Frontend Chicane Simulations in MARS

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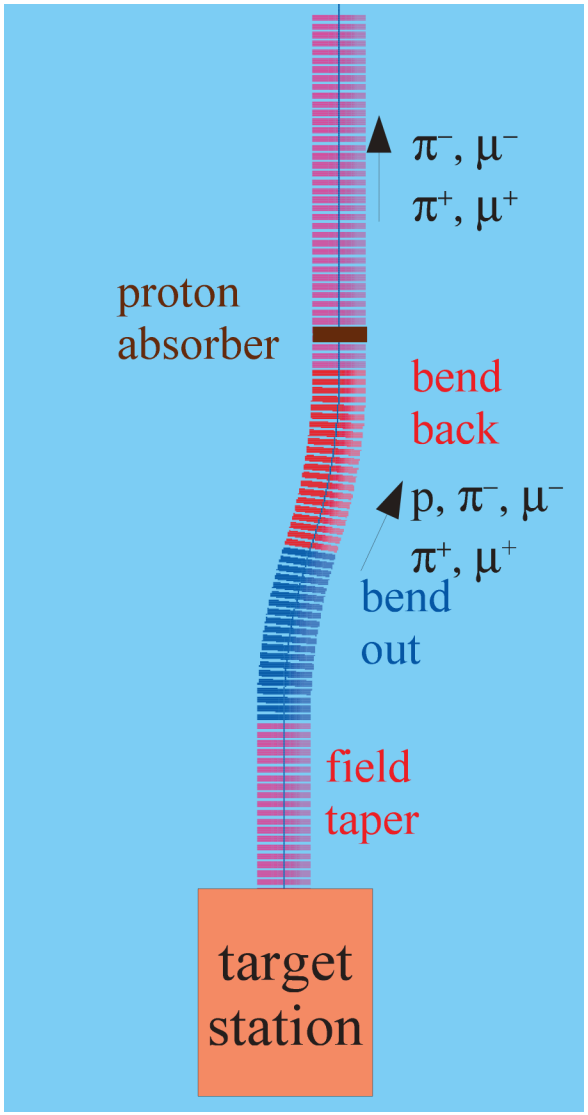
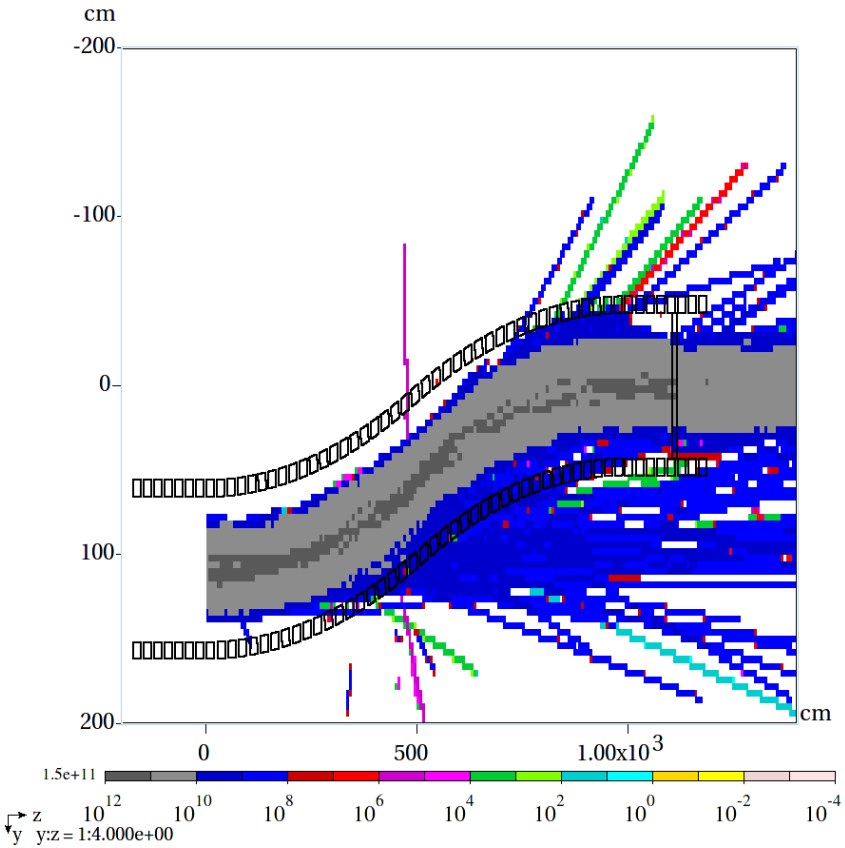
(IIT/Fermilab)

