Final Thoughts

MUTAC REVIEW

Fermi National Accelerator Laboratory

April 7, 2009

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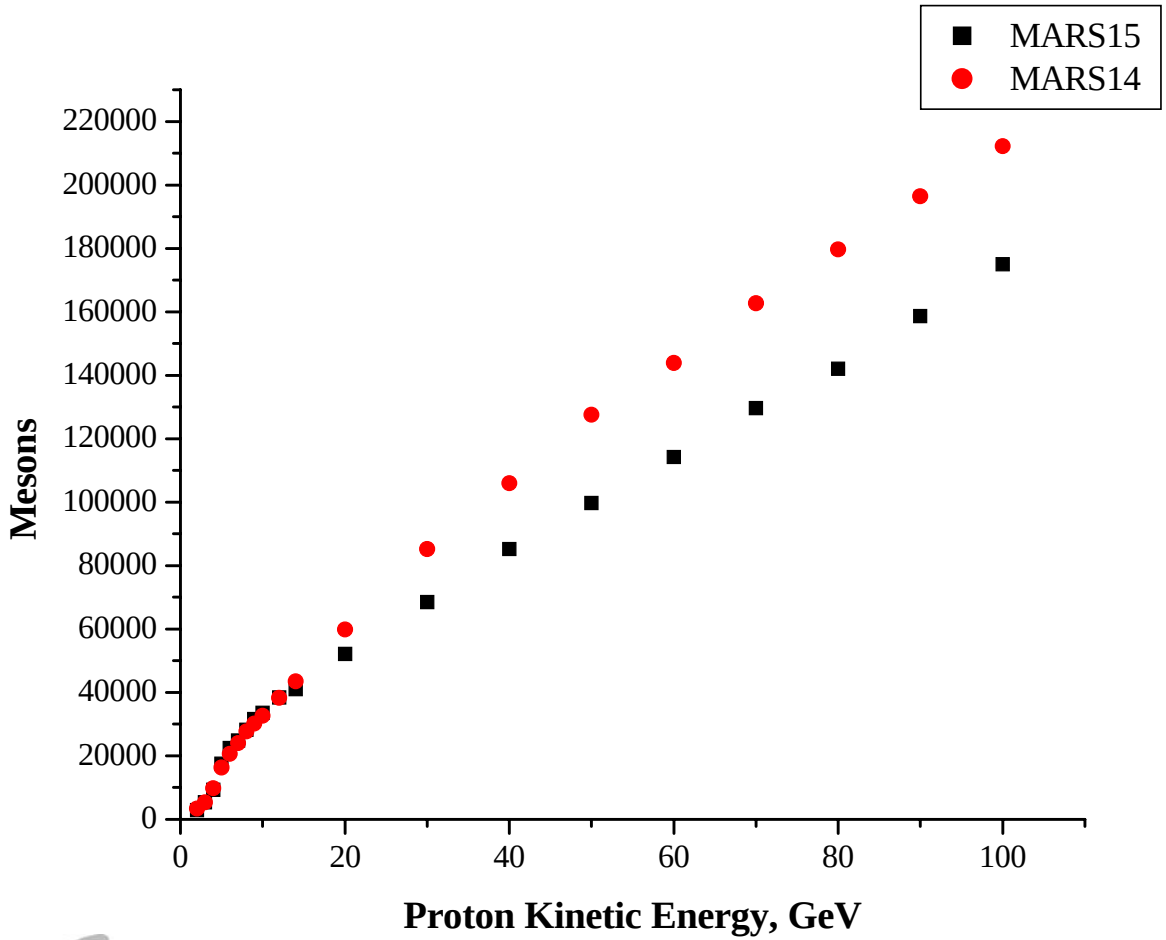
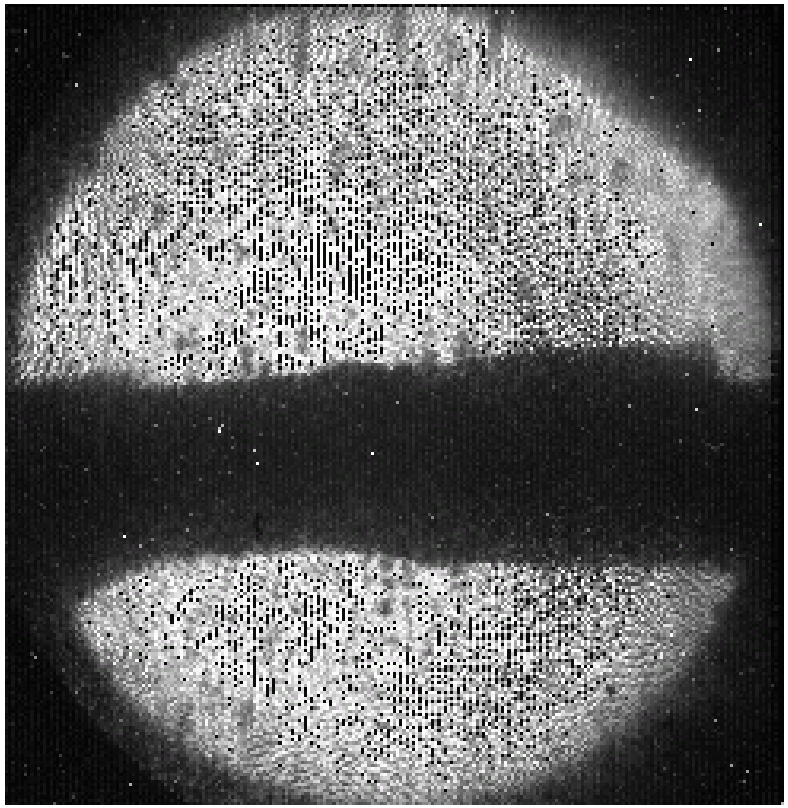
Brookhaven National Laboratory

