Direct γ-hadron correlations in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with ALICE

Eliane Epple
for the ALICE collaboration

Motivation

In specific LO-QCD scattering processes direct photons (γ) are produced back-to-back with a parton. In the case where these hard scattering events occur inside of a heavy-ion collision, they can be utilized to probe the properties of the created medium. While the parton fragments and interacts with the medium, the photon leaves the QCD medium unaffected. Thus, correlating the γ with the fragmented hadrons in an event can yield information about the properties of the medium and how the presence of the QCD medium affects the fragmentation process.

Previous Observations

Measurements of γ-hadron correlation functions in heavy ion collisions have been performed at RHIC (see right figs.). These measurements showed that the parton fragmentation function is modified with respect to pp collisions. The data revealed a depletion of fragments at high z_T (p_T^h/p_T^γ), which is equivalent to low ξ ($\log(1/z_T)$), and an enhancement at low z_T. We do not know precisely, the extent to which this effect depends on p_T^h, p_T^γ and/or the angle off the main jet axis in which the fragments are counted. To answer this question, new analyses which differentiate with respect to the above quantities are on the way.

A. Adare et al [PHENIX Coll.]
Phys. Rev. Lett. 111 (2013) 3, 032301

L. Adamczyk et al [STAR Coll.]
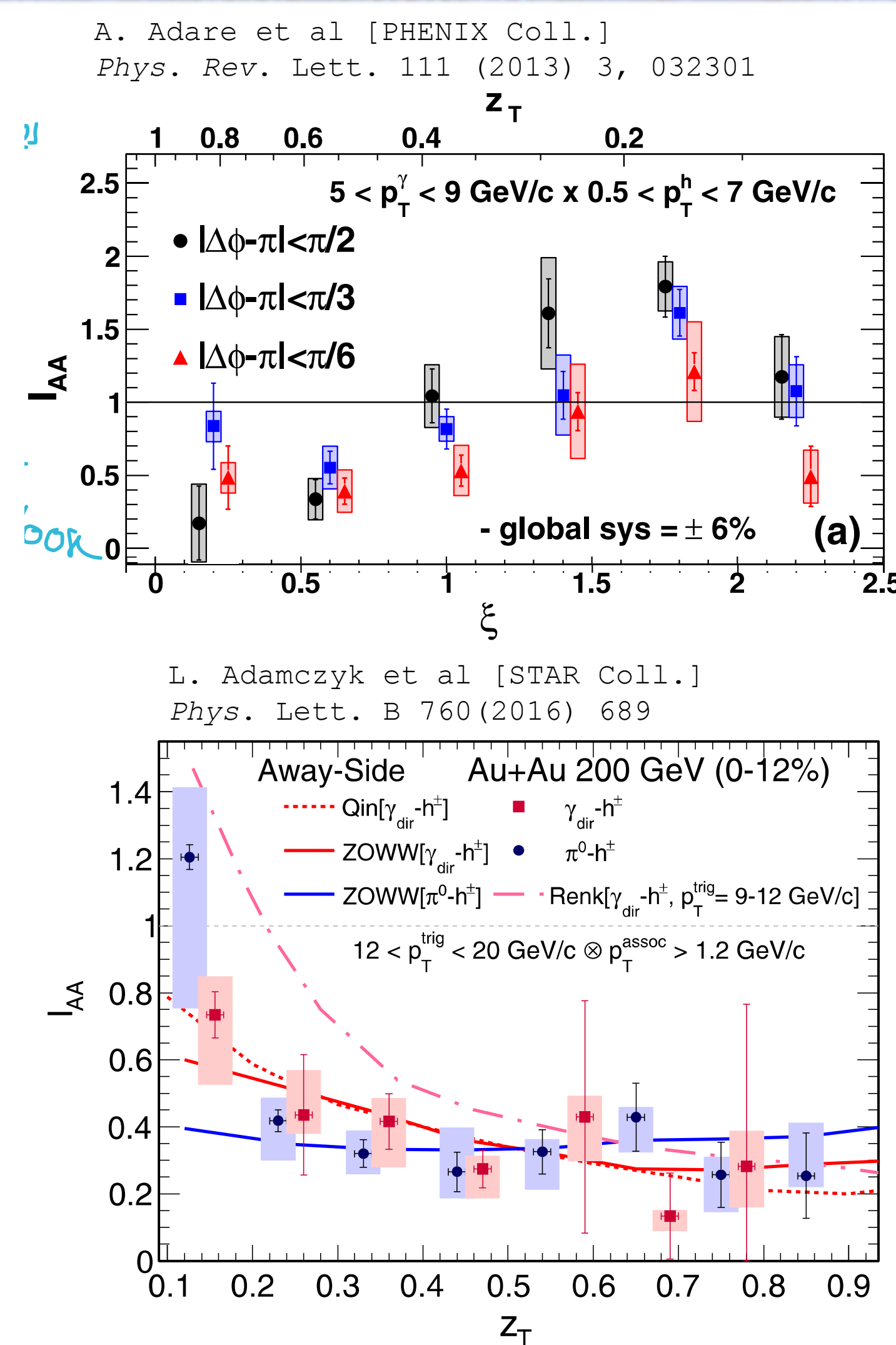*Phys.* Lett. B 760 (2016) 689

Selected Subsystems of ALICE

ALICE is a multipurpose spectrometer, designed for heavy-ion experiments. For the present data analysis, tracks were reconstructed in the time projection chamber (**TPC I**) and inner tracking system (**ITS II**) and were combined with clusters from the electromagnetic calorimeter (**EMCal III+IV**).
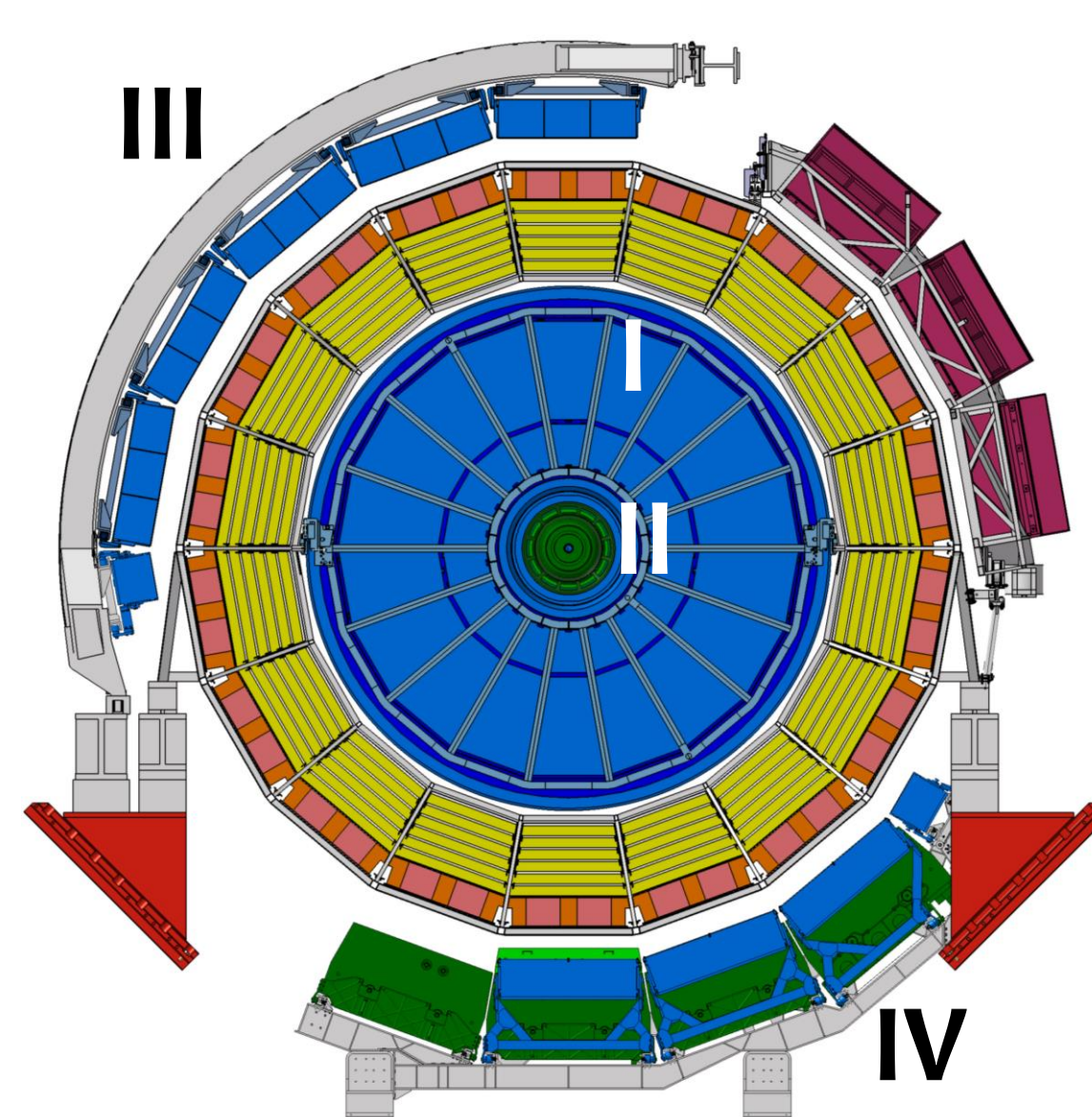
While tracks are reconstructed in full azimuth and for $|\eta|$<0.9, clusters in the EMCal are reconstructed for (III) $|\eta|$<0.7 and 80°<φ<187° (IV) 0.22<$|\eta|$<0.7 and 260°<φ<327°.

