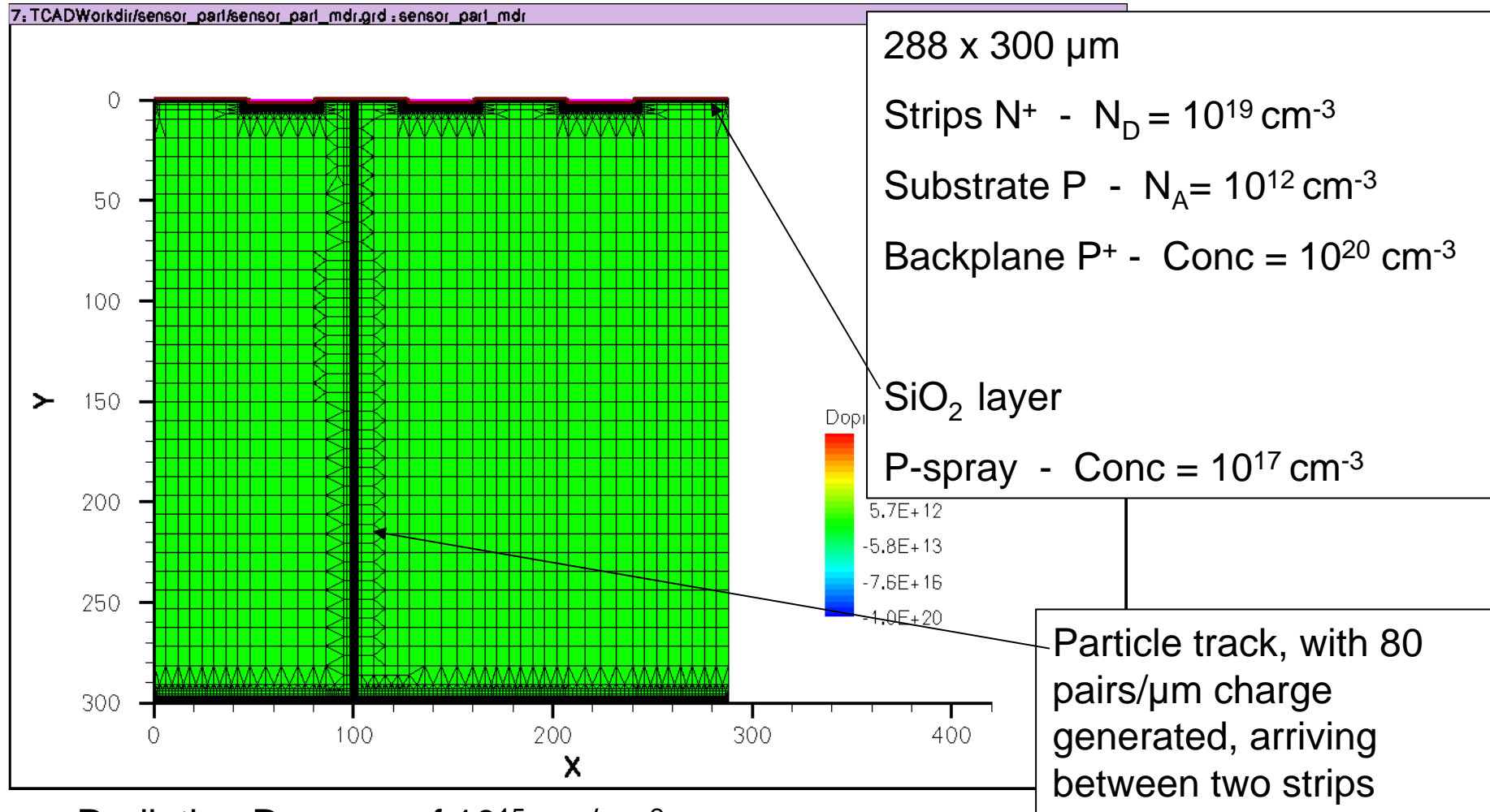


The background of the slide is a complex, green-toned digital visualization. It consists of numerous vertical lines and clusters of points, creating a sense of depth and movement, reminiscent of a data stream or a virtual forest. The colors range from dark forest green to bright, almost white-green highlights, giving it a textured, three-dimensional appearance. The overall effect is that of a dense, interconnected network of data points.

