Overview of a high-intensity muon source

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MAP Winter Meeting

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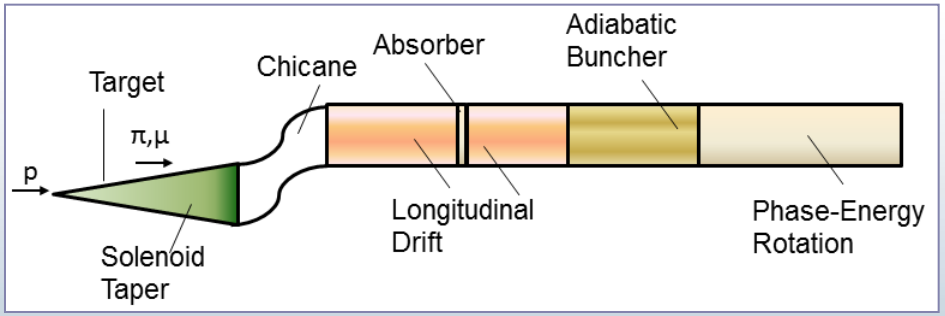
SLAC, Menlo Park CA, USA

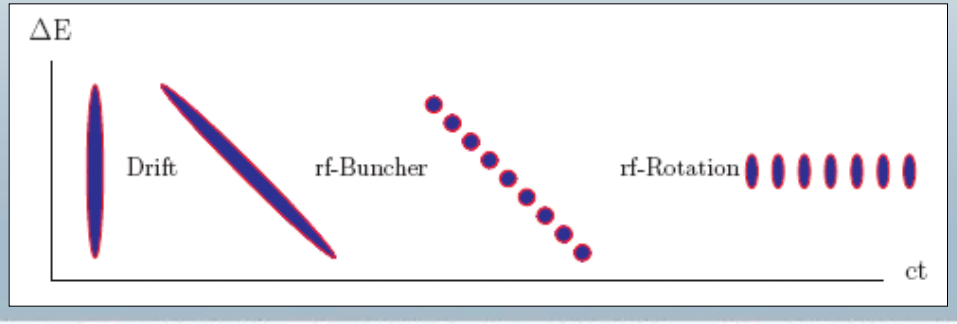
Outline

- Goals and motivation
- Accomplishments since last collaboration meeting
- Current activities
- Future work
- Summary

High-intensity muon source

- Goals of a high-intensity muon source
  - Capture muons that result from the decay of pions that are produced by a high intensity proton beam impacting a target
  - Perform initial phase space manipulation of these muons to make them well-suited to subsequent accelerator systems and/or experiments
- Major components:
  - Target & capture
  - Chicane
  - Decay channel
  - Buncher
  - Phase-Rotator



