Target Baseline

IDS-NF Plenary

CERN

March 23-24, 2009

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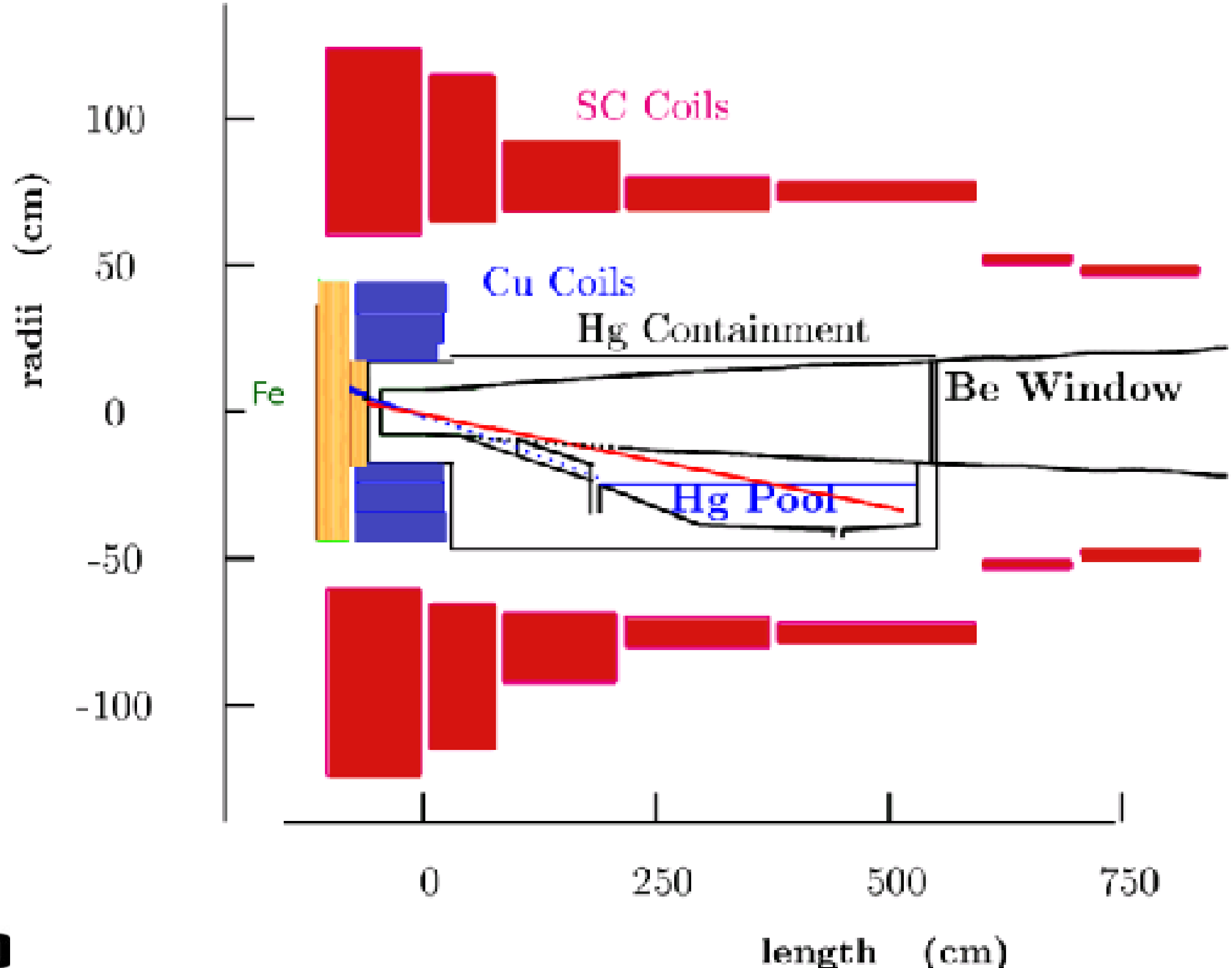
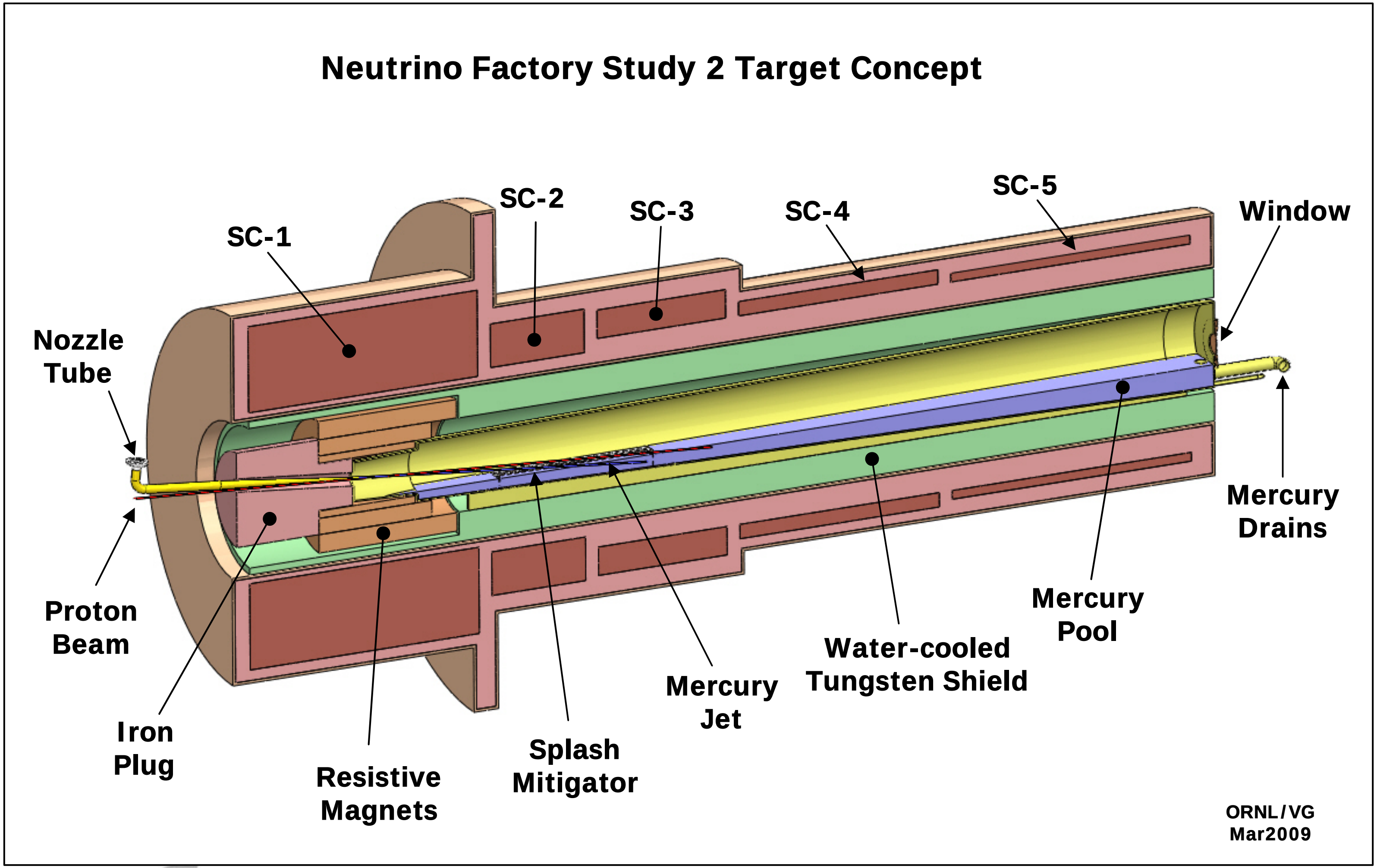
Brookhaven National Laboratory

