ALICE

N. Bianchi, G.P. Capitani (Ass.), A. Casanova Diaz (Ass.), L. Cunqueiro (Ass.),
P. Di Nezza (Resp. Loc.), A. Fantoni, P. Gianotti, S.Liuti (Ass.), A. Moregula (Ass.), V. Muccifora,
A. Orlandi (Tecn.), A.R. Reolon, F. Ronchetti (Ass.), A. Viticchié (Tecn.)

1 Introduction

ALICE is an experiment at CERN which involves about 1100 physicists from more than 100 Institutions from several Countries. Italy participates with 12 groups and about 200 physicists. The Frascati group is deeply involved in the electromagnetic calorimeter project (EMCal), both on the hardware and software side taking, in addition, the responsibility of System Run Coordinator for the full year. On the data analysis side the group is focused on the physics of the jets. This choice comes from the fact that the EMCal enables ALICE, like no other experiment before, to explore the physics of jet quenching, i.e. the interaction of energetic partons with the QCD hot and dense medium, over the large kinematic range provided by the LHC. The EMCal provides both fast triggers (level 0 and 1) for photons, electrons, and jets and a High Level Trigger (HLT) as well. The EMCal also measures the neutral energy component of jets, enabling full jet reconstruction in all collision systems, from proton-proton to Pb-Pb, passing through the p-Pb collisions scheduled for the 2013. The combination of the EMCal, the excellent ALICE charged tracking capabilities, and the modest ALICE magnetic field strength, is a preferred configuration for jet reconstruction in the high background environment of heavy-ion collisions, allowing detailed optimization of background rejection while preserving the crucial jet quenching signals at low transverse momenta. The first paper on jets had the Frascati group as co-first author while, at the moment, a new analysis investigating the hadron-jet correlation, close to be published, sees the Frascati group as the main author. ALICE data open the frontiers to rare events, to very high transverse momentum jets and give new tools for investigating the QCD and the Quark Gluon Plasma physics. An EMCal extension, called DCal, has been completed and is ready to be installed during the LHC long shutdown 2013-2014.

2 EMCal

The calorimeter was fully working for the whole data taking of the ALICE spectrometer. Together with the Inner Tracking System, it was the most efficient detector, participating at the 94% of the data taking time. The status of the system is shown in Fig.1 where the percentage of the dead calorimetric cells is plotted for the 15 periods of the 2012 full data taking; the number of inefficiencies is always $\leq 2\%$. In Fig.2 is shown the average number of clusters per event for a sample of runs and for each of the 10 Super-Modules. Also in this case the stability of the system is clear.

2.1 High Level Trigger optimization of the new clustering algorithms using p-p collisions

The EMCal HLT Clusterizer component merges individual signals (digits) of adjacent cells into structures called clusters. Since the typical cluster size in the EMCal can vary according to the detector occupancy due to shower overlap effects, which are much different for pp and heavy-ion collisions, clustering algorithms with and without a cutoff on the shower size have been developed (both in offline and in the HLT) to optimize the cluster reconstruction for the different cases. Events originating from pp collisions, tends to generate smaller, spherical and well-separated clusters in the EMCal, at least up to 10 GeV/c. At higher transverse momenta, the overlapping of the showers

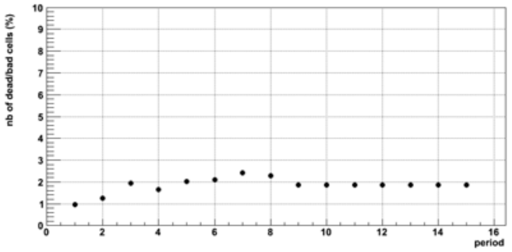

Figure 1: Percentage of the dead calorimetric cells for the 16 periods of the 2012 full data taking.

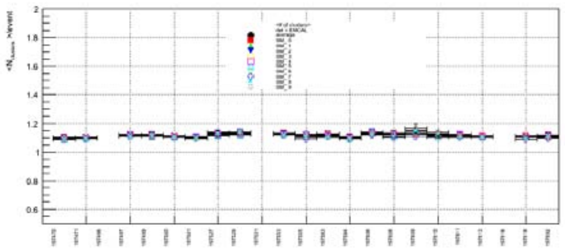

Figure 2: Average number of clusters per event for each of the 10 Super-Modules plotted for a sample of runs.

requires a shape analysis to extract the single shower energy. Above 30 GeV/c the reconstruction can be performed only with more sophisticated algorithms such as isolation cuts to identify direct photons.