Chicane in MARS

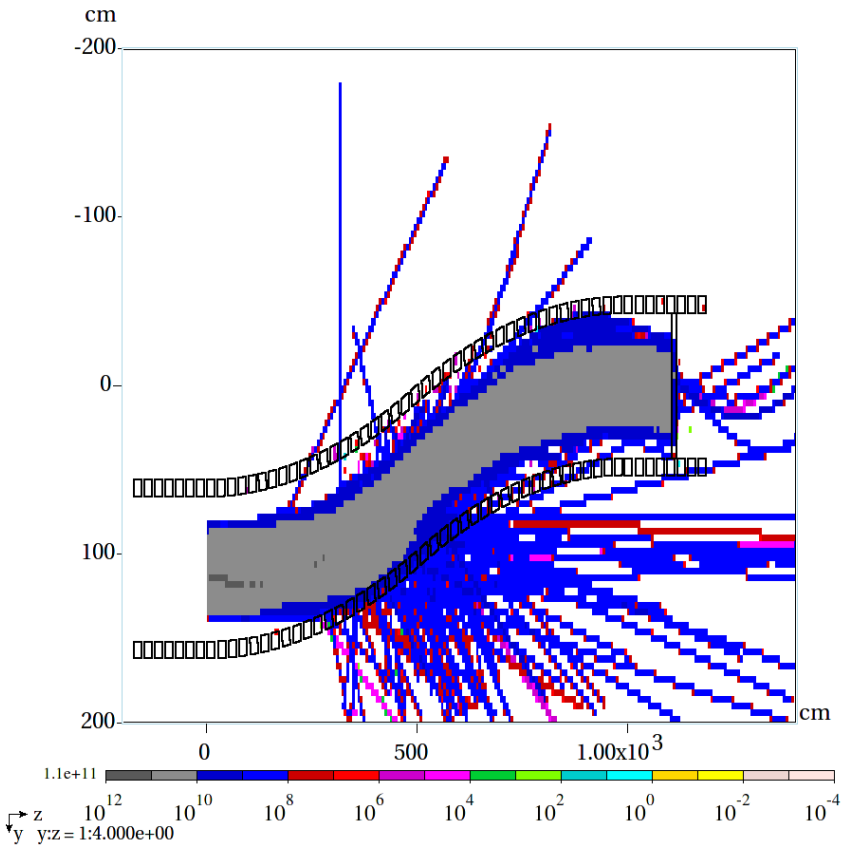


- The aim of the chicane is to remove the high energy protons
- The aim of the absorber is to remove the remaining protons with relatively low energies
- A single chicane is sufficient as shown in the next slides
- Magnetic field map of the chicane is produced by G4beamline
- Particle distributions are generated entirely in MARS (thanks to Nicholas Souchlas)
- The simulation is carried out in two steps: target/capture (30 meters) + chicane (11.5 m).
- Proton absorber: 10 cm of carbon
- Simulation results: the muon flux is not reduced significantly by going through the chicane + proton absorber, while there is virtually no proton flux downstream of the absorber

Muon vs proton flux (top view, particles/cm^2/s)



