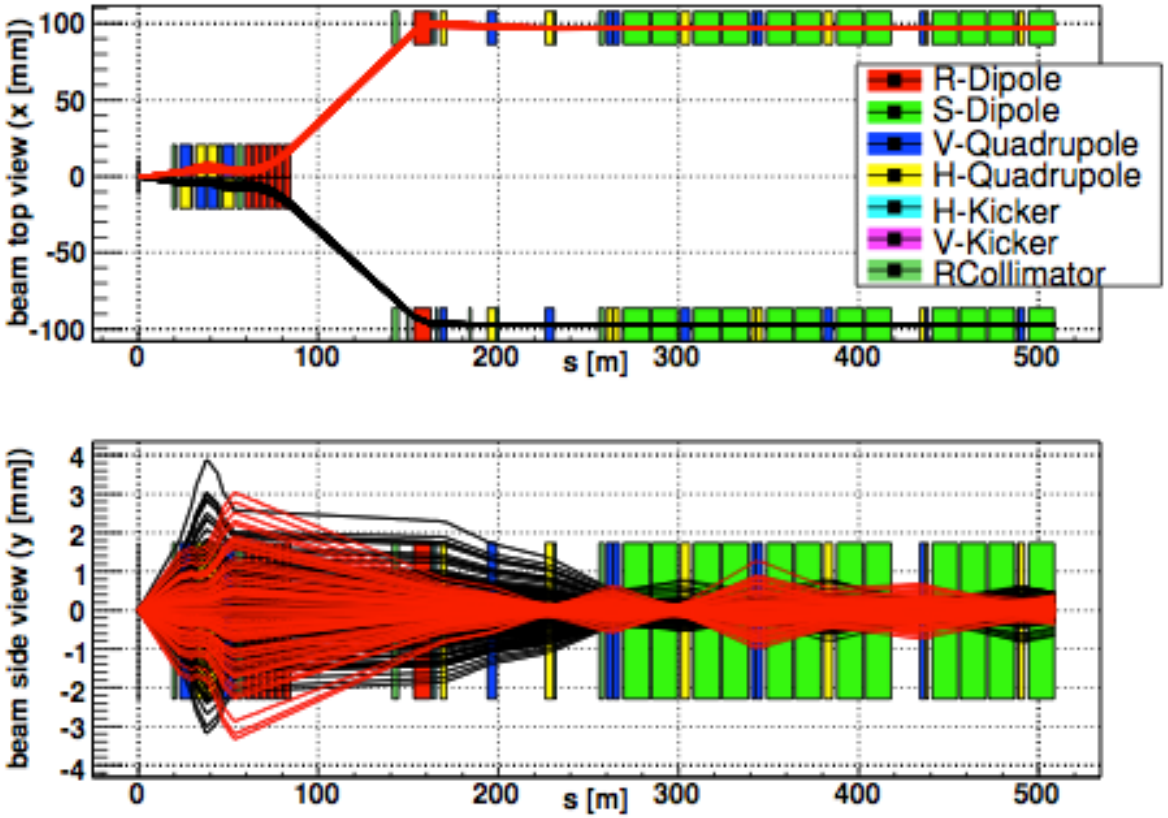
Detector and physics performance

Caveat: plots/numbers to be updated

Chapter – where do we stand:

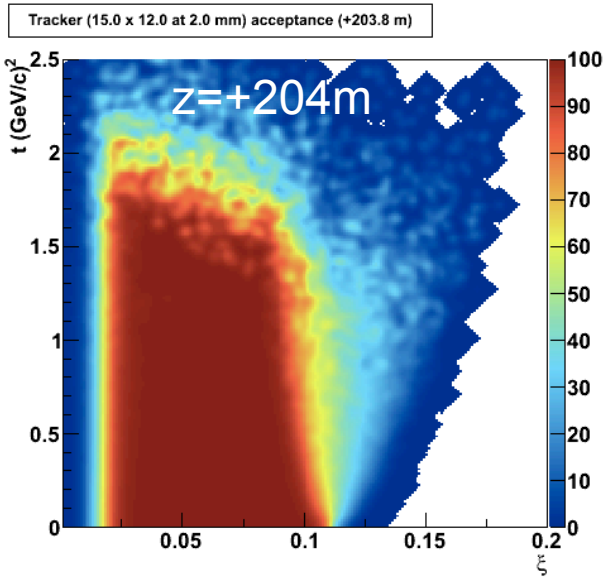
- Machine optics
- Detector acceptance
- Detector resolution
- RP alignment
- Machine induced background
- Trigger efficiency/strategy (?)
- Physics processes (excl. dijet, excl. WW)

