Work Done in Final Weeks

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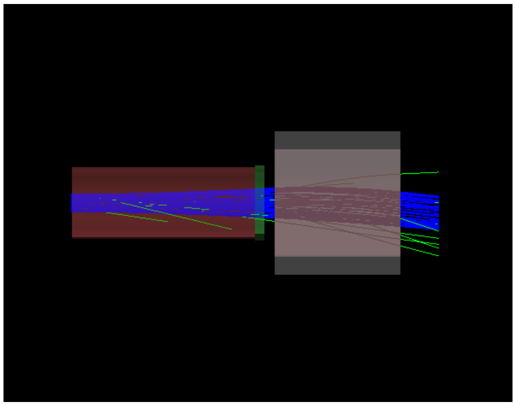
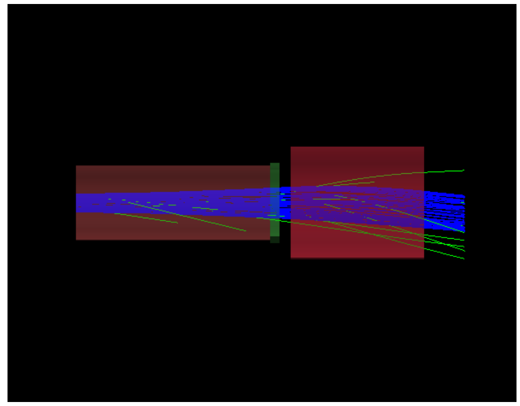
Abstract

Just a work document explaining some of the work I did in the time since completing the Summary_of_work.pdf document. I found that literally no difference between using multipole and placing a genericquad inside of a genericbend. A tune for an idealized 70 MeV/c transversely muon polarized cone was found using GMINUIT. Applying to steering to this idealized beam, a tune was also found. I also tested difference between using musim0 and musim1 with mpi. Musim0 is $\sim$3.3 times faster than musim1.



(a) A genericquad placed inside of a genericbend. Could be used to steer muon beam coming out of solenoid.



(b) A multipole element, in contrast to (a). Could be used to steer muon beam coming out of solenoid.

Figure 1 – Since the muon beam comes out slighltly misaligned, it is hoped that this could be corrected by steering the beam coming out of the solenoid. There appears to be no difference how you model this in G4BL.

1 G4BL's Multipole Element

It was thought that the muon beam coming out of the solenoid could be steered using an element with a dipolar and quadrupolar component. There are multiple ways this could be simulated in G4BL though and understanding which is the right to use is imperative. When I tested using the multipole element, as well as using a genericquad inside of a genericbend. I found that the same field strengths results in the exact same effect on the beam, as illustrated in Fig. 1. Therefore it does not matter which method is used to simulate.

2 Post-Solenoid Beam Width

Syd wanted me to try to tune to catch as many spin polarized 70 MeV/c muons coming out of the solenoid. These muons will come out with a cone angle of 20 degrees. I thought it appropriate to see how the beam would drift through this region coming out of the solenoid. If the beam expands in both transverse directions beyond the limits of the pipe, it will be impossible to catch all muons coming out. This is because the application of a quadrupolar field will result in defocussing in one of the transverse directions. I found, as shown in Fig. 2, that it will not be possible to catch all of the transverse muons. In response, the beampipe was increased to 16 inches for simulations purposes.