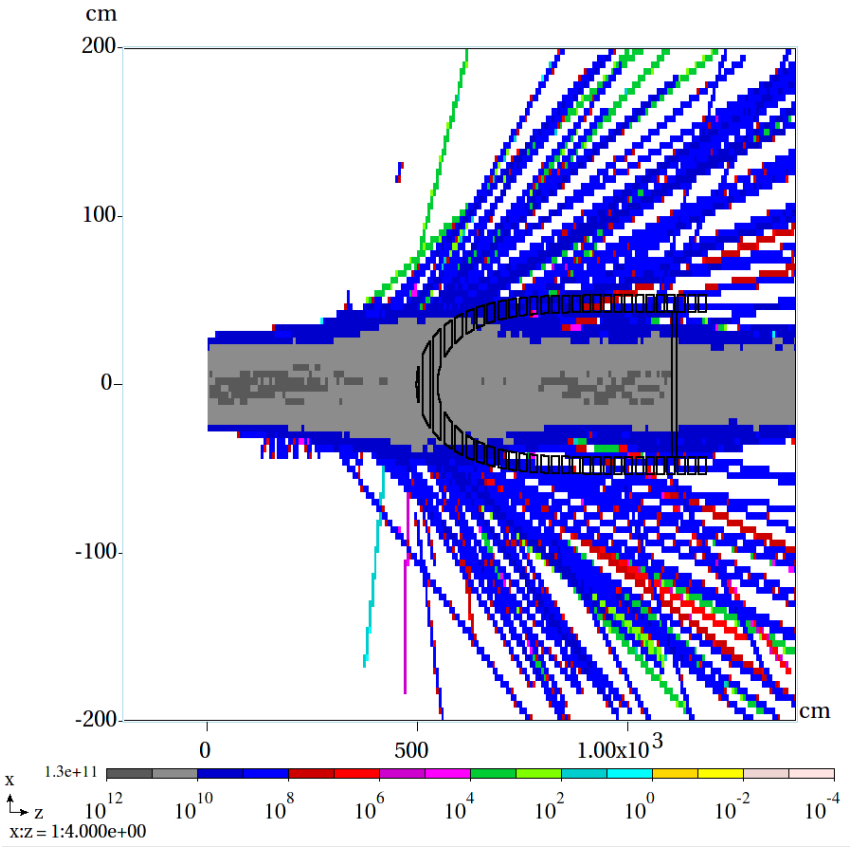
Slight reduction in the muon flux

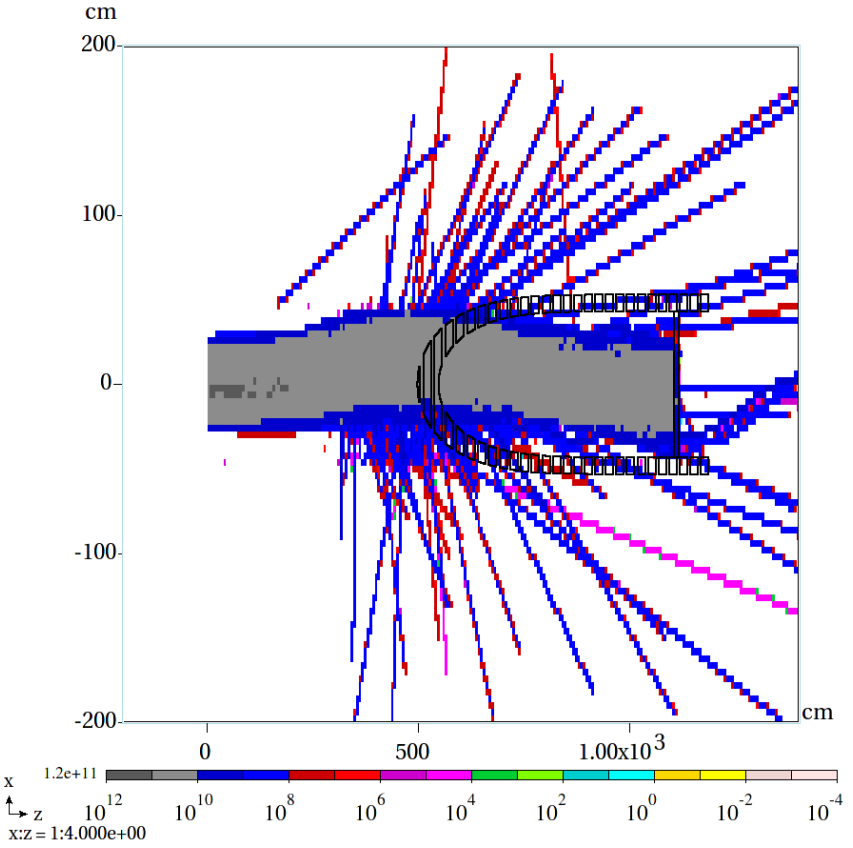


Virtually no protons downstream of the absorber

Muon vs proton flux (side view, particles/cm^2/s)

(illustrates why a single chicane is sufficient)

