FASTRAD and Geant4-related activities at TRAD

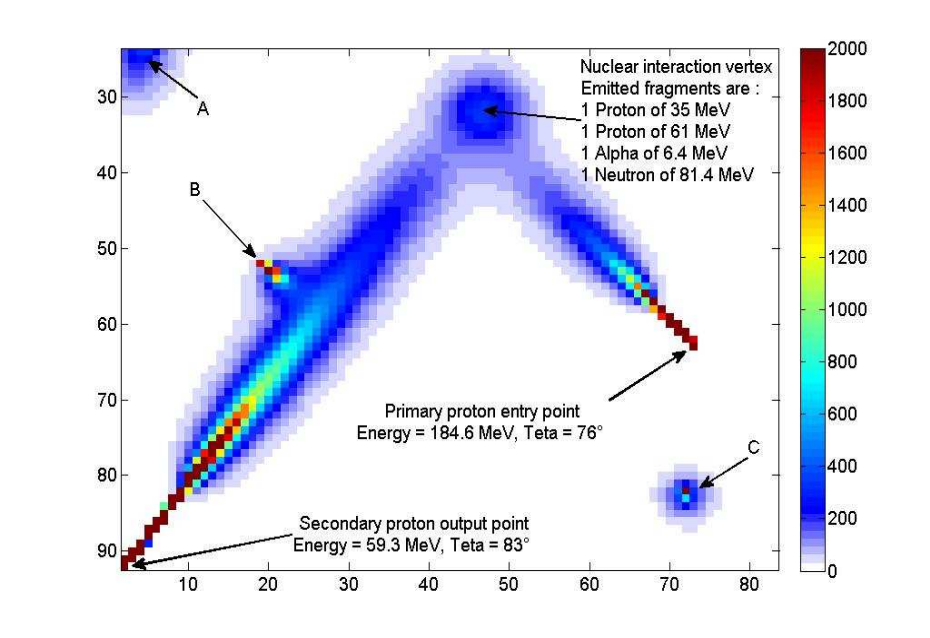
Geant4 Workshop, Madrid
May 21st, 2009

Summary

- Geant4-related CNES actions
- FASTRAD
  - Brief description
  - Geant4 Interface
  - GDML Geometry Export
  - Particles Tracking Viewer
  - GRAS Interface (in progress)
- Other TRAD Geant4-related activity
  - Effect Study on a PMOS dosimeter

TRAD Tests & radiations

GEANT4 at CNES



Guy ROLLAND. CNES Toulouse DCT/AQ/EC.

SUMMARY of the Geant4-Related CNES Actions :

- R&D Contracts with TRAD (2003 → 2009) :
  - Feasibility, Implementation in FASTRAD and Optimisation of Forward and Reverse Monte Carlo Methods for Ionising Dose Calculations based on G4.
  - G4 Simulations for the Design and the Validation of a Proton Beam Degrader Facility.
- R&D Contracts with ONERA / DESP (2003 → 2009) :
  - Development of a G4 based Nuclear Reaction Data Base used in the NEMO / OMERE code (for NIEL calculations) and in the STARDUST code (Simulation of Particles Tracks in Detectors).
  - G4 Simulation of the Behaviour and Sensitivity of Particle Detectors (ICARE-NG / CARMEN).
  - Development of G4 Pre-processors and Post-processors based on Root.
  - G4 based Displacement Damage Studies in Semiconductors (current).
- CNES Specific Use (2004 → 2009) :
  - Calculation of the Ionizing Absorbed Dose by a Comet (G4 Feasibility Study) .
  - G4 Calculation of the Radiation Environment Spectra at the COROT Satellite Focal Plane.
  - Use of some G4 Xsection models in the STARDUST Code.
- Perspectives :

  These actions are re-evaluated each year by the CNES R&D arbitration committees.

Guy ROLLAND. CNES Toulouse DCT/AQ/EC.

