Systematic Modeling and Simulations with Analytical Solutions of Electric and Weighting Fields of 2D-Planar-Electrode and 3D-Trench-Electrode Detectors and Detector Array in Cartesian and Cylindrical Coordinates

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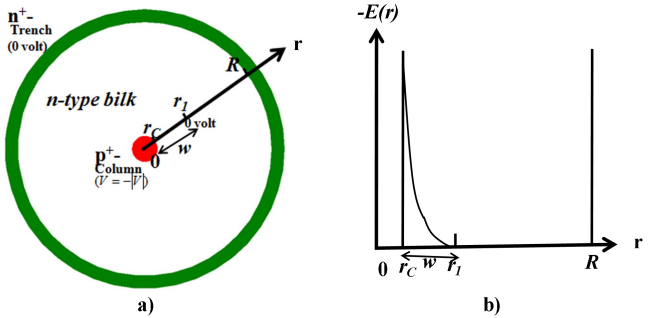
3D-Trench-CJ Detector:



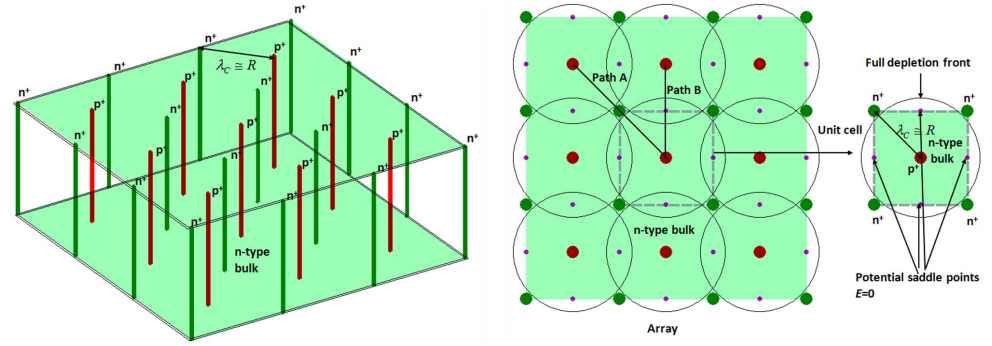
a) b)

Fig. 7 a) a cross section view of a cylindrical 3D-Trench-CJ electrode detector, b) electric field profile (super-linear).

$$E_{CJ}(r)=\begin{cases}\begin{cases}0 & (r\ge r_1)\\ -\dfrac{qN_{eff}}{2\varepsilon\varepsilon_0}r-\dfrac{qN_{eff}}{2\varepsilon\varepsilon_0}\dfrac{r_1^{\,2}}{r} & (r\le r_1)\end{cases} & (\text{before full depeltion},\ |V|\le V_{fd,CJ})\\ -\dfrac{qN_{eff}}{2\varepsilon\varepsilon_0}r-\dfrac{qN_{eff}}{2\varepsilon\varepsilon_0}\dfrac{r_C^{\,2}}{r}-\dfrac{|V|-V_{fd,CJ}}{r\ln\dfrac{R}{r_C}} & (\text{over full depeltion},\ |V|\ge V_{fd,CJ})\end{cases}$$

$$\phi_{CJ}(r)=\begin{cases}\dfrac{qN_{eff}}{4\varepsilon\varepsilon_0}(r^2-r_C^{\,2})+\dfrac{qN_{eff}}{2\varepsilon\varepsilon_0}r_1^{\,2}\ln\dfrac{r}{r_C}-|V| & (\text{before full depeltion},\ |V|\le V_{fd,CJ})\\ \dfrac{qN_{eff}}{4\varepsilon\varepsilon_0}(r^2-r_C^{\,2})+\dfrac{qN_{eff}}{2\varepsilon\varepsilon_0}R^2\ln\dfrac{r}{r_C}-|V|+\dfrac{|V|-V_{fd,CJ}}{\ln\dfrac{R}{r_C}}\ln\dfrac{r}{r_C} & (\text{over full depeltion},\ |V|\ge V_{fd,CJ})\end{cases}$$

Conventional 3D-Column-Electrode Detectors :



a) b)

$$V_{fd}^{3D,COLUMN}\cong\frac{qN_{eff}}{4\varepsilon_0\varepsilon}(R^2-r_C^{\,2})+\frac{qN_{eff}}{2\varepsilon\varepsilon_0}R^2\ln\frac{R}{r_C}$$

$$V_{fd}^{3D,COLUMN}\le\frac{qN_{eff}}{4\varepsilon_0\varepsilon}R^2+\frac{qN_{eff}}{2\varepsilon\varepsilon_0}R^2\ln\frac{R}{r_C}=\frac{qN_{eff}}{4\varepsilon_0\varepsilon}\lambda_c^{3D\,2}[1+2\ln\frac{\lambda_c^{3D}}{r_C}]$$

Fig. 13 a) A 3D view of a conventional 3D-Column-Electrode detector; b) the cross section view