Project 5
Analysis of Proton Transport Through LHC

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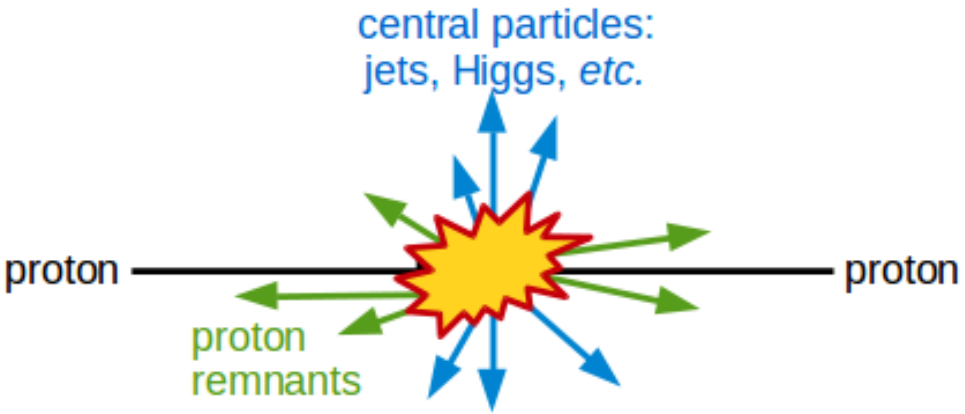
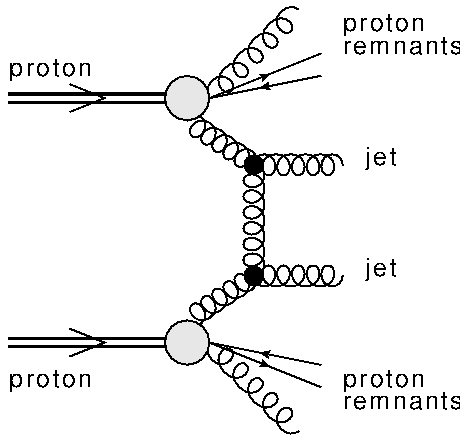
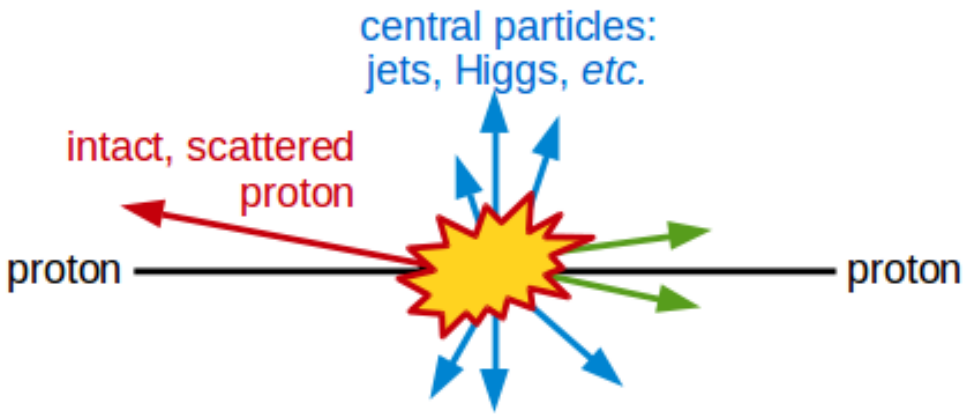
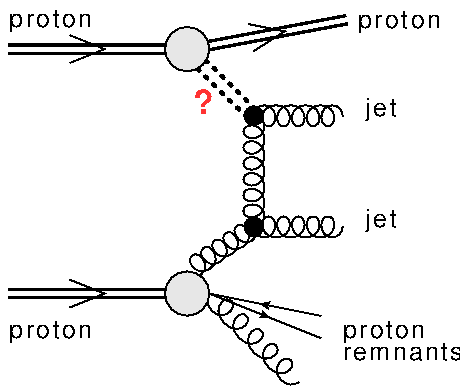
Usual situation at Large Hadron Collider:





Can proton(s) remain intact?



