Angular correlations in UPC with ALICE

Josué Martínez García* , Mario Rodríguez Cahuantzi
josue.martinez.garcia@cern.ch

Faculty of Science Physics Mathematics
Benemérita Universidad Autónoma de Puebla
Mexico

ALICE Mexico day

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Ultraperipherical Collisions (UPC)

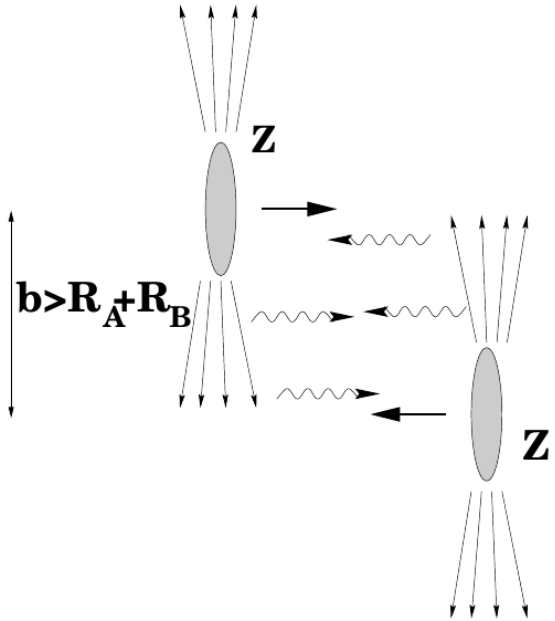
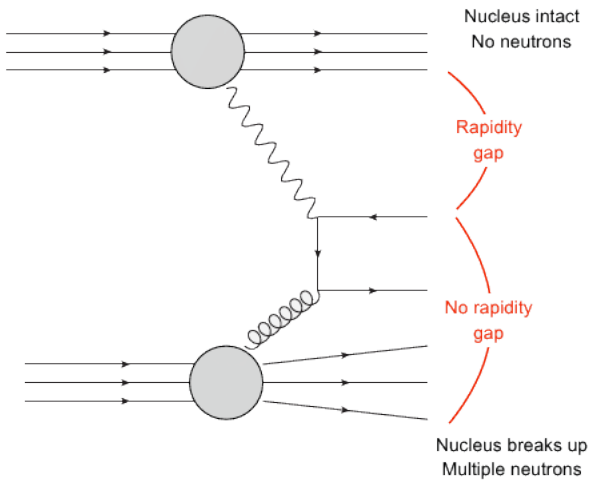
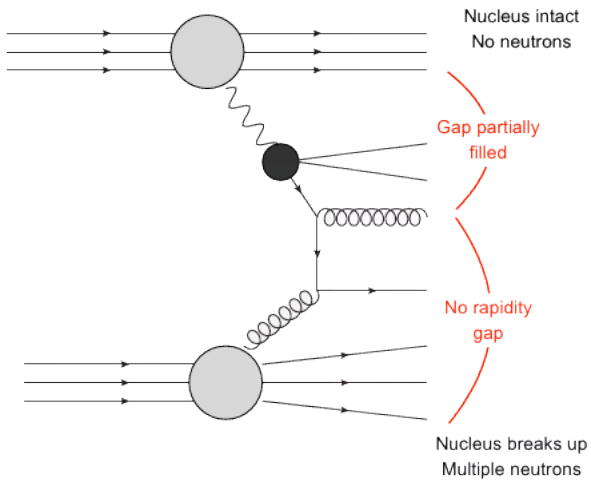
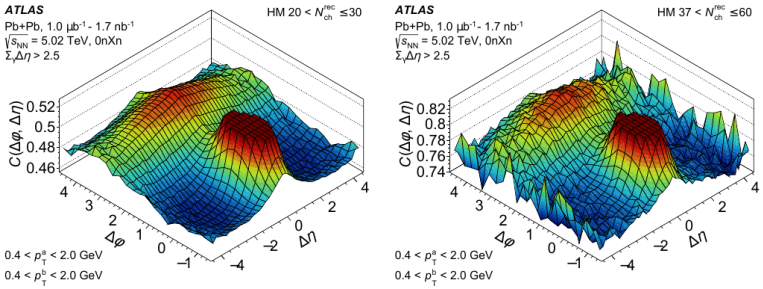


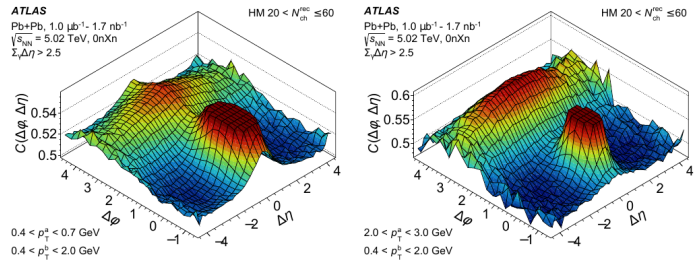
Figure: Scheme of a UPC.