3 Tune for Centered Muon Beam

Using an idealized beam of transversely polarized muons, a tune was achieved in order to obtain a starting point for determining the real M9H tune. The field values are summarized in Table 1. The beam command used to generate the muons was as follows:

```
param -unset Pmu=70
param -unset meanXpmuAngle=20
param beamYmu=3.335641*$Pmu*sin($meanXpmuAngle*deg)/4

beam gaussian particle=mu+ nEvents=$nEvents meanMomentum=$Pmu sigmaP=0 \
     sigmaX=4 sigmaY=4 meanXp=tan($meanXpmuAngle*deg) sigmaXp=0 \
     sigmaYp=0 beamZ=6250+3000*($SolDir==0) igmaZ=-2500*($SolDir!=0) \
     sbeamY=$beamYmu*$SolDi
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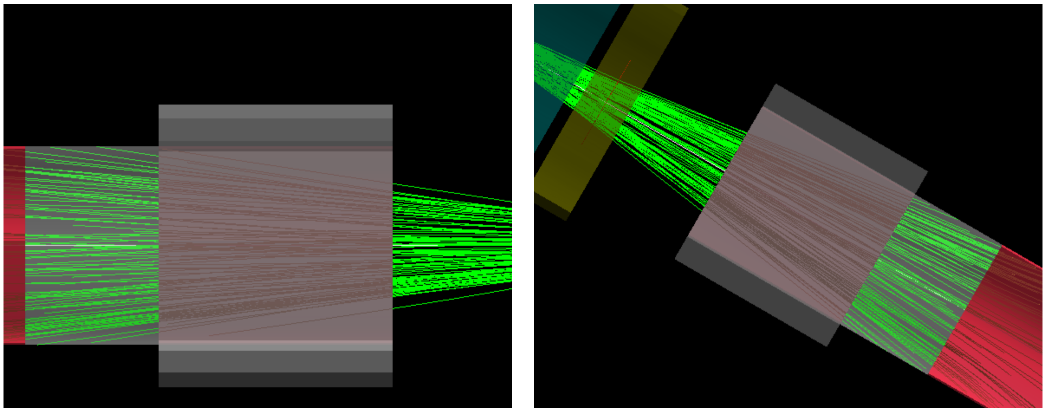

(a) A horizontal view of a centered muon beam coming out of the solenoid. With Q3 off, the beam expands beyond the pipe radius.

(b) A vertical view of a centered muon beam coming out of the solenoid. With Q3 off, the beam expands beyond the pipe radius.

Figure 2 – When Q3 is off, the muon beam expand beyond the beam pipe radius as it comes out of the solenoid. This implies that it will be impossible to catch all of the transverse muons produced in a 20 degree angle cone.

Table 1 – This is the tune for a centered transversely polarized muon beamline originating from inside of the solenoid.

Element	Polarity	Tune (T)
M9AQ3	+	1.676
M9AQ4	-	1.585
M9AQ5	+	0.603
M9AQ6	+	0.974
M9AQ7	-	1.600
M9AQ8	+	1.520
M9AQ9	+	0.772
M9AQ10	-	1.518
M9AQ11	+	1.401

4 Tune for Steered Muon Beam

Additionally, it was hoped that it would be possible to steer the edge of the transverse into the beamline. Initially, the transverse muons are generated in a cone with an angle of approximately 20 degrees. This is in direct response to Section 2 Since this spread is too large to be caught inside of the beampipe, it is likely optimal to try to bring one of the edges of the cone near the center of the beamline, rather than trying to squeeze the cone into a smaller angle. To accomplish this in G4BL a multipole element was used in place of M9HQ3 and M9HQ5 in order to add an additional dipolar element, as well as the quadrupolar element. A field strength of 0.035 T was eyeballed in the GUI with the quads off, in an attempt to bring the reference path to the edge of the beam pipe (or more practically, bring the edge of the beam envelope to the center of the beam pipe). This is best illustrated in Fig. 3.

Table 2 – This is the tune for a steered transversely polarized muon beamline originating from inside of the solenoid. Steering is applied to Q3 and Q5 with strength of 0.035 T.

Element	Polarity	Tune (T)
M9AQ3	+	1.539
M9AQ4	-	1.619
M9AQ5	+	0.748
M9AQ6	+	1.179
M9AQ7	-	1.551
M9AQ8	+	1.153
M9AQ9	+	1.186
M9AQ10	-	1.722
M9AQ11	+	1.837

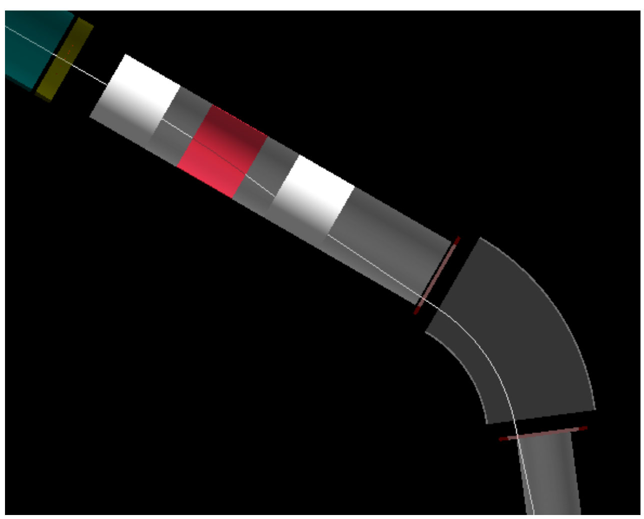

Figure 3 – The addition of dipolar components to the quadrupoles M9HQ3 and M9HQ5 allow the beam of idealized muons to be realigned. This allows an approximation for how to catch transverse muons in a real beamline.