Physics Block Simulations

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University of Glasgow
Experimental Particle Physics

MICE

Summary of Physics Challenge

Purpose of Exercise

- Evaluate step IV beam line settings.
- Test the scope of potential physics results.
- Prepare analysis in advance of data collection.
- Ensure that machinery for batch simulation exists.

Course of exercise

1. Define settings for simulations.
2. Ensure machinery for simulation is prepared.
   - MAUS
   - CDB
3. Run simulations locally — Ensure settings and software are valid.
4. Run simulations on the grid — Ensure production simulation works.
5. Produce "publication ready" plots from simulation.

Channel Settings

- Evaluate transport through absorber at various momenta and initial emittance

3π 140 MeV/c	6π 140 MeV/c	10π 140 MeV/c
3π 200 MeV/c	6π 200 MeV/c	10π 200 MeV/c
3π 240 MeV/c	6π 240 MeV/c	10π 240 MeV/c

- Beam line settings defined from M0 spreadsheet.
- Used the LiH absorber for simulations so far.
- Diffuser and solenoid settings provided by VB

- G4Beamline simulation of 6π200 MeV settings have been generated by JN
- Further simulations to be generated based on physics priority
  - Do we want to study multiple scattering or emittance or some combination?

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Simulation Machinery

MAUS

- Assumed version 0.9.1 as a baseline
- Needed to add functionality for the geometry
  - Air is the default material.
  - Ability to define interior modules to allow for vacuum volume.
- Adjustments have been made to the tracker algorithm.
- Changes made to allow material validation.

Configuration Database

- Settings for the simulation be maintained here including
  - Beam line currents.
  - Solenoid currents.
  - Diffuser settings.
  - Pointers to G4Beamline interface files.
- Geometric description of geometry also contained in CDB.

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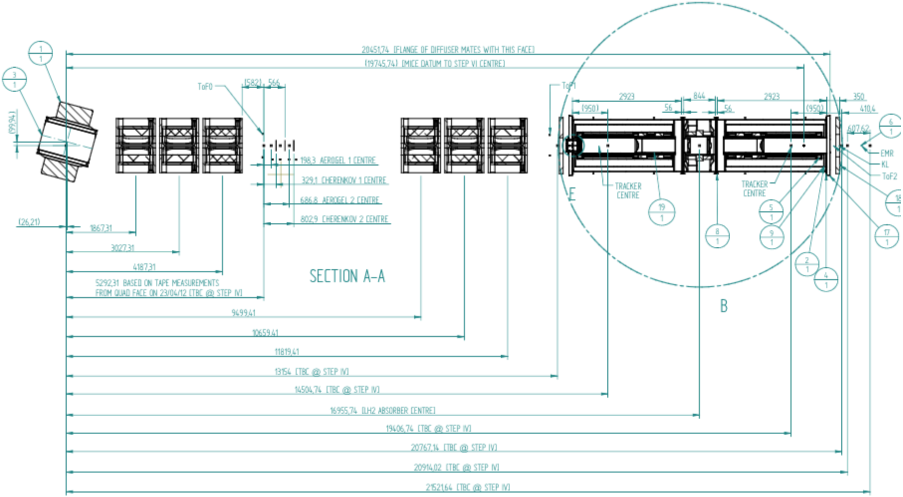
- Implementation of Cooling Channel table still in progress.

Geometry Used in Simulations



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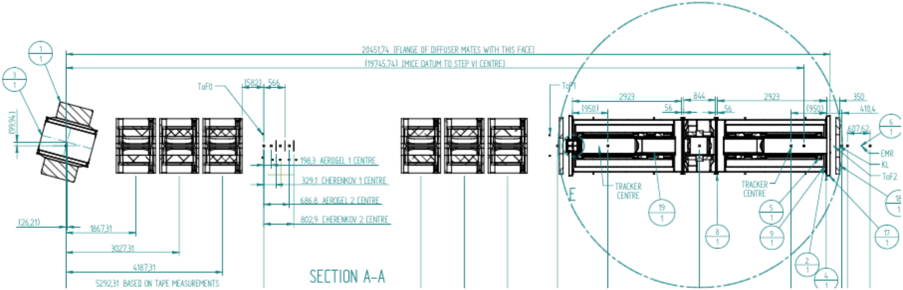
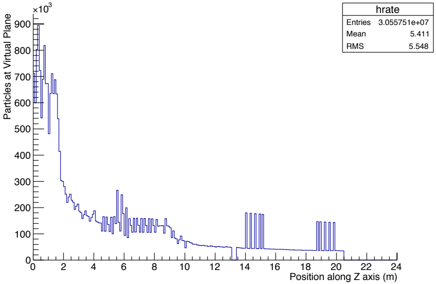


- Geometry derived from Jason Tarrant's CAD model.
- Origin at D2.
- Absorber at z=16955.74 mm.
- Geometry has been vetted — see Sunday talk by Chris Rogers.

