Project 6

Analysis of Cluster Shapes in the ATLAS AFP Detector

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IFJ PAN Particle Physics Summer Student Programme 2021

Krakow, Poland, 5^{th} July 2021

Usual situation at Large Hadron Collider:

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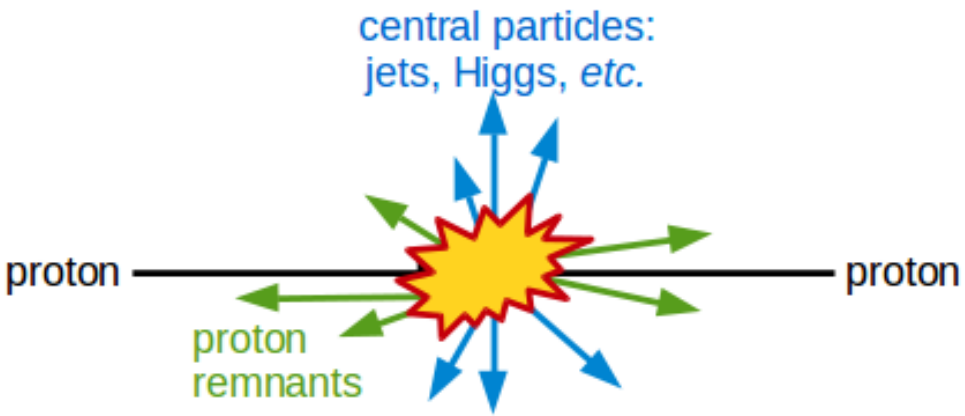

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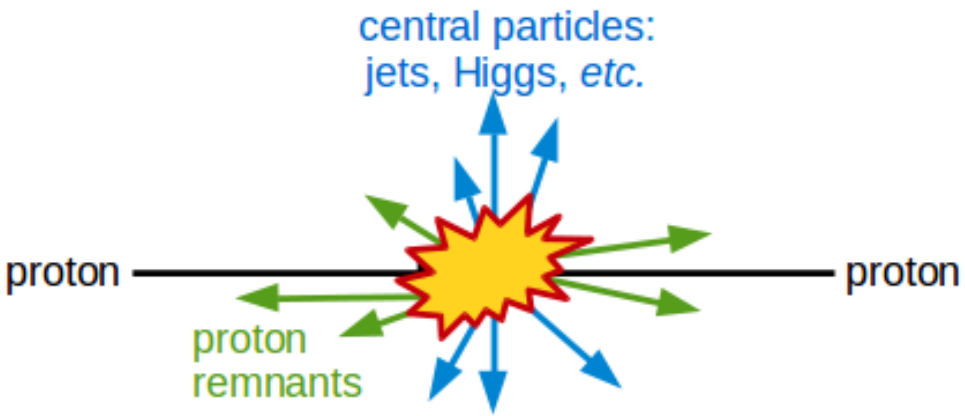