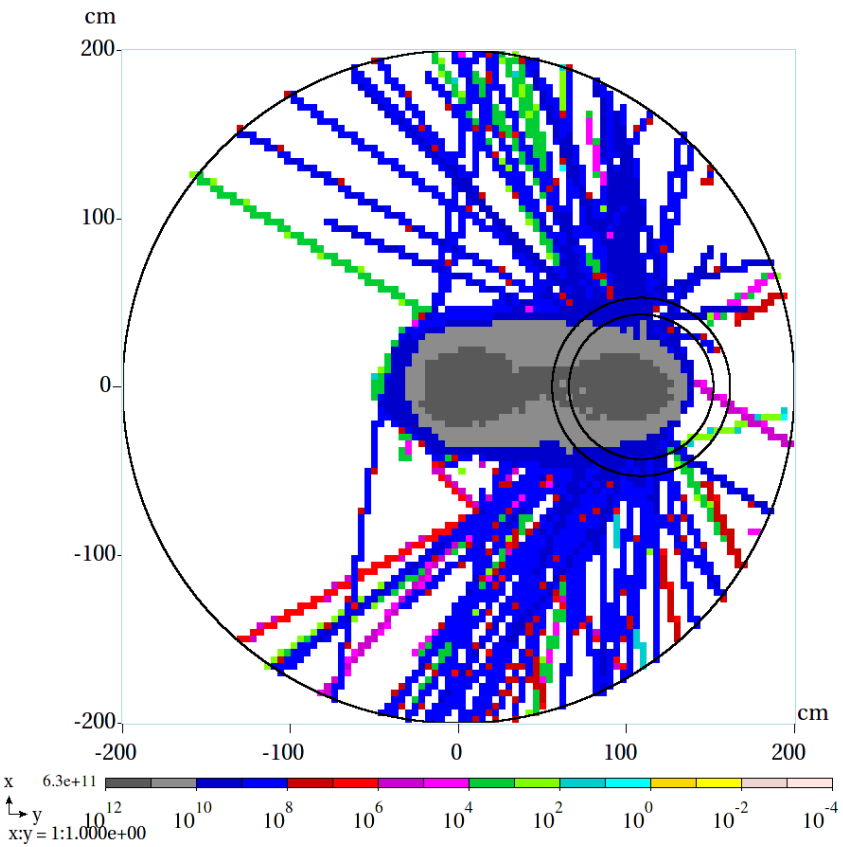




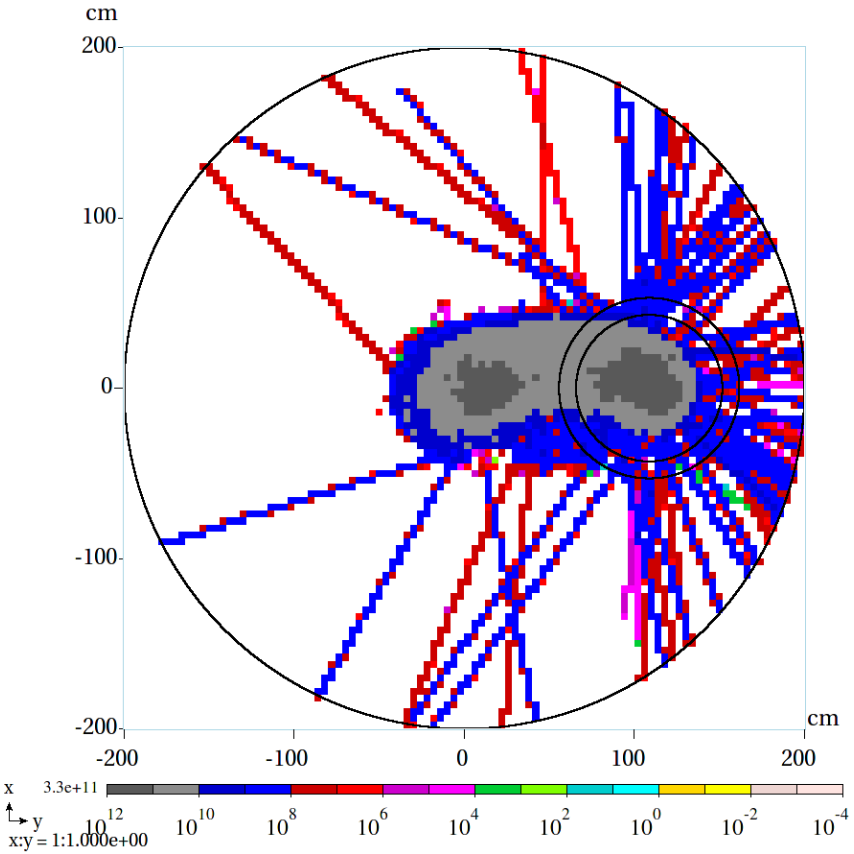
Muons of both signs are tracked resulting in increased beam width in the middle

Protons are only bent upwards

Muon vs proton flux (front view, particles/cm^2/s)