# Simulations within Advanced TCAD

# MIP Simulation: Irradiated P-type $\mu$ strip silicon Detector



Radiation Damage of  $10^{15} n_{\text{eq}}/\text{cm}^2$  :

- Simulation by modelling behaviour of trap levels directly : University of Perugia trap models (see later)
- High positive charge in Oxide/ Silicon interface: Conc =  $10^{12} \text{ cm}^{-3}$

# University of Perugia trap models

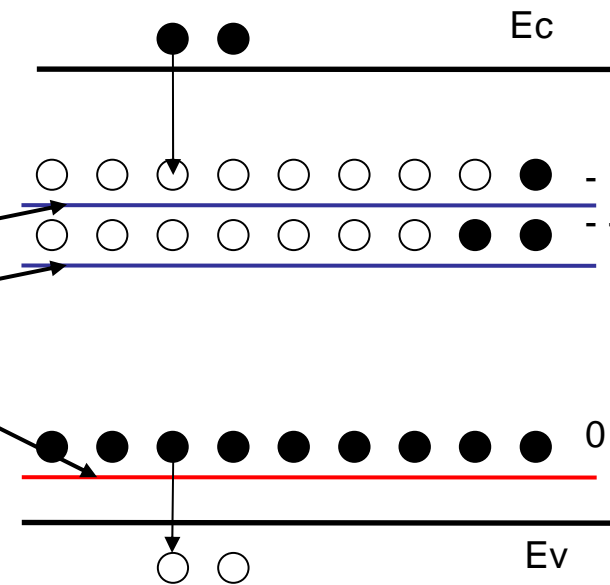
*IEEE Trans. Nucl. Sci., vol. 53, pp. 2971–2976, 2006*

**“Numerical Simulation of Radiation Damage Effects in p-Type and n-Type FZ Silicon Detectors”**, M. Petasecca, F. Moscatelli, D. Passeri, and G. U. Pignatelli

**Perugia P-type model (FZ)**

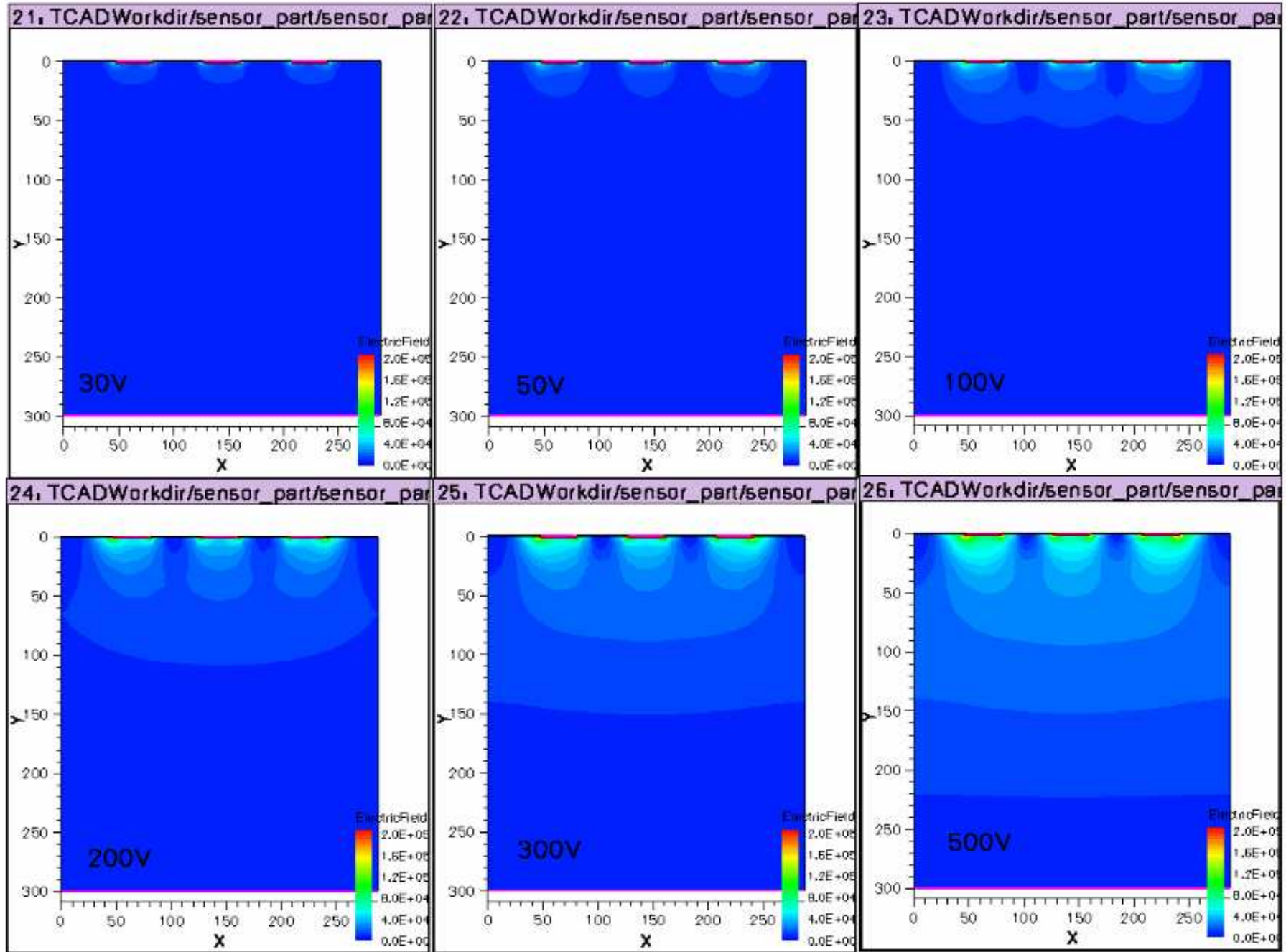
Type	Energy (eV)	Trap	$\sigma_e$ (cm <sup>2</sup> )	$\sigma_h$ (cm <sup>2</sup> )	$\eta$ (cm <sup>-1</sup> )
Acceptor	$E_c - 0.42$	VV	$2.0 \cdot 10^{-15}$	$2.0 \cdot 10^{-14}$	1.613
Acceptor	$E_c - 0.46$	VVV	$5.0 \cdot 10^{-15}$	$5.0 \cdot 10^{-14}$	0.9
Donor	$E_c + 0.36$	CiOi	$2.5 \cdot 10^{-14}$	$2.5 \cdot 10^{-15}$	0.9

