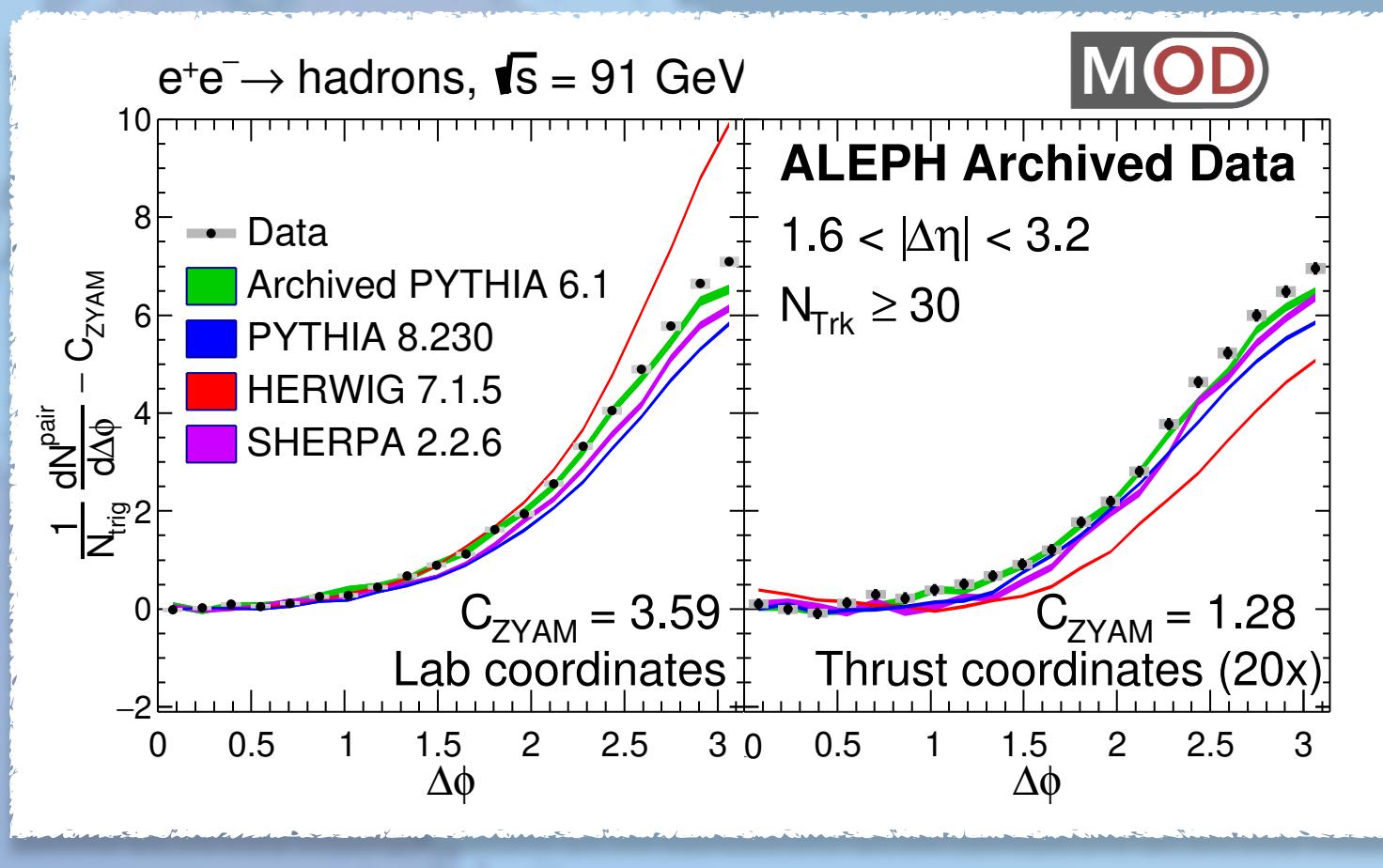
LEP-II ($\sqrt{s} = 183-209$ GeV)

Ridge yields comparison

- First 2PC analysis with e^+e^- collision data
- No hint of azimuthal anisotropic correlations

