- Spatial Resolution of DEPFET Prototype Sensors
- Characteristics of Background Hits in the Vertex Detector

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Determination of DEPFET Prototype Sensor Resolution in Testbeam

- Sensor resolution is measured by employing supporting device : the Bonn Atlas Telescope (BAT)
  - Pitch size $= 50\ \mu$m ; intrinsic resolution $= 4.5\ \mu$m
- The track is reconstructed from the point measurements in the four planes of telescope, straight line fit is employed
- Resolution is defined as a difference between reconstructed position in the DEPFET sensor and intersection point of the reconstructed track with the sensor plane
- Total point resolution : $\sigma_{\mathrm{tot}} = \sigma_{\mathrm{depfet}} \oplus \sigma_{\mathrm{MS}} \oplus \sigma_{\mathrm{telescope}}$

Point Measurement with DEPFET Sensor

- Determination of point position in DEPFET is based on η-algorithm

- First, quantity η is calculated : $\eta = Q_{right} / (Q_{right} + Q_{left})$, where Q_{right} & Q_{left} are charges deposited on two hottest neighboring rows (columns) of pixels

- The resulting position is determined as :

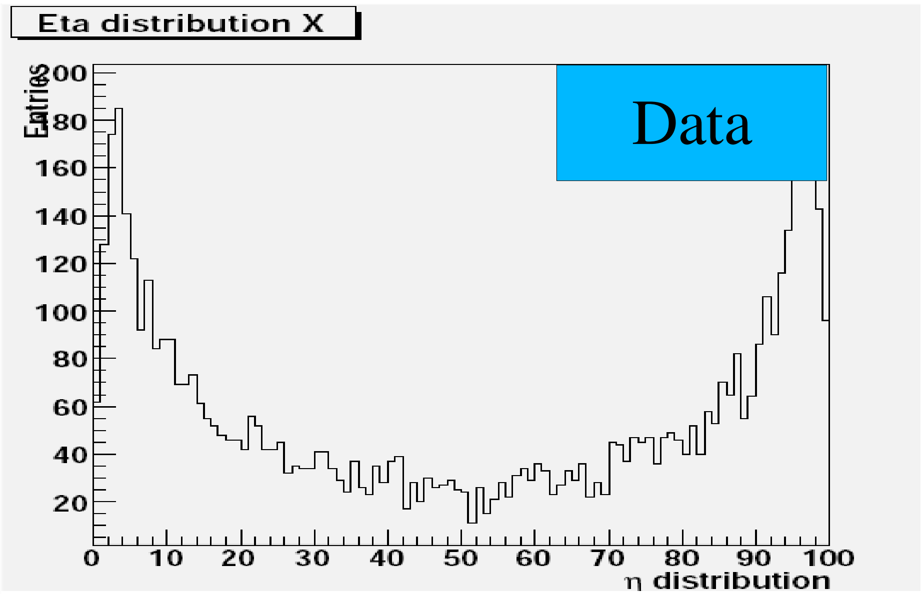
$$x_{\eta} = x_{left} + \Delta x \cdot \int_{0}^{\eta} f(\eta') d\eta'$$

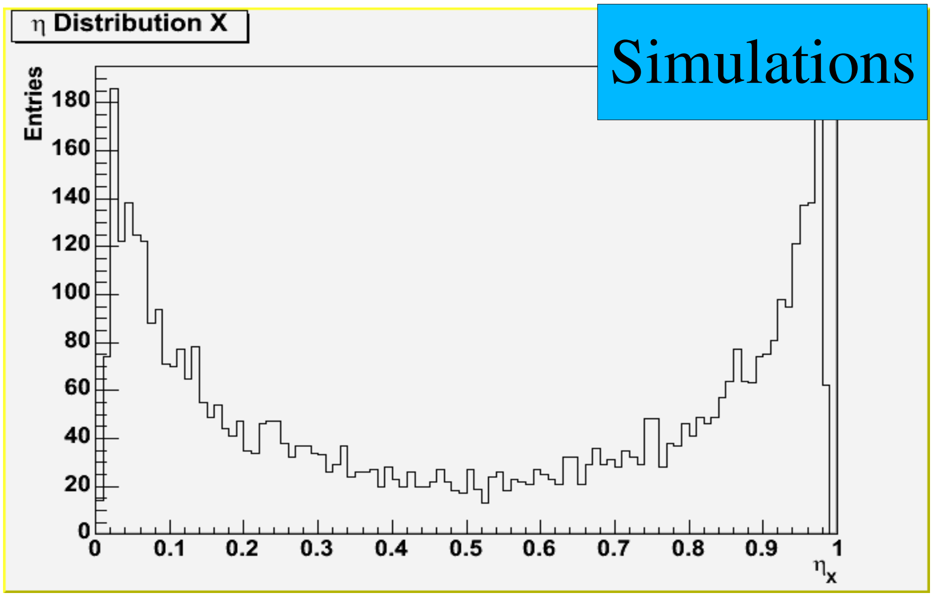
x_{left} is coordinate of left row, Δx is pitch size, $f(\eta')$ is pdf assocciated with distribution of η