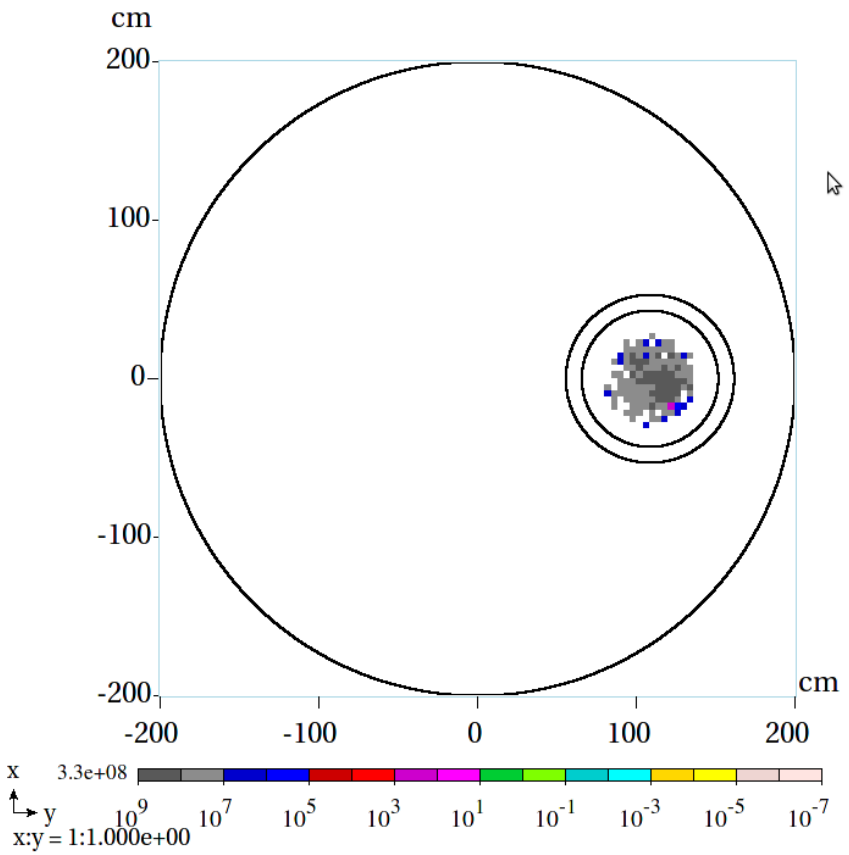


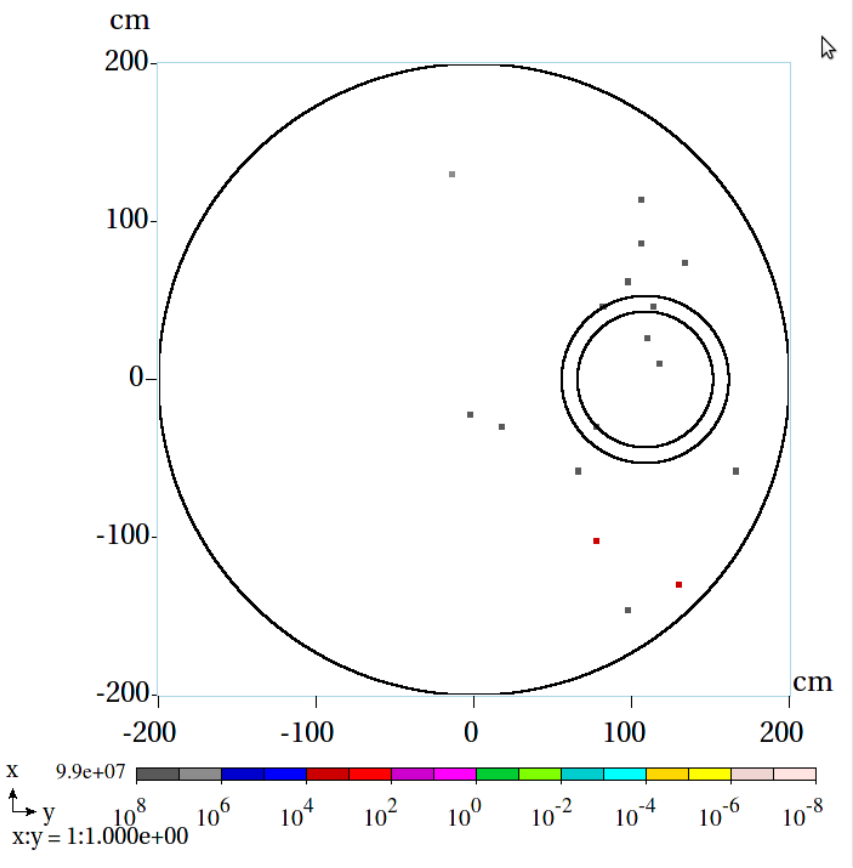
Muons of both signs are tracked resulting in increased beam width in the middle



