

Overview of muon campus beam dynamics phone meetings

Diktys Stratakis

Fermi National Accelerator Laboratory

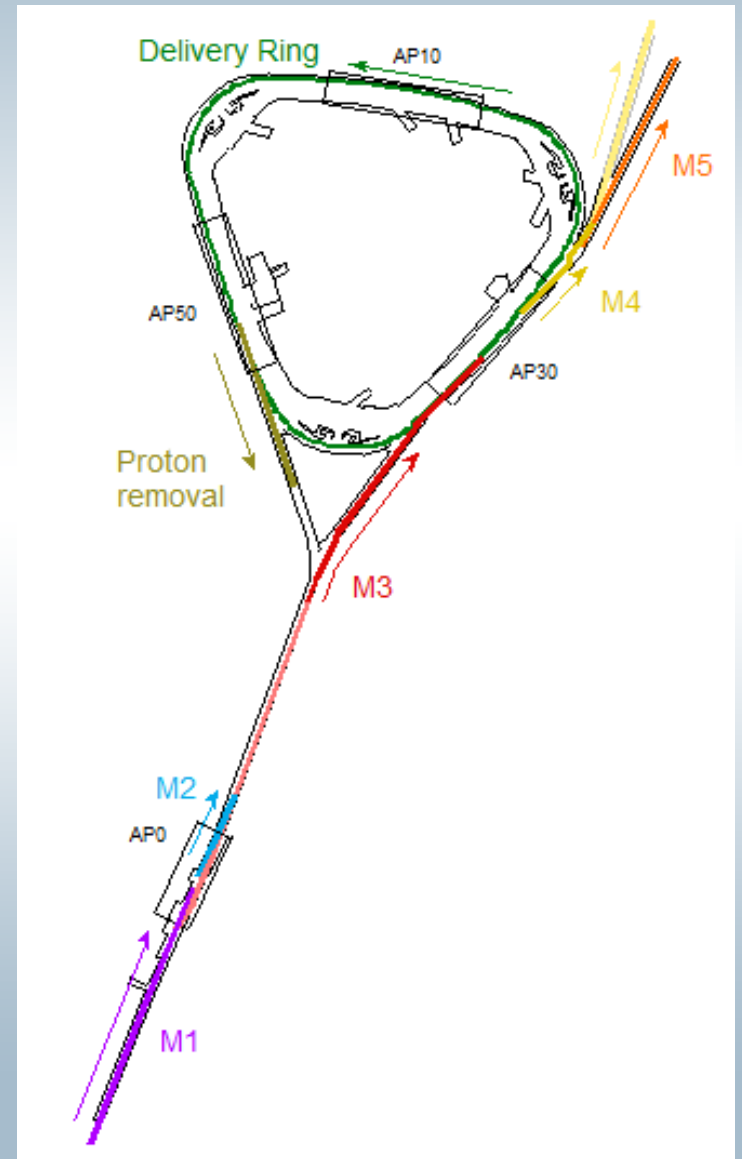
Version 2

Muon campus beam dynamics phone meeting

December 02, 2015

g-2 main lattice components

- M1 line will deliver an 8.89 GeV/c proton bunch to the target
- M2/ M3 lines will carry 3.1 GeV/c secondary beam towards the DR
- The beam loops DR many times
- 3.094 GeV/c muons are extracted into the M4 line and bent into M5 for transport to the g-2 storage ring
- **Goal: End-to-end simulation of all beam lines including the storage ring**

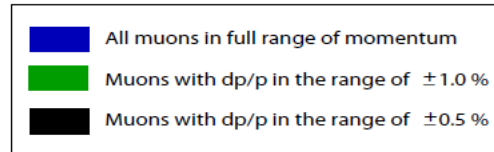
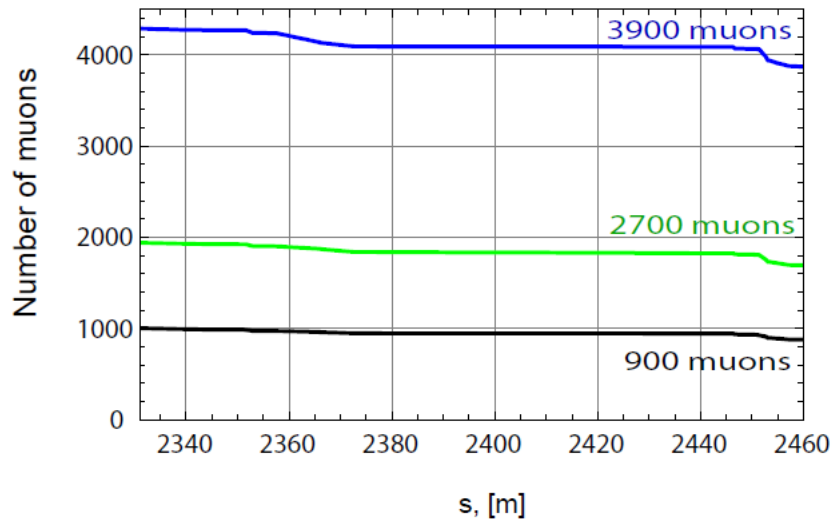