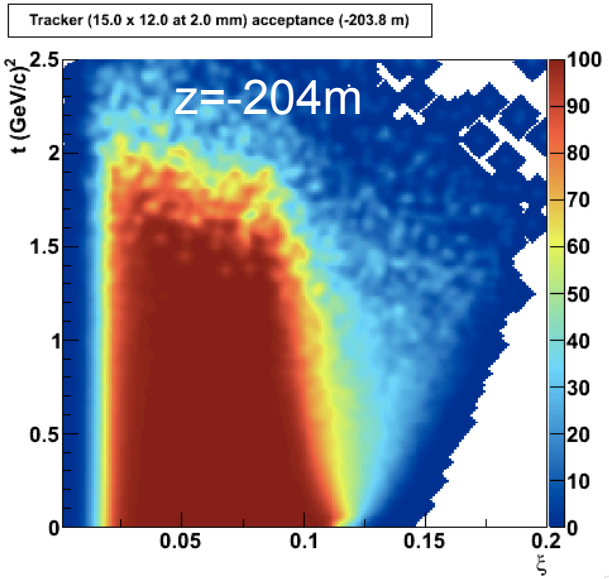
Machine optics



- HECTOR, a fast simulator for particle transport in a beamline
- good agreement with MADx
- Full transport line simulation in CMSSW

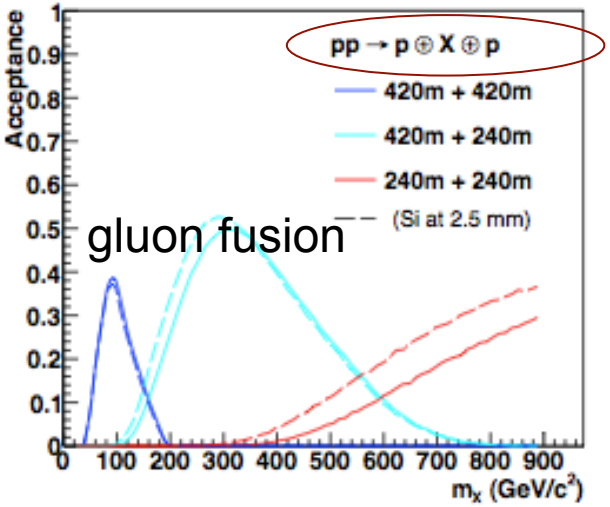
Detector acceptance

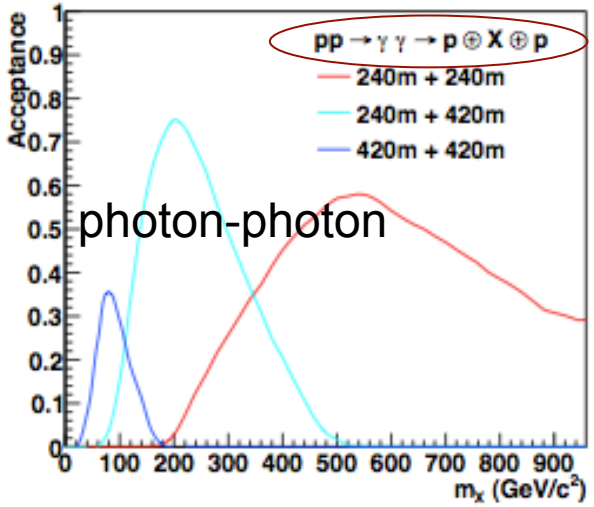




acceptance: ξ vs t

- Particle gun (t,ξ,φ) based on HECTOR at √s = 14 TeV
- Single arm acceptance in t,ξ 15mmx12mm detector (QUARTIC) at 2 mm from beam
- Based on ExHuME gen.



