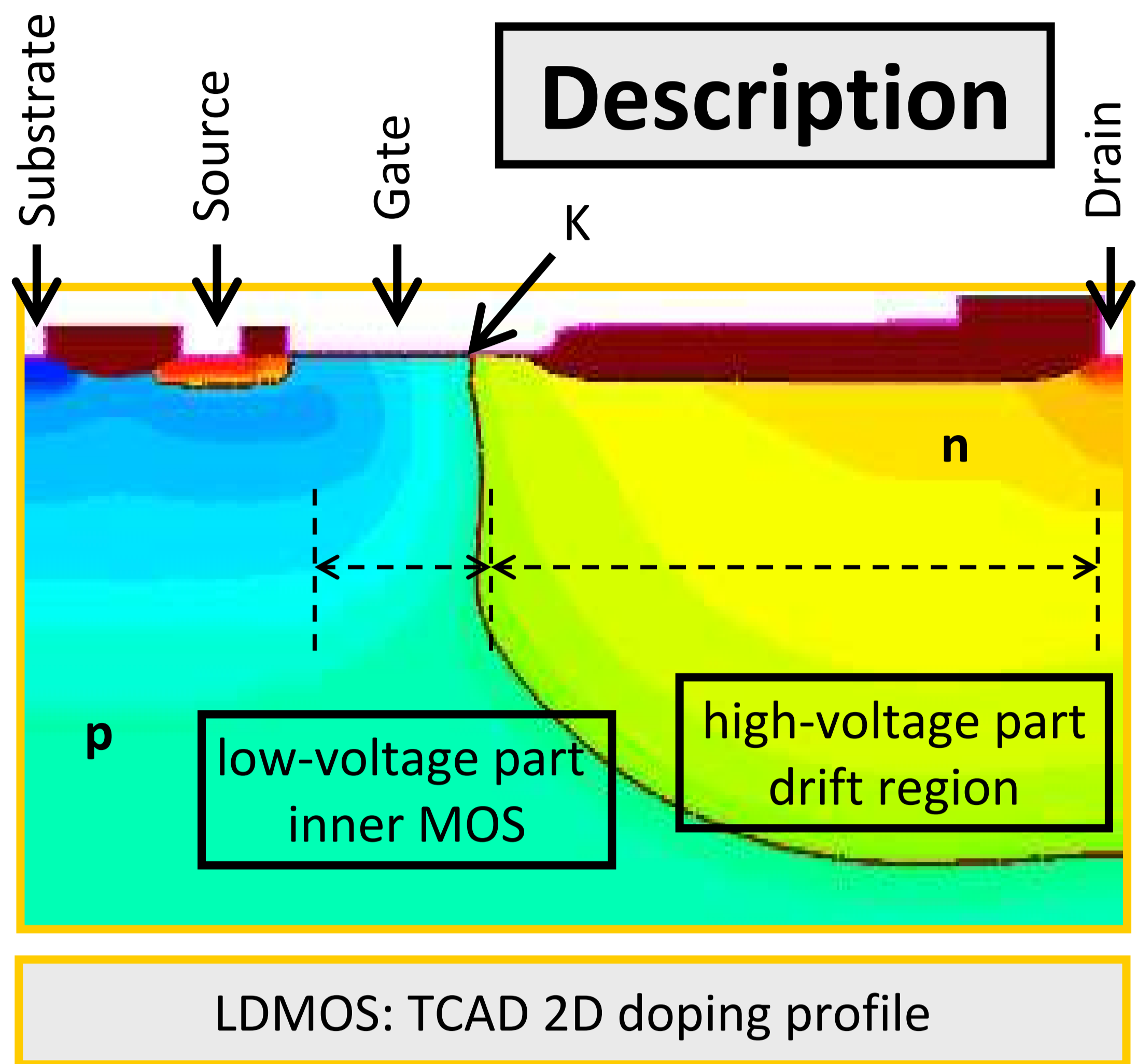


Recent Developments on the EPFL - High Voltage MOSFET Model (EPFL- HVMOS)

