THE MERIT HIGH-POWER TARGET EXPERIMENT AT THE CERN PS

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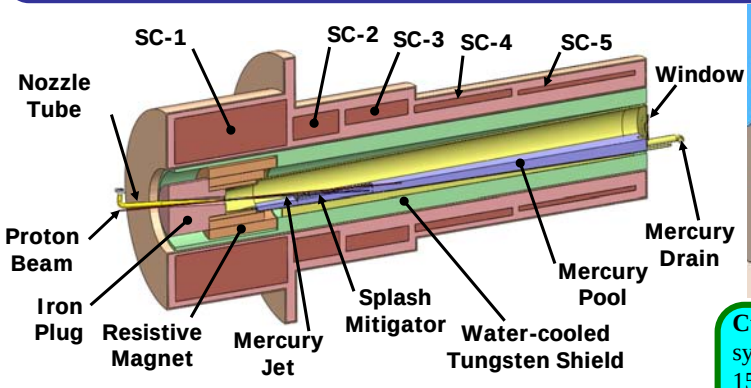
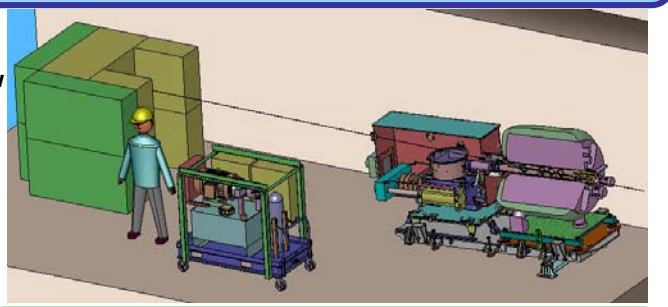
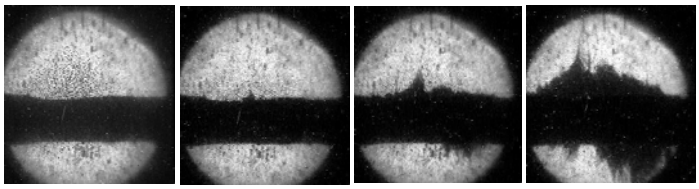
The **MERIT Experiment**, which ran at CERN in 2007, is a proof-of-principle test for a target system that converts a 4-MW proton beam into a high-intensity muon beam for either a neutrino factory complex or a muon collider. The target system is based on a free mercury jet that intercepts an intense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



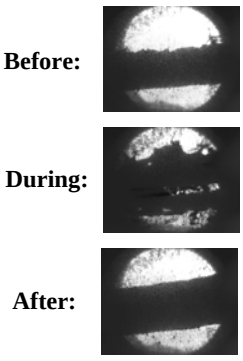


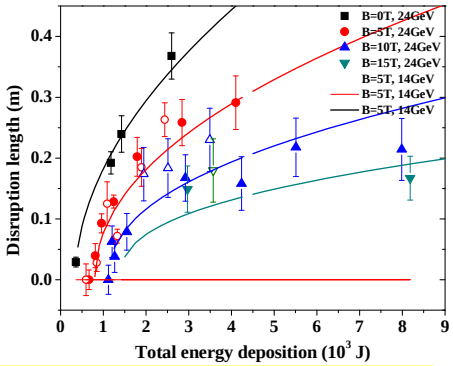
Cutaway view of the MERIT experiment. The solenoid/Hg jet system is tilted by 100~mrad with respect to the beam/floor. The 15-T magnet is cooled by LN_2 and can be pulsed every 30 min. The Hg jet is 1-cm in diameter and has a velocity of 20 m/s, which presents a new, 2-interaction-length target to the beam every 20 ms.

Concept of a continuous mercury jet target for an intense proton beam. The jet and beam are tilted by 100~mrad and 67~mrad, respectively, with respect to a 20-T solenoid magnet that conducts low-momentum pions into a decay channel.

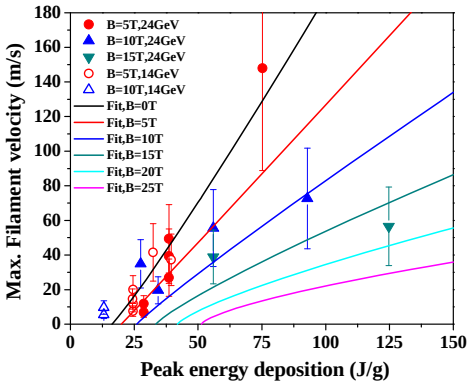


A 1-cm diameter, 15-m/s Hg jet at 0, 75, 175, and 375 μs after interaction with 10×10^{12} 24-GeV protons in a 10-T solenoid field. The velocity of the filamentary dispersal was ~ 40 m/s.

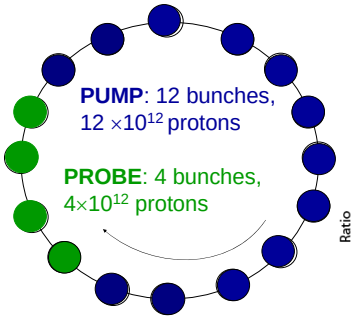




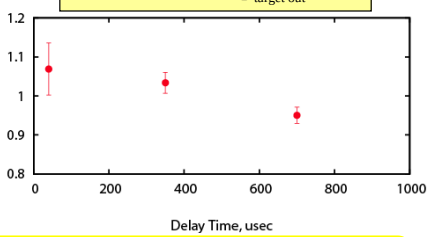
Above: The disruption of the jet by the beam is confined to the beam/jet interaction region, and is damped by high magnetic fields.



Above: Observed filament velocities, together with a global fit, for various proton beam energies and magnetic field. High magnetic fields damp the velocity.



$$\text{Ratio} = \frac{\text{Probe}_{\text{target in}} - \text{Probe}_{\text{target out}}}{\text{Pump}_{\text{target in}} - \text{Pump}_{\text{target out}}} \Big/ \frac{\text{Probe}_{\text{target out}}}{\text{Pump}_{\text{target out}}}$$



Above : Studies with a second set of proton bunches up to 750 μs after the first show negligible reduction in the production of pions.

The **MERIT Experiment**, has demonstrated the a free mercury jet target could be used in pulsed protons beams of power up to 8 MW, taking into account that a strong magnetic field reduces the disruption of the jet by the beam.