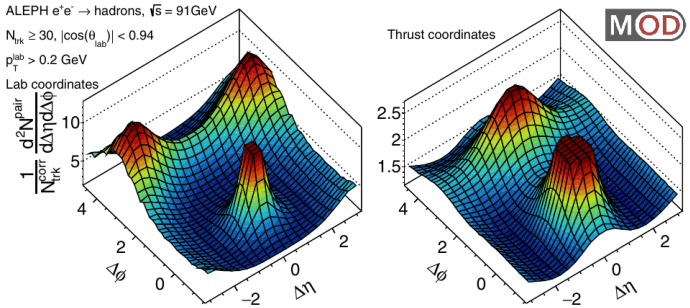


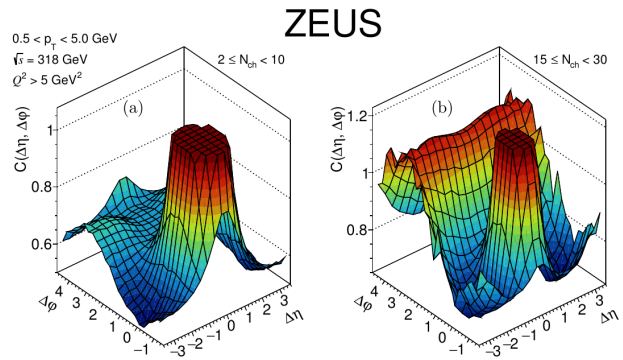


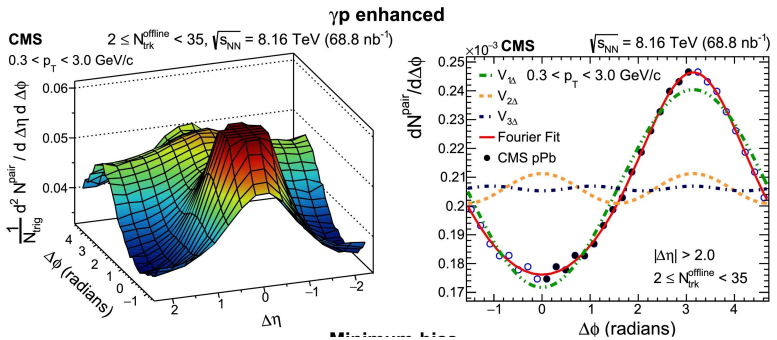
State of the art











[1] Two-particle azimuthal correlations in photonuclear ultraperipheral Pb+Pb collisions at 5.02 TeV with ATLAS

[2] Two-particle azimuthal correlations as a probe of collective behaviour in deep inelastic ep scattering at HERA

[3] Measurements of Two-Particle Correlations in e^+e^- Collisions at 91 GeV with ALEPH Archived Data

[4] Two-particle azimuthal correlations in γp interactions using pPb collisions at $\sqrt{s_{NN}}$ = 8.16 TeV

State of the art

※ Increase of interest in the study of properties of the system photonuclear.

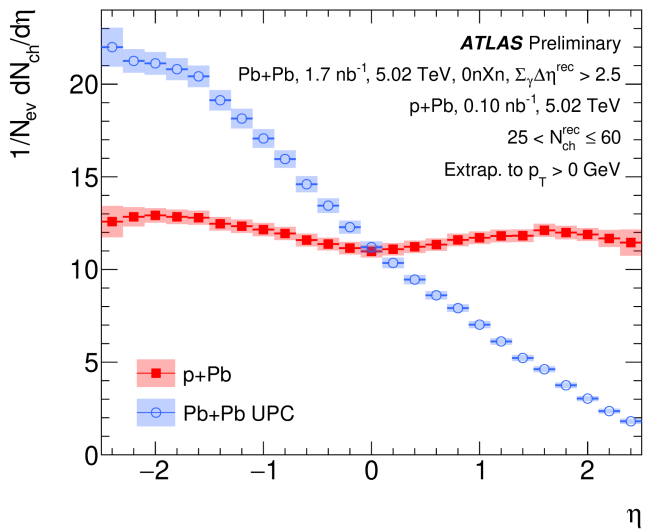


Figure: Charged-hadron yields as a function of η. [1]