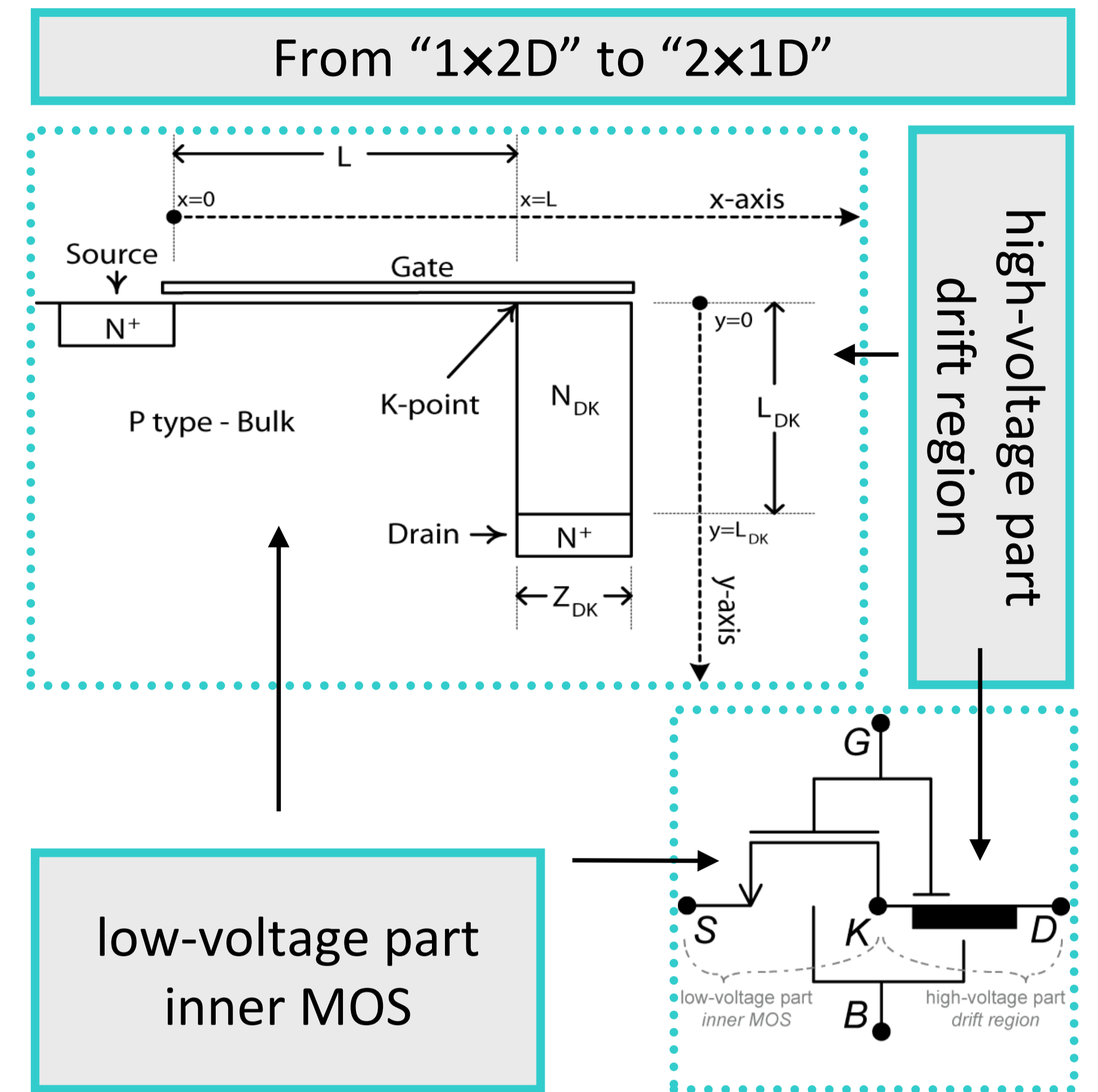
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Abstract: We present the latest developments and some preliminary results on **High-Voltage MOSFET modelling at EPFL.**

A novel physics-based compact model is derived for the **drift region**. It includes velocity saturation and Poisson equation in a self consistent formalism. Next, this drift extension has been combined with a non-uniformly doped MOSFET compact model for the low voltage section of the device. The complete model has been **implemented in Verilog-A** language. **Evaluation** against TCAD simulations and actual **measurements** on state-of-art HV-MOS devices confirm the soundness of this approach.



