A Compact Model of Ballistic CNFET for Circuit Simulation

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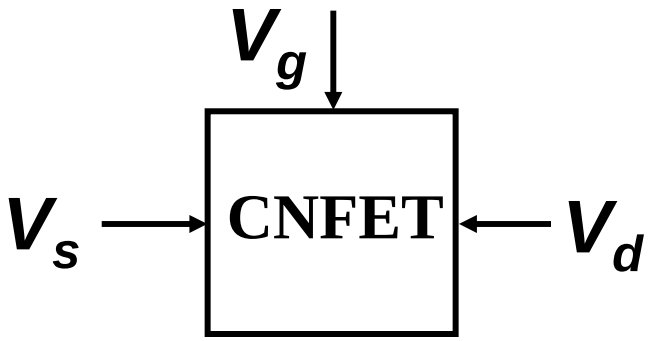
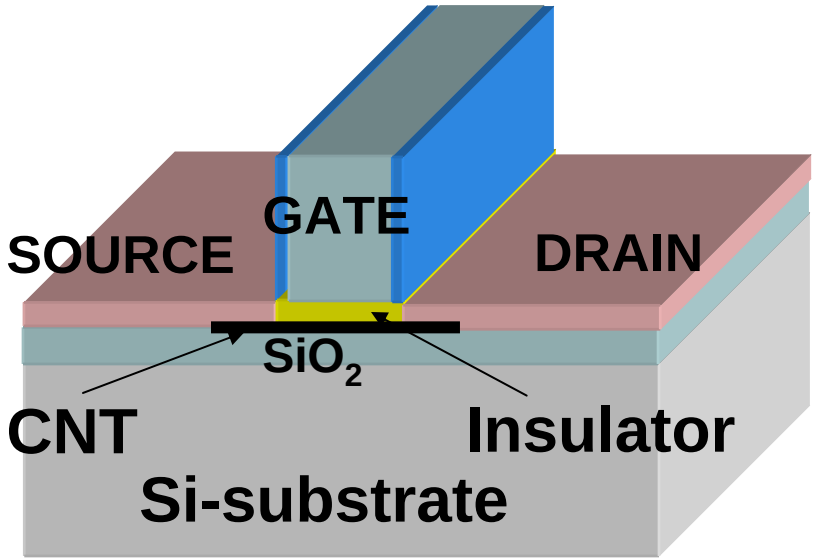
Objective

To achieve *ANALYTICAL* expression for device electrostatics



$$I_D = f_1(V_g, V_d, V_s)$$

$$C = f_2(V_g, V_d, V_s)$$



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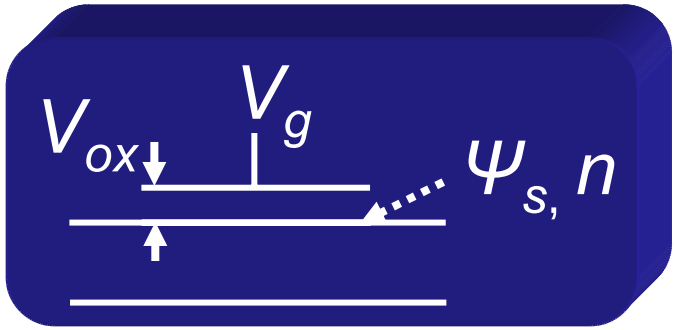
Challenges

- To obtain CLOSED form integral

$$n_p = N_0 \sum_{v_i = v_s, v_d} \left[\int_0^{\infty} \frac{dz}{1 + e^{\left(\sqrt{z^2 + \varepsilon_{c,p}^2} - (\varphi_s - v_i) \right)}} \right]$$

