Geometry Status

An As Built Geometry for Step IV

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Contents

Introduction

Requirements for the geometry implementation

- Needed to check and validate the detector models.
- Need to generate the CAD models with the correct survey information.
- Need to validate the material budget in the beam-line.

Use case status

- Must be downloaded by the user from CDB
- Can be downloaded by run, as the current geometry (broken), or from a geometry ID.
- Download by run also downloads corresponding beamline currents
  - ▸ No cooling channel currents yet — default (200 MeV/c beam) used.
- Beamline and Cooling Channel currents can be downloaded in conjunction with geometry ID download
  - ▸ Beamline information can be downloaded by run or by CDB tag.
  - ▸ Cooling channel can be downloaded by tag (not yet stored by run).
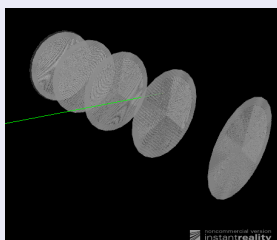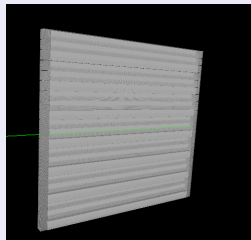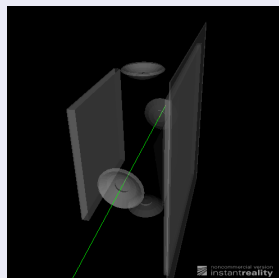
CAD Model
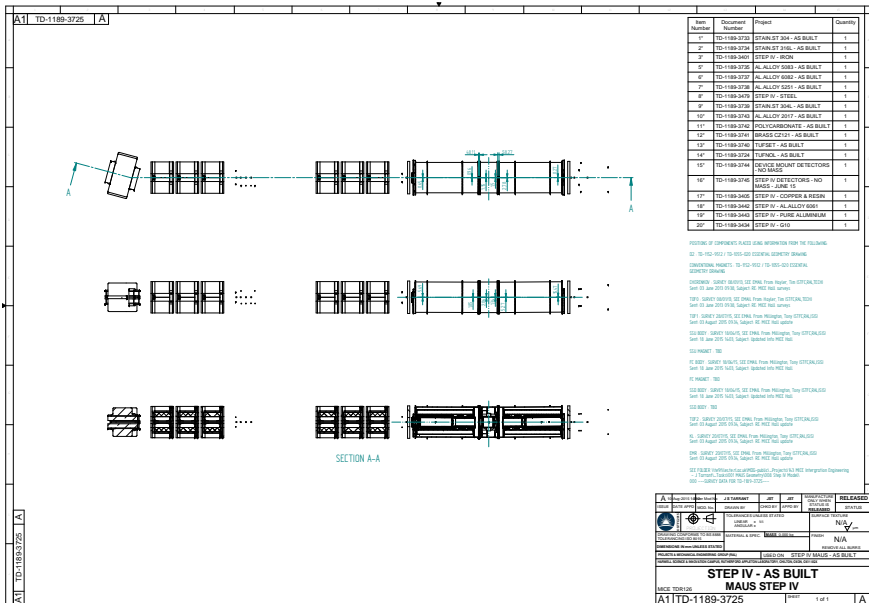
Detector Geometries from the GDML Files

TOF1
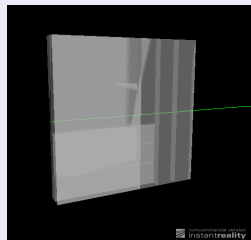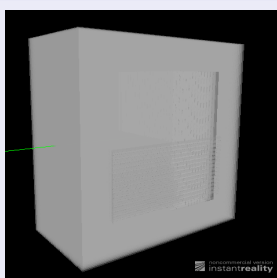

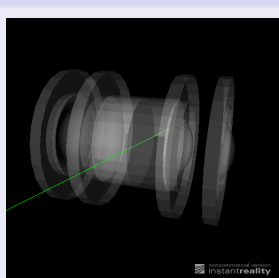
Tracker1

KL

Ckov1

EMR

LH2

Recent(ish) Changes to Detector Models

No Changes

- LiH Disk absorber

Changes to Volumes

- Trackers (US and DS)
  - ▸ metrology reapplied
- LH2 absorber
  - ▸ interior window flipped
- KL — Added stepping limits
- TOF0 — Added external world volume
- EMR — Added external world volume

Added volumes

- Helium volumes.
  - ▸ Fill empty space between tracker and diffuser.
  - ▸ Fill empty space between tracker and He windows.