$$Conc(cm^{-3}) = \Phi_{eq} \eta$$



- **2 Acceptor levels:** Close to midgap
  - Leakage current, negative charge ( $N_{eff} \sim |N_A - N_D|$ ), trapping of free electrons
- **Donor level:** Further from midgap
  - Trapping of free holes

# ELECTRIC FIELD



# Particle crossing through the detector @ 500V

## Electron Current Density

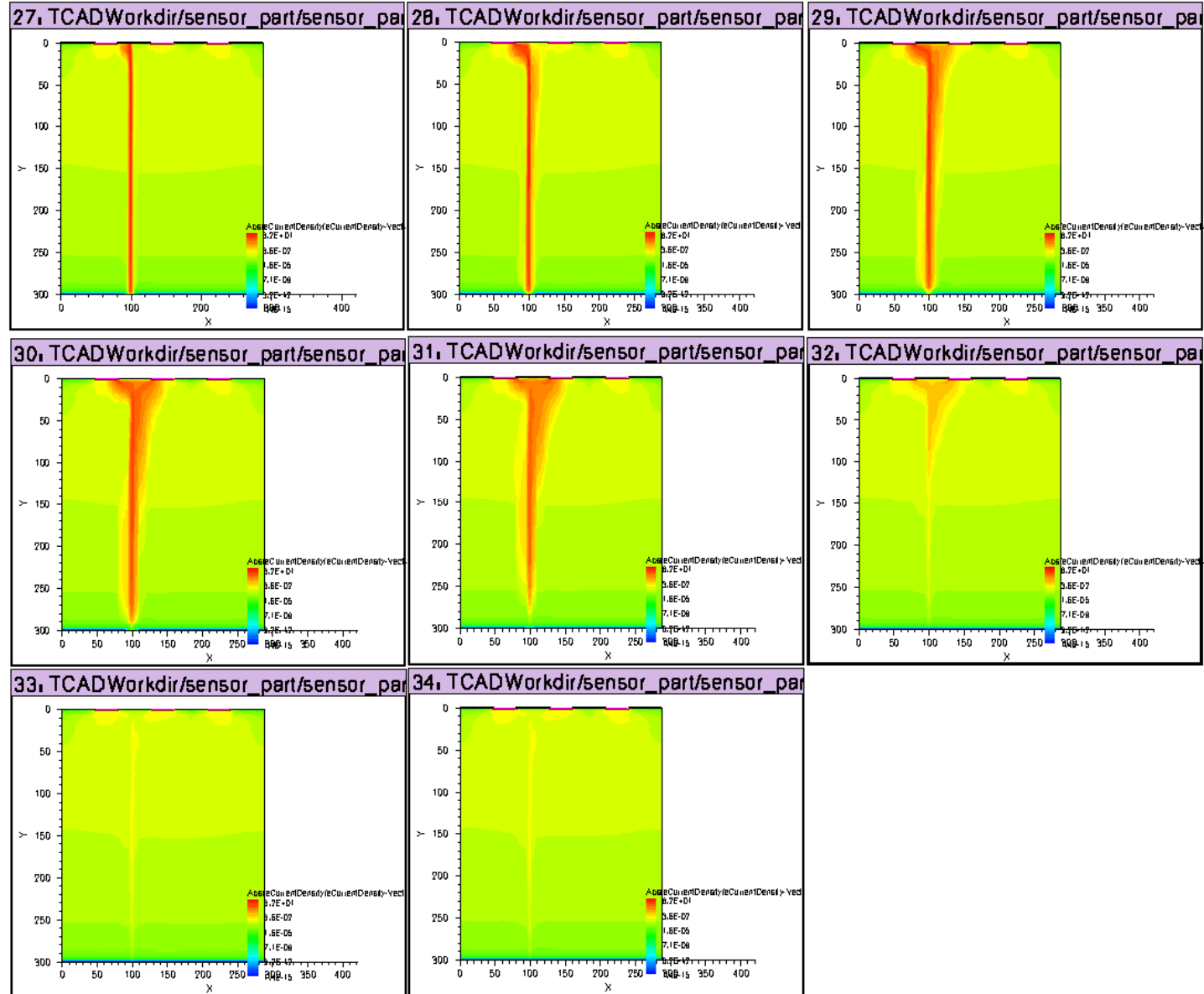
Time:

0 → 25ns

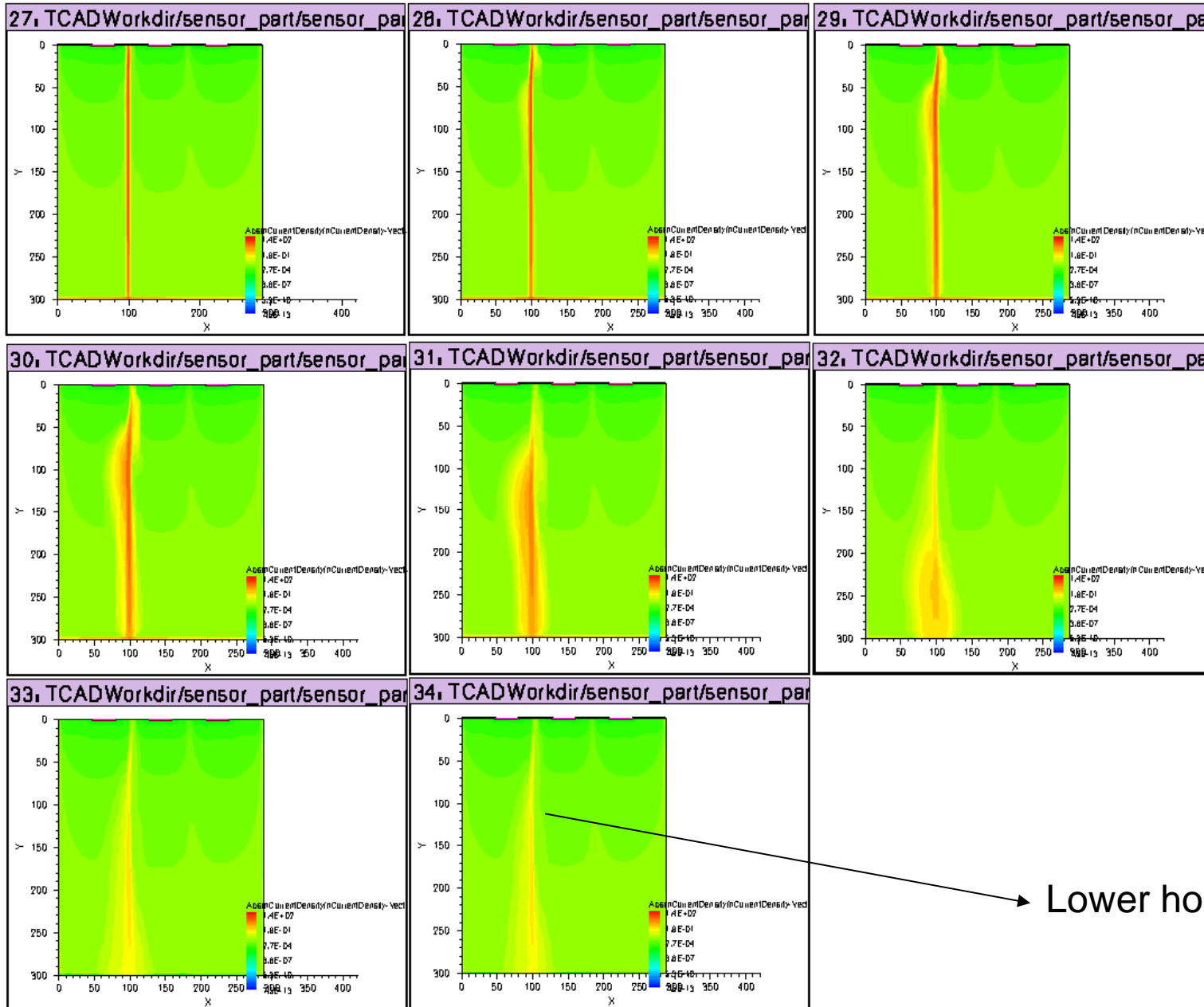
- Particle picks the sensor at 0.02ns

- Pictures correspond :

