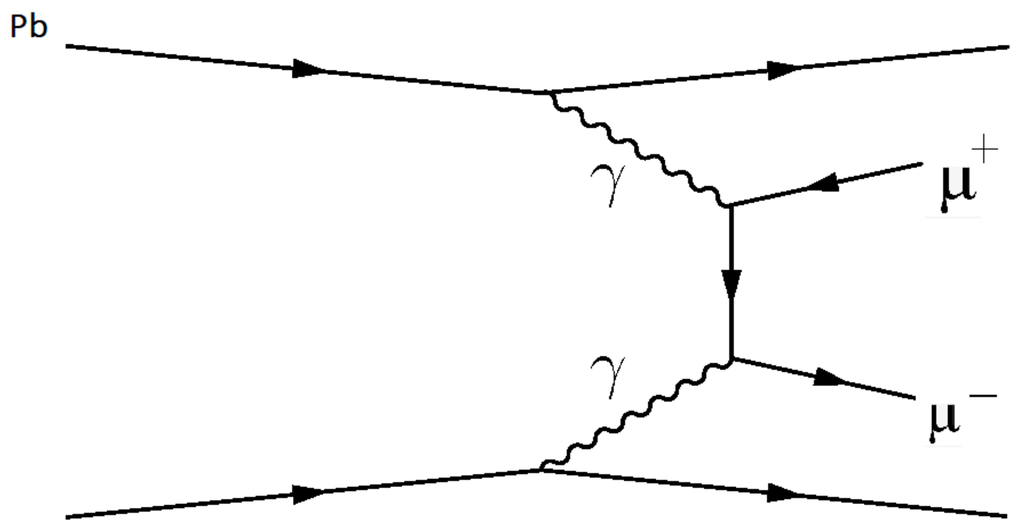
# Photoproduction of muons using ultraperipheral PbPb collisions at CMS

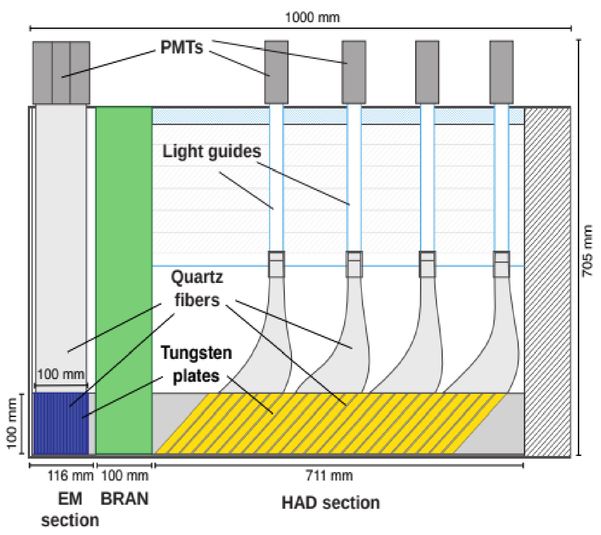
Juan Marquez on behalf of the CMS Collaboration

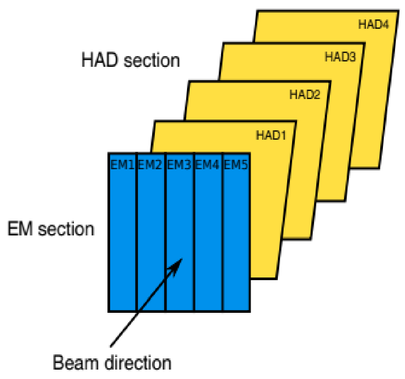



Twiki.cern.ch/twiki/bin/view/CMSPublic/FWD11004ExclusiveDiPhotonDiElectron

Ultraperipheral collisions (UPC) correspond to electromagnetically interacting ions separated with a high impact parameter (b), and whose electric fields collide. As shown in the leading order-Feynman diagram, the relativistic ions act as sources of photons that collide with each other and for example produce muons. We use 2018 PbPb CMS data with an integrated luminosity of 1.5nb$^{-1}$ to study the γγ → μμ interactions.

## Zero-degree Calorimeter




Zero-degree- calorimeters (ZDC) are located ±140m from the interaction point. They are used to detect neutral particles like neutrons. The neutrons are used to determine the topology of the collision. It covers the pseudorapidity range $|\eta| > 8.3$

## Acoplanarity

Azimuthal measurement of how back-to-back two muons are to each other after a collision.

$$\alpha = 1 - \Delta\phi/\pi ,$$

where α is the acoplanarity and Δϕ is the difference in azimuthal angle between the two muons.