- HV-MOS: 2 parts
 - Connection point: 'K'
 - Doping changes type
 - Between channel and drain
- Low-voltage part
 - inner MOSFET
 - inner drain is 'K'
- High-voltage part
 - Drift region
 - A physics-based model is derived within this work
- 2 parts are inseparable
 - Go together like a horse and carriage



Low Voltage Part - Inner MOSFET [1]

- Any Compact MOSFET Model
 - Lateral Non-Uniform doping
 - Temperature dependence
 - Common temperature with DRIFT region
 - Self-heating effect
 - Second order mobility reduction due to vertical field
 - Geometry scaling
 - Velocity saturation
 - Channel length modulation
 - Subthreshold barrier lowering

High Voltage Part - Drift region [2]

- A physics-based analytical compact model
 - Charge and potential analysis
 - Poisson's equation
 - Boltzmann's equation
 - drift-diffusion model
 - The electrostatic behaviour of the device depends on its current

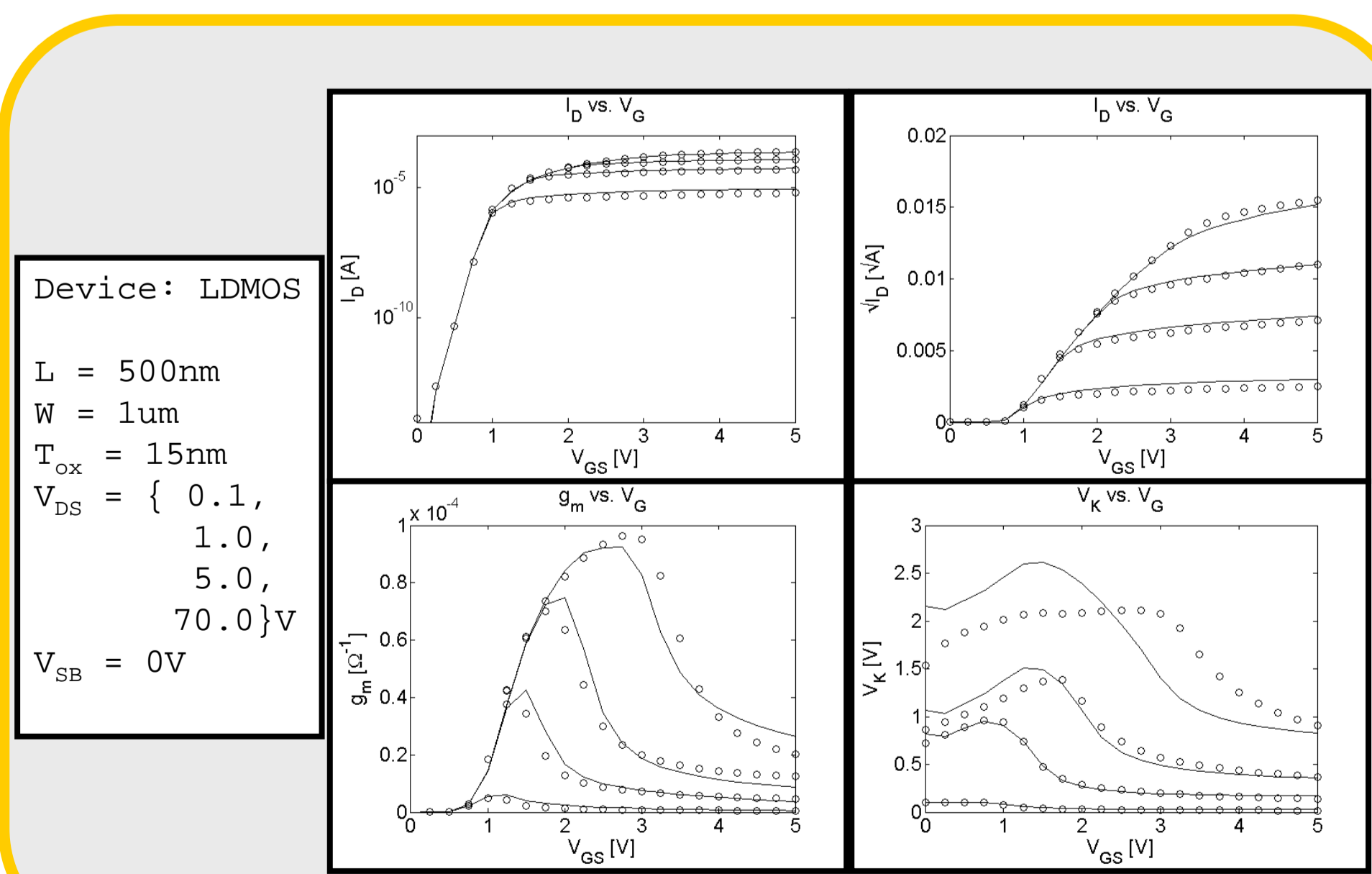
- Mobility high field reduction, 1st order
- Calculation of the average charge density of the DRIFT region
 - as a function of V_{GK} and V_{DK}
 - Continuous expression (accumulation / depletion)
- Normalized quantities / equations
- Higher order effects
 - Temperature dependence
 - Self-heating effect
 - Quasi-saturation
 - Impact ionization current

