A Large Ion Collider Experiment

THE WRIGHT LAB CONTRIBUTION TO ALICE

The ALICE Experiment

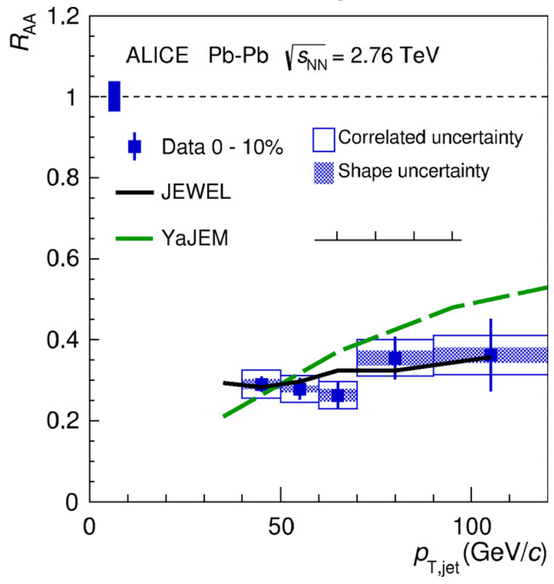
ALICE is a multipurpose detector located at the Large Hadron Collider at CERN. Its primary goal is to study the properties of nuclear matter under extreme conditions (temperature and density) which is achieved by colliding lead nuclei at energies of a couple of TeV.
Our collaboration aims to understand if the nuclear matter at these conditions undergoes a phase transition to a state of deconfined strongly interacting matter, called the quark gluon plasma.
We can investigate the reaction products (hadrons, leptons, photons, jets) of these lead collisions to infer the properties of the medium from which they originate.

How do we probe the state of matter created in these collisions?

There are several data analysis projects in the relativistic heavy ion group at Yale to study the properties of various collision systems mainly with hard probes (high p_T particles).

Jet suppression in Pb+Pb collisions

Is the yield of reconstructed jets per nucleon+nucleon collision different in Pb+Pb vs. p+p systems? We expect yes, as jets (originating from quarks or gluons) will have to traverse the hot collision zone before they are reconstructed in our spectrometer.



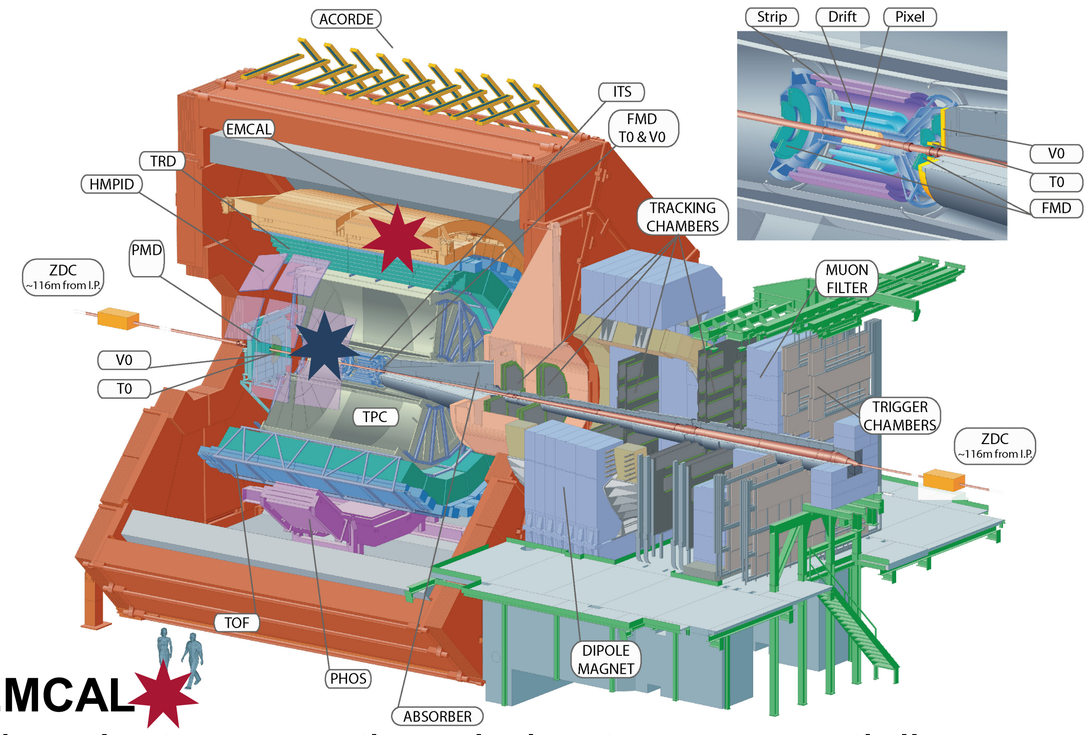
As we determined (left figure) the ratio of measured jets in these two systems is ~0.3. This is an enormous depletion in yield.
Questions that remain to be answered are: What exactly caused this and where did the jet energy go?

Jet production in p+Pb collisions

To answer the first question raised above, we have studied jet production in p+Pb collisions. Do cold nuclear matter effects deplete the jet yield?
The answer is no. Our result (right figure) shows no difference in reconstructed jet yield for Pb+p and p+p collisions. This depletion must come from the dense system created in the heavy ion collision.

Our involvement in detector design

The relativistic heavy ion group at Yale has participated in several detector construction and upgrade projects.



EMCAL

The electromagnetic calorimeter was partially assembled and calibrated here in the Wright Lab. It was newly installed in ALICE in 2009 and 2011. With this new detector we can now reconstruct photons and perform measurements with full jets (charged and neutral energy).

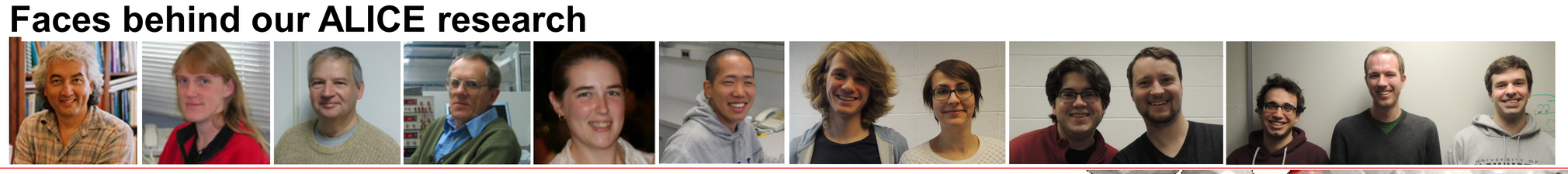
TPC (see more on poster of N. Smirnov)

The time projection chamber installed in ALICE is the largest of its kind (diameter: 5 m, length: 5 m). It is a type of detector that is used for charged particle tracking and their mass determination (PID). Due to the planned luminosity increase at the LHC (300 1/fb after 2018) and the wish to collect data at high rates, a different type of charge amplification and ion back flow suppression in the TPC will become necessary. To achieve this, we contribute to the TPC upgrade which involves the exchange of the detector part where charges are amplified and collected. The new design will include stacks of 4 GEM foils which simultaneously amplify the primary ionization and suppress back flowing ions created in this amplification process. It is planned to install the new detector components by 2019.

More things we currently do

- Reconstruct jets with charm content.
- Investigate di-jet imbalances in Pb+Pb.
- Study jet-hadron and γ-hadron correlations in Pb+Pb.
- Characterize longitudinal particle correlations in Pb+Pb

Faces behind our ALICE research



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Neutrinos
Dark Matter
Nuclear Structure
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