Study of jet-hadron and hadron-hadron correlations in ALICE

Jiri Kral
University of Jyväskylä

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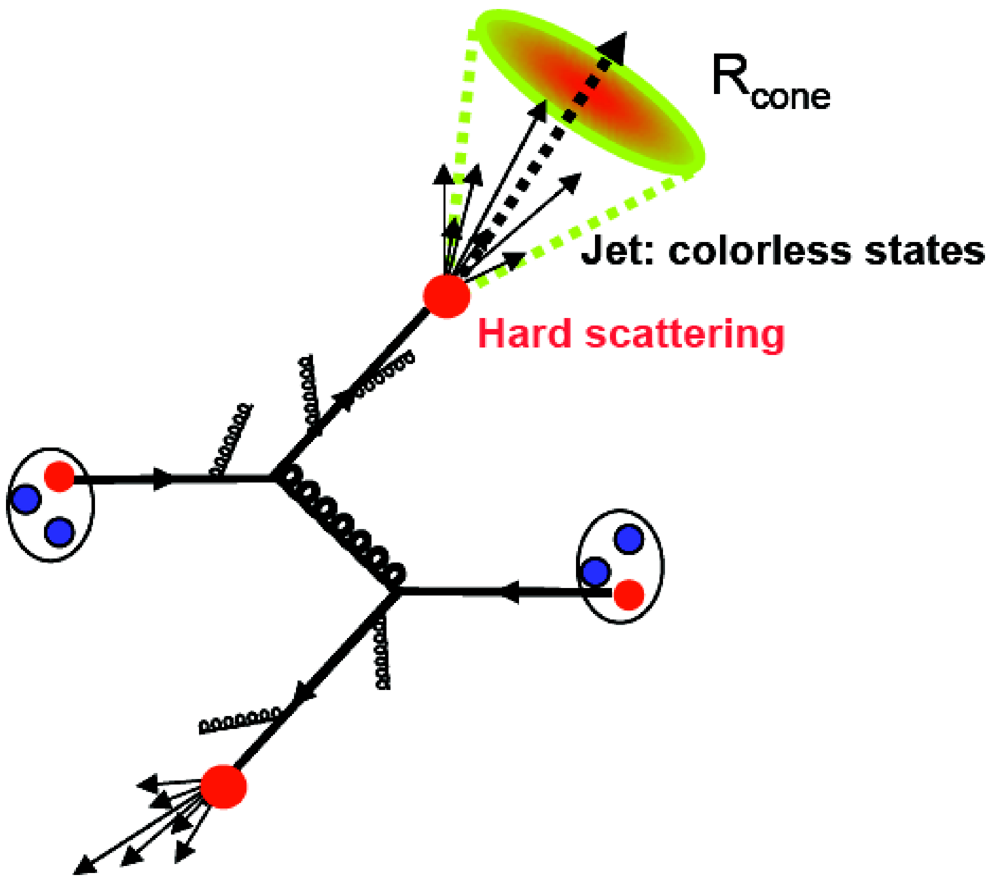
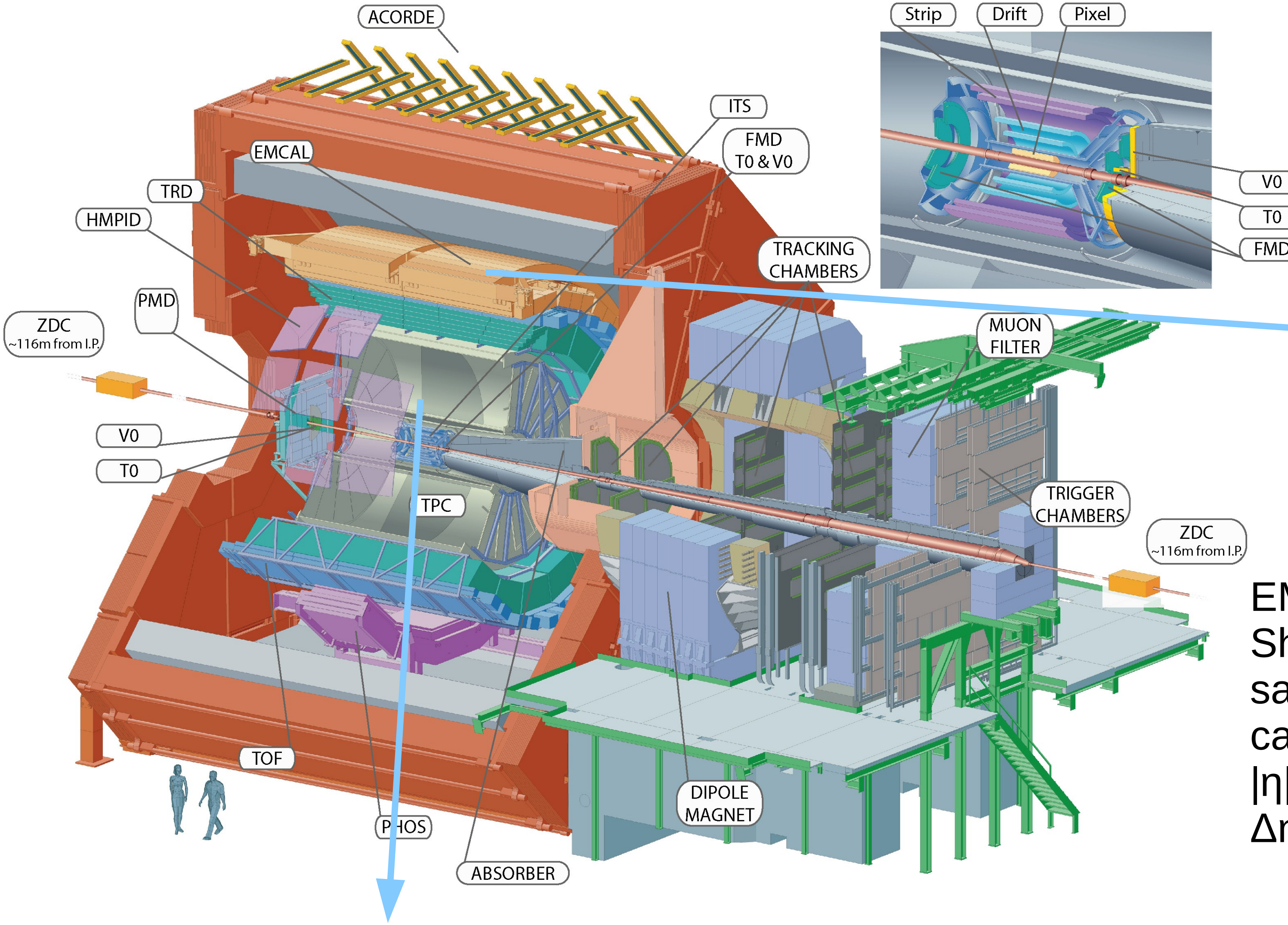
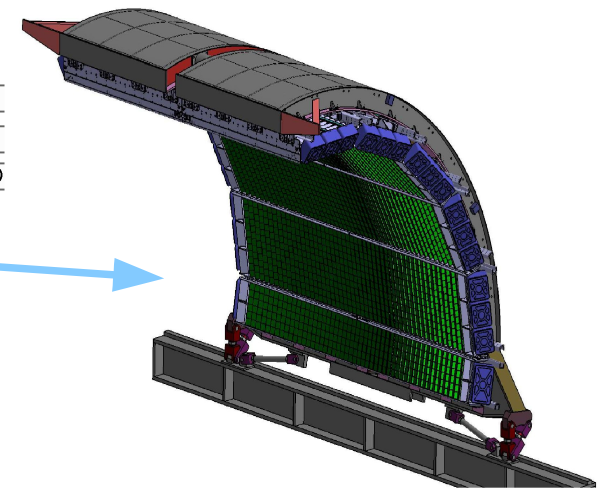
Jets

