



Study of central exclusive dijets production using the PPS spectrometer

Update

<https://twiki.cern.ch/twiki/bin/view/Main/PPSBrazil>



Samples

- ExHuMe (pp \rightarrow gg \rightarrow dijets) + Pythia 8 (minBias, 50 PU - Run II)
 - $\sigma = \sim 1700.0$ fb
 - 10000 events NoOOT with PU
 - 10000 events NoOOT without PU
 - Generator cuts:
 - $0 < |t| < 4$
 - $0.01 < \xi < 0.2$
 - $300 < M < 2000$ GeV
- **POMWIG**
 - **Background – DPE / Inclusive Dijets**
 - **In production**

Code

Working in CMSSW_6_2_X release.



Kinematic Selection for CEP

- Select the leading jet and choose it as the central vertex reference
- Associate the central vertex with PPS vertex
- Tagging reconstructed protons that arrived to both PPS arms and are in the region:
 - Tracking station 1: $-9.0 < y < 9.0$ mm $-23.15 < x < -3.15$ mm
 - Tracking station 2: $-9.0 < y < 9.0$ mm $-22.03 < x < -2.03$ mm
- Select jets from the same vertex as the leading jet (CEP algorithm)
 - $p_T(j_1, j_2) > 100$ GeV/c (new value)
 - $|\eta|(j_1, j_2) < 2.0$

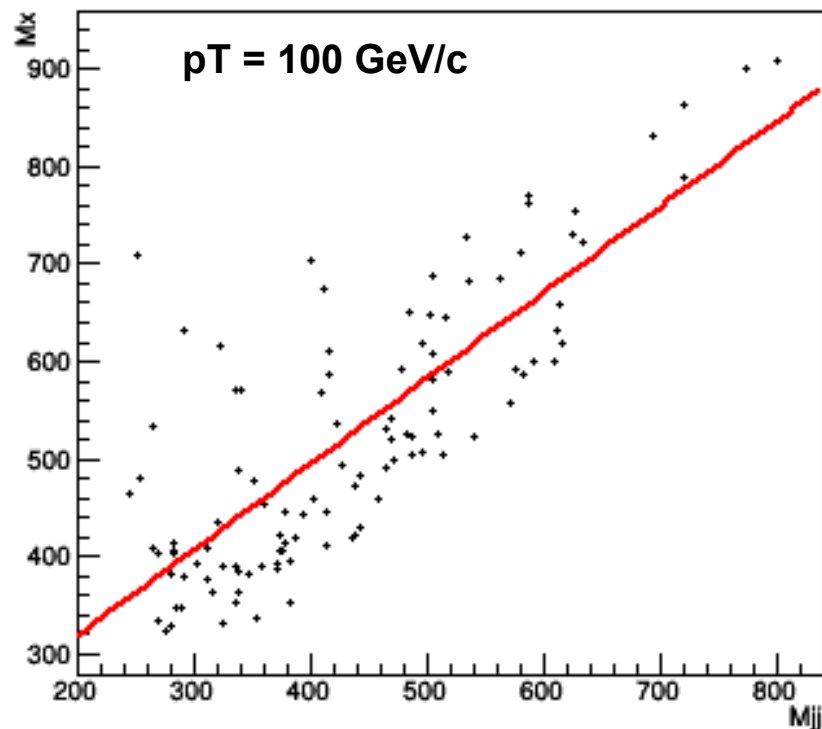
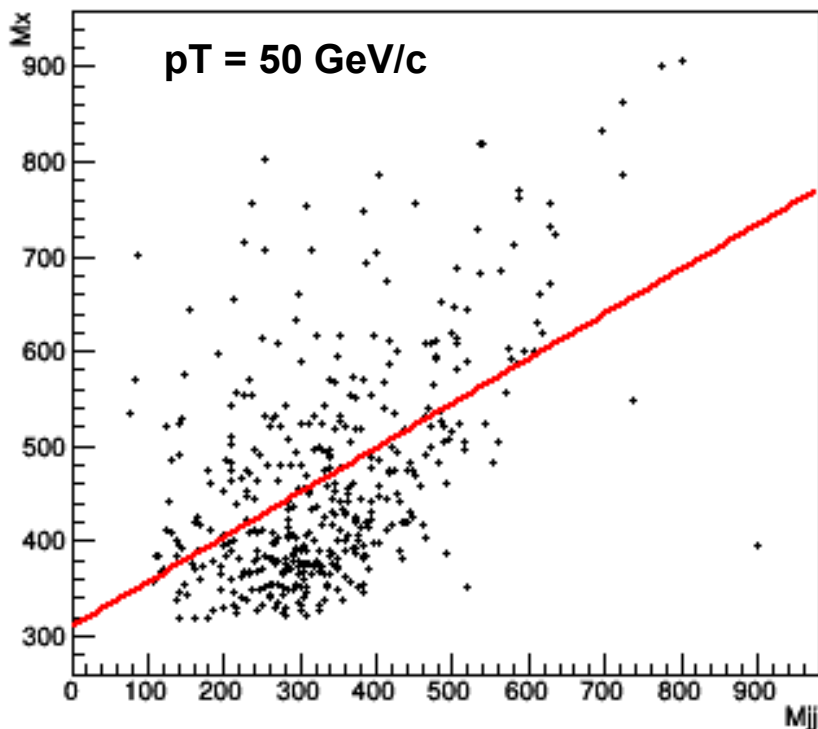


