Quantum
Mechanical &
Electromagnetic
Systems
Modelling Lab

Master thesis in Electrical Engineering @ quest

Prof. Dries Vande Ginste

quest.

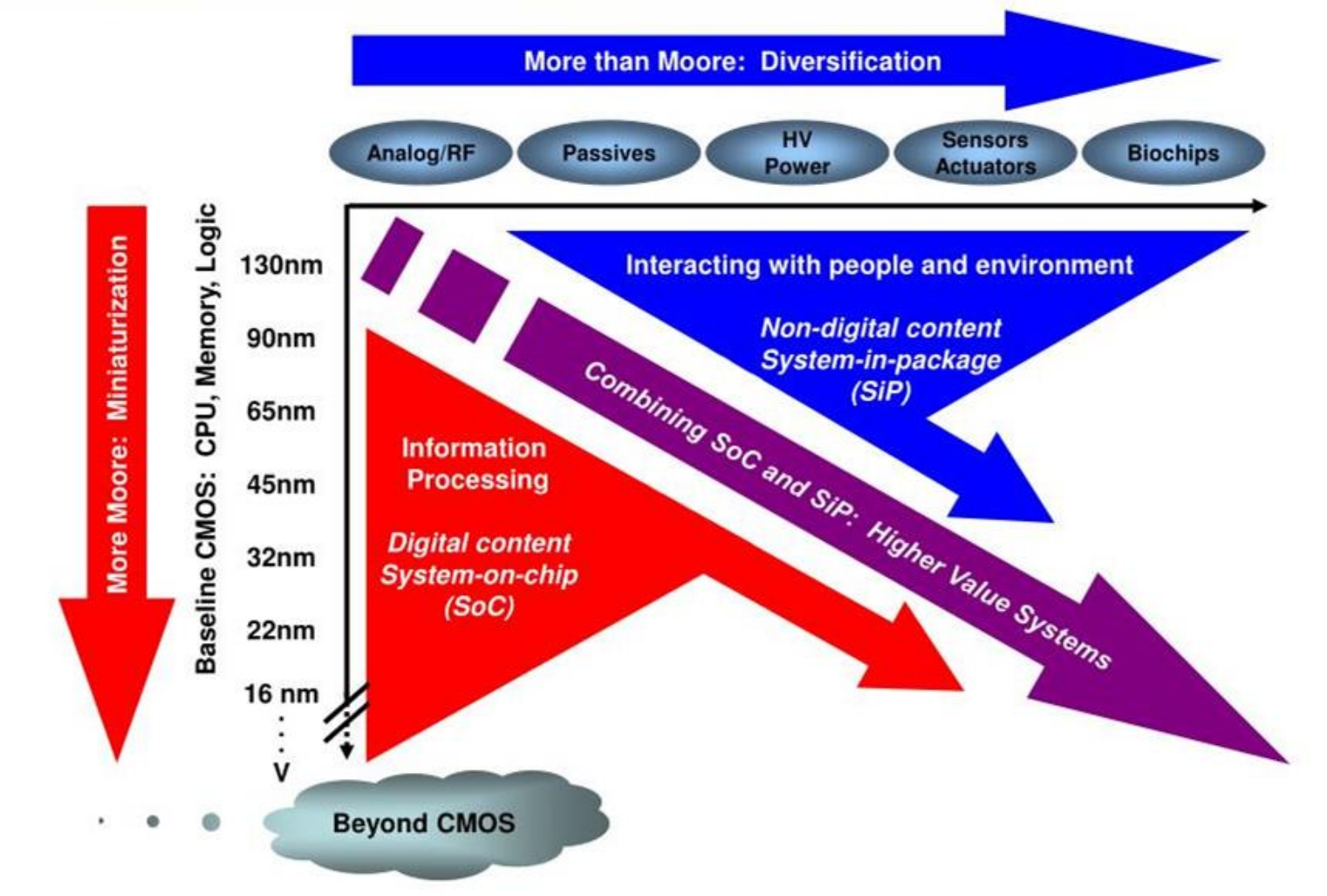
Introduction

Quest – quantum mechanical and electromagnetic systems modelling lab

- New lab (since 1 March 2021)
- Scope goes beyond traditional EM (see also further):
  modelling of QM/EM devices and systems + development of computer-aided design tools
- Novel research domain with high academic + industrial relevance
- Create knowledge + critical mass
- Reach-out to relevant (academic and industrial) partners
- Coaching/educating/training of young researchers in a new and versatile research domain

