MICE Geometry Status

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Experimental Particle Physics

25 October, 2014
MICE CM40, Rome

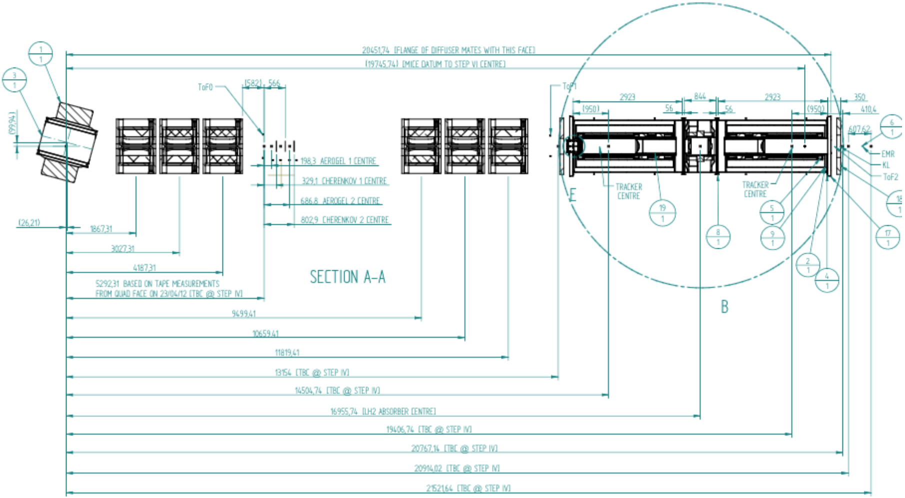
Purpose for CDB Implementation of Geometry

- Need an accurate and reproducible record of the beam line geometry.
- Need to reproduce the geometry in software for the purpose of prediction and data reconstruction..
  - Limited by the knowledge available to the programmer.
  - Loss of corporate knowledge makes later analysis difficult.
- Implementing system to extract geometry from engineering drawing
  - As developed by Matthew Littlefield
  - Geometry is written to Calibration Data Base.
  - Geometry indexed by id number, by time, or by run.

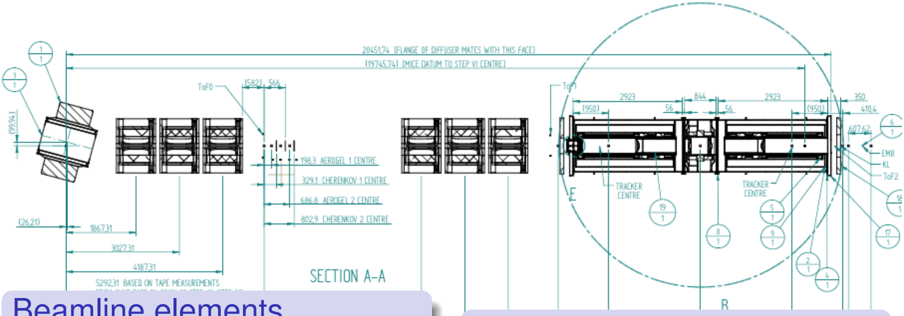
Currently involves

Stephania Ricciardi	Validation
Ryan Bayes	Software
Jason Tarrant	CAD Generation

CAD Geometry



CAD Geometry



Beamline elements

- Positions provided from surveys
- Magnet currents taken from CDB (by run download)
- Default fields provided for a 6π 200 MeV/c beam.

Detectors

- Positions of detectors indicated by "dummy" volumes in CAD.
- Volumes replaced by detector description in processing.

Status of Geometry Model

Detectors in CDB

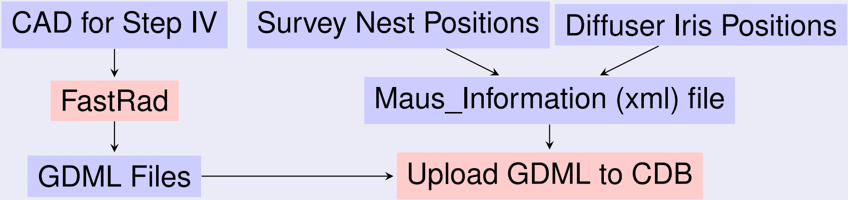
- TOF shielding removed in favour of PRY (June).
- KL description updated (June)
- Ckov completely revised (September)
- Tracker in their correct positions
- EMR model confirmed and committed to CDB
- LiH and LH2 absorbers committed

Fields Definition

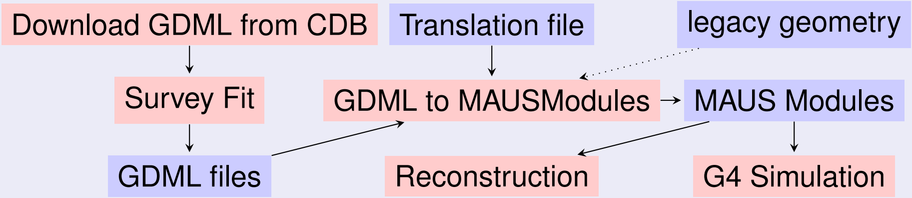
- Dipole and solenoid field maps use legacy maps
- Default currents correspond to a $6\pi200$ MeV beam.
- Positions based on CAD technical diagrams.
- Beam line settings to be drawn from CDB when downloaded in "run" mode.
- Cooling channel settings drawn from CDB in future release.