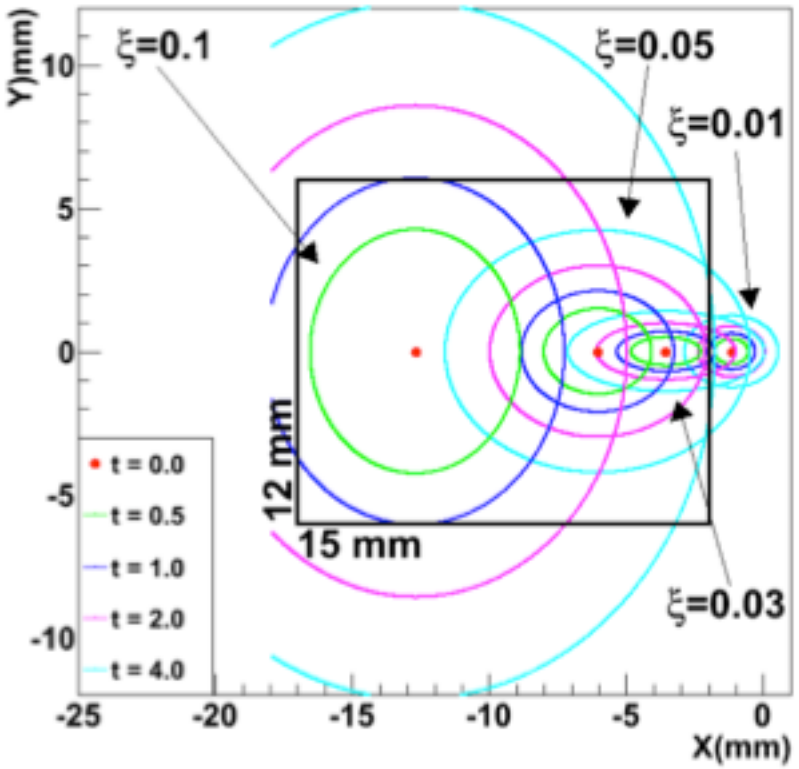


⇒ change to 204/214 m

acceptance vs m_X

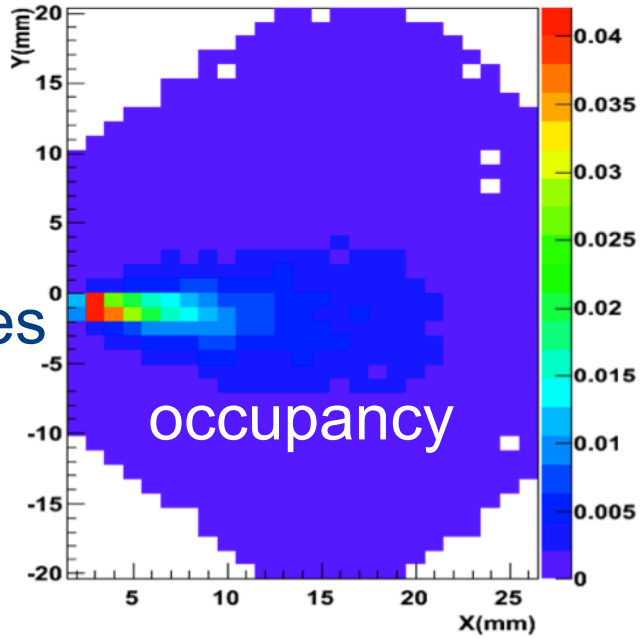
Detector acceptance (cont.)

Acceptance:
X vs Y
(includes ξ,t
ellipses)