Increase the pT cut to 100 GeV

- In order to improve the reconstructed dijet mass versus the M_x , it was necessary to increase the jets pT cut to 100 GeV

$$p_0 = 307,988 \pm 13.4501$$
$$p_1 = 0.471303 \pm 0.0377059$$

$$p_0 = 141.012 \pm 29.5433$$
$$p_1 = 0.878431 \pm 0.0652752$$





Numbers

Selections ()	Number of events	Relative cumulative efficiency	Number of events / 1 fb-1
Total Number of events	10000	100 %	1700.0 ± 0.02
Associate vertex	3486	34.9 %	592.6 ± 0.04
# PPS Tagging	514	5.1 %	87.4 ± 0.1
# Jet1Pt && Jet2Pt > 100 GeV	112	1.1 %	19.0 ± 0.2
# Jet1Eta && Jet2Eta < 2.0	110	1.1 %	18.7 ± 0.2



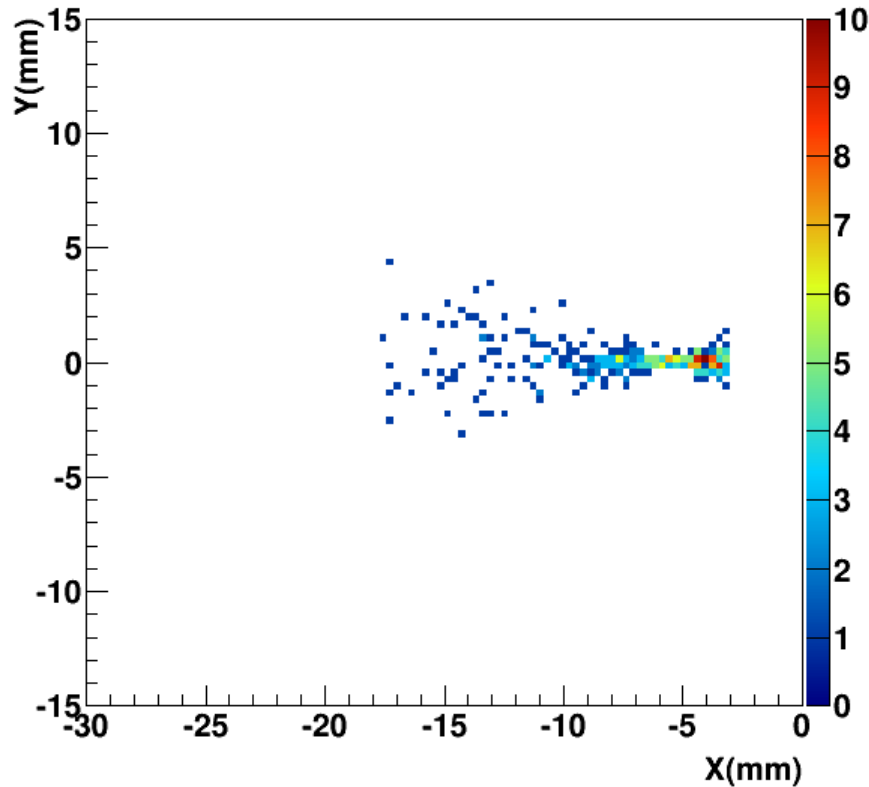
Beam halo background

- Using the Jonathan procedure (his presentation of April 23th meeting)
- Mixing each entry of the Mirko's ntuple, which corresponds to the background measured in the RP in data for one BX, extrapolated to pileup $\mu=50$, with one entry of the dijet samples.
- **Only the central dijets cuts were applied**
 - $p_T(j_1, j_2) > 100 \text{ GeV}/c$
 - $|\eta(j_1, j_2)| < 2.0$
 - **There is no vertex matching in the beam halo study**