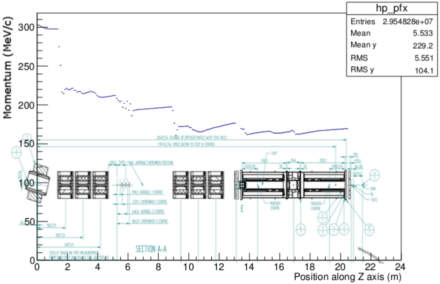
Local Simulations

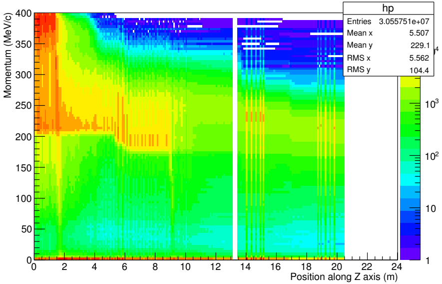
- Ran $6\pi200$ simulations on the Glasgow batch system
  - Runs sourced from 789 interface files
  - More files available — more nursing required.
  - 382 particles for each interface files at Geneva 1.
  - 35000 particles available at the end of the channel.
- Currently available at
  http://ppes8.physics.gla.ac.uk/~rbayes/MICE_6pi200_1/

- Beam line, solenoid, and diffuser settings implemented by hand.
- Used CDB geometry ID 44.



Momentum Through Channel





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- "Increase" of momentum due to low momentum particles stopping.
- M0 beam nearly provides advertised momentum at absorber.

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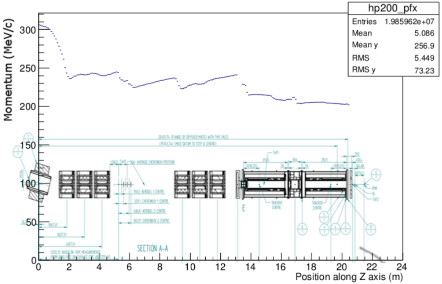

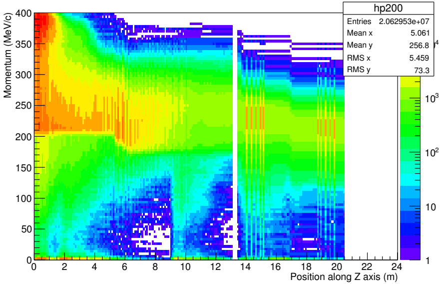

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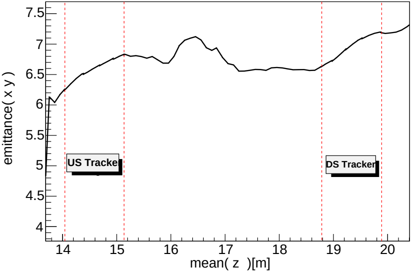
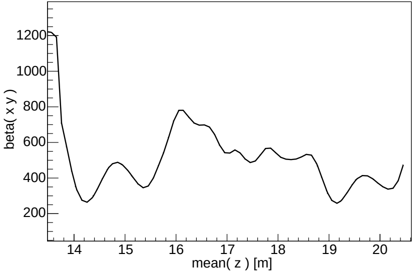
Beam Within Cooling Channel

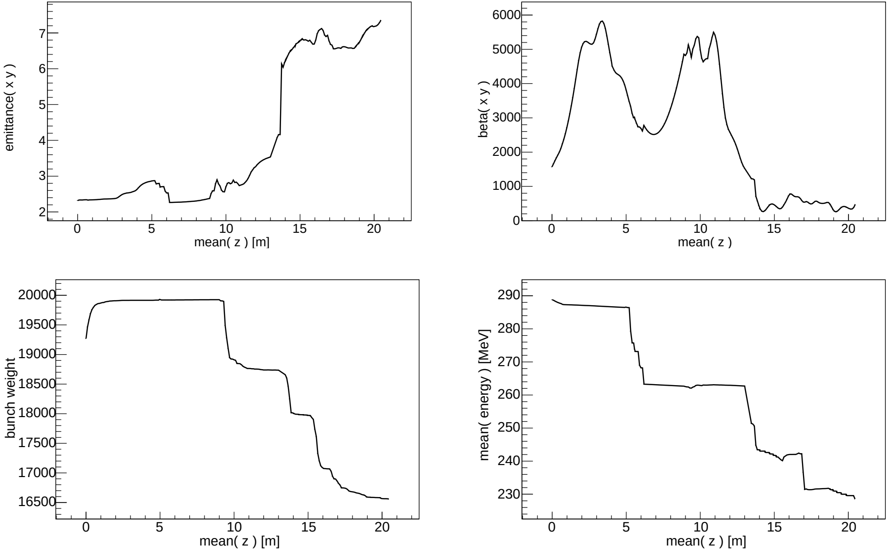
Completed using Chris Hunt's virtual plane analysis





- Increase of emittance through trackers.
- Net decrease in emittance between first stations of upstream and downstream trackers ($\approx$ 0.5 mm).
- Inflation of emittance between tracker due to
  - spurious Al window in SSU (to be removed in future iterations).
  - no beam selection in analysis — some muons are lost.

Beam Properrties Through the Beam line



Simulations on the Grid

- We are not yet ready for grid submissions of simulation.

Requirements for submission

- Complete script for job submissions
- Create data cards on CDB (Beam line and cooling channel settings)
- Generate G4 Beam line interface files.
- Produce a MAUS release containing required features

Tentative Program for Running on Grid

- Prepare a full local simulation with similar constraints to Grid
- Prepare an "interim" grid simulation of $6\pi200$ MeV/c.
- Run other simulations after confirmation of success.

Summary

- Conducted a simulation of MICE StepIV with MAUS using G4Beamline interface.
- 6π 200 MeV beam line settings have been simulated.
  - Further settings planned
  - Priority should be based on "physics interest".
- Simulation had to be nursed through a batch system.
  - Generated about half of the expected sample.
  - Used a "non-release" version of MAUS.
- Some small analysis has been conducted so far.
  - "truth bank" analysis contributed by Chris Hunt.
  - Data accessible though private tar-ball.
  - Grid submissions will be available from web.
- Analyzers start your engines.