

Local Hit Reconstruction works in KA

Infos from a Diploma Thesis finished last
year

Toy Simulation

- Sensor composed of cubicle pixels;
- Energy Deposition proportional to length of track in the pixel;
- Landau fluctuation (for energy deposition) and Gaussian smearing (for Read-Out noise);
- Threshold cut,

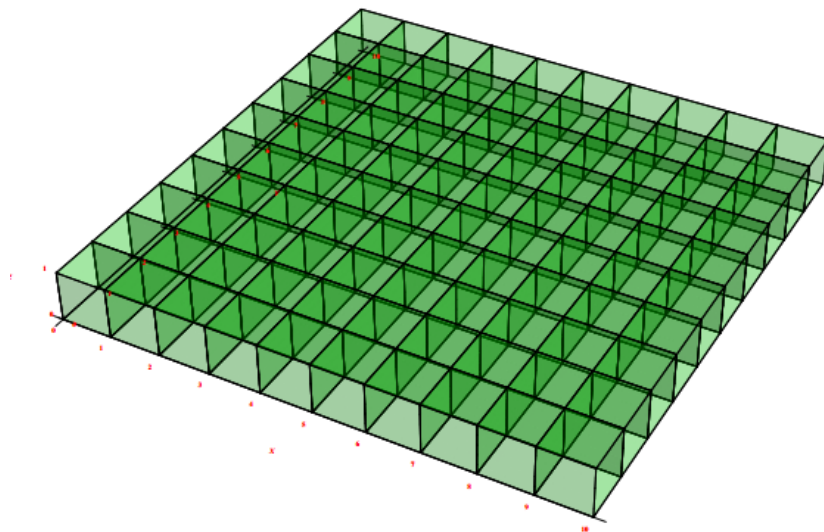
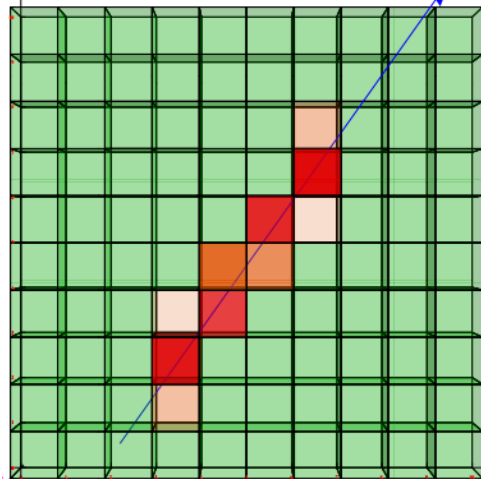
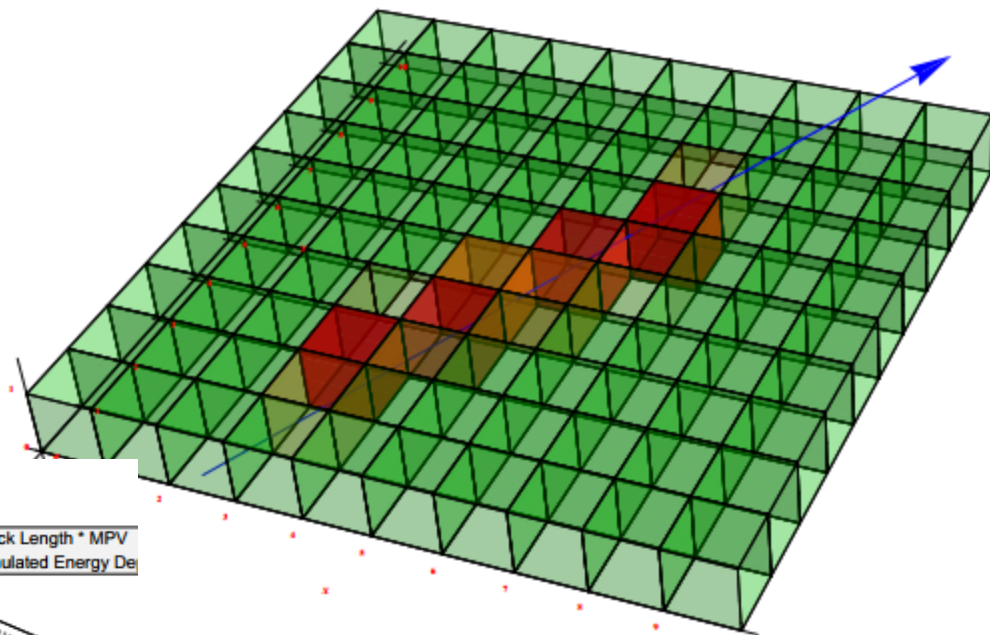