- 0.05 ns
- 0.2 ns
- 0.5 ns
- 1 ns
- 2 ns
- 5 ns
- 10 ns
- 25 ns



# Hole Current Density



Pictures correspond:

- 0.05 ns
- 0.2 ns
- 0.5 ns
- 1 ns
- 2 ns
- 5 ns
- 10 ns
- 25 ns

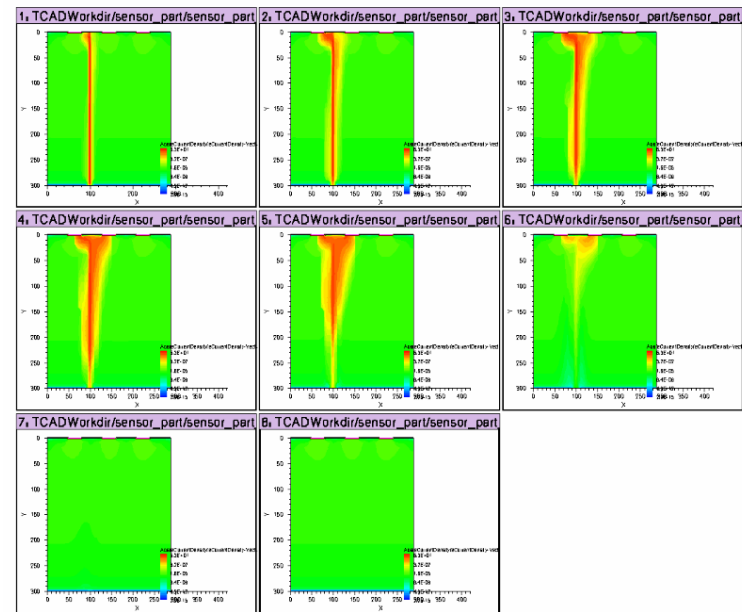
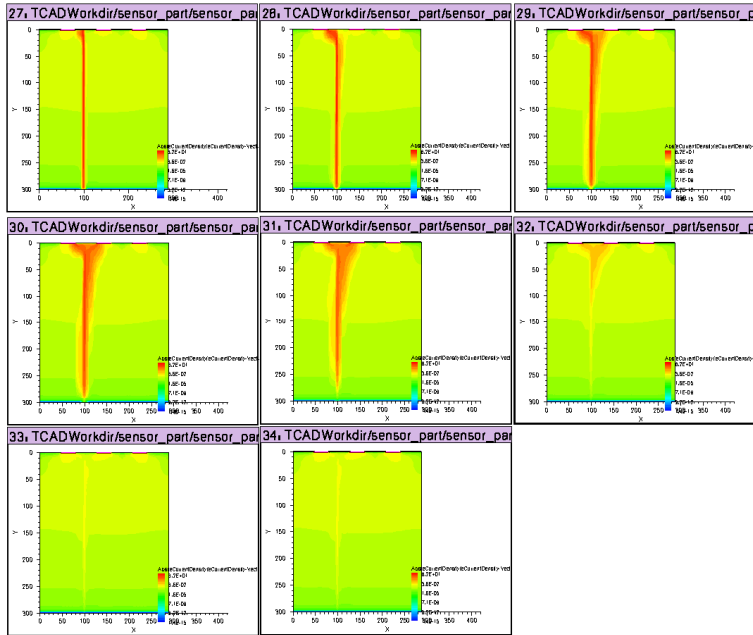
Lower hole mobility