Protons are only bent upwards

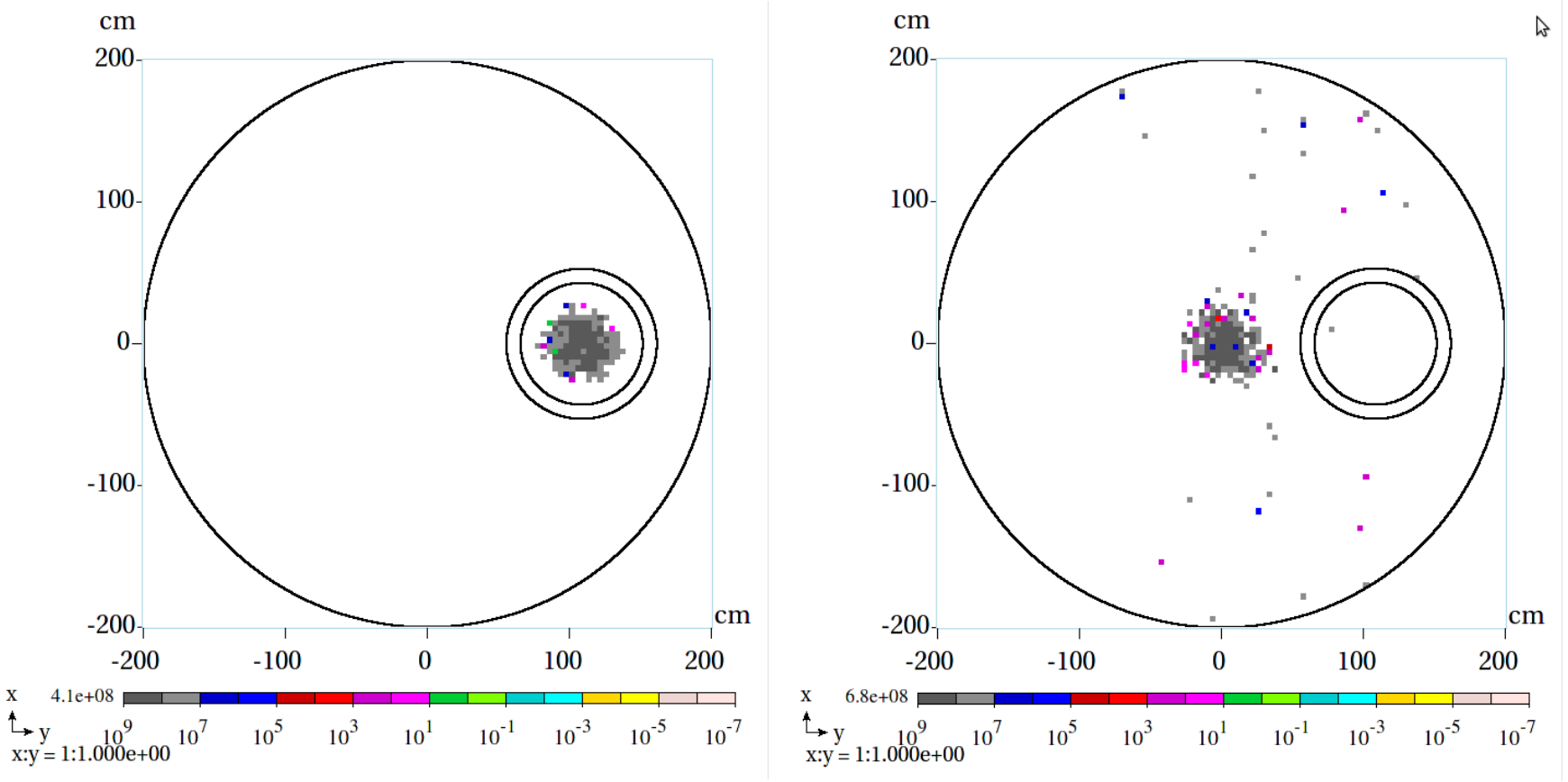
Proton flux (us/ds of the chicane)