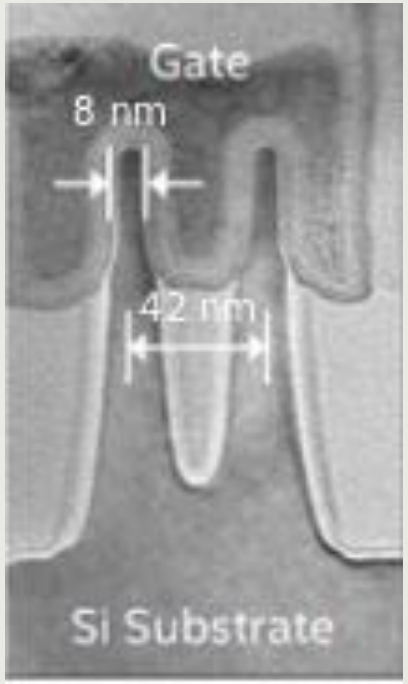
Research context

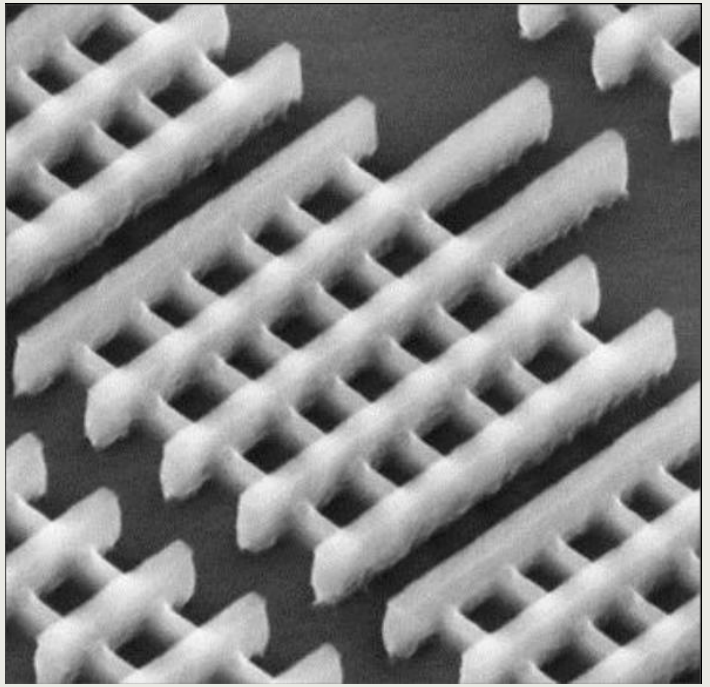
Roadmap for semiconductors



Research context

Example “More Moore”: Intel’s Core i7-8700K

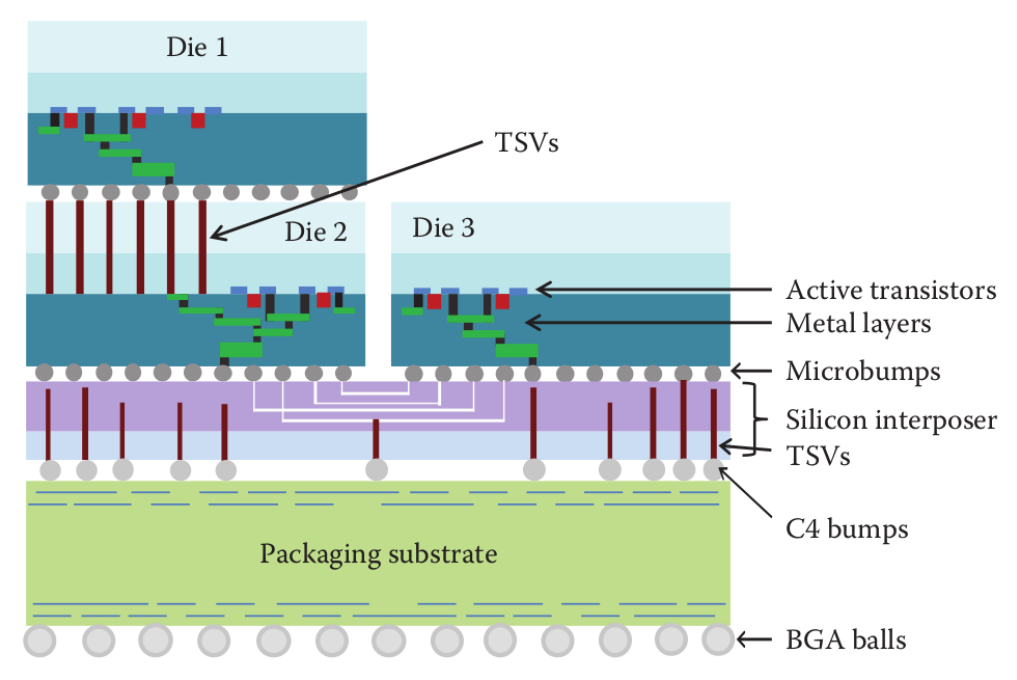