The identification of an isolated single electromagnetic cluster in the EMCal can be performed using different strategies: summing up all the neighboring cells around a seed-cell over threshold until no more cells are found or adding up cells around the seed until the number of clustered cells reaches the predefined cutoff value. The first approach is more suitable for an accurate reconstruction. A further improvement to this clustering algorithm would be the ability to unfold overlapping clusters as generated from the photonic decay of high-energy neutral mesons, however this procedure usually requires computing intensive fitting algorithms. Such performance penalty must be avoided in the online reconstruction so the cutoff technique is preferred. In the EMCal HLT reconstruction a cutoff of 9 cells is used (according to the geometrical granularity of the single cell size), so the clusterization is performed into a square of 3x3 cells. In pp collisions the response of the two methods is very similar since the majority of clusters are well separated, while in Pb-Pb collisions, especially in central events, the high particle multiplicity requires the use of the cutoff (or unfolding in offline) to disentangle the cluster signals from the underlying event to avoid the generation of artificially large clusters.

The reconstruction quality of the EMCal online clusterizer algorithms implemented in the HLT chain were checked against offline as shown in Figs.3 and 4, where it can be seen that the performance is in a reasonable agreement in all cases. Since the EMCal HLT reconstruction is mainly targeted for triggering, a small penalty in the accuracy of the energy reconstruction of the clusters is accepted as a trade off in favor of faster performance, and for this reason the cutoff clustering method was used, especially for Pb-Pb collisions.

2.2 High Level Trigger development for correlation measurements in heavy ion collisions

The online HLT chain is capable of producing trigger decisions based on full event reconstruction. In terms of EMCal event rejection, the following relevant trigger observables have been implemented:

- neutral cluster trigger;
- electron and jet trigger.

The single shower triggering mode is primarily targeted to trigger on photons and neutral mesons. In all collision systems, the high level trigger post-filtering can improve the hardware L0 and L1 trigger response by using the current bad channels map information and calibration factors.

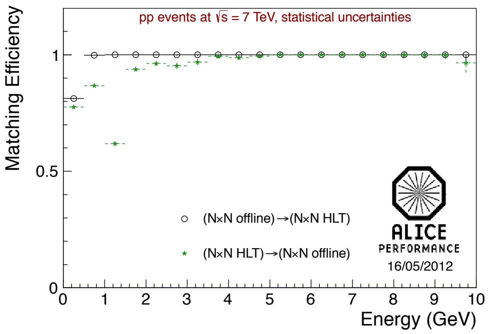

Figure 3: Reconstruction efficiency for the $N \times N$ algorithm (cutoff) in offline and HLT. The notation $(A) \rightarrow (B)$ indicates the fraction of clusters found using method A that are also found using method B.

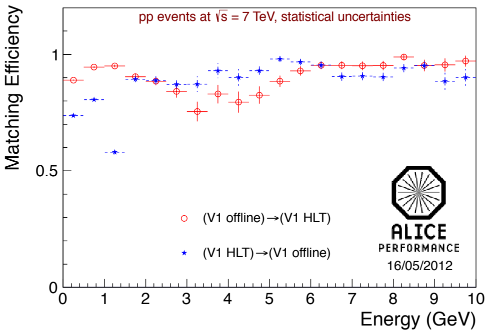

Figure 4: Reconstruction efficiency for the $V1$ algorithms (no cutoff) in offline and HLT. The notation $(A) \rightarrow (B)$ indicates the fraction of clusters found using method A that are also found using method B.

For the electron trigger, the cluster information reconstructed online by the EMCal HLT analysis chain is combined with the central barrel tracking information to produce complex event selection as a single electron trigger (matching of one extrapolated track with an EMCal cluster).

Performance and accuracy studies of the track matching component developed for this purpose have been done using simulated and real data taken during the 2011 LHC running period 1).

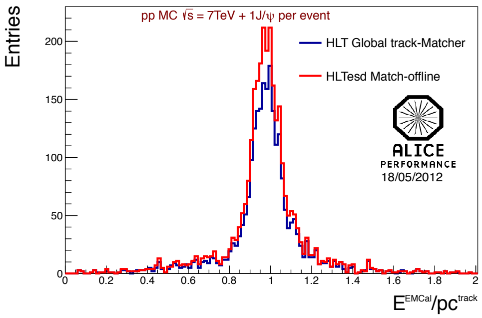

Figure 5: E/pc distributions obtained with the track extrapolation - cluster matching via the online algorithms compared to the ESD-based tracking (red).

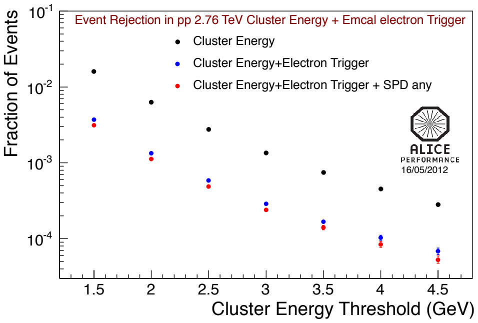

Figure 6: Improvement in the event selection for $E_{e^-} > 1$ GeV from simulation with minimum bias pp at $\sqrt{s} = 2.76$ TeV.

