

Observations in tests of high-beta at injection energy

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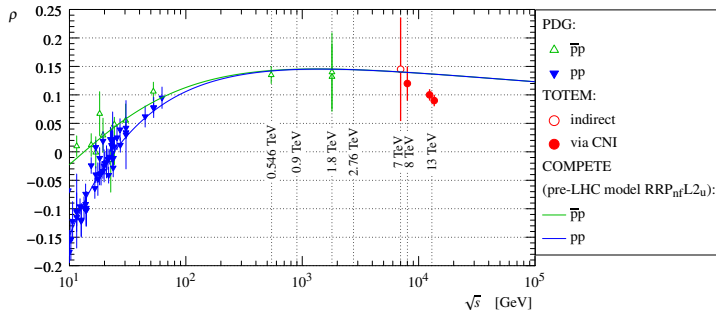
on behalf of the TOTEM collaboration



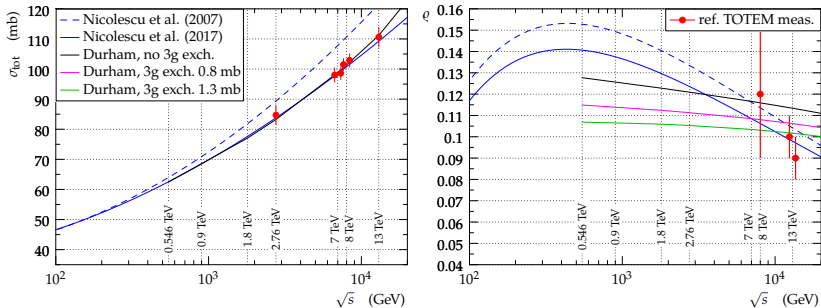
4th Elba workshop on Forward physics
26 May 2018

Motivation for ρ determination at low energy

- no ρ measurements in proton-proton between ≈ 100 GeV to 7 TeV



- discrimination between models with different energy-dependences of ρ

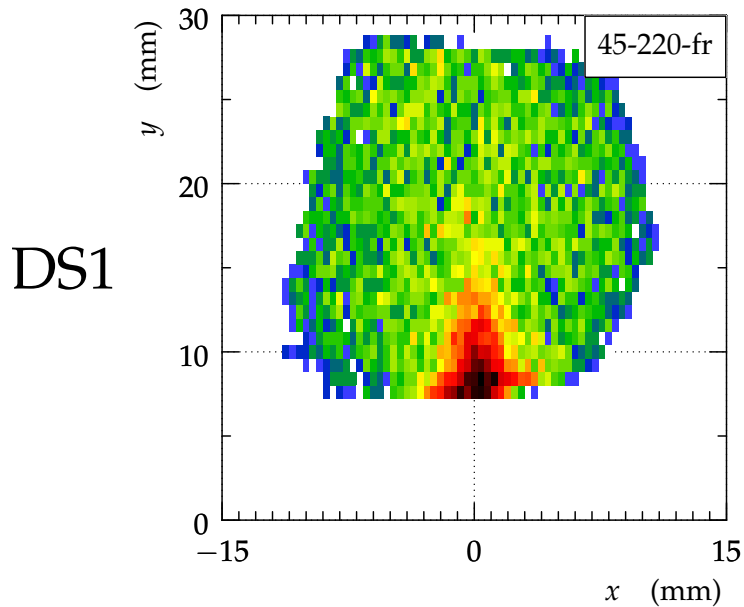


- $\sqrt{s} = 900$ GeV: the lowest (easily) accessible energy at LHC

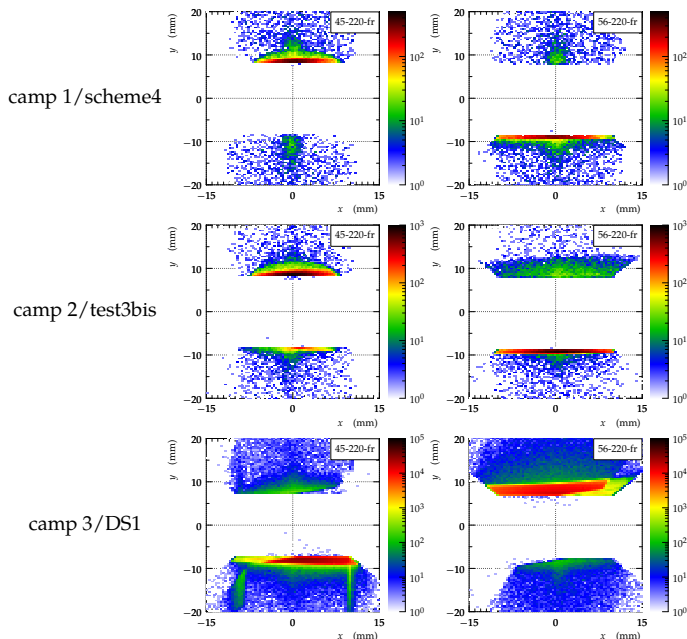
- ρ measurement \Rightarrow very low $|t|$ needed \Rightarrow RPs at about $3 \sigma_{\text{beam}}$
 - special collimation scheme needed
 - beam background can be an issue
- test campaigns
 - campaign 1: 8 Nov 2017
 - campaign 2: 22 Nov 2017
 - campaign 3: 8 May 2018
- test actions
 - many collimation schemes tried
 - RP alignment repeated (to prevent outliers)
 - different bunch intensities tried (to prevent IBS)
 - higher RF voltage tried (to prevent debunching)
 - online background assessment: XY hit distributions at RPs
 - offline background assessment: application of elastic-tagging cuts