FASTRAD

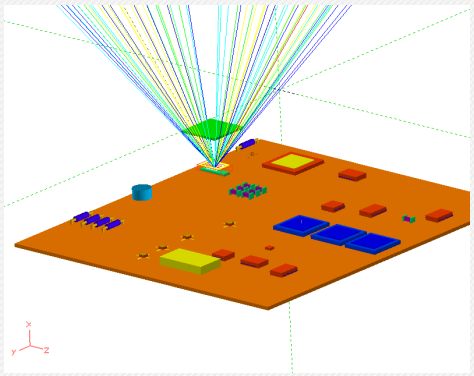
Geant4 Workshop, Madrid
May 21st, 2009

TRAD
Tests & radiations

Brief description - Functionalities

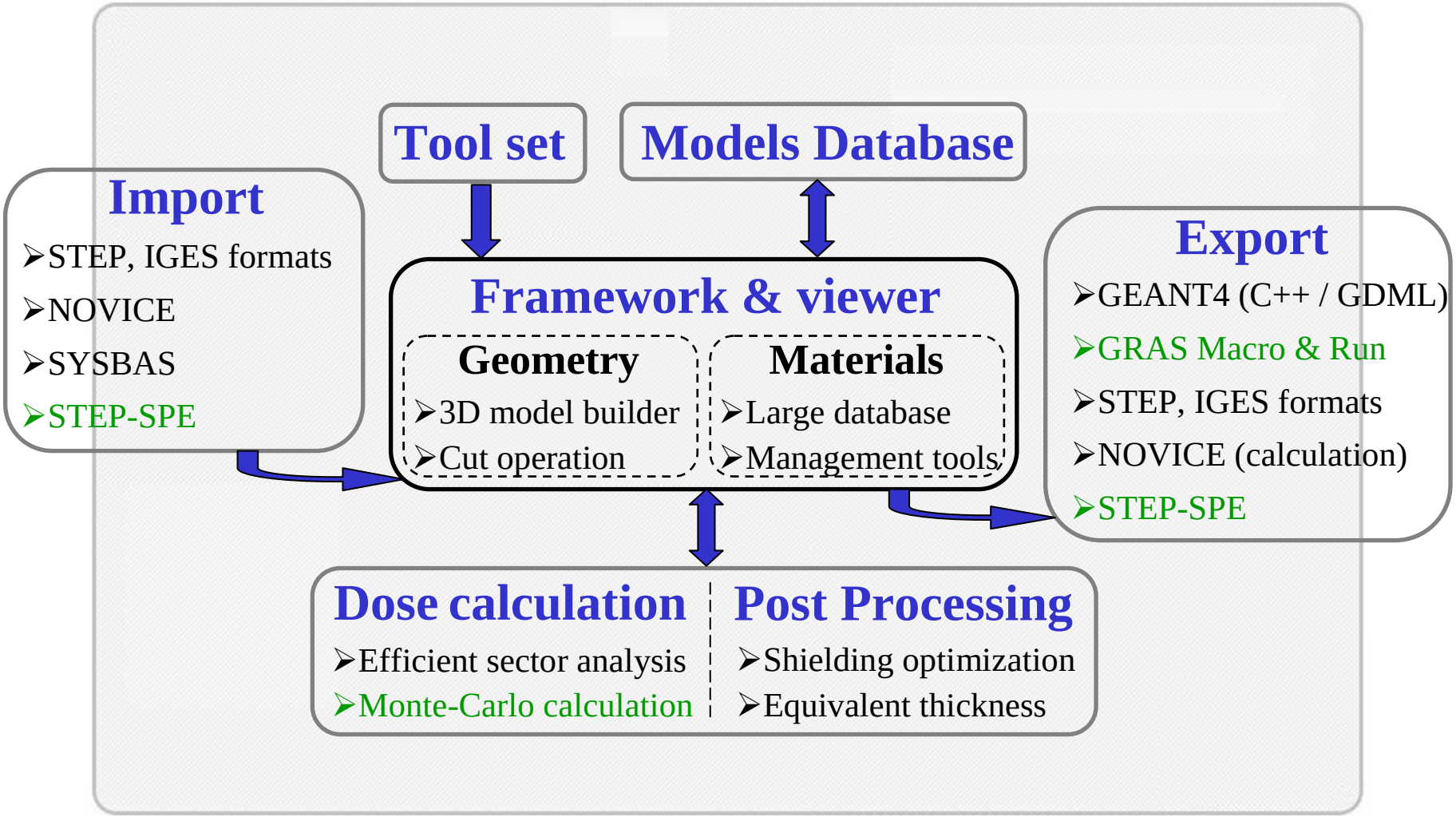
- Radiation CAD (Computer-Aided Design) Tool
  - 3D Geometry modeler, materials, sensitive detectors
  - Design assistance tools.
  - Import 3D models : STEP, IGES