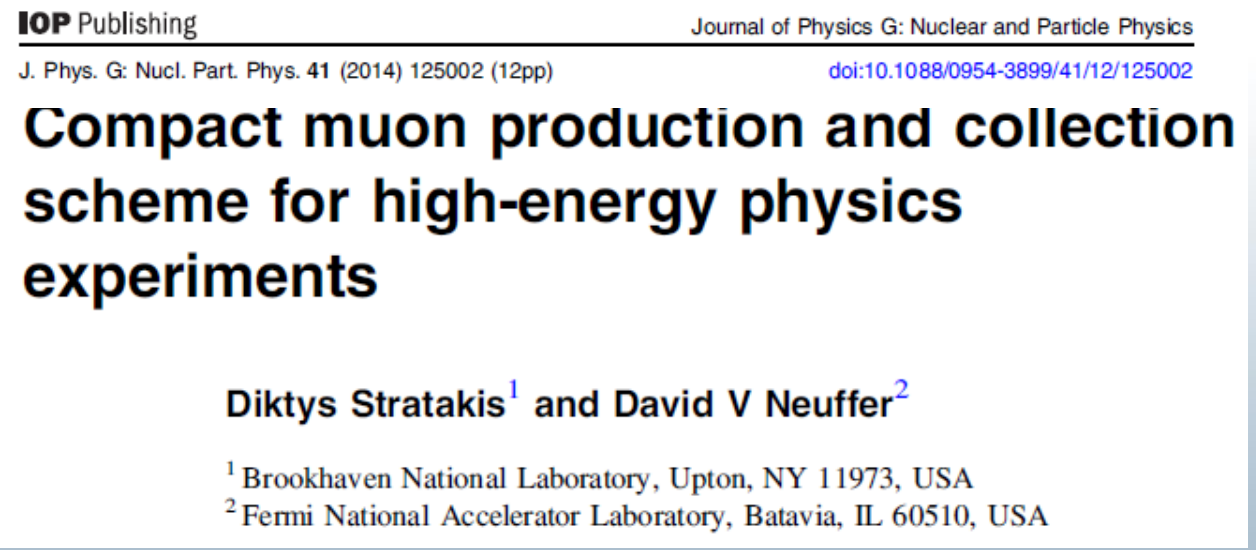


Accomplishments since last MAP meeting

- Presented several (10) posters at IPAC 2014
- Conceptual design of a carbon target, optimized for 1 MW 6.75 GeV proton beam.
- Produced new distributions with MARS.
- Designed a magnet configuration for a short (5 m), 20 T to 2 T field taper.
- Produced concept specifications for chicane, buncher and phase-rotator for the new target parameters.

More accomplishments…

- Review paper published in Journal of Physics G
- http://iopscience.iop.org/0954-3899/41/12/125002



IOP Publishing Journal of Physics G: Nuclear and Particle Physics

J. Phys. G: Nucl. Part. Phys. **41** (2014) 125002 (12pp) doi:10.1088/0954-3899/41/12/125002

Compact muon production and collection scheme for high-energy physics experiments

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Current activities

- Finalize design and document results as part of the MAP ramp down
- Address key design issues
  - Energy deposition from unwanted particles
  - Utilizing gas filled cavities on buncher & phase-rotator
- Expand the range of applications to which our source can be applied
  - Applications besides neutrino factories and muon colliders