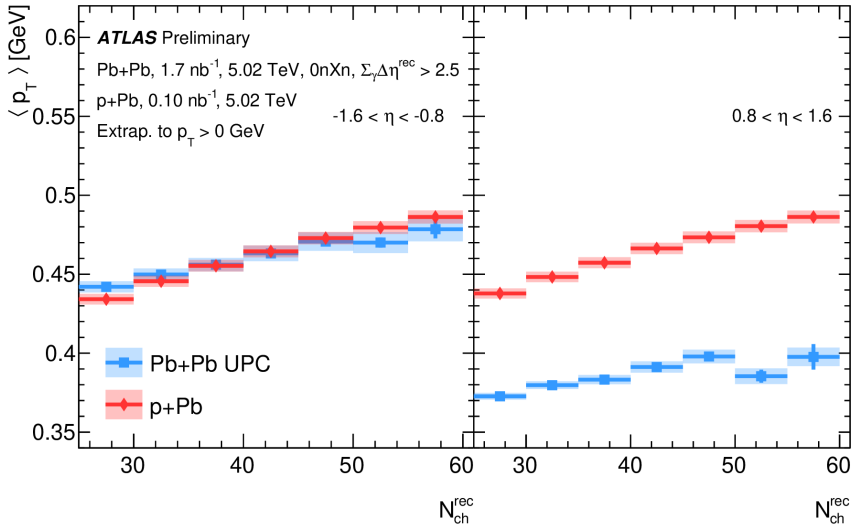


Figure: $\langle p_T \rangle$ of charged-hadron yields as a function of N_{ch}^{rec}.[1]

[1] Charged-hadron yield measurements in photo-nuclear collisions using 5.02 TeV Pb+Pb data with ATLAS

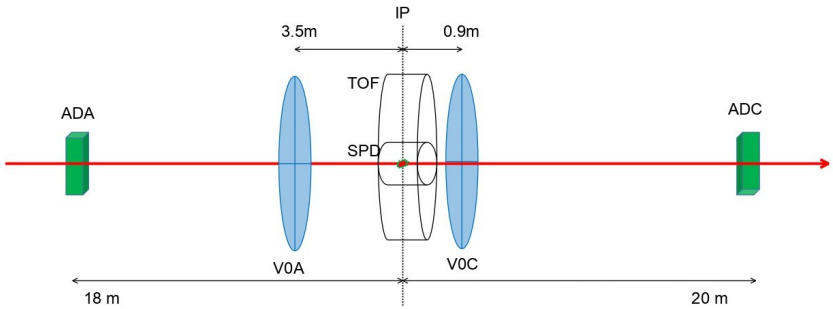
UPC with ALICE

※ **Nuclear Dissociation.** Presence of none neutron in one side and at least one neutron in the opposite side:

⇝ ZNC energy: $E > 1$ TeV.

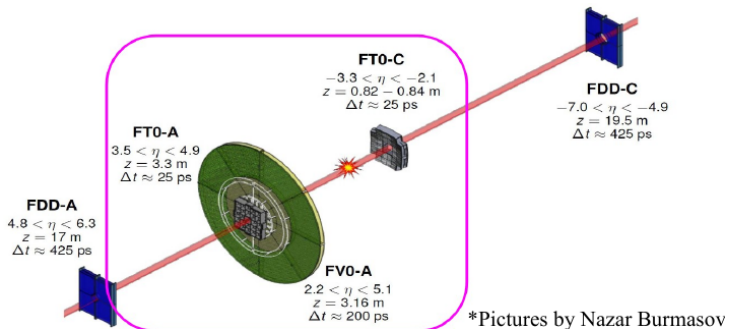
⇝ ZNA energy: $E < 1$ TeV.

※ **Run 2**



⇝ **Online Trigger:** Vetos en los detectores V0 y AD con diferentes combinaciones de señales en los detectores TOF y SPD [1].

※ **Run 3**



*Pictures by Nazar Burmasov

⇝ **Offline Selection:** Definition of **gap sides** in base of FIT activity over a amplitude threshold in ± 2 BCs:

※ FT0A < 50 to gap side A

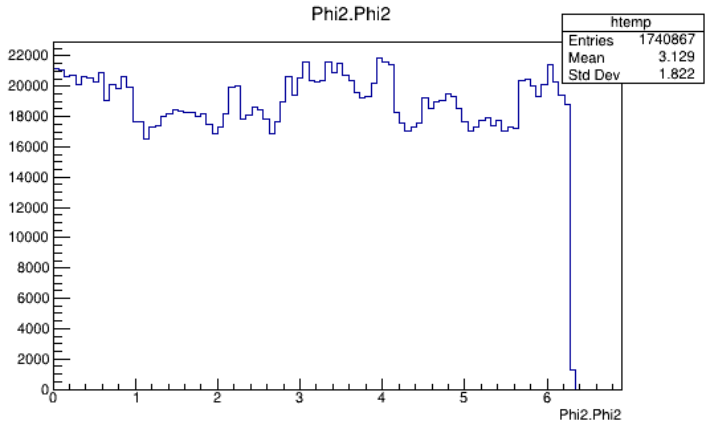
※ FT0C < 50 to gap side C

[1] Trigger definition to UPC.