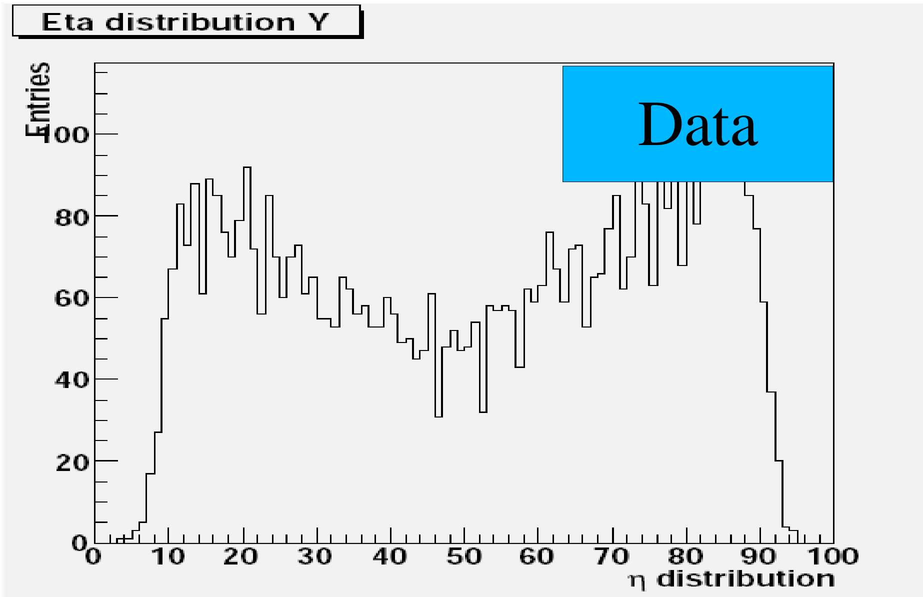
Testbeam Results

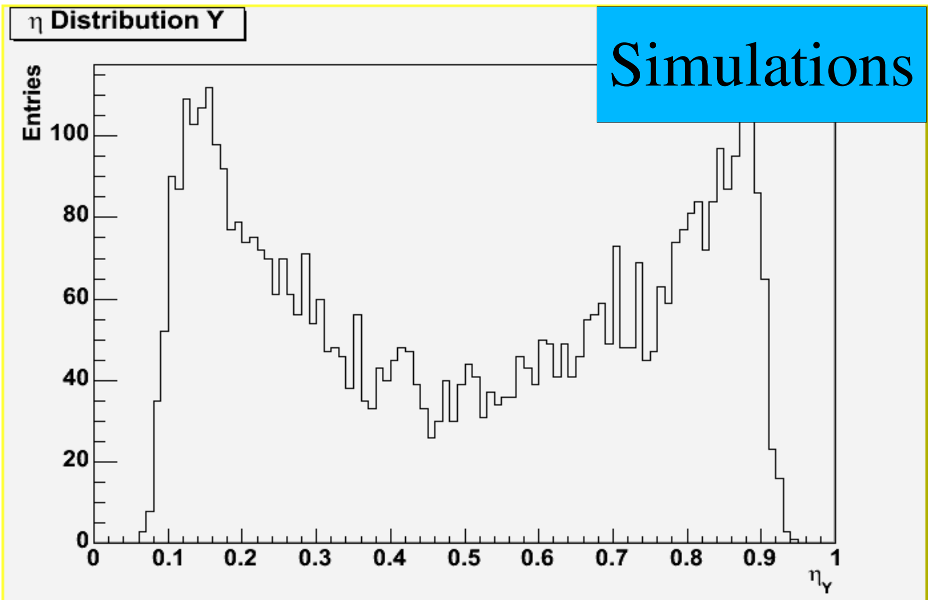
- Results are presented for representatively chosen matrix Hyb2A
  - Pitch size (X,Y) = (36,22) μm; Thickness = 450 μm
- Resolution is measured as a function of e^+ beam energy; energy scan in the range 1-6 GeV has been performed
- Obtained resolutions @ 6 GeV beam energy
  - $\sigma_{\mathrm{x,tot}} = 8.1\ \mu\mathrm{m}\ ;\ \sigma_{\mathrm{y,tot}} = 7.1\ \mu\mathrm{m}$
- Contributions from various factors can be understood by performing simulation studies