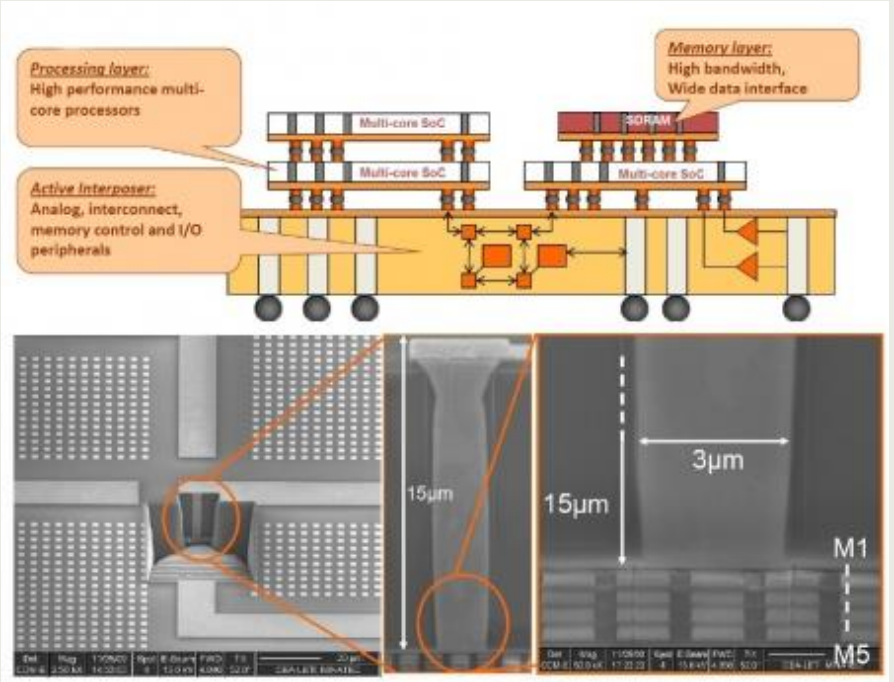


- Full-wave simulations needed
- But highly multiscale

Research context

Example “More than Moore”: 3-D ICs

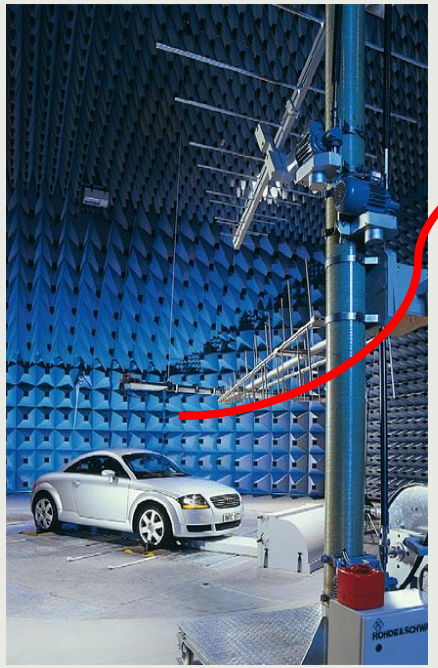


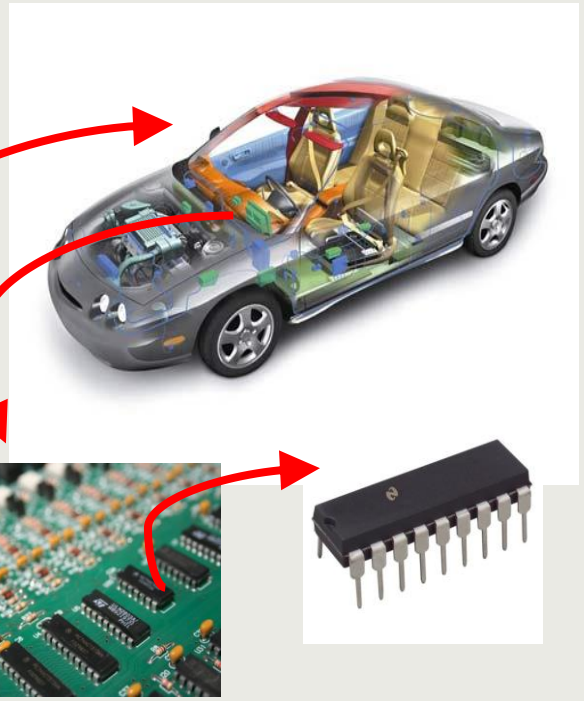