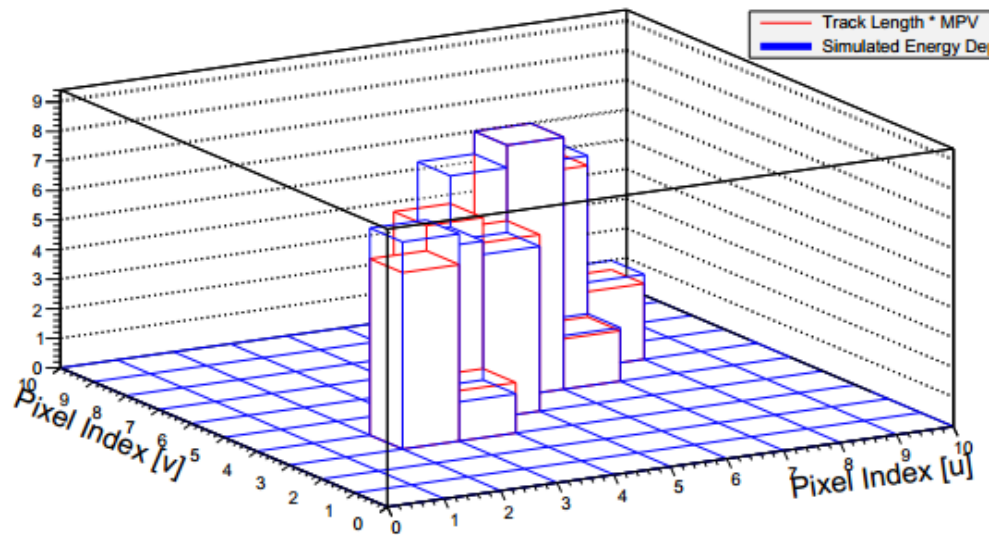
FIGURE 3.7: The Toy Simulation pixel array illustrated. 100 “pixel cubes” are closely aligned in a 10×10 array, each with a side length of 1. The bottom plane of the pixel layer coincides with the $x - y$ plane in the given coordinate system, while one vertical edge of the “corner” pixel coincides with z -axis.



'Energy Deposit' of a Single Particle Simulation



'Energy Deposit'



A single low incident angle in this toy simulation.

Why Toy Simulation?

- Easier to understand what is happening;
- Switch on physics effects and see what happens;

Center of Gravity

Formula would yield true result, if sum would be replaced by integral over the (constant) signal-height times the true position of the infinitesimal portion; e.g. infinitely small pixels would yield true position.

With the CoG even a fluctuation-free simulation would give wrong position.

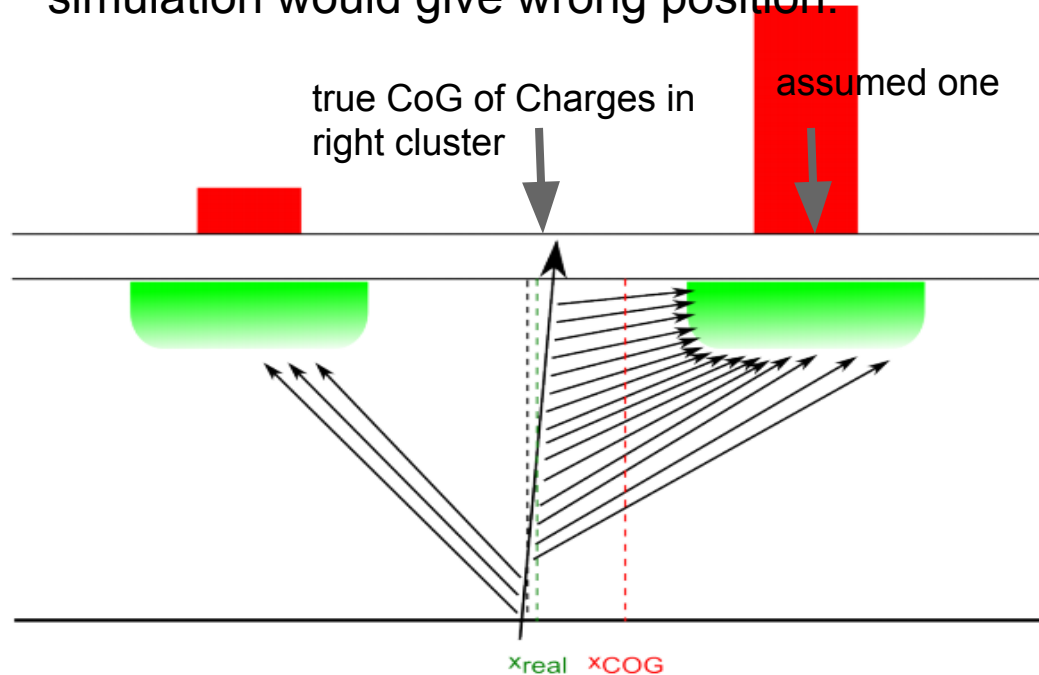
Signal-Height



$$X_{COG} = \frac{\sum_{cluster} (S_i \cdot x_i)}{\sum_{cluster} S_i}$$



Center of the Cluster, e.g. not the true position of the respective cluster charge!