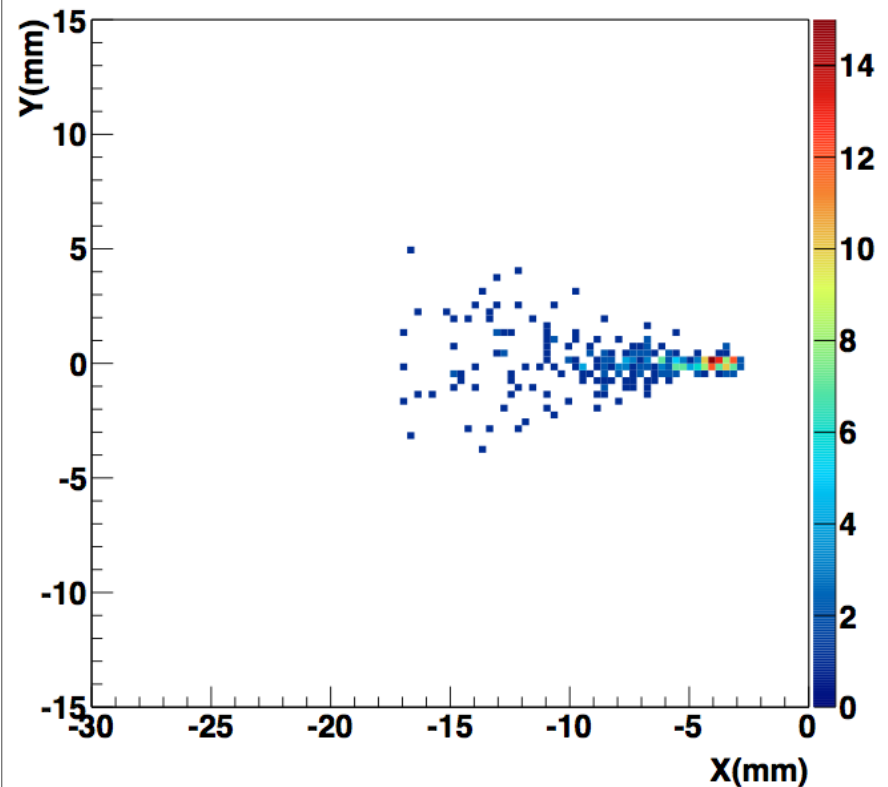


Hitmaps from signal file

Hitmap det1 ArmF Signal



Hitmap det2 ArmF Signal



10 000 entries with dijet selection

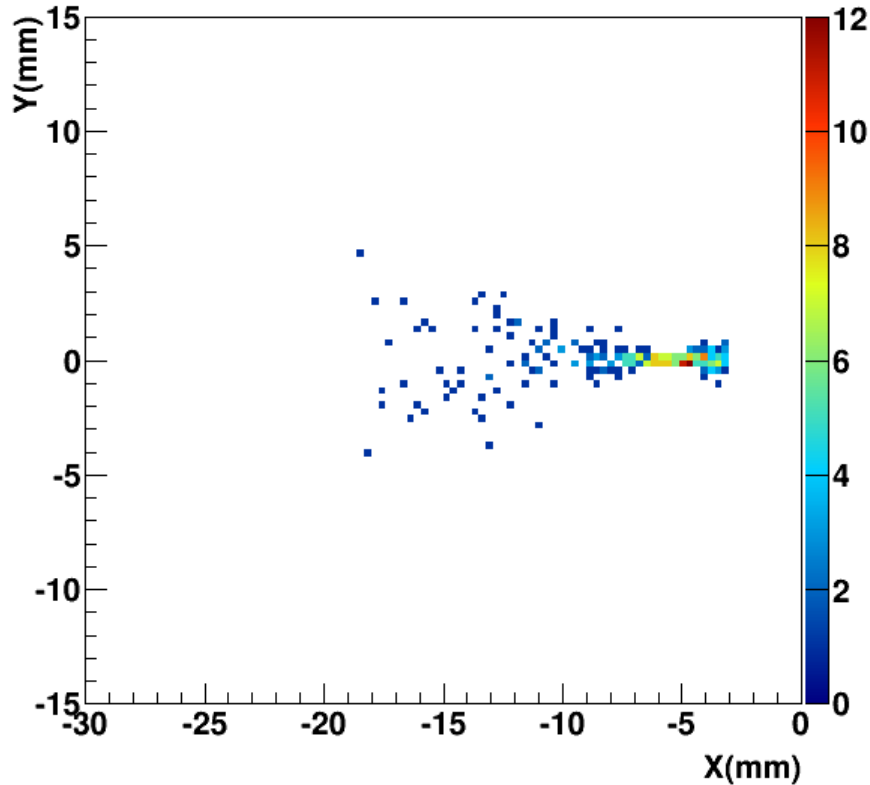
There are two independent analyses of the both arms from PPS

- hits in Det1 and Det2 in the fiducial region @ 15 sigma
- hits in the Quartic (15mm x 12 mm) @ 15 sigma
- 340 events in armF and 324 in armB