- Jets originate from the hard scattered of partons
- Fragment and hadronize into a spray of particles
- The spray (initial parton) is partially recovered using clustering algorithms
  - Resulting jets depend on cuts
- Tests of PDFs, fragmentation and pQCD hard scattering



The ALICE detector





EMCal:
Shaslik Pb/organic scintillator sampling electromagnetic calorimeter
$|\eta| < 0.7$; $1.4 < \Phi < \pi$
$\Delta\eta \sim \Delta\Phi \sim 0.014$

TPC + ITS (silicon) tracking
$|\eta| < 0.9$; $0 < \Phi < 2\pi$

Charged constituents (tracks) → JET ← Neutral constituents (clusters, *optional*)

Fragmentation scheme

μ_F

Showering

$Q^2 >> \lambda_{QCD}$

$z << 1$

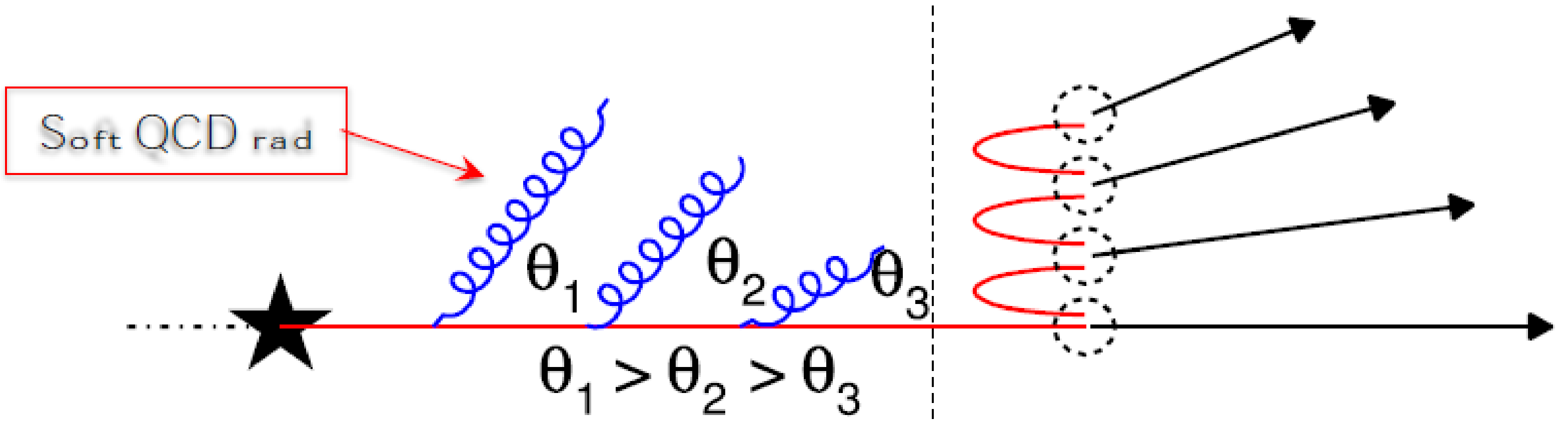
Angular Ordering

Hadronization

$Q^2 \approx \lambda_{QCD}$

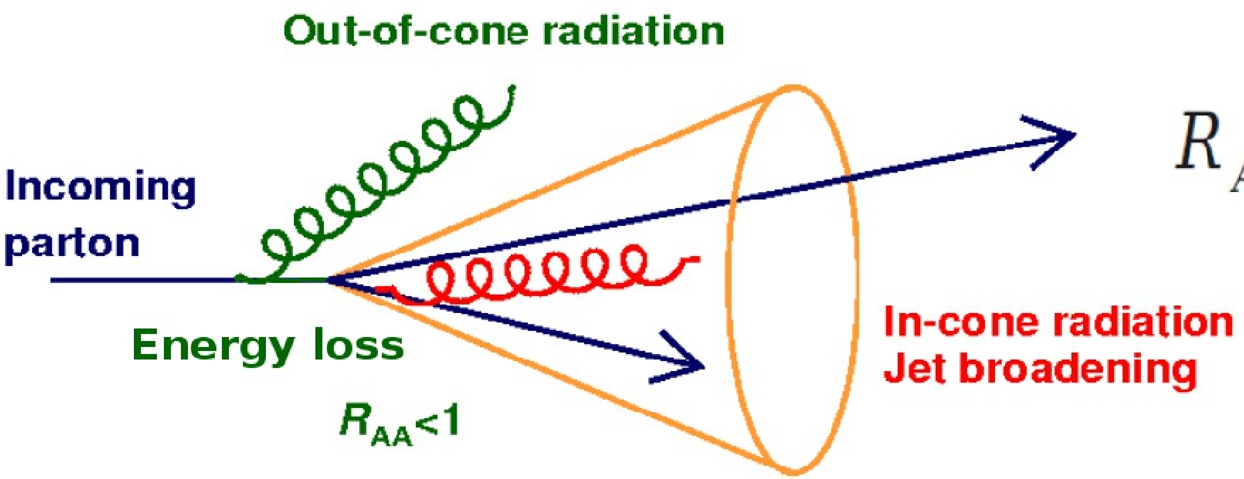
$z >> 0$

Lund String frag.



Jets in medium

- Jets are important probes to a medium that the parton passes through
  - Strong interaction in between the parton and the medium
  - Energy loss due to induced gluon radiation
- pPb collisions allow to probe the cold nuclear medium
- Challenging task to subtract the large soft background



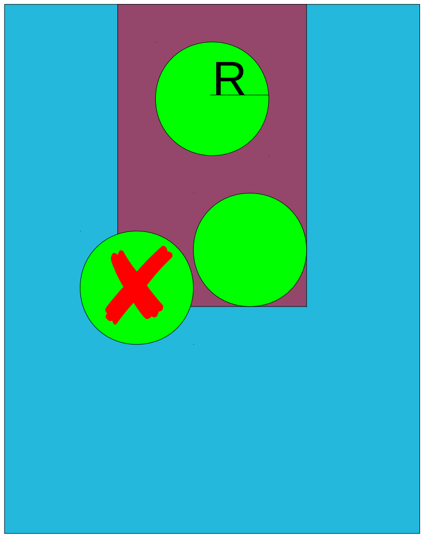
$$R_{AA} = \frac{\sigma_{pp}^{inel}}{\langle N_{coll} \rangle} \frac{d^2 N_{AA} / dp_T d\eta}{d^2 \sigma_{pp} / dp_T d\eta}$$