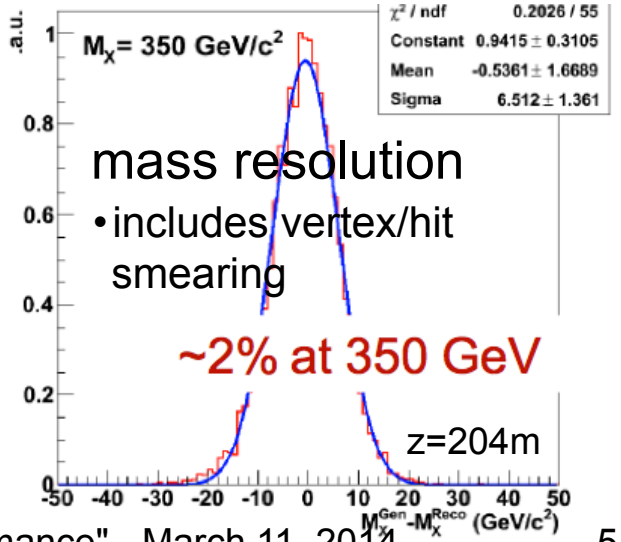


Detector resolution

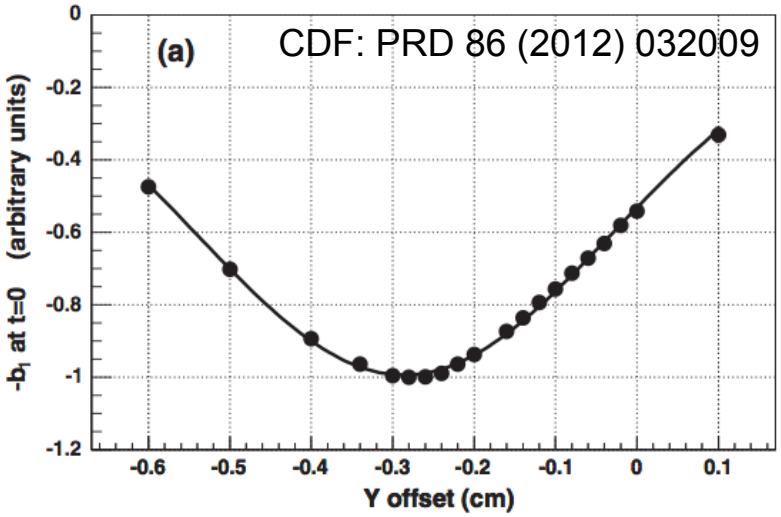
- Study occupancy, track multiplicity
- Focus on timing performance
  - timing resolution, detector segmentation
- Establish requirements to do physics studies
- Timing detector optimization (?)



- Propagate protons to PPS
- Smear resolution according to the vertex, beam divergence, momentum
- Translate background into (in)efficiency
- Time resolution scenarios:
  - 10 ps (optimistic)
  - 30 ps (baseline)

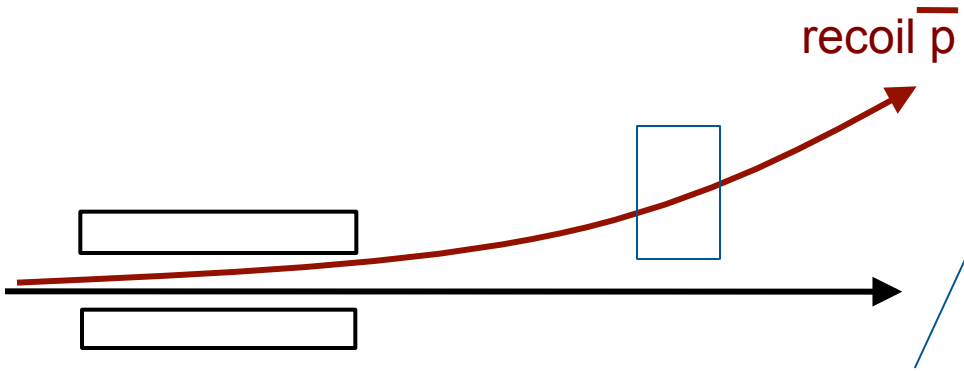


RP dynamic alignment

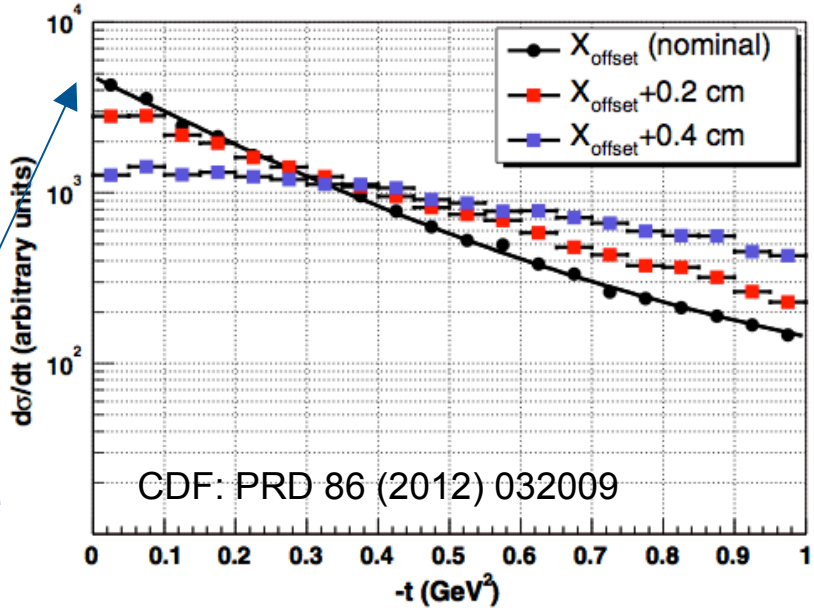


maximize the |t|-slope
(normalized to max slope)