The Neutrino Factory Target Concept

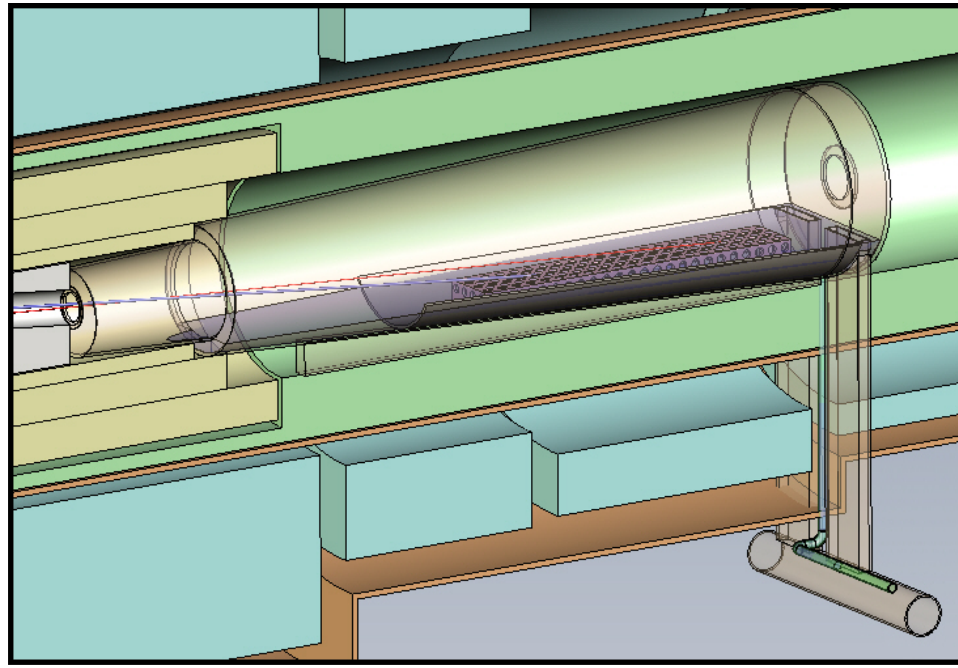


Path toward a Target System Design



Alternative Collection System

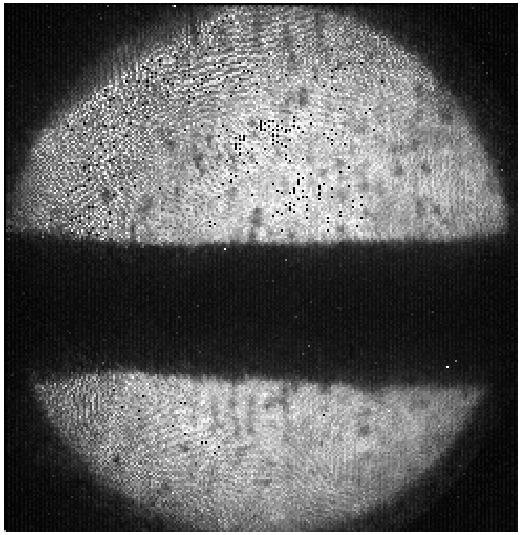
- Another containment approach includes a shortened Hg container
- Drain lines exit cryostat between SC-3 and SC-4
- This would trap container in the cryostat, preventing future replacement

