Bari digit level 1 approach

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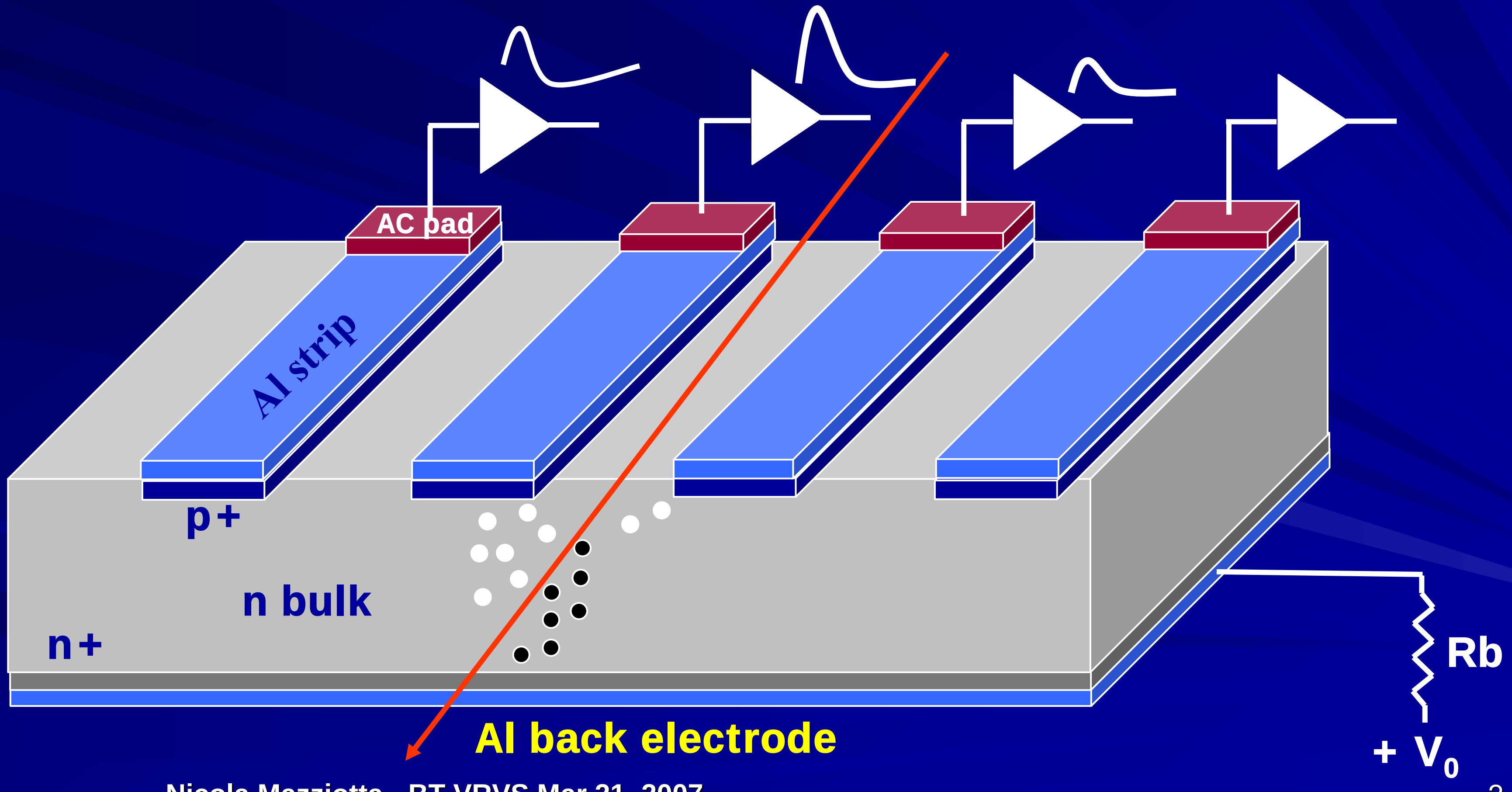
Mar 21, 2007

Current Signal

Holes generated in a silicon detector will drift towards the p strips (grounded), electrons towards the n electrode (at positive voltage) under the action of the electric field. During their drift, electrons and holes are diffused by multiple collisions. Due to the motion of carriers, signals will be induced on the electrodes.