In addition to the extrapolation of the track from the central barrel to the EMCal interaction plane and the matching with a compatible nearby cluster, the electron trigger component must finally perform particle identification to issue a trigger decision. The selection of electron candidates is done using the E/pc information where the energy is measured from the EMCal cluster, and the momentum from the central barrel track as shown in Fig.5. To determine the possible improvement of the event selection for electrons with energies above 1 GeV, simulations of the HLT chain using pp minimum bias data at 2.76 GeV and the EMCal geometry have been used. These studies have shown that at least a factor 5 to 10 in event selection can be gained compared to the single shower trigger, as shown in Fig.6, where the red points are obtained with the requirement of one hit in one of the inner tracker silicon pixel (SPD) layers to reject a higher fraction of photon conversions.

The EMCal online jet trigger component was developed to provide an unbiased jet sample by refining the hardware L1 trigger decisions. In fact, the HLT post-processing can produce a sharper turn on curve using the track matching capabilities of the online reconstruction chain. In addition, a more accurate definition of the jet area than the one provided by the hardware L1 jet patch, is obtained choosing a jet cone based on the jet direction calculated online. The combination of the hadronic and electromagnetic energy provides a measurement of the total energy of the jet by matching the tracks identified as part of the jet with the corresponding EMCal neutral energy.

The use of the HLT jet trigger also allows a better characterization of the trigger response as a function of the centrality dependent threshold by re-processing the information from the V0 detector directly in HLT. Performance considerations, due to the high particle multiplicity in Pb-Pb collisions, impose that the track extrapolation is done only geometrically without taking into account multiple scattering effects introduced by the material budget in front of the EMCal. The pure geometrical extrapolation accounts for a speedup factor of 20 in the execution of the track matcher component with respect to the full-fledged track extrapolation used for pp collisions. The identification of the jet tracks is performed using the anti-k_T jet finder provided by the FastJet package which was embedded in the HLT framework.

3 DCal

The first upgrade approved by the ALICE collaboration was an extension of EMCal, denominated DCal (Di-jet Calorimeter) 2). The DCal expands the physics capabilities of the EMCal by enabling back-to-back correlation measurements that are essential to obtain a complete picture of the physics addressed by the EMCal. Together, DCal and EMCal form a two-arm electromagnetic calorimeter. The EMCal subtends 110° and the DCal subtends 67° in the azimuthal angle ϕ, with both detectors covering $|\eta| < 0.7$, thereby providing good acceptance for di-jets with radii R<0.4 up to transverse momenta $p_T \sim 150$ GeV/c. Simulation studies of the DCal have been carried out and have verified that the technology, originally developed for and implemented in the EMCal, meets all the needs of the DCal project. As a consequence, from a technical perspective, DCal is an extension of EMCal having super-modules built exactly as they are in the EMCal, out of strip-modules, but with reduced length in η: in fact, each DCal super-module contains 16 strip-modules instead of 24 present in the previous calorimeter. Also in this case, there are 2 extensions made of reduced super-modules 1/3 (each of them done by 16 strips with 4 modules), matching the angular coverage back-to-back for the EMCal extension.

DCal will be situated immediately adjacent to PHOS on both the ALICE “A” and “C” sides, causing unavoidably a small gap in η ($\delta\eta \sim 0.02$) between the sensitive volumes of the two detectors, due to the super-module structure. DCal+PHOS can be considered as one integrated detector system for the study of jets, consequently all simulations done include PHOS as well as DCal super-modules.

In Fig. 7 is shown a schematic view of the 6 DCal super-modules together with the 2 reduced width (1/3) DCal super-modules and with the PHOS super-modules in between.

The DCal Collaboration is the EMCal one plus the Tsukuba (Japan) and Wuhan (China) groups. The Frascati group has the responsibility of coordinating the construction and assembly in the European-Asiatic zone. Moreover the Frascati group provided all WLS fibers for 1.5 DCal super-module and for the 2 reduced length super-modules including cutting, ice-polishing and aluminizing procedure. A total of about 62000 fibers, grouped in 1700 bundles, with 36 fibers each have been produced at LNF, part of those in collaboration with the Wuhan group. As for EMCal, each fiber bundle is built of two sub-bundles to match the different path lengths between

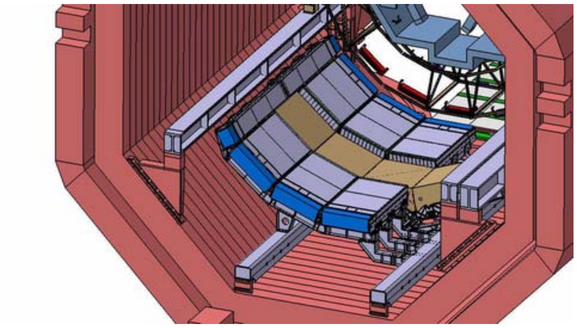

Figure 7: 6 DCal (in blue) super-modules plus the 2 with reduced length (1/3) with the PHOS super-modules (in violet) in between.