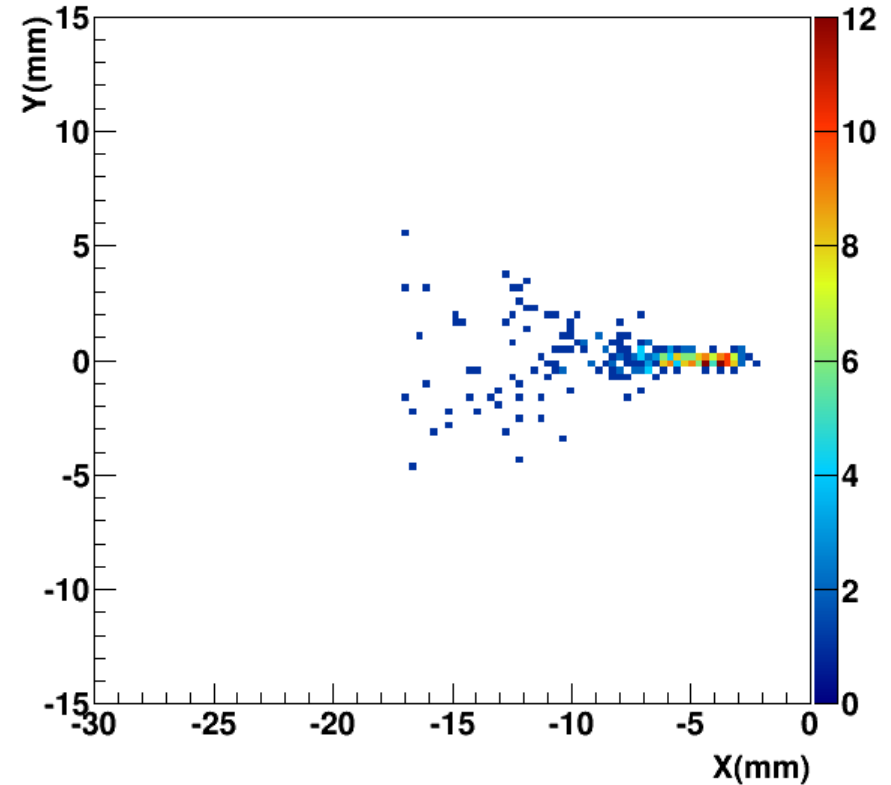


Hitmaps from signal file

Hitmap det1 ArmB Signal



Hitmap det2 ArmB Signal



10 000 entries with dijet selection

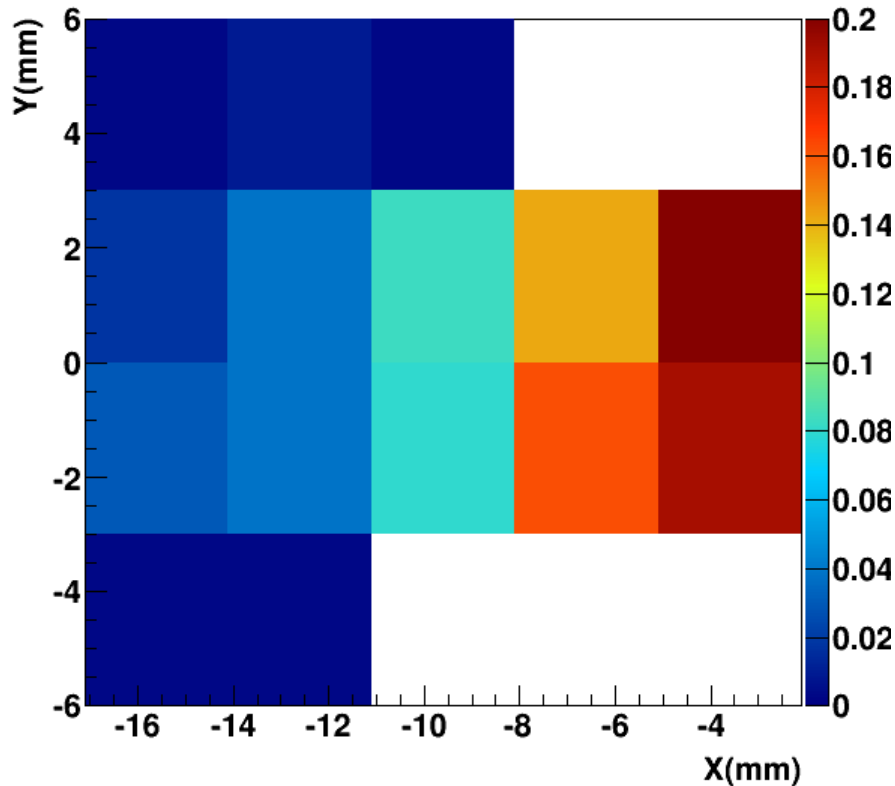
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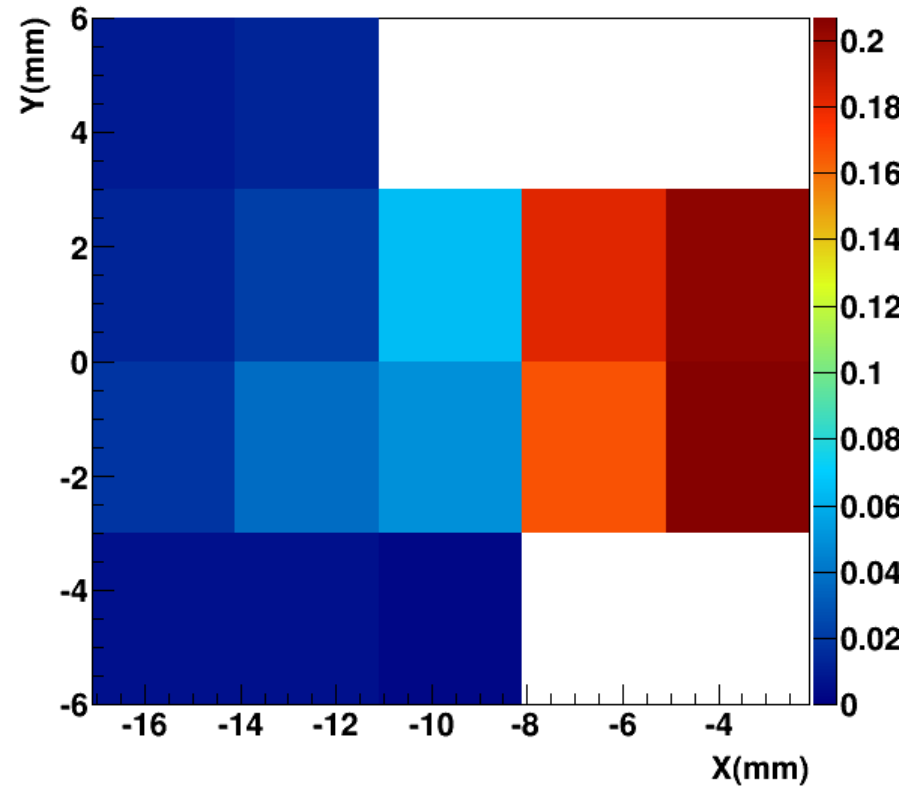