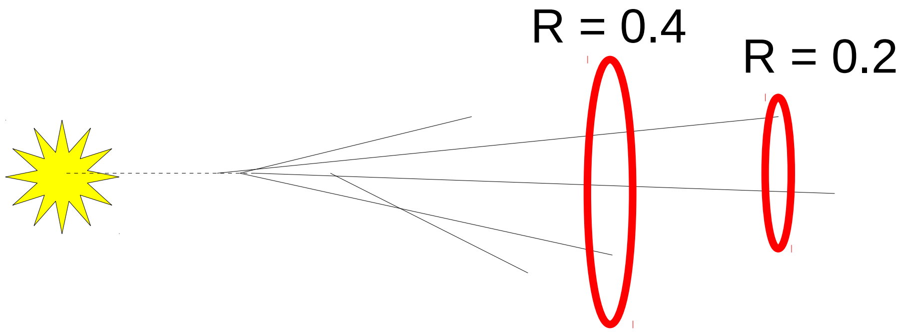
Data sets

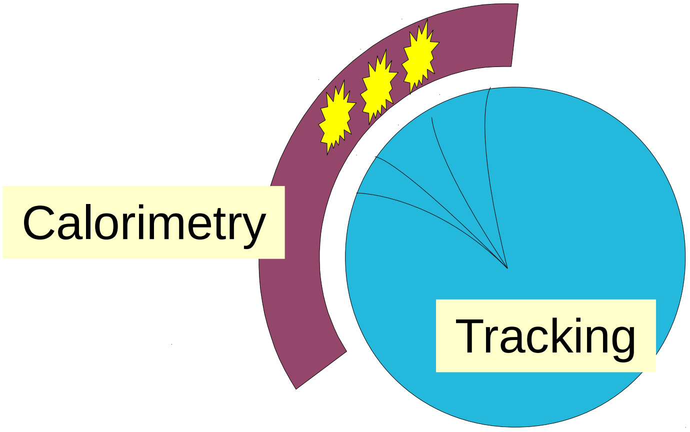
- p-p $\sqrt{s} = 2.76$ TeV
  - Clean reference sample, with no media at all (likely)
- P-Pb $\sqrt{s} = 5.02$ TeV
  - Cold nuclear matter
- Pb–Pb $\sqrt{s} = 2.76$ TeV
  - Strongly interacting QCD medium

Jet reconstruction with EMCal

- Get as close to the initial parton
- Sequential clustering of hits
- Jets fully contained in acceptance
- Charged tracks (ITS+TPC) and optionally clusters from EMCal
- Anti-k_T algorithm for signal jets, k_T for background
- R = 0.4, but can be 0.2 – 0.7