Motion of charge carriers

After being produced, electrons and holes will drift under the action of the electric field towards the n back and the p strips, according to the equation:

$$\vec{v} = \mu \vec{E}$$

where the mobility is related to the E field by the parameterization:

$$\mu = \frac{v_m / E_c}{\left[1 + \left(E/E_c\right)^{\beta}\right]^{1/\beta}}$$

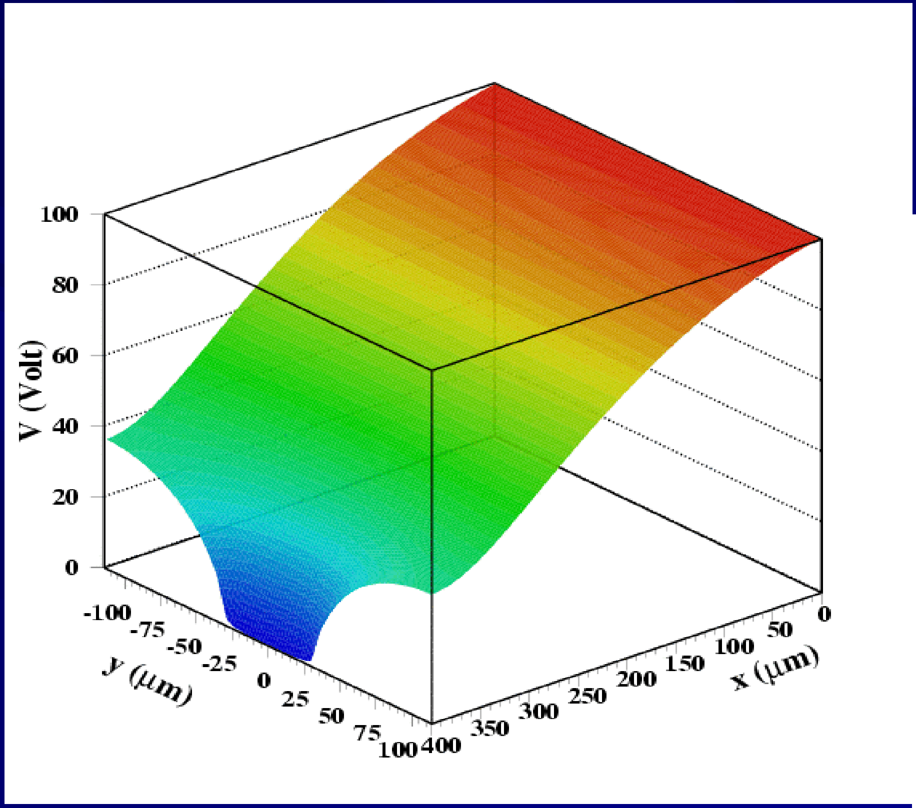
The parameters v_m, β and E_c are different for electron and holes and depend on the temperature.