# Current Density Comparison

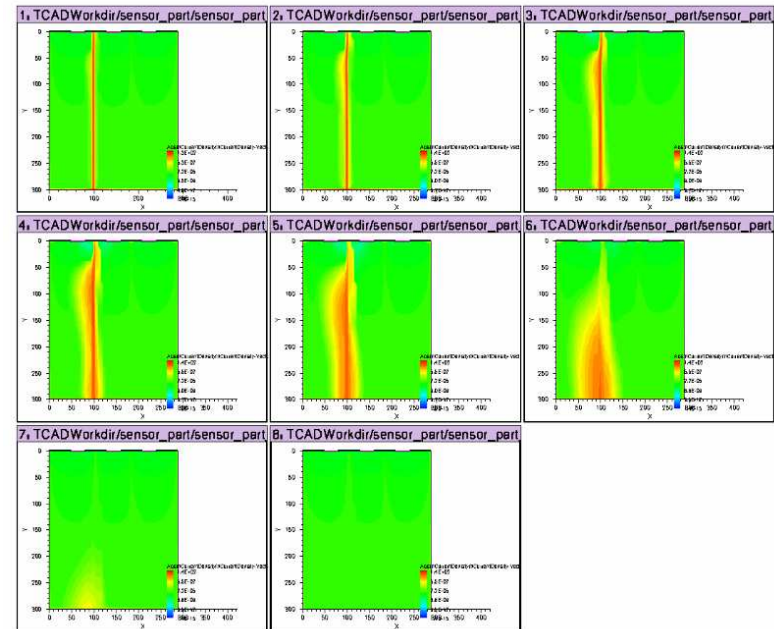
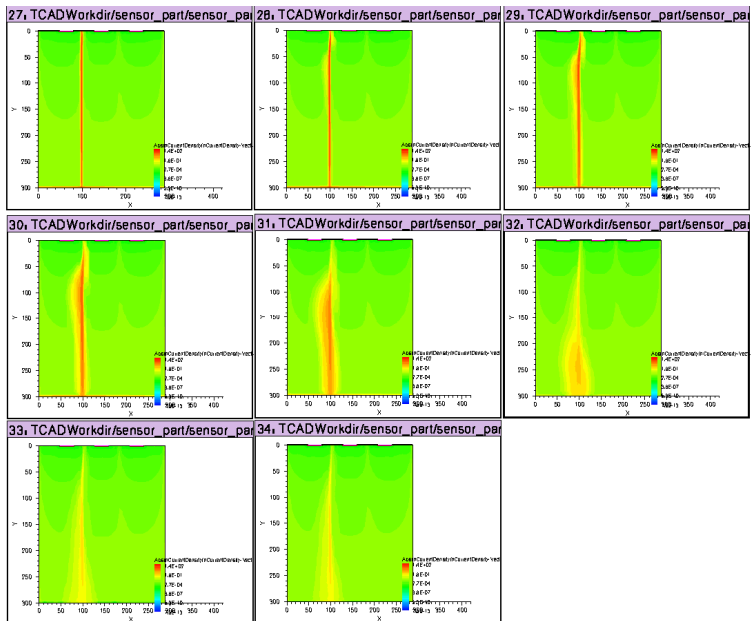
Irradiated detector