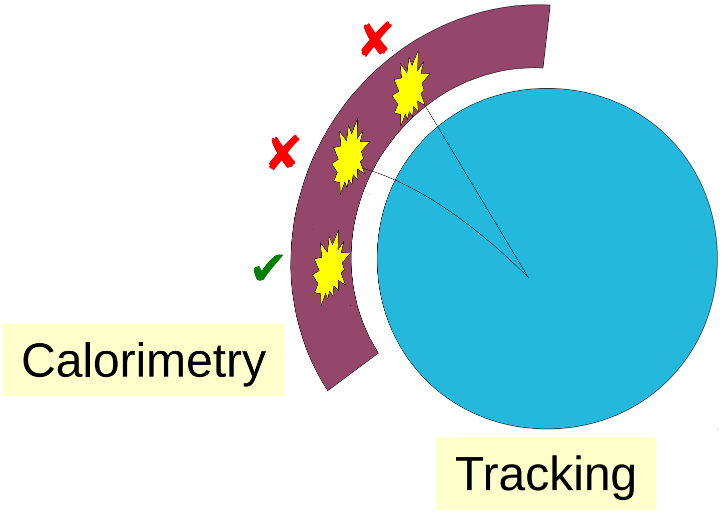


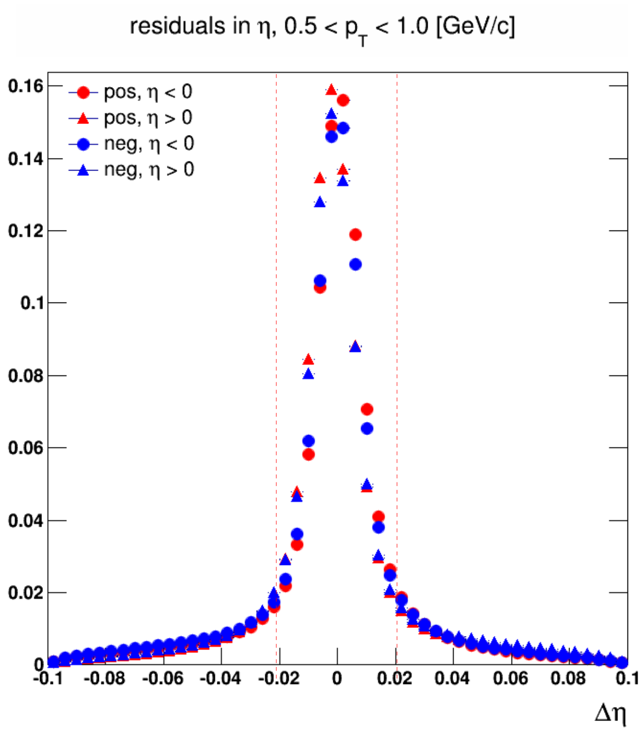




Hadronic correction for full jets

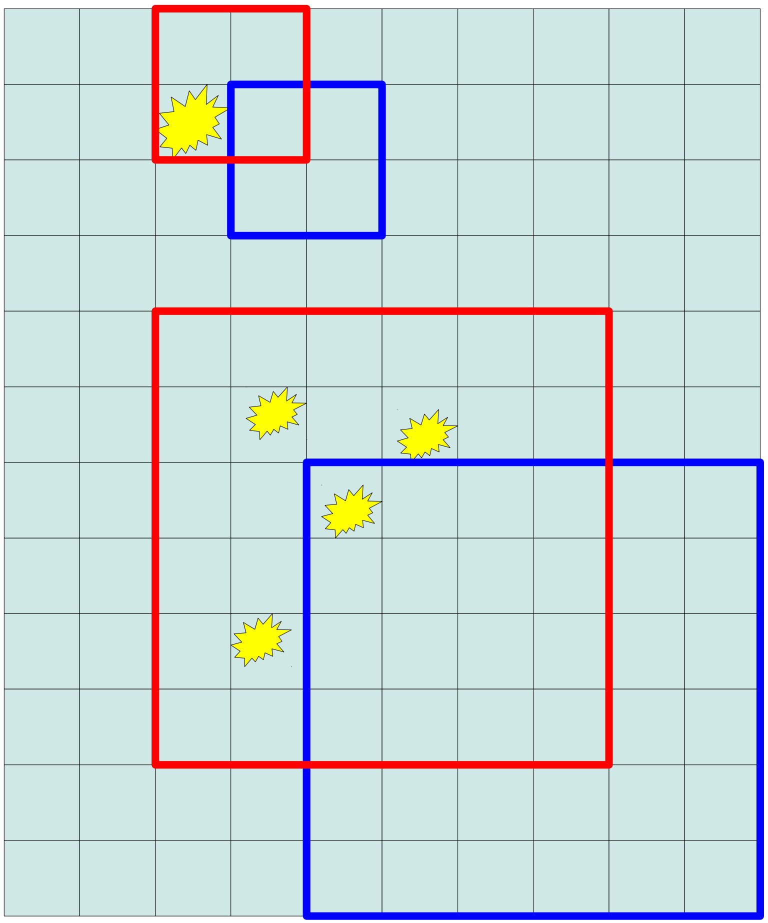
- Charged particles deposit energy in EMCal
- Need to avoid double counting of the momenta
- Track matching and subtraction of a fraction of momenta
- $E_{cluster}^{corr} = E_{cluster}^{orig} - f \cdot \sum E_{track}; \qquad E_{cluster}^{corr} \geq 0$
- The f is a fraction of track p_T to subtract, set to 1 (100%)





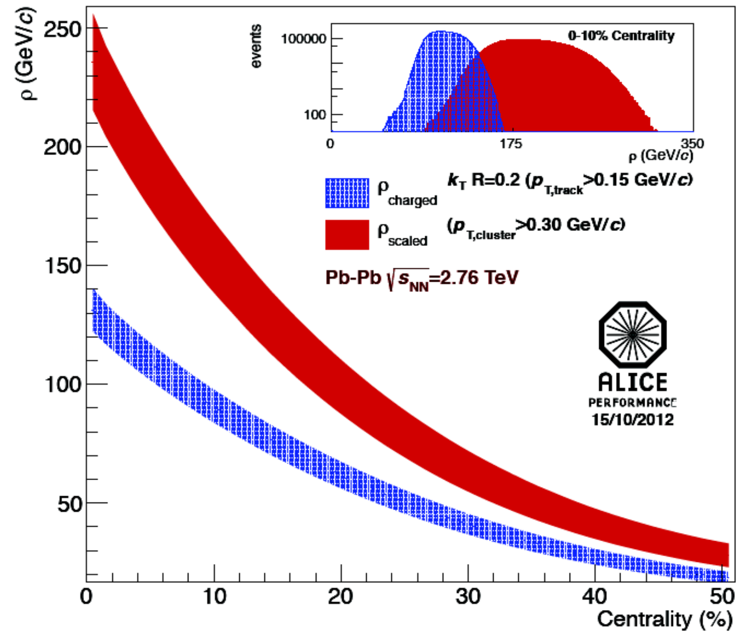
Triggering in EMCal

- Triggering on integrated energy deposits in an area of EMCal
- Sliding window algorithms of different granularity and steps
- L0 (600ns), deposits in 4x4 towers
- L1 (~5μs) deposits in 4x4 towers towers without HW borders
- L1 (~5μs) deposits in 32x32 towers, jet trigger



Underlying event

- Event by event subtraction
  - k_T jets energy over area
  - Scaled charged + EMCal