cross section through ALICE

Analysis of Inclusive-γ-h Correlations

The analysis is performed on Pb-Pb collisions at a center of mass energy of $\sqrt{s_{NN}}$ = 5.02 TeV. During the data taking, an EMCal L1-γ trigger was used to enhance the statistics for events that contain clusters with E_T>10 GeV (Fig. 1 a).

For this analysis, tracks of p_T>0.15 GeV/c are combined with selected EMCal clusters of E_T>10 GeV. Their pair yield is presented as per $\Delta\eta^{cluster-h}\Delta\varphi^{cluster-h}$ (Fig. 2). The correlated yield in the near and away side is visible and sits on top of a large background of uncorrelated pairs from the underlying event. The analysis is performed in different bins of $E_T^{cluster}$, $p_T^h/E_t^{cluster}$, and $\log(E_T^{cluster}/p_T^h)$ to deliver results that can be compared to the previous RHIC measurements. Distributions for two of the bins in $E_T^{cluster}$ are presented in Fig. 2. The distributions in Fig. 1 show that the potential reach of this analysis is promising in yielding broad z_T and ξ value ranges.
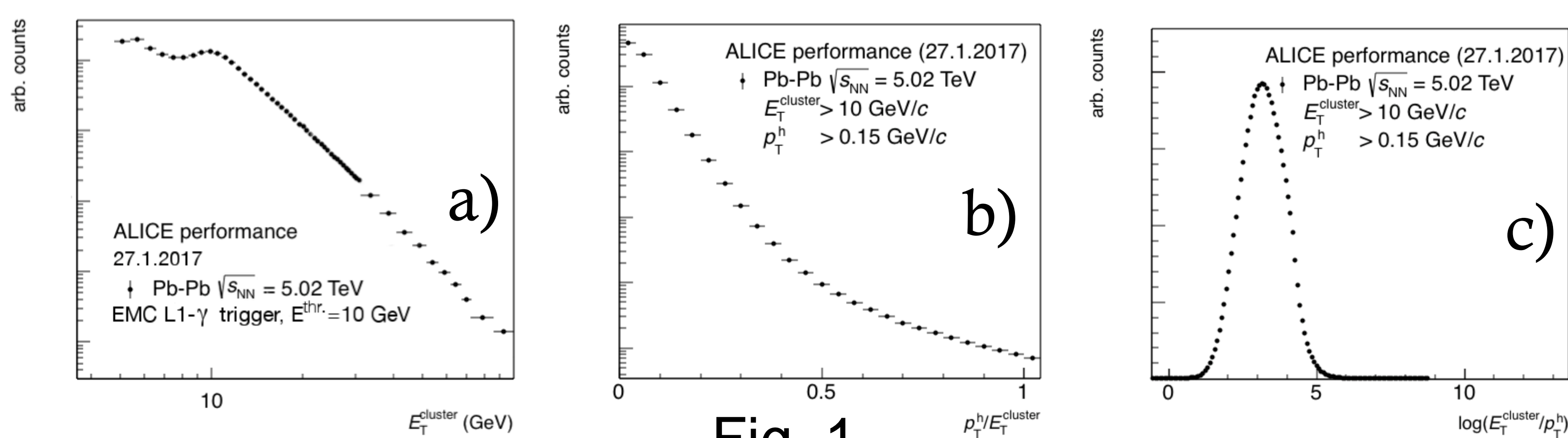