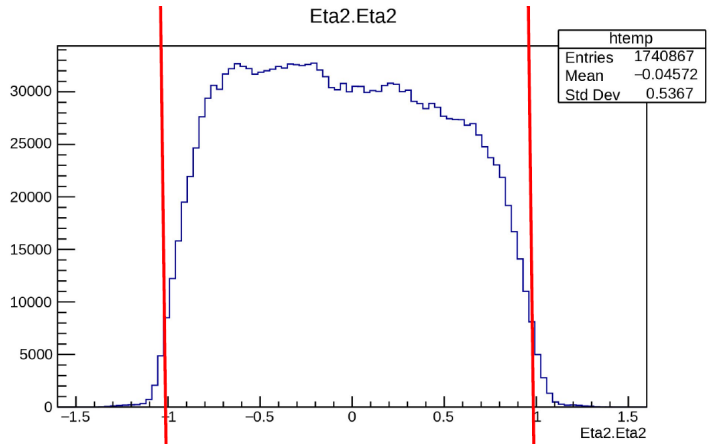
Results in Run 2

The next features were found to UPC events.

※ ϕ distribution:

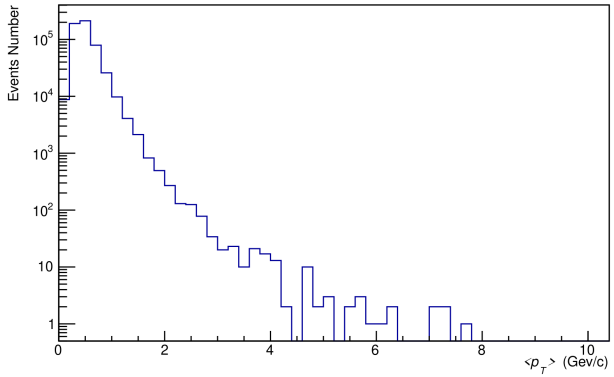


※ η distribution



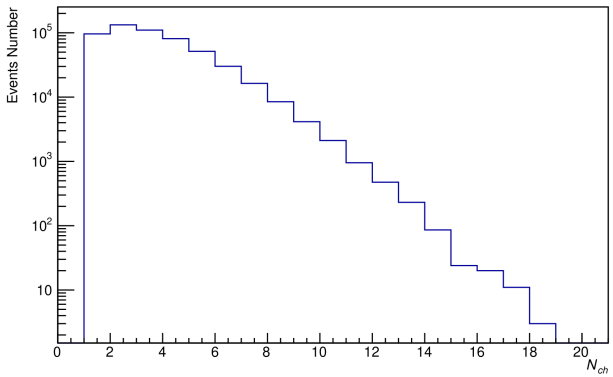
$|\eta| < 1$

※ $\mathbf{p_T}$ dsitribution:



Range 0.15 GeV $\leq p_T \leq$ 10 GeV.

※ $\mathbf{N_{ch}}$ distribution



Angular correlation with ALICE

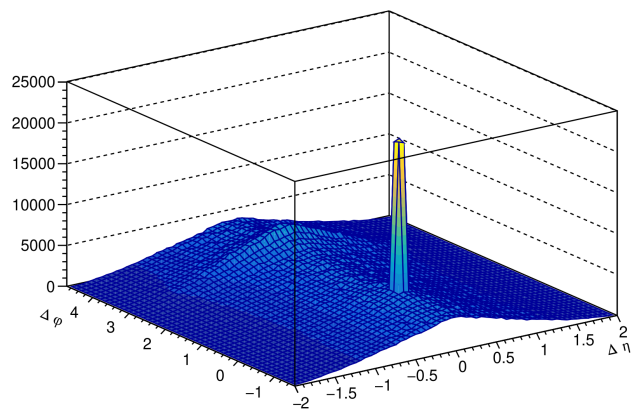
To obtain the angular correlation at two particles, we took into account the relative variations: $\Delta\eta = \eta^a - \eta^b$ and $\Delta\phi = \phi^a - \phi^b$.

- ※ Labels denote cinematic selection of first and second particle.
  - ⇝ $0.15\ \text{GeV} \leq p_T \leq 10\ \text{GeV}$.
  - ⇝ $|\eta| < 1$
- ※ Particles a and b are generally different but with same cinematic selections.