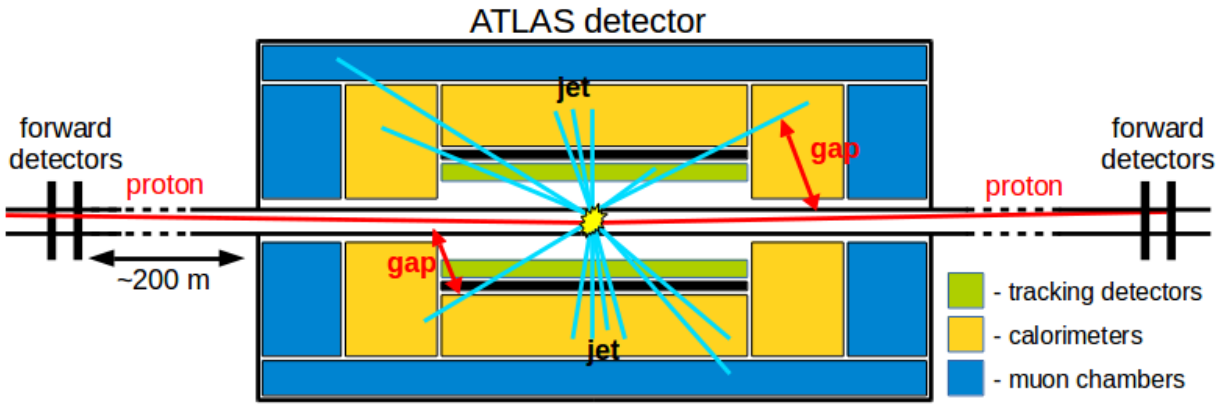


Yes! But exchanged object must not change quantum numbers of proton(s):

- 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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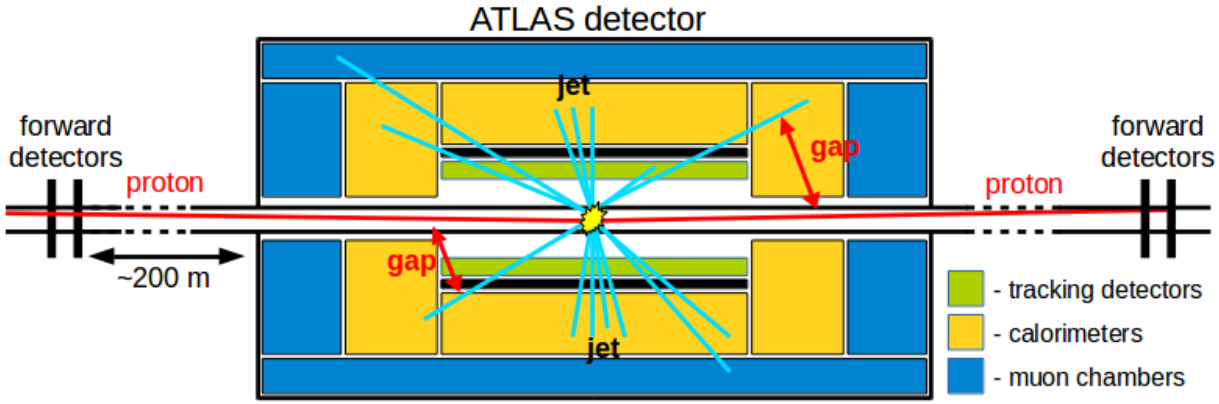
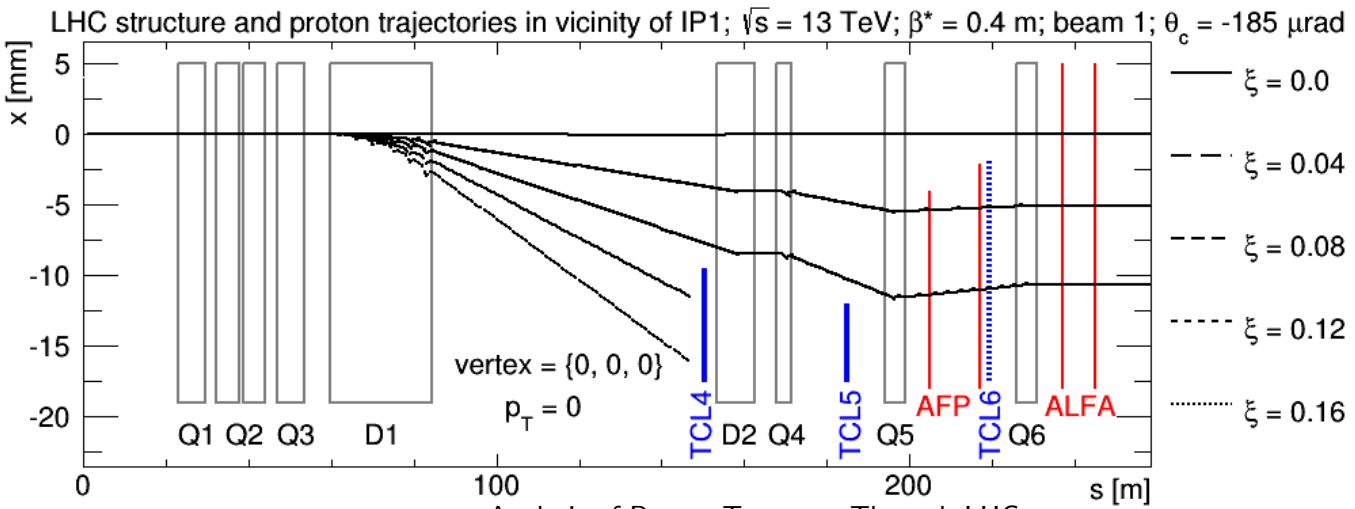


