Event Classification - Why?

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Overview

Contents:

Primary objective

Dorothea Pfeiffer et. al. have shown that a Gd-coated GEM is able to detect thermal neutrons with high precision, by analysing the tracks from conversion electrons in the GEM drift volume.

Primary objective:

- Assemble signals from the individual strips into events consisting of signals from only one neutron event.
- Refine the algorithm (if possible) to obtain the highest possible precision.

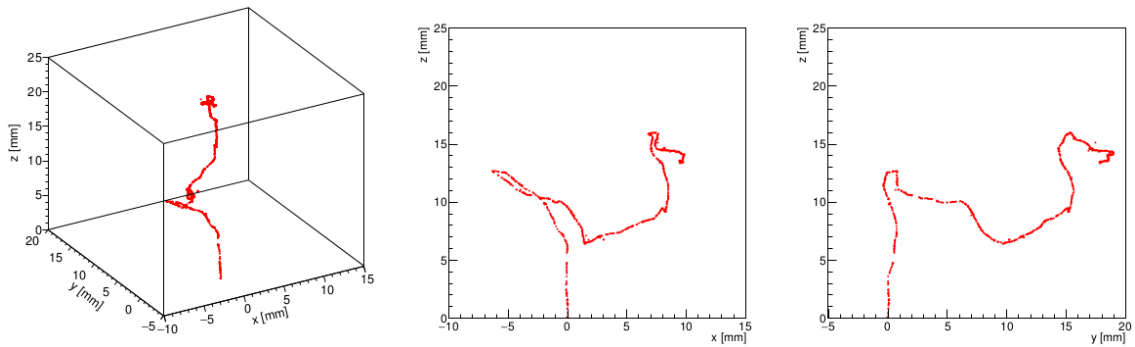
(The data from the final detector configuration will not be segmented into individual neutron events.)

Event Classification

Conversion electrons have relatively low energy ∼100keV.
Electrons trajectories may therefore be "far from" straight lines due to scattering.
Tracks are therefore quite different.

We want to:

- Know the amount of "problematic events"
- Characterise an event sample
- Compare test-beam data with simulation results