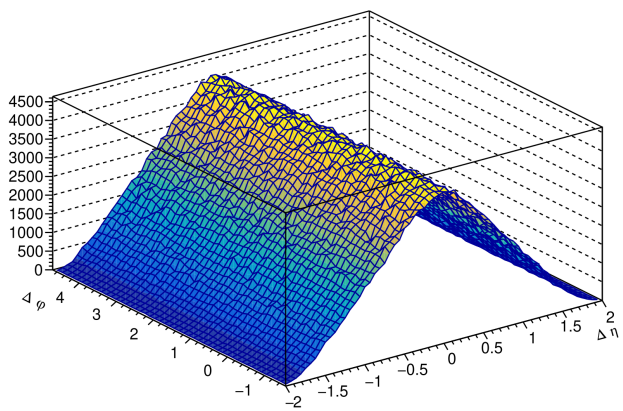
The angular correlation function studied is

$$C(\Delta\phi, \Delta\eta) = \frac{1}{N_a}\frac{d^2N_{pair}}{d\Delta\phi d\Delta\eta} \Big/ \frac{1}{N_{pair}^{mixed}}\frac{d^2N_{mixed}}{d\Delta\phi d\Delta\eta} \tag{1}$$

The numerator consist of the angular correlation for the same event and is corrected for acceptance effects dividing by a angular correlation to mixed events.
$|\eta| < \mathbf{1}$



(a) Same-event pair distribution. **This work.**



(b) Different event pair distribution. **This work.**

Angular correlation with ALICE

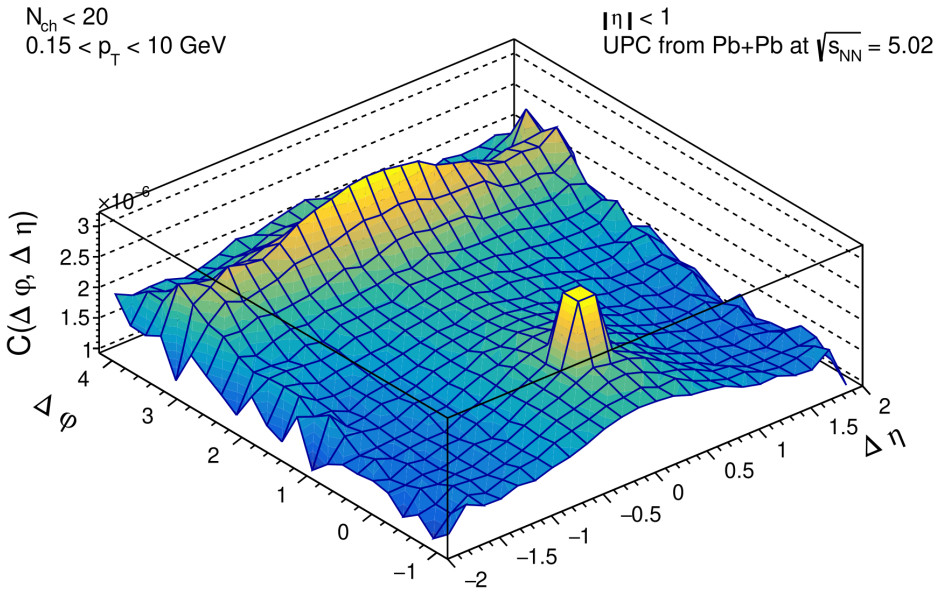


Figure: Función de Correlación Angular $C(\Delta\phi, \Delta\eta)$. **This work.**

※ Range in $\Delta\eta$: $-2 < \eta < 2$.

※ Range in $\Delta\phi$: $-\pi/2 < \phi < 3\pi/2$.

※ It doesn't contains autocorrelation at $(\Delta\phi, \Delta\eta) = (0.0)$.

※ A ridge structure is observed.

Complementary studies: $\langle p_T \rangle$ vs N_{ch}

The relation $\langle p_T \rangle$ vs N_{ch} in the photonuclear system is shown together with pp, p+Pb y Pb+Pb systems in the range $|\eta| < 0.3$.

