

# WG 5.2.1 Meeting Simulation - Phase-I

September 22nd 2022

Marco Leite (USP)

# WG 5.2.1 Simulation Phase-I

Recap: What is Phase-I ?

- 1) Radiation interaction with LGAD and other structures and hits output
  - a) Geant-4
- 2) Electrical field inside LGAD and I(t) output
  - a) TCAD
- 3) Standardize a format in a framework for data exchange between packages**
- 4) Document the steps and results here :

[https://ultra-fast-silicon-detectors.gitlab.io/documentation/ufsd\\_online\\_documentation/](https://ultra-fast-silicon-detectors.gitlab.io/documentation/ufsd_online_documentation/)

- 5) Gitlab repository :

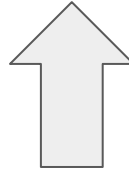
<https://gitlab.com/ultra-fast-silicon-detectors/simulation>

**We will soon move to a new repository with full Gitlab license (TBA)**

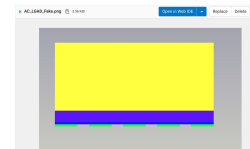
# WG 5.2.1 Simulation Phase-I

Geant-4 simulation :

- 1) Geometry definition (GDML)
- 2) Material definition (GDML)
- 3) Radiation
  - a) High energy hadrons/electrons (GeV)
  - b) Low energy X-Rays (~ keV)
  - c) Low energy protons, ions (few Mev)
- 4) Physical process
- 5) Do we need the Electrical field as well (3c) ?
- 6) Output (hits) format and content
- 7) Framework integration



```
AC-LGAD.gdml v1 X materials.xml
Geometry > AC-LGAD.gdml
1 <?xml version="1.0" encoding="UTF-8" standalone="no" ?>
2
3 <!DOCTYPE gdml [ <!ENTITY materials SYSTEM "materials.xml"> ]>
4 Follow link (ctrl + click)
5 <gdml xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="http://
service-spi.web.cern.ch/service-spi/app/releases/GDML/schema/gdml.xsd">
6
7
8 <!-- ===== -->
9 <!--
10 Prefixes used in variables:
11 p(name) for position
12 v(name) for volumes
13 s(name) for solids
14 m(name) for materials
15
16 Marco Leite
17 leite@usp.br
18 Sept. 2022]
19 -->
20 <!-- ===== -->
21
22 <!-- The content of the materials.xml file will be included here -->
23 &materials;
24 <!-- ===== -->
25 <!-- ===== -->
26
27 <!-- ===== -->
28 <define>
29
30 <!-- Constants -->
31 <constant name="HALFPI" value="pi/2."/>
32 <constant name="PI" value="pi"/>
33 <constant name="TWOPI" value="2.*pi"/>
34 <constant name="wextent" type="length" value="20.0" unit="mm"/>
35 <rotation name="identity" x="0.0000" y="0.0000" z="0.0000" />
36
37 <!-- Variables -->
38 <variable name="i" value="1" />
39 <variable name="num" value="5" />
40
41 <!-- AC-LGAD structure dimensions -->
42 <constant name="det_length" type="length" value="5000" unit="um"/>
43 <constant name="det_thickness" type="length" value="30" unit="um"/>
44 <constant name="det_width" type="length" value="700" unit="um"/>
45 <constant name="gain_thickness" type="length" value="5.0" unit="um"/>
46 <constant name="gain_thickness" type="length" value="5.0" unit="um"/>
```



# WG 5.2.1 Simulation Phase-I

TCAD simulation :

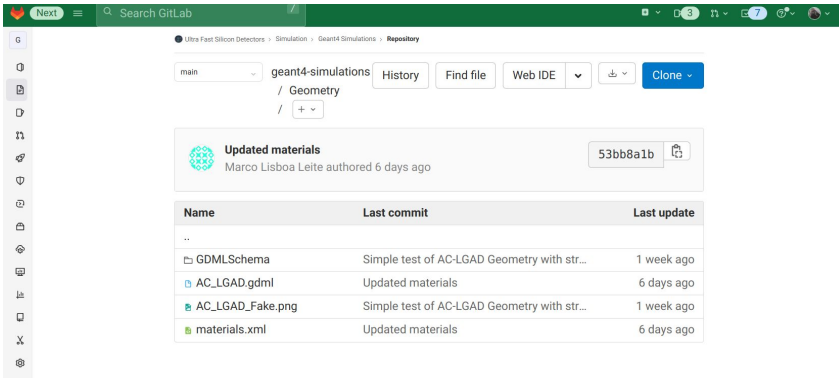
- 1) Geometry definition
- 2) Material definition
- 3) Operating conditions
- 4) Input (hits) from G4
- 5) Output Electrical field for G4
- 6) Output (I(t))
- 7) Framework integration
- 8) First working model sent by U. California group (Taylor Shin)
- 9) We need to be careful sharing this material, there may be sensitive data (doping profile)