Hitmaps from signal file

ToF Quartic @ -2.1mm(15 σ) ArmF Signal



ToF Quartic @ -2.1mm(15 σ) ArmB Signal



10 000 entries with dijet selection

There are two independent analyses of the both arms from PPS

- hits in Det1 and Det2 in the fiducial region @ 15 sigma
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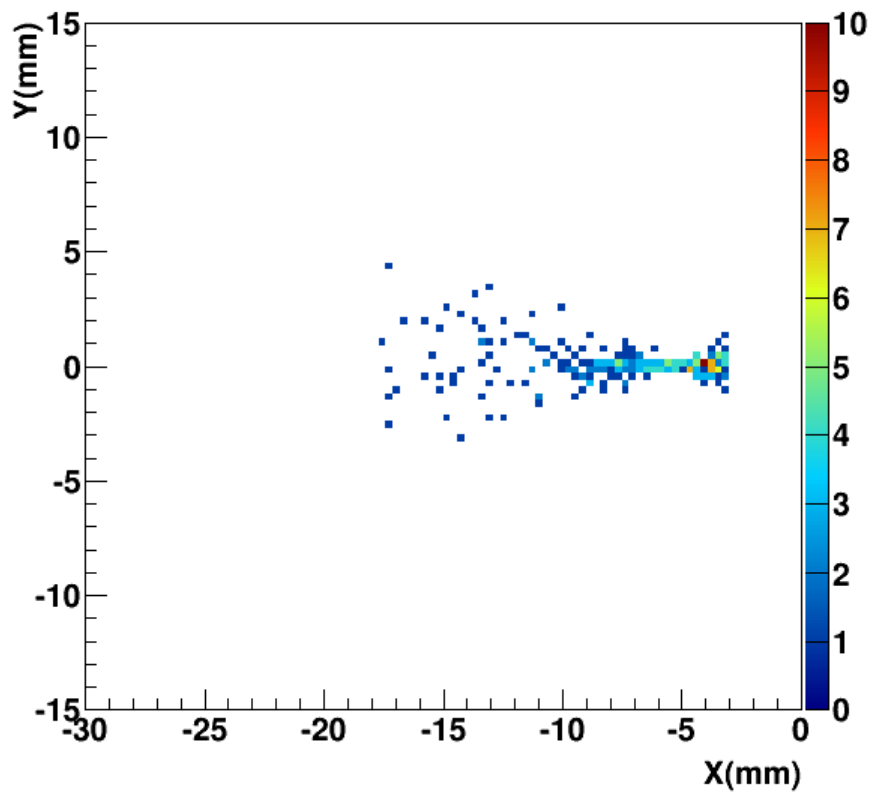
Mixing signal with halo sample (50 PU)

- Mixing each entry of the Mirko's ntuple, which corresponds to the background measured in the RP in data for one BX, extrapolated to pileup $\mu=50$, with one entry of the dijet samples.
- Determine the ToF cell for each signal event and the ToF cell for the halo, with the 50 protons of each event
- If any ToF cell from the signal is the same of the halo, discard the arm for this event
- After that there are 267 events in the armF and 259 in the armB
 - Reminder:
Using only the signal sample - 340 events in armF and 324 in armB

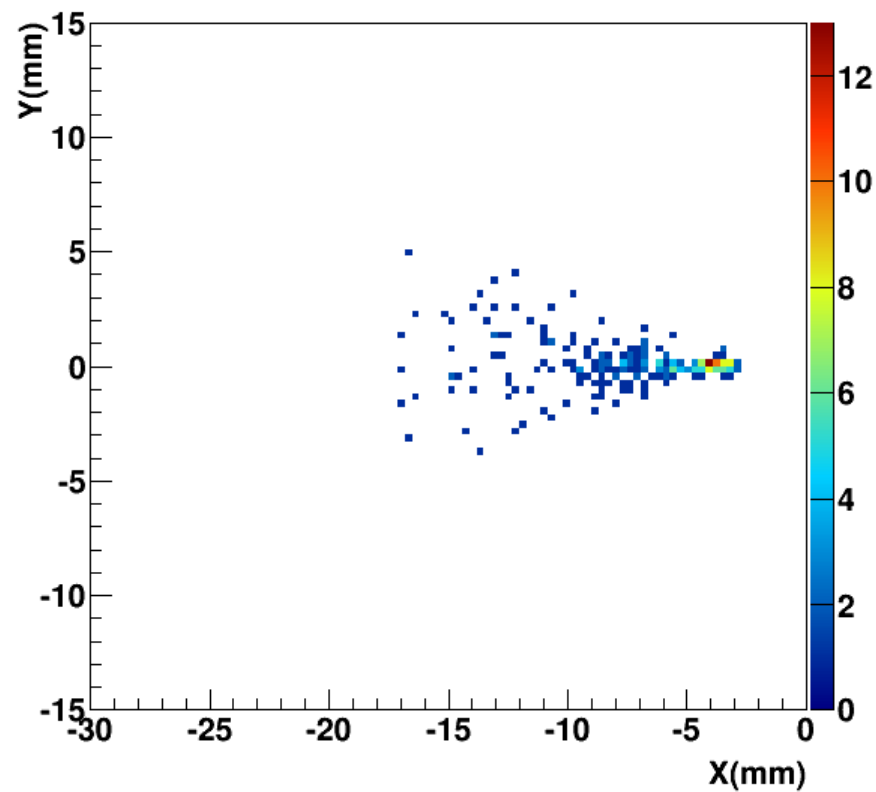


Mixing signal with halo sample (50 PU)