- Radiation Transport Tools
  - Ray-tracing method.
  - Monte-Carlo calculation.
  - Post processing



- CAD Interface for others software
  - NOVICE import/export
  - **GEANT4 export**

Brief description - FASTRAD Application



Geant4 interface - Description

Creation of Geant4 type files based on geometrical models designed with FASTRAD through 3 dialog boxes.

Interface provides several important tools :

- Detailed source definition (using GPS commands)
- 3 analysis modules
- 16 different Physics Lists

Geant4 interface - Geant4 Files

FASTRAD provides ready to compile Geant4 files:

- Header files (.hh)
- Source files (.cc)
- Main file
- Macro files, allowing changes without rebuilding

  Geant4 executable thanks to Geant4 Messengers:
  - Detector type
  - GPS commands (particles type, source modification)
  - Visualisation definition (choice of visual display, creation of visualisation, visualisation's option)

Geant4 interface - Post Processing

3 different types of post processing :

- Received dose by primary particles and secondary electrons and gammas + sampling of deposited energy
- Sampling of LET spectrum for primary particles
- Sampling of incident energy for primary and secondary particles on the detector + details for each hitting particle : # event, particle type, incident energy, deposited energy, momentum and origin volume (only for secondary particles)

GDML Geometry Export

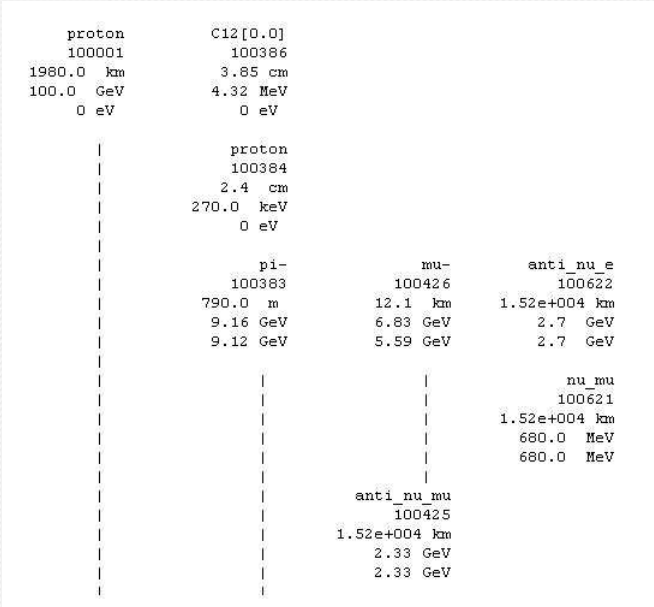
Full geometry translation into GDML format.

- Every shapes are taken into account :
  - Simple solids,
  - Hollowed shapes based on simple solids,
  - Tesselated shapes (STEP/CAD format).
- Compatible with new Geant4 version
- Project funded by ESA under REAT2-MS contract