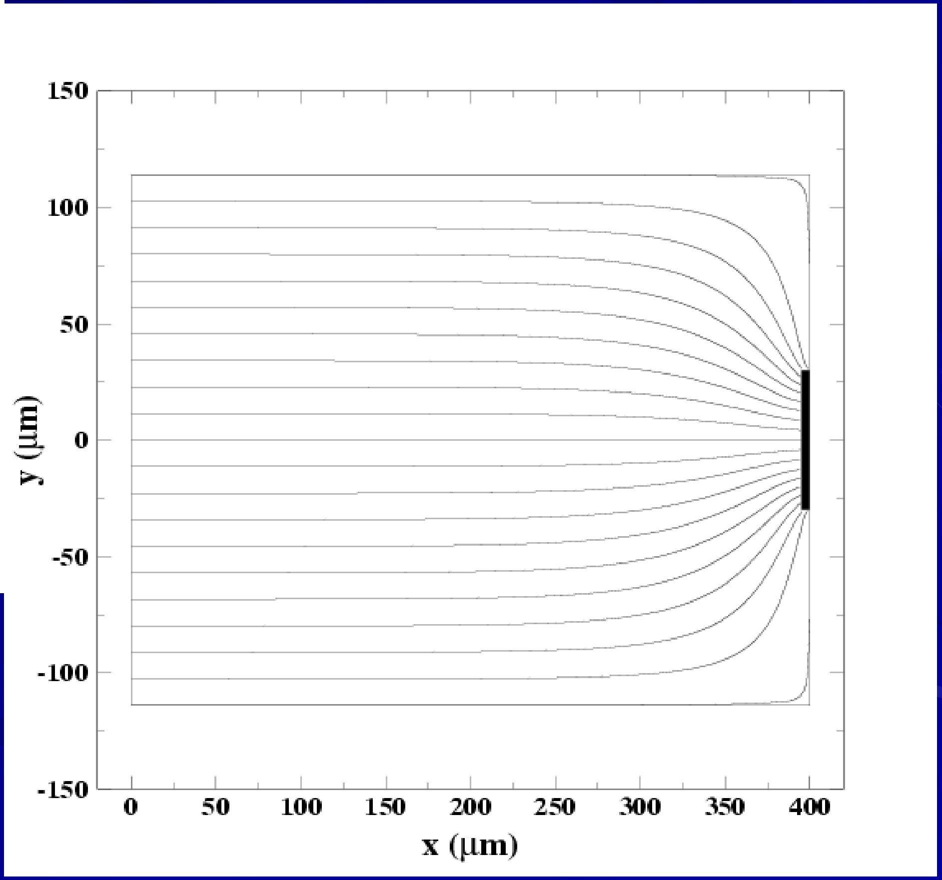
During their drift, carriers are diffused by multiple collisions according to a gaussian law:

$$\frac{dN}{N} = \frac{1}{\sqrt{4\pi\pi D}} exp\left(-\frac{r^2}{4DT}\right)dr$$

$$D/\mu = k\,T/e$$