Fig. 1

The Road to Direct γ-h Correlations

To arrive at a final result for direct γ-hadron correlations, same event distributions are divided by the correlation functions from mixed events to correct for finite acceptance and efficiency. The remaining underlying event is then subtracted, taking into account v_n components. At the end, the decay γ-hadron contribution to the inclusive-γ-hadron yield will be subtracted. To determine the amount of decay contribution that needs to be subtracted, one can use an R_γ-factor (relating number of inclusive to decay photons, see Fig. 3). These steps will allow us to obtain in a final step direct γ-h correlations, in order to reconstruct the fragmentation function.
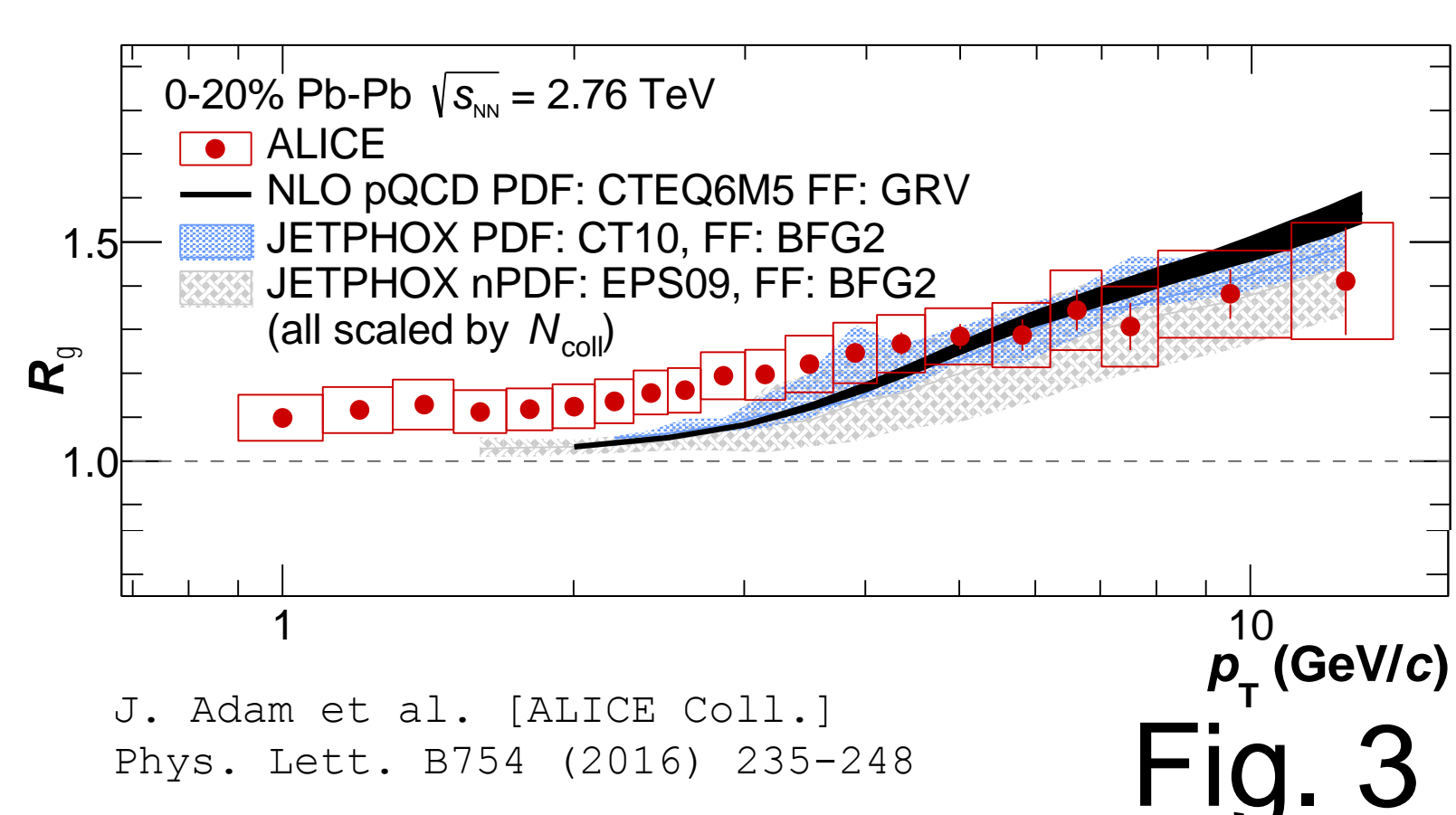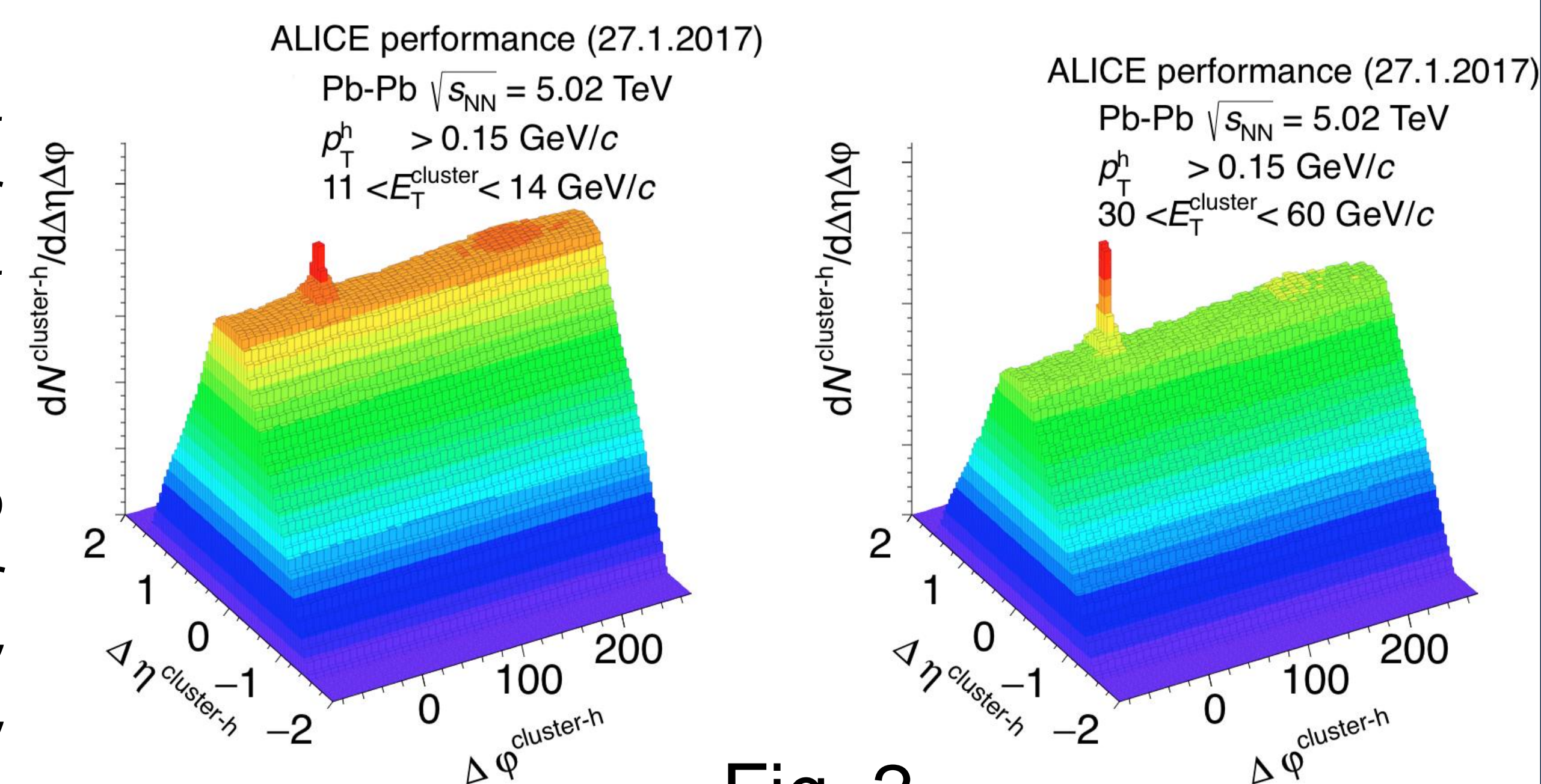

J. Adam et al. [ALICE Coll.]
Phys. Lett. B754 (2016) 235-248

Fig. 3

Fig. 2