Jet Study in Ultra-Relativistic Heavy-Ion Collisions

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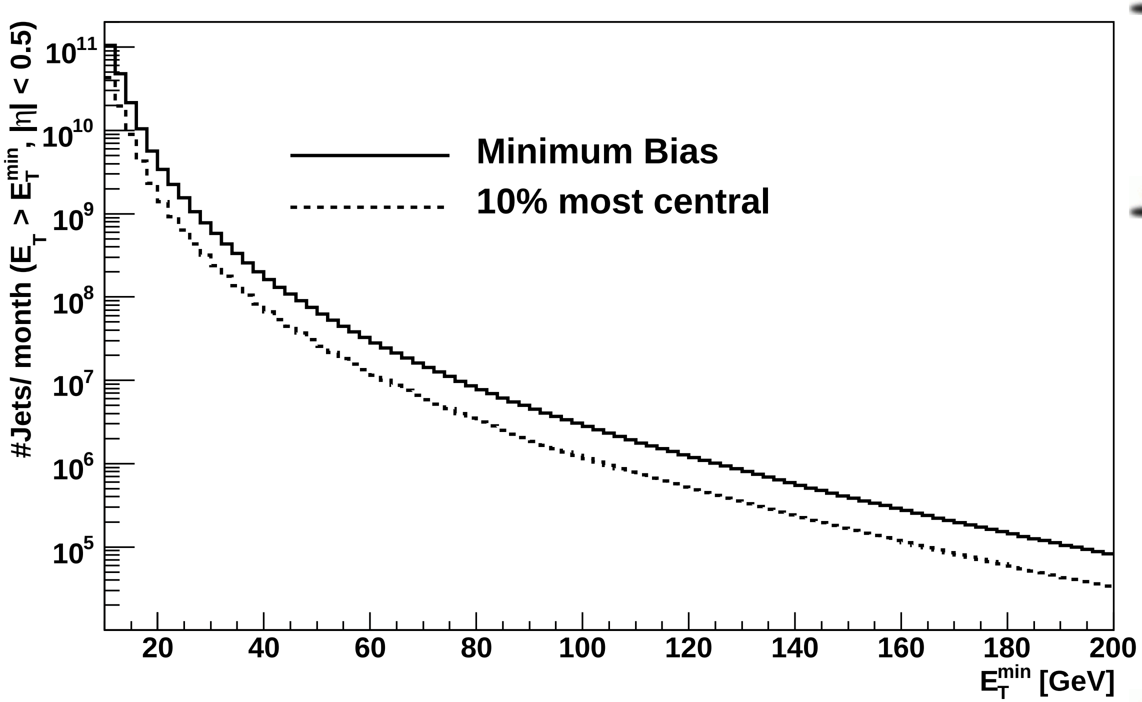
Outline

- Jet production in ALICE
- Jet reconstruction algorithms
- Monte Carlo generation
- Di-Jets
- Conclusion and next work

Jet production in ALICE

ALICE will study the whole spectrum of jet production ranging from minijets, $E_{\mathrm{T}} > 2\,\mathrm{GeV}$, to high-$E_{\mathrm{T}}$ jets of several hundred GeV.



Average number of jets with $E_{\mathrm{T}} > E_{\mathrm{T}}^{\mathrm{min}}$ and $|\eta| < 0{,}5$ per event in the 10 % most Pb–Pb collisions (dashed line) at $\sqrt{s_{\mathrm{NN}}} = 5{,}5\,\mathrm{TeV}$

- For $E_{\mathrm{T}} > 20\,\mathrm{GeV}$, 17 % of the produced jets are in the ALICE fiducial region $|\eta| < 0{,}5$.
- A fraction of 8.6 % of the accepted jet events contain back-to-back di-jets defined as events having a second accepted jet with at least 90 % of the minimum transverse energy required for the leading jet.
- For $E_{\mathrm{T}} > 100\,\mathrm{GeV}$, the single jet acceptance rises to 26 % and the di-jet acceptance to $13{,}5\,\%$.

Jet reconstruction algorithms

- Cone algorithms form jets by associating together particles whose trajectories (*i.e.*, towers whose centers) lie within a circle of specifi c radius R in $\eta \times \phi$ space.
- Starting with a trial geometric center (or axis) for a cone in $\eta \times \phi$ space, the energy-weighted centroid is calculated including contributions from all particles within the cone.
- This new point in $\eta \times \phi$ is then used as the center for a new trial cone.
- As this calculation is iterated the cone center "flows" until a "stable" solution is found, *i.e.*, until the centroid of the energy depositions within the cone is aligned with the geometric axis of the cone.