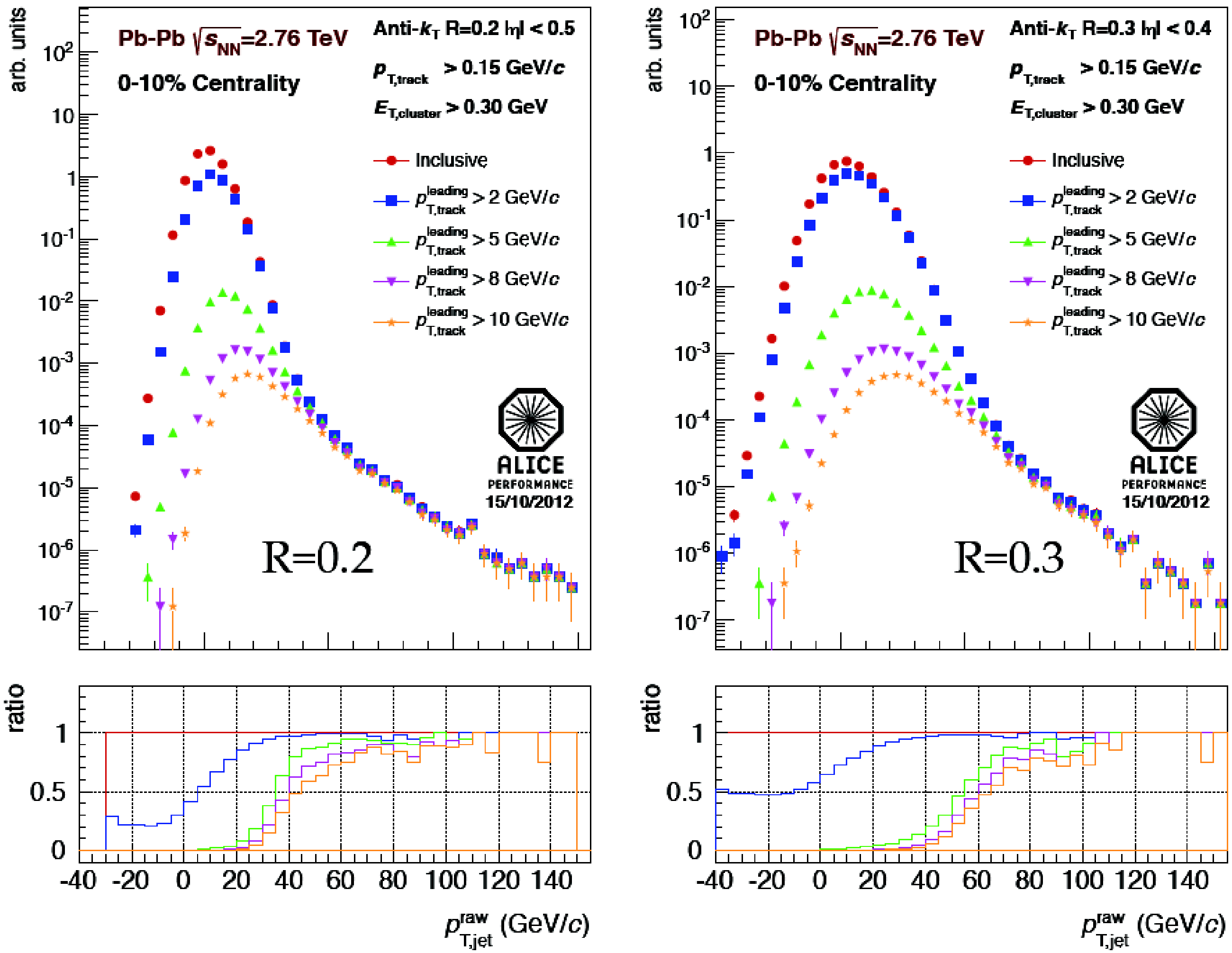


$$\rho_{full} = s_{full/ch} \cdot \rho_{ch} = s_{full/ch} \cdot median\left(\frac{p_T^{k_T\,jet}}{A^{k_T\,jet}}\right) \cdot C$$

$s_{full/ch}$ is scale in between charged and full jets
C is a factor averaging for whole acceptance

CMS collaboration: arXiv:1207.2392

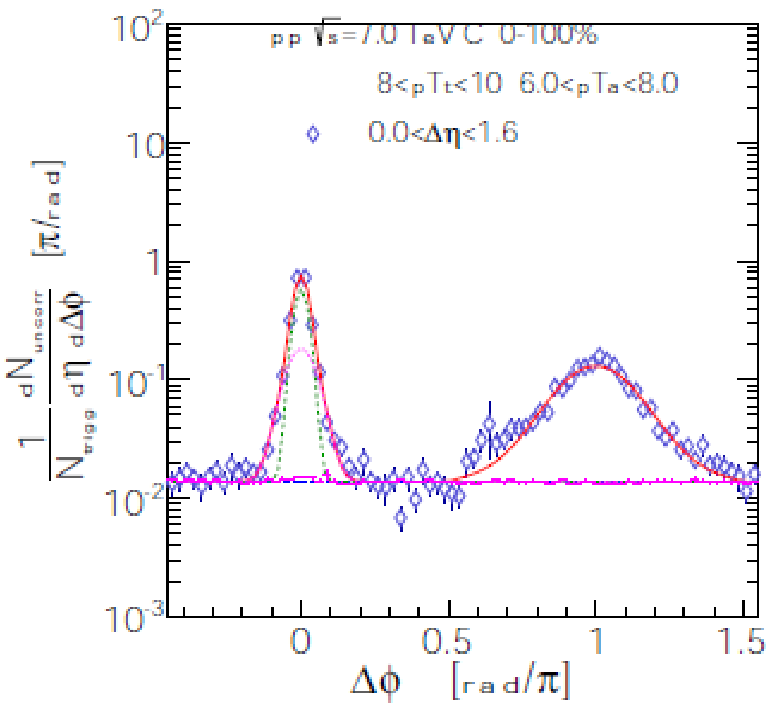
Leading particle bias

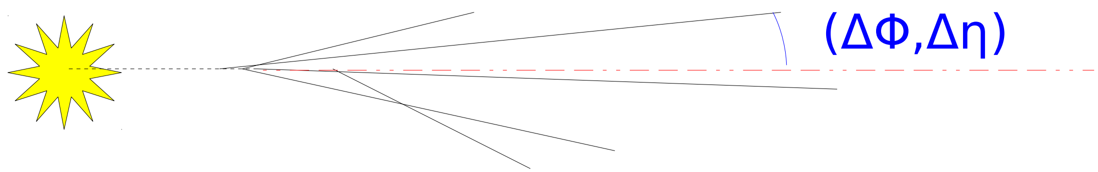


- Offline requirement of a high-p_T jet constituent
- Removal of combinatorial jets, made of soft particles