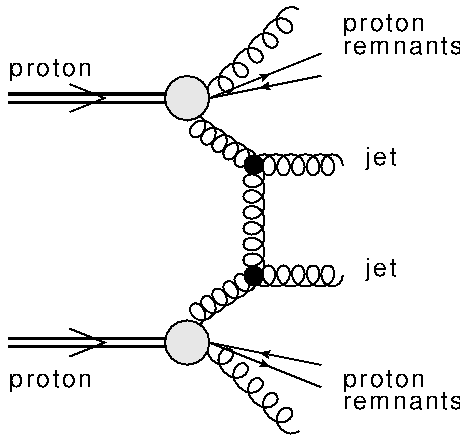

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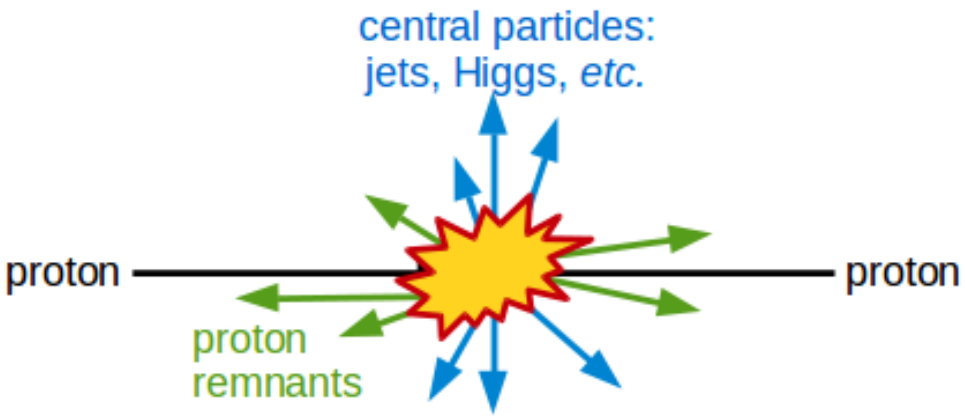

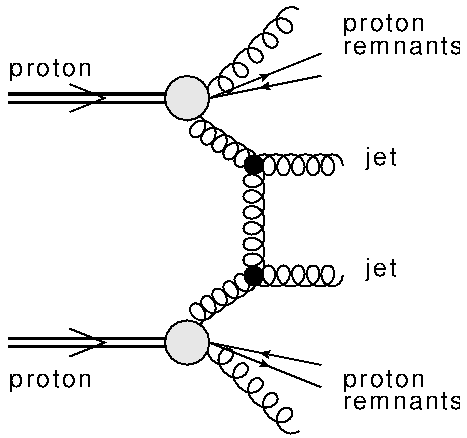

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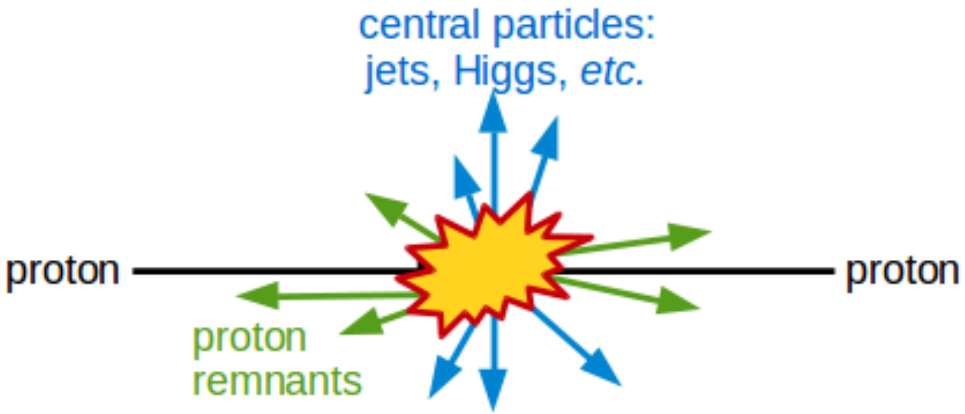