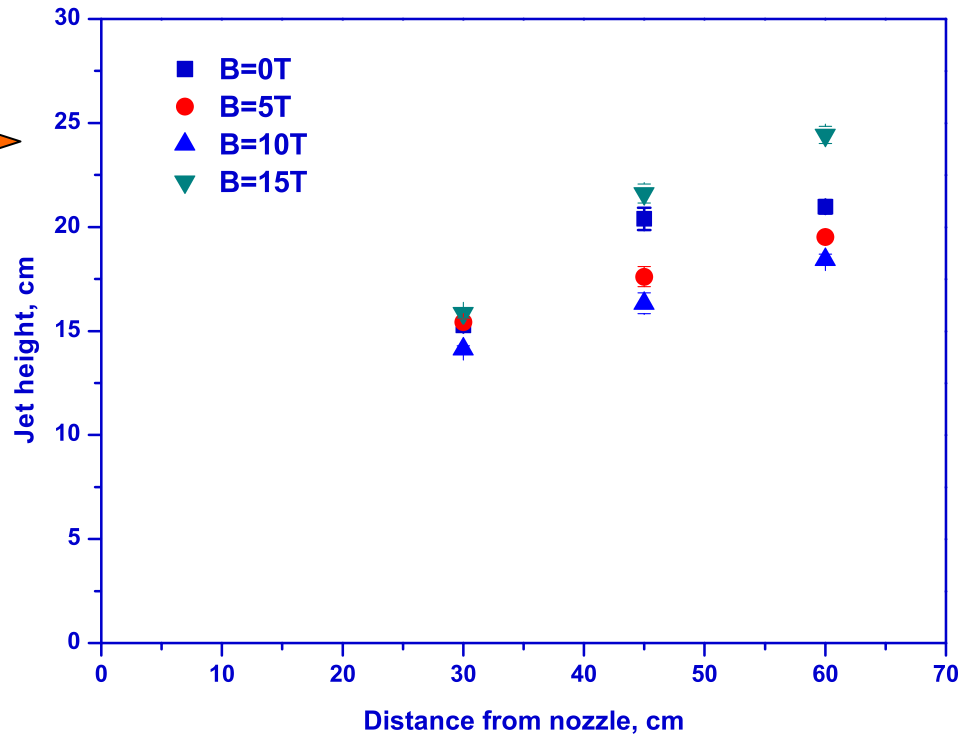


The Hg Jet Nozzle

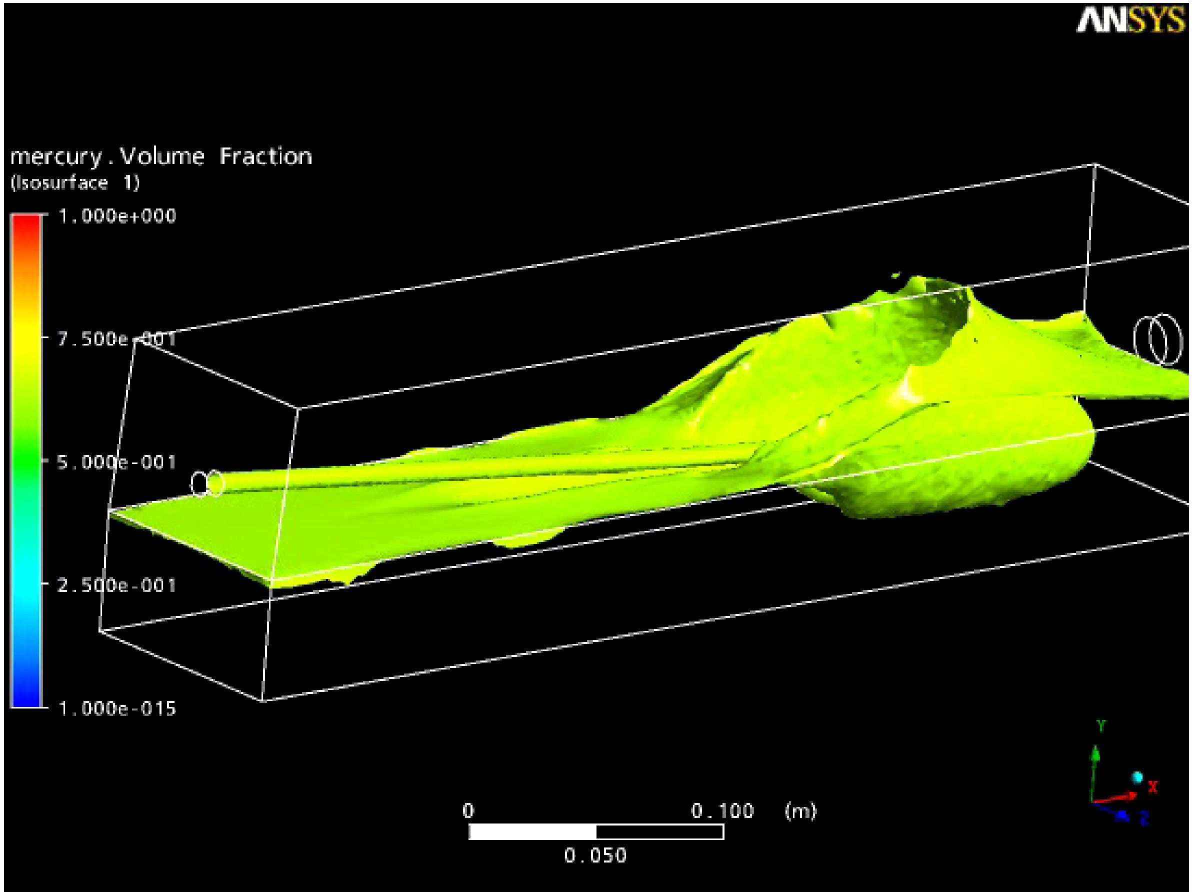
Nozzle performance:

The Issue





The Jet/Beam Dump Interaction



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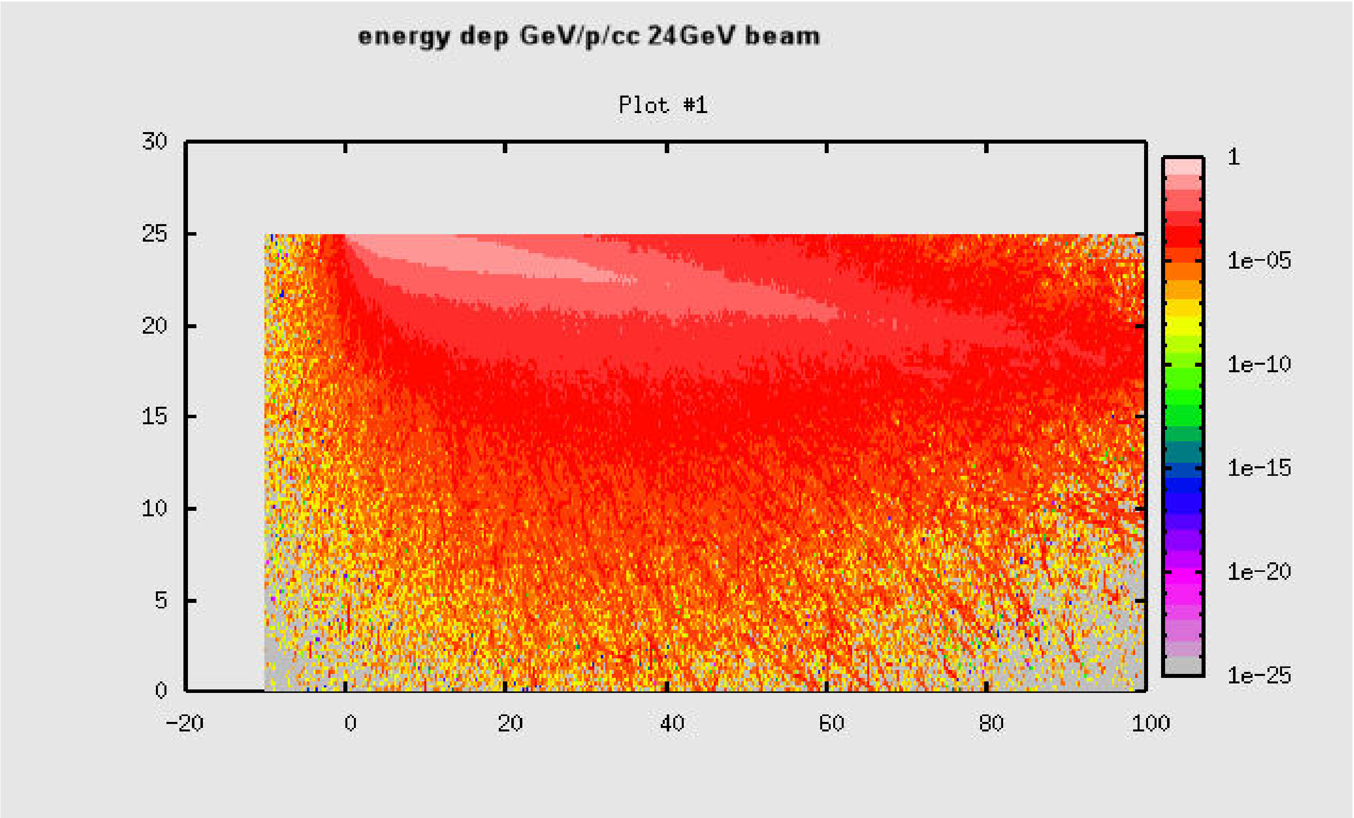
Fluka Simulation - Energy deposition in mercury pool with 24GeV beam



