Targetry and Capture
for the Muon Collider

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Outline

1. The Baseline
2. Targetry/Capture Issues
3. The Targetry R&D Program
4. Alternative Approaches

The current Scenario

μ's/bunch:

In the Collider : 2 x 10^{12}
Losses in Acceleration (1/2) : 4 x 10^{12}
Losses in Cooling (1/2) : 8 x 10^{12}
Capture efficiency (1/2) : 16 x 10^{12}

Proton beam:

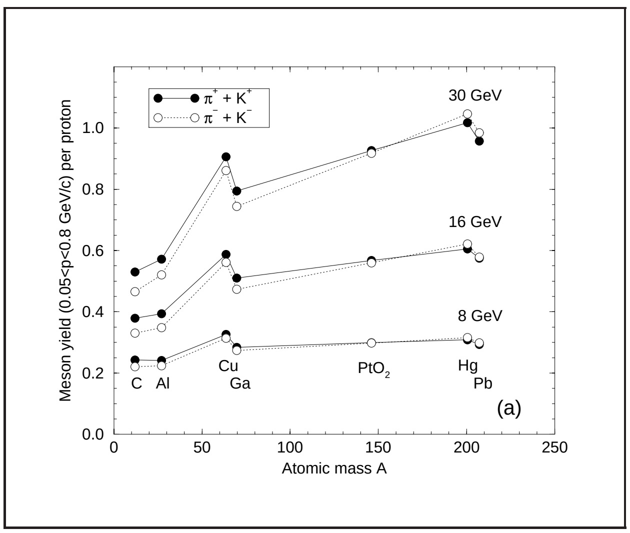
Pions/Protons (0.6) : 2.7 x 10^{13} $\Rightarrow$ 70 kW
(16 GeV/c protons and 0.05 $< p_\pi <$ 0.80 GeV/c)
Bunches/Pulse (4) : 280 kW
15 Hz Operation : 4 MW

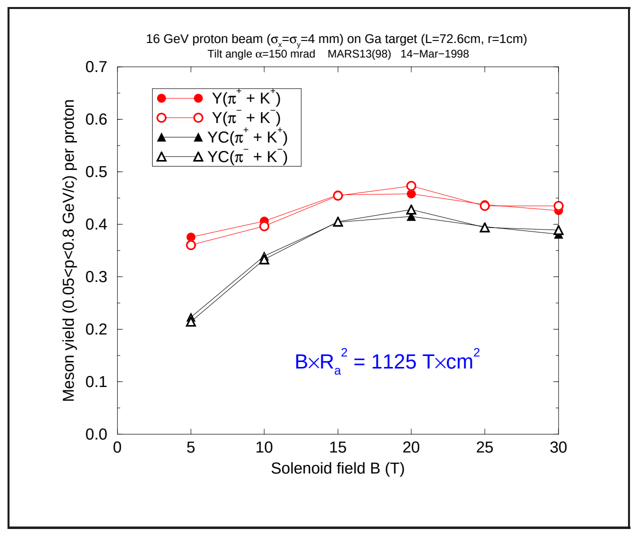
Power on the Target:

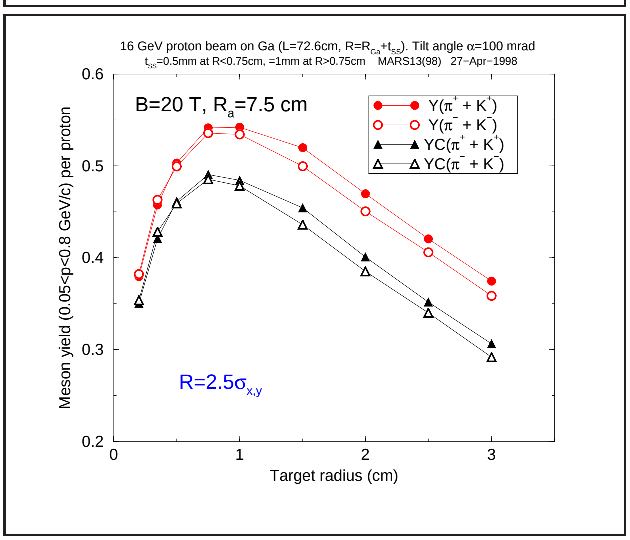
Per Pulse : 28 kW
15 Hz Operation : 400 kW