Mars14 vs Mars15 Comparison



15TP 14GeV Proton Beam

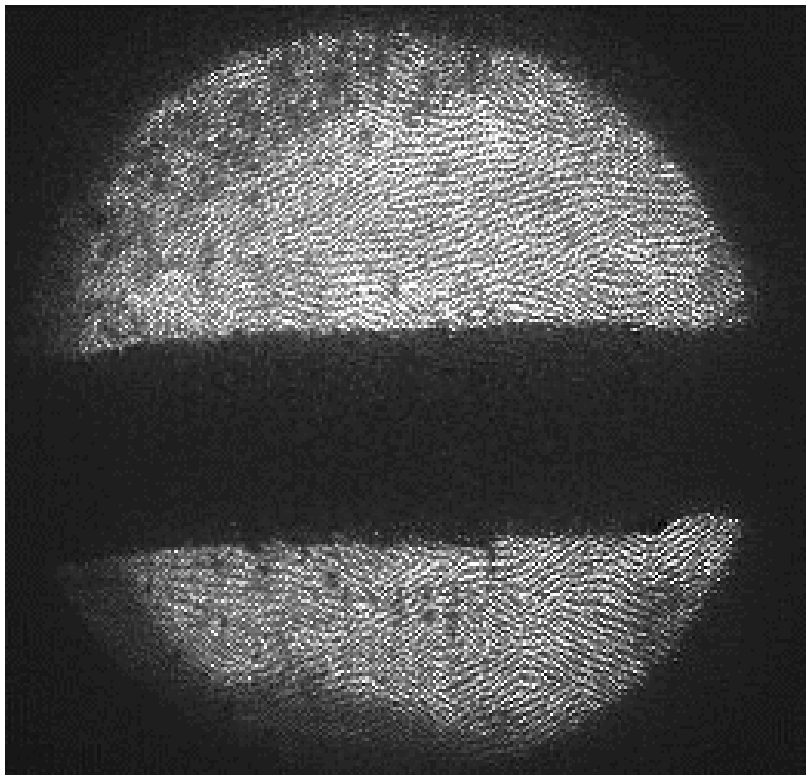


Oct. 27, 2007
Solenoid Field at 5T

Viewport 2

Beam 5016, Hg 15m/s, 100μs/frame, Total 1.6ms

Viewport 3: Jet/proton interaction



1 cm

Shot 16014
- 14 GeV
- 12×10^{12} protons/pulse
- B-field 10 T
- 500μs/frame

Disruption Length =16.5cm

The Muon Collider Coordination Committee

MCTF

MUTAC07 Recommendation

Coordination of MCTF with NFMCC is essential to ensure that the muon collider effort makes best use of limited resources, avoids duplication, and shares infrastructure, codes, and results.

MCCC Mandate

Formed at the request of MCOG (Muon Collaboration Oversight Group----S. Holmes, J. Siegrist, S. Vigdor)

Purpose: Coordinate the NFMCC and MCTF to assure minimal duplication and optimal effort in U.S. Muon R&D

MCCC Membership

Leadership of the NFMCC and MCTF

NFMCC: A. Bross, H. Kirk, M. Zisman

MCTF: S. Geer, V. Shiltsev

Key MCCC Activity

Response to MUTAC08 recommendations:

- **Develop a detailed plan to reach the goal of a MC feasibility study by 2012 for presentation to the MUTAC in 2009**

- **To organize and complete the 2012 feasibility study, NFMCC and MCTF must become more tightly coordinated, in order to optimally manage the resources available across the national labs, its integration with international experiments and the US participation for the neutrino factory IDS.**

Challenges

- **The attrition in support for muon accelerator R&D experienced in recent years needs to be reversed if the challenges are to be met in a timely way.**
- **The support that NFMCC + MCTF presently receive is inadequate to provide enough information for the HEP community to judge the viability of Muon Colliders by ~2013.**
- **If ~2013 really is the time that the community makes the next round of long-term decisions, then only with prompt support can the plan deliver its goals in time for these decisions.**