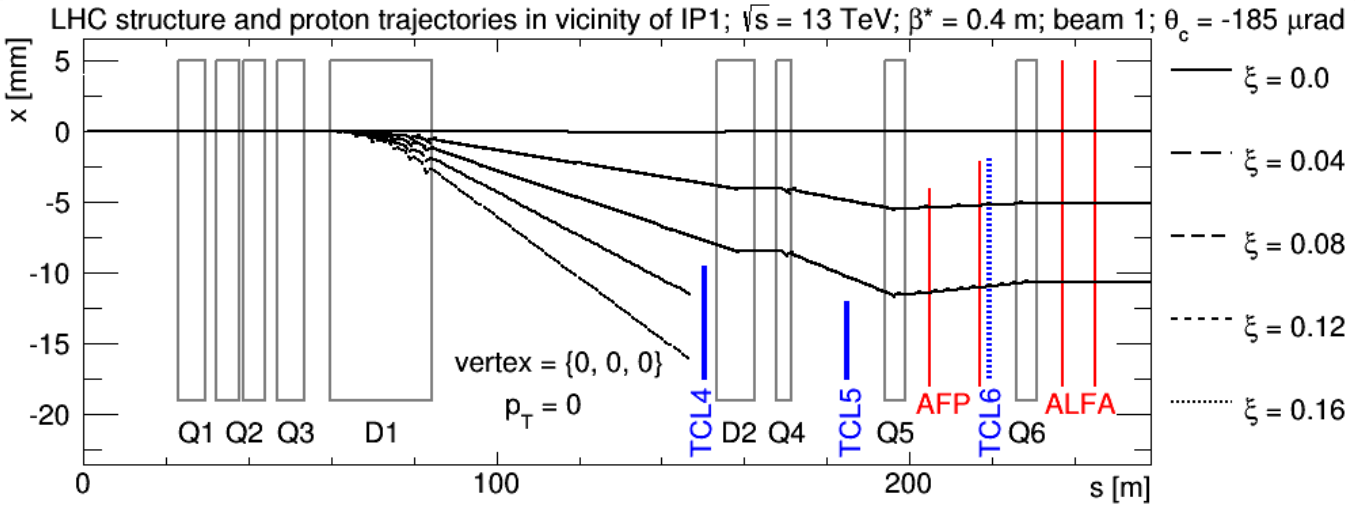
Intact protons are scattered at very small angles, typically into LHC beampipe.

They are measured in special detectors called Roman pots (RP), which are installed about 200 meters from collision point (IP).

Region between IP and RP is not empty – it contains several LHC magnets.

Magnetic fields have impact on proton trajectories.





Between ATLAS IP and AFP detectors two dipoles, five quadrupoles and several kickers are located.

For our studies, each magnet can be described by four parameters: position in x, y, z and strength k.

Main task: understand the impact of LHC magnets on the proton position in AFP detectors.

Tools: standalone C++ code for proton transport, sample with diffractive protons generated by Pythia.

(...) simple tracking tool was prepared. It uses information about magnets (position, strength) from available official LHC files. Nevertheless, the 'design' parameters may differ from reality, i.e. magnetic field may be a bit stronger than assumed or magnet can be displaced by few hundred micrometers.