Non-irradiated detector

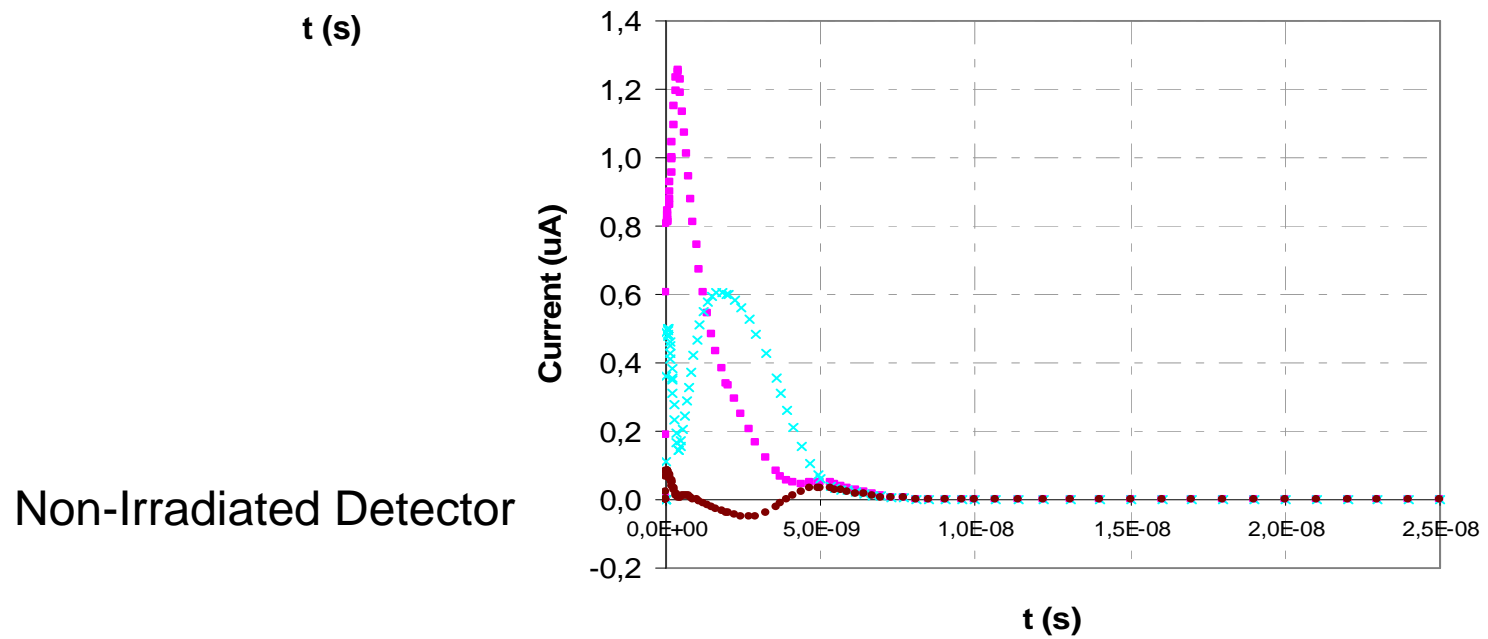
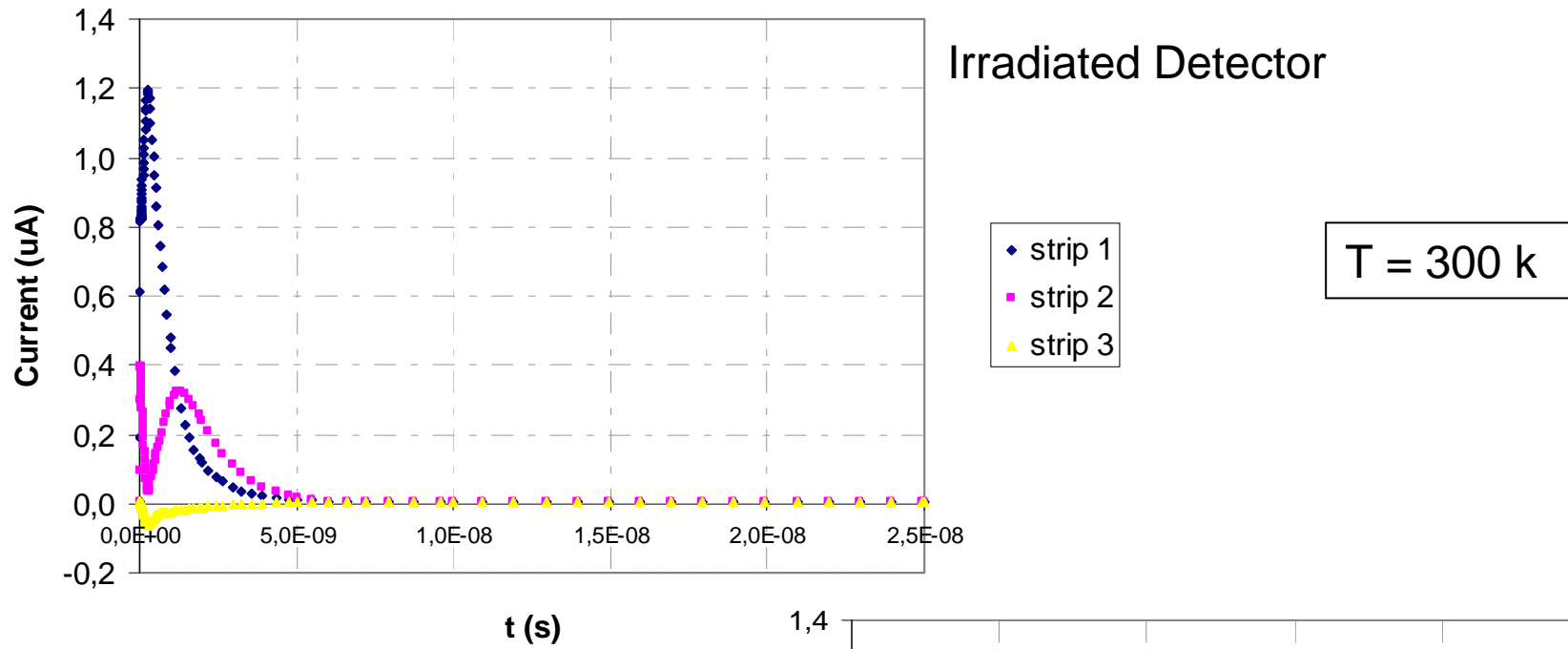
Electron



