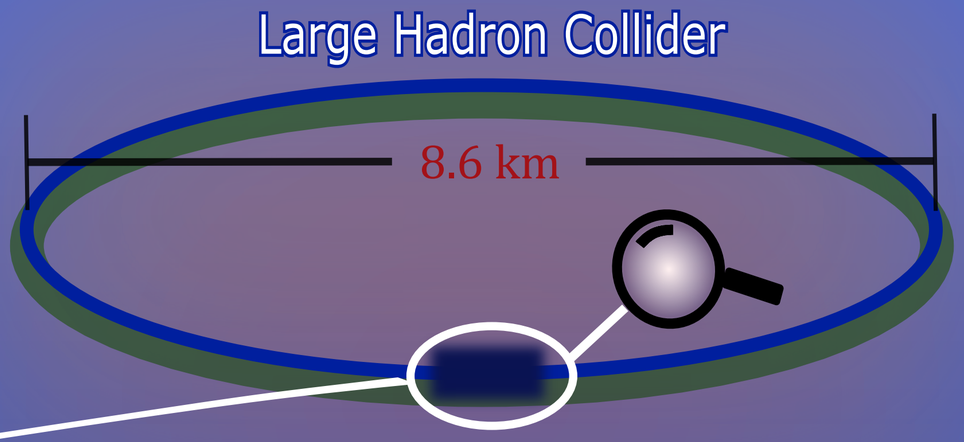
NO BANG, STILL BOOM

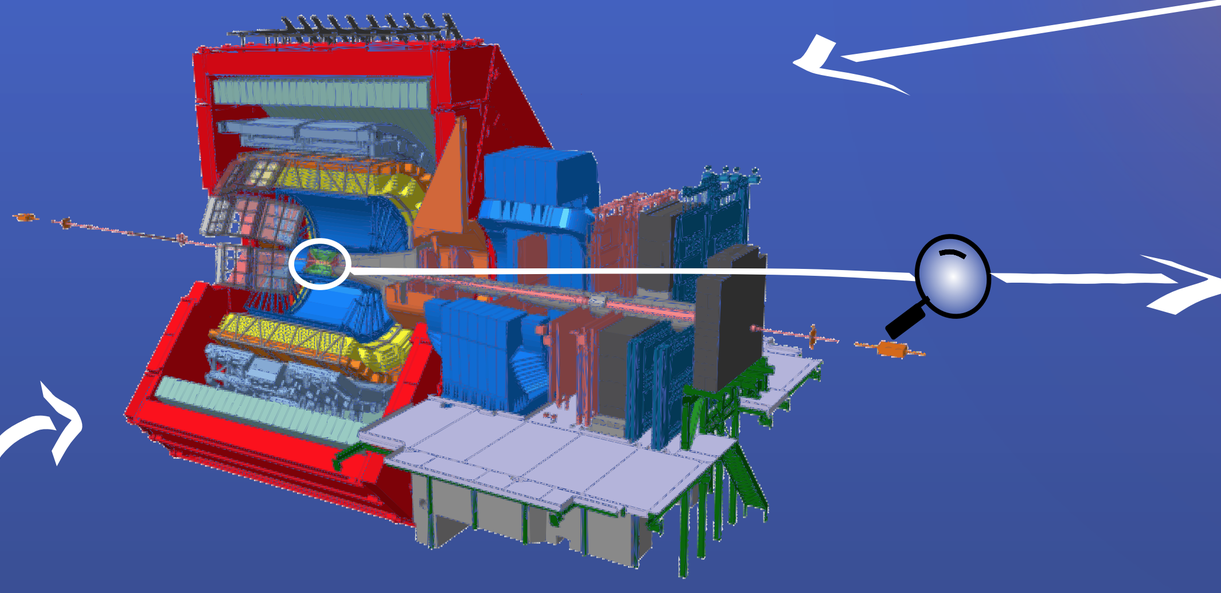
— Particle Identification in Ultraperipheral Collisions —