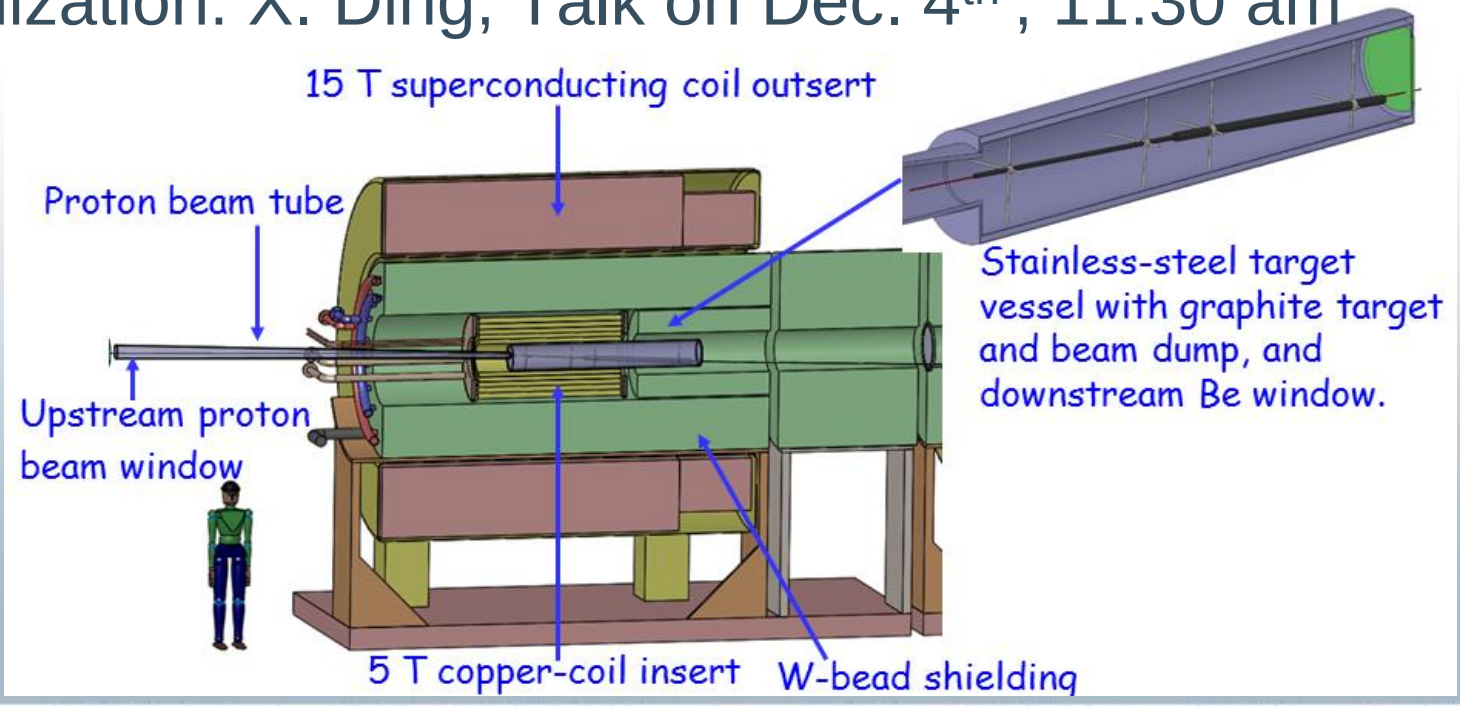
Monitoring activities

- We maintain a web page with all simulation decks, papers, reports etc…
- Biweekly phone meetings

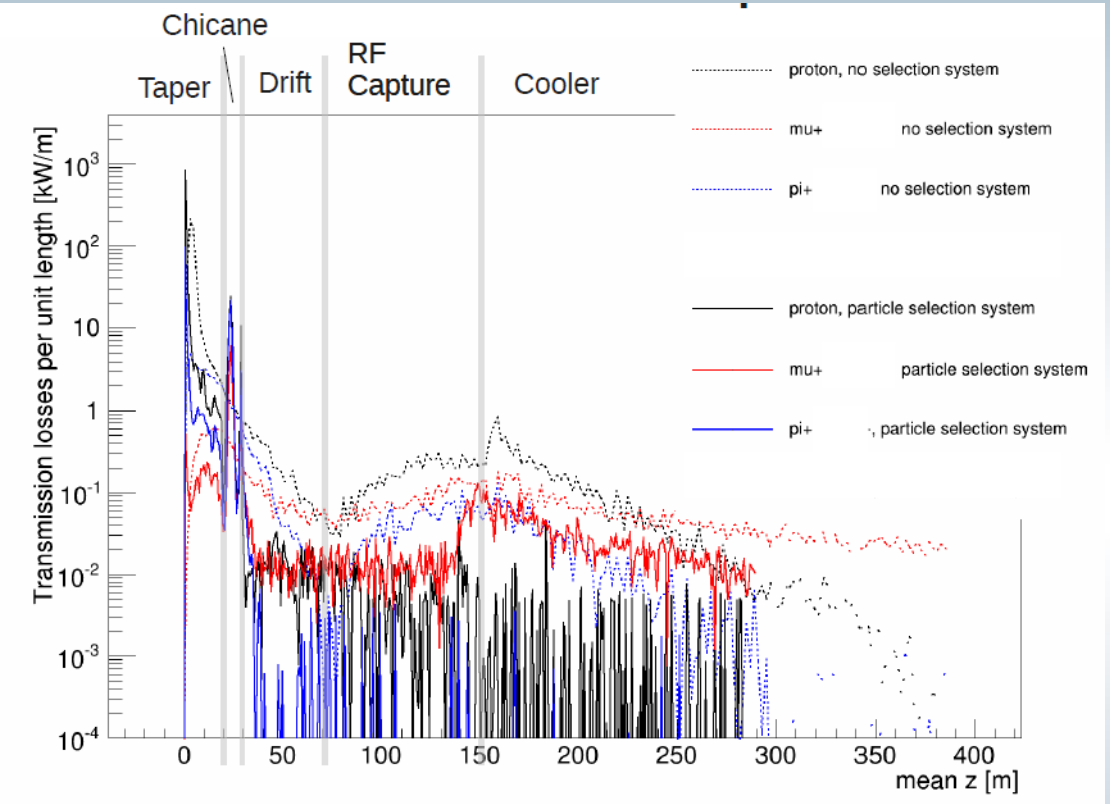
https://pubweb.bnl.gov/~diktys/FE.html

Target & capture system

- New target concept:
  - Solid target module inside a high-field solenoidal magnet
  - 1 MW initial beam power
- Target Details: K.T. McDonald Talk on Dec 5th, 2:00 pm
- Optimization: X. Ding, Talk on Dec. 4th , 11:30 am