Detector Changes

- TOF1 and TOF2
  - ▸ Removed shielding
  - ▸ Reduced size of volume
- Ckov 1 and Ckov 2
  - ▸ Change the sensitive detector to the aerogel.

Detector Positioning

- Positions of survey nests provided.
- Can be used to determine position of detectors in hall coordinate system.
- Positions of the nests relative to detector centres
  - Mostly accessible from surveys.

Survey Nests for TOF2, KL, and EMR

TOF2 - 1
TOF2 - 2
TOF2 - 3
TOF2 - 4
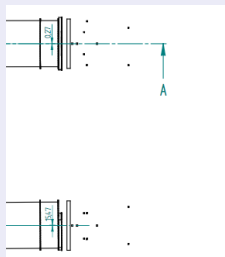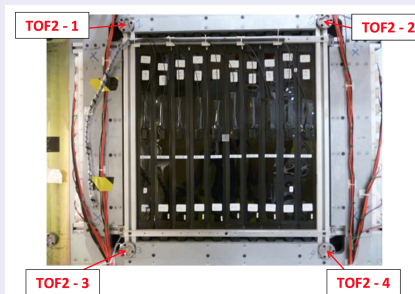
TOF0 and Ckov Nests

Positions of Survey Nests Relative to Detectors

- Information requested but not supplied (Except for EMR)
- Found by
  1. Assuming the nests are co-planer and describe a rectangle.
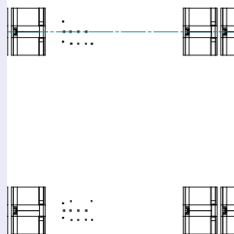 2. Calculating the location of the vertices from halving the distance between the survey nests.

Example: TOF1

	x(mm)	y(mm)	z(mm)	x_{Det}(mm)	y_{Det}(mm)
X5	184.90	-241.29	12953.10	191.02	-242.39
X6	186.05	243.48	12955.19	191.24	242.39
X7	-196.42	241.31	12955.11	-191.24	241.62
X8	-197.14	-241.92	12953.00	-191.02	-241.62
Averages	-5.65	0.395	12954.1		

- Positions and rotations of detectors found with a χ^2 minimization of the points in the detector coordinates to the points in hall coordinates.
- $\vec{x}_{survey} = R(\theta_x)R(\theta_y)R(\theta_z)\vec{x}_{det} + \vec{x}_{hall}$

Fits for Positions and Rotations of Detectors

- Fits conducted assuming a tolerance and base uncertainty of 50 mm.
- Output uncertainty is too large — scale by $\sqrt{\chi^2/ndf}$.

Detector	x (mm)	y (mm)	z (mm)	χ^2/ndf
TOF0	3.0±0.1	2.9±0.1	5285.6±0.1	4.4×10^{-5}/6
TOF1	-5.6±0.4	-0.4±0.4	12929.4±0.4	0.00044 / 6
TOF2	13.92±0.04	-9.40±0.04	21152.30 ±0.04	5.8×10^{-6}/6
KL	17.0±2.6	-11.9±2.6	21234.6±2.6	0.022 / 6
Ckov 1	-0.0±0.4	0.0±0.6	5617.1±1.4	0.000128 / 3
Ckov 2	0.7 ± 2.3	5.0±2.6	5994.6±6.9	0.00238 / 3
EMR	-84.3±0.2	5.6±0.2	21962.4±0.2	7.77×10^{-5} / 6
Detector	θ_x (mrad)	θ_y (mrad)	θ_z (mrad)	χ^2/ndf
TOF0	-6.0±0.5	-5.2±0.4	-3.7±0.3	4.4×10^{-5}/6
TOF1	5.7±1.5	0.0±1.9	-0.3±1.2	0.00044 / 6
TOF2	-2.1±0.1	-6.7±0.1	0.3±0.1	5.8×10^{-6}/6
KL	0.0±6.7	-7.9±3.9	8.6 ±3.4	0.022 / 6
Ckov 1	1.3±1.1	7.6 ± 3.8	-2.2±1.4	0.000128 / 3
Ckov 2	-1.0±0.5	7.0±18.1	-1.0±5.7	0.00238 / 3
EMR	2.2±0.3	2.5±0.3	-0.0±0.2	7.77×10^{-5} / 6