The electric field and drift lines





Induced current signals

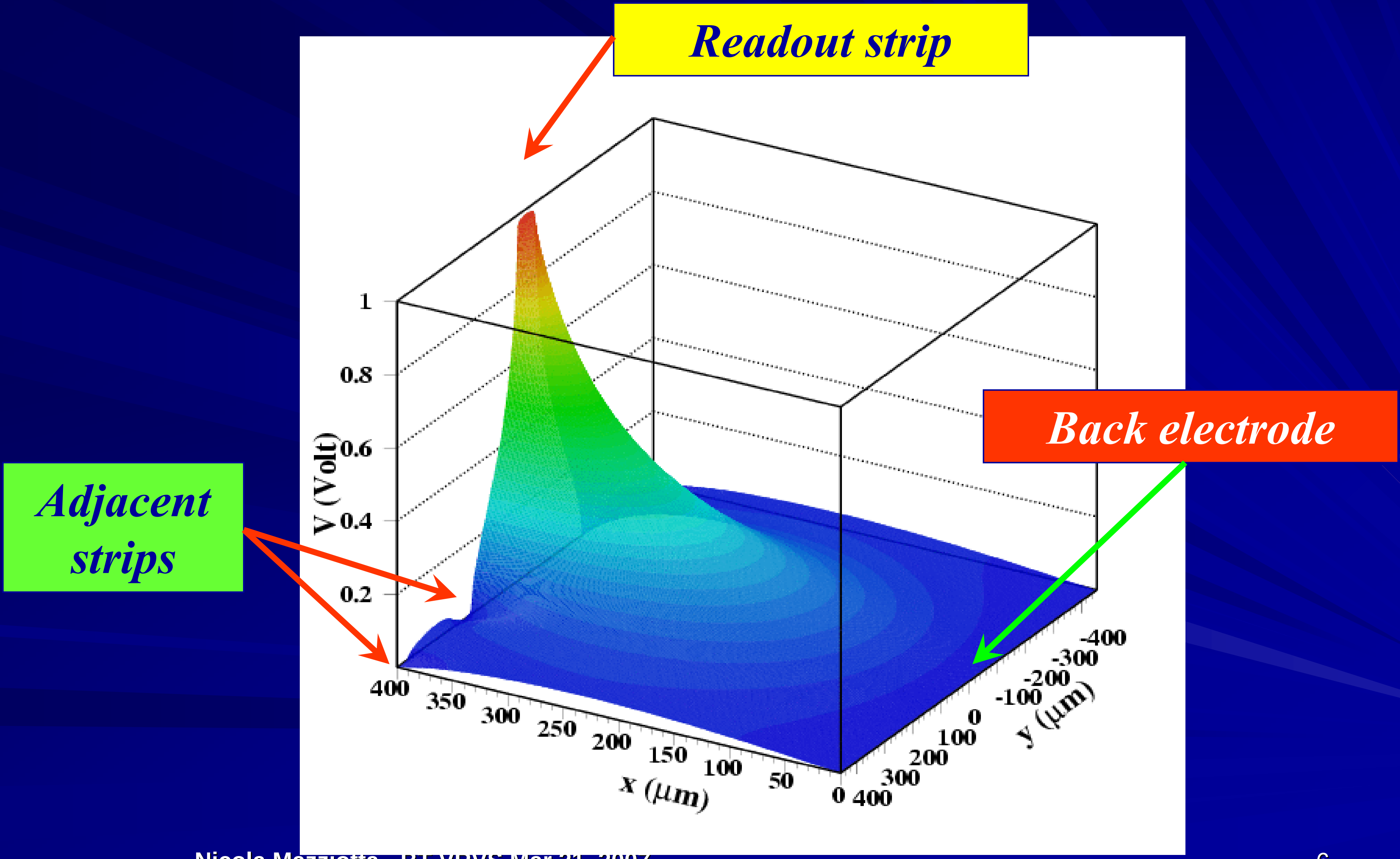
The current signals induced by the moving carriers on the readout electrodes are calculated using the Shockley-Ramo's theorem:

$$i_k(t) = \sum_{carriers} -q\vec{v}(t) \cdot \vec{E}_k\left(\vec{r}(t)\right)$$

The weighting field E_k describes the geometrical coupling between the moving carrier and the k-th electrode. It has been evaluated by solving the same Maxwell's equation as for the electric field with $\rho=0$ and with the boundary conditions:

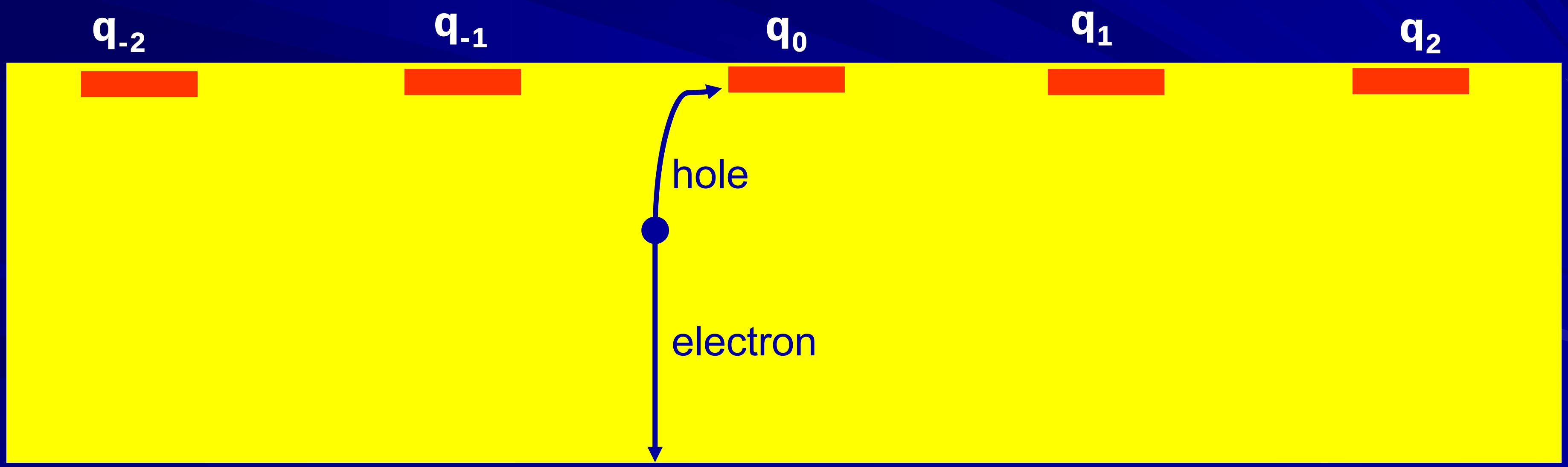
$$\begin{aligned} &V_k = 1V \\ &V_j = 0 \quad if\ j \neq k \end{aligned}$$

