One Year Research Plan

- *Comparisons between different full quantum models for the electron transport in semiconductor devices.*
- *Development of a simulator based on Wigner MC for the simulation of electron transport in semiconductor devices.*
- *Validation of the method.*
- *Applications to technologically relevant situations.*

Results Achieved

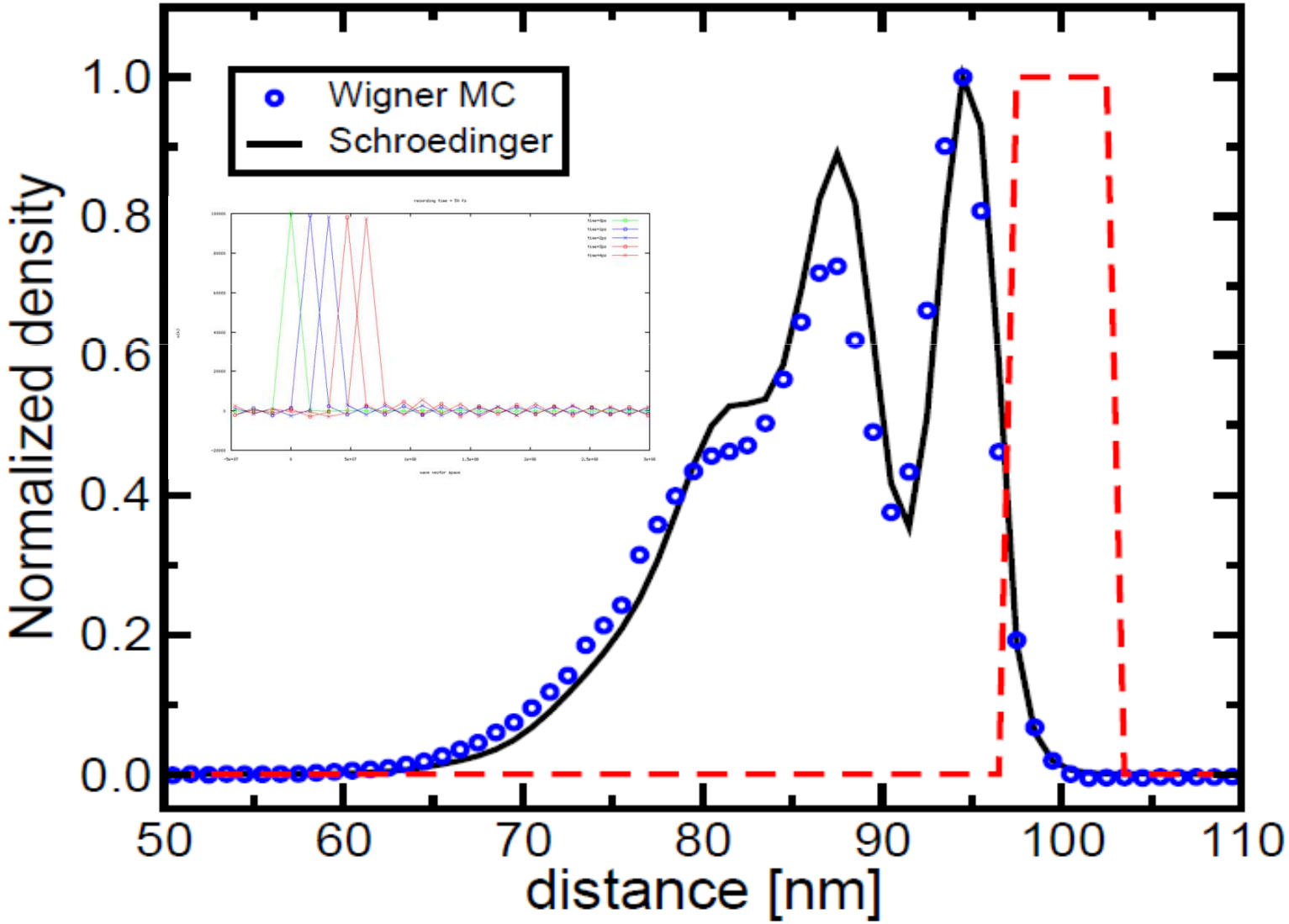
- *Comparisons have been done between our Wigner MC method based on particles signs, the Wigner MC based on particles affinities, a potential decomposition technique and the Schroedinger equation, showing that our method is the only one that reproduce Schroedinger results in a quantitative way.*