⇒determine X and Y offsets

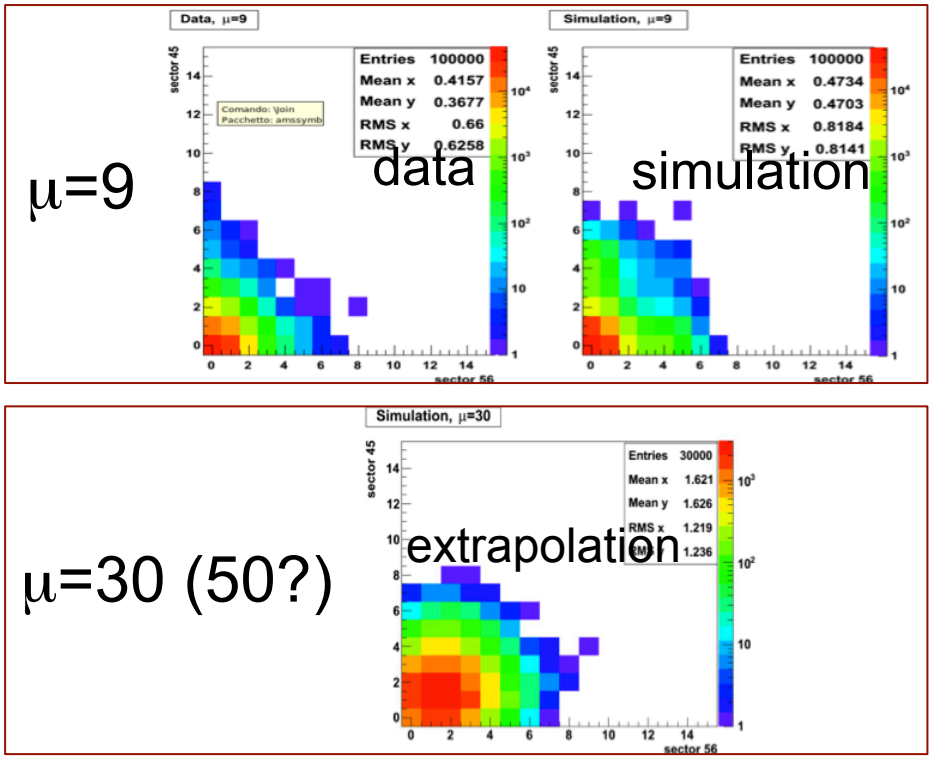


maximize the slope



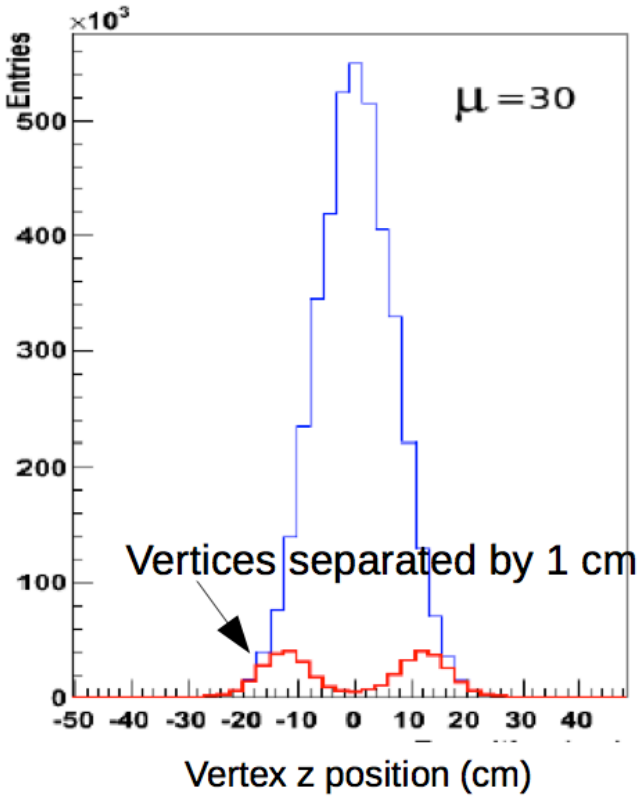
Machine induced backgrounds

- Use experience from data
- Need to extrapolate from μ=9 to μ=50
- Extrapolate background cross-checked with simulation in order to reproduce track multiplicity in data