Corrections to the Channel Positions and Orientations

- Flanges at upstream and downstream ends of both solenoids and the focus coil was surveyed.

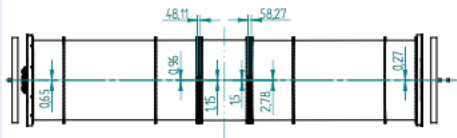- Orientation and positions of solenoids calculable from these data.

Rotations of Magnets

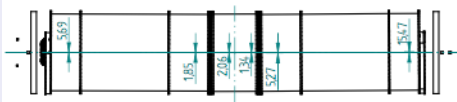| Magnet	θ_x	θ_y
US solenoid	-0.15°	0.03°
Focus Coil	0.05°	-0.02°
DS solenoid	0.41°	0.06°

- Order of magnitude greater than field alignment. [a]

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[a] https://indico.cern.ch/event/
374187/session/6/contribution/29/
attachments/745674/1022924/
Mapping-CM42s.pdf
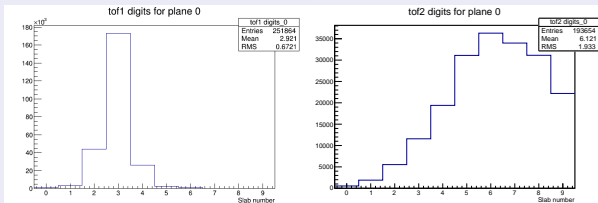
X-Z view of MICE channel
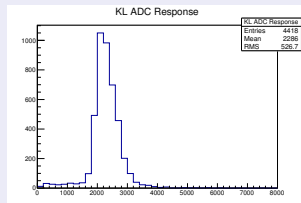

Y-Z view of MICE channel

- Positions of magnetic fields adjusted to match.

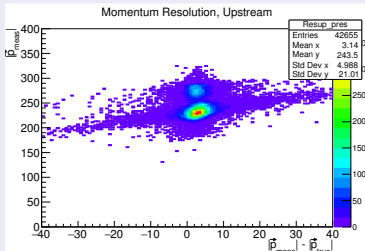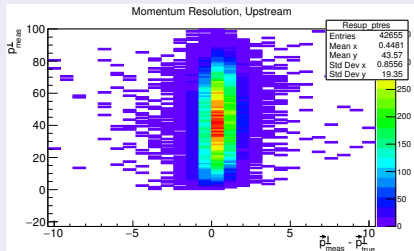# Reconstructed 200 MeV/c μ^+ MC with CDB Geometry

TOF Reconstruction

KL Reconstruction

Tracker Reconstruction

- Problem with the EMRSD identified recently — fix in progress

Current Status

- Corrections have been made to the GDML models of the Ckovs, EMR, KL, and the TOFs.
- Still need to produce EMR sensitive detectors (in progress).
- Positions of detectors and SC magnet models have been adjusted.
- Two official geometries have been uploaded.
  - ID 71: TOF, EMR, and KL positions valid from 21 June
  - ID 72: TOF, EMR, and KL positions valid from 13 July
- Four preliminary geometries (no survey data) also exist
  - ID 73: LH2 Vessel filled
  - ID 74: LiH disk absorber in place.
- Geometry developed from model provided September 2014.
- Detector surveys taken from model provided 13 August 2015.