(a) 3D (b) Projection zx (c) Projection zy

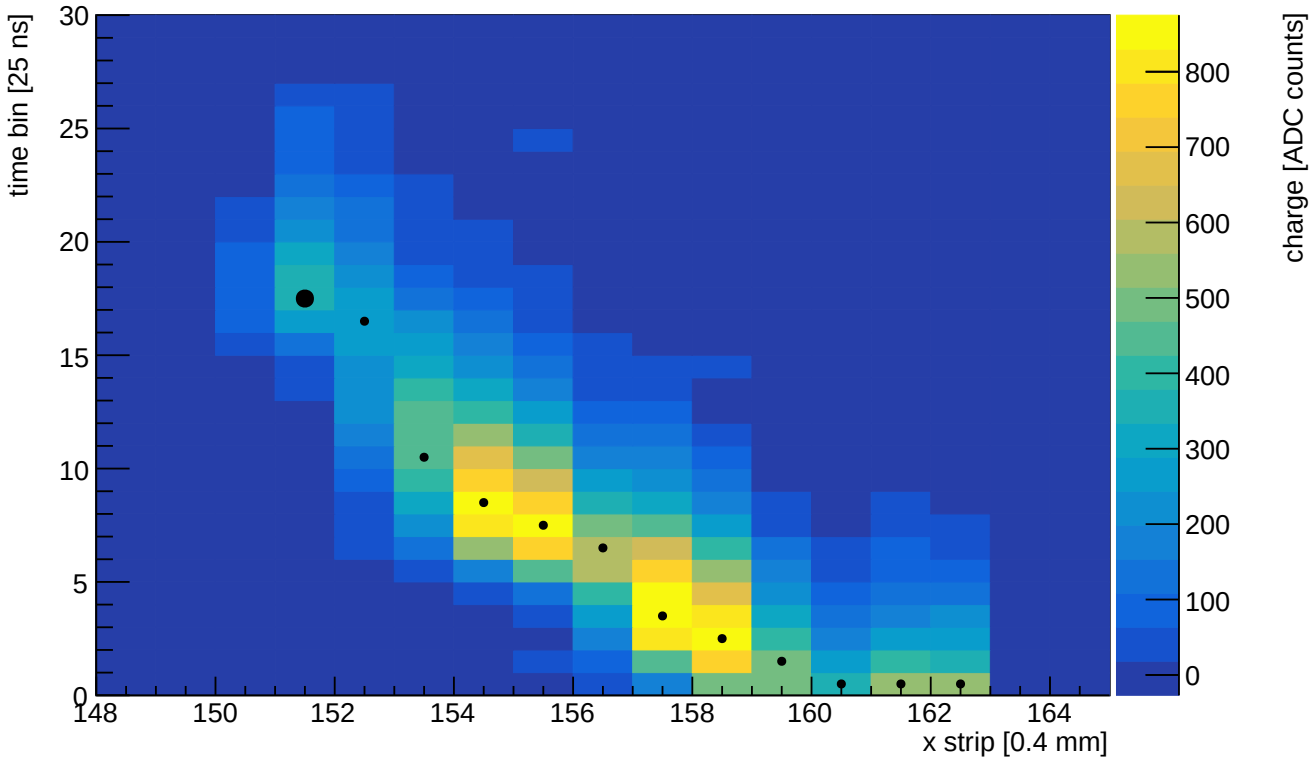
Figure from: JINST vol. 11, May 2016

Test-Beam Data

Data was recorded from beam test with thermal neutrons in Olso.

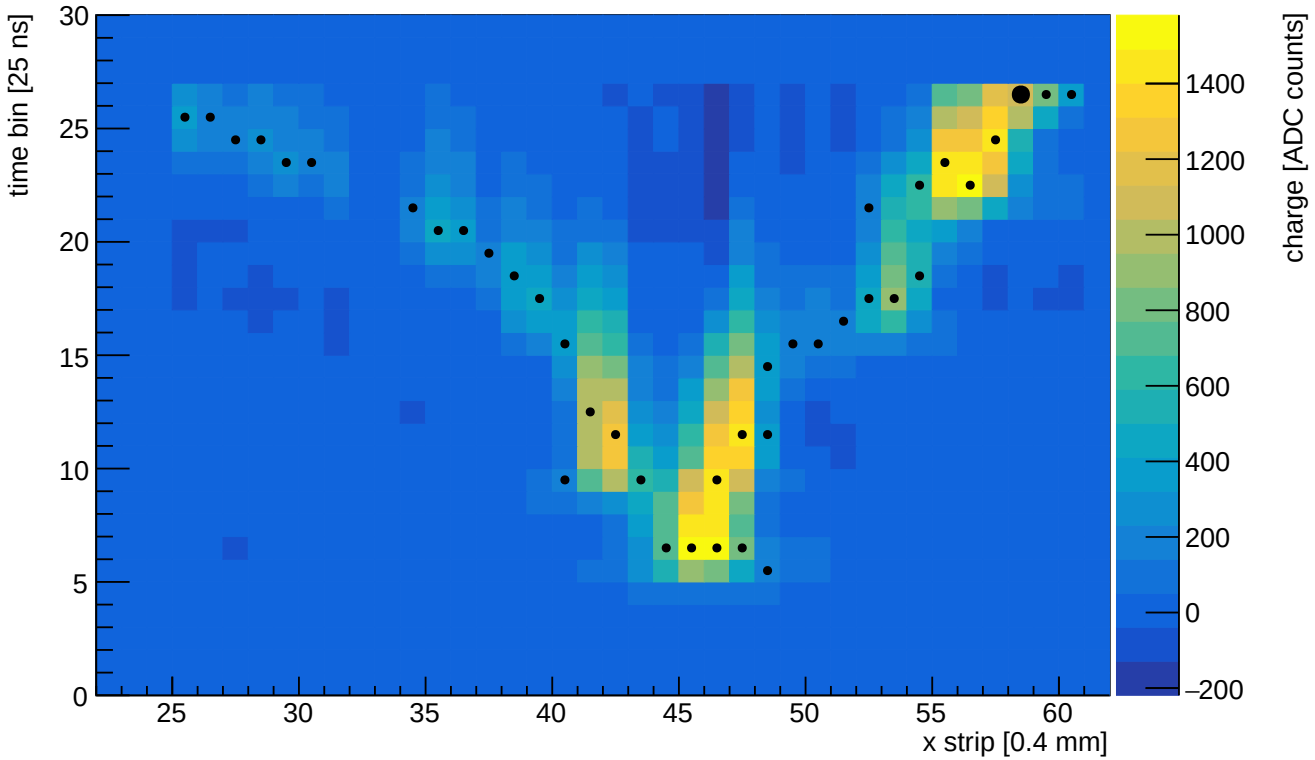
- APV25 chip used for readout.
- Records full waveform - not only maxima and maxima location (VMM3)
- Events are "triggered" - therefore segmented into single neutron events