η-Distributions : Testbeam Data vs. Simulations

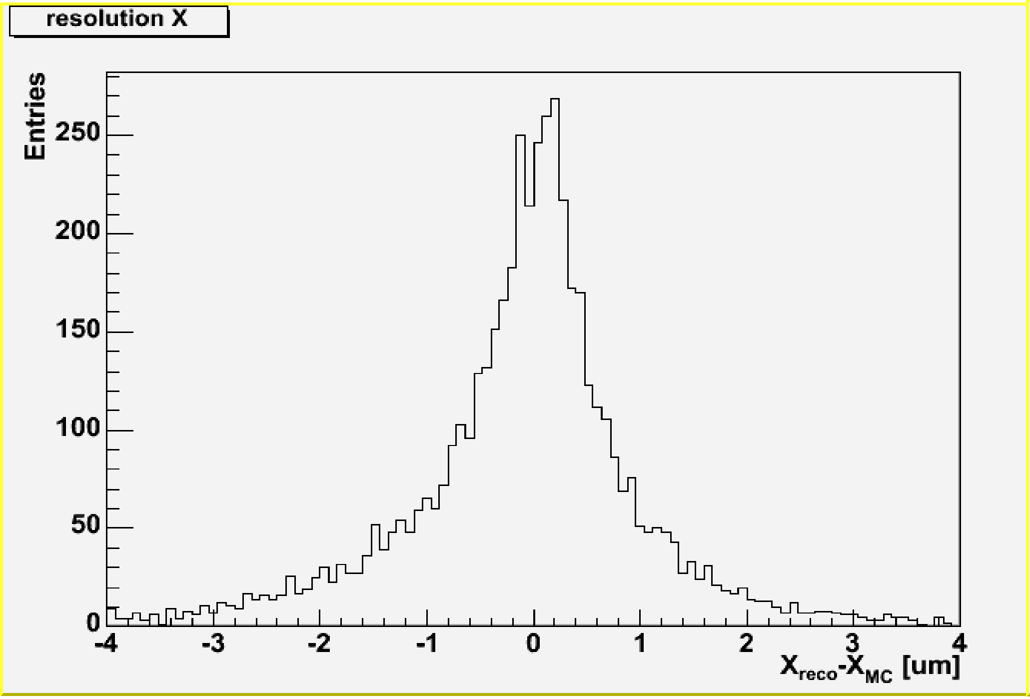


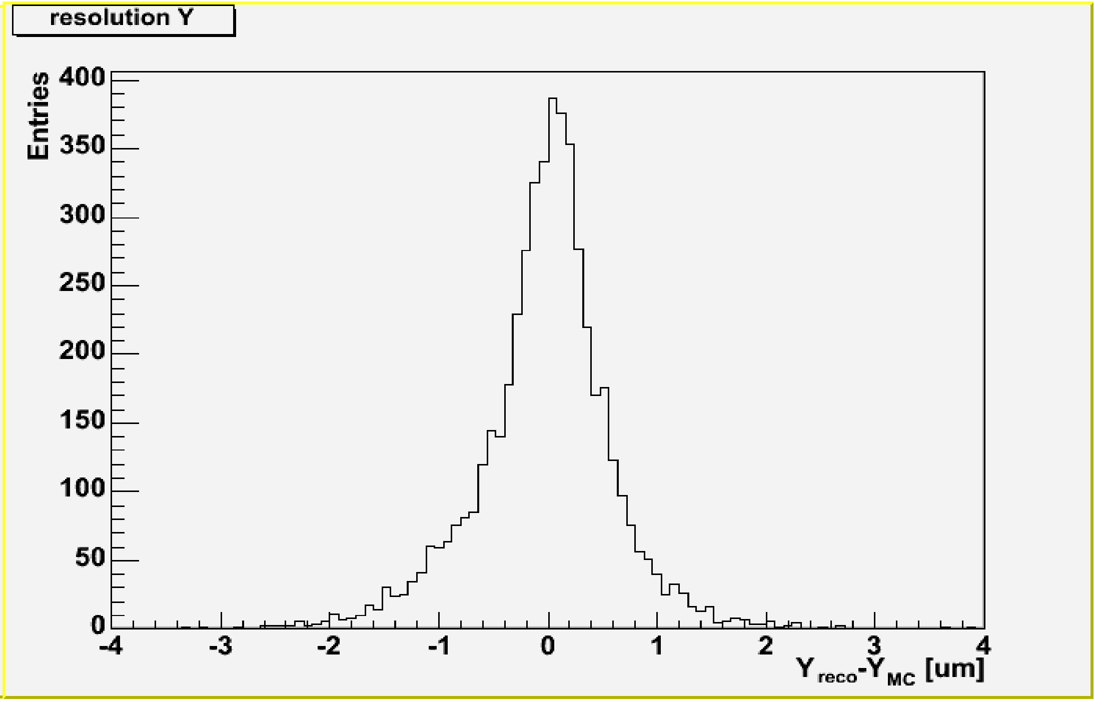






Spatial Resolution of DEPFET Prototype Sensors (Simulations)





