Updates on eAST developments

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May 5th, 2021

- eAST (eA Simulation Tool) project is to develop a tool for fast and full simulations built on top of Geant4.
- Requirements:
  - ability to **reuse existing simulation works**
  - ease of **switching detector options** with comparable levels of detail
  - ease of switching between **detailed and coarse** detector descriptions
  - ease of **leveraging new and rapidly evolving**
- Updates:
1. Importing CAD file into detector simulation
   a. Converting CAD file to GDML
   b. Assigning material composition
   c. Vacuum volume
2. Centrally maintained and validated physics list
   a. Baseline physics list
   b. Validation with test beam data
   c. Repository
3. Next steps

- MRADSIM developed by INFN is very promising
  - Developer team is very responsive!
  - Thanks to Wouter and Jan, few issues were identified and reported to the developers. Some of them have already been addressed.
- As a backup solution, a commercial tool is confirmed to work.
- Thanks, Elke and Rolf, for sample STEP files.

- As a preliminary measurement, navigating through tessellated solids is ~5 times slower than simple CSGs
  - With physics interactions, difference should be much smaller.
  - Further study is required with tuning granularity of facets.
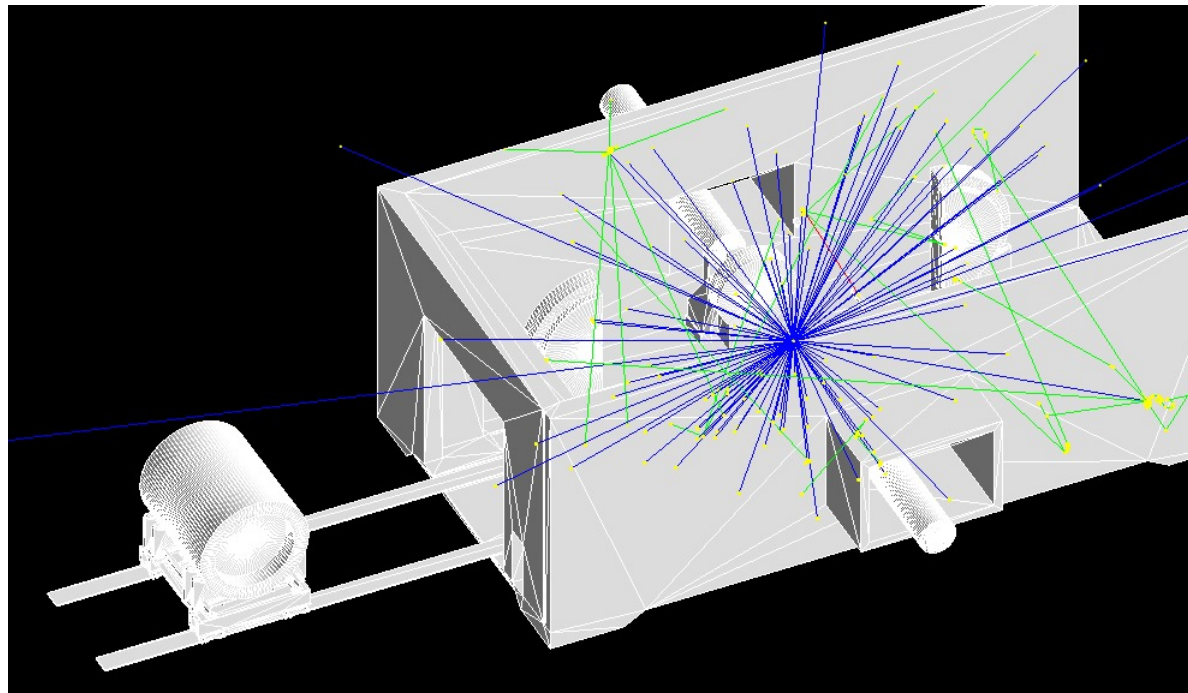
EIC_model.gdml converted by a commercial tool and simulated by Geant4-based application