Data Example - Regular



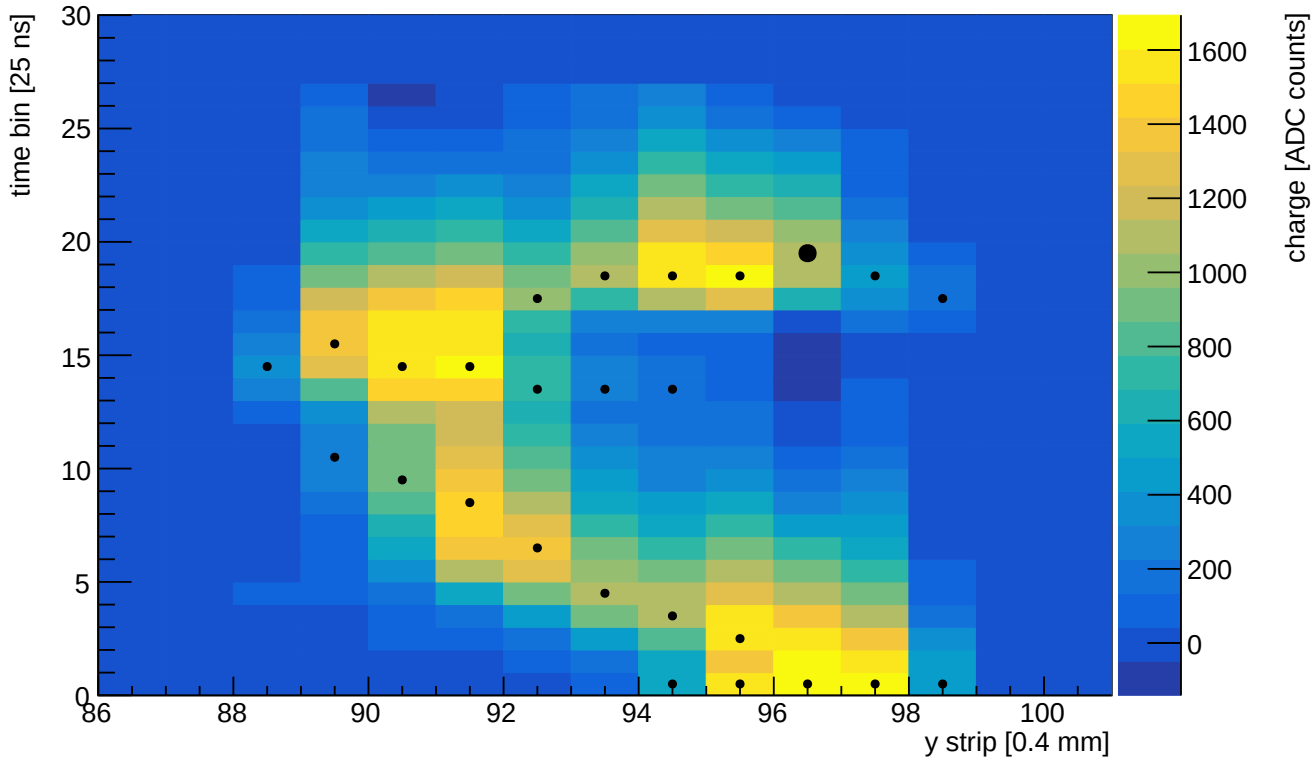
Data and analysis/plotting program: D. Pfeiffer et. al.