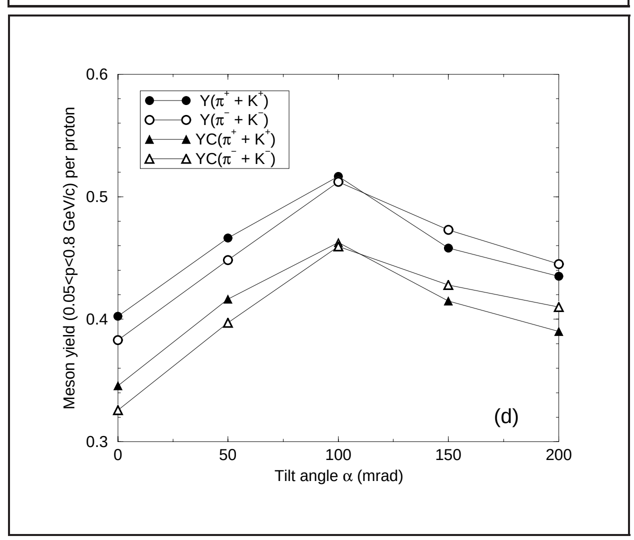
N. Mokhov

PION PRODUCTION

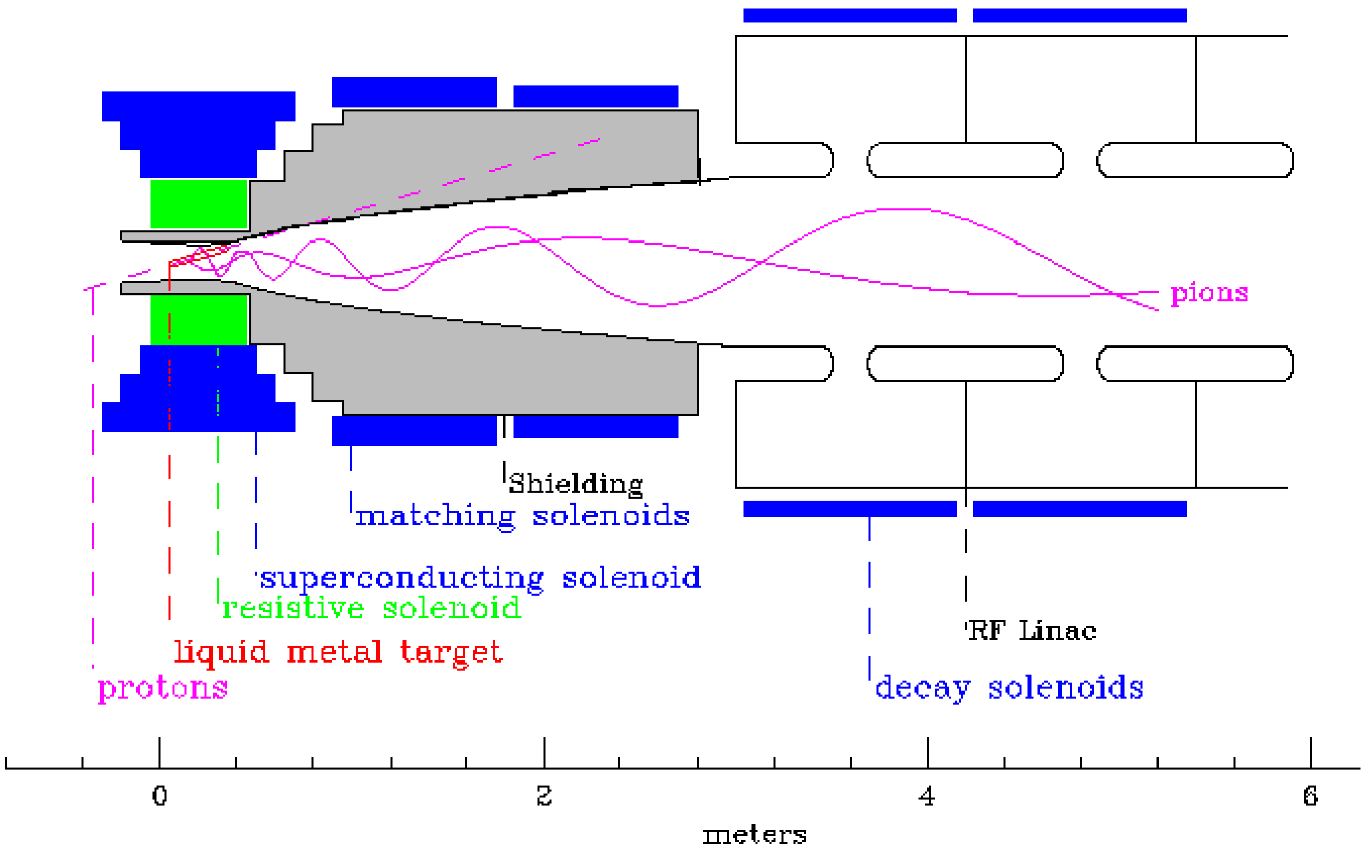






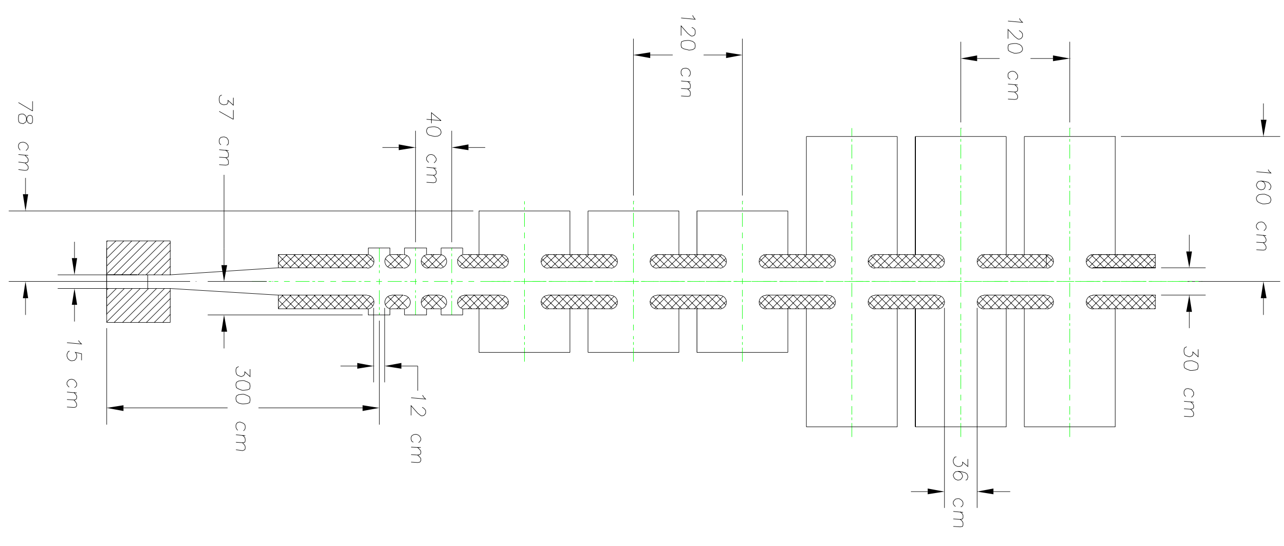


TARGET, CAPTURE & DECAY



- TARGET:Liquid Metal Jet
- CAPTURE:20 T Solenoid
- BEAM DUMP
- MATCHING
- DECAY & PHASE ROT:1.25 T