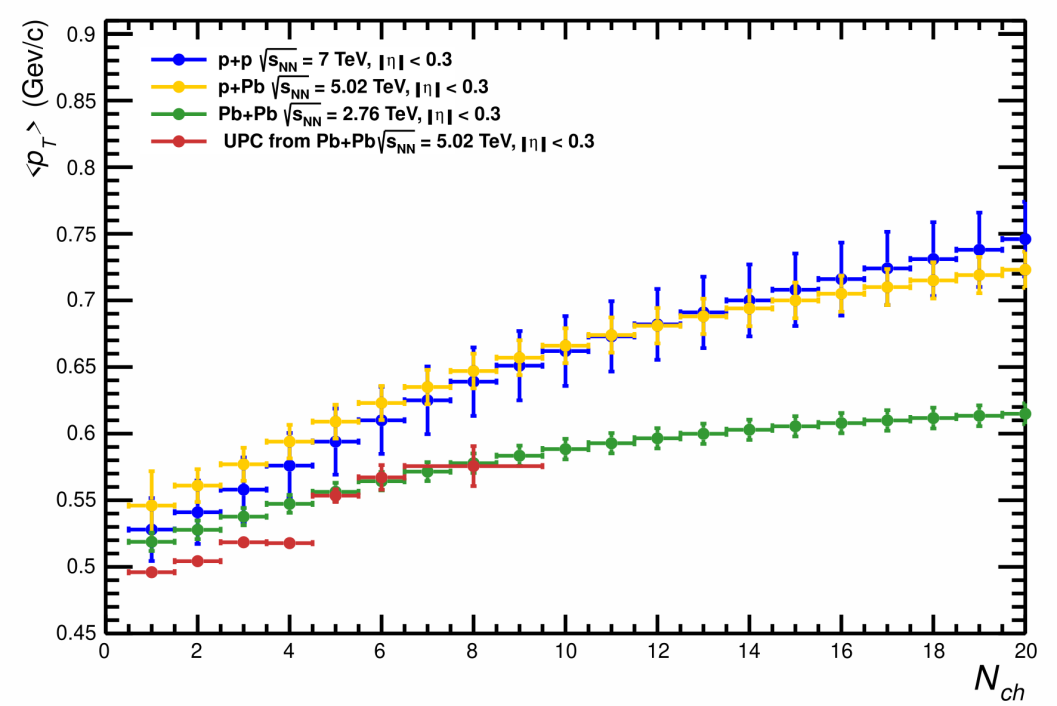
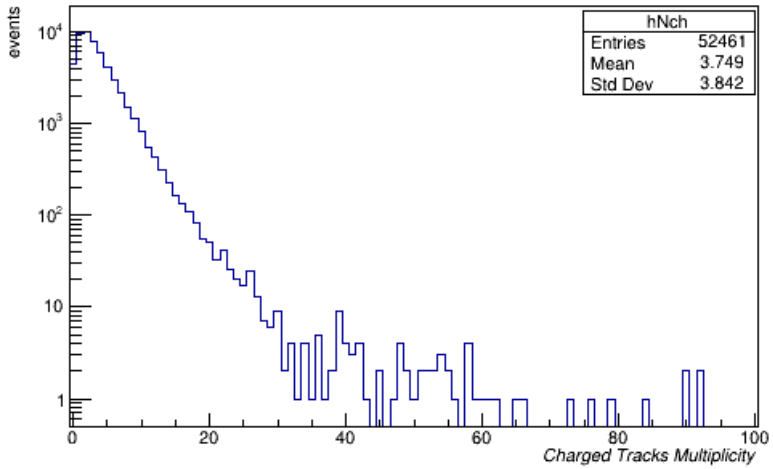


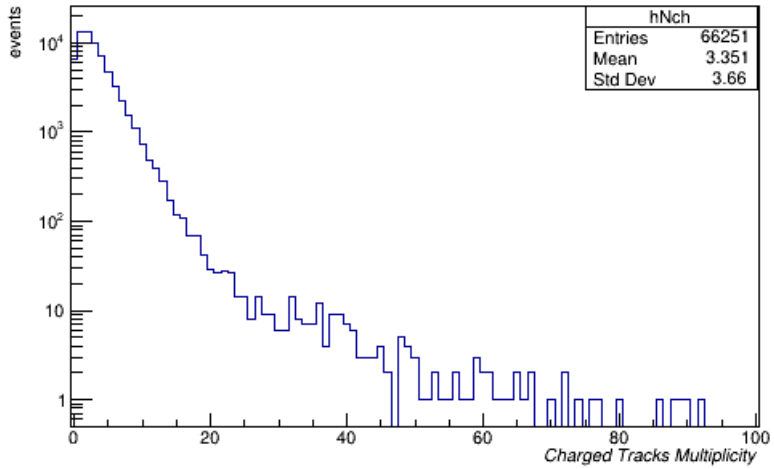
Figure: $\langle p_T \rangle$ vs N_{ch} measured in **this work** (in red) in comparison with measurements done by ALICE [1].