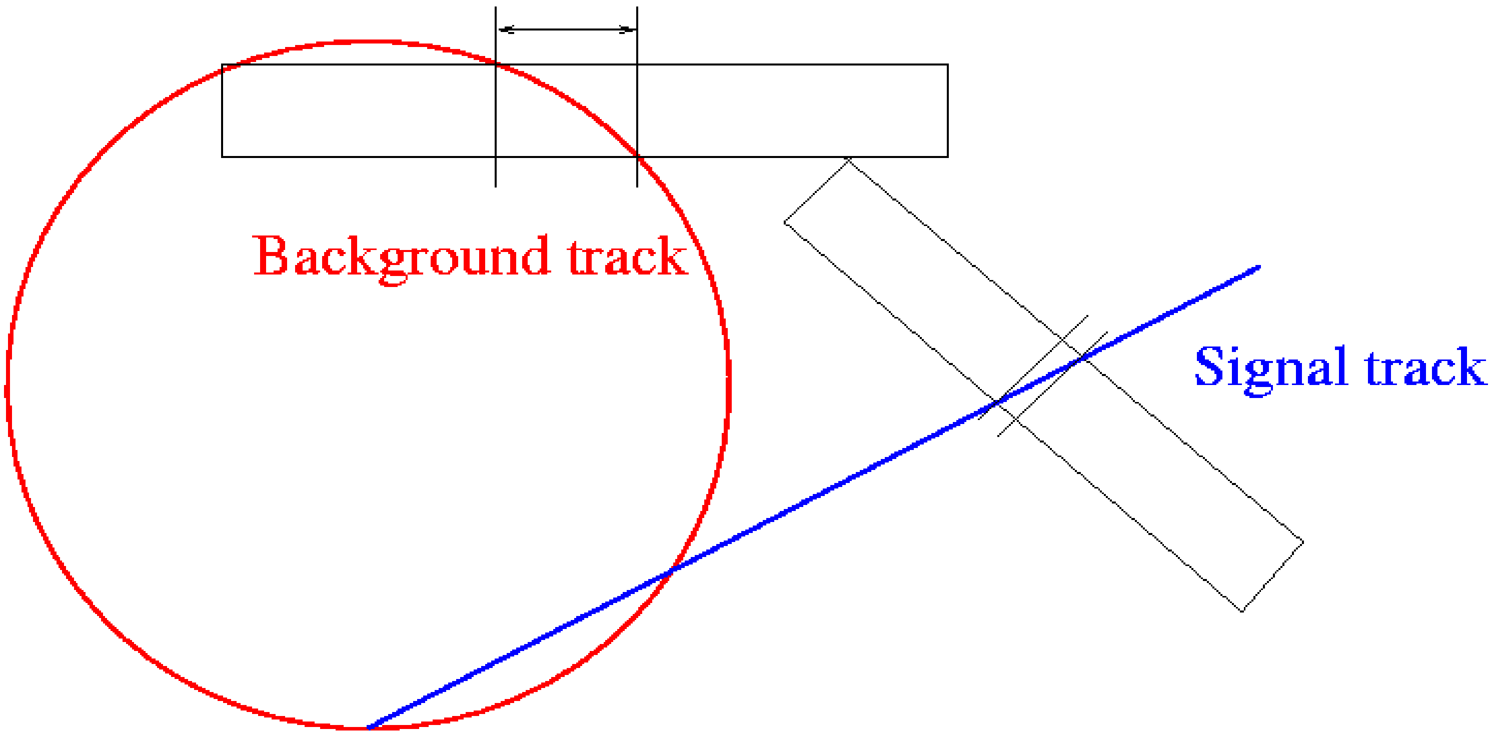
$$\sigma_{x,rms} = 1.3\ \mu m$$

$$\sigma_{y,rms} = 0.7\ \mu m$$

Contribution from Multiple Scattering

- Effect of MS is evaluated by simulating particle interactions with DEPFET sensors and telescope planes within Geant3 framework (Bonn group)
- Estimated MS resolution @ 6GeV e^+ energy : 6.5 μm
- Resulting total resolution obtained from MC simulations
  - $\sigma_x = 7.0\ \mu m$; $\sigma_y = 6.8\ \mu m$ compared to
  - $\sigma_x = 8.1\ \mu m$; $\sigma_y = 7.1\ \mu m$ (testbeam results)
- Total resolution as measured in testbeam seems to be totally dominated by MS and intrinsic telescope resolution
- Data @ higher energies are needed to reduce MS effect

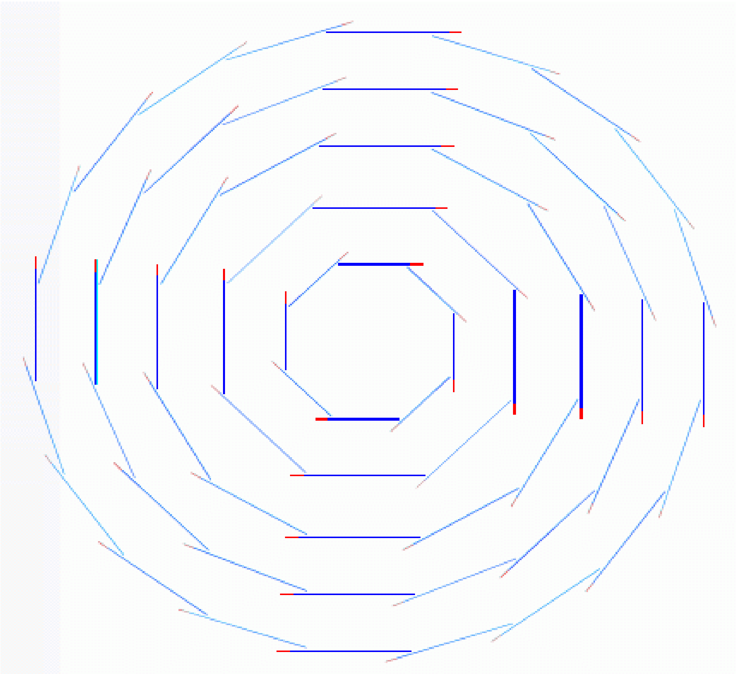
Characteristics of Background Hits



- Hits originating from beam induced backgrounds are produced by low momentum particles curling in magnetic field. This results in a rather shallow incidence angles w.r.t VXD planes ⇨ background hits
  - have on average bigger clusters (larger width in r-ϕ plane)
  - are characterised by larger deposited charge