- *A 1D/2D/3D simulator based on Wigner MC has been implemented named nano-archimedes (www.nano-archimedes.com).*

- *Nano-archimedes has been validated against Schroedinger and Boltzmann equations.*

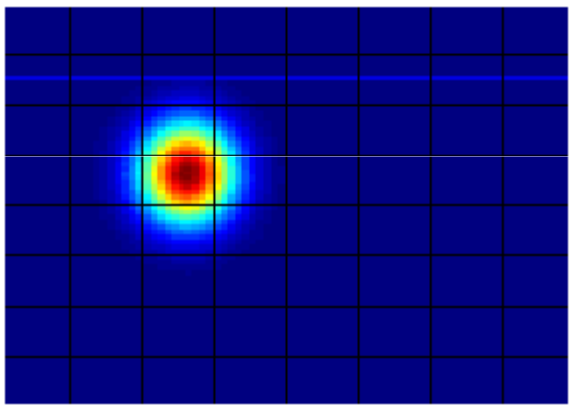
- *Applications to technologically relevant situations have been carried out, in particular the study of traps and scattering centers in CMOS technology. Applications have also been done in the field of mesoscopic physics (study of decoherence).*

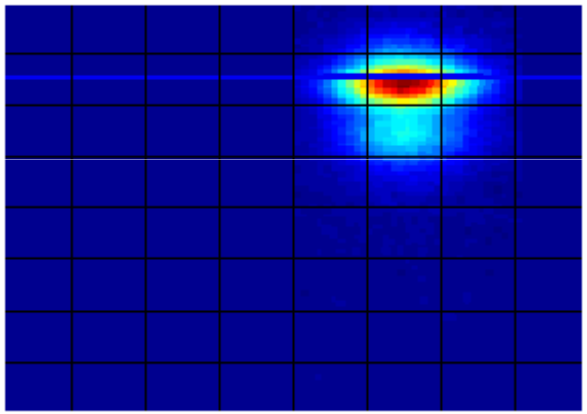
Validations

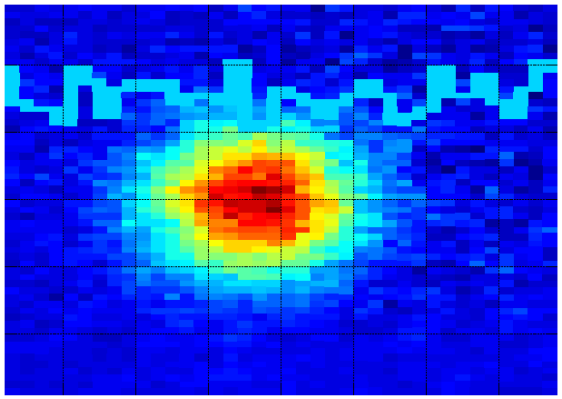


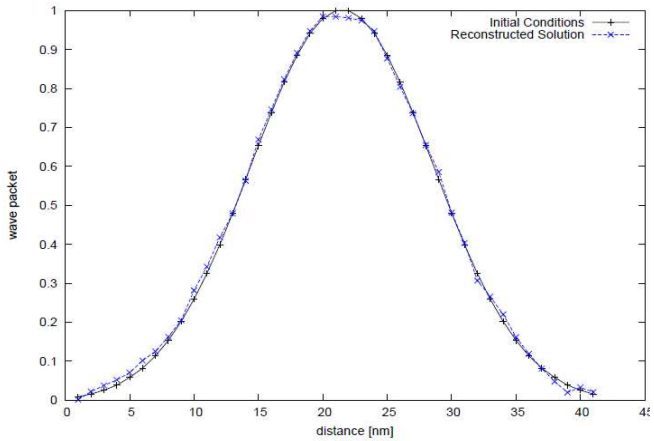
Emergence of Decoherence

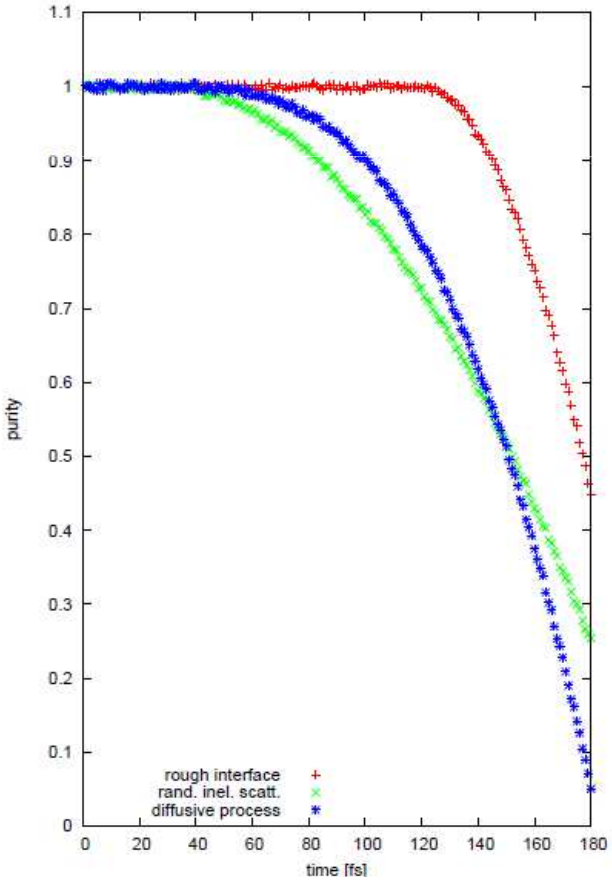
- Time-dependent study in the presence of dispersive processes, inelastic processes, etc.