Figure 8: Left: picture of 1 full DCal super-module. Right: photo of the 2 reduced DCal super-modules.

central and peripheral fibers in the four towers of the single module. The module assembly started in 2011 and has been completed in 2012. All fibers have been inserted in the modules and the corresponding strip-modules have been assembled and calibrated in Grenoble (France). In Fig. 8 is shown a picture of one full DCal super-module after calibration (left panel) and a picture of the two reduced width DCal super-modules (right panel).

All DCal super-modules will be installed in ALICE during the LHC long shutdown (LS1) in 2013-2014. Concerning the mechanical DCal installation, the common PHOS-DCal support structure has been shipped to CERN and load-tested successfully as shown in Fig.9.

A preparatory work of the calorimeters has also been coordinated in order to have interventions during the LHC LS1. In particular, it was planned to switch from the RCU GTL-bus based readout to the new parallel (SRU) point-to-point readout (same as DCal) which will enable the EMCal/DCal to sustain the 50 kHz Pb-Pb interaction rate foreseen for running the central barrel detectors after 2018.

The preparation of the insertion tooling (different from the one used for the EMCal since the super-module size is different) is underway and the detector installation is foreseen for September 2013.

Figure 9: Common DCal-PHOS support structure under load test at the CERN P2.

4 Physics results

Frascati group contributed to the development of the field of jets in heavy ion collisions with two publications [3] [4] and a preliminary experimental analysis [5].

While studies at hadron level have been crucial in order to establish the existence and to gain understanding on the jet quenching phenomenon, the study of jets was proposed long ago as a complementary possibility. Specifically, single hadron spectra are supposed to be mostly sensitive to the medium-induced energy loss of the leading parton coming from a hard scattering, while jet-related observables should offer information about the medium modifications on the QCD branching process. The latter are expected to be affected by potential biases in a different manner than the former and, thus, they offer a possibility to additionally constrain the mechanism of energy loss and characterize the medium produced in the collisions. In the last two years several jet-related analysis have been performed at the LHC, that have triggered great interest and a large experimental, phenomenological and theoretical activity. Summarizing, the results show: (i) a larger imbalance of the transverse energy of leading and subleading jets in Pb-Pb collisions than in pp and increasing with centrality, which indicates the existence of medium-induced energy loss; (ii) a similar azimuthal distribution between leading and subleading jets in central Pb-Pb collisions to that in pp, apparently pointing to the absence of sizable medium-induced broadening in transverse momentum; (iii) an excess of soft particles at large angles with respect to the subleading jet in Pb-Pb collisions and increasing with increasing dijet momentum imbalance, compared to Monte Carlo expectations which reproduce pp data; (iv) a lack of sizable modifications of the hard jet fragmentation (i.e. the fragmentation into particles with energies close to the jet energy) between pp and Pb-Pb collisions. These observations look, at first sight, challenging for the standard explanation of jet quenching in terms of medium-induced gluon radiation in which energy loss and broadening are linked and the induced radiation is semi-hard.

In ALICE, we published the first studies [4] on event background fluctuations and their impact on the jet spectrum. Jet reconstruction in the complex environment of a heavy-ion collision requires a quantitative understanding of background-induced fluctuations of the measured jet signal and the effects of the underlying heavy-ion event on the jet finding process itself. Here, region-to-region background fluctuations are the main source of jet energy or momentum uncertainty and can have a large impact on jet structure observables, such as the fraction of energy inside the jet core or the shape of the jet, and will distort the measured jet energy balance even in the absence of medium effects. The conclusion of this first detailed study of event background fluctuations for jet reconstruction is that the standard deviation of the fluctuations in the 10% most central events is $\sigma = (10.98 \pm 0.01)$ GeV/c within a rigid cone of $R = 0.4$ and for a low p_T cut-off of $0.15\,\mathrm{GeV}/c$. It has been shown that the non-statistical sources of fluctuations are

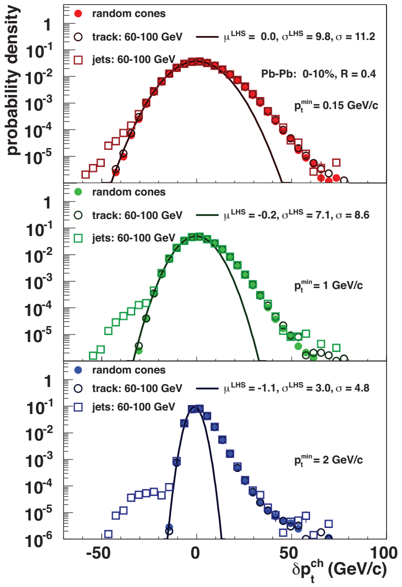

Figure 10: Fluctuations distributions for different minimum particle momentum cutoff and different objects embedded.