- We continue validating MRADSIM.
- We are developing a mechanism of mapping volume names to material compositions.
  - With a human-readable table
- Placing vacuum in the beam pipe is a challenge.
  - We need dedicated volume(s) that represent vacuum, either in the tracking world or in the virtual parallel world.
  - Otherwise, at least for the time being, the entire experimental hall will be filled by vacuum.
- We also need to iterate on the level of detail of the CAD geometries.
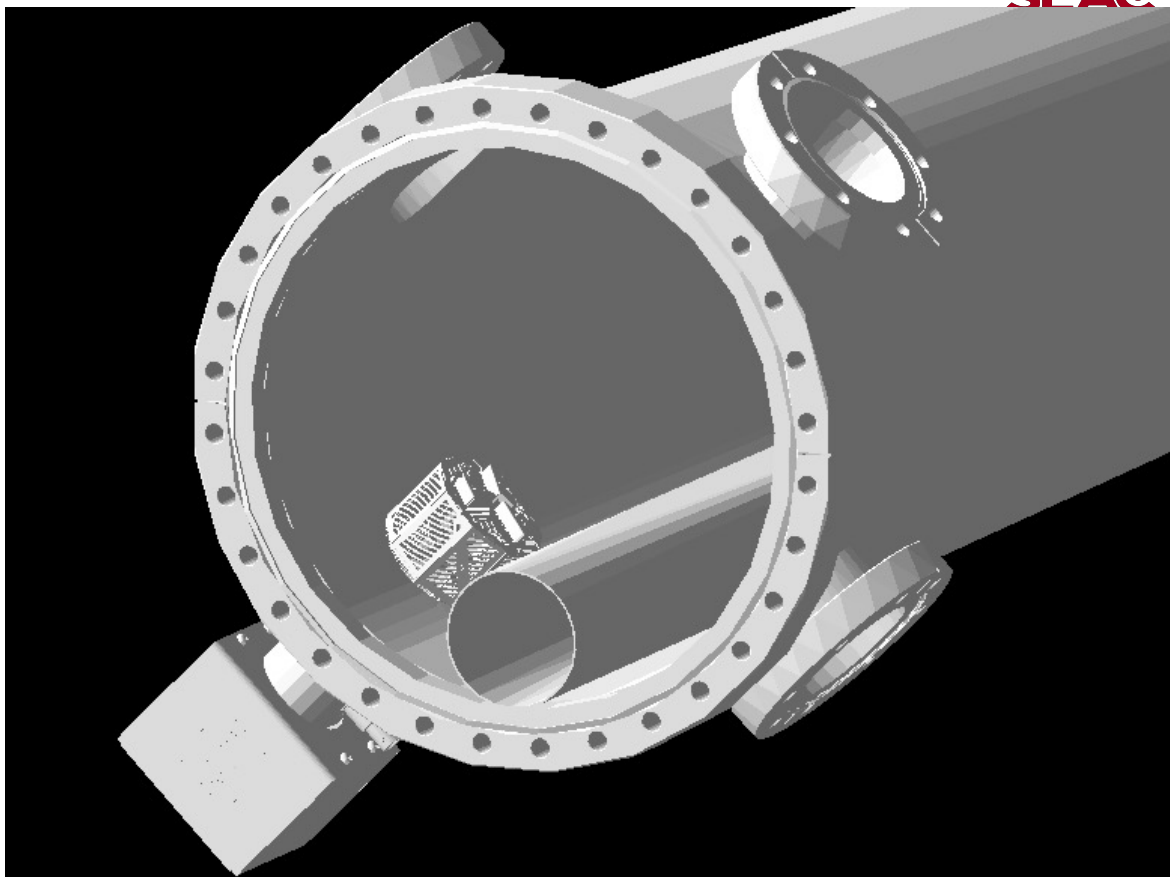
- Baseline physics list will be ready soon
  - It works with Geant4 version 10.7-patch01 (may work with v10.6 as well, but not with earlier version)
    - Do we need support for earlier version(s)?
  - "Open box", i.e. hard-coded. Not a black box.
  - General/basic validation within Geant4 validation suite is under preparation.
  - Maintenance required. Current physics list won't work with Geant4 version 11.
    - Hadronic physics processes will have a major restructuring.

- "Baseline"
  - It can be used for every EIC detector component as a baseline.
  - It needs tuning / optimization / specialization for each detector component.

- Validation is required.
  - We need validation with test beam data.
    - If you have your simulation code with geometry description, share it with us.
    - If you plan to implement your simulation, let's work together.
    - If sensitive test beam data is identified, we will port it to Geant4 benchmarking suite.

- Component-specific customization
  - Higher precision EM physics for vertex detector
  - Optical photon processes for DIRC
  - Tuning of production thresholds
  - Shower parameterization

- Code repository
  - To avoid uncontrolled divergence, all code should be centrally maintained and distributed.
  - Code repository with physics validation results must be set up.
    - Including test beam data / geometry

- Start regular meetings on physics list
  - For all topics related to physics options
  - First meeting in the later half of this month

- To make the plug-and-play capability, eAST will define each detector component as a region.
  - A region is responsible for implementing the geometry in it.
    - May interface to existing simulators or GDML parser
  - A region may have its own
    - physics options (including fast simulation)
    - sensitive detectors
    - stepping actions, etc.
  - Any daughter volumes in a region must not protrude from the region.
    - Sanity check provided.

