

# Charged particle distributions in diffractive events tagged with ATLAS AFP detectors

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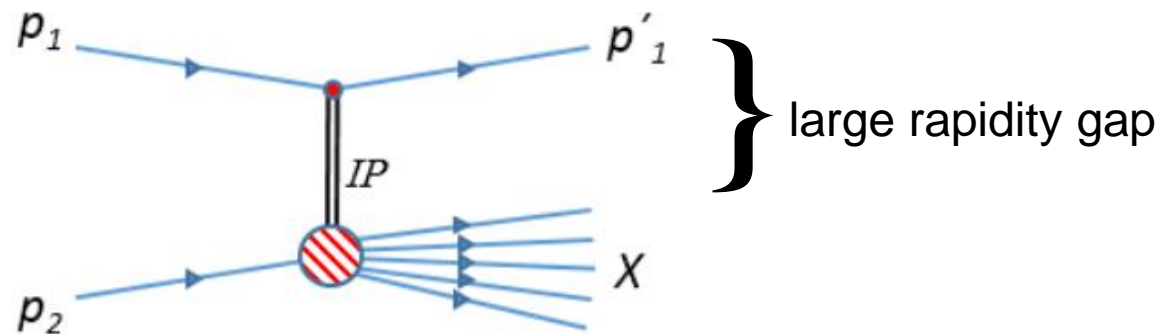


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# Diffractive events

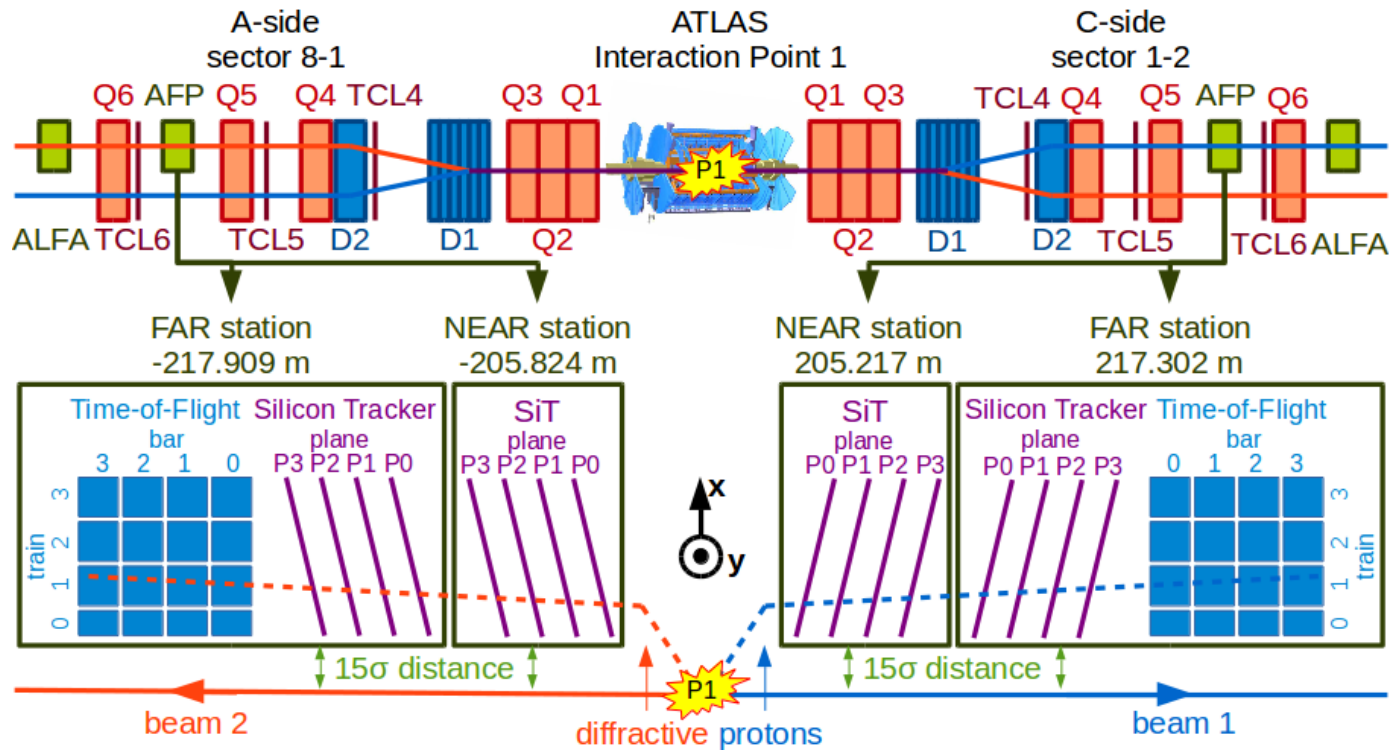
- diffractive event - there is a colour singlet exchange, the incident particle is excited and the diffractive dissociated system is created (multi-particle final state)
- single-diffractive (SD) event - only one of the beam particles breaks up and it produces particles at high rapidities on one side of the interaction point