Software Workflow Updated

File Preparation Workflow



User Workflow



File Downloaded from CDB

GDML Files

- Beam line elements (CAD)
- Cooling Channel elements (CAD)
- Detector Survey positions (CAD)
- Detector descriptions (G4Solids)

Beam line Info

- run number
- Diffuser setting (int from binary)
- Conventional magnet currents
- Conventional magnet polarization

MAUS Information

- Specification of fields
  - positions
  - rotations
  - dimesions
  - default current/scaling
- Detector specification
  - identity of survey points.
  - position of survey points in detector coords.

Cooling Channel Info

- Super-conducting magnet current densities
- Super-conducting magnet polarities.

Running Simulations with CAD Geometry

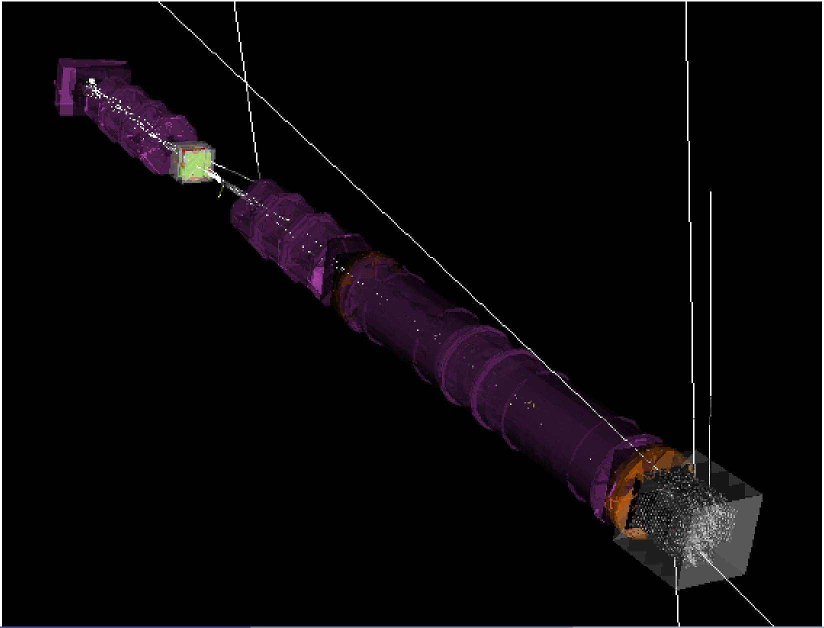
Steps For Simulation with MAUS

1. Select (by run or ID) and download geometry to {download_directory}.
2. Run simulation script with "–simulation_geometry_file" option
   - e.g. python bin/simulate_mice.py –simulation_geometry_file {download_directory}/ParentGeometryFile.dat

Full simulations completed with this geometry

- Single particle simulations with pencil beam for validation.
- SciFi tracker simulations for solenoid field validation.
- Test with G4Beamline interface for transport validation.

Visualization of Latest CDB Geometry



Adding New Geometries

- Geometry release procedure has been revised

http://micewww.pp.rl.ac.uk/projects/maus/wiki/Geometry_release_procedure

	Process	Responsible
1	New geometry is released as a set of gdml files	JT
2	New geometry is uploaded to preprod configuration database	RB (or SR)
2.1	Run a test job on the test server	RB (or SR)
2.2	Upload geometry validation plots to wiki page	RB (or SR)
3	Assuming tests pass, upload geometry to the production CDB	RB (or SR)

Changes to Model

Corrections and Amendments

- Correct implementation of closed diffuser irises as disks
- Helium windows added by hand

Separation of Model into modules

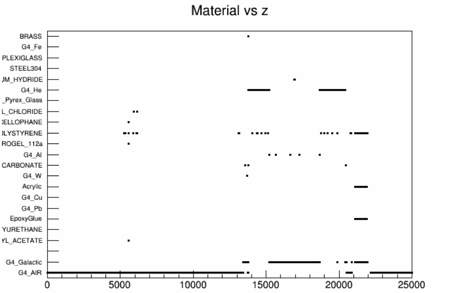
- Motivated by requirement of vacuum volume in cooling channel.
- Propose six modules
  - Quad triplets 456 and 789
  - Dipole
  - Upstream spectrometer solenoid
  - AFC
  - Downstream spectrometer solenoid

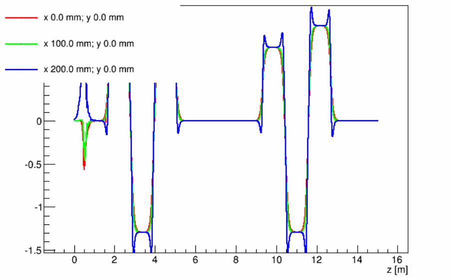
Addition of cooling channel information

- Solenoid current densities to be read into CDB.
  - APIs not yet available to MAUS by default.
  - Still finalizing format details.