Particles Tracking Viewer

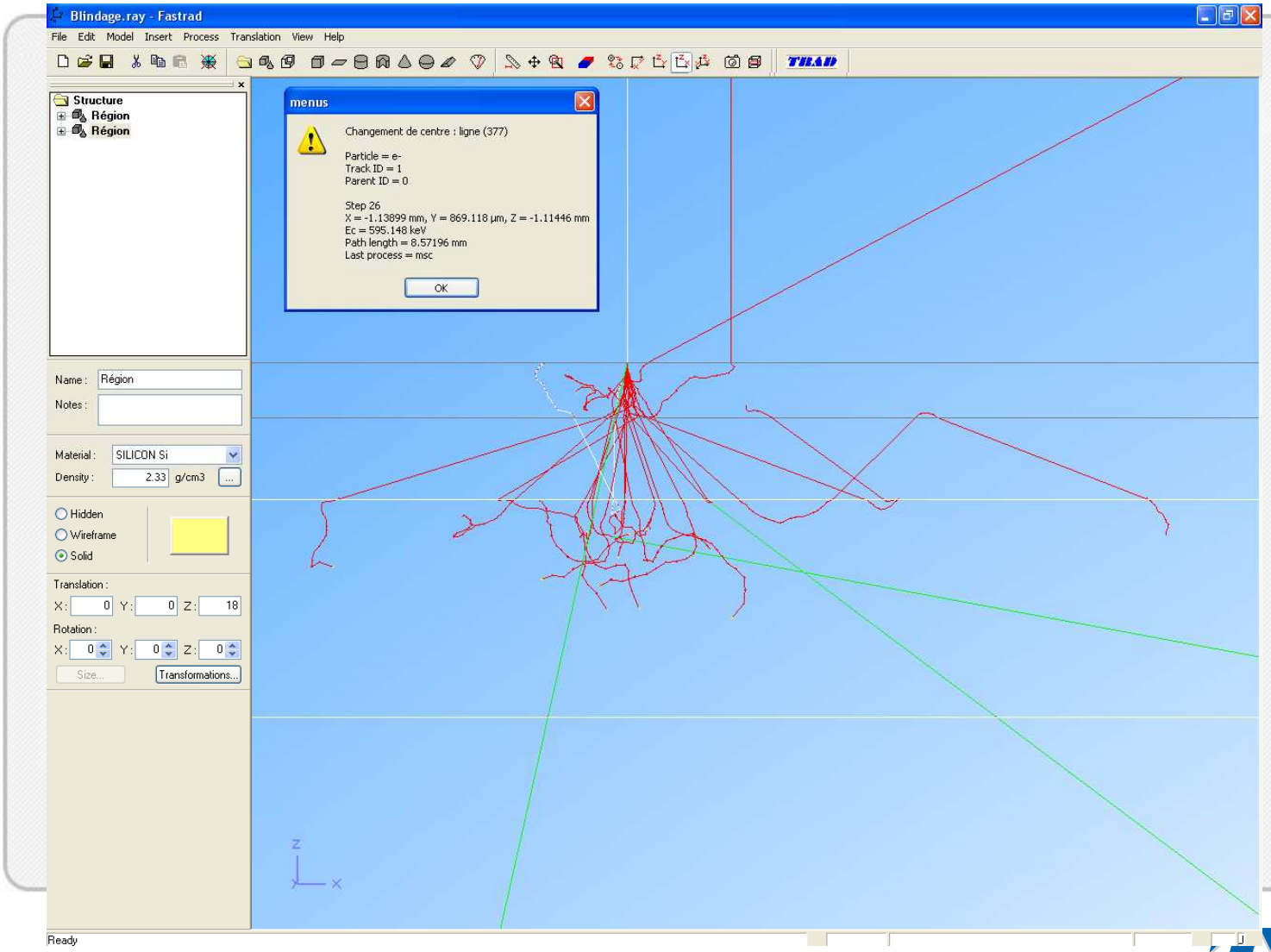
Trajectories Viewer from Geant4 tracking verbose:

- Trajectory visualisation of all particles inside your geometry
- Information on each interaction :
  - kinetic energy
  - Position
  - path length
  - interaction process
  - ID



- Creation of a file describing the particle cascade.

Particles Tracking Viewer - Example



GRAS Interface (Work in progress)