Monte Carlo generation

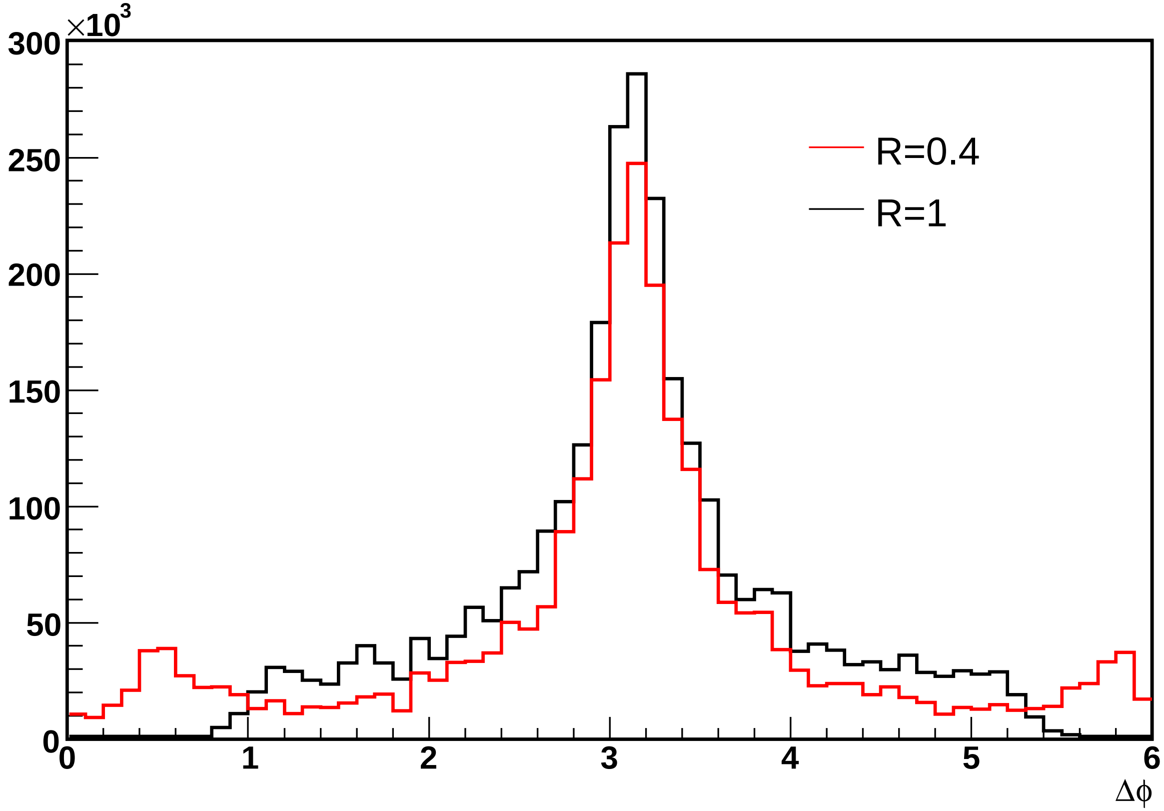
Simulating hard processes in pp collisions using PYTHIA 6.214 (signal) and embedding them in the underlying event of the Pb–Pb collisions simulated using the HIJING v1.36 event generator (background).

PYTHIA

1. 100 000 events (only generated)
2. Center of mass energy: 5.5 TeV
3. η range:$|\eta| < 0{,}5$
4. p-p Jets
5. p_t hard:5-200 GeV/c