- Solving SELF- CONSISTENT equations

$$\psi_s = V_{gs} - V_{INS} = V_{gs} - \frac{Q_{CNT}}{C_{INS}}$$



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Approximate Solution

$$Q_{CNT} = e^{(\alpha_0 + \alpha_1 \psi_s)}$$

for $V_{gs} < V_T$

$$Q_{CNT} = \lambda_0 + \lambda_1(\psi_s - \psi_T) + \lambda_2(\psi_s - \psi_T)^2$$

for $V_{gs} > V_T$

Effect of V_{ds} is insignificant for $V_{ds} > 3k_BT/q$

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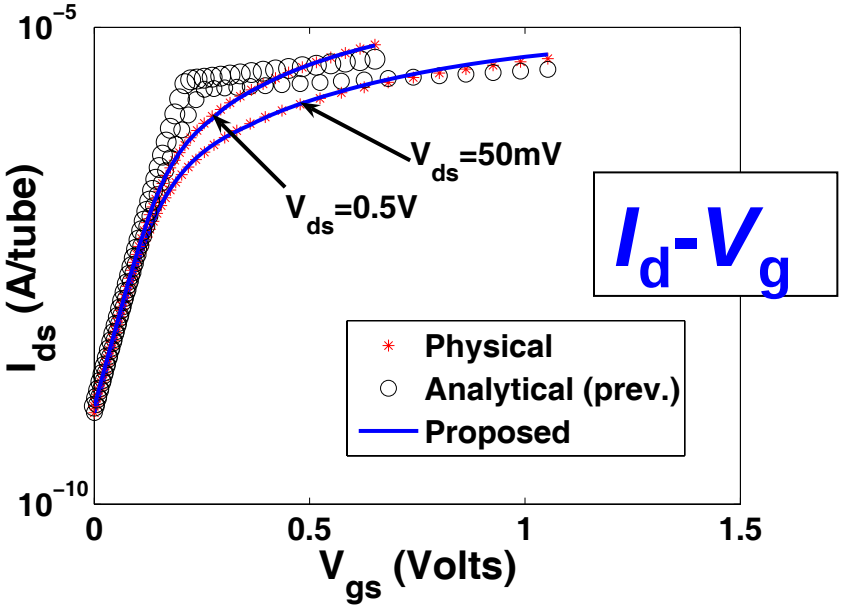
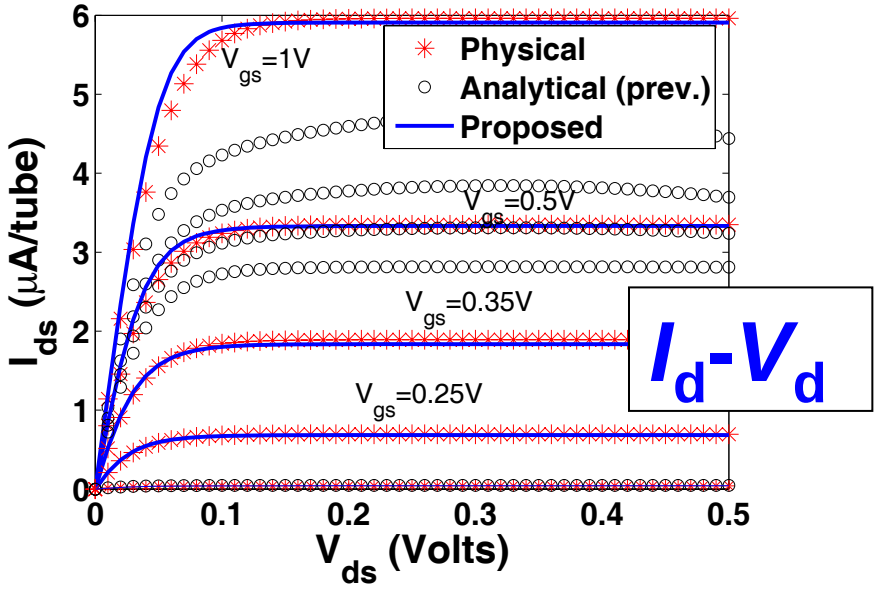
Simulation Results

Diameter = 2nm

C_{ox} = 48.3pF/m, V_T = 0.3V





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