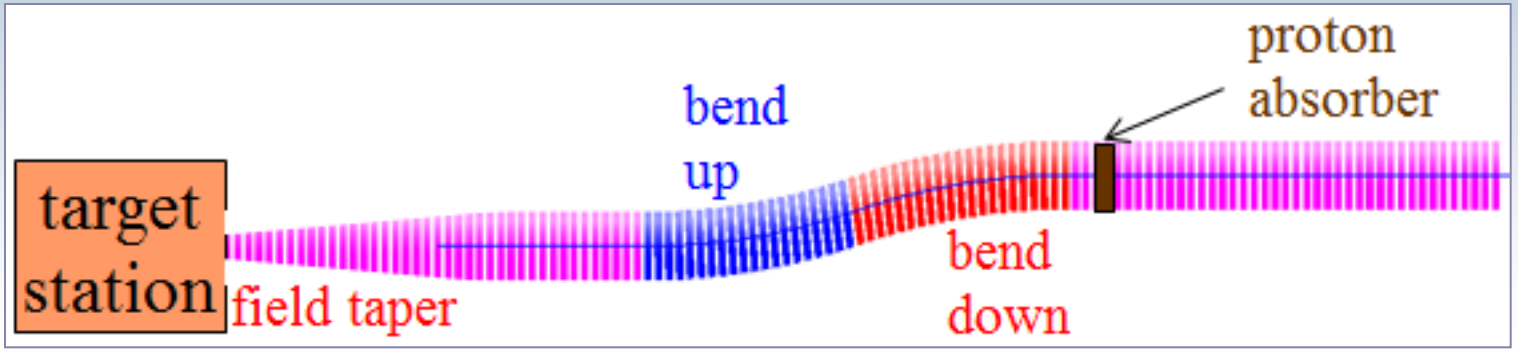


Energy deposition



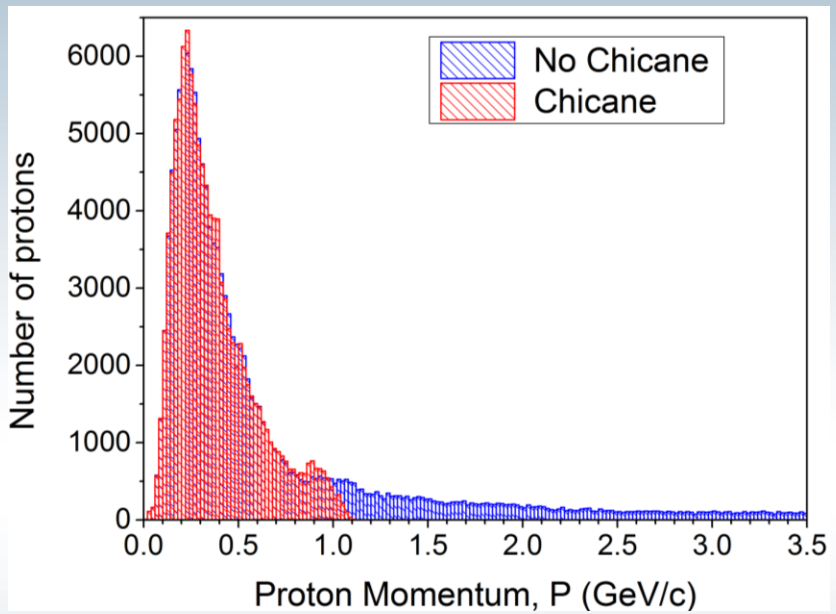
- One challenge of a muon source is energy deposition from unwanted particles in the accelerator components
- Concepts have been identified that could mitigate the impact of energy deposition