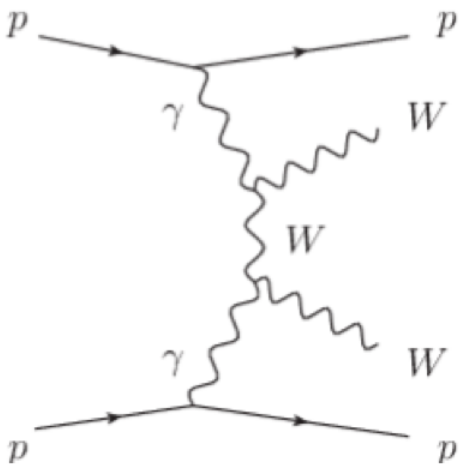
Trigger efficiency

- Define triggers needed to perform physics studies
  - trigger in RP: single(?)/double-arm
  - trigger in central detector
- Observables: t_1 and t_2
  - time of collision: $(t_1+t_1)/2$
  - vertex position: t_1-t_2



Physics processes

- Exclusive dijets
  - high jet p_T events (M_{jj} up to~700-1000 GeV)
  - test of pQCD mechanism of exclusive production
- Exclusive WW
  - quartic gauge boson coupling WW$\gamma\gamma$
  - sensitivity to anomalous couplings
  - use central WW trigger



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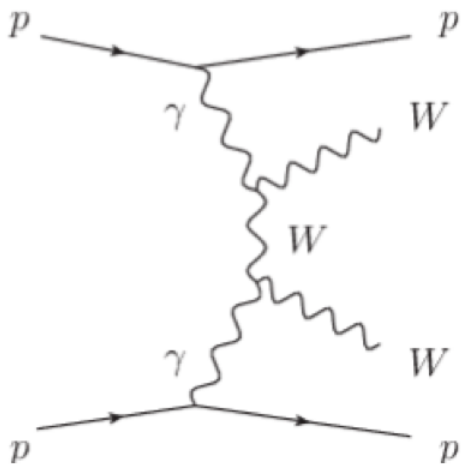


- Include instrumental background in physics simulation
  - Signal (WW, dijets) + physics background according to pileup (includes detector simulation)
  - Instrumental background: given in terms of probability of having additional track in a certain cell of the timing detector (includes inefficiency of multiple-hit, timing resolution efficiency, etc.)
- Timing detector optimization (?)

Running conditions

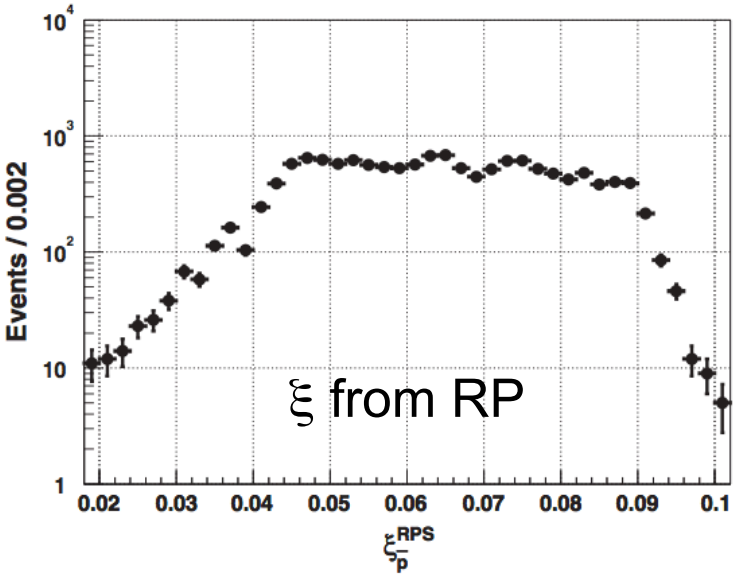
- β~0.5-0.6m
- $N_{bunches}$~2800
- N_p~1.5 x 10^{11}
- E_{beam}=6.5 TeV
- μ=50
- L=30-100 (-300) fb^{-1}