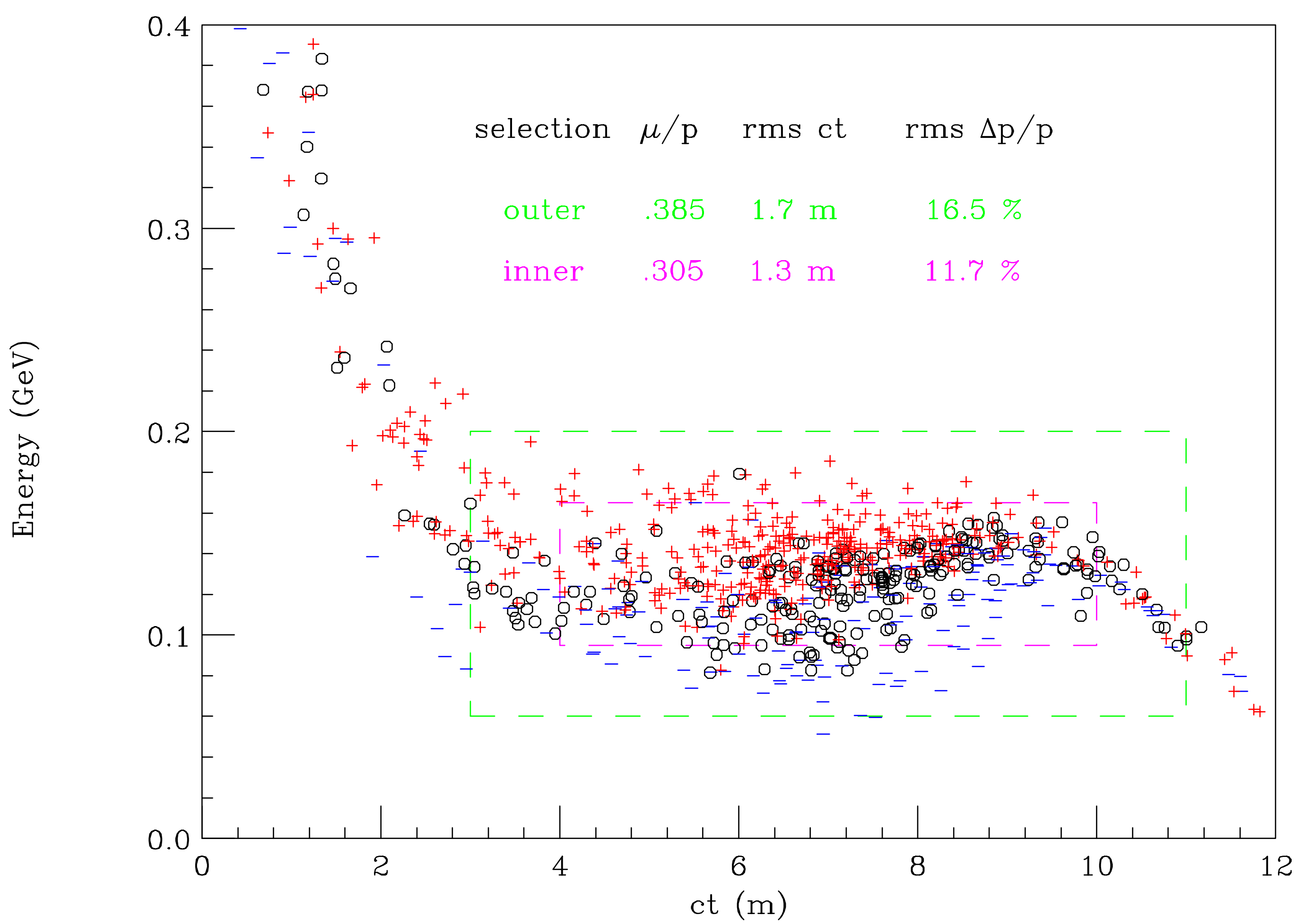
Phase Rotation Channel



R. Palmer

Muons at End of Phase Rotation

+ muons with P > $\frac{1}{3}$
- muons with P < -$\frac{1}{3}$



Targetry Challenges

Require $> 10^{15}$ protons/sec onto high-Z target

- Proton beam power $\approx$ 4 MW on target
- Need thermohydrodynamic modeling of target

Solid Target may not be feasible

Free Liquid Metal Jet Possible

- Contained liquids may explode

Capture in 20 T SC Solenoid

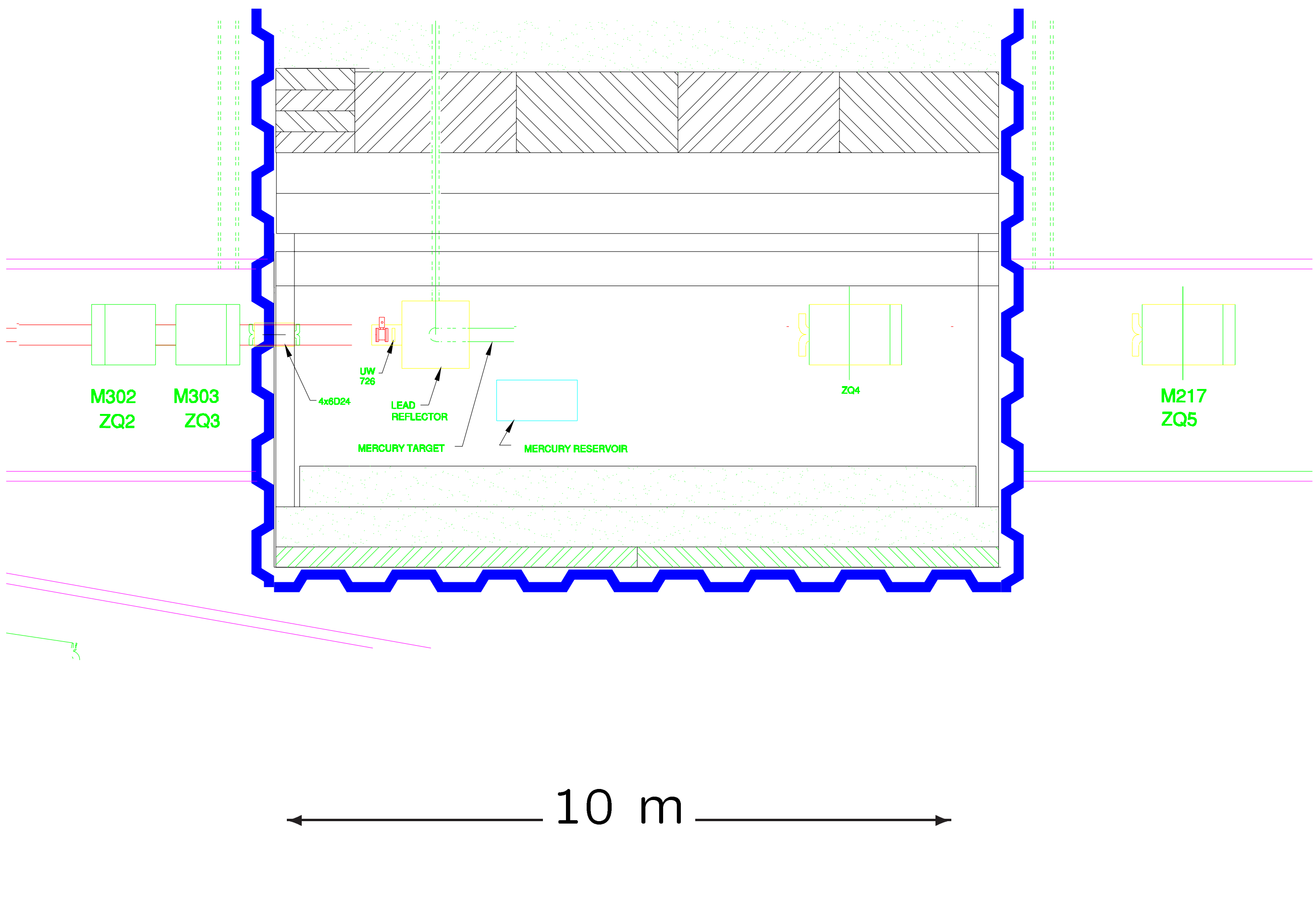
- Need magnetohydrodynamic modeling of target in 20T field

