PhD thesis

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The goal of ultra-relativistic heavy-ion collisions experiments is to create and study the quark-gluon plasma (QGP), a phase of matter in which quarks and gluons move freely in thermal and chemical equilibrium. A variety of signatures has been proposed although experimental measurements are complicated due to the time/space evolution of the system and final state hadronic interactions. This work will focus on a specific hard-probe namely high-p_{T} jets.
A definition of a jet is a collimated group of hadrons which originate from the fragmentation of an initial hard scattered parton. The jet particle are contained within a cone of radios $R_{\mathrm{c}} = \sqrt{(\Delta\eta)^2 + \Delta\phi)^2}$. The total energy and direction of the jet is expected to be closely related to that of the parton. It is expected that the strong density of the medium will cause the modification of the fundamental properties of hard-scattering like broadening parton transverse momentum k_{T} and the momentum perpendicular to the jet axis, j_{T} . Thus the measurement of this for $p + p$ collisions provides a baseline for comparison to the results in heavy-ion collisions.

Jets identification

1. Jets identification in $p + p$ collisions and jets embedding in minimum bias events in order to simulate heavy ion-collisions in the ALIROOT environment
   - Event Shape Analysis (ESA): Identify events with well defined jets
   - JETAN: UA1-based cone jet finding algorithm

- $p + p$
  - jets (PYTHIA: Program for the generation of high-energy physics events) at $\sqrt{s_{NN}} = 14$ TeV and $\sqrt{s_{NN}} = 5.5$ TeV
- Heavy-ions
  - jets+MB (PYTHIA+HIJING:Heavy Ion Jet INteraction Generator) at $\sqrt{s_{NN}} = 5.5$ TeV

Signatures

1. Intrinsic transverse momentum k_{T}
2. Momentum perpendicular to the jet axis j_{T}

- Monte Carlo simulation models for the parton energy loss implemented as modification of standard PYTHIA jet event
  - PYQUEN: Event generator for simulation of rescattering, radiative and collisional energy loss of hard partons in expanding quark-gluon plasma created in ultrarelativistic heavy ion AA collisions
  - Q-PYTHIA: Implementation of medium-effects in parton shower

- Compare heavy ions jets with $p + p$ jets at $\sqrt{s_{NN}}$ 5.5 TeV

Jets identification

Work done

- ESA and JETAN
  - $p + p$ jets at $\sqrt{s_{NN}} = 200$ GeV, 5.5 TeV and 1.4 TeV

Work to do

- ESA and JETAN
  - Heavy-ions at $\sqrt{s_{NN}} = 5.5$ TeV
- Jets identification ESA+JETAN

Signatures

Work done

- k_{T}
  - Jets reconstructed with JETAN in $p+p$ collisions and parton energy loss with PYQUEN at $\sqrt{s_{NN}} = 5.5$ TeV
- j_{T}
  - Jets reconstructed with JETAN in $p+p$ collisions and parton energy loss with PYQUEN and Q-PYTHIA at $\sqrt{s_{NN}} = 5.5$ TeV

Work to do

- k_{T} and j_{T}
  - Same analysis with ESA+JETAN