Hole

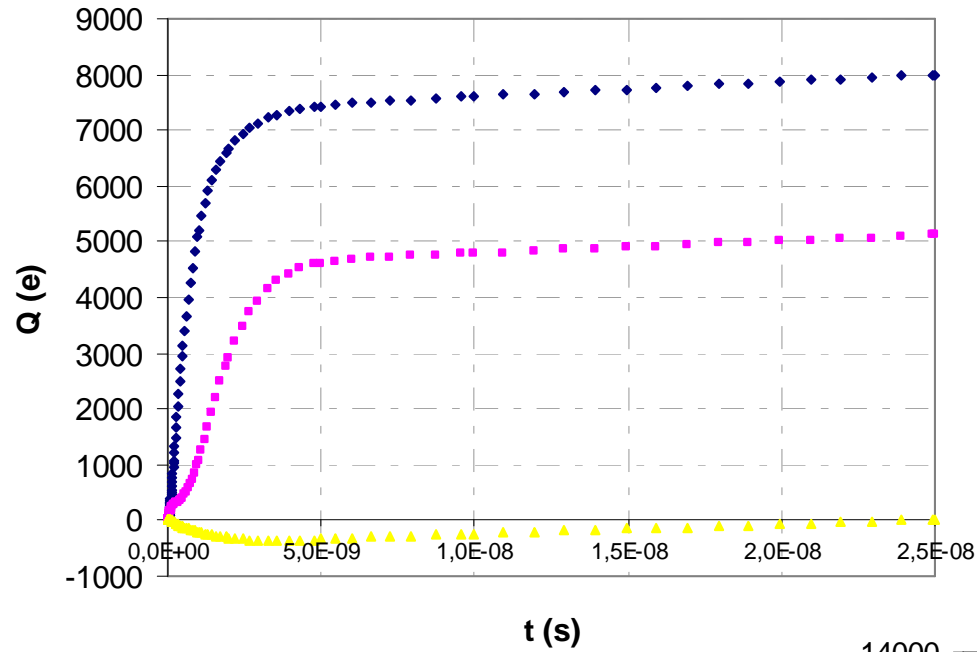


# Signal Current in separated strips @ 500V





# Charge collected by separated strips @ 500V

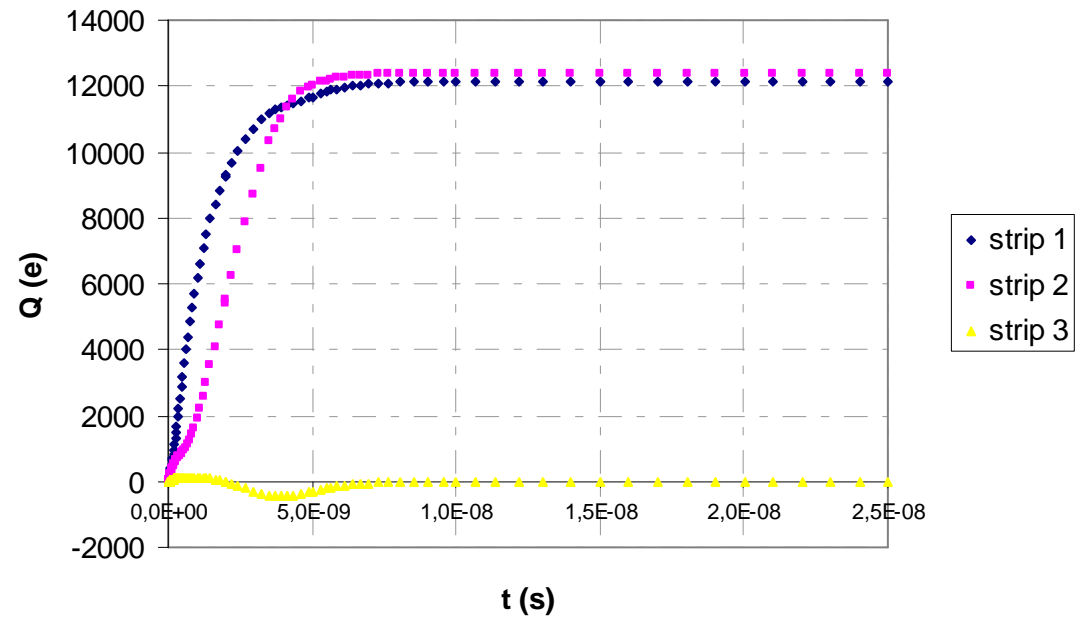


Irradiated Detector

$$\Phi = 10^{15} n_{eq} / \text{cm}^2$$

CCE ~ 55%

Non-Irradiated Detector



# Future Work

- CCE at different voltages
- Comparison with our FZ experimental data (if possible)
- Charge Sharing for different particle positions
- Weighting fields (It will be explained in the next meeting)