Hitmap det1 ArmF Signal+50Halo



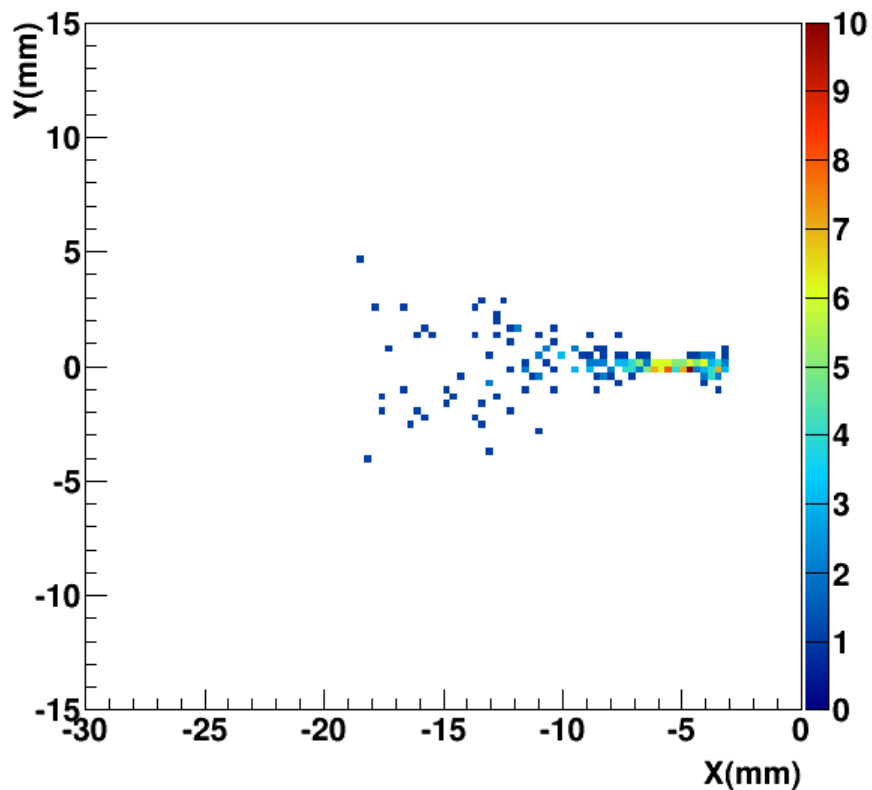
Hitmap det2 ArmF Signal+50Halo



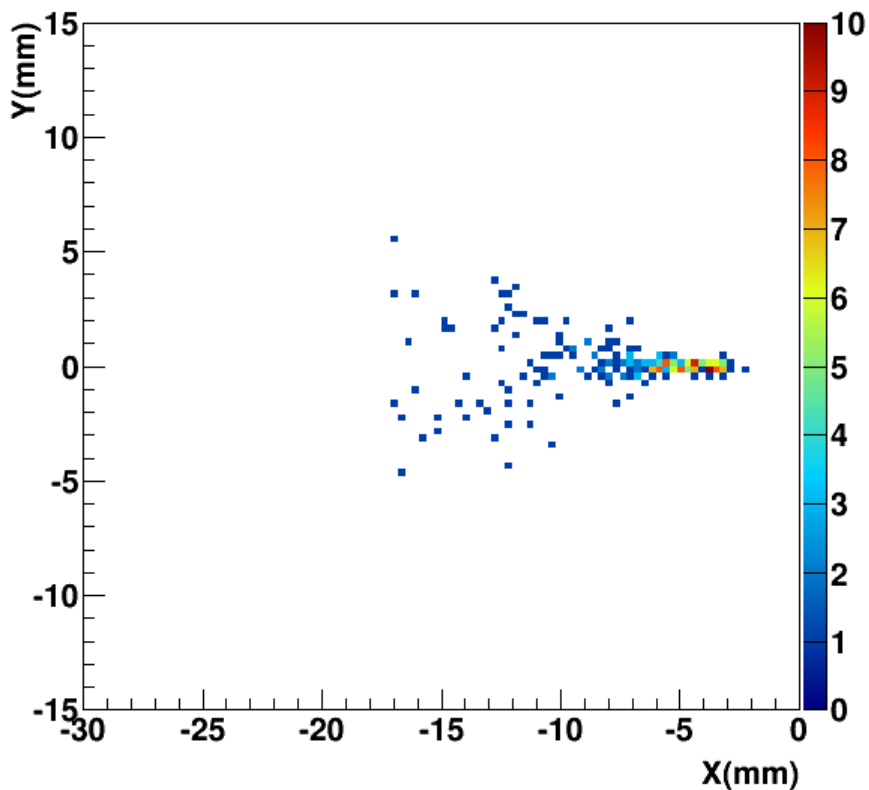


Mixing signal with halo sample (50 PU)