Correlation

- Relative measurement of a fragment property in respect to a selected axis
  - 1D or 2D (eta, phi)
  - Trigger = charged / neutral particle / jet
  - Leading / all particle triggers

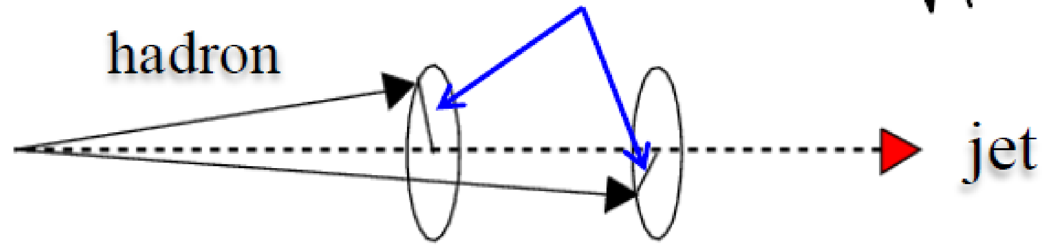




Jet transverse structure

- Transverse momentum of products in respect to the jet axis
- Can be recovered from two particle angular correlation in azimuth
- Assuming jet is symmetric in ΔΦ,Δη

vector $\vec{j}_T$ measured as 2D RMS $\sqrt{\langle j_T^2 \rangle}$



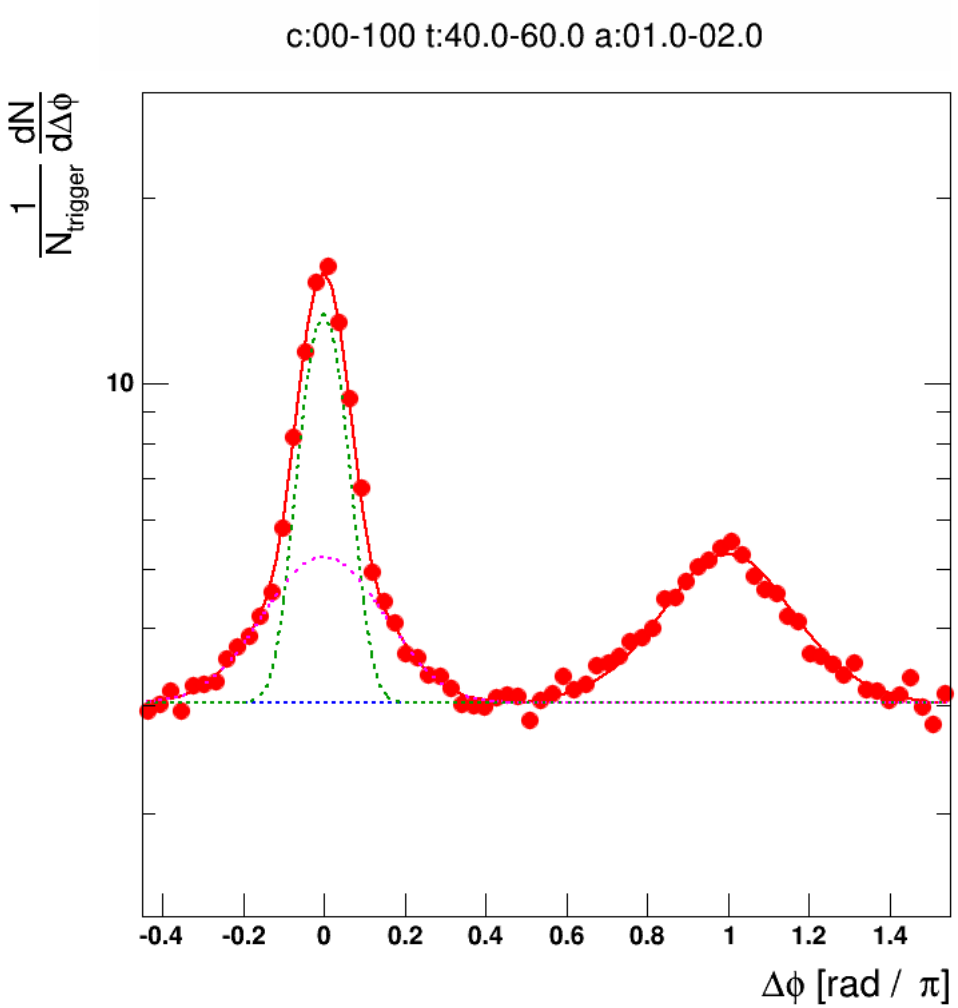
$$\sigma_N^2 = \langle \Delta\phi^2 \rangle \approx \left\langle \left(\frac{j_{Ty}}{p_{Ta}} \right)^2 + \left(\frac{j_{Ty}}{p_{Tt}} \right)^2 \right\rangle$$

$$\sqrt{\langle j_T^2 \rangle} = \sqrt{2 \langle j_{Ty}^2 \rangle} \approx \sigma_N \frac{\sqrt{2} \langle p_{Tt} \rangle \langle p_{Ta} \rangle}{\sqrt{\langle p_{Tt} \rangle^2 + \langle p_{Ta} \rangle^2}}$$