Material and Field Validations

- Chris Rogers has provided code to evaluate material in channel.
- Identified a number of problems in the model
  - AFC filled with air.
  - Missing vacuum window at downstream end of DS Solenoid.
  - Reversed helium windows.
  - Incorrect material for diffuser vacuum windows.
  - Quad field positions did not match the material position.
- Issues corrected and latest geometry shown.





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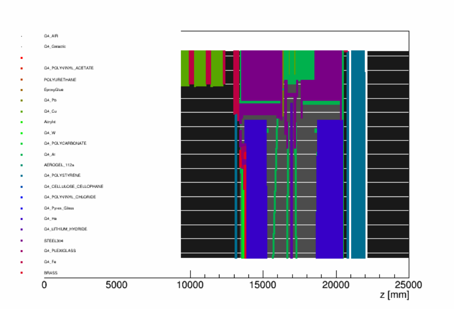
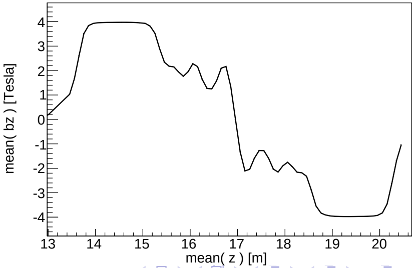
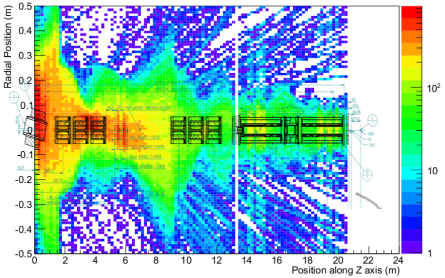
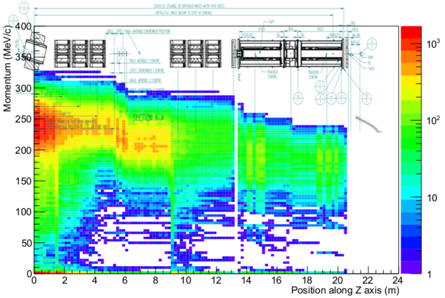




Tracking Through Beamline





- Simulate $6\pi200$ MeV/c beam through channel using MAUS default beam.
  - Started a 258 MeV beam upstream of D2
  - Inverse diffuser settings (1001 instead of 0110).
  - Lithium Hydride absorber.
  - Used CDB geometry 43
- Beam line schematic superimposed for z-scale.

Upcoming Changes to Geometry Implementation

Use of GDML parser

- Use GDML format directly for definition of geometry.
- Parser seems stop be optimized for the use of Tessellated solids.
- Dramatically decreases loading time

Representative simulation times

Legacy Geometry	8 min 02 s
Debug Geometry	9 min 27 s
CAD Geometry after MM conv.	28 min 27 s
CAD Geometry with GDML interface	7 min 52 s

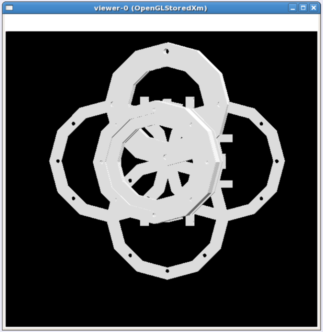
A Reminder

- Important for the acceleration of simulation.
- Lag in load times due to Tessellated solid placement.
- Reduction needed for online simulation.

GDMLParser Status

- All G4Detectors (except Ckov) written in GDML.
- Identified subtle overlaps in CAD GDML
  - Small overlaps in objects lead to offset in positions
  - Solved in recent CAD re-generation by adding "gaps"
- GDML accessed through use of ParentGeometryFile
  - Should not "look" different to the user.

Diffuser Inner Rings



Remaining requirements

- Update to run in parallel to existing implementation
- Ensure that all detectors produce hits.
- Correct download scripts to manipulate the GDML.

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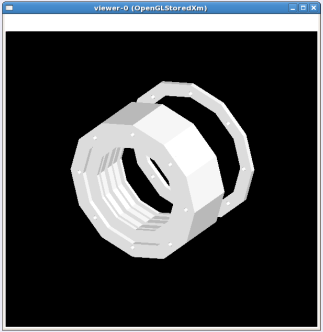

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Conclusions

Step IV CDB Geometry is "Complete"

- CAD geometry definition static since May.
- Last detector added (Ckov) in September.
- Vacuum and helium windows are in place.
- Material and field validations have been conducted and the results have been reacted upon.
- Implementation is suitable for batch submission.

Measures for Fast Processing

- Reduced "debug" geometry available.
  - Only contains detectors.
  - No tessellated solids.
- Implementing a GDML parser.
  - Load time comparable to legacy geometry.
  - Make full use of CAD geometry.
  - Technical detail prevented completion of evaluation.