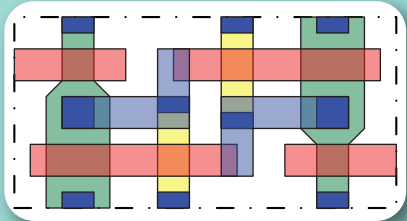
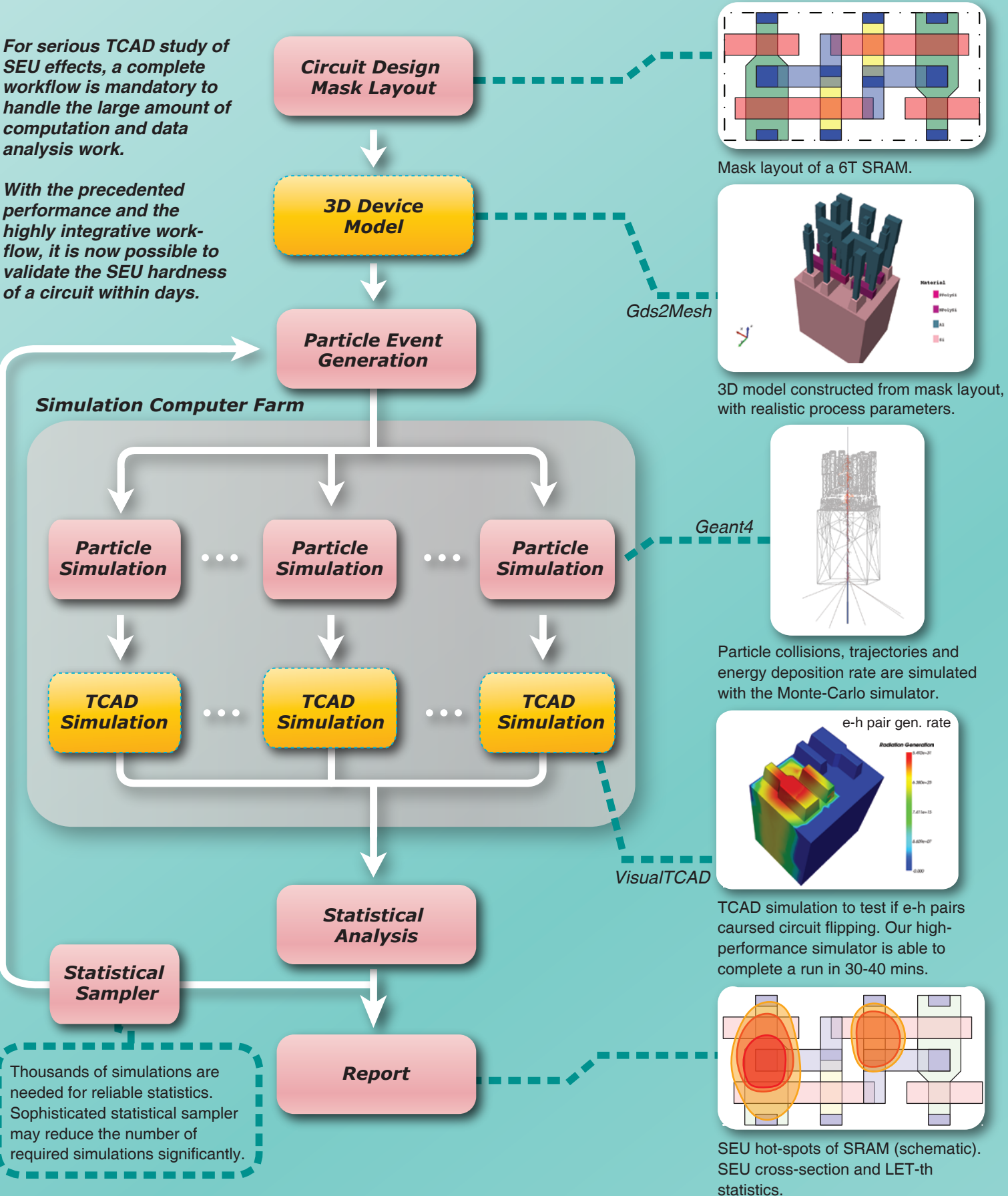


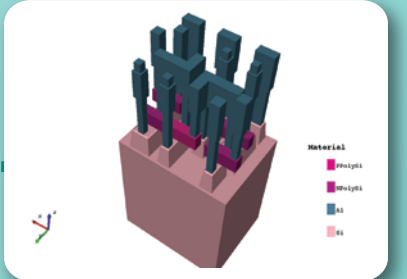
Single Event Upset (SEU) Integrated Workflow for Evaluating SEU Effects

For serious TCAD study of SEU effects, a complete workflow is mandatory to handle the large amount of computation and data analysis work.

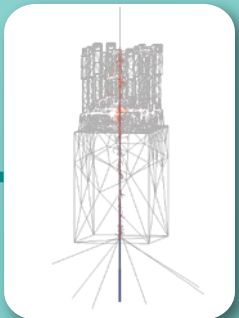
With the precedented performance and the highly integrative workflow, it is now possible to validate the SEU hardness of a circuit within days.



Mask layout of a 6T SRAM.