Expectable XY distribution for signal

(extracted from campaign 3, DS1, "better diagonal", after all cuts)



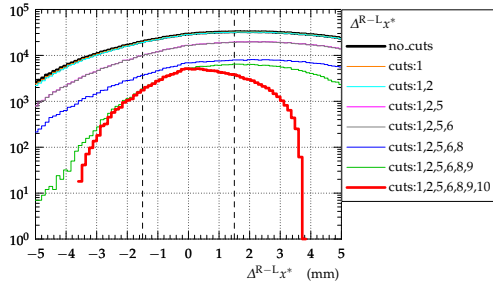
- best dataset from each campaign (diagonal coincidence required)



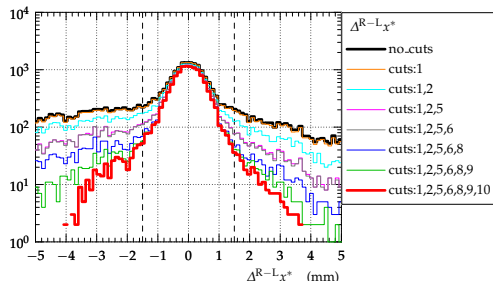
- two background structures - occurrence and intensity not reproducible neither understood
 - sharp horizontal bands
 - round, beam-halo like

- example from campaign 3/DS1: one diagonal pessimistic example, the other optimistic one
- gradually applied 8 cuts enforcing the kinematics of elastic scattering
 - black histogram: not cut applied, red: all cuts applied
 - signal expected between the vertical dashed lines ($\pm 3 \sigma$)

DS1
45b – 56t



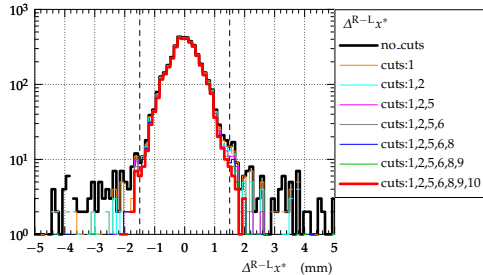
DS1
45t – 56b



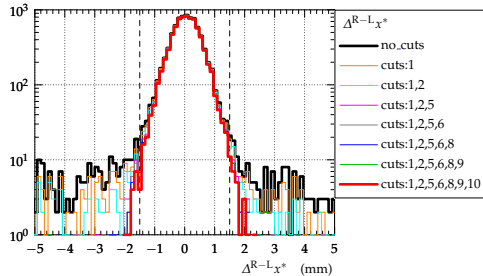
- top example: dominated by background, bottom example: background few %

- exclude regions affected by background: cut $|y| > 10.5$ mm
- example from campaign 3/DS1: one diagonal pessimistic example, the other optimistic one