How much of the beam energy is absorbed in the beam dump?

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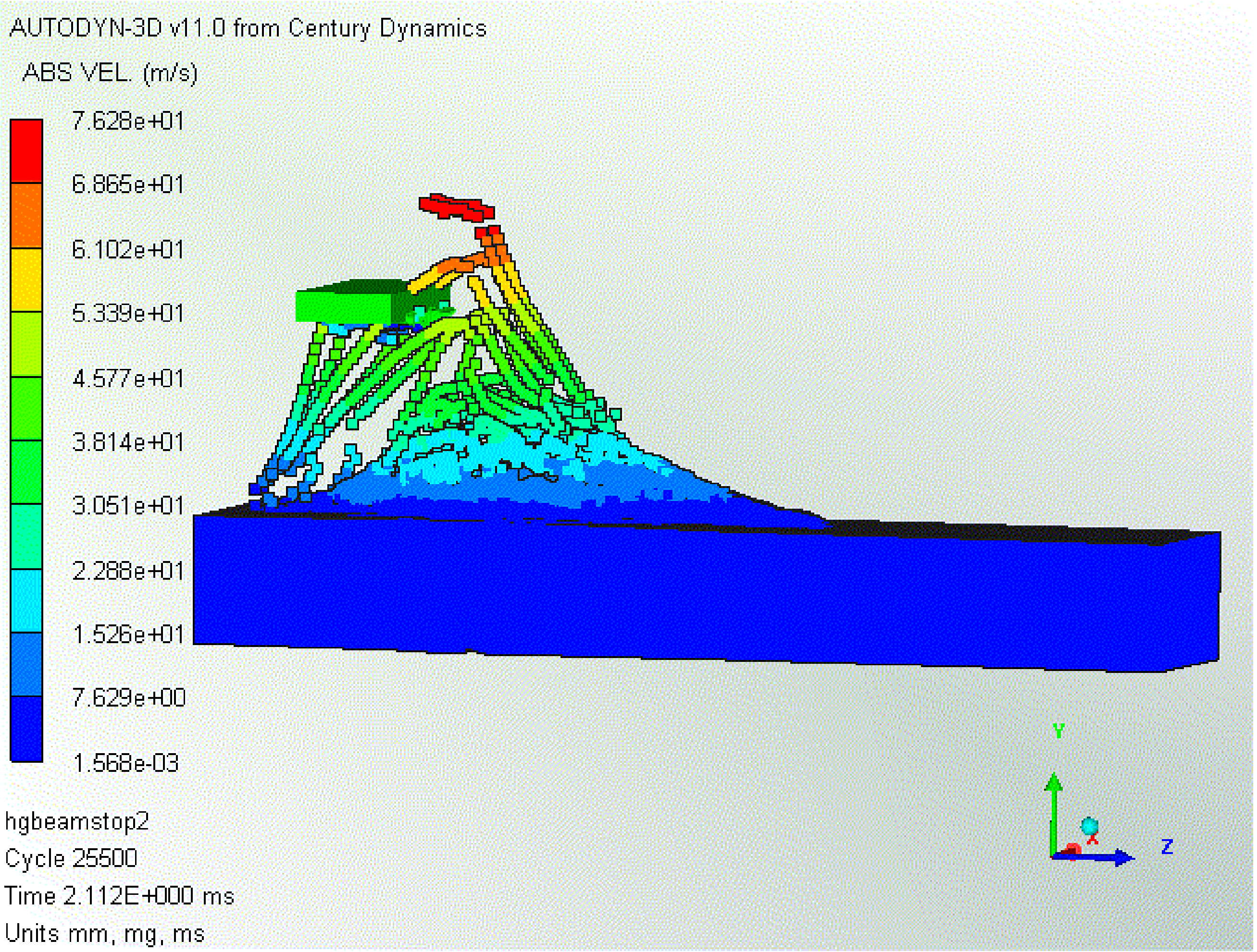
Eruption of mercury pool surface due to 24GeV proton beam