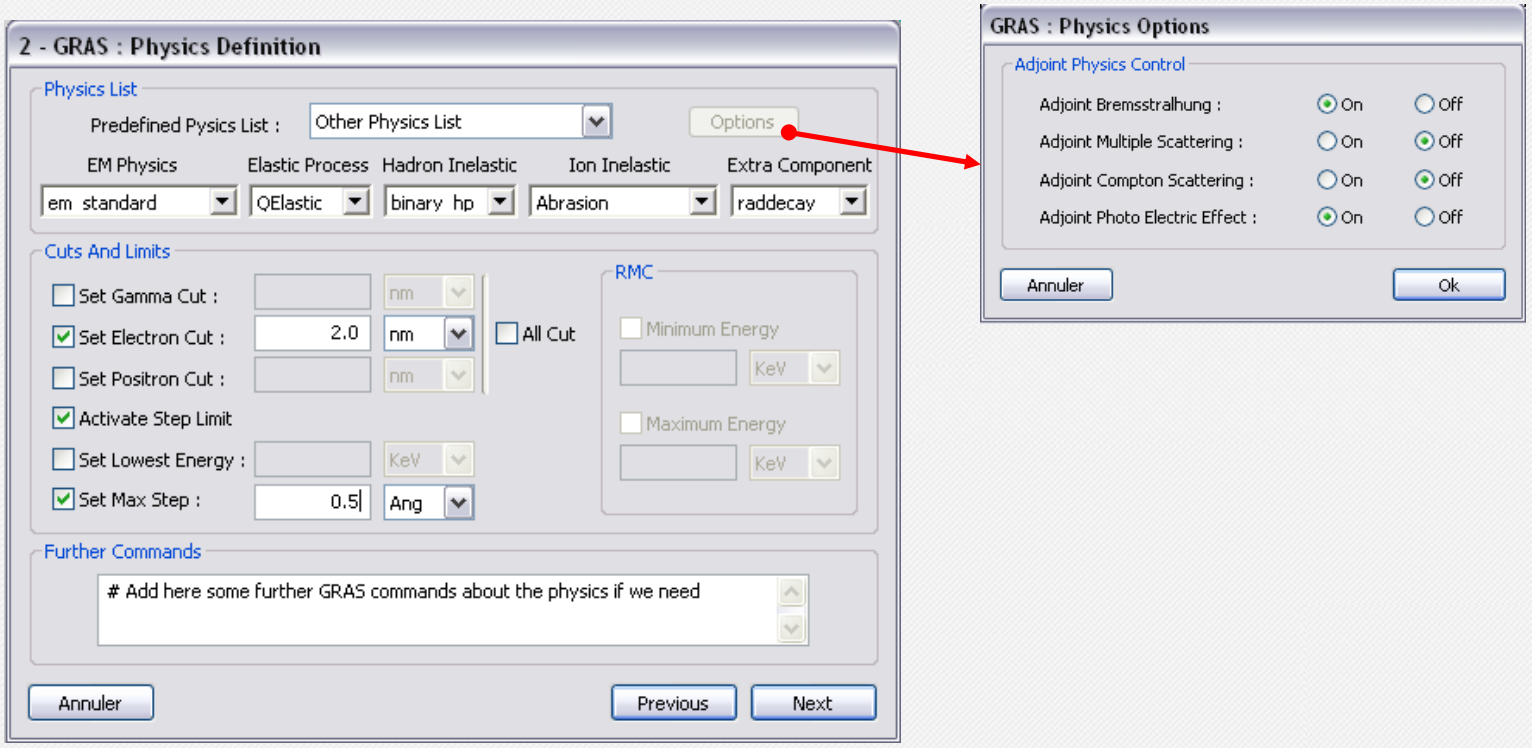
Project funded by ESA under RRMC contract

Sequential setting of a GRAS project : The user has to fill in several forms in order to define step by step the GRAS run.

- Initialisation and geometry input
- The physics lists and cut-off
- The incident particle definition (positional, directional, spectral distributions)
- The required analysis modules with the associated histogram schemes
- The verbosity

GRAS Interface (Work in progress)