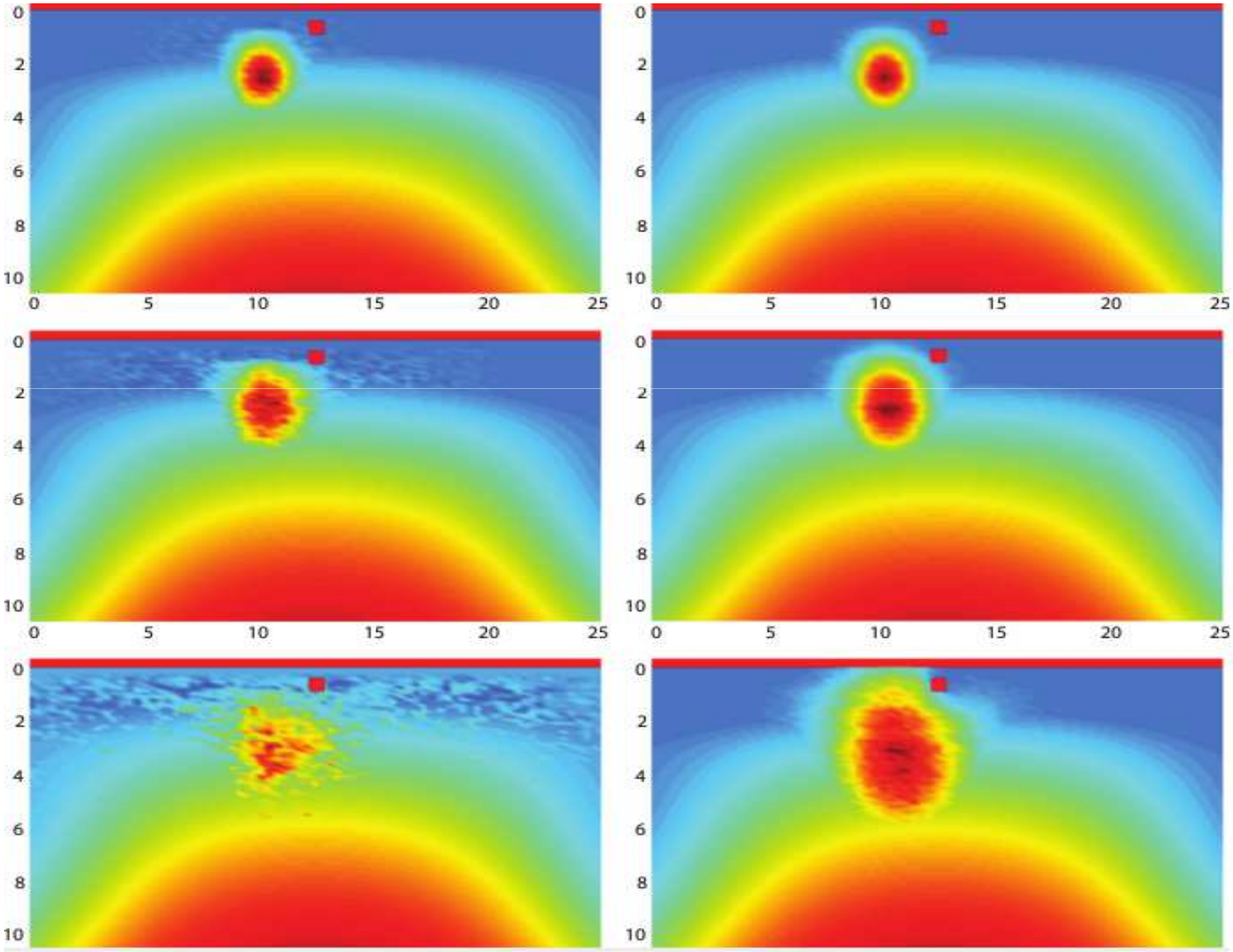








Applications to CMOS technology



Published Papers and Proceedings

1. M. Nedjalkov, P. Schwaha, S. Selberherr, J.M. Sellier, D. Vasileska,
"Wigner Quasi-Particle Attributes: An Asymptotic Perspective",
Appl. Phys. Lett., 102, 163113, (2013).

2. P. Schwaha, J. M. Sellier, M. Nedjalkov, I. Dimov, S. Selberherr,
"The Ultimate Equivalence Between Coherent Quantum and Classical Regimes",
Poster: International Workshop on Computational Electronics (IWCE), Nara, Japan; 2013-06-04 - 2013-06-07; in Proceedings of the 16th International Workshop on Computational Electronics (IWCE 2013), (2013), ISBN: 978-3-901578-26-7; 152 - 153.

3. P.Schwaha, M. Nedjalkov, S. Selberherr, J.M. Sellier, I. Dimov, R. Georgieva,
"Stochastic Alternative to Newton's Acceleration",
Talk: International Conference on Large-Scale Scientific Computations (LSSC), Sozopol, Bulgaria; 2013-06-03 - 2013-06-07; in Abstracts International Conference on Large-Scale Scientific Computations (LSSC), (2013), 77 - 78.

4. J.M. Sellier, M. Nedjalkov, I. Dimov, S. Selberherr,
"The Role of Annihilation in a Wigner Monte Carlo Approach",
Talk: International Conference on Large-Scale Scientific Computations (LSSC), Sozopol, Bulgaria; 2013-06-03 - 2013-06-07; in: Abstracts International Conference on Large-Scale Scientific Computations (LSSC), (2013), 78.

5. S. Amoroso, L. Gerrer, A. Asenov, J. M. Sellier, I. Dimov, M. Nedjalkov, S. Selberherr,