TCAD

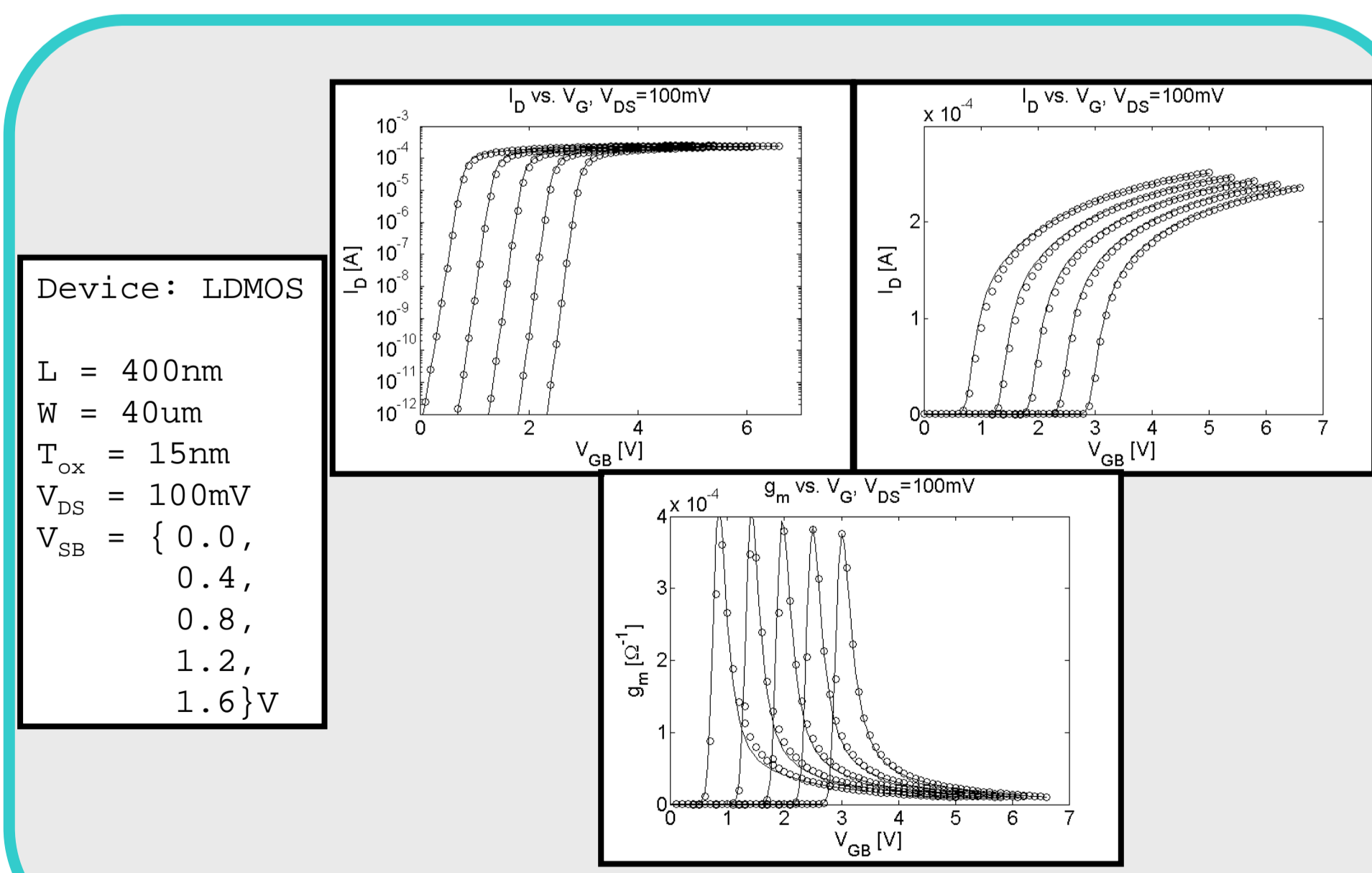
Evaluation

DC Measurements

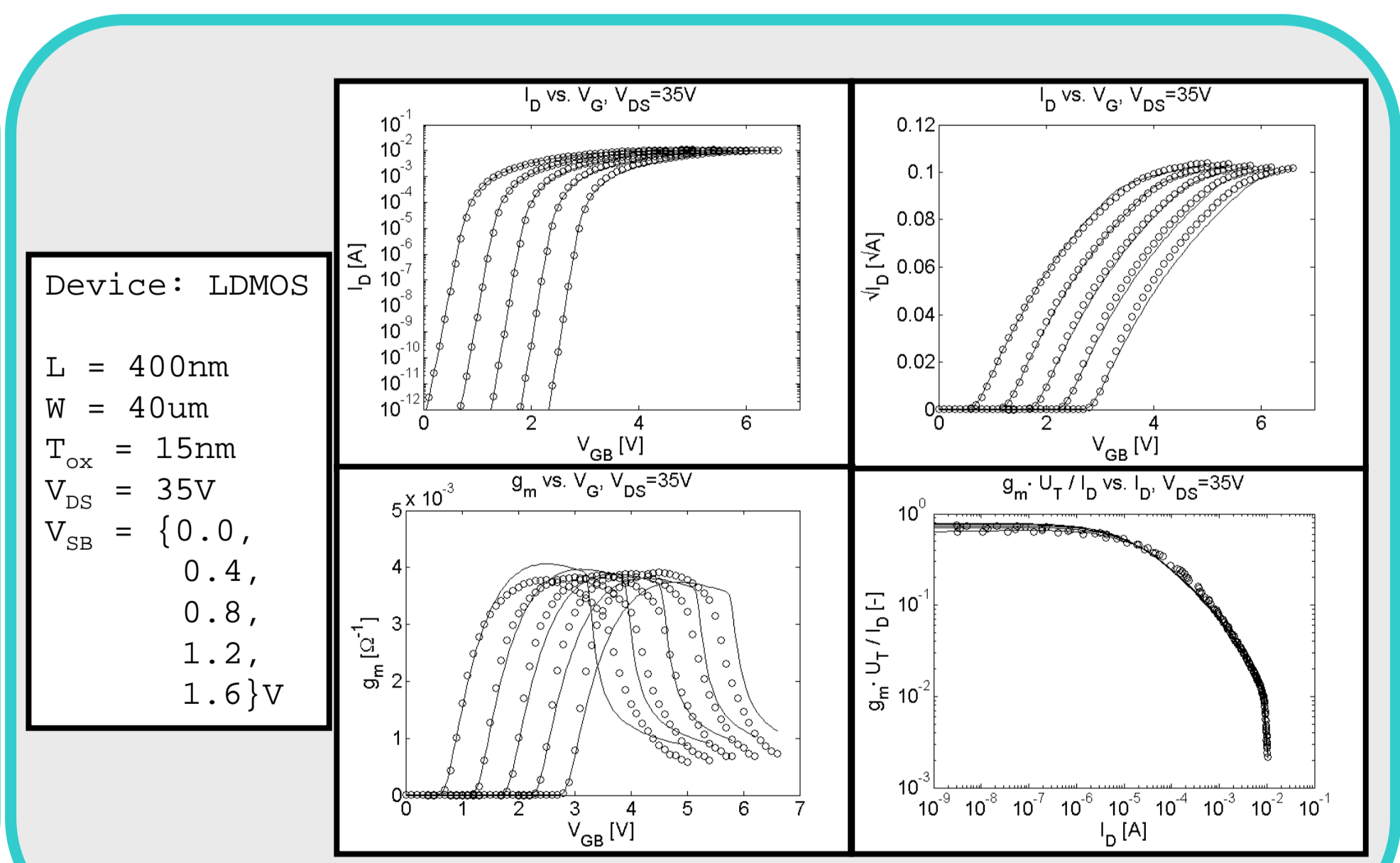
I_D vs. V_G



I_D vs. V_G , $V_{DS} = 0.1V$



I_D vs. V_G , $V_{DS} = 35V$



[1] Y. Chauhan, F. Krummenacher, R. Gillon, B. Bakeroot, M. Declercq, and A. Ionescu, "Compact Modeling of Lateral Nonuniform Doping in High-Voltage MOSFETs," Electron Devices, IEEE Transactions on, vol. 54, no. 6, pp. 1527–1539, June 2007.

[2] A. Bazigos, F. Krummenacher, J.M. Sallèse, M. Bucher, E. Seebacher, W. Posch, K. Molnar, and M. Tang, "A physics-based analytical compact model for the Drift region of the HV-MOSFET," Electron Devices, IEEE Transactions on, (submitted for publication).