MERIT Experiment Status

NFMCC Collaboration Meeting

FNAL

March 17-20, 2008
The Collaborating Institutions

U.S.

Brookhaven National Laboratory
Fermi National Accelerator Laboratory
Oak Ridge National Laboratory
Princeton

Europe

CERN
Rutherford Appleton Laboratory
MERIT Experiment in the TT2a Area

- Upstream beam elements (new)
  - Quadrupoles for final focusing
  - Collimator
  - Beam profile measurement
  - Beam intensity measurement

- Solenoid & Hg loop
- Beam dump
- Material access shaft
- Personnel access
- Racks & electronics
- N2 Exhaust line

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Harold G. Kirk
The Pump/Probe Detectors

- ACEM (Aluminum Cathode Electron Multiplier)
- Diamond

Behind dump in beam line

+/- 10 degrees

+/- 20 degrees

In beam line, upstream of target

March 20, 2008 M. Palm, CERN - AB/ATB/EA

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Sectional view of the MERIT Experiment

Secondary Containment

Syringe Pump

Solenoid

Jet Chamber

Proton Beam

Hg Jet

Beam Window

BROCKENHAM NATIONAL LABORATORY

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Harold G. Kirk
Profile of the Experiment

- 14 and 24 GeV proton beam
- Up to $30 \times 10^{12}$ protons (TP) per 2.5μs spill
- Proton beam spot with $r \leq 1.5$ mm rms
- 1cm diameter Hg Jet
- Hg Jet/proton beam off solenoid axis
  - Hg Jet 33 mrad to solenoid axis
  - Proton beam 67 mrad to solenoid axis
- Test 50 Hz operations
  - 20 m/s Hg Jet
Proton Beam Characteristics

- PS was run in a harmonic 4, 8, and 16 mode
- Fast extraction can accommodate entire 2.5 $\mu$s PS fill.
- Full single turn extraction at 24 GeV
- Partial/multiple extraction possible at 14 GeV
- First Beam on Target October 17 2007
MERIT Beam Shots

- 30 x $10^{12}$ protons/pulse!!!
- 24 GeV
- 115kJ !!! a PS record
A 3TP Pump Pulse and a 1TP Probe Pulse with 1ms delay

Run 3011, Diam right 10, 1.0 ms Pump/Probe [Pump]

Run 3011, Diam right 10, 1.0 ms Pump/Probe [Probe]
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

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

Disruption Length
= 16.5 cm
Influence of B-field on Jet Disruption

Disruption Length, m

Proton Intensity, TP

24 GeV Proton Beam

Disruption Length, m

Proton Intensity, TP

24 GeV Proton Beam

Harold G. Kirk
The 24 GeV 30TP shot

Beam pulse energy = 115kJ
B-field = 15T
Jet Velocity = 20 m/s
Disruption Length = 16 cm

We will replace 2 interaction lengths (28cm)

Then the jet transport time is 28cm/20m/s = 14ms
⇒ Rep rate of 70Hz
⇒ Proton beam power at that rate is 115kJ *70 = 8MW
4TP + 4TP Delay Study: 14 GeV 7T

Single Turn Extraction ➞ 0 Delay

4TP Probe extracted on subsequent turn ➞ 3.2 μs Delay

4TP Probe extracted after 2nd full turn ➞ 5.8 μs Delay

Target supports 14 GeV 4TP beam at 172kHz rep rate without disruption
Decommissioning

- Optics has been shipped to BNL
- Pulsed Solenoid ready to be removed from TT2a
- Hg Injection System
  - Hg removed to shipping vessels
  - 200 ml of Hg spilled and cleaned up (floor to be repainted)
  - Hydraulic fluid removed to shipping barrel
- Solenoid and Injection System to be removed from TT2a within next 2 weeks
- Solenoid, Cryo-system, Hg Injection system to be shipped to U.S. January 09
Data Analysis Activities

Disruption threshold based on proton beam characteristics
   Intensity variations
   Proton beam harmonic structure
Disruption threshold based on solenoid field strength
Pump/probe studies
   15TP pump + 5TP probe with delays 2 to 700μs
   24 GeV pump/probe studies with delays < 2μs
Magnetohydrodynamic studies
   Disruption (filamentation) velocities
   Quadruple distortions
Proton beam spot size analysis
More MERIT Reports to Follow

Optical Diagnostic Results       HeeJin Park
MERIT Simulations               Sergei Striganov