The screenshot shows a GitHub repository interface. At the top, the breadcrumb navigation is 'Ultra Fast Silicon Detectors > Simulation > TCAD Simulations'. Below this, the file path is shown as 'main / tcad-simulations / AC-LGAD / Baseline / aclgad\_3d\_UCSC\_Taylor /'. There are buttons for 'History', 'Find file', 'Web IDE', and a 'Clone' button. A commit message is displayed: 'Added simplified doping profile for AC-LGAD from Taylor UCSC' by Marco Lisboa Leite, authored 1 week ago, with commit hash 467ad08b. Below the commit message is a table listing files and their last commit details.

Name	Last commit	Last update
..		
Reference	Added simplified doping profile for A...	1 week ago
.gitignore	Update directory strucutre	2 weeks ago
.project	Update directory strucutre	2 weeks ago
Grant.C	Update directory strucutre	2 weeks ago
Grant.h	Update directory strucutre	2 weeks ago
GrantMod.C	Update directory strucutre	2 weeks ago
GrantMod.h	Update directory strucutre	2 weeks ago
IV_Check.tcl	Update directory strucutre	2 weeks ago
Makefile	Update directory strucutre	2 weeks ago
Massey.C	Update directory strucutre	2 weeks ago
Tran_Check.tcl	Update directory strucutre	2 weeks ago
compile_PMI.sh	Update directory strucutre	2 weeks ago
gcomments.dat	Update directory strucutre	2 weeks ago
gtree.dat	Update directory strucutre	2 weeks ago
modelview_doping_conc.tcl	Update directory strucutre	2 weeks ago
sde_dvs.cmd	Update directory strucutre	2 weeks ago
sde_dvs.prf	Update directory strucutre	2 weeks ago

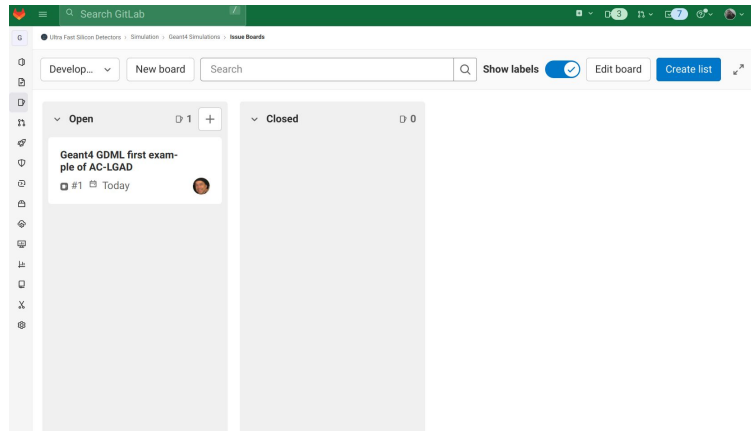
# WG 5.2.1 Simulation Phase-I

## Geant4 Gitlab



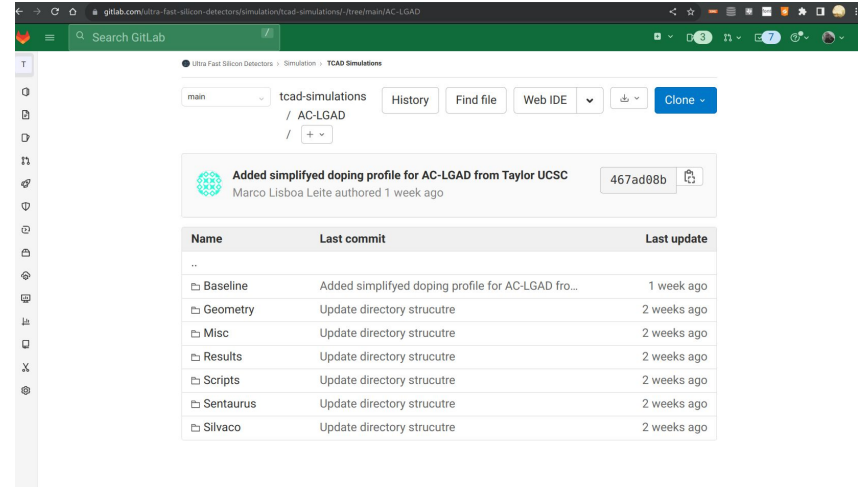
Screenshot of the Geant4 GitLab repository page. The repository is named "geant4-simulations" and is located in the "Ultra Fast Silicon Detectors" project. The current branch is "main". The page shows the repository structure, including a "Geometry" directory. A recent commit by Marco Lisboa Leite is highlighted, with the message "Updated materials" and commit hash "53bb8a1b". Below this, a table lists the files in the repository:

Name	Last commit	Last update
..		
GDMLSchema	Simple test of AC-LGAD Geometry with str...	1 week ago
AC_LGAD.gdml	Updated materials	6 days ago
AC_LGAD_Fake.png	Simple test of AC-LGAD Geometry with str...	1 week ago
materials.xml	Updated materials	6 days ago



Screenshot of the Geant4 GitLab issue board. The board is titled "Issue Board" and shows a list of issues. The "Open" column contains one issue: "Geant4 GDML first example of AC-LGAD" with ID "#1" and a status of "Today". The "Closed" column is currently empty.

## TCAD Gitlab



Screenshot of the TCAD GitLab repository page. The repository is named "tcad-simulations" and is located in the "Ultra Fast Silicon Detectors" project. The current branch is "main". The page shows the repository structure, including an "AC-LGAD" directory. A recent commit by Marco Lisboa Leite is highlighted, with the message "Added simplified doping profile for AC-LGAD from Taylor UCSC" and commit hash "467ad08b". Below this, a table lists the files in the repository:

Name	Last commit	Last update
..		
Baseline	Added simplified doping profile for AC-LGAD fro...	1 week ago
Geometry	Update directory strucutre	2 weeks ago
Misc	Update directory strucutre	2 weeks ago
Results	Update directory strucutre	2 weeks ago
Scripts	Update directory strucutre	2 weeks ago
Sentaurus	Update directory strucutre	2 weeks ago
Silvaco	Update directory strucutre	2 weeks ago

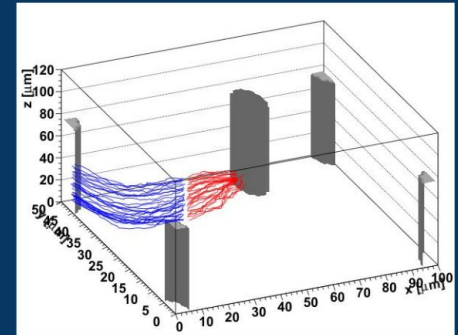
- We will follow the tasks, milestones etc. using Git
- **All communication preferably done creating/answering the directly the issues**

# WG 5.2.1 Simulation Phase-I

- 1) New item : KDetSim (<http://kdetsim.org>)
  - a) Custom package developed by G. Kramberger (ATLAS)
  - b) G. Saito is taking a look on it
  - c) Customizable
  - d) Can add models etc.
- 2) Lower priority

## KDetSim

- Both 3D and 2D
  - Would be useful for 3D pixel detectors
- Basic electronics readout
  - Preamp and RC filter
- Radiation damage taken into account
  - Trapping of drifting charge
- Built-in TCT simulation
- Inclined Particle Tracks



# WG 5.2.1 Simulation Phase-I

## 1) SLAC Stanford (SSRL) Test beam (AC-LGAD) in November-January

From Simone Mazza <simazza@ucsc.edu> ★

Subject **Re: Meeting reminder UCSC USP :Thursday Sep. 22nd @08:30 PST (12:30 BRT)**

9/20/22, 14:1

To Me ☆

Cc Hartmut Sadrozinski <hartmut@ucsc.edu> ★, Abe Seiden <abs@scipp.ucsc.edu> ★ 4 more

Hi Marco,

yes, here they are:

BL 11-3 (high energy): 11/23 -> 11/28 (Goal: rep. rate, high energy X-rays compton, energy resolution, gain suppression)

BL 7-2 (focused): 01/25 -> 01/30 (Goal: rep. rate, energy resolution, gain suppression, AC-LGADs)

Cheers

Simone