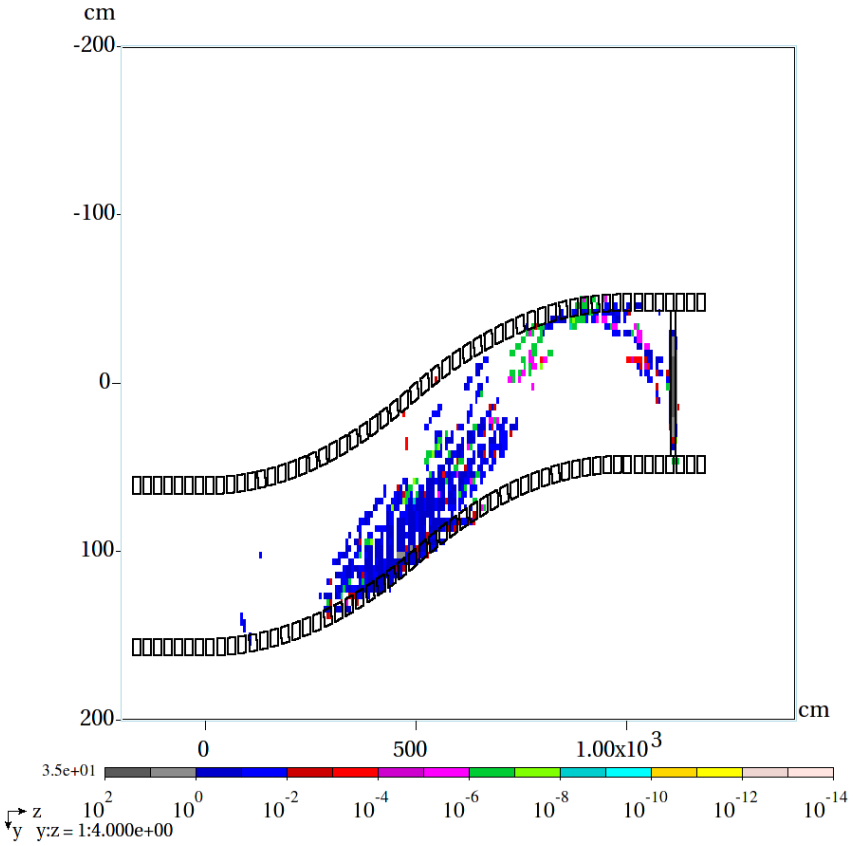
Virtually no protons downstream

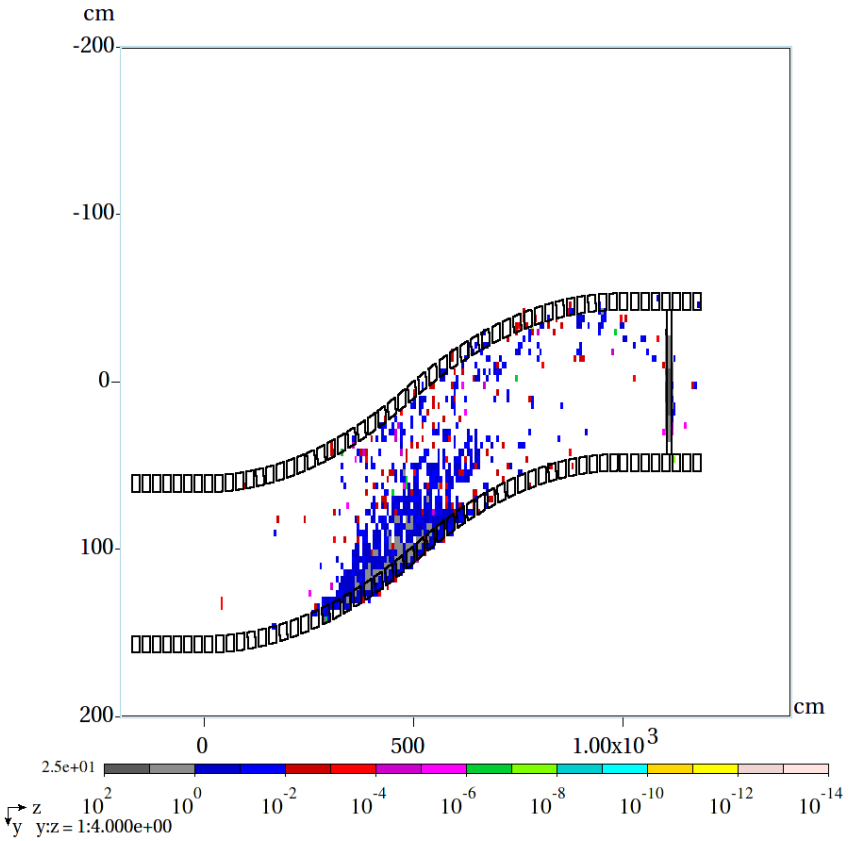
Muon flux (us/ds of the chicane)