driven in part by the anisotropy of the particles emitted from the collision (elliptic and triangular flow). It was also concluded that the anti-k_T algorithm has a modest dependence on the method used to characterize the fluctuations, in particular, on the jet fragmentation pattern. The use of reconstructed charged particles down to $p_T^{min} = 0.15\,\mathrm{GeV}/c$ allows a comparison of the impact of background fluctuations with a minimal bias on hard fragmentation in jet finding to the case with increased bias ($p_T^{min} \geq 1\,\mathrm{GeV}/c$). The observed reduction, Fig.10, of the standard deviation to $\sigma = (4.82 \pm 0.01)\,\mathrm{GeV}/c$ for the $p_T^{min} = 2\,\mathrm{GeV}/c$ case, is driven by the smaller number of particles and the reduced influence of soft region-to-region fluctuations. The asymmetric shape of the δpt distribution with a tail towards positive fluctuations has a large impact on the jet measurement, compared to purely Gaussian case, though the role of signal jets contributing to the tail has to be considered. Using different assumptions on the shape of the true jet spectrum it is found that for $p_T^{min} = 0.15\,\mathrm{GeV}/c$ fluctuations can have a large influence on the charged jet yield for transverse momenta up to $100 \pm 15\,\mathrm{GeV}/c$. The conclusions of this paper are key ingredients to upcoming ALICE papers measuring the jet spectrum.

In $^{3)}$ we address the question of the effects of jet reconstruction and background subtraction in high-energy heavy-ion collisions on different jet observables. Our aim is to gain insight on how these issues affect the understanding and detailed characterization of the produced medium through present jet observables (using the experimental data on the dijet asymmetry and azimuthal correlation and on the missing transverse momentum as references). For this purpose, we use a highly flexible toy model for the background - where particles are simulated according to a thermal spectrum matched to a power law at larger transverse momentum - that allows fluctuations both among different events and, more importantly, event-by-event. By changing the slope of the exponential function, T, we can set different values for the background fluctuations, σ_{jet}, and for the average level of energy deposition, ρ. The results of the toy model have also been checked and found in agreement with those using a detailed Monte Carlo simulator for the background, the PSM model. Jets are generated through pp events in PYTHIA for vacuum jets. In order to address possible interplays between a different structure of in-medium quenched jets, we also generated samples of jets with different degrees of quenching through pp collisions in Q-PYTHIA. We have studied two background subtraction techniques: the FastJet area-based method, where the estimation of the background parameters is made at jet level; and a pedestal method, where the background estimation is made at a calorimetric level and uses a pedestal subtraction.

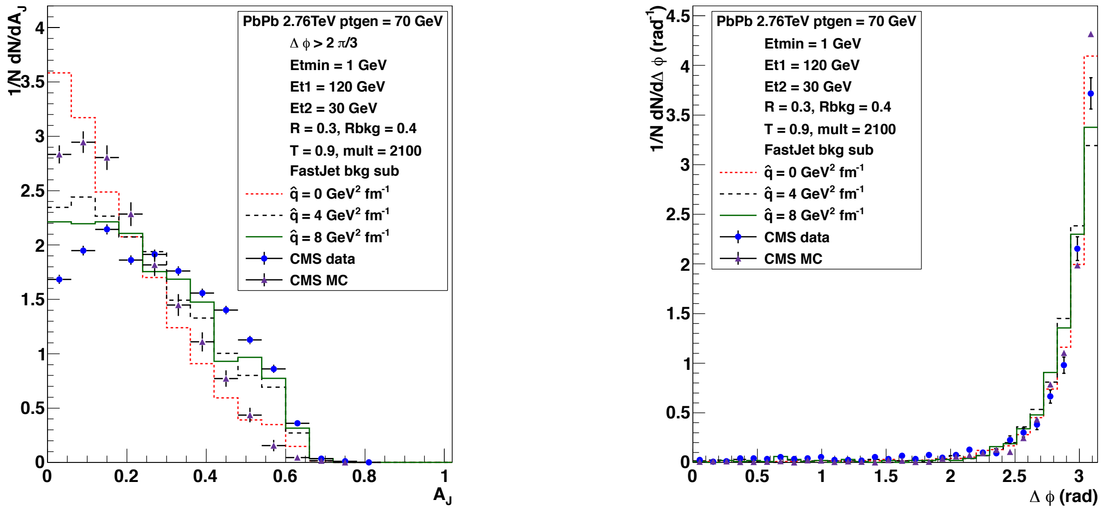

Figure 11: Dijet observables for a simulation using Q-PYTHIA with different $\hat{q}$ embedded in a background with $T = 0.9$ GeV ($\sigma_{jet} \simeq 11$ GeV). The red dotted lines corresponds to $\hat{q} = 0$, the black dashed ones to $\hat{q} = 4$ GeV^2 fm^{-1} and the green solid ones to $\hat{q} = 8$ GeV^2 fm^{-1}. The blue dots are the CMS data with the corresponding error bars, and the purple triangles the CMS Monte Carlo. The background subtraction method is the area-based FastJet one.