"Quantum Insights in Gate Oxide Charge-Trapping Dynamics in Nanoscale MOSFETs",
Talk: International Conference on Simulation of Semiconductor Processes and Devices (SISPAD), Glasgow, Scotland, United Kingdom; 2013-09-03 - 2013-09-05; in Proceedings of the 18th International Conference on Simulation of Semiconductor Processes and Devices (SISPAD), (2013), ISBN: 978-1-4673-5733-3; 25 - 28.

6. J. M. Sellier, M. Nedjalkov, I. Dimov, S. Selberherr,
"Two-dimensional Transient Wigner Particle Model",
Talk: International Conference on Simulation of Semiconductor Processes and Devices (SISPAD), Glasgow, Scotland, United Kingdom; 2013-09-03 - 2013-09-05; in Proceedings of the 18th International Conference on Simulation of Semiconductor Processes and Devices (SISPAD), (2013), ISBN: 978-1-4673-5733-3; 404 - 407.

7. J.M. Sellier, M. Nedjalkov, I. Dimov, S. Selberherr,
“Decoherence and Time Reversibility: The Role of Randomness at Interfaces”, to appear on Journal of Applied Physics.

Papers under review

1. J.M. Sellier, M. Nedjalkov, I. Dimov, S. Selberherr,
"A benchmark study of the Wigner Monte-Carlo method",
Monte Carlo Methods and Applications.

2. J.M.Sellier, S. Amoroso, M. Nedjalkov, S. Selberherr, A. Asenov, I. Dimov,
"Electron Dynamics in Nanoscale Transistors by Means of Wigner and Boltzmann Approaches",
Physica A.

3. J.M. Sellier, M. Nedjalkov, I. Dimov, S. Selberherr,
“A Comparison of Approaches for the Solution of the Wigner Equation”,
Mathematics and Computers in Simulations.