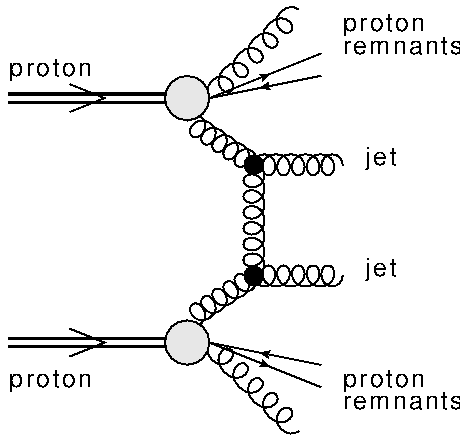

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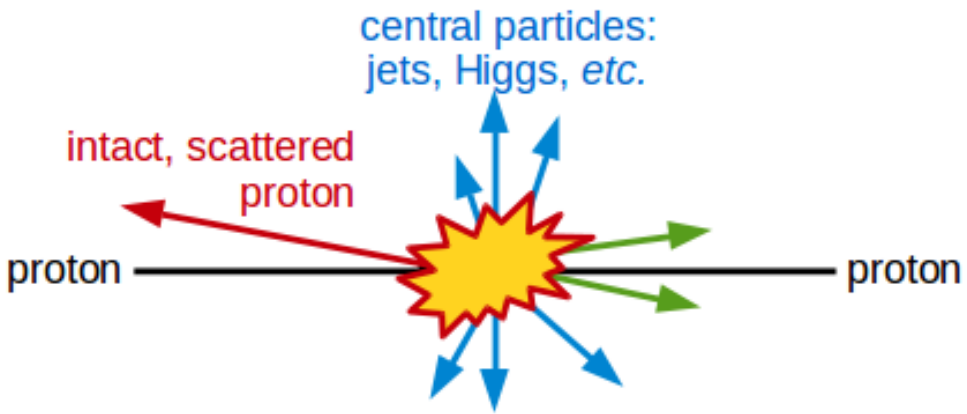

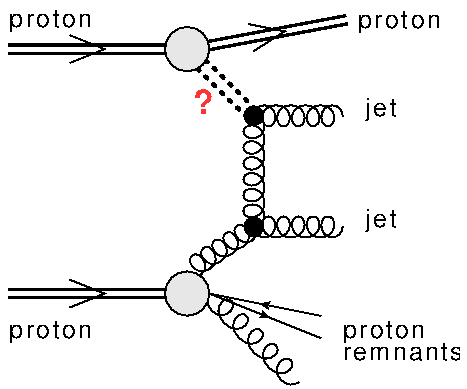

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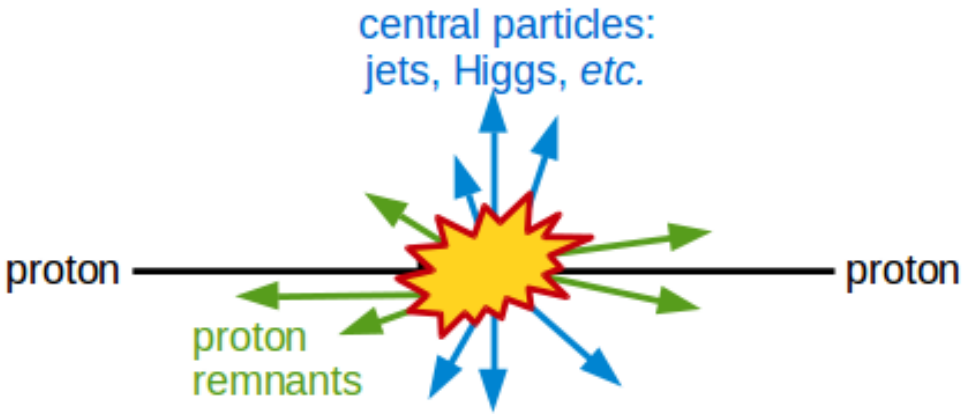