Approach

- Simulation from the target to the storage ring injection point by two different models:
 - G4Beamline (Fermilab, BNL effort)
 - BMAD (Cockcroft Inst, U. Liverpool, U Lancaster effort)
- There are some discrepancies between the two efforts
- The goals of our beam dynamics phone meetings are:
 - Diagnose and resolve those discrepancies
 - Address remaining physics issues (for instance look at fringe fields, MSU team)
 - Your suggestions are very important

Example of discrepancy

- Korostelev (2015)



At the end of the Final Focus (before the inflector):

Number of all muons in terms of proton on target (POT: μ^+/pot) is 3.9×10^{-6} (in full range of momentum)

Number of muons with $\Delta p/p = \pm 1.0\%$
POT is 2.7×10^{-6}

Number of muons with $\Delta p/p = \pm 0.5\%$
POT is 0.9×10^{-6}

- Sayed (2015)

Number of muon with $dp/p = 0.5\%$ is $2.0 \times 10^{-7} \mu^+/\text{pot}$ **4.5 times less**

Number of muon with $dp/p = 2.0\%$ is $6.7 \times 10^{-7} \mu^+/\text{pot}$

Number of all muons with no dp/p cut is $7.1 \times 10^{-7} \mu^+/\text{pot}$ **5.5 times less**

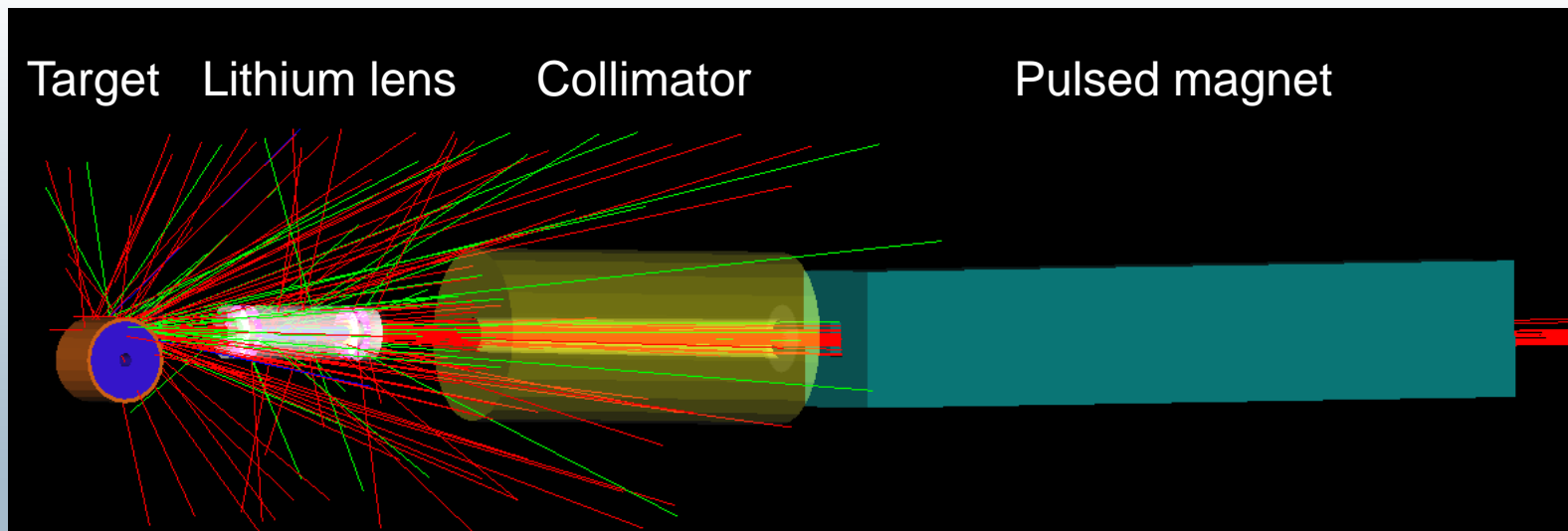
** pot = Proton on target

Solution

- Start with the same distribution at the target
- Use the same MADX optics files
- If any optimization of the magnet settings is done, it should be noted. For example for injection or extraction.
- Step by step comparison: First M2M3, then DR, then M4M5
- Finally, we need to establish criteria for comparison. I will come back into this at the end...