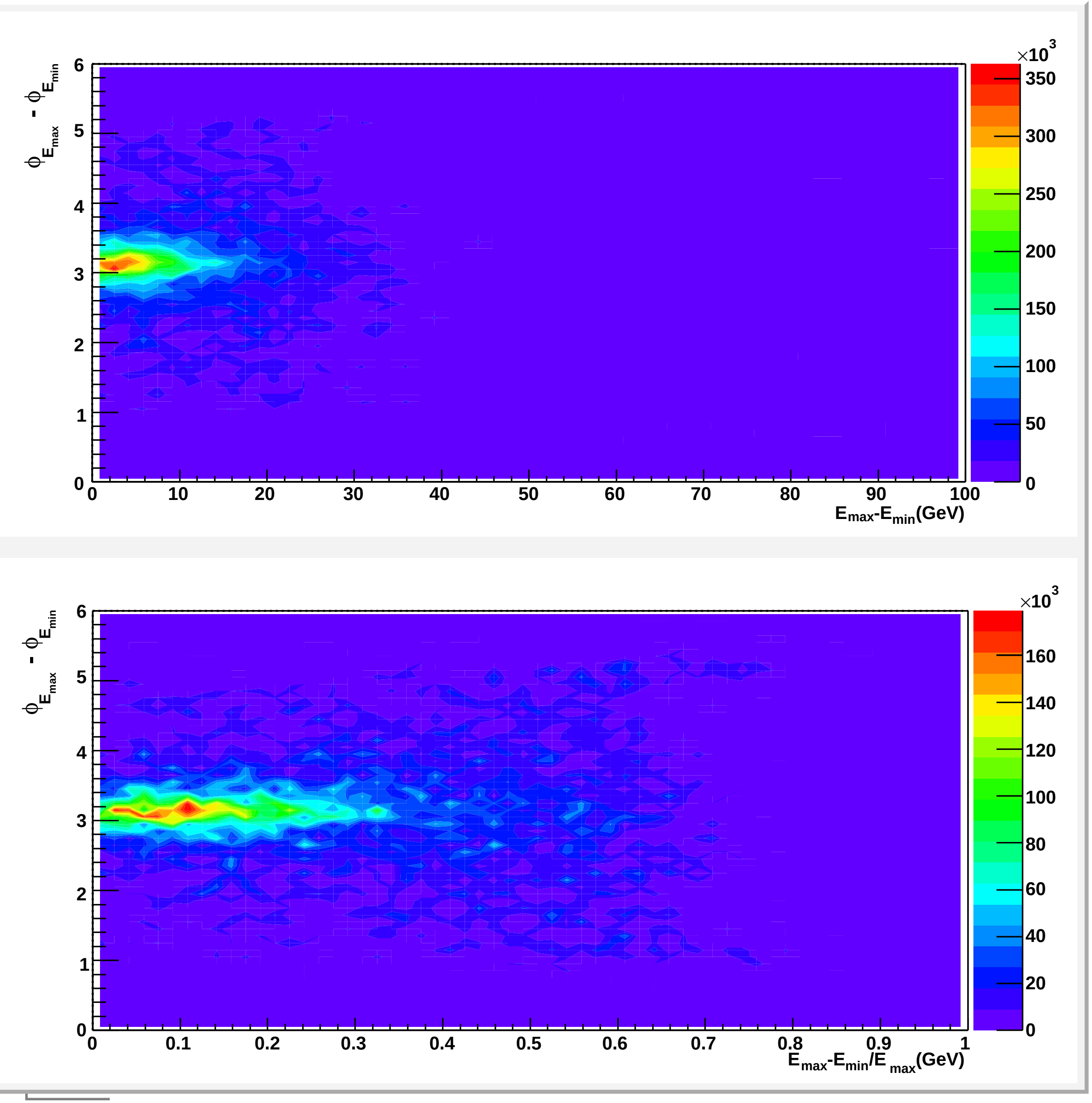
Azimuthal correlations

The back-to-back azimuthal correlations is written as $\Delta\Phi = \Phi_{E_{max}} - \Phi_{E_{min}}$ where max/min are the jets with maximum/minimum energy in the same event.



- For $R_c = 0{,}4$ exist fails jets reconstructed at $\Delta\Phi = 0{,}5$ and $\Delta\Phi = 5{,}5$ due to part of the energy of the jet is not inside the cone.
- This fails jets disappeared increasing the cone size to an a ideal case with $R_c = 1$ where all the energy of the jet is include in the cone.