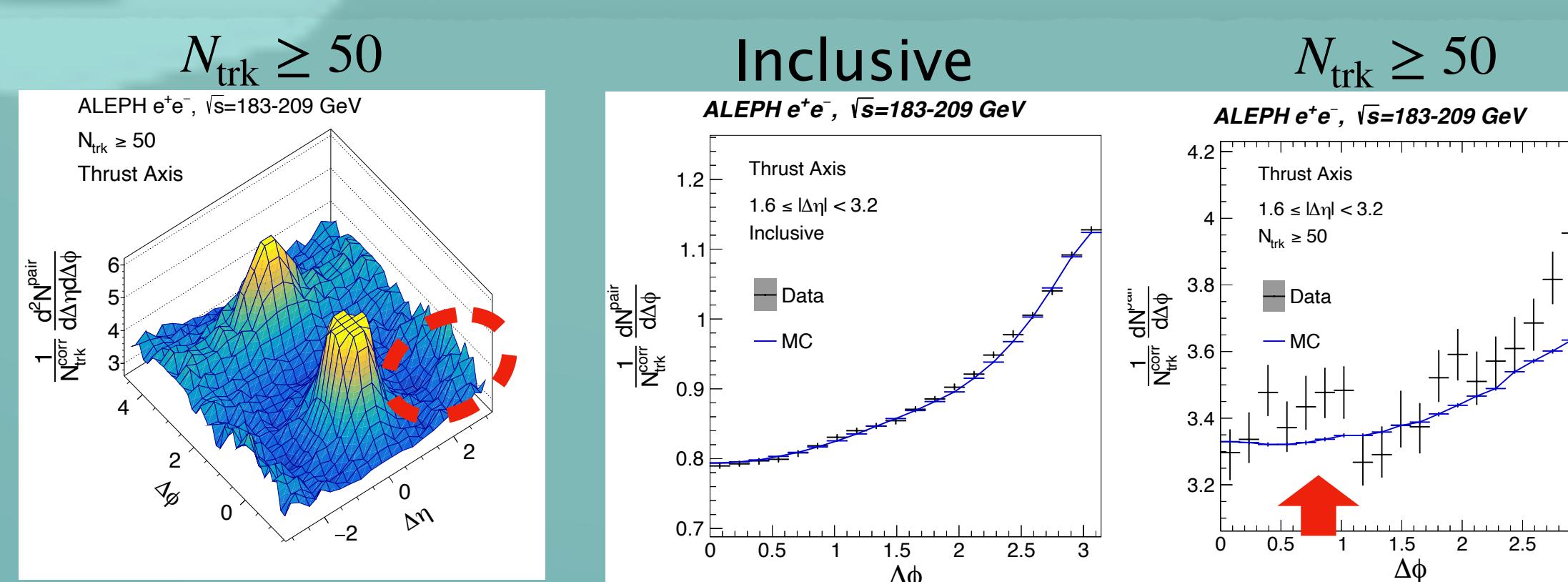


- Agreements between data & Pythia6 MC

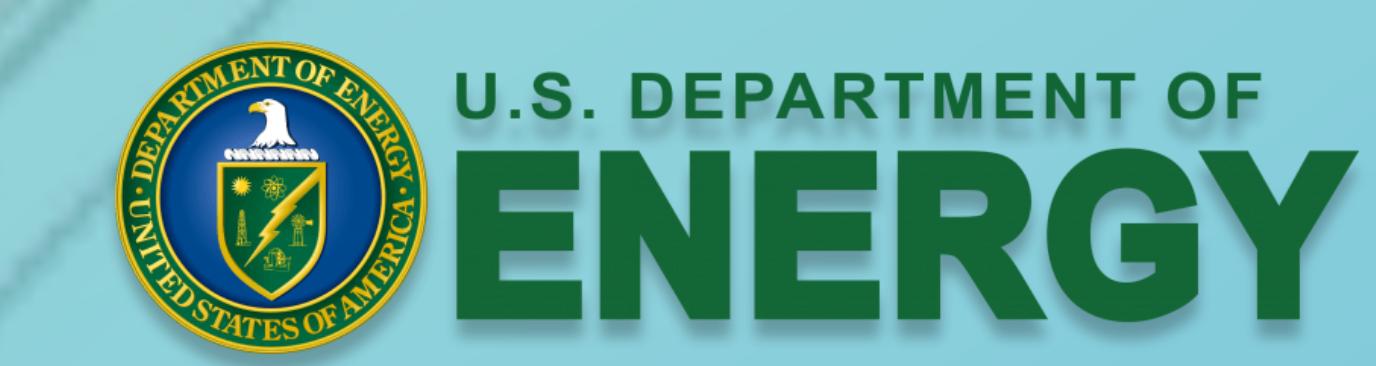
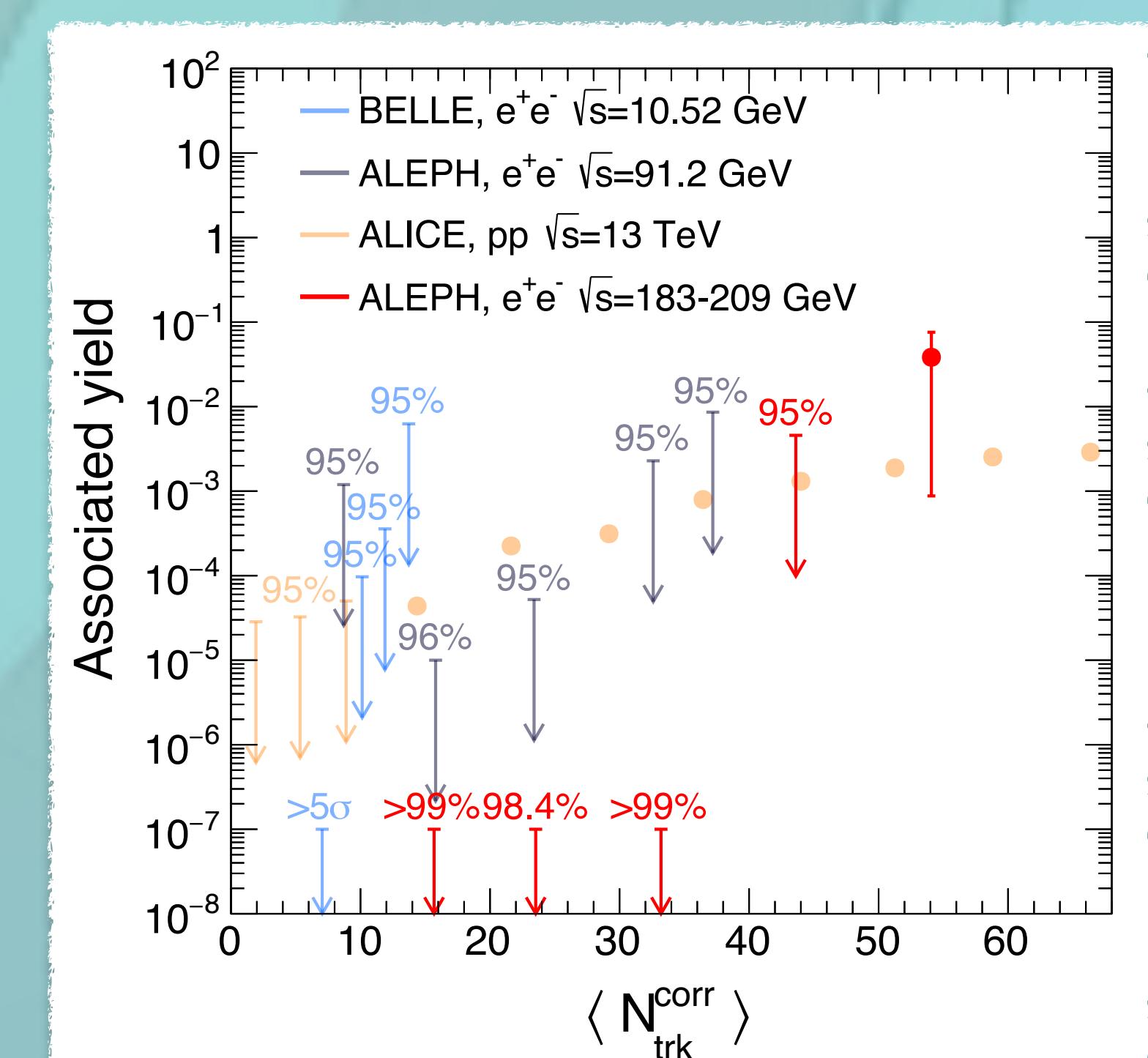
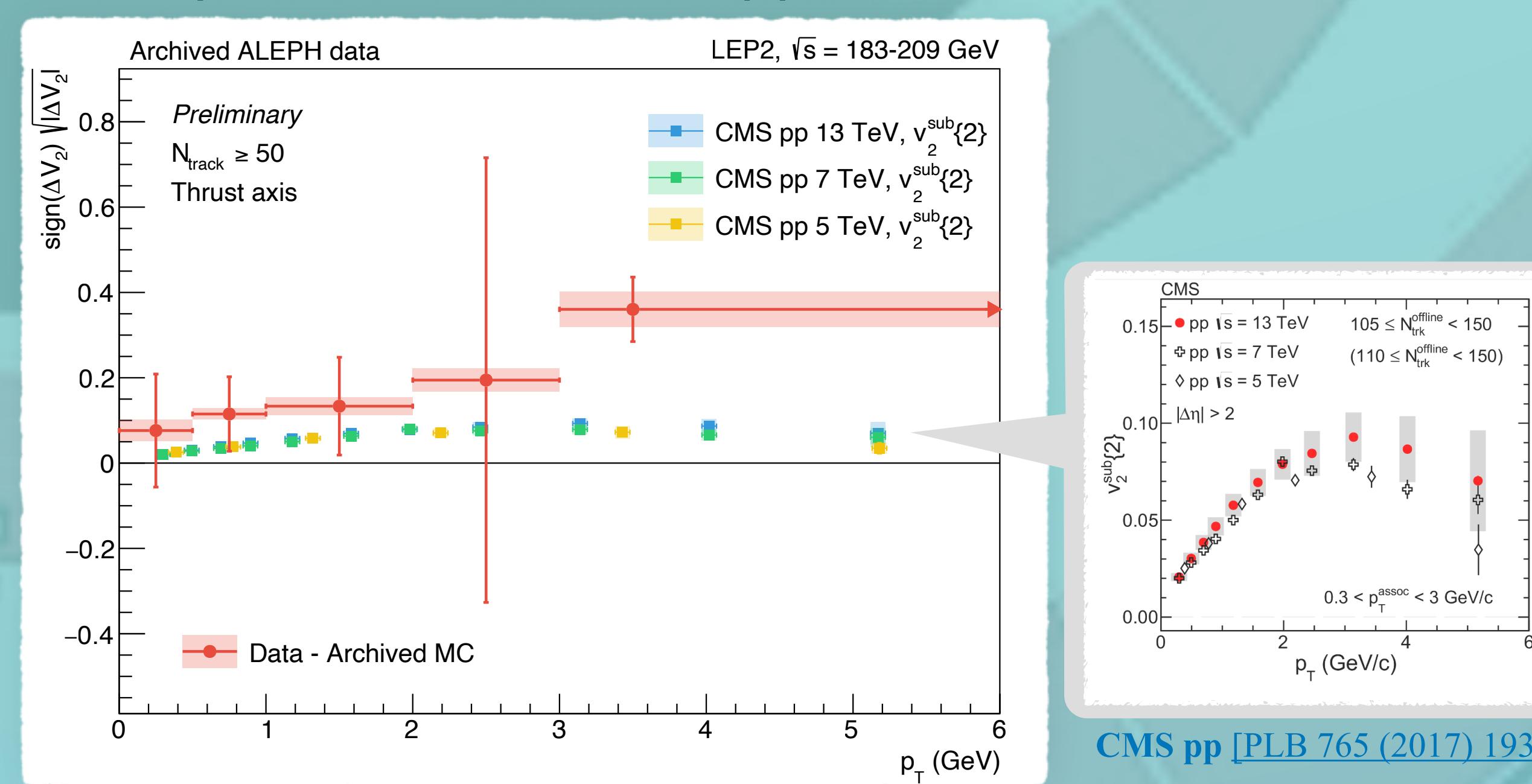


LEP1 e^+e^- 2PC
[Phys. Rev. Lett. 123, 212002 (2019)]

- Exciting long-range near-side enhancement appears only in data but not in MC!



- Excess of flow coefficient $\text{sign}(\Delta V_2)\sqrt{\Delta V_2}$, where $\Delta V_2 = V_{2,\text{data}} - V_{2,\text{MC}}$, demonstrates a correspondence with LHC pp data!



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