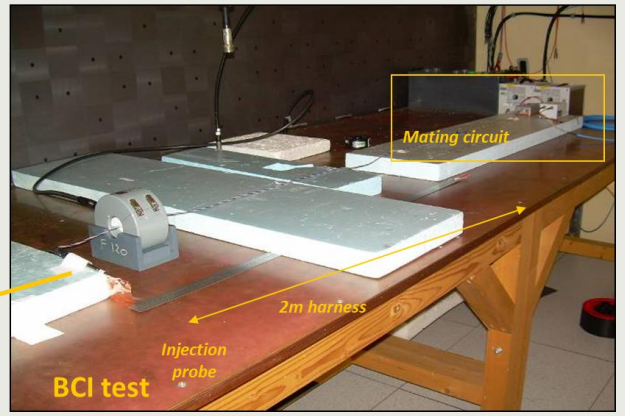
- Again multiscale problem + very heterogeneous
- Also: multiphysics problem

Research @ quest: some results

EMC of automotive ICs







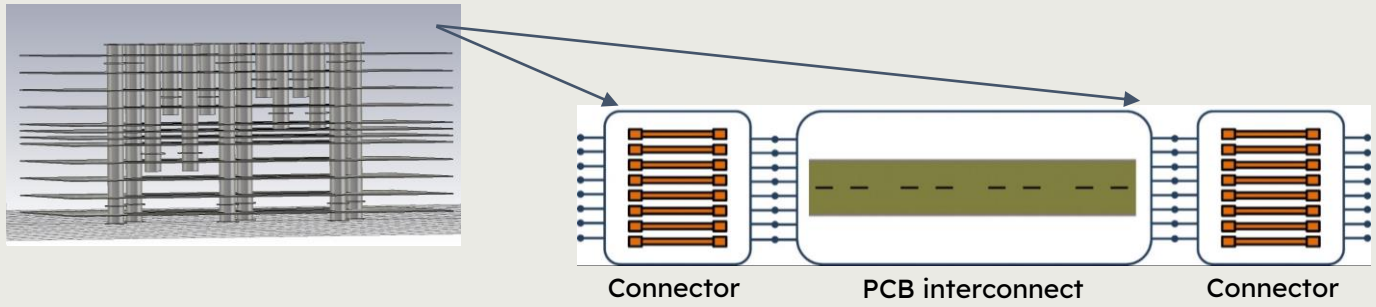
BCI/DPI and transient (e.g., ESD) test setups