We need you!
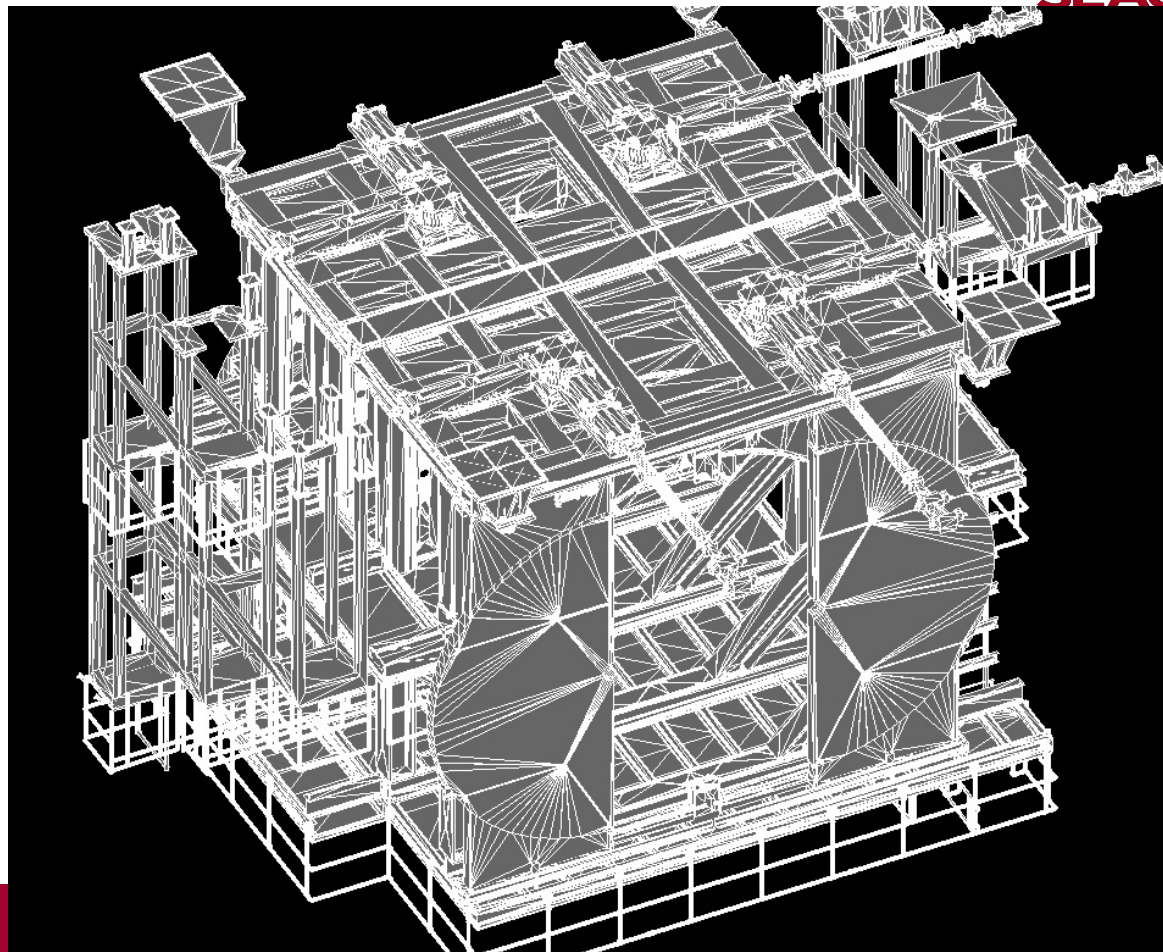
Top priorities

- CAD interface
  - Iteration with CAD engineers for collecting necessary CAD files with reasonable level of detail
  - Develop / benchmark vacuum "volume"
- Physics list
  - Collect test beam data / geometry and validate the common physics list
  - Benchmark physics options / parameters for each detector component
- Region
  - Develop the global detector construction that enables plug-and-play
  - Develop region classes that interface to existing simulators, i.e. *EicRoot*, *Eic-Smear*, *ESCalate* and *Fun4All*, and to CAD/GDML parsers
- Identify liaisons to each detector components
- Data flow (from event generators, to reconstructions) needs coordination

Contact Torre, Markus, Andrea and/or me if you wish to join.