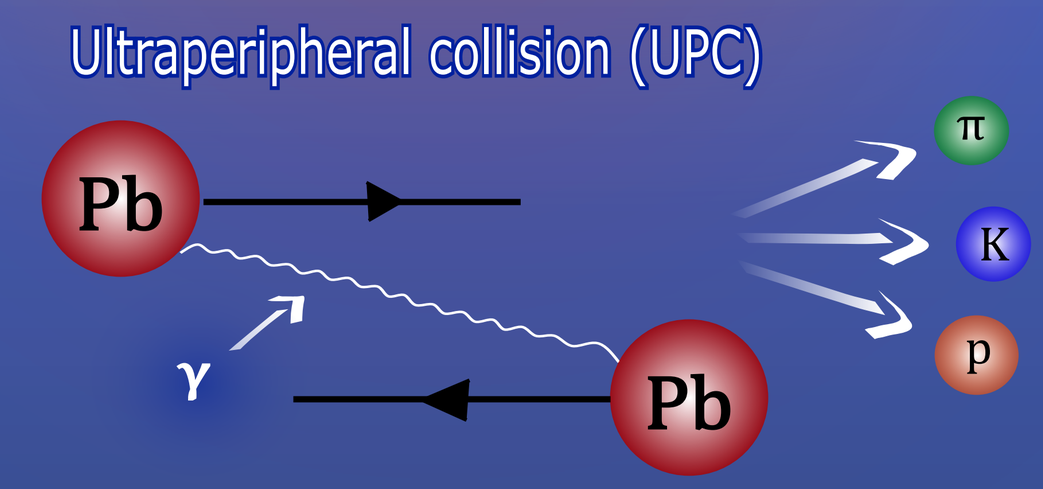
Rakeb B. Erana & Nina Rey P. Isaksen

INTRODUCTION

What happens when two heavy ions *pass by eachother* with a center-of-mass energy of trillions of electron volts? This project takes aim at showcasing the reconstruction process in the aftermath of ultraperipheral collisions based on data from the ALICE experiment at CERN.







THE ALICE DETECTOR

ALICE consists of several outward layers of subdetectors which identify different defining properties of the particles created in the UPC, enabling us to understand what happened in the ultraperipheral collision.

What is a UPC?

Ultraperipheral collisions do not describe a head-on collision, but an interaction between heavy ions that *just miss eachother*. Ions carry electric fields, and the range of the electromagnetic force allows them to interact by mediating so-called **virtual photons**, even at a distance. Virtual photons are not free particles, but act as mediators for the **electromagnetic force** during interaction and emerge only temporarily, hence the name. The heavy ion pairs accelerated at LHC can achieve center-of-mass-energies up to 5 TeV. The reaction process can be written as $\gamma + A \rightarrow V + A$, where A is a nucleus of mass A and V is a vector meson, which the photon (γ) decays into.

