Irradiated Si detectors simulation

Status and the next steps

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Detector simulation for low voltage operation

Basic strategy:

minimization of the amount of effective parameters

Conditions:

- ✓ N_{DL} proportional to fluence
- ✓ σ^i_e, σ^i_h – not affected by electric field
- ✓ No impact ionization

2 MGL model	***2 MGL model (advanced)***	***2+1 DL model***	***Microscopic model***
MGL1-e-trap MGL2- h-trap Gj(T) - current	MGL1-e-trap MGL2- h-trap	MGL1-e-trap MGL2- h-trap DL_{tr} - trapping	E^i_{act}, σ^i_e, σ^i_h
SRH – fill factor $\nabla^2\varphi$=-e$N_{eff}/\varepsilon\varepsilon_0$ **divj = G_j**	**SRH – fill factor** $\nabla^2\varphi$=-e$N_{eff}/\varepsilon\varepsilon_0$ **divj = G_j**	**SRH – fill factor** $\nabla^2\varphi$=-e$N_{eff}/\varepsilon\varepsilon_0$ **divj = G_j**	**SRH – fill factor** $\nabla^2\varphi$=-e$N_{eff}/\varepsilon\varepsilon_0$ **divj = G_j**
⇓	⇓	⇓	⇓
E(x)[V,T,ϕ]	**E(x)[V,T,ϕ]**	**E(x)[V,T,ϕ]** **CCE[V,T,ϕ]** **i(t)[V,T,F]**	**? ? ?**

Detector simulation for high voltage operation

2+1 DL model
MGL1-e-trap
MGL2- h-trap
DL_{tr} - trapping

SRH – fill factor
$\nabla^2\varphi$=-e$N_{eff}/\varepsilon\varepsilon_0$
divj = G_j

High voltage operation requires switching on impact ionization.
For SYNOPSIS
- ✓ **Use *α(E)* as it is default**
- ✓ **Simulate up to the high V**

2+1 DL model
MGL1-e-trap
MGL2- h-trap
DL_{tr} - trapping
α – impact ion.
SRH – fill factor
$\nabla^2\varphi$=-e$N_{eff}/\varepsilon\varepsilon_0$
divj = G_j

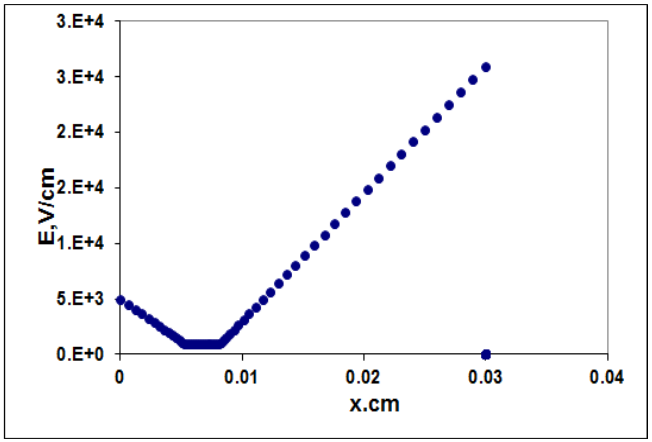
E(x)[V,T,ϕ]
CCE[V,T,ϕ]
i(t)[V,T,F]

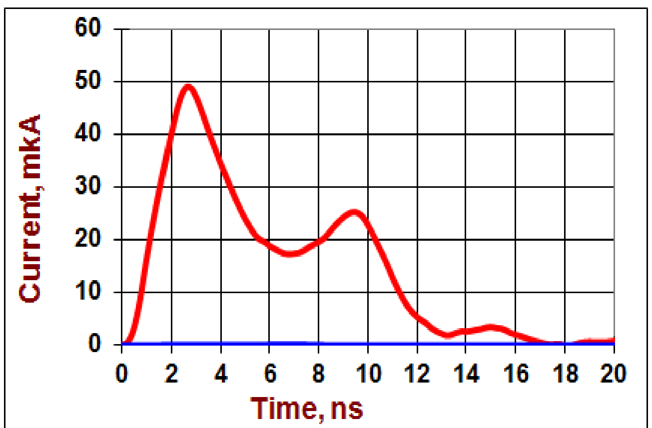
E(x)[V,T,ϕ] ??
CCE[V,T,ϕ] ??
i(t)[V,T,F] ??

Experimental data for simulation proof

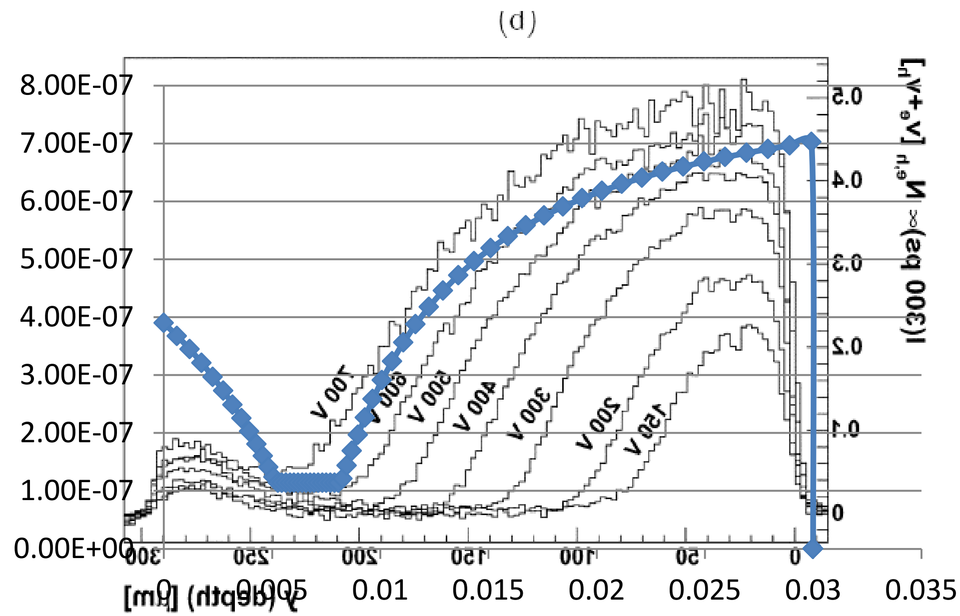
Classic TCT — $i(x) = 1 * q(x) * v_{dr}(x); \; x = \int v_{dr}(t)\, dt$

Edge TCT — $i(t=0, x) = v_{dr}(x); \; V_{dr}(E) = f(E)$





Example of comparison the Data from Ljubljana group with simulation from PTI group



The main achievements and the future

Strategy based on minimization of effective parameters works

"on - going" steps

1. Comparison of simulated E(x) with the results of edge TCT
2. Extension of the advanced 2MGL model to high voltage detectors operation using the default parameters of SYNOPSIS
3. CCE(F) modelling

4. The new subject – "Inter-strip resistance radiation hardness"

The simulation group is interested on edge TCT data for :

- modelling tools calibration
  (non irradiated detectors)
- models development/proofs
  (fluence and voltage dependences for irradiated detectors)

Timo Peltola will help to distribute the essential data for the cross-test modelling