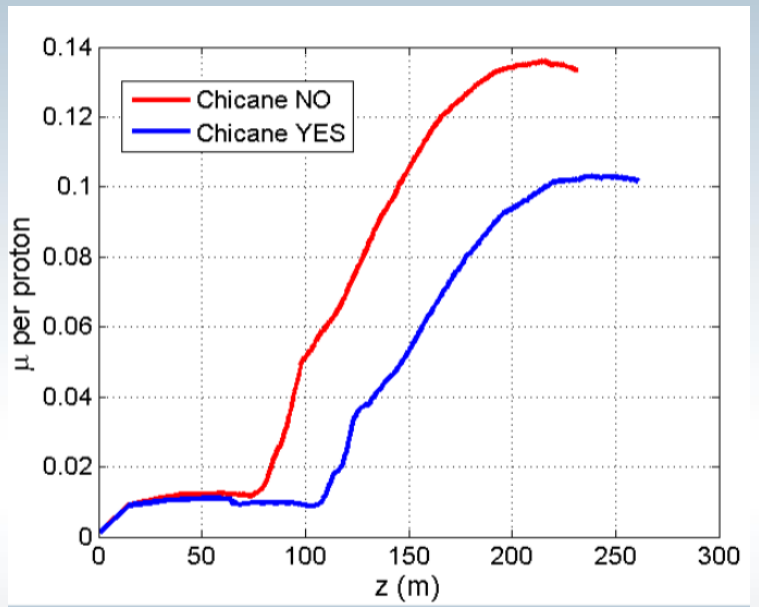
Solenoidal chicane



- Concept introduced by C. Rogers (RAL)
- Bent solenoid chicane induces vertical dispersion in beam
  - High-Momentum particles scrape
  - Single chicane for both muon signs
- Proton absorber to remove low momentum protons

Chicane optimizations

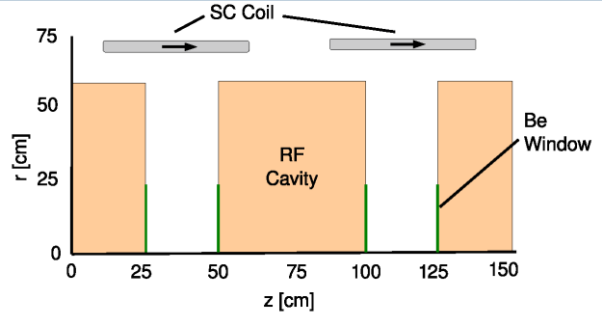


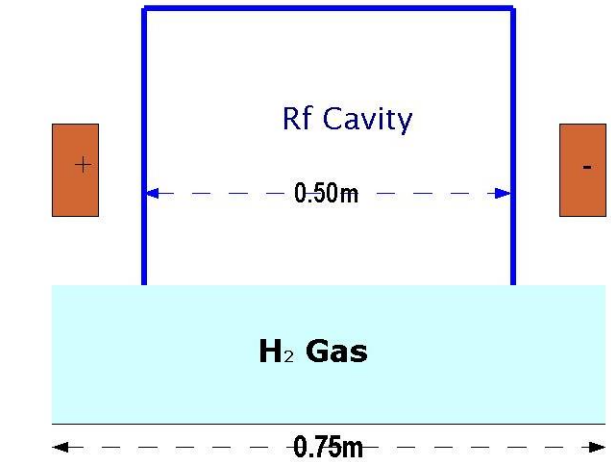


- We need to study this concept to understand what design choices best reduce unwanted energy deposition while maintaining transmitted muon flux
- Chicane Talk: J.S. Berg, Dec 4th, 12:05 pm
- Energy Dep. Talk: P. Snopok, Dec 4th, 12:25 pm

Muon source with gas filled cavities

- Phase-Rotator requires vacuum rf operation at 20 MV/m at 2 T
- Pressurized cavities are a demonstrated solution for operating rf cavities in multi-T fields.
- The impact of this solution on the buncher and phase-rotation systems of the muon source will be studied to understand its consequences
- Details: D. Neuffer Talk , Dec 4th, 11:45 pm





Deliverables FY 15

- Update design specifications for the chicane, buncher, phase-rotator for a C target 1 MW, 6.75 GeV driver & evaluate performance
- Energy deposition studies along different accelerator components
- Utilize gas filled cavities on buncher & phase-rotator
- Publish a report describing all design parameters and performance of our new proton based muon source

Summary

- Under MAP management, significant progress has been made in developing advanced concepts for the capture and transport of a muon beam produced by the interaction of a intense proton beam with a target
- A new muon source for a C target and 1 MW proton driver is underway
- We will address two key (and new) issues in FY 15
  - Energy deposition in accelerator components
  - Utilizing gas filled in the muon source
- Our goal is to deliver a report with specs and performance studies by the end of FY 15.

Acknowledgement

- A. Alekou, J.S. Berg, X. Ding, H. Kirk, K. McDonald, D. Neuffer, R. B. Palmer, C. T. Rogers, R. Ryne, P.Snopok, H. Sayed, B. Weggel