[1] Multiplicity dependence of the average transverse momentum in pp, p–Pb, and Pb–Pb collisions at the LHC

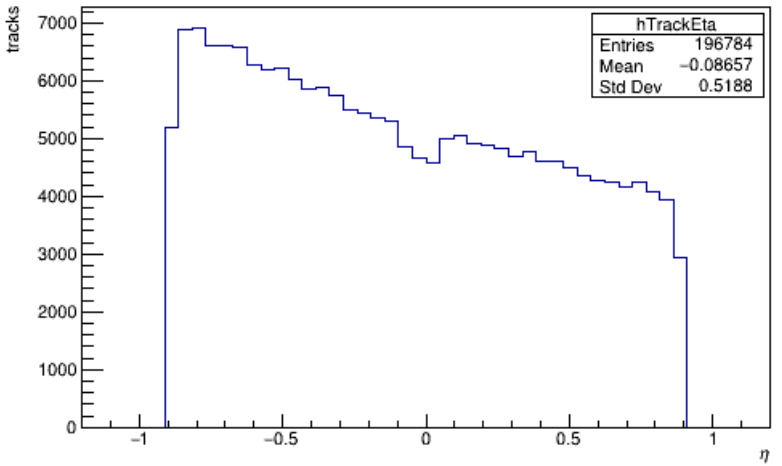
Complementary studies: $\langle p_T \rangle$ vs N_{ch}. First look into Run 3 data



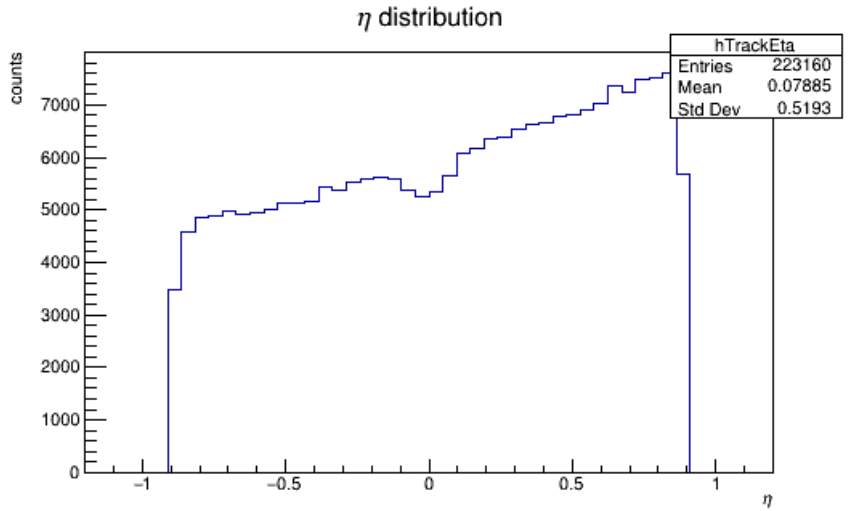
(a) Charged tracks distribution by events. Gap on side A.



(b) Charged tracks distribution by events. Gap on side C.

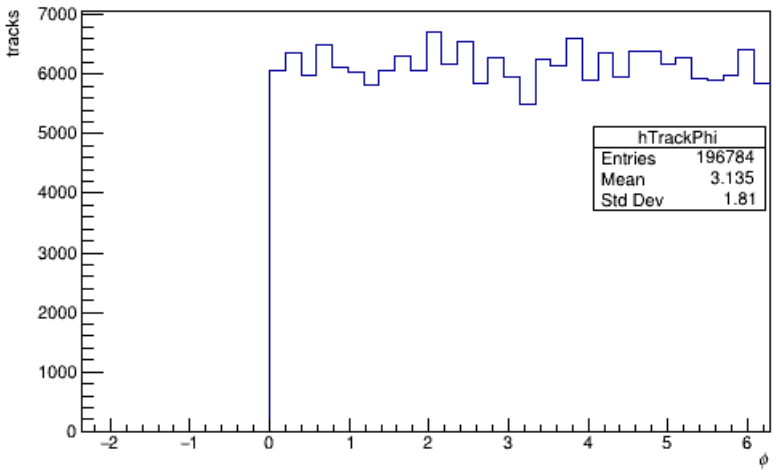


(a) η distribution. Gap on side A.