Weighting potential

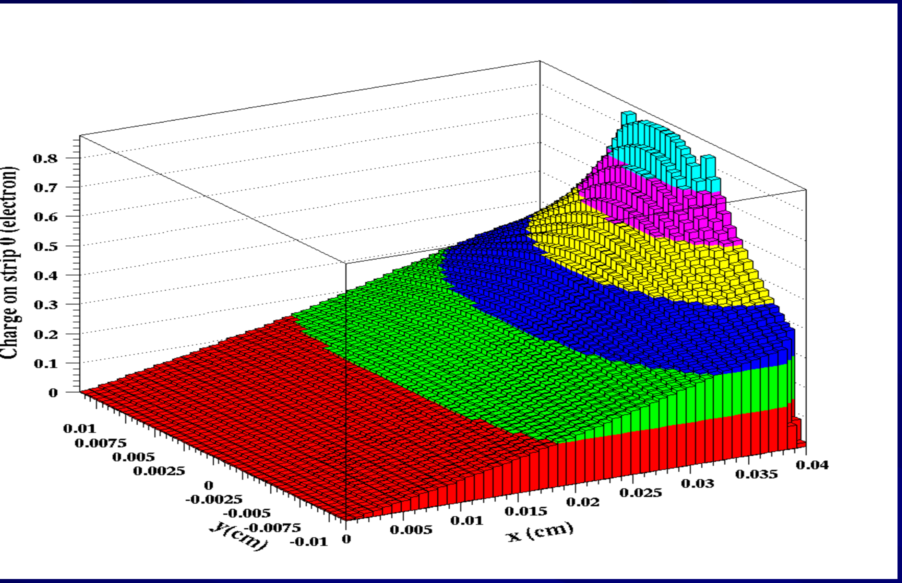


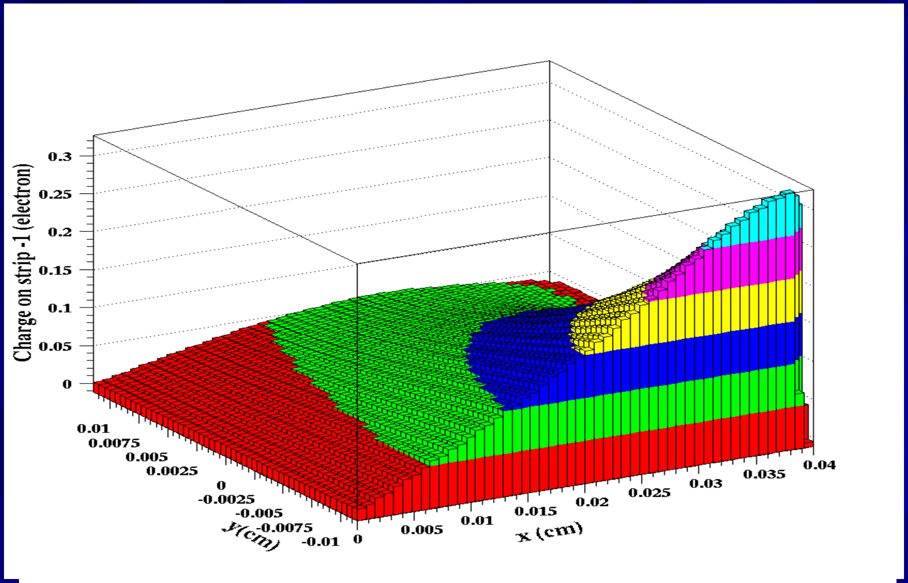
Charge sharing simulation

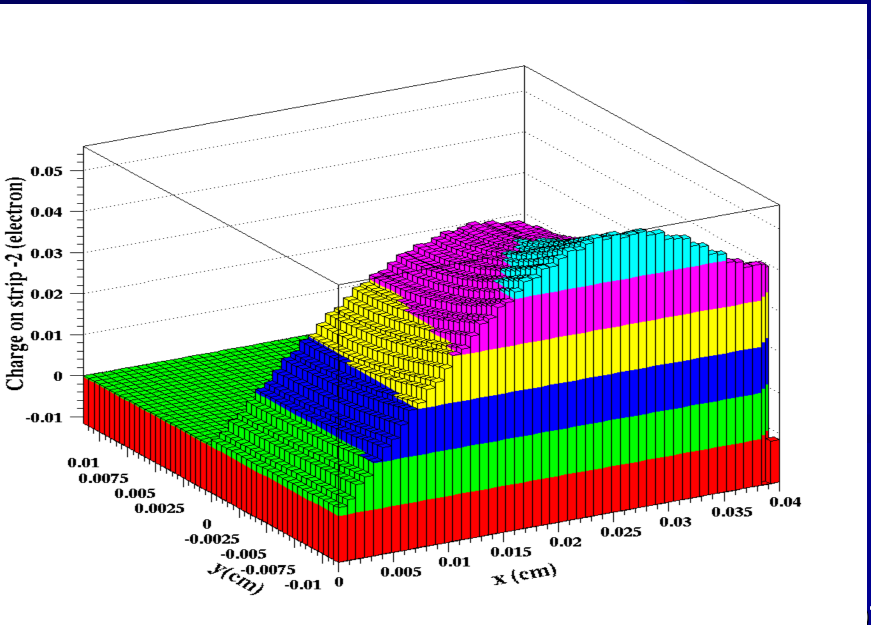
To evaluate the charge sharing on the read-out strips a full simulation is needed to drift all charge carriers produced in the silicon sample has, in this case a large amount of CPU time is required.