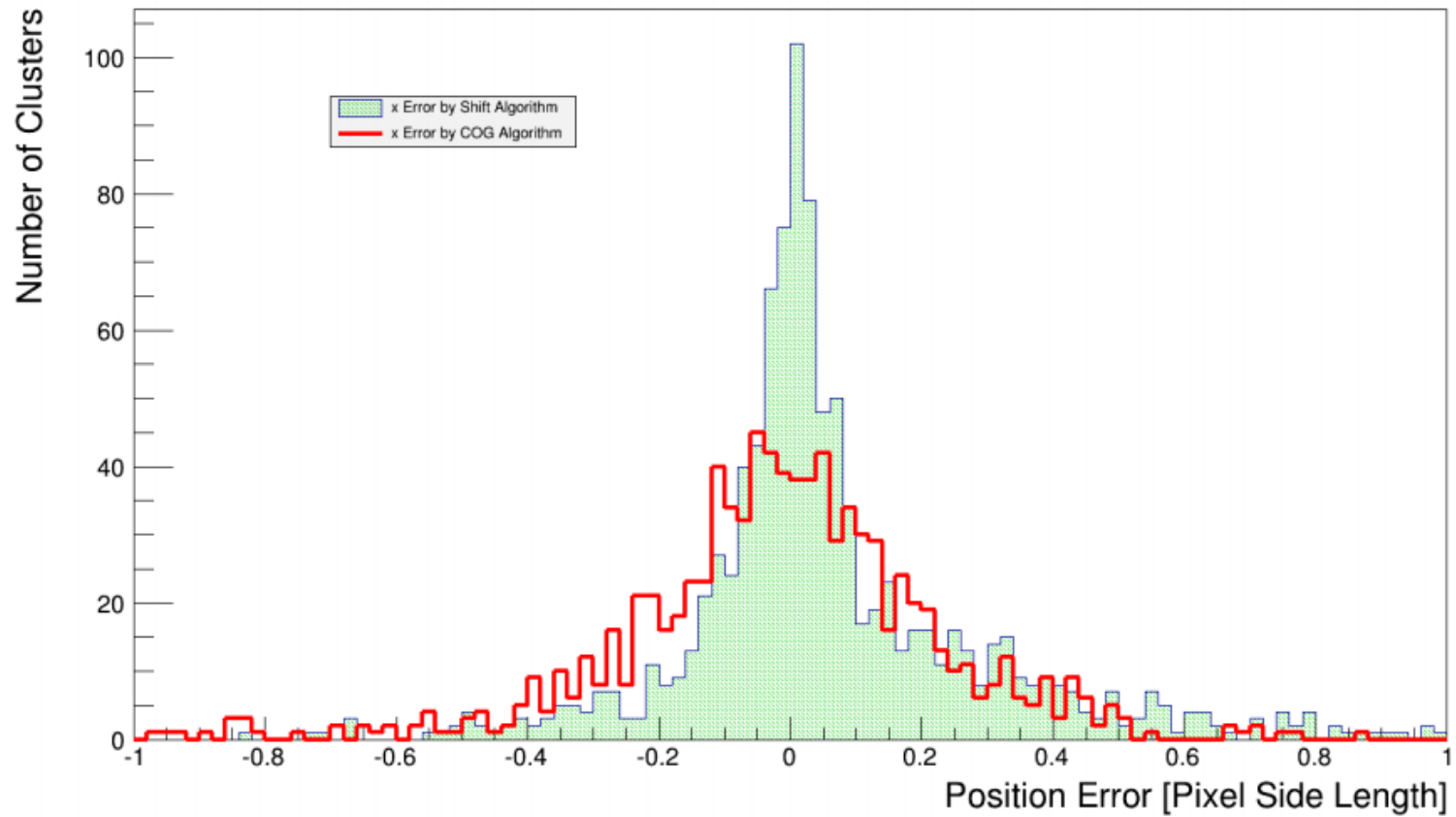
Yipeng's Algorithm

- Assume incident angle of the track known.
- Step the track in steps $1/100$ th of the pixel size through the sensor and take the position where the difference between the expected mean energy deposition (= track length in the respective pixel) and the measured value is smallest.

Results

- In case of more than 1 pixel is hit in the respective direction with no fluctuations, the position is recovered exactly.
- If a track only touches a pixel lightly, the expectation is as well below the cut; → no bias due to the threshold; estimation of overall energy deposition automatically estimates lost charge and therefore distance travelled in the off pixel (although the Landau fluctuation may make this unusable in the real world);
- Computational time still reasonable;

Shift and COG Algorithms: Position Error in x dimension for 1000 Toy Simulation Clusters



...as discussed yesterday...

- angle would be retrievable from “constructMeasurementsOnPlane” function, but details can better be given by Tobi and Johannes;
- within that function, there can be a callback to a quite heavy local rereconstruction using the stateOnPlane information;
- It is not clear, if the increased resolution would have any meaningful effect on the track parameters;