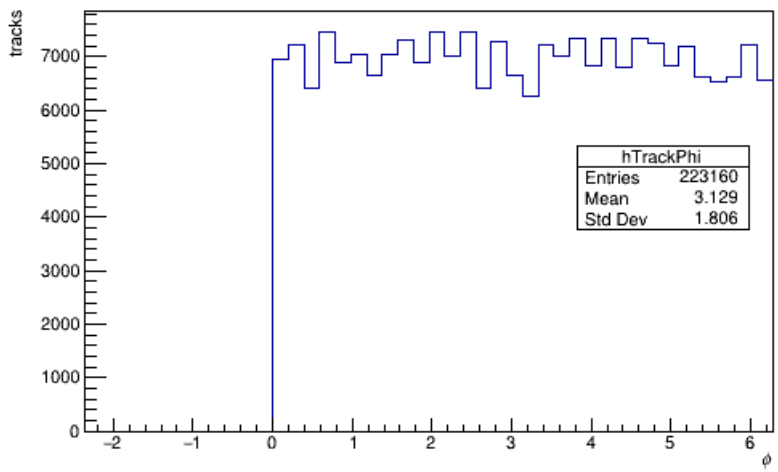


(b) η distribution. Gap on side C.

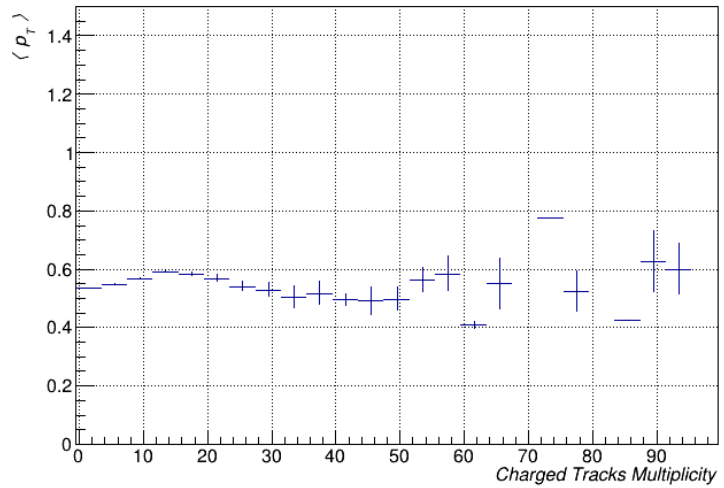
Complementary studies: $\langle p_T \rangle$ vs N_{ch}. First look into Run 3 data



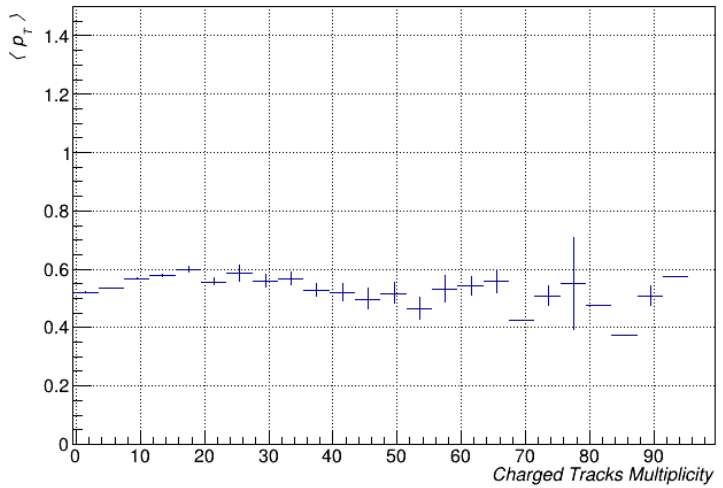
(a) ϕ distribution. Gap on side A.



(b) ϕ distribution distribution. Gap on side C.



(a) Gap on side A.



(b) Gap on side C.

※ Summary

- ⇝ An angular correlation along $\Delta\eta$ at $\Delta\phi \approx \pi$ in the photonuclear system studied was observed.
- ⇝ UPC group point me to systematic studies are needed and there is a challenge to perform them with Run 2 data due to lack of statistics to verify the results. We have started to use Run 3 datasets.
- ⇝ $\langle p_T \rangle$ vs N_{ch} analysis in photonuclear collisions may provide ground insights to understand collectivity phenomenon in small systems being a system with initial state simpler.
- ⇝ The measurement of $\langle p_T \rangle$ vs N_{ch} correlation obtained in this work represent a reference to theoretical models in UPC events and how it is related with small systems.

※ Future work

- ⇝ Implementation of the current angular correlation analysis with Run 3 data and the following points:
- ⇝ Zero-Yield-At-Minimum (ZYAM) subtraction in the angular correlation at two particles.
- ⇝ Subtraction of non flow contribution of angular correlation at two particles.
- ⇝ Obtaining projection of $\Delta\phi$ onto $\Delta\eta$ in the angular correlation at two particles.
- ⇝ ...
- ⇝ We expect preliminary results around the summer of next year.

Thanks!