Data Example - U-type



Data and analysis/plotting program: D. Pfeiffer et. al.

Data Example - C-type



Data and analysis/plotting program: D. Pfeiffer et. al.

Simulation

Is inspired by the program "NeutronGEM" by D. Pfeiffer.

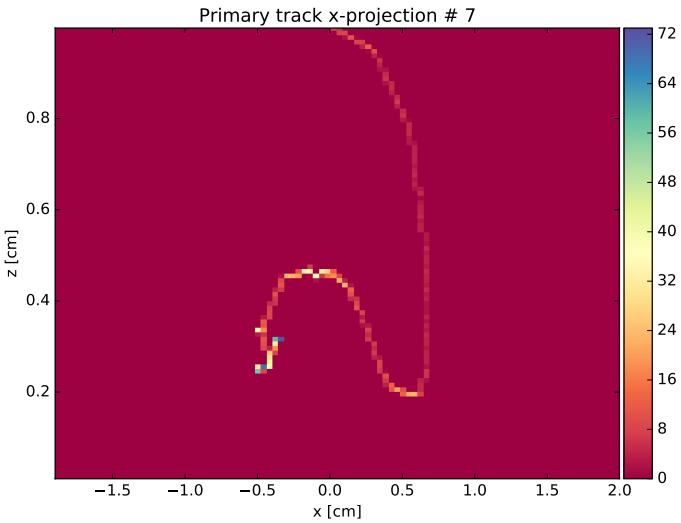
This implementation is in the ESS Detector Group coding framework and uses:

- GEANT4
  - Propagates all particles (except electrons in the drift volume)
  - Neutron-Gd interaction - production of electrons
- Garfield++
  - Ionization of the gas and liberation of electrons
  - Drift of liberated electrons

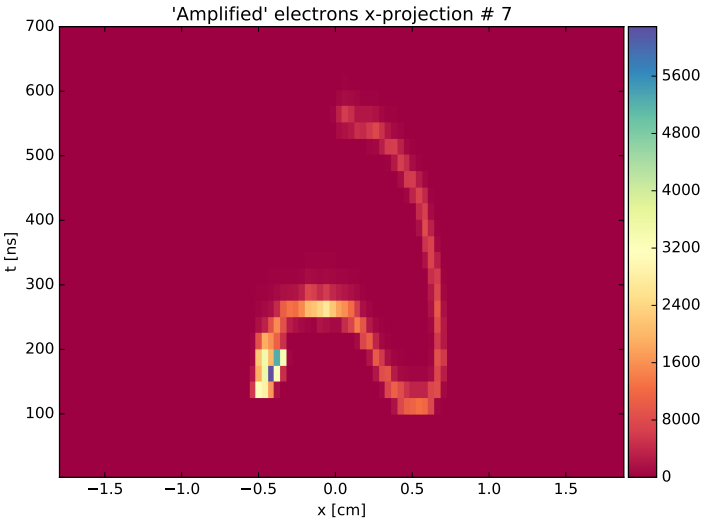
The amplification stage in the GEM is not simulated, but parametrised. This part needs improvement.

Simulation Example

Primary particle: 50 keV electron



Electron clusters



Drift and "amplification"

Signal formation and noise will be added in the near future.