Cooperation with Melexis

Research @ quest: some results

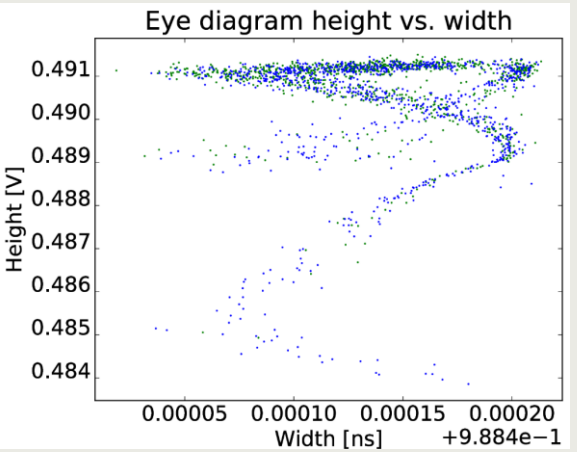
SI-aware modelling and design

Stochastic link analysis: connector footprint + on-PCB interconnect

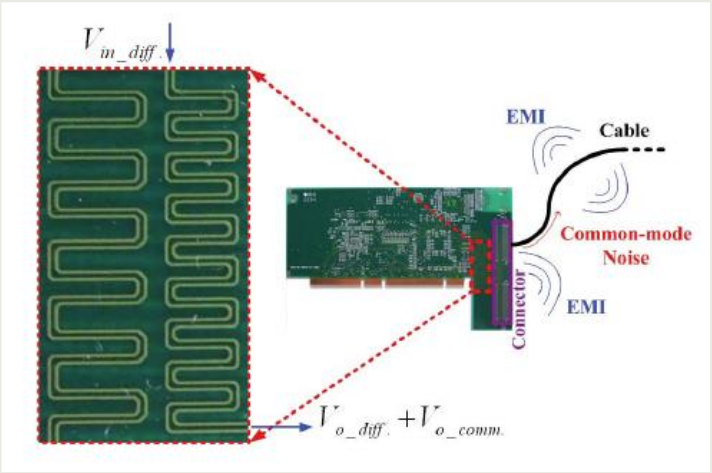


Machine Learning

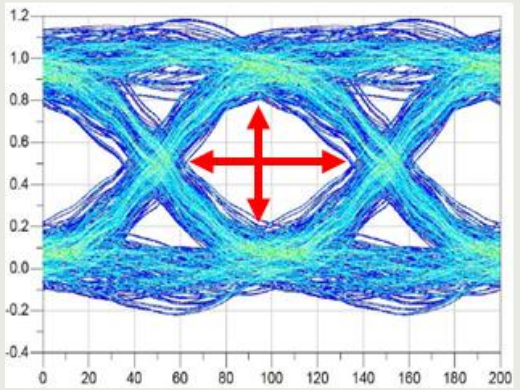
Variability of eye diagram



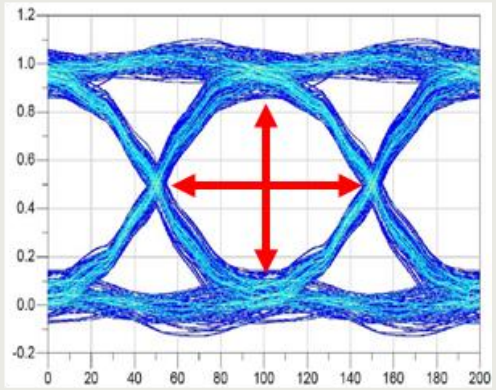
Design for differential signaling and common-mode noise reduction