Most muons survive the chicane + absorber

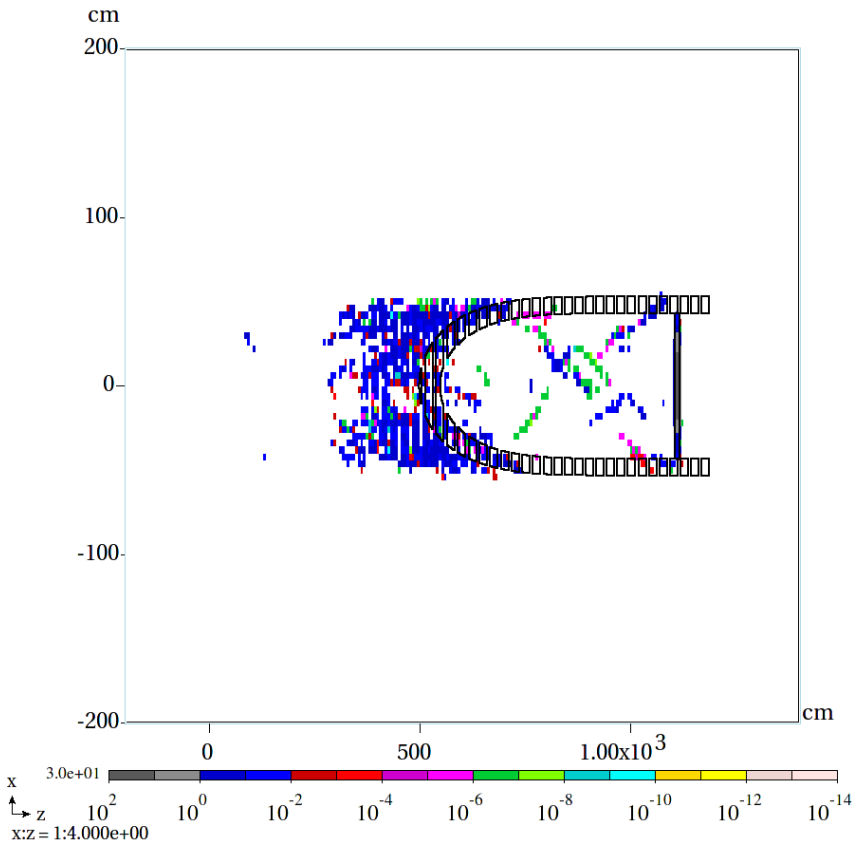
Muon vs proton power density (top view, mW/g)

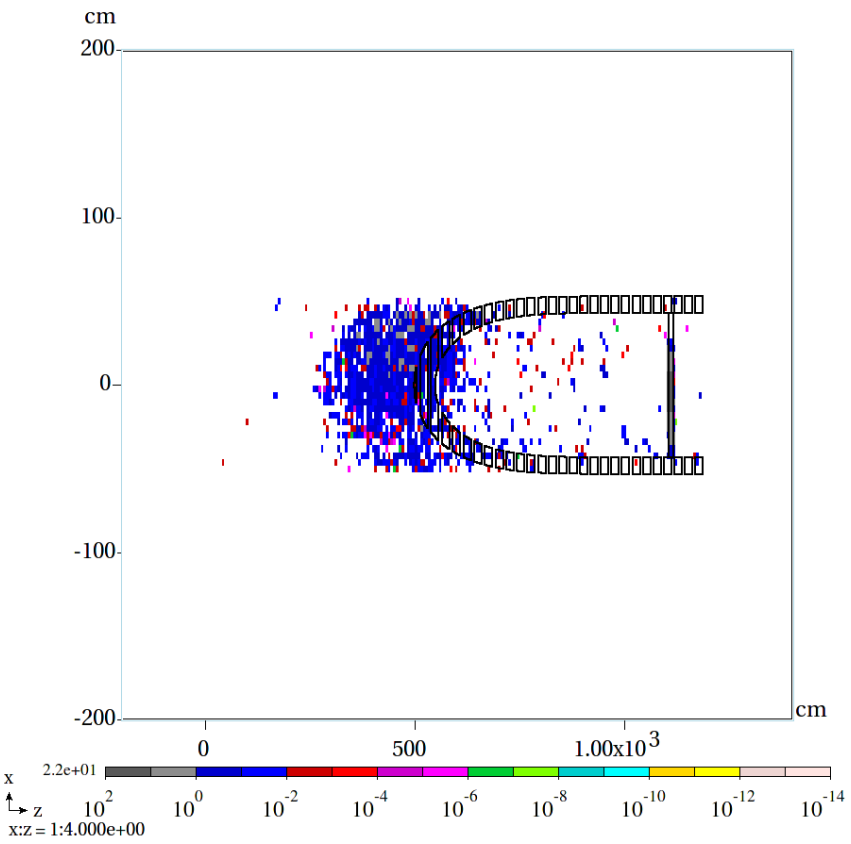




Max power density is about 35 mW/g (mainly at the absorber)

Muon vs proton power density (side view, mW/g)





Max power density is about 35 mW/g (mainly at the absorber)

Summary

- A single chicane + proton absorber do a good job of removing protons
- Energy deposition issues need to be addressed (for particles leaving the channel, especially high energy protons)
- The time distribution of the beam is changed by the absorber => need buncher and phase rotator re-optimization (see presentation by Chris Rogers at http://hepunx.rl.ac.uk/uknf/wp1/idsfrontend/2011-09-13/reoptimising_phase_rotation.pdf)
- So far: ~10% extra losses compared to the baseline