DS1-y-cut
45b – 56t



DS1-y-cut
45t – 56b

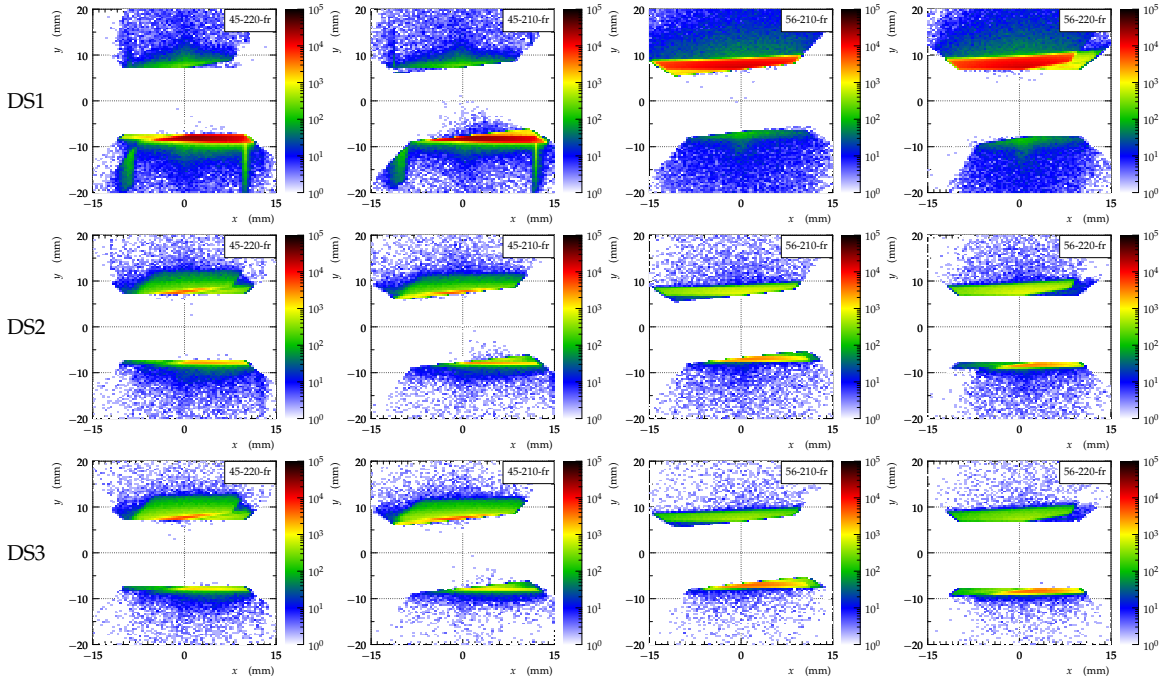


- both diagonals: background negligible

- horizontal background bands: the show stopper
 - dominate over signal, concentrated at low $|t|$
 - cannot be eliminated with conventional cuts
 - occurred in all 3 test campaigns
 - at different RPs, with different sizes/intensities → not reproducible
 - possible to find a configuration where not present ??
 - consensus: due to non-optimal collimation scheme (detailed source not known)
- “standard” beam background
 - can be eliminated with conventional cuts to few-percent level
- if RP “moved out” by ≈ 3 mm
 - background (after cuts) negligible
 - however reduced acceptance: $|t|_{\min}$ shifts from $3 \cdot 10^{-4}$ to $\approx 7 \cdot 10^{-4}$ GeV²
 - impact on physics in evaluation/discussion

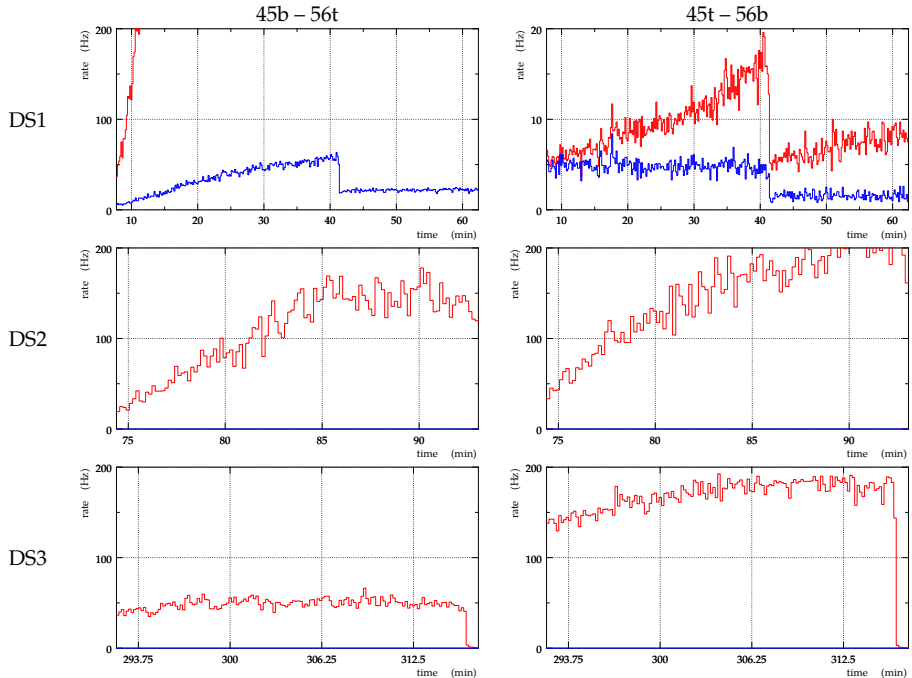
Backup

- only tracks in 4 diagonal RPs required



- DS1: 1 “good”, 1 “bad” diagonal
- DS2 and DS3: both diagonals “bad”

- rates of reconstructed events
 - red: diagonal requirement (4RP), blue: all (8) tagging cuts applied



- collimation experts find a solution
 - currently, to my knowledge they don't have any idea
 - not much time left, if run to be in 2018
- we move RPs further from beam
 - bands irreproducible → how much to shift ?
 - Coulomb normalisation in danger
 - ρ determination probably possible, if another normalisation method found
- run at 1.8 TeV
 - background improvement disputable
 - clear loss in turn-around time: needed ramp, de-squeeze, etc.
 - at 0.9 TeV, campaign 3: showed that physics-physics time can be ~ 15 min