classic design

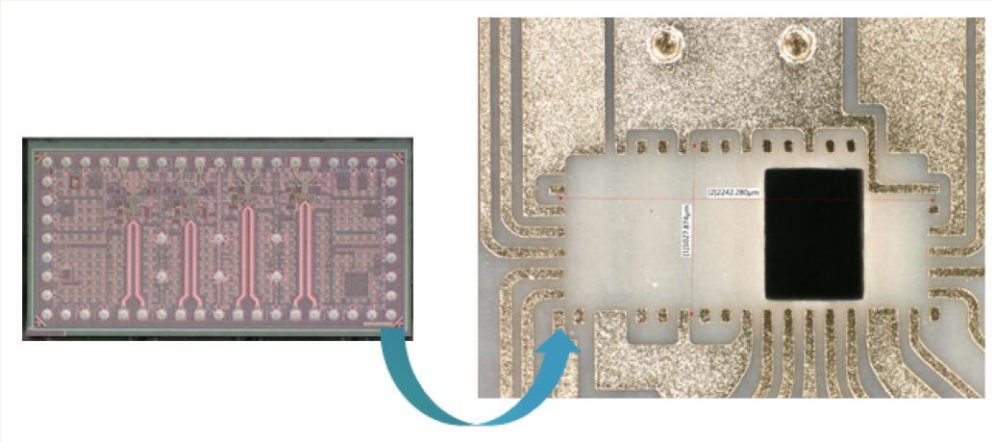


improved design



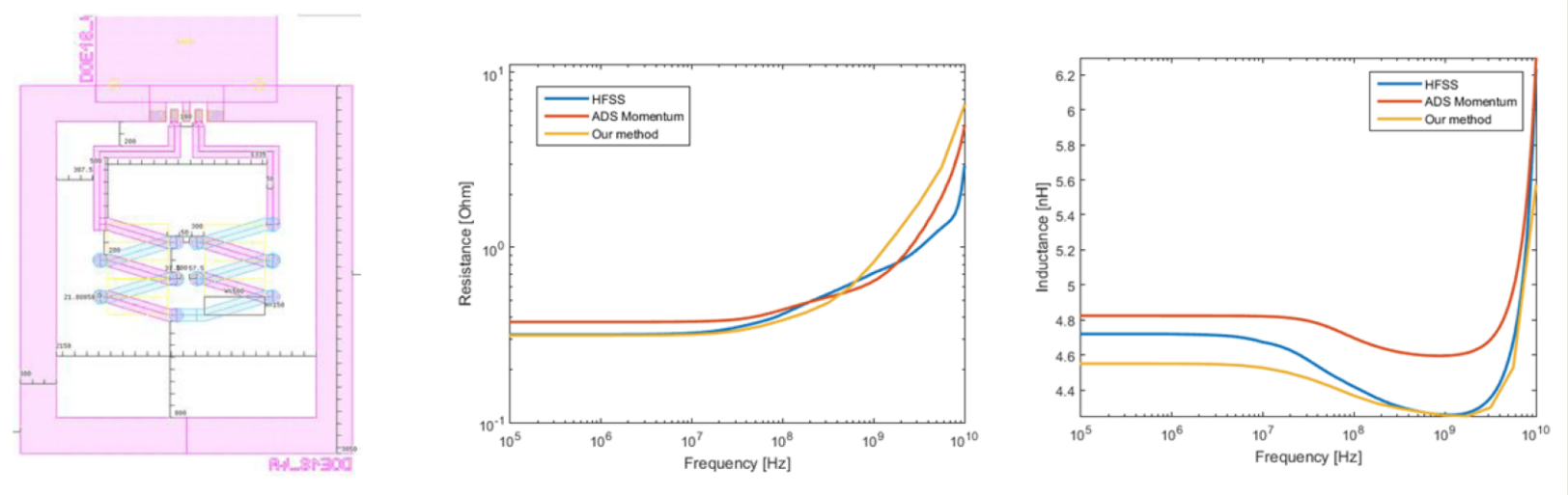
Research @ quest: some results

EMC/SI/PI-aware modelling and measurements of mmWave ICs



Confidential results / cooperation with

HUAWEI



Cooperation with

imec

Research @ quest: mission and strategy

EMC/SI/PI-aware modelling and design of electronic devices

- Modelling tools are not only indispensable for design, but also help to understand the physics
- Modelling tools are validated by designs and measurements
- EMC/SI/PI research domain:
    - Many challenges but also many opportunities (academic / industrial)
    - Various application domains + potential strategic partners