Progress Since MUTAC08

- Collaboration with Project X Team
- 6D Cooling Simulations
  - Guggenheim
  - Helical Cooling Channel
  - FOFO Snake
- Collider Ring Optics (β^*=10 mm)
- MTA RF- and Cryo-infrastructure
- National HTS Program
- 50T Solenoid Design Concept
- RF Breakdown models
- 3D Magnetohydrodynamic simulations
- MERIT Pump/Probe Analysis
- Meson Production Efficiency vs Proton KE
- NF Acceleration Scenario
- Submission of 5-year Plan to DOE OHEP

To Do List

- **Beam into the MTA Hall**
  - **HPRF test**
- **MICE**
- **Support EMMA**
- **Advance Muon Collider Scenario**
- **Participate in IDS-NF**
- **Study High-Power Target Infrastructure**
- **Solve the RF/Magnetic Field Challenge**

  (Biggest Technical Challenge-It's the RF Stupid!)
- **Obtain timely approval for 5-year plan**

  (Vital for delivery of MC Feasibility Study by ~2013)

Summary

Substantial Progress since MUTAC08!

Experimental Program

- **MERIT analysis progressing**
- **MICE experiment is underway**
- **MUCOOL RF program progressing**
- **MTA beam line finished - 1st beam into hall this Fall**
- **EMMA experiment being assembled**

Simulation Program

- **6D cooling simulations**
- **Neutrino Factory design work within IDS auspices**
- **Muon Collider design effort progressing with NFMCC/MCTF coordination**

The NFMCC and the MCTF are working well together

MUTAC08 recommendations have been addressed
We look forward to the MUTAC09 recommendations

5-Year Plan has been submitted to DOE OHEP

A strong endorsement for the 5-year plan from MUTAC09 will be helpful!

Backup Slides

MUTAC 08 Recommendations

The muon collider feasibility study needs to quantify the energy, luminosity, and detector requirements for addressing the various physics signal scenarios that might be observed at the LHC. Eichten, Demarteau

Complete the analysis of the data from the MERIT experiment and compare with hydrodynamic calculations and benchmark particle production simulations. Determine what further targetry studies are required to establish the feasibility of a muon collider. McDonald, Samulyak

Measure the energy spectrum of dark currents from the 201 MHz cavity as a function of magnetic field and gradient, and use these data to predict backgrounds in the MICE tracking system. Torun

Recommendations II

The muon collider feasibility study needs to quantify the energy, luminosity, and detector requirements for addressing the various physics signal scenarios that might be observed at the LHC. Eichten, Demarteau

Pursue a more aggressive program at MTA, taking advantages of its unique facilities to do experiments that compliment the MICE program. Li, Torun

NFMCC should focus on completing all the remaining steps in MICE. Zisman

Working together, NFMCC and MCTF need to identify those pieces of information from the MICE experiment expected to contribute to the muon collider feasibility study. Jansson

Recommendations III

The committee strongly supports significantly increasing the manpower and scope of simulations studies. It also emphasizes the need for well coordinated efforts with focus on the bench-marking of the key process and cross-checking of the codes. Leveraging resources within the MCCC and UKNF collaborations, and Muons Inc., and Tech X to increase the manpower directed towards simulations of the acceleration system and storage ring is critical.

Parametric studies should be carried out to explore various scenarios of muon colliders leading to an optimal choice of accelerator type for each stage of a muon collider.

Significant simulation will be required to more accurately evaluate the performance of the chosen muon collider scheme. Phenomena in need of study includes wake-field and space-charge effects, and simulations of the matching sections, etc. The simulation effort should lead ultimately to self-consistent start-to-end simulations of the entire complex.

The committee recommends the collaboration aggressively pursue code development for full-blown simulation of key components with a clear plan of bench-marking codes with planned experiments. Recent results from MERIT should be used as the test bed for such bench-marking.

Fernow

Recommendations IV

Develop a detailed plan to reach the goal of a MC feasibility study by 2012 for presentation to the MUTAC in 2009. Geer

Develop tools to narrow the options for a MC. This includes a parametric optimization of the entire muon collider facility in terms of cost and performance, particularly the acceleration section, 6D cooling, and decay ring. Geer

The MC will require high field solenoids. We strongly endorse the formation of new DOE technology effort to promote the development of HTS for high field applications. Tollstrup

Reassess the feasibility of a MC detector and incorporate detector issues into the optimization of the decay ring. Departeau

Recommendations V

To organize and complete the 2012 feasibility study, NFMCC and MCTF must become more tightly coordinated, in order to optimally manage the resources available across the national labs, its integration with international experiments and the US participation for the neutrino factory IDS. Geer

A detailed costing breakdown of the 5-year plan and its activities is requested before the next MUTAC review, to ensure that task priorities are effectively matched to meet both international commitments and feasibility study deliverables by 2012. Geer

Recommendations VI

The committee recommends that the 5-year plan be a fully-integrated, joint effort, to capture and enumerate the full scope of R&D plans for both NFMCC and MCTF activities. Geer

The committee recommends that the 5-year plan include the initiation of planning for a 6-D cooling demonstration experiment. Jansson

Consider in the 5-year plan the evaluation of the various physics scenarios, circa 2012, to establish requirements for energy and luminosity of a MC and to help narrow the range of parameters. Departeau