the most crucial assumption $j_T \ll p_{Tt}$ and p_{Ta}

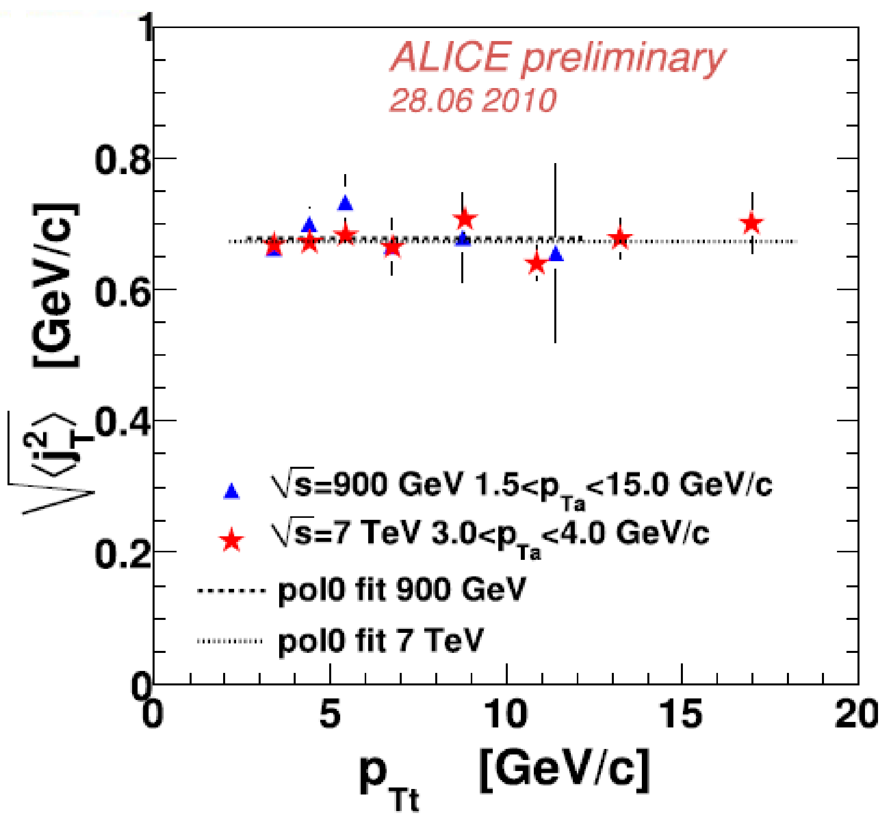
Signal extraction

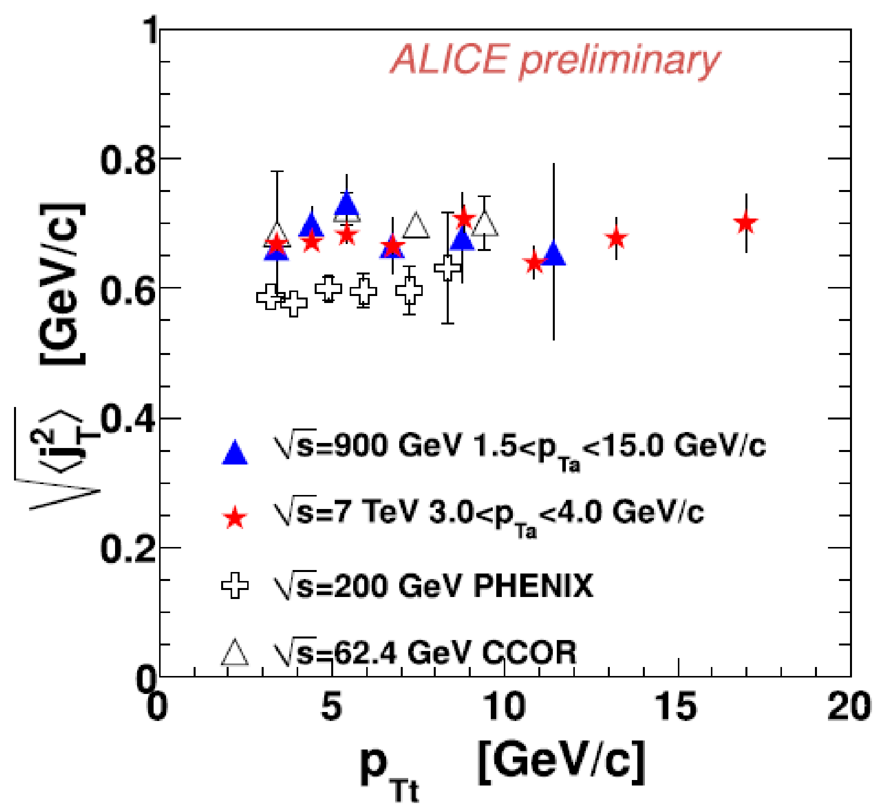
- Event mixing used to simulate the uncorrelated background
- Two gausian fits of the near side + single gausian on away side



Results

- In the studied range, j_T of products seems to be constant within errors with the initial parton momentum
- Also the results are consistent through different √s





Outlook

- Work in progress on the full jet – hadron correlation