Thesis @ quest

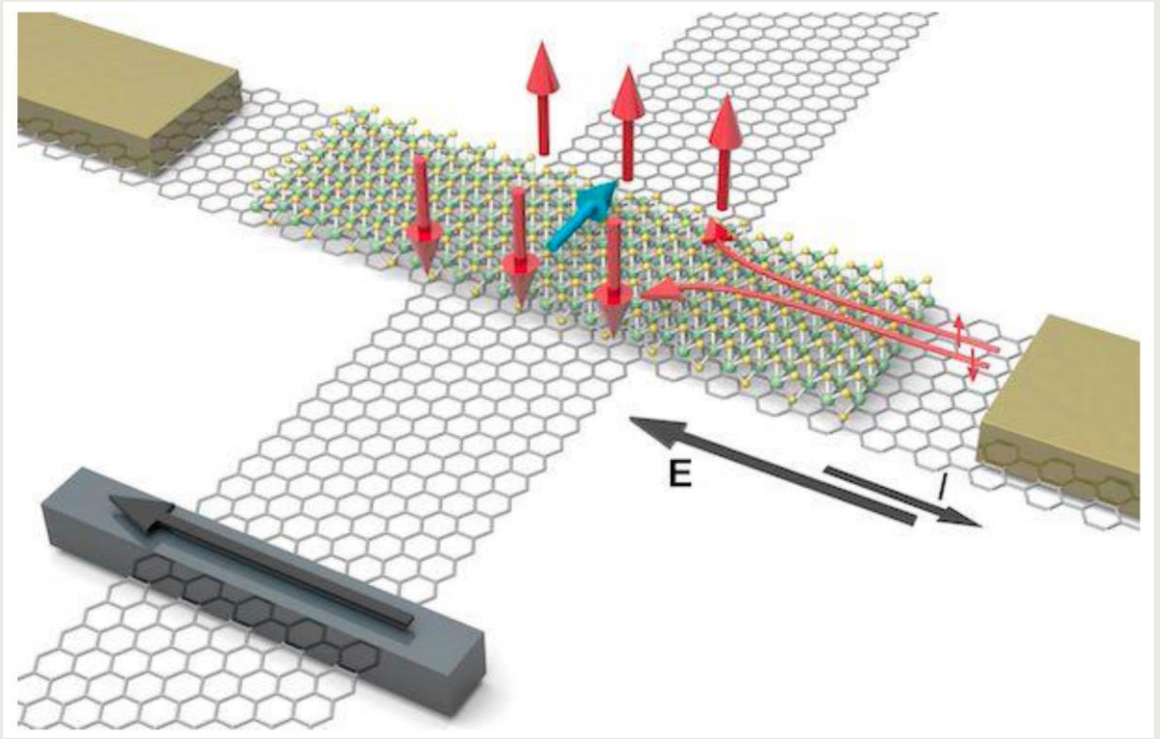
Classification of topics

- EM and hybrid QM/EM modelling topics
- EMC/SI/PI-aware modelling and design topics
- Concrete topics:
  - will be posted on Plato in April
  - can be chosen as such or can be tailored to student's interest
  - detailed discussion with quest (preferably personal appointment)

Thesis topics vs quest's strategic research agenda

- Useful for the student: knowledge / skills / future opportunities
- Useful for quest: building knowledge + tools

Conclusion



Modelling and EM-aware design
of electronic systems and (nano)devices

- Groundbreaking research
- Academic and industrial need

Thesis @ quest

- Research freedom
- Close counselling by highly motivated team
- Prospect: relevant to student (academic or industrial career) and to research lab

quest.

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GHENT UNIVERSITY

imec

Technologiepark – Zwijnaarde 126, B-9052 Gent, Belgium
T +32 9 264 33 54 — **dries.vandeginste@UGent.be**
www.QuestLab.be

Prof. Dries Vande Ginste