From this study, when using the toy model to simulate the background, or a more realistic Monte Carlo simulator, we conclude that for the FastJet background subtraction, an average ρ and σ_{jet} are sufficient to characterize a background, since no apparent dependency was found. As for the pedestal method, we find a higher sensitivity to the background intrinsic structure which requires a tuning of the parameters in the method, specifically the value $E_{T,jets}$ that separates those jets whose constituents are included in the background estimation from those whose constituents are not included, and the value κ that sets the level of background subtraction above the average and leads to larger empty cells for reconstruction. We investigated the dijet asymmetry (A_J) and the average missing transverse momentum observables by comparing Q-PYTHIA embedded in a background with the CMS results. We checked first a Q-PYTHIA simulation without medium effects ($\hat{q} = 0$) which results in qualitative agreement with the CMS simulation (PYTHIA events embedded in a HYDJET background). Then, switching quenching on, we found that Q-PYTHIA has the same trend than CMS data for A_J, meaning an excess of events with large energy imbalance, as shown in Fig.11. Concerning the missing p_T, a softer composition in the subleading jet direction that persists even at large angles from the dijet direction is found. Considering that both this fact and the interpretation of the dijet asymmetry and azimuthal correlations as energy loss without broadening defy the 'standard' understanding of radiative medium-induced energy loss (in which energy loss and broadening are linked and radiation is semi-hard and takes place at large angles), we find this qualitative agreement between Q-PYTHIA and data noteworthy.

From our study, it seems unavoidable to conclude that the naive expectation that background subtraction methods are enough for phenomenological jet studies to extract medium characteristics without considering the background, becomes strongly weakened. Indeed, it seems that realistic - even real - background events and the use and detailed understanding of the background subtraction method used in each experiment are required in order to achieve the medium characterization through jet observables.

In [5] we presented the analysis of the semi-inclusive distribution of reconstructed charged particle jets recoiling from a high p_T hadron trigger in central Pb-Pb collisions at $\sqrt{s} = 2.76$ TeV. Since a high p_T hadron trigger isolates a single high Q^2 interaction within the complex fireball of a central Pb-Pb collisions, we expect to have a similar true coincidence rate per trigger in central Pb-Pb collisions as in pp, modulo quenching, initial-k_T, and other nuclear effects such as shadowing. However, the very large multiplicity in such collisions, which originates almost entirely from interactions that are incoherent with hard interaction generating the hadron trigger, will generate a population of uncorrelated (mainly combinatoric) jets in the recoil acceptance at the rate of a few per trigger, forming a very large background relative to the expected true coincidence rate of a few percent.

Model studies show that an attempt to measure the hard jet distribution by unfolding background fluctuations without prior removal of the combinatorial jet component is not a mathematically well-posed problem, leading to unstable and wildly wrong results. In order to suppress the non-coincident jet contribution without introducing infra-red unsafe or collinear-unsafe cuts, we utilize the differential coincidence observableΔ_{Recoil}. The technique is based on the realization that the distribution of combinatorial background jets is, by definition, *uncorrelated* with p_T^{trig}. This raises the possibility of a purely data-driven elimination of the combinatorial jet population, by considering the measurement of the *difference* of the recoil jet distributions for two *exclusive* hadron trigger classes, "signal" and "reference":

$$\text{Signal}: p_{T,low}^{Sig} < p_T^{trig} < p_{T,high}^{Sig} \tag{1}$$

$$\text{Reference}: p_{T,low}^{Ref} < p_T^{Ref} < p_{T,high}^{Ref}, \tag{2}$$

where $p_{T,low}^{Sig} > p_{T,high}^{Ref}$. Then the differential observable Δ_{Recoil} is defined as:

$$\Delta_{Recoil} = \frac{1}{N_{trig}^{Sig}} \frac{dN}{dp_T^{jet}} \mid_{Sig} - c \cdot \frac{1}{N_{trig}^{Ref}} \frac{dN}{dp_T^{jet}} \mid_{Ref} . \tag{3}$$

The scaling factor c of the Reference distribution is applied to account for the observed strict conservation (at the per mille level) of jet density in the experimental acceptance, which results in increasing displacement of combinatorial jets by true, hard coincidence jets as p_T^{trig} increases. The scaling factor c is measured in the region of negative and low jet p_T where the combinatorial contribution dominates, and differs from unity by less than 4%.

Δ_{Recoil} represents the *evolution* of the coincident recoil jet distribution, i.e. from the same hard interaction, as the trigger p_T evolves from the lower p_T trigger interval ("reference") to the higher p_T trigger interval ("signal"). This observable, while uncommon, is nevertheless perturbatively well-defined.