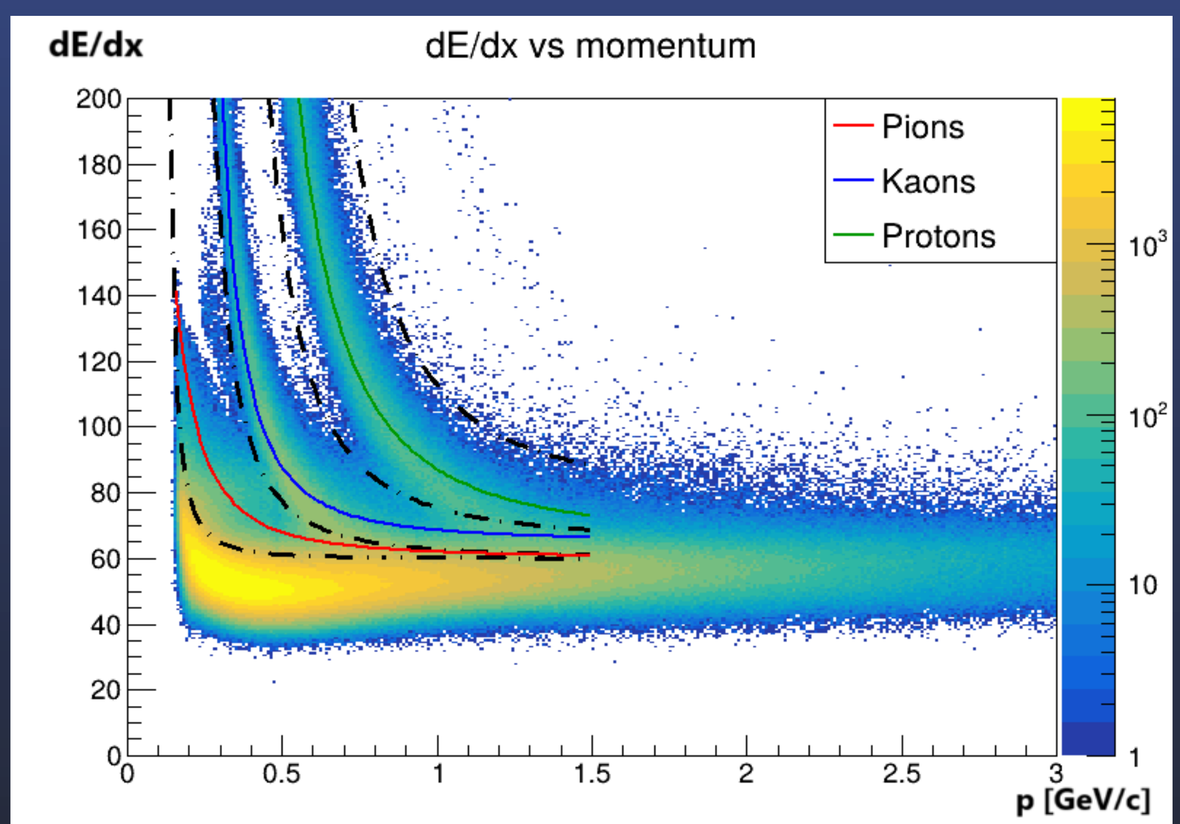


Figure 1: **Particle identification techniques** include measuring their energy loss through ALICE's Time Projection Chamber, which is filled with gas. Plot it against the particles' momenta in a histogram, and the different species **separate beautifully** as shown in this figure!

Why do we perform them?

UPCs show us that we don't have to smash particles together to study high energy physics. They allow us to avoid the messy strong-force interactions that happen in central collisions, while still enabling us to study the parton content (gluons and quarks) of nuclei further.

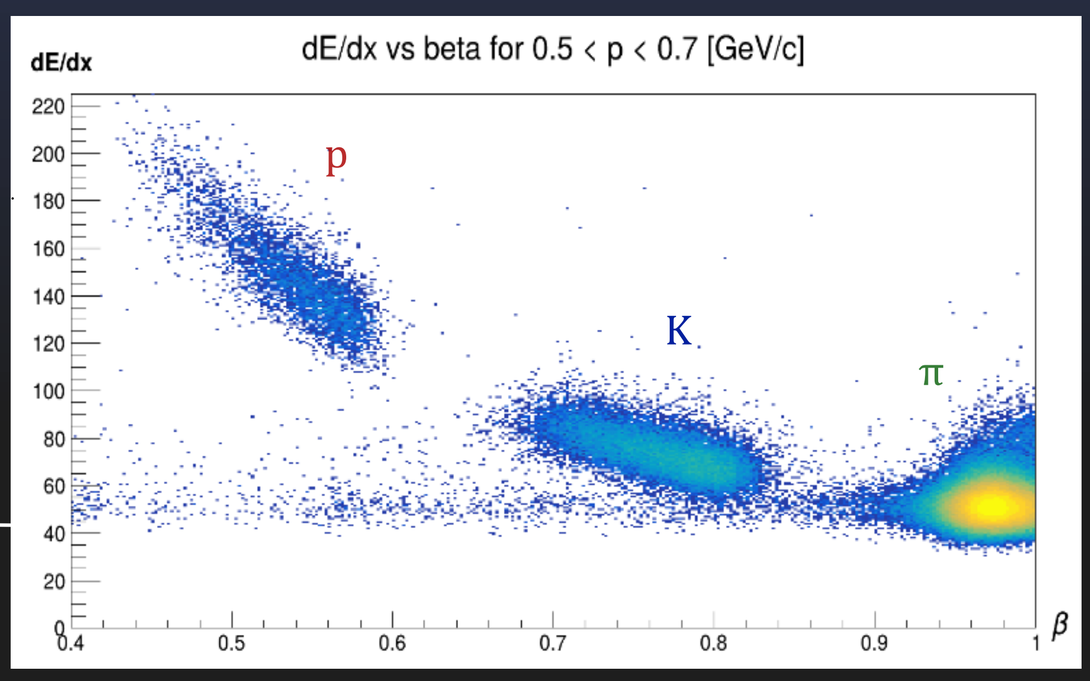


Figure 2: By plotting energy loss versus $\beta = v/c$ — the ratio between the particle's velocity and the speed of light — this **unique cluster formation** appears, depicting groupings of **protons**, **kaons** and **pions**. Because of their differing mass, they move at different speeds, causing the cluster spread along the β-axis.

UNIVERSITY OF BERGEN
Faculty of Science and Technology

Feel free to contact us via email for any inquiries:
rakeb.erana@student.uib.no
nina.isaksen@student.uib.no

P299.3