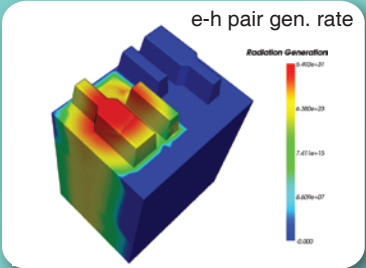


3D model constructed from mask layout, with realistic process parameters.

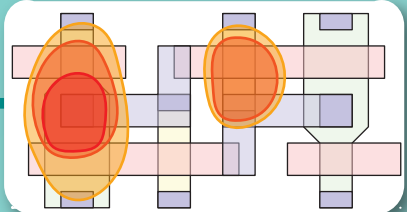


Geant4

Particle collisions, trajectories and energy deposition rate are simulated with the Monte-Carlo simulator.



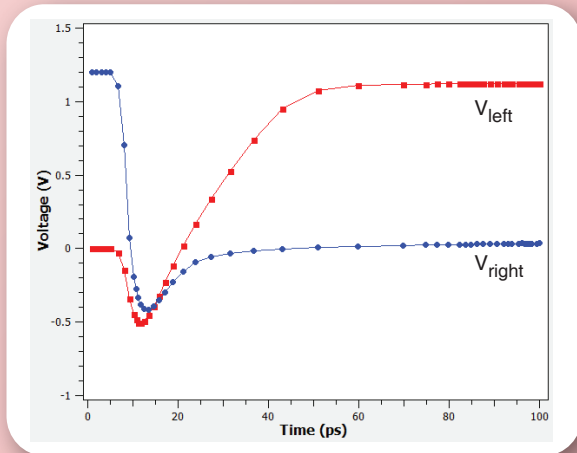
TCAD simulation to test if e-h pairs caused circuit flipping. Our high-performance simulator is able to complete a run in 30-40 mins.



SEU hot-spots of SRAM (schematic). SEU cross-section and LET-th statistics.

Thousands of simulations are needed for reliable statistics. Sophisticated statistical sampler may reduce the number of required simulations significantly.

Flipping of SRAM Cell Under Radiation



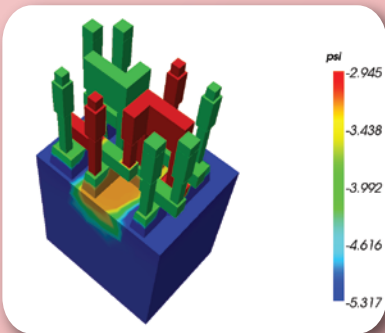
An alpha particle is incidented at the drain junction of the left pull-down nMOSFET, which was in off-state. The particle trajectory and LET data are simulated with Geant4. Carrier generation rate profile in the SRAM cell is calculated in VisualTCAD, and the transient behavior of the circuit is simulated.

The waveforms of the left- and right-nodes are plotted in the chart. Flipping started within 10 ps after the incident of the alpha particle.

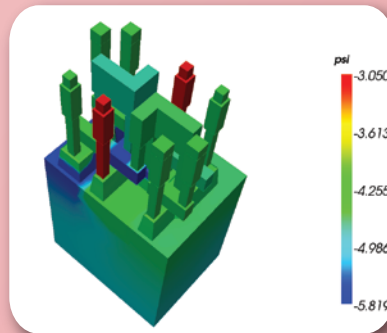
Simulation summary:

- 0.13 μm CMOS 6T SRAM
- 1.6 MeV alpha particle
- simulation time: 99.4 ps
- run time: **38 min** (6 core)

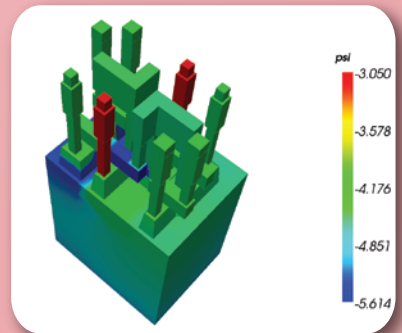
0 ps



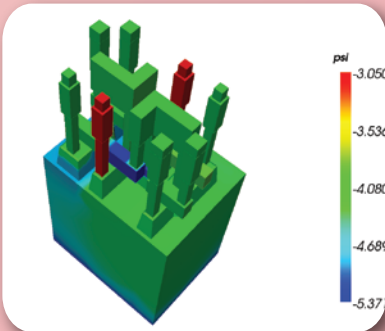
11.1 ps



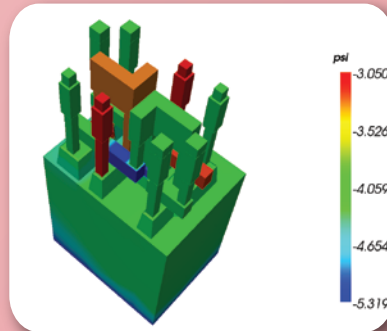
17.1 ps



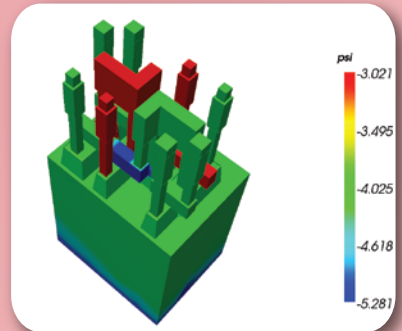
27.3 ps



43.2 ps



99.4 ps



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