View of the physics dialog box



TRAD Geant4-related activities

Geant4 Workshop, Madrid
May 21st, 2009

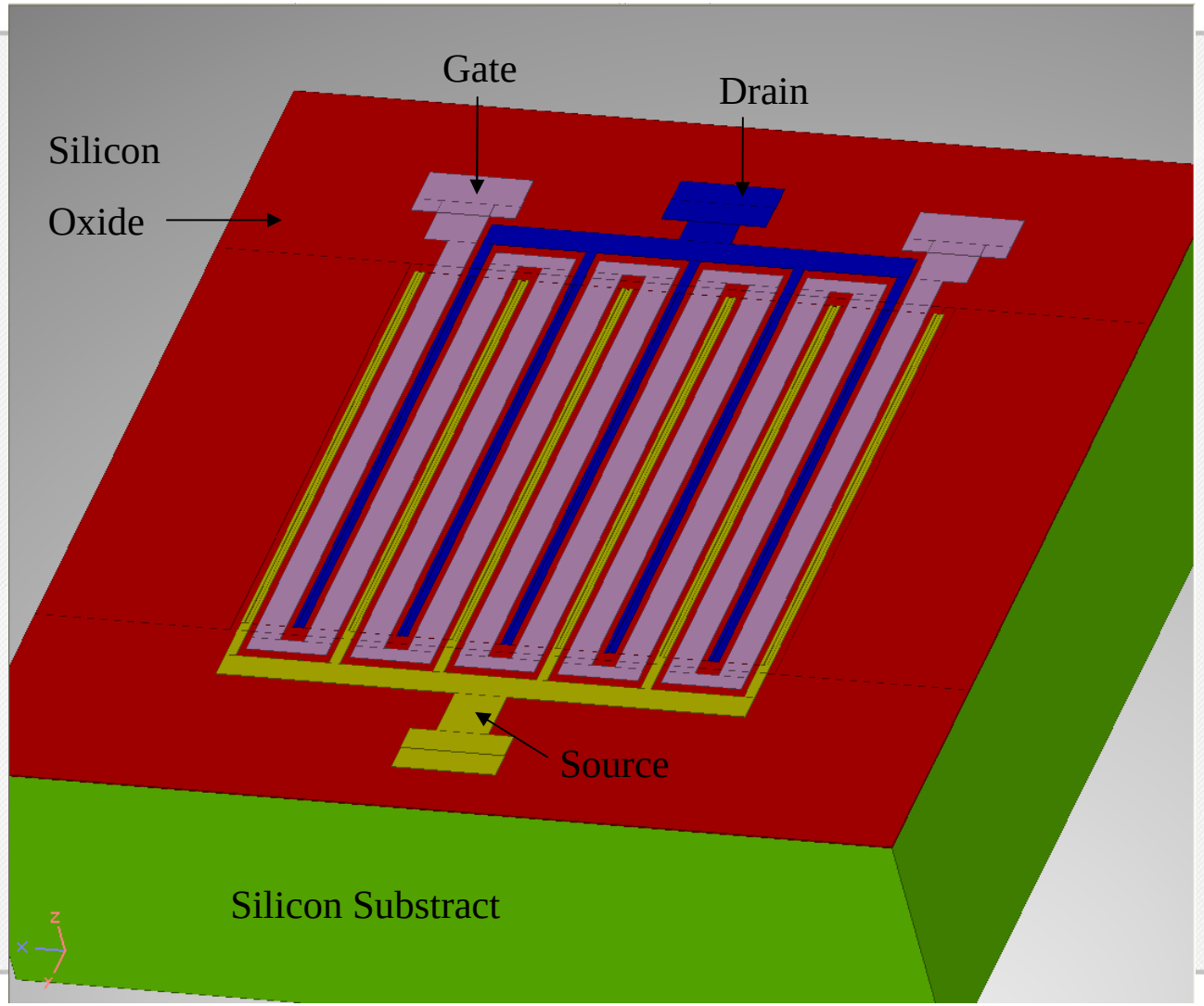
TRAD
Tests & radiations

Radiation effects on a PMOS dosimeter - Description

- Interest : DGA (french military Agency) funded study of microscopic effects inside the silicon and silicon dioxide layers explaining the dosimeter behaviour.
- Creation of a PMOS model with oxide sensitive layers of 0.1µm thickness using FASTRAD.
- Simulation of different particle sources corresponding to existing radiation facilities (Co60, X Rays, electrons beams with energy up to several MeV).