Back-to-back di-jets

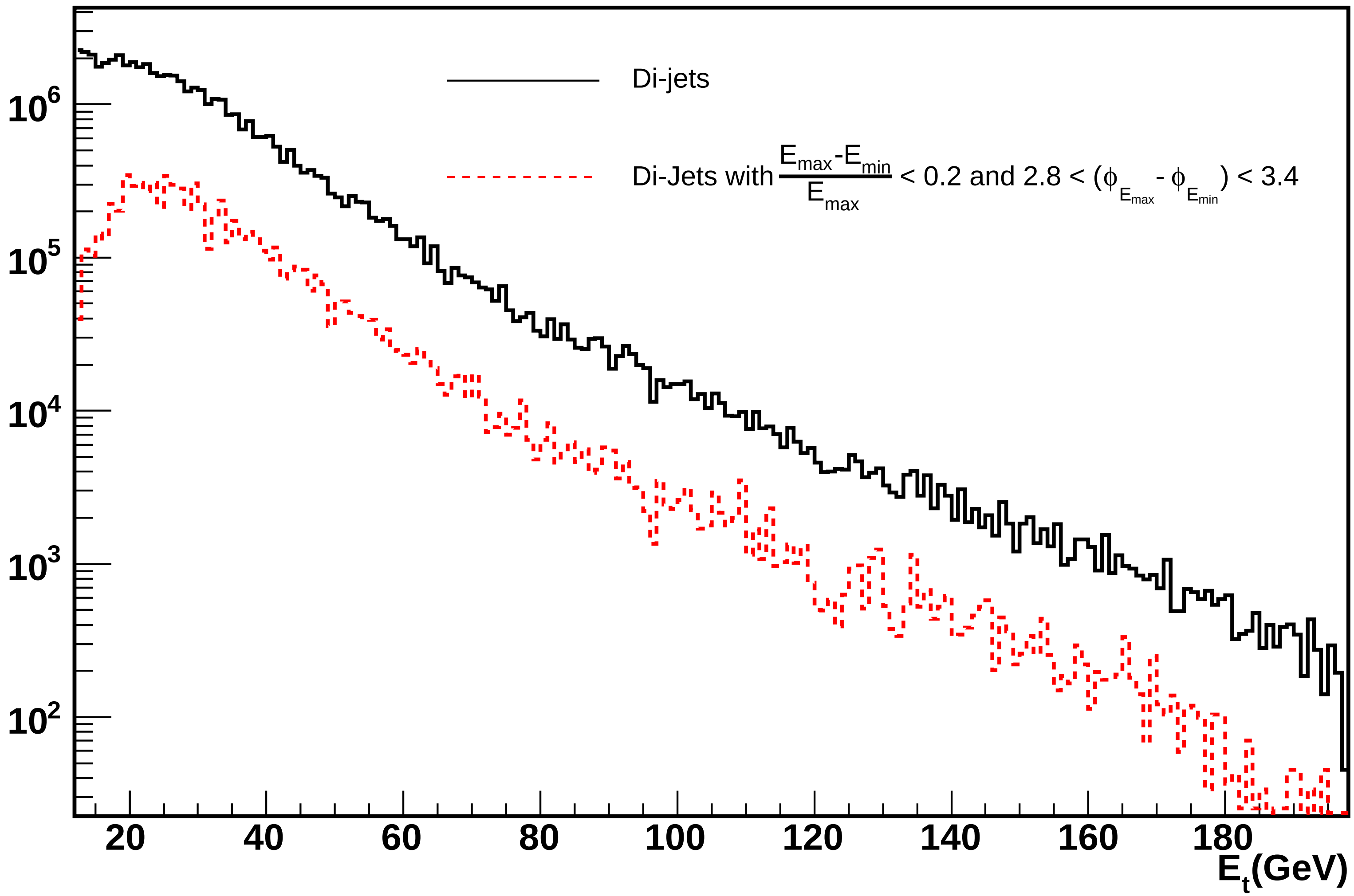


Using the ideal case ($R_c = 1$) we define energy and $\Delta\Phi$ cuts to accept only real di-jets. This cuts are:

- $2{,}8 < \Phi_{E_{max}} - \Phi_{E_{min}} < 3{,}4$
- $\frac{E_{max} - E_{min}}{E_{max}} < 0{,}2.$

Back-to-back di-jets

With this cuts only a fraction of 11 % of the accepted jet events contain back-to-back di-jets.



Conclusion and next work

- Azimuthal distributions provide us information to defi ne di-jets
  - With $2{,}8 < \Phi_{E_{max}} - \Phi_{E_{min}} < 3{,}4$ and $\frac{E_{max}-E_{min}}{E_max} < 0{,}2$ only real di-jets are accepted and there is enough statistic
- Jets Signal+Background