The Pb-Pb measurements are compared to a pp PYTHIA reference distribution generated at the same energy. Modification of the jet structure due to quenching is explored by varying the cone radius R (0.2, 0.4) and the lower p_T cutoff of the charged particle constituents (0.15, 2.0 GeV/c). To explore the energy redistribution within the recoil jets, we consider the ratio for the measured Δ_{recoil} distribution over the same observable calculated with PYTHIA,$\Delta_{\mathrm{IAA}}^{\mathrm{PYTHIA}}$. This ratio is presented in Fig.12 for $R = 0.4$ and $p_{\mathrm{T}}^{\mathrm{const}} > 0.15$ GeV, for $R = 0.2$ and $p_{\mathrm{T}}^{\mathrm{const}} > 0.15$ GeV and for $R = 0.4$ and $p_{\mathrm{T}}^{\mathrm{const}} > 2$ GeV. Comparison of these distributions does not indicate a large energy redistribution, relative to PYTHIA, transverse to the jet axis, or towards lower p_T constituents, though more precise statements will be possible with reduced systematic uncertanties and higher statistics data.

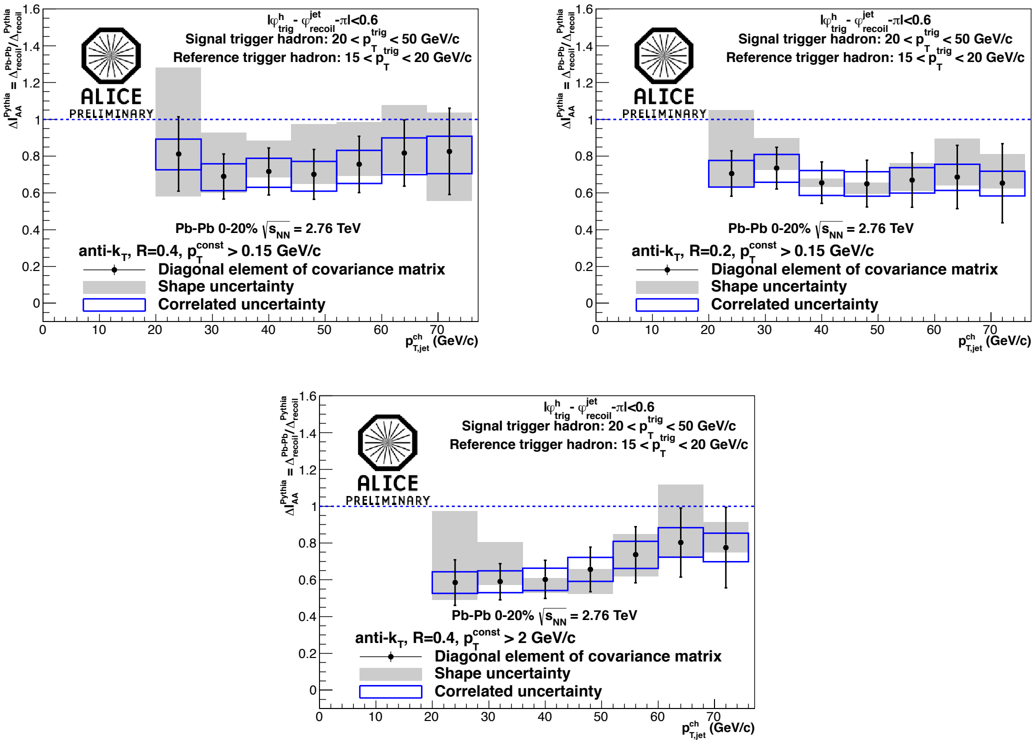

Figure 12:Δ $^{PYTHIA}_{IAA}$ distributions for different radius.

5 Activity in the Seventh Framework Programme in HadronPhysics3

Part of the activities of the LNF group described in the present activity report, have been performed in HadronPhysics3 in the Seventh Framework European Programme. In particular a Joint Research Activity has been developed in collaboration with the Centre National de la Recherche Scientifique CNRS/IN2P3 and the Universidad de Santiago de Compostela, with the aim to expand the physics capabilities of the ALICE Electromagnetic Calorimeter (EMCal) by enabling back-to-back correlation measurements.

The collaboration among these institutes concentrated the efforts on the first LHC runs showing that the EMCal has superb capabilities for inclusive jet measurements. However, as discussed in the previous sections, a critical consideration in the detector design for the measurement of the correlations is the capability to deliver acceptance adequate for dijet measurements with p_t up to 150 GeV/c, and an energy resolution and an electromagnetic shower shape determination sufficient for γ/π_0 discrimination, up to at least $p_t \simeq 30$ GeV/c, in central Pb-Pb collisions. The simulation studies carried out verified that the technology originally developed for the EMCal meet these requirements. As a consequence, the technical solutions developed in the framework of the electomagnetic calorimeter constuction, as well as the developed tools for the calorimeter assembling and tests and the dedicated infrastructure, have be used for the DCal construction.