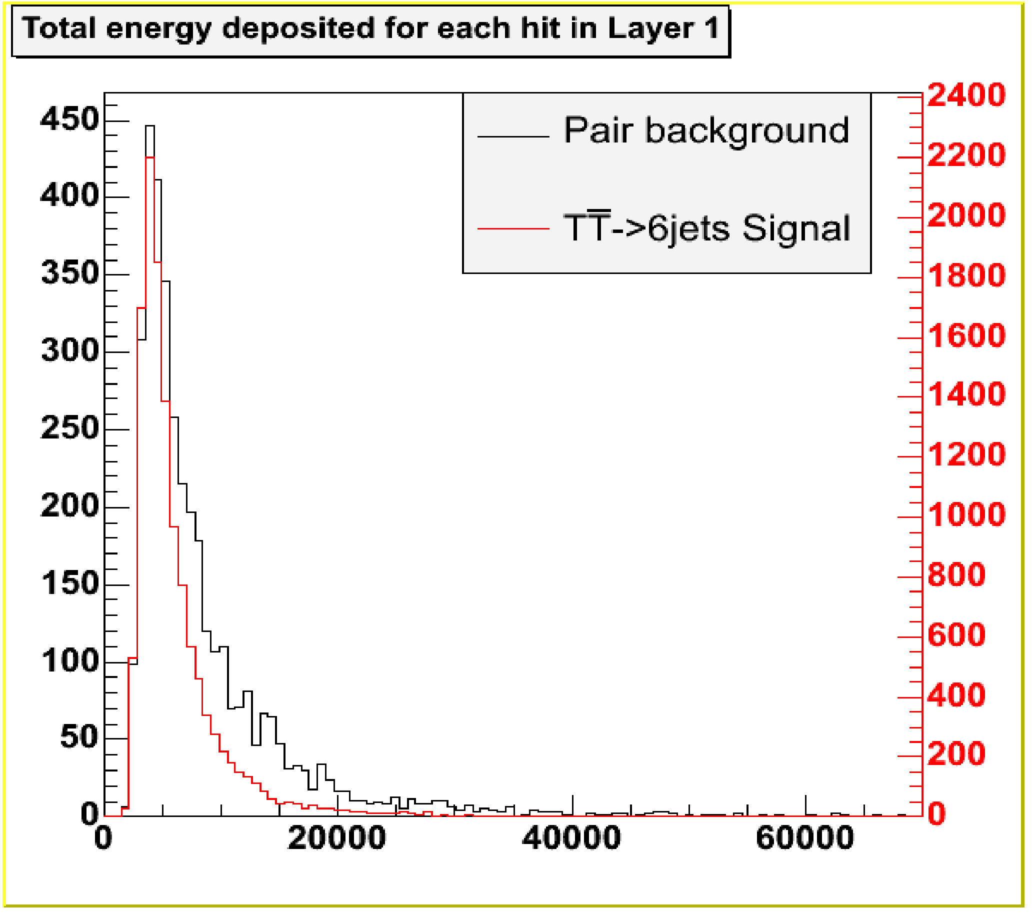
Background vs. Signal Hits

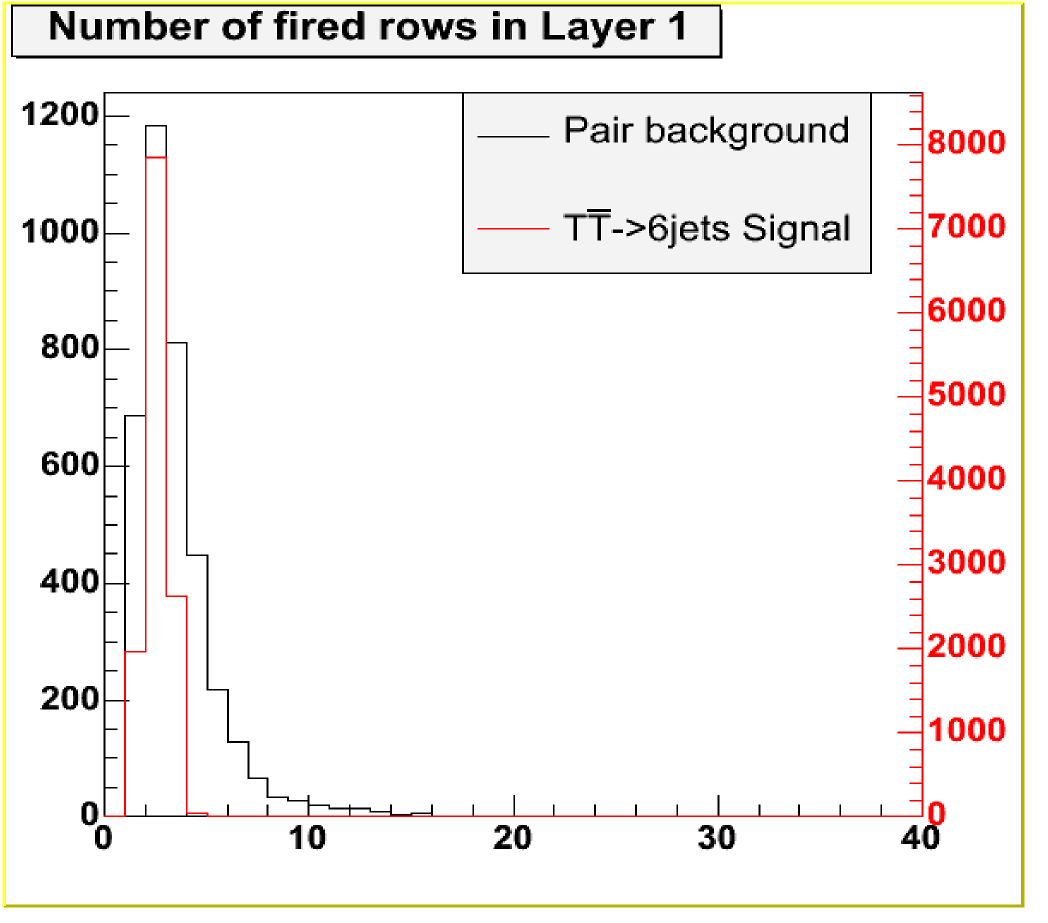
- Characteristics of background hits are compared to those produced in signal reactions, e.g. tt ⇨ 6jets @ 500 GeV
- Simulated DEPFET sensors have thickness of 50 μm and pitch size $25\times25\ \mu\text{m}^2$
- VXD Geometry



