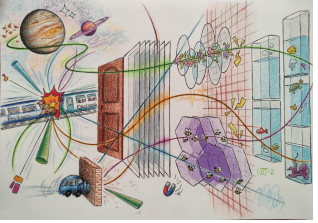

WP4 - Modelling simulations

Proposal for workplan and milestones

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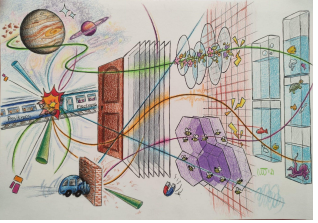
M. Bomben, S. Spannagel

on behalf of the WP4 preparation/proposal group



Current status

DRD3

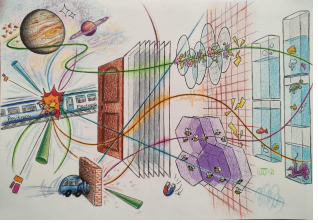
Different approaches to TCAD radiation damage modeling

- EVL Model (2 levels)
- Delhi-2014 (2 levels)
- KIT (Eber) (2 levels)
- New Univ. Of Perugia Bulk+Surface (3 levels)
- Folkestad (CERN model)/LHCb (3 levels)
- Hamburg Penta Trap Model (HPTM) (5 levels)

All the radiation damage models work fine but limited to some datasets and devices.

GOAL: General purpose TCAD model

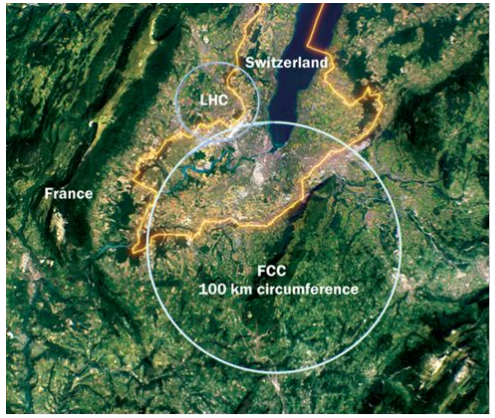
- Not over specific → set of “effective” defects within the semiconductor bandgap.
- Can predict the behavior of different types of devices manufactured by a same material.
- Accounts for different irradiation levels and particles types.
- A common benchmark for the agreement between simulations and measurements must be defined → numerical model validation purposes.



Directions of research

DRD3

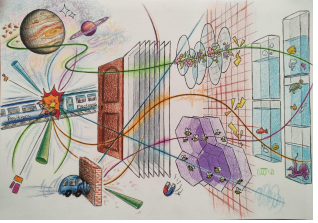
The Future Circular Collider-e^+e^- (FCC-ee) is the CERN project for the realization of the new very large electron-positron collider of ~100 km circumference. It is the first of a two-stage program: after the FCC-ee, the same tunnel will host a hadron collider (FCC-hh).



The proposed layout of the Future Circular Collider. Credit: CERN.

- FCC-ee → Surface damage (extreme doses)
- FCC-hh → Bulk + Surface (extreme fluences >1e17 1MeV n_{eq}/cm^2)

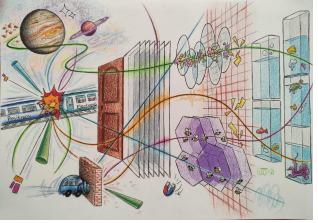
- Collaboration toward the development and extension of models for semiconductor materials into simulations tools
  - Modeling dopant removals, impact ionization, carriers' mobility, traps dynamics
- Modeling of different (WBG) materials: SiC, aSi:H, diamond, …



Milestones and Deliverables

DRD3

- Short term (S-) / mid term (M-) milestones (-M) and deliverables (-D):
  - SM: The definition of a benchmark for the validation of the model with measurements.
  - SM: Implementation of newly measured semiconductor properties into simulations tools.
  - SD: A best performing model according to benchmark.
  - MD: Numerical modeling of a comprehensive combined BULK+SURFACE radiation damage effects (-40-+25°C).
- Long term (L-)
  - LD: General model for extreme fluences accounting for the saturation effects and inclusion of comprehensive models of other WBS.
  - LD: “User manual” to guide the user in TCAD radiation damage effects simulation.



Estimated resources

DRD3

- A brief survey of questionnaires on the topic
  - TCAD and MC modelling of the damage - 12 institutions
  - Integration of other materials in the simulation tools, TCAD & MC - 3 institutions

- Estimated Required resources - **For each Institution**
  - TCAD Licenses
    - Synopsys - 3.5k euro/year via Europractice (20 licenses + Membership)
    - !Warning! the cost outside Europractice
    - Silvaco - commercially confidential information (ask Marco Bomben for details)
  - High performance workstations (CPUs/GPUs) for large computational cost simulations (3Ds, LGADs, …)
    - 20k-50k euro/ institution
  - Manpower required
    - 4 FTE/year