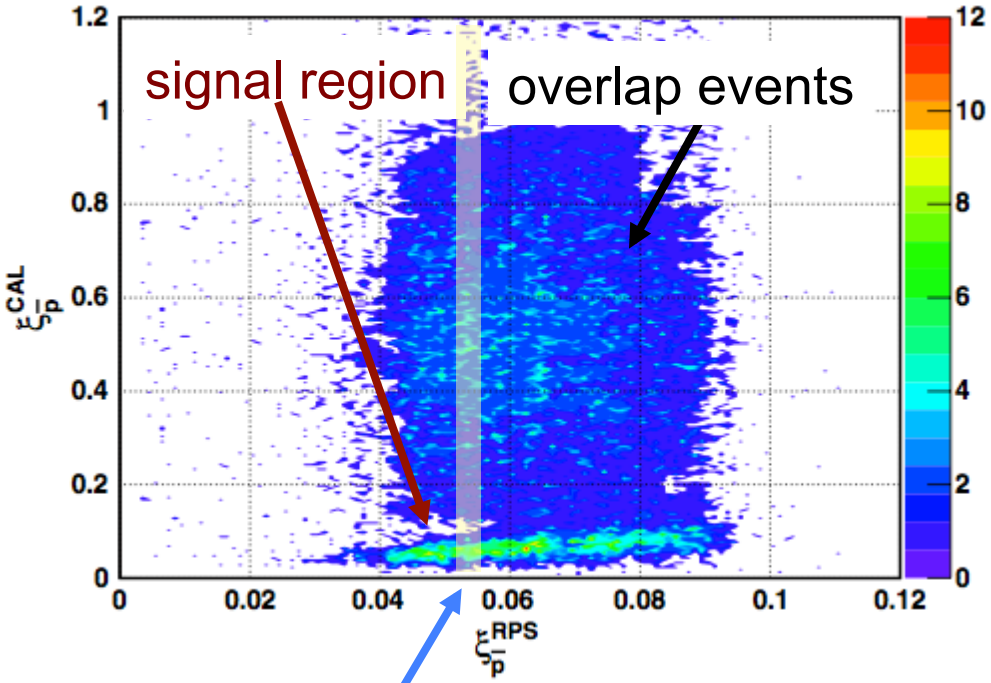
- RP position wrt beam: 15 (20?) σ
- RP tracking position: z= 204/214 m
- RP timing position: z=216 m