	Radius (cm)	Ladders	Length (cm)
1	1.5	8	10.0
2	2.6	8	2×12.5
3	3.8	12	2×12.5
4	4.9	16	2×12.5
5	6.0	20	2×12.5

Quantities Discrimination Background & Signal Hits





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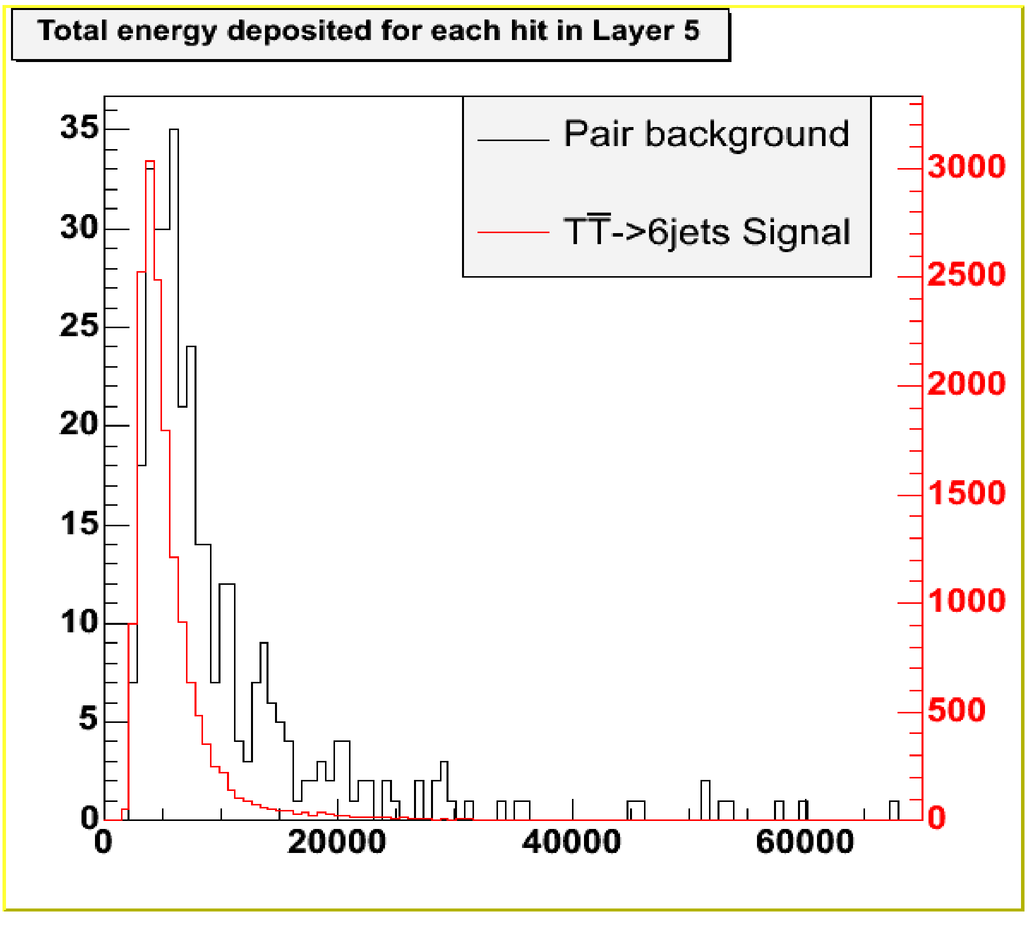