Autodyne simulation

Splash following pulse of 20Terra protons

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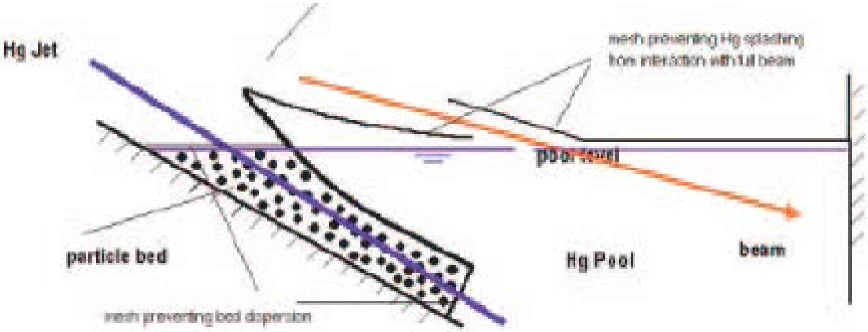
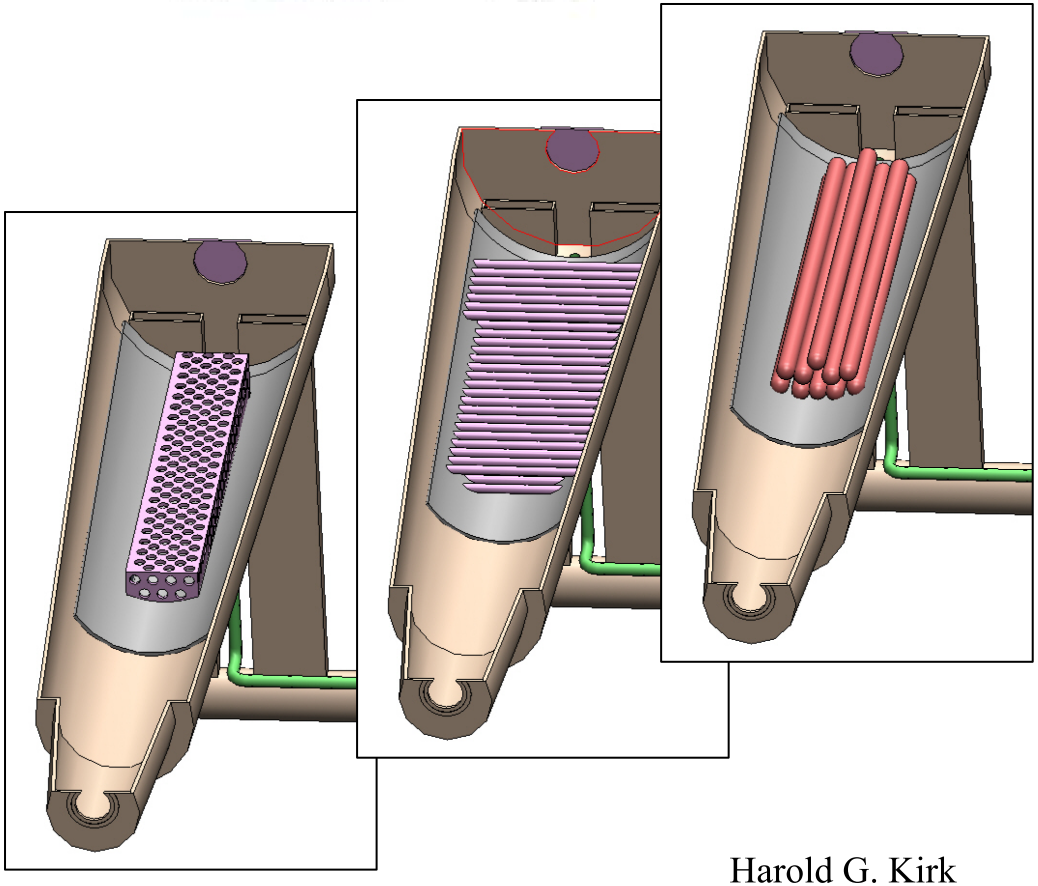
Splash Mitigation