- experimental signatures of SD:
  - large rapidity gap
  - forward scattered proton at the microradian (!) angles

# ATLAS Forward Proton (AFP) Detector

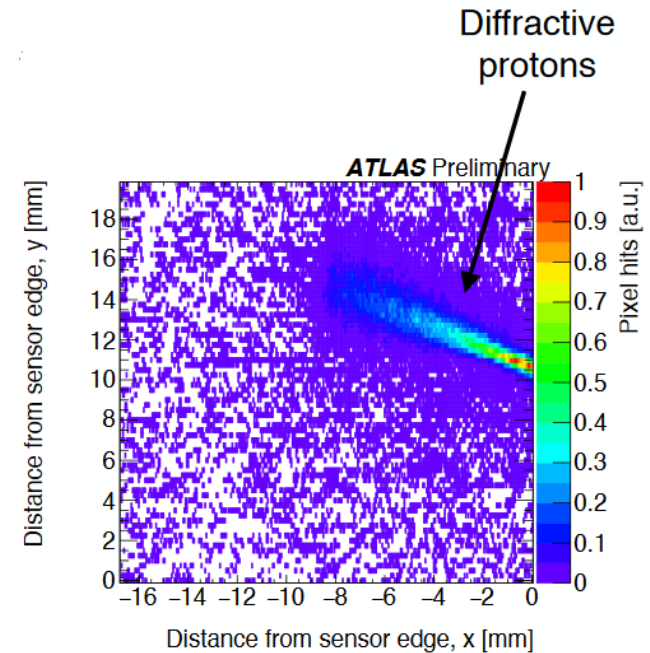
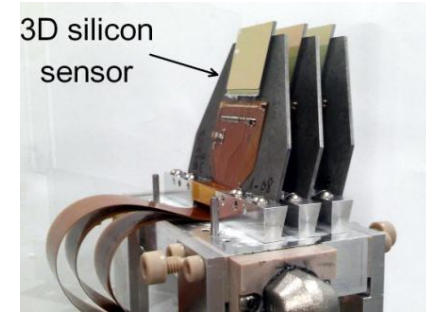
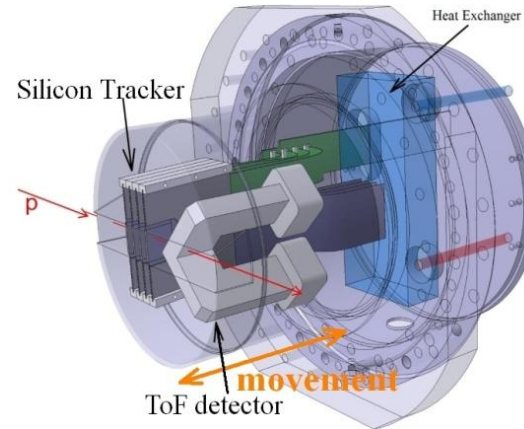
- the recently installed detector dedicated to the measurement of diffractively scattered protons
- situated at about 210 m from the interaction point