Operation of rf Cavity in High-radiation Environment

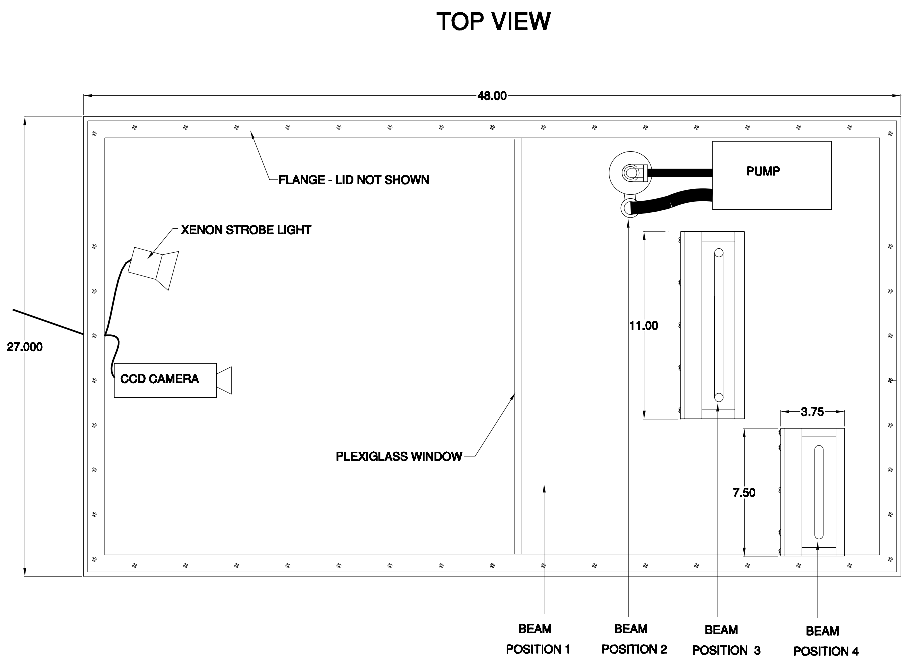
Targetry
R & D Program

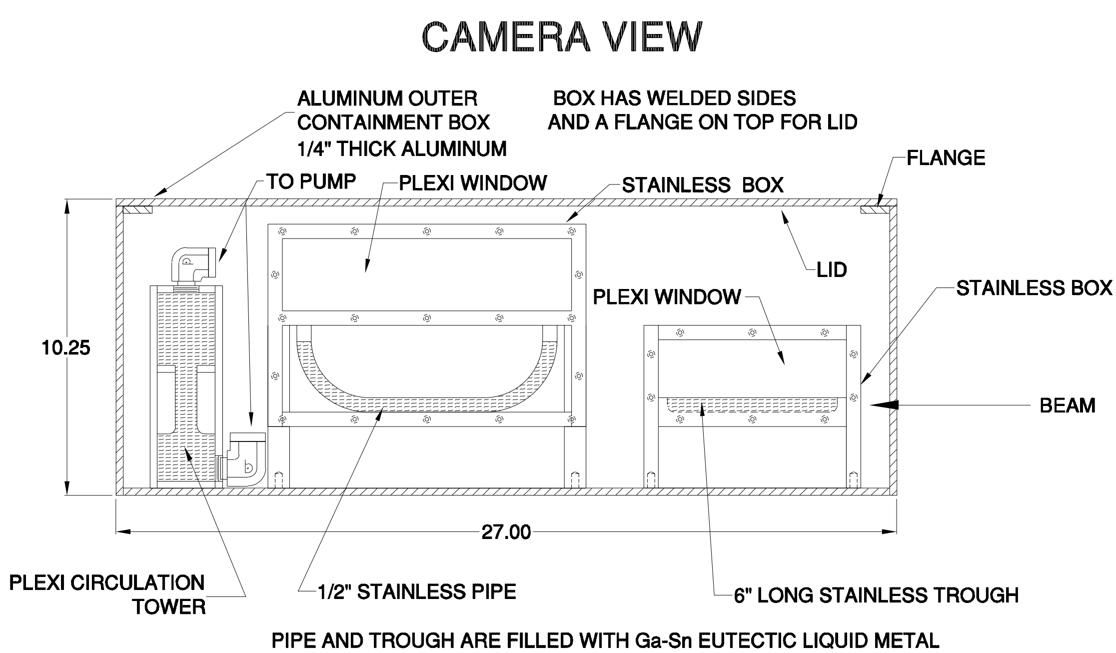
1. Studies of liquids and solids in proton beam
2. Liquid-metal jet in 20T solenoid at NHMFL
3. Liquid-metal jet in 10^{14} ppp beam
4. Liquid-metal jet in proton beam + 20T
5. Studies of 70 MHz Cavity downstream of target with proton beam–no 1.25 T solenoid
6. Studies of 70 MHz Cavity downstream of target with proton beam–with 1.25 T solenoid
7. Characterization of pion yield
8. Simulation of liquid metal performance