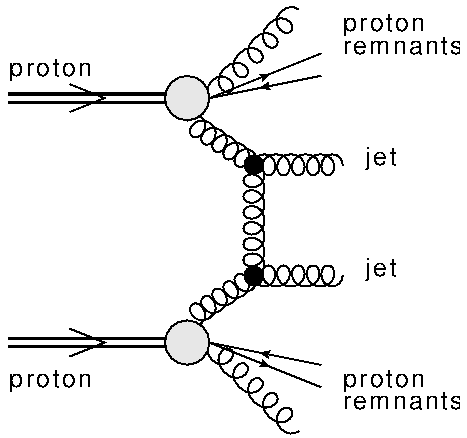

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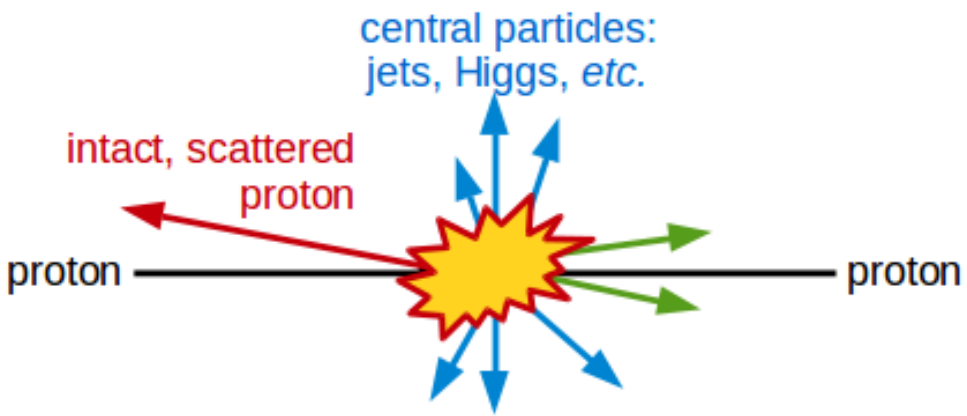
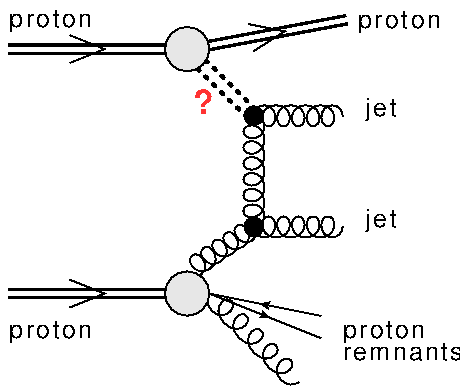


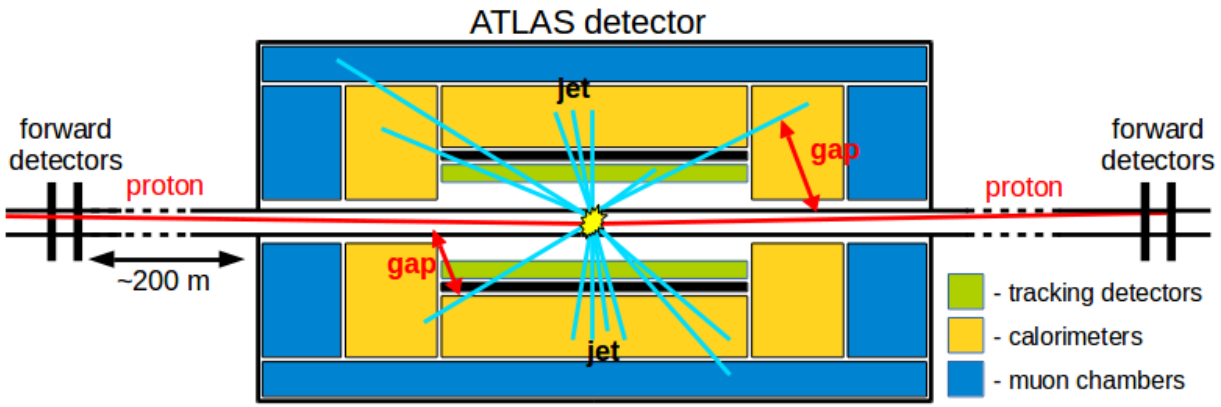


Yes! But exchanged object must not change quantum numbers of proton(s):

- electromagnetic force: photon,
- **strong force: Pomeron** (QCD = two gluons + h.o. terms).

Such events are often called diffractive ones.

Typical diffractive topology: a gap in rapidity is present between proton(s) and central system and one or both interacting proton stay intact.