- consists of four stations located at both sides of the interaction point

# The AFP Detector construction

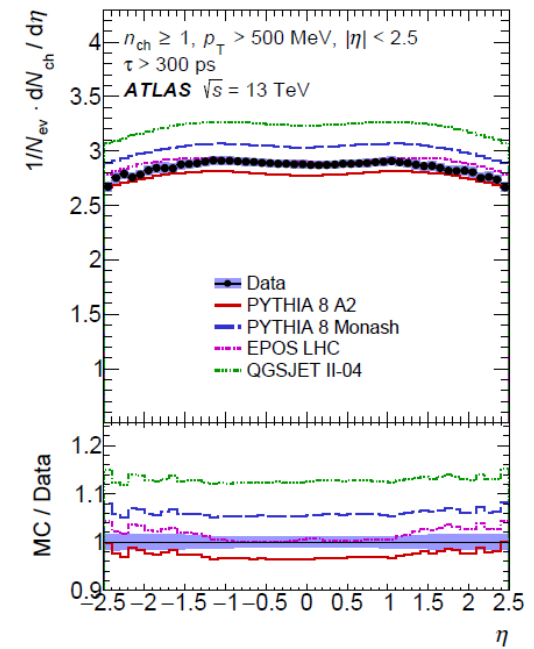
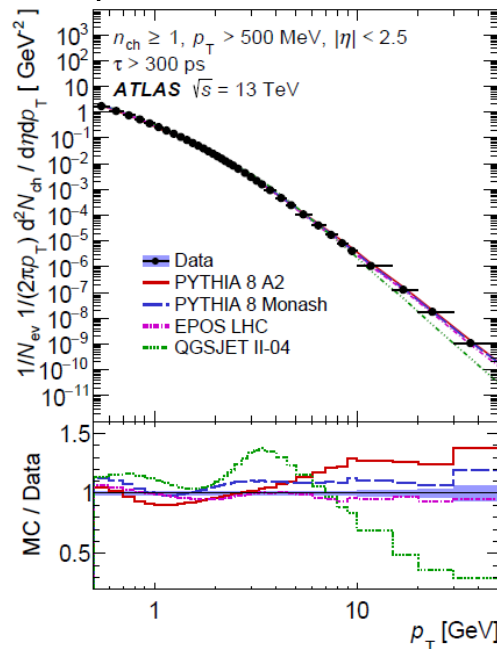
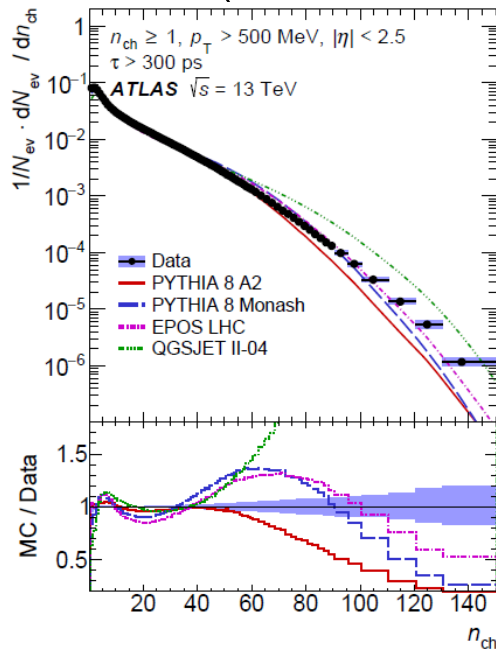
- Roman Pot technology allows insertion of the detector into the beam pipe and retraction when needed
- Silicon Tracker is a 3D silicon pixel detector composed of four layers
- Time of Flight detector allows determining position of the primary vertex of the proton so its possible to distinguish protons from different interactions in the same bunch crossing