The Neutrino Blockhouse



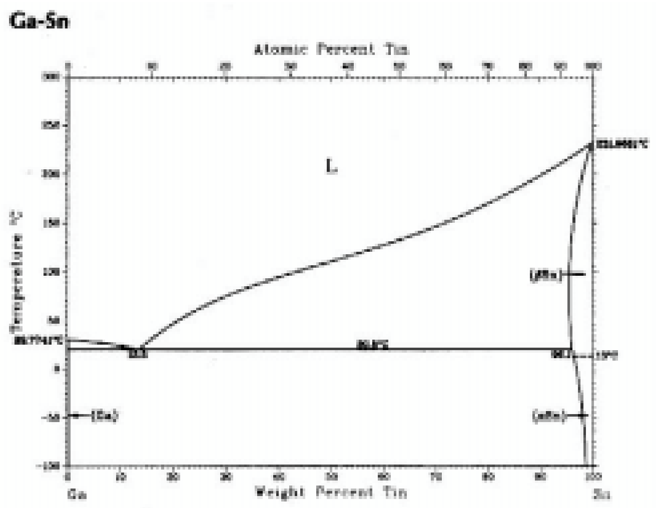
Initial Beam/Liquid Experiment





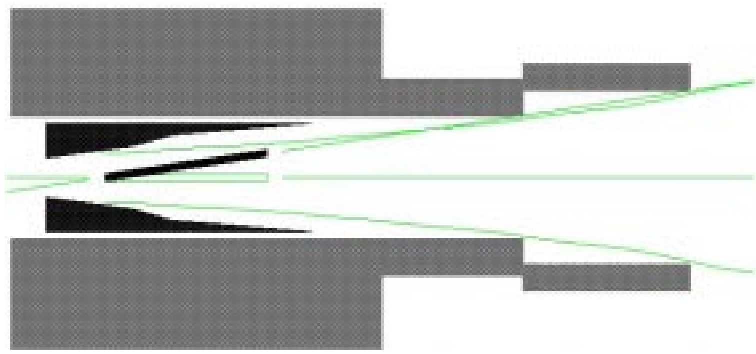
K. McDonald

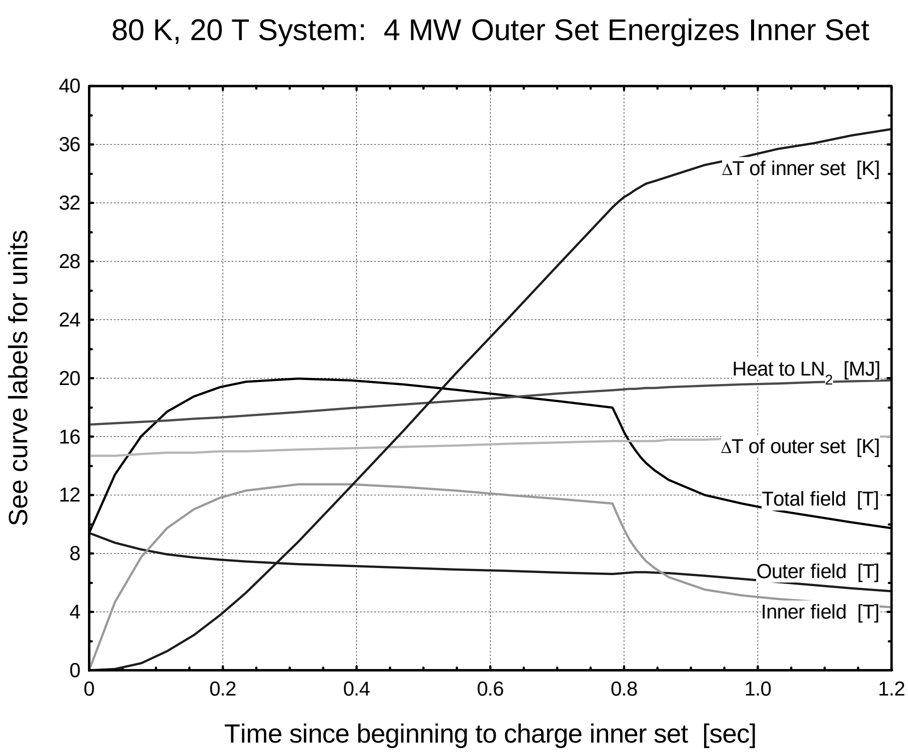
GaSn Liquid Metal



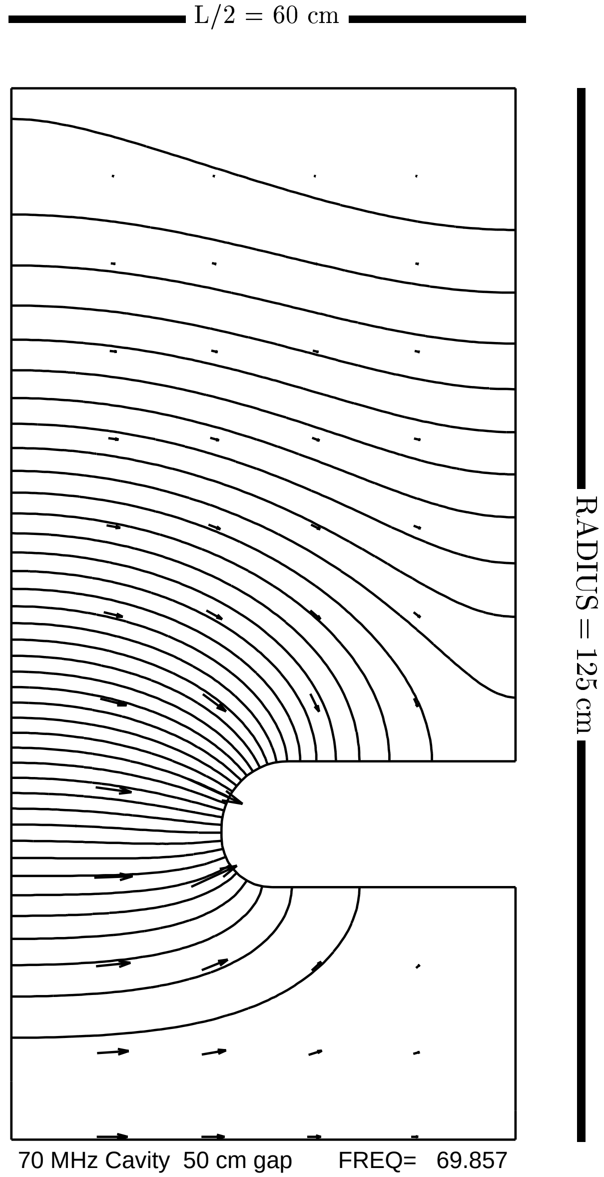
R. Weggel

The Pulsed 20 T Solenoid





The 70 MHz rf cavity



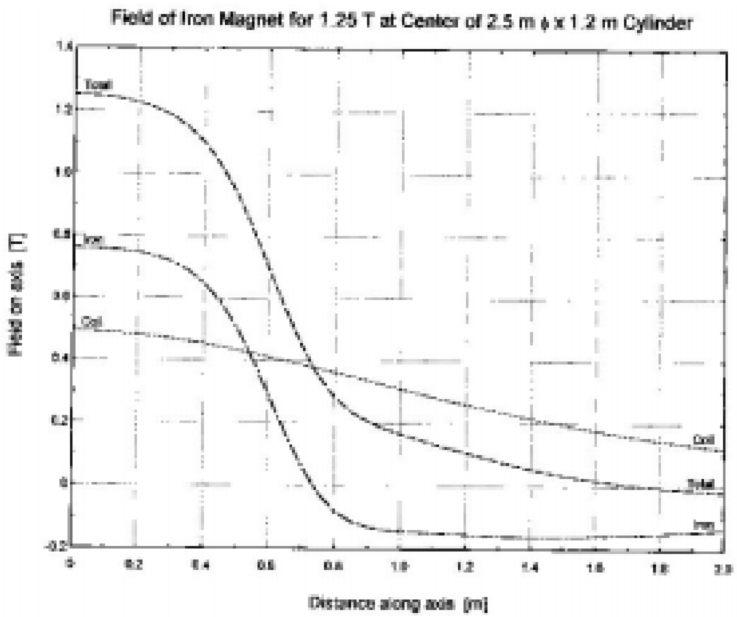
70 MHz rf Cavity Parameters

RF frequency [MHz]	70
Cavity Length [cm]	120
Full Gap length [cm]	50
Cavity Radius [cm]	125
Beam Pipe Full Aperture [cm]	60
Q/1000 (from SFISH)	63.1
Shunt Impedance [MΩ/m]	13
Ave Gradient [MV/m]	5.0*
RF Peak Power [MW]	2.4*
Stored Energy [J]	330*