Hitmap det1 ArmB Signal+50Halo



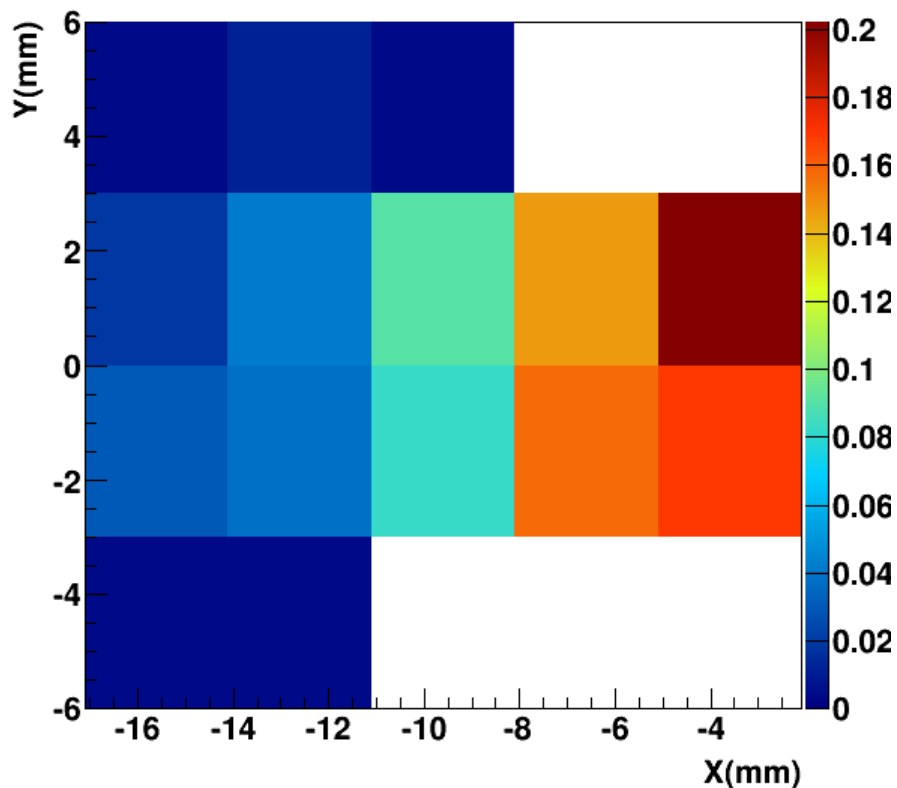
Hitmap det2 ArmB Signal+50Halo



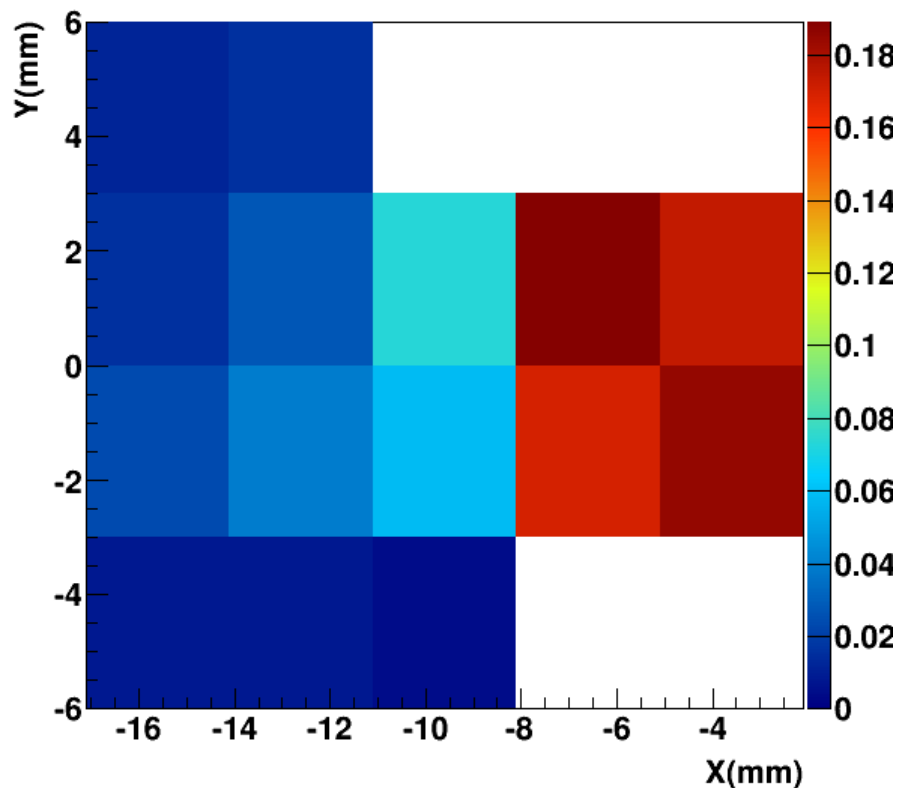


Mixing signal with halo sample (50 PU)

ToF Quartic @ -2.1mm(15 σ) ArmF Signal+50Halo



ToF Quartic @ -2.1mm(15 σ) ArmB Signal+50Halo



- hits in the Quartic (15mm x 12 mm) @ 15 sigma
- 267 events in armF and 259 in armB

Conclusion:

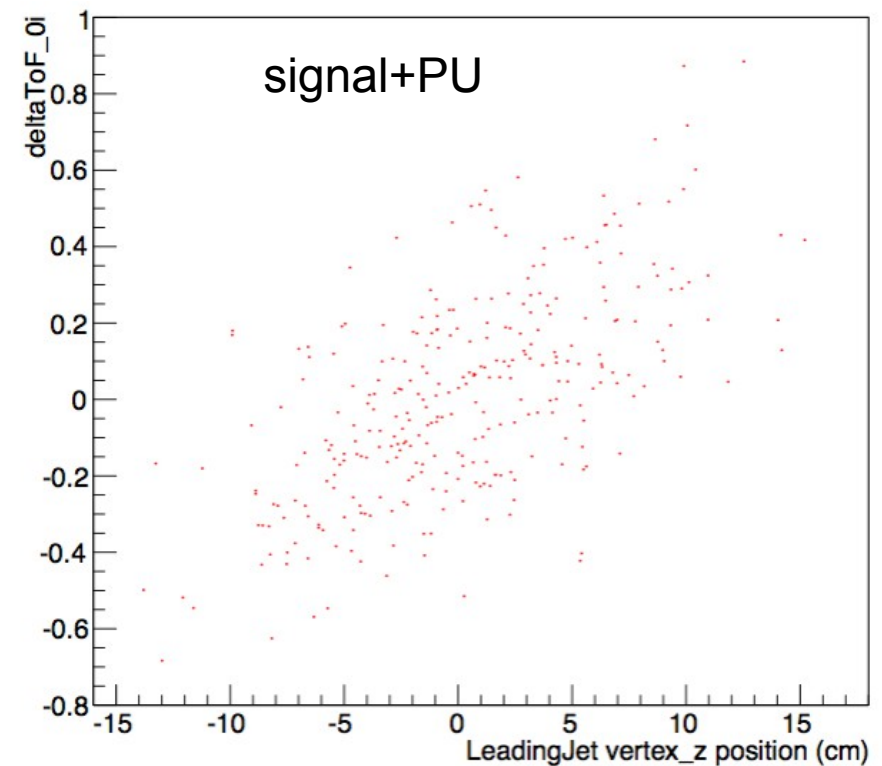
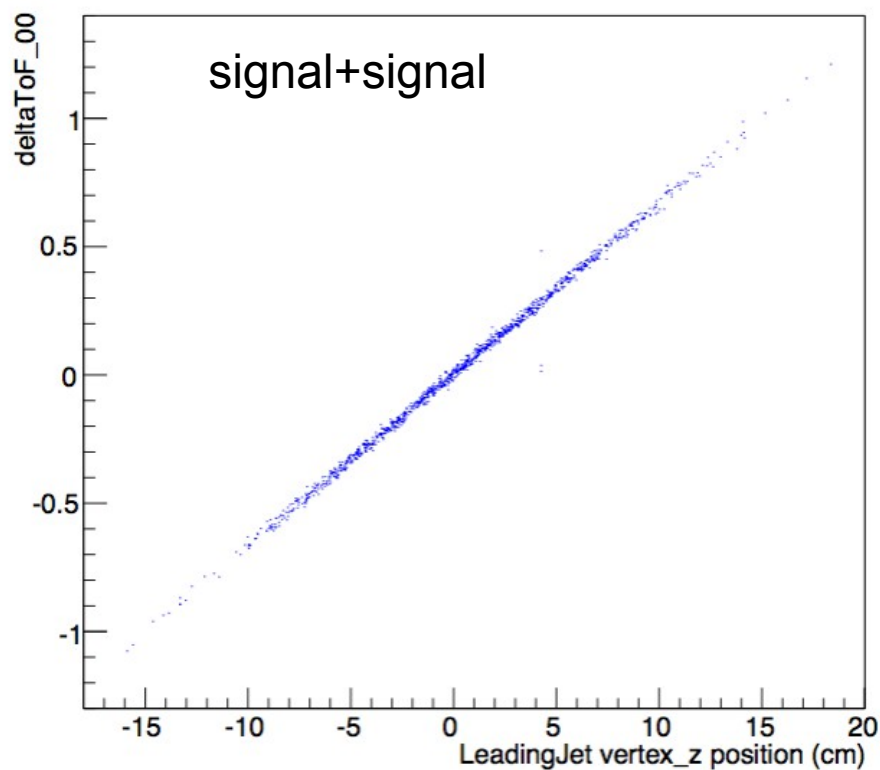
~ 22% of the events are lost because of the beam halo



Numbers (add hits overlapping)

Selections ()	Number of events	Relative cumulative efficiency	Number of events / 1 fb ⁻¹
Total Number of events	10000	100 %	1700.0 ± 0.02
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# PPS Tagging	514	5.1 %	87.4 ± 0.1
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# Jet1Eta && Jet2Eta < 2.0	110	1.1 %	18.7 ± 0.2
no overlapping hits in timing detectors	86	0.9 %	14.6 ± 0.3

Checking timing correlation



Timing correlation plots (10 ps resolution in simulation) -
 Requiring all cuts in central detector, all combinations
 (signal+pileup) of 2 protons in acceptance of
 tracking/timing stations of both arms of PPS



Next steps

- Delta ToF check for 30 ps
- Add combination of proton from signal + PU
- Add physics background
 - DPE - inclusive dijets
 - Pomwig