An essential capability for the measurement of hadron-, jet- and γ- jet correlations is a fast and efficient Level 1 (L1) trigger, (obtained by means of a “jet patch”on total energy summed over finite phase space area), provided by the combination of electromagnetic calorimeters EMCal and DCal. The L1 trigger architecture developed for EMCal will be used for DCal and applied in the correlation measurements. However, at the L1 the jet trigger operates only on the Electromagnetic Calorimeter response and a full energy measurement is possible only at High Level Trigger (HLT), where the charged particle momenta become available as input to the trigger algorithms. More specifically: i) in pp collisions HLT can re-evaluate the L0/L1 hardware trigger decision and can be used for both monitoring of the triggers and post-filtering of the triggered events. ii) in Pb-Pb collisions the primary role of the HLT is to provide further rejection power. In particular, HLT is designed to increase the statistics of recorded physics events of interest by a factor of 10 for Pb-Pb collisions. Thus, to fully exploit the broad range of correlation measurements that will be performed by the overall EMCal + DCal calorimeters, the trigger optimization using the HLT response for the full event reconstruction is mandatory. The activity performed in 2012 concerning the HLT development has been focused on the optimization of clustering algorithms using p-p collisions and on the development for correlation measurements in heavy collisions. A significant amount of effort in this framework has been placed in the development of the jet reconstruction and background subtraction. This activity mainly included the introduction of new jet algorithms, the comparison between different algorithms, the study of new techniques for the subtraction of the underlying event. In 2012 we perform an extensive study of jets with focus on dijet asymmetry and missing transverse momentum. We addressed the question to which extent the most commonly used subtraction techniques are able to eliminate the effects of the background on the most commonly discussed observables at present: single inclusive jet distributions, dijet asymmetry and azimuthal distributions. The analysis of the influence of background subtraction and quenching on jet observables in heavy ion collisions have been completed.

References

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2. J. Allen *et al.*, *ALICE DCal: An addendum to the EMCAL Technical Design Report*, CERN LHCC-2010-011, 20 June 2010;

3. N. Armesto, L. Apolinario, L. Cunqueiro *An analysis of the influence of background subtraction and quenching on jet observables in heavy ion collisions*, JHEP **1302** (2013) 022;

4. ALICE Collaboration, *Measurement of Event Background Fluctuations for Charged Particle Jet Reconstruction in Pb-Pb collisions at* $\sqrt{s_{NN}} = 2.76$ *TeV*, JHEP **1203** (2012) 053;

5. L.Cunqueiro, *Jet structure at* 2.76 *TeV collisions at ALICE*, arXiv: 1210.7610, QM 2012, to be published in Nuclear Physics, Section A.

Publications

The ALICE Collaboration has published 26 papers in 2012. The publications are accessible at the link: http://aliceinfo.cern.ch/ArtSubmission/publications

1. N. Armesto, L. Apolinario, L. Cunqueiro, *An analysis of the influence of background subtraction and quenching on jet observables in heavy ion collisions*, JHEP **1302** (2013) 022.

Conference Talks

1. N. Bianchi, *Hadron multiplicities in SIDIS off nucleons and nuclei*, HEP in the LHC Era, Valparaiso, Chile, January 2012;
2. L. Cunqueiro *Jet Physics with ALICE*, 7^{th} International Workshop on High-pT physics, March 2012, Hanau-Frankfurt;
3. F. Ronchetti, *The ALICE electromagnetic calorimeter high level triggers*, Computing in High Energy and Nuclear Physics (CHEP), May 2012, New York;
4. A. Fantoni, *An overview of the ALICE experiment at LHC*, LatinoAmerican Workshop on High Energy Physics: Particles and Strings, July 2012 - Havana, Cuba (invited talk);
5. L. Cunqueiro, *ALICE latest results*, Fundamental Physics Coference, July 2012, Benasque, Spain (invided talk);
6. P. Di Nezza, *Probing the medium with hard probes in ALICE*, Heavy Ion Collisions in the LHC Era, July 2012, Qui Nhon, Vietnam (invited talk)
7. L. Cunqueiro, *Jet structure in 2.76 TeV Pb-Pb Collisions at ALICE*, Quark Matter, August 2012, Washington.

Conferences Organization

1. High Level Trigger Meeting, LNF 9-11 February, 2012;
2. Alice Physics Week, LNF 16-20 April, 2012.

Proceeding and Notes

1. F. Ronchetti et al., *The ALICE electromagnetic calorimeter high level triggers* Journal of Physics: Conference Series 396 (2012) 012045;
2. L. Apolinario, N. Armesto and L. Cunqueiro, *Background subtraction and jet quenching on jet reconstruction*, arXiv:1207.6587, Hard Probes 2012;
3. L.Cunqueiro, *Jet structure at* 2.76 *TeV collisions at ALICE*, arXiv: 1210.7610, QM 2012, to be published in Nuclear Physics, Section A;
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