*** 2 Kilpatrick Operation**

R. Weggel

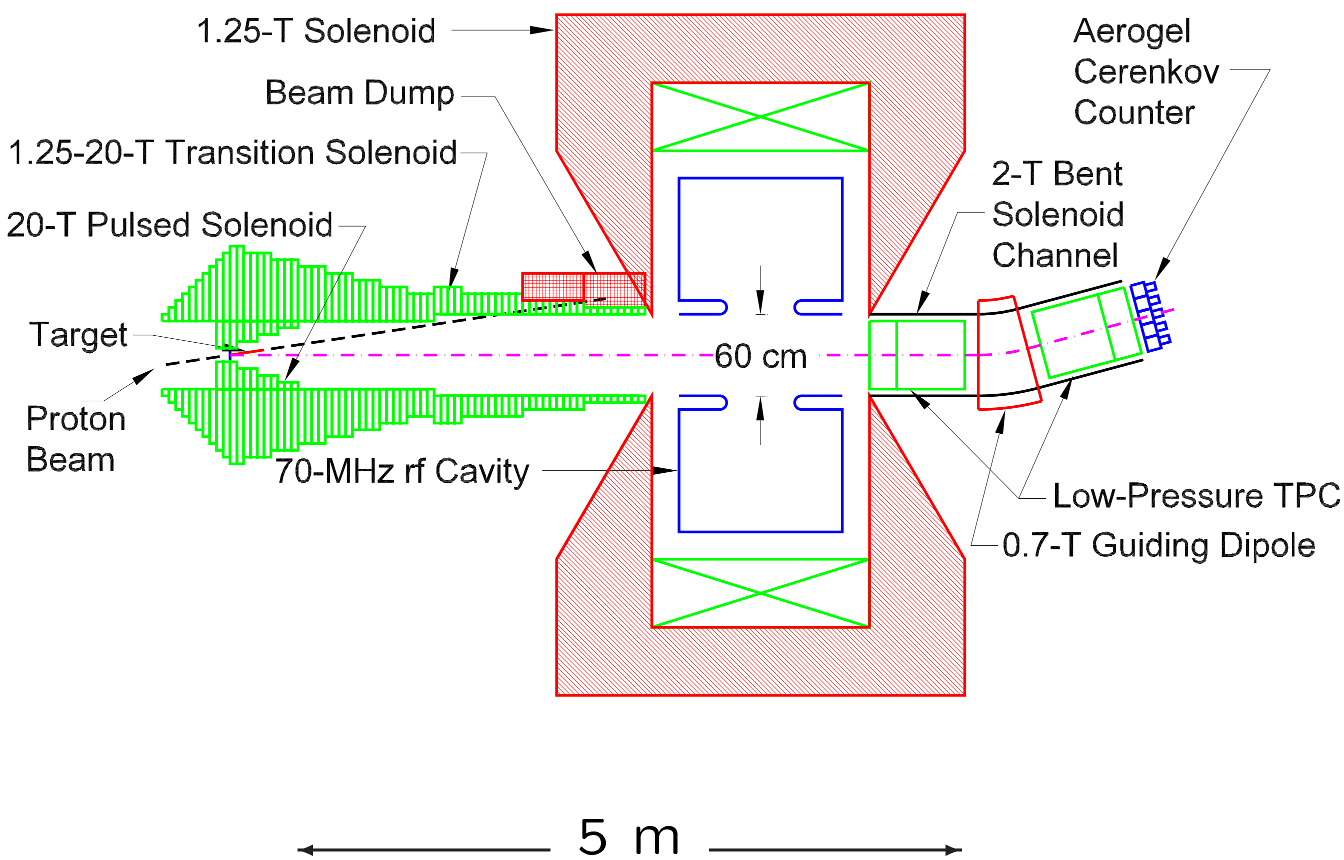
The 1.25 T Solenoid



Magnet features

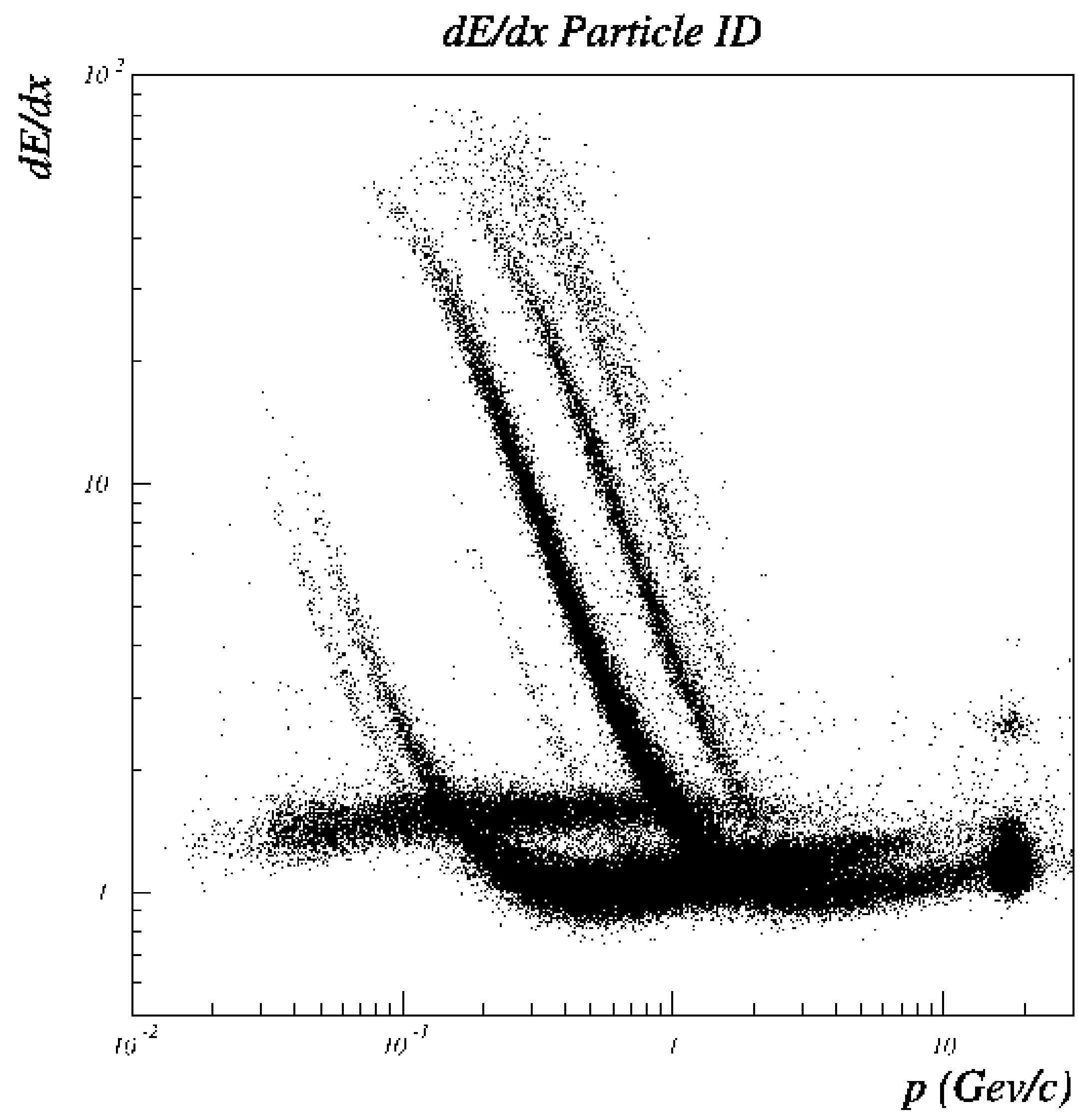
- 20-ton copper coil
- 140-ton iron return-flux yoke
- 1.2 MW cw power
- Similar to existing AGS E-787 magnet