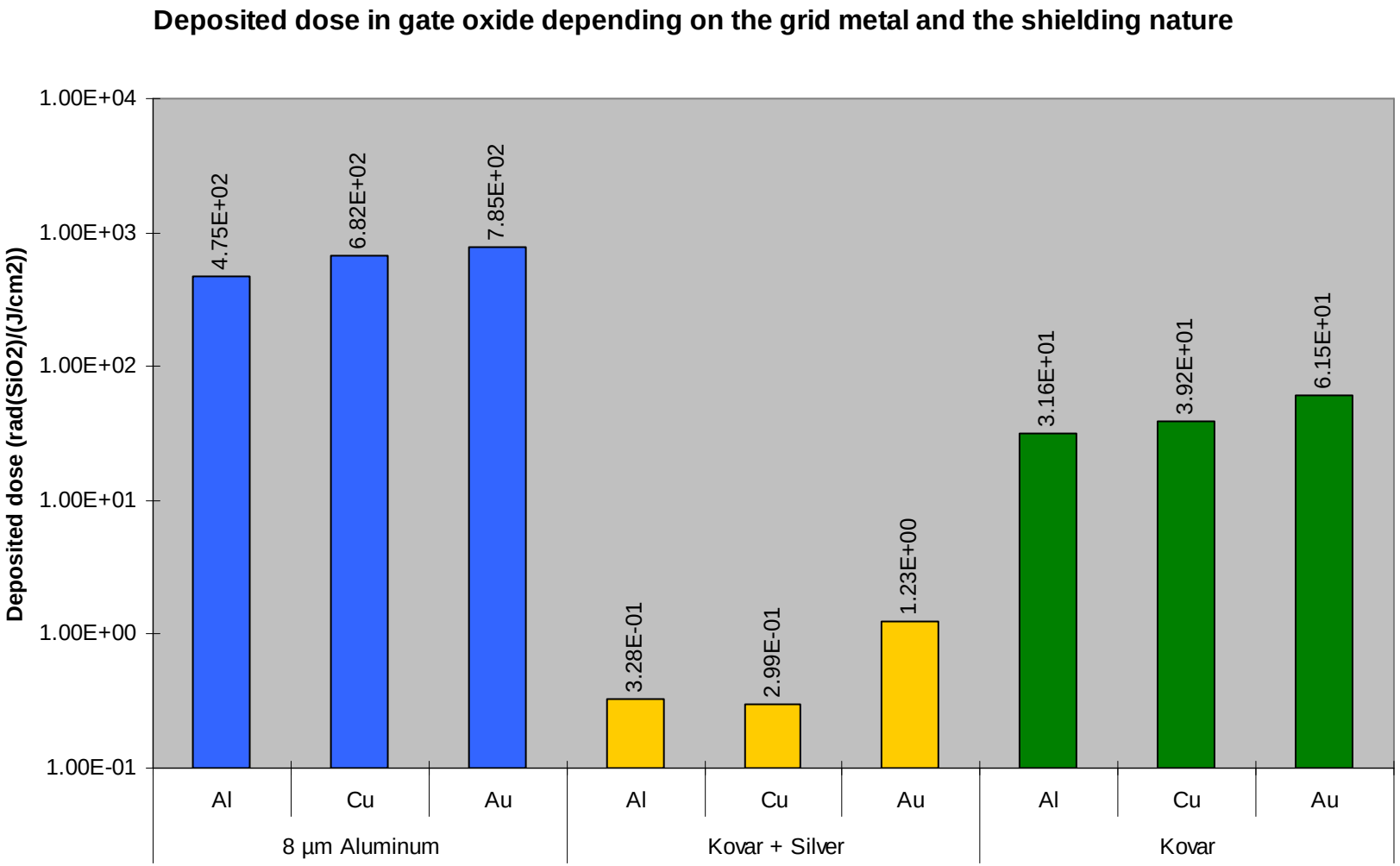
TRAD Tests & radiations

Radiation effects on a PMOS dosimeter - Model



TRAD
Tests & radiations

Radiation effects on a PMOS dosimeter – Results example



TRAD
Tests & radiations

Conclusion

- TRAD provides efficient tools for Geant4 with the FASTRAD application:
  - Geant4 Interface,
  - GDML Geometry Export,
  - Tracking Particle Viewer,
  - GRAS Interface (in progress).
- Current development of a Reverse Monte-Carlo simulation code based on Geant4 to calculate dose deposition.
- Contacts for further information:
  - http://www.trad.fr (company website)
  - Fastrad@trad.fr (software team)
  - Pierre.Pourrouquet@trad.fr (personal e-mail)