<https://twiki.cern.ch/twiki/bin/view/AtlasPublic/ForwardDetPublicResults>

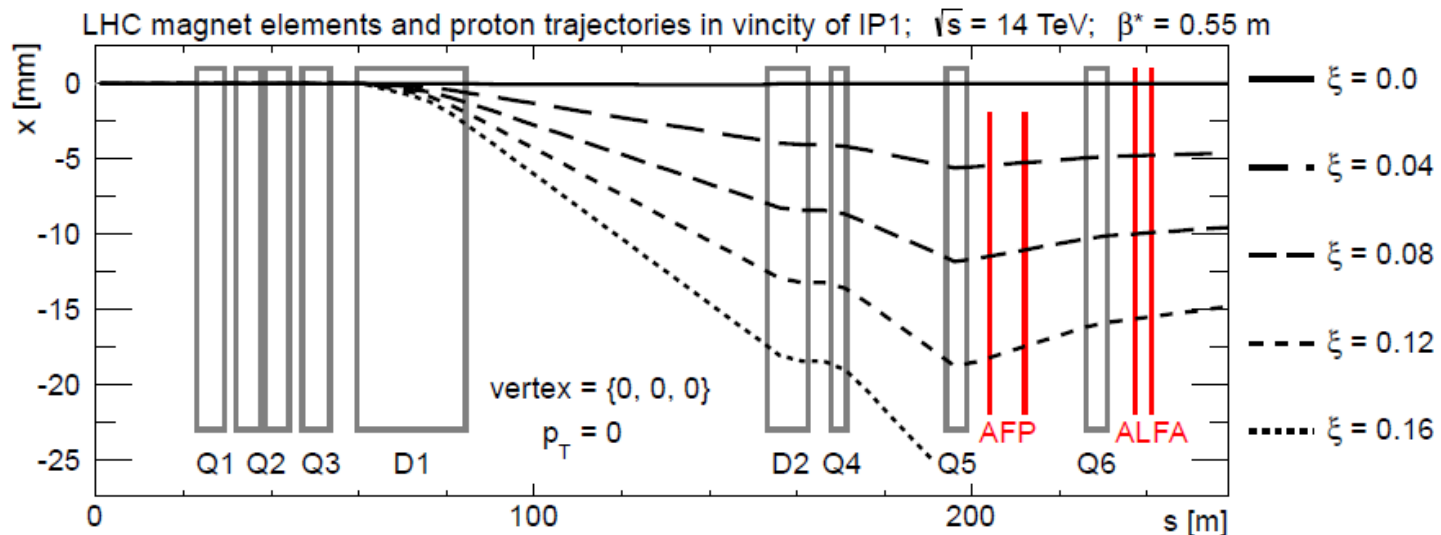
# The idea of measurement

- first idea: to measure inclusive charged particles distributions in so-called “minimum bias” (MB) events
- the only requirement in MB analysis is to have at least one track in a given region
- in practice “minimum bias” contains mainly non-diffractive events
- present analysis: only diffractive events (single-diffractive)
- MB results (Phys. Lett. B758 (2016) 67):



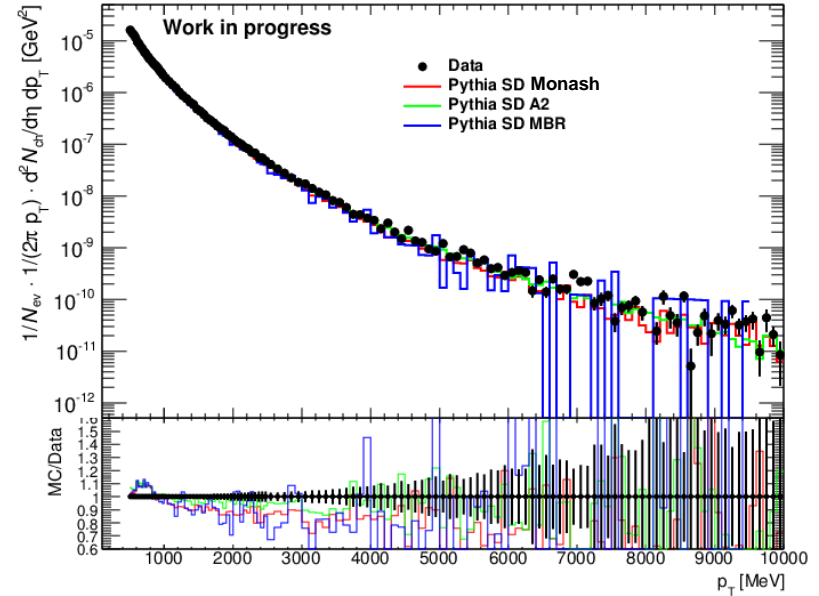
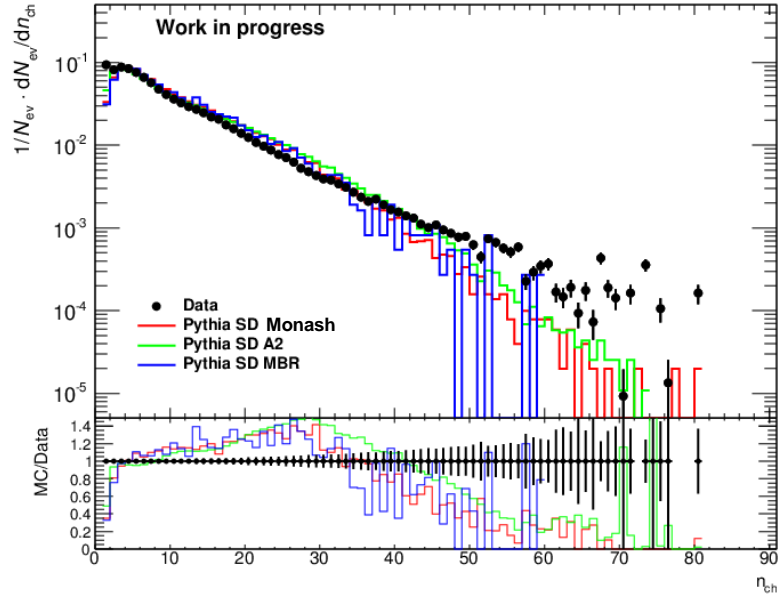
# Main experimental problems