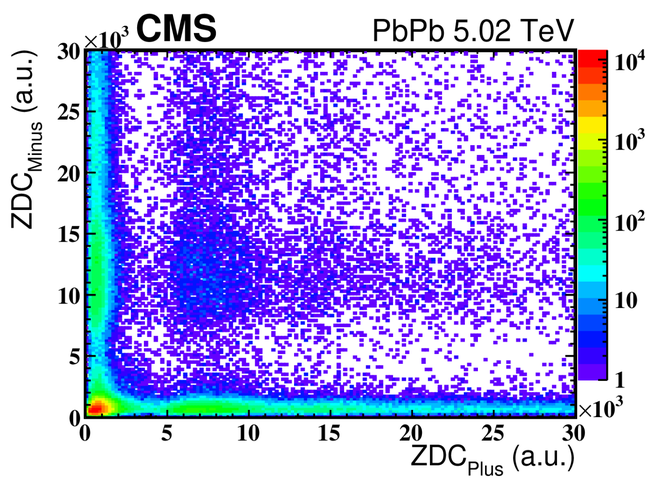
## Summary

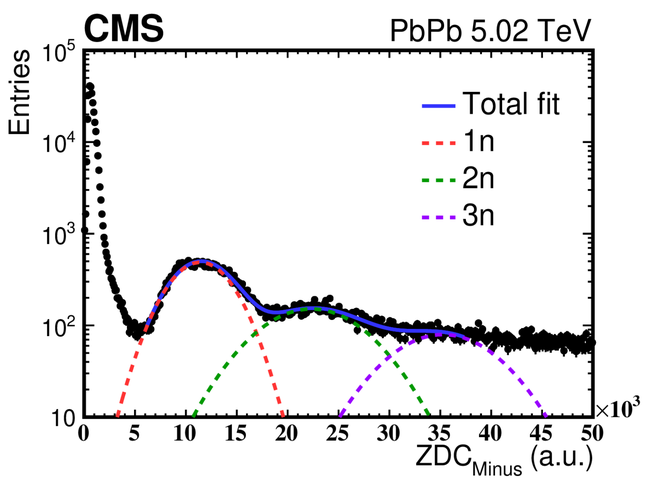
First measurements of the γγ → μμ dependence on the multiplicity of neutrons at √s = 5.02 TeV are reported. We see an increase of average α and mass at higher forward neutron multiplicities, signifying an impact parameter dependence in the average transverse momentum of the initial photons.

## Reference

CMS Collaboration. Observation of Forward Neutron Multiplicity Dependence of Dimuon Acoplanarity in Ultraperipheral Pb-Pb Collisions at √sNN =5.02 TeV. Phys. Rev. Lett. **127** (122001) 2021

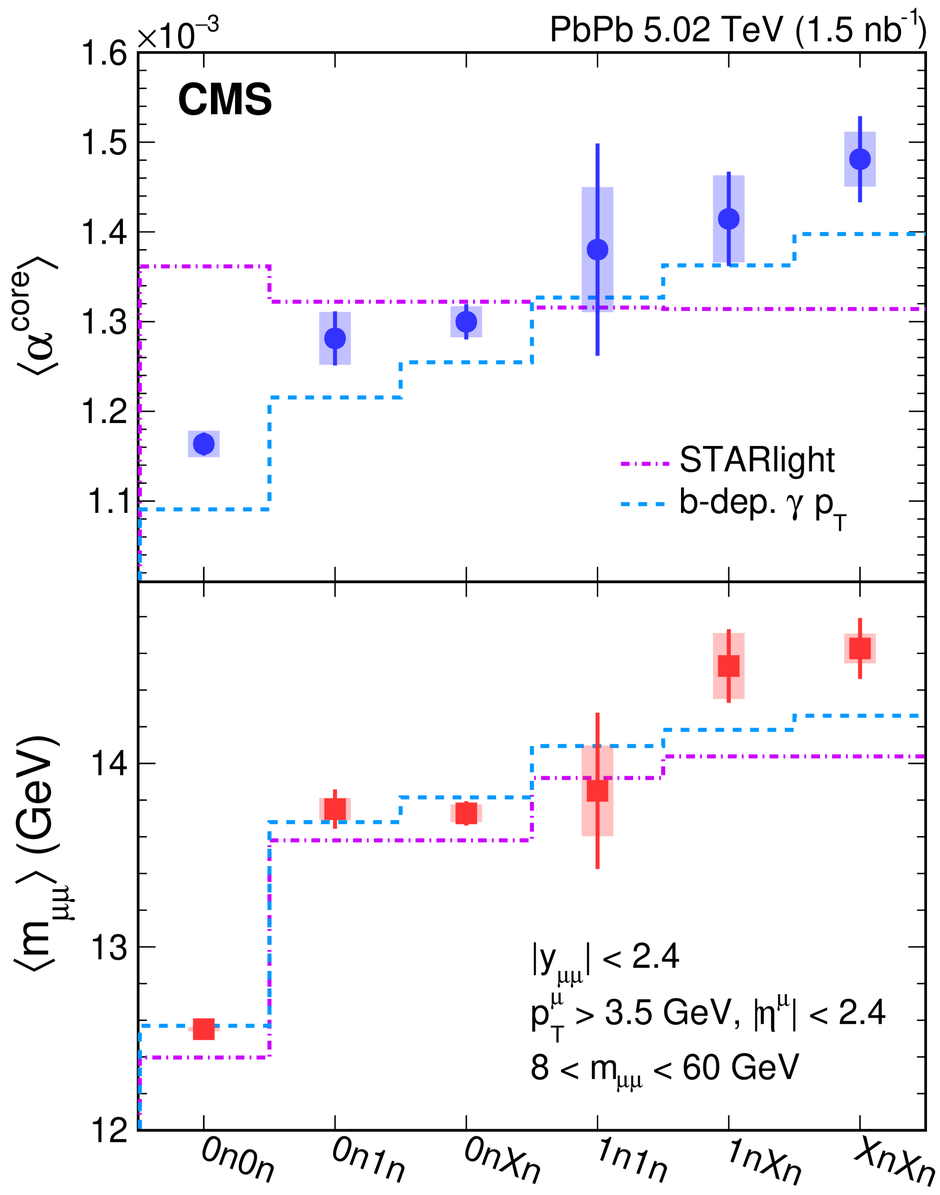
## Topology




The left frame shows the 2D representation for the energy distributions for both ZDCs. The right frame shows the Gaussian best-fit for the number of neutrons emitted with respect to the energy distribution of the ZDC: the more neutrons that are emitted, the higher the measured ZDC energy. The "bumps" are a proxy for the number of neutrons detected in the ZDC.

## Results




The average α and mass of dimuons as a function of neutron multiplicity. For both cases, α and mass increase at higher multiplicities. Starlight prediction with no b-parameter dependence does not describe the data. Analytical prediction with b-parameter dependence has a better description