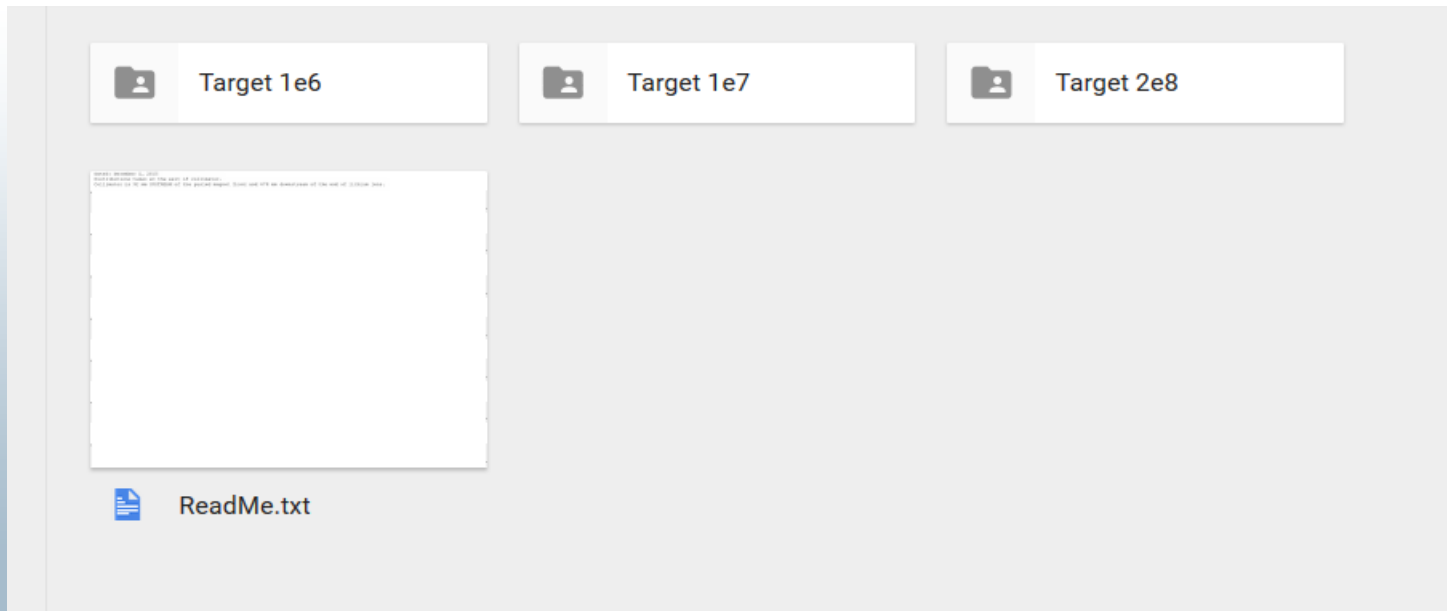
Target Station

- I have created new input distributions using parameters from: *Grange, Muon Technical Design Report, 2015*
- Distributions are extracted after the collimator, 92 mm upstream of the front-face of the pulsed magnet.



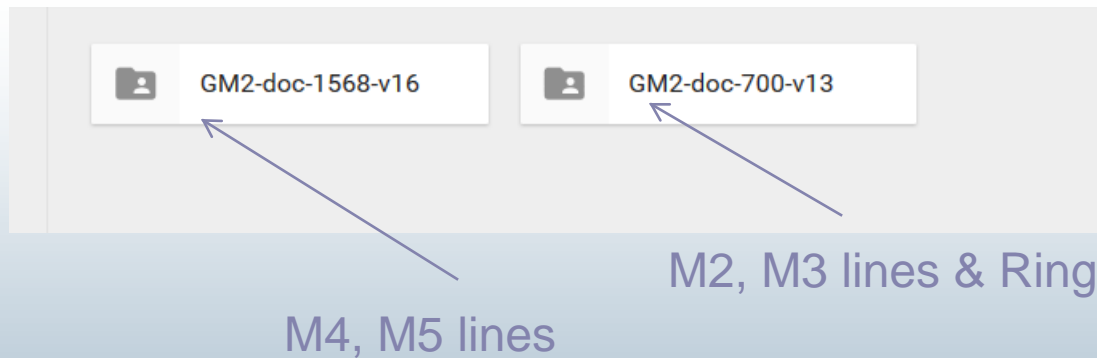
Input distributions

- Distributions with 10^6 , 10^7 , 2×10^8 protons on target
- I can generate more if necessary, but I suggest starting with 2×10^8
- Distributions available here: [Link](#)



MAD8 models

- M2M3 and DR: *Johnstone g2 docDB 700-v13*
- *M4M5 lines: Johnstone g2 docDB 1586-v16*
- Distributions available here: [Link](#)



Next steps

- Submit an abstract on beam simulations for IPAC (deadline Dec. 7)
- Continue phone meetings to discuss progress
- Biweekly first, maybe weekly later on.
- Next meeting: analyze results for M2/M3 beamlines
- Both G4BL & BMAD teams will report results
- Using established criteria...(next slide)

Criteria for comparison

- Total number of pions within 1%, within 2% and total (decay off)
- Total number of muons, within 1%, within 2% and total.
- Momentum distribution, dp/p
- Anything else?

Last remarks

- Contact me if you like to give a talk
- Please use files from the posted links. If not, please reference the files you are using.
- Please don't send me your talk last moment. Please send it to me at least 1 hour before the meeting
- Lets keep meetings short (~45 min)