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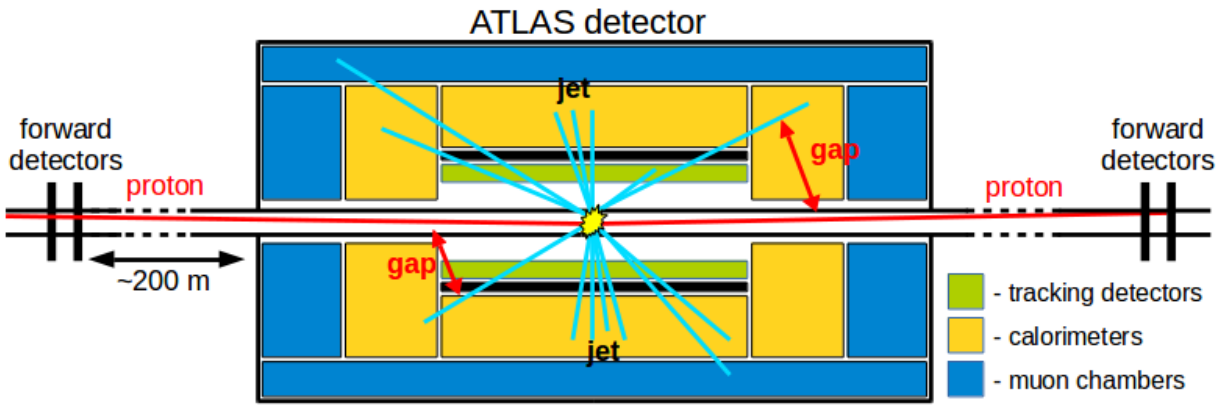


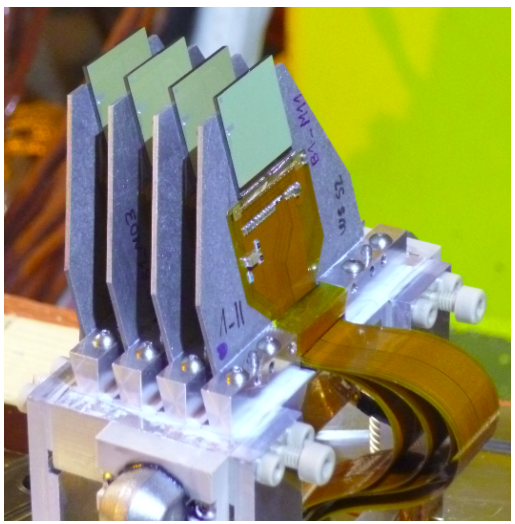
Intact protons are scattered at very small angles, typically into LHC beampipe.

In order to measure them, special detectors called Roman pots, must be installed.

ATLAS is equipped with two sets of such detectors ALFA and AFP.

AFP (ATLAS Forward Proton) detectors are located about 210 m from ATLAS collision point.

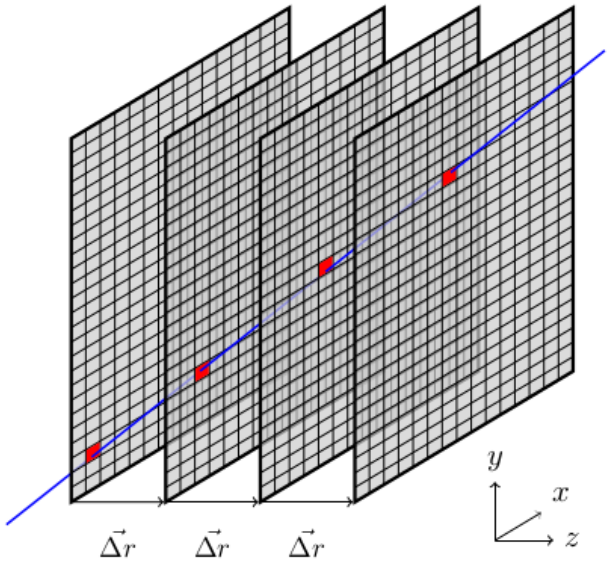
For position measurement 3D-silicon sensors are used.



Each AFP Roman pot contains four layers of silicon senors.

In the first approximation, each layer can be described as a matrix of 338×80 pixels.

Proton passing through detector induce signals in pixels, forming clusters.



Main task: deepen the knowledge on how protons form cluster hits in AFP silicon detector.

Tools: ROOT macros for analysing data from 2017 low pile-up runs.

You will start from learning about basic properties of hits formed in the AFP detector. After making few event displays, you will classify different classes of cluster shapes. You will try to identify, if they originated from diffractive protons, beam halo or particle showers. This should lead to recommendations how algorithms should form clusters.