- correction of tracks from charged particles for detector effects (track reconstruction efficiency, vertex reconstruction efficiency, trigger efficiency, migrations in  $p_T$  and in the number of particles)
- determination of alignment of the AFP detector
- understanding of magnetic fields of LHC between the interaction point and the detectors (machine optics)



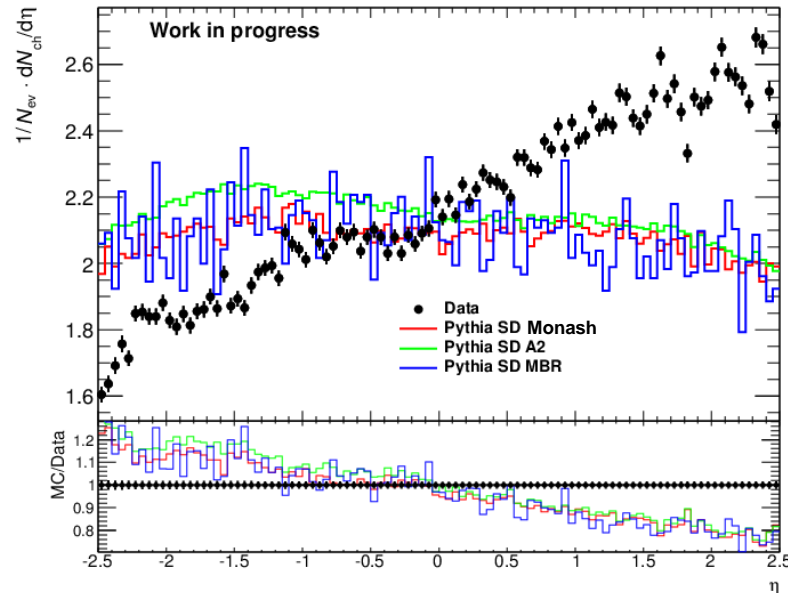
- estimation of sources of background

# Preliminary results



Data from AFP dedicated run with low pile-up ( $\mu \approx 0.3$ ), at the center of mass energy of 13 TeV

Data unfolded in the multiplicity, corrected for the track reconstruction efficiency and for the background



# Summary and plans

## Summary:

- analysis of 2016 data (with AFP detectors on one side) is ongoing
- data from ATLAS Inner Detector under control
- data from AFP detectors need better understanding – afterwards alignment and optics need to be included in the detector simulation
- overall background level - few percent

## Plans:

- tuning of Monte Carlo models
- now full AFP setup is installed (two arms) which will allow measurements of **central diffractive processes** (data taking planned for this year)