Layout of the Targetry Experiment

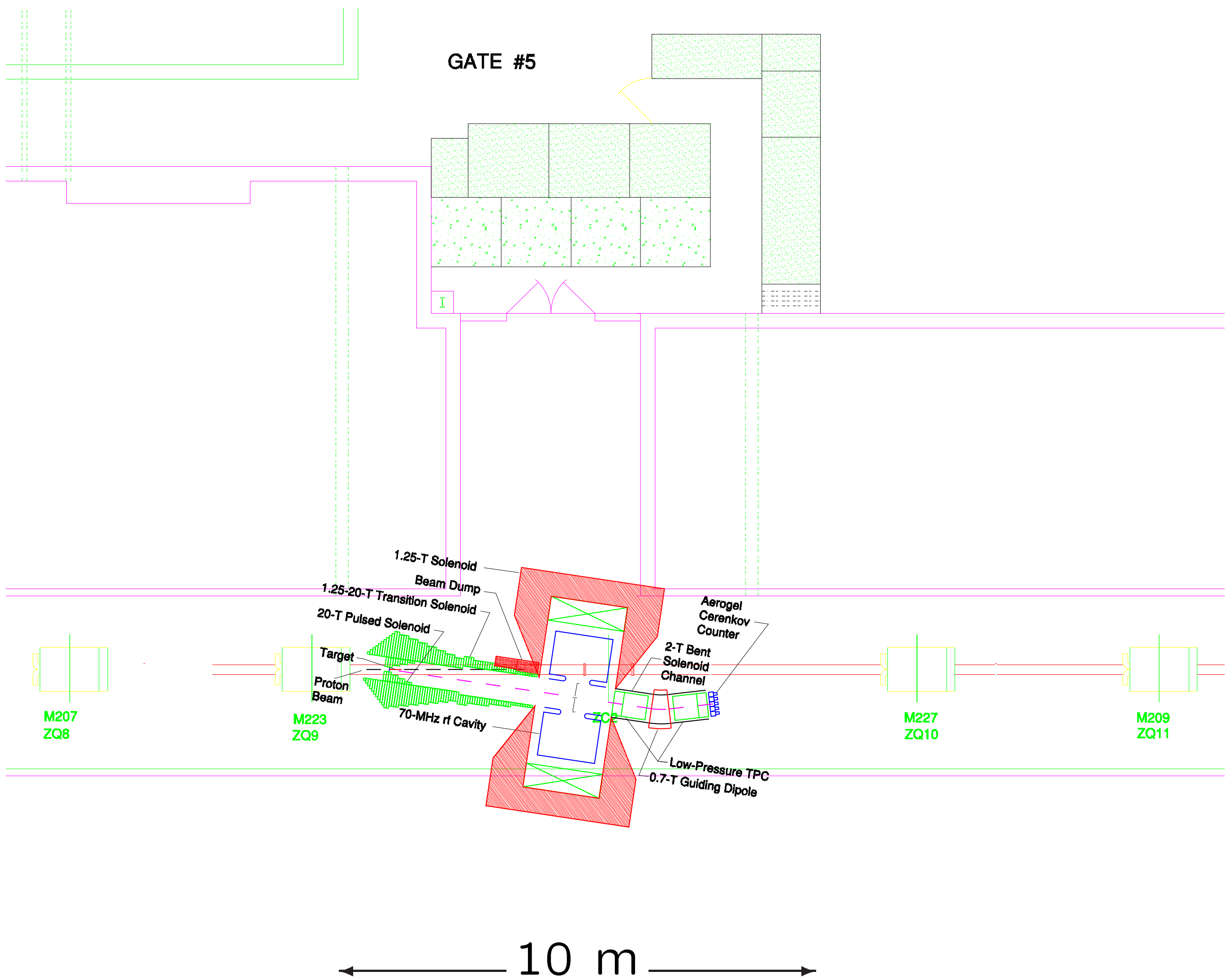


H. Hiejima

E910 TPC tracks

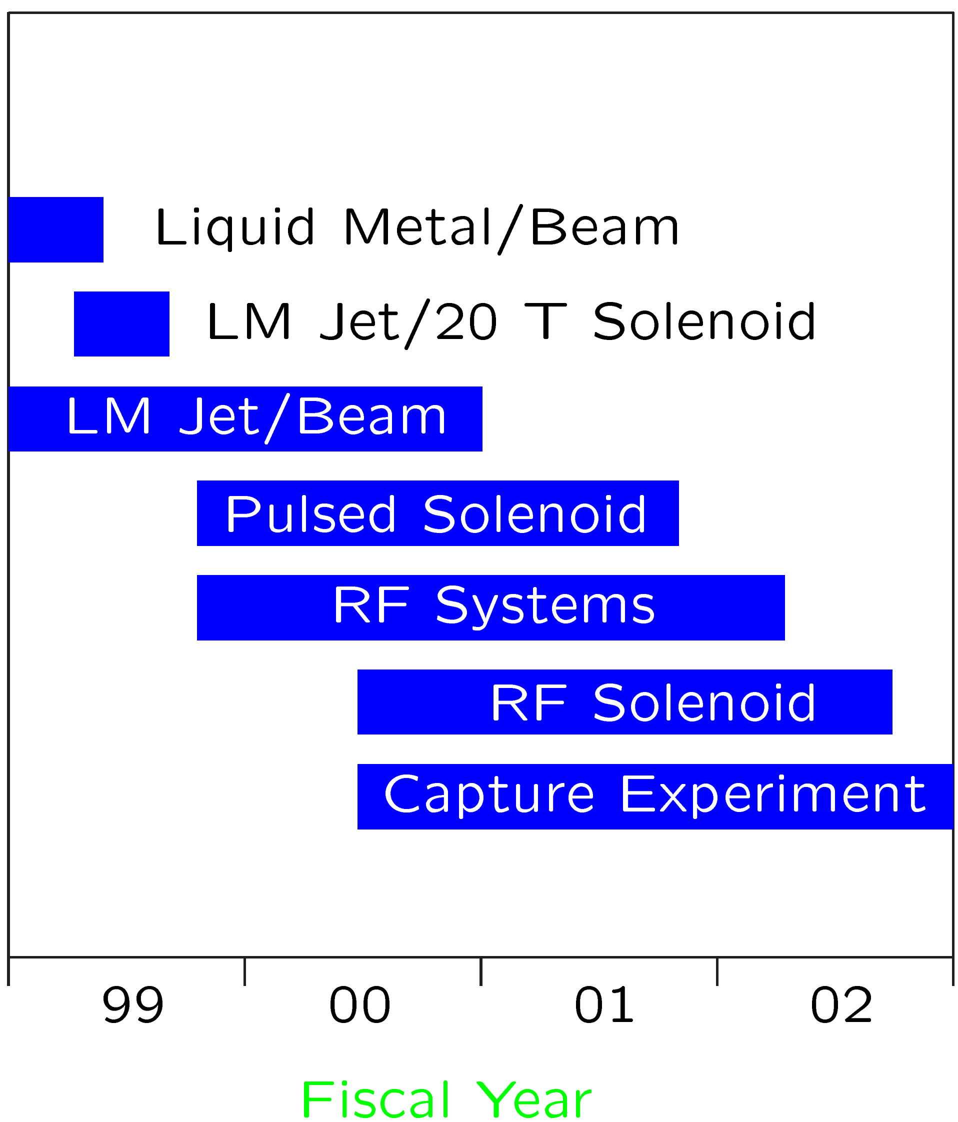


The Target Experiment in the Beamline