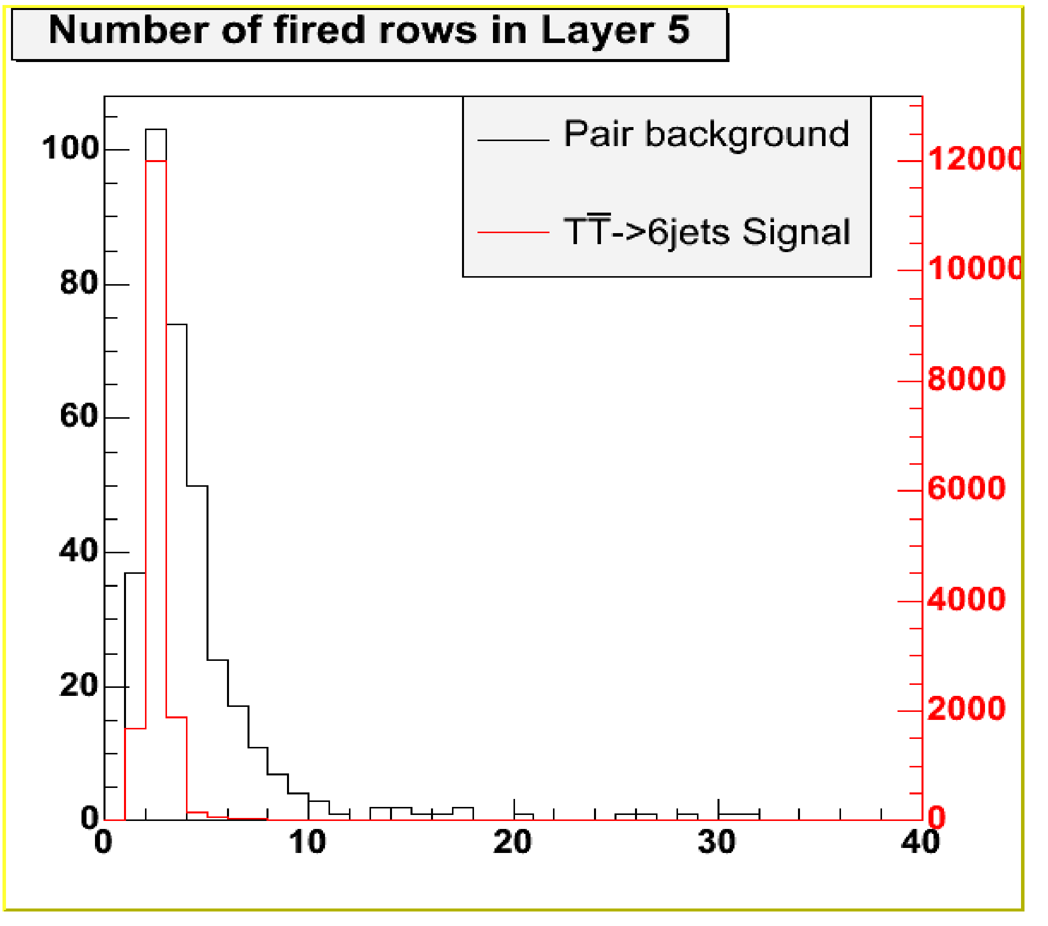

Outlook: Proposed Strategy to Handle Fake Tracks

- Differences in the characteristics of signal and background hits can be exploited to suppress fake track rate
- One possible solution (proposed by Ariane) would be to combine discriminating quantities of all hits contributing to a given track with reconstructed track parameters (curvature, polar angle) into neural network or correlation-sensitive likelihood in order to quantify the probability of track to be a fake (consisting mainly of background hits)
- A cut on NNet output or likelihood can be imposed to select "good" tracks
- A detailed dedicated studies are planned