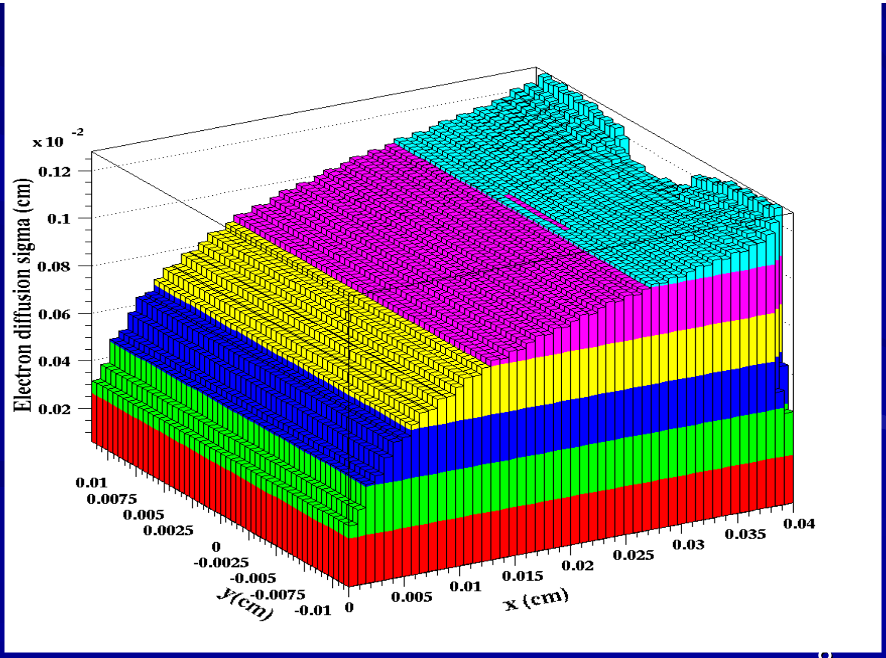


Charge sharing tables





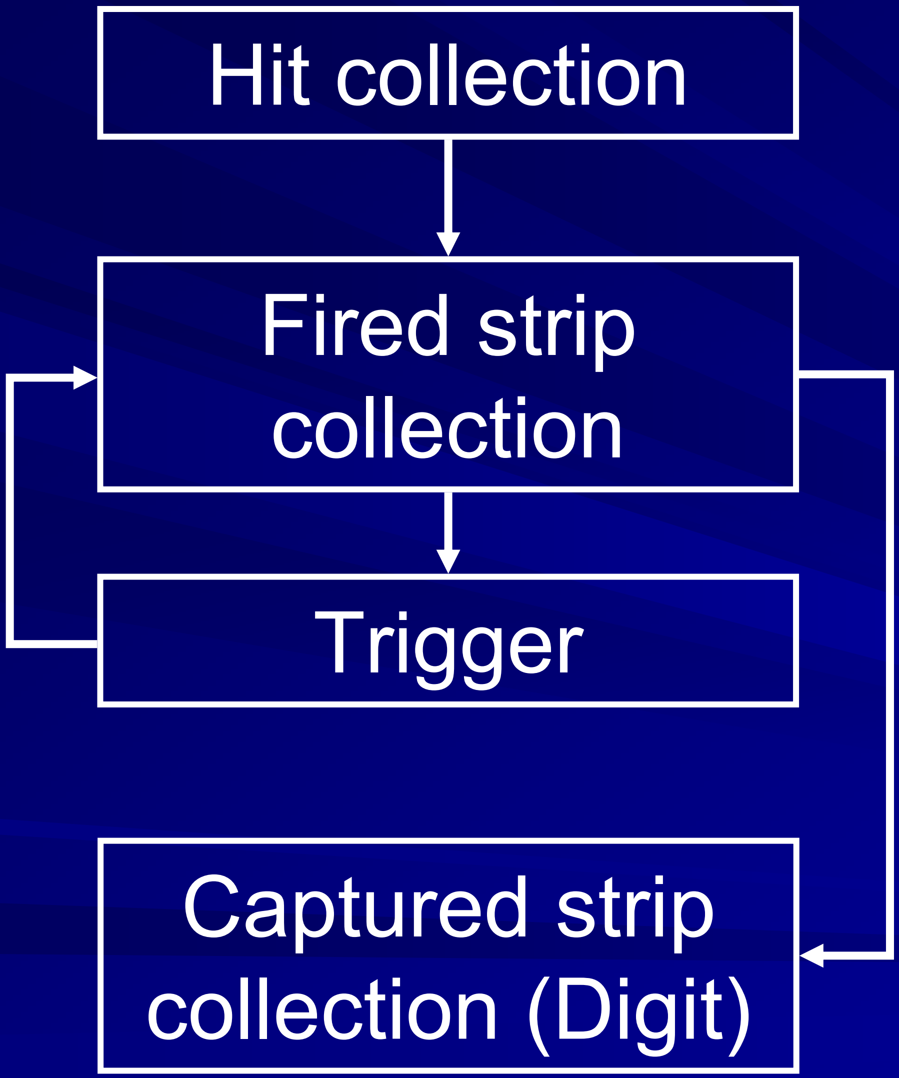




Charge sharing fast simulation approach

- Divide the hit track inside the silicon volume in sub tracks (TBD)
- For each sub track convert the energy deposited according to its track length to the number of pairs Np=Edep/3.6eV (cluster)
- add a fluctuation on Np by using a gaussian random number with mean=0 and σ = sqtr(F*Np), where F=0.1 is the Fano factor for Silicon
- Randomize the cluster position according to the diffusion
- Evaluate the charge induced on read out strip by means of table
- For each read-put strip involved in the charge sharing, proceed as the Bari Digit Level 0

From hit to digit



In the current Gleam the TKR trigger is simulated starting from the Digit, i.e. the trigger is formed by using the fired plane configuration as evaluated by the digit.

TKR Trigger formation