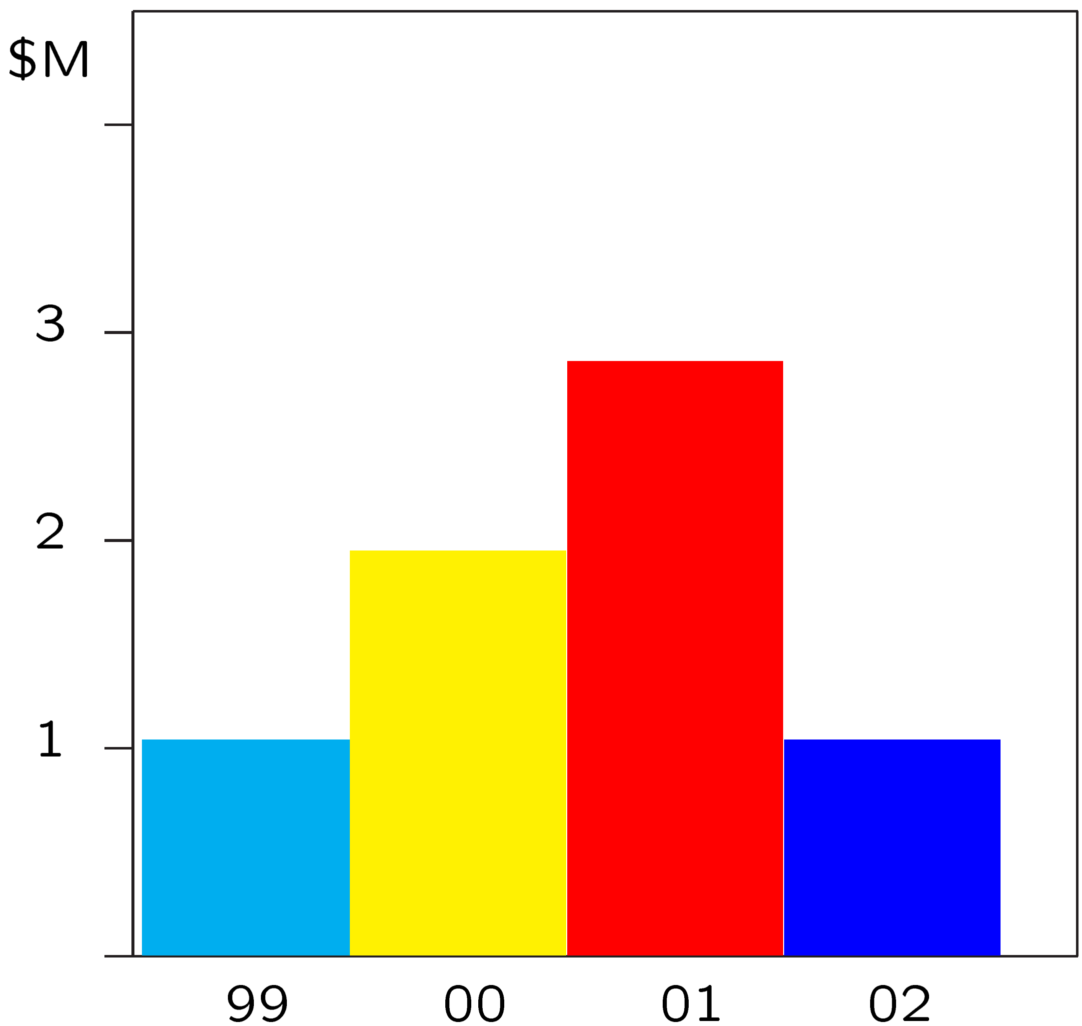
Targetry Experiment

Task Profile



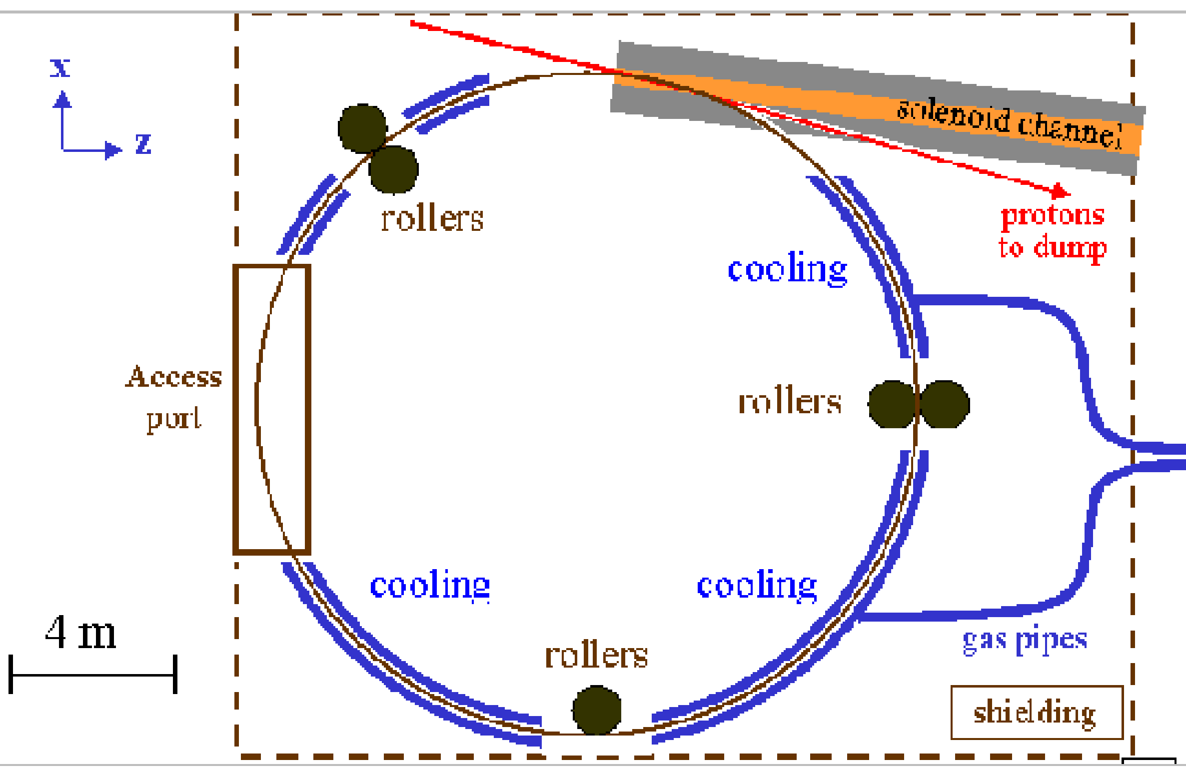
Targetry Experiment

Funding Profile



B. King

Solid Target Alternative



The Distributed Target