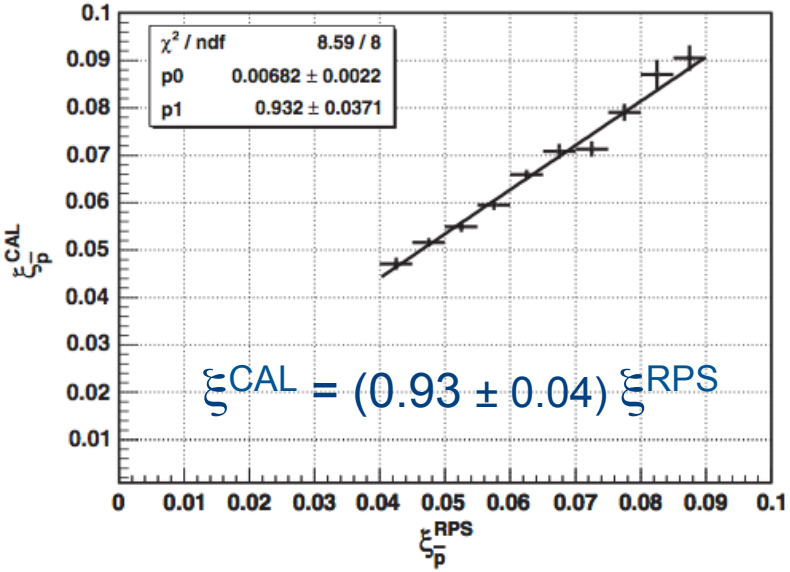
backup

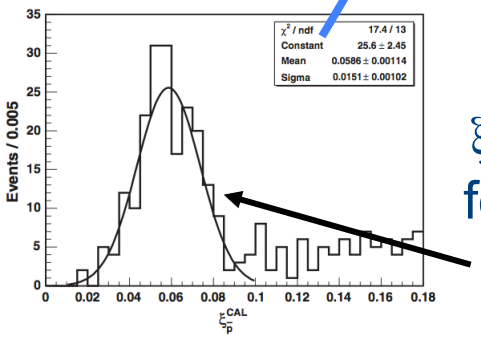
Multiple interactions at CDF

CDF: PRD 86 (2012) 032009









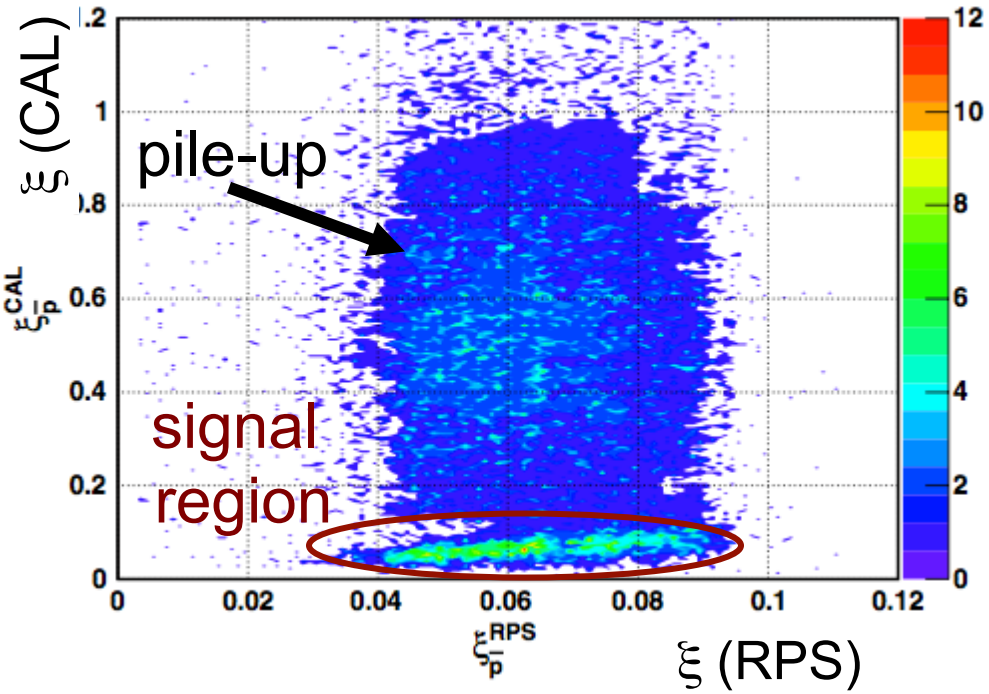
ξ^{cal} distribution for slice of ξ^{RPS}

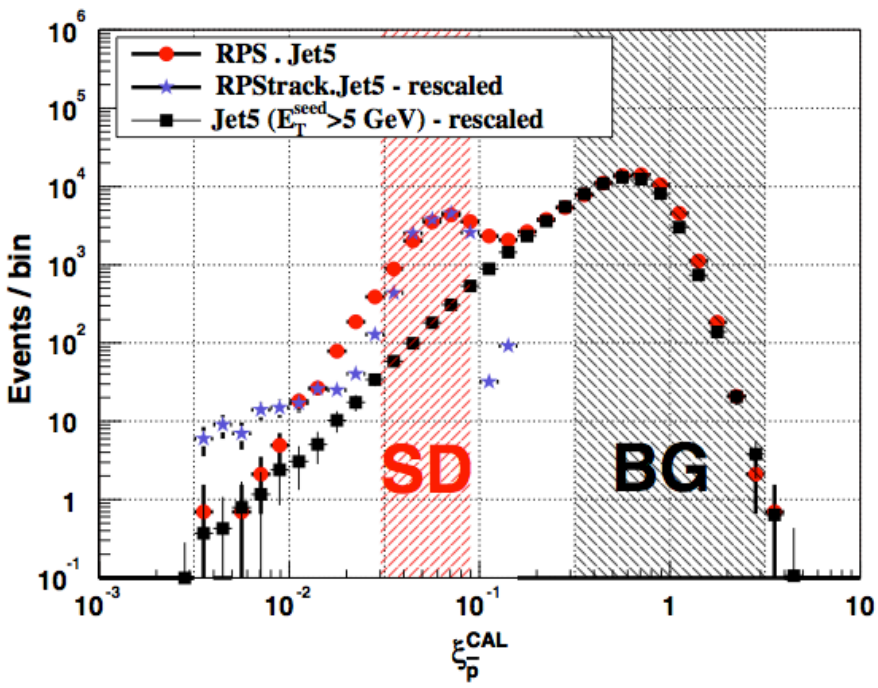
σ/mean ~ 30%

Multiple interactions at CDF

CDF: PRD 86 (2012) 032009

- Multiple proton-antiproton interactions spoil diffractive signature





- Measure ξ from calorimeter and from RP tracking
- Reject multiple interactions
  - exclude ξ>0.1 (ND+SD interactions)