Systems Testing of a Free Hg Jet System for Use in a High-Power Target Experiment

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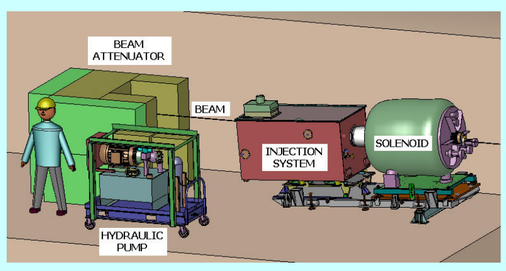
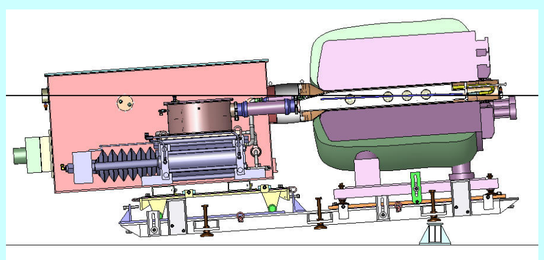
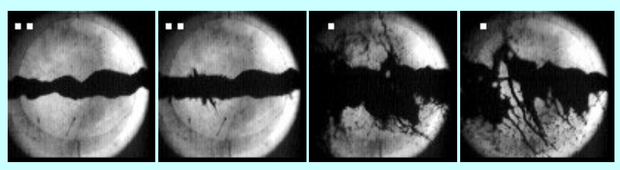
DESCRIPTION

The **MERIT experiment**, to be run at CERN in 2007, is a proof-of-principle test for a target system that converts a 4-MW proton beam into a high-intensity muon beam for either a neutrino factory complex or a muon collider. The target system is based on a free mercury jet that intercepts an intense proton beam inside a 15-T solenoidal magnet.

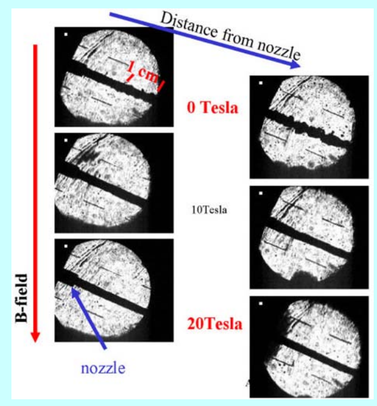




MERIT equipment and cross-section view through solenoid bore.



Past studies: A 1-cm-diameter, 2.5-m/s Hg jet at 0, 0.75, 10, and 18 ms after interaction with 3.8 x 10^{12} 24-GeV protons. The velocity of the filamentary dispersal was ~ 40 m/s.

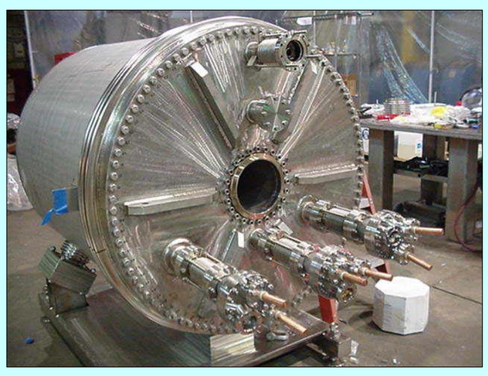


Past studies: The Rayleigh instability of a mercury jet (4-mm diameter and 12-m/s velocity) is suppressed by high magnetic fields.

EQUIPMENT

Hg Delivery System

- Hydraulically-actuated syringe pump
- Center 25-cm-dia Hg cylinder w/two side-mounted 15-cm-dia drive cylinders
- Hydraulic power unit: 30kW, 50 liter/min pump, 260 bar
- Hg volume: up to 23 liter
- Up to 12 sec jet duration for 20 m/s jet

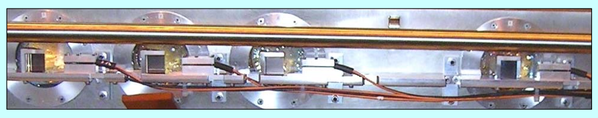


Solenoid

- 15-T, DC-pulsed magnet
- LN2 cooled to 80K operating temperature
- 7200A/700V/5.5MW
- 3 nested copper coil construction
- Warm bore: 15-cm dia, 1-m length

Optical Diagnostics

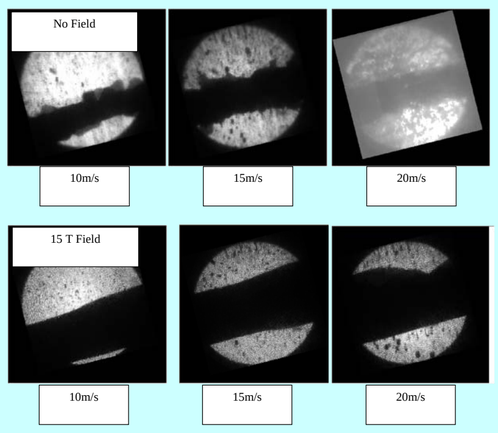
- Back-illuminated, laser shadow photography
- Passive optic components inside solenoid bore
- Radiation-resistant fiber bundles, 30K pixels/bundle
- Light source: 20W, 850-nm, Class 4 lasers
- Frame rates up to 1μs/frame



TESTING

Integrated systems testing was conducted at MIT during March 2007.

- 14 runs completed
- Field strengths: 5 T, 10 T, 15 T
- Jet velocities: 10 m/s, 15 m/s, 20 m/s



Observations

- Jet edges constrained by field
- Jet size increased with velocity
- For 20 m/s jet, size in 10 T field was smaller than in 15 T field, possibly due to quadrupole effect

STATUS

The MERIT equipment is currently being installed at CERN in preparation for the in-beam experiment scheduled to begin in the summer of 2007!