- Study 2 assumed a particle bed of tungsten balls to minimize effects of jet entering pool
- Many other feasible concepts to accomplish this function
- Simulation/analytical studies may be useful to limit options
- Pool circulation and drainage locations also need to be studied
- Prototypic testing needed for comparison & final determination





Containment Design Requirements

Material compatible with high-field magnets

- Must also withstand some number of full-power beam pulses with no Hg in vessel (accident scenario)

Desire no replaceable components

Provide support for Hg weight

- ~220 liters, 3 metric tons

Sloped (1°-2°) for gravity drain

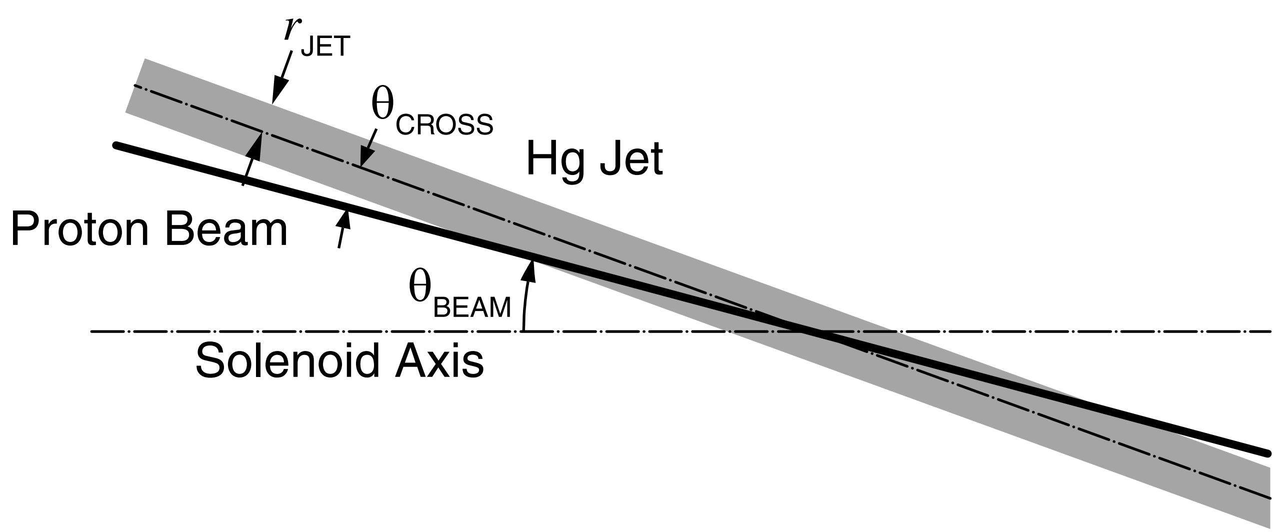
Overflow drain for 20m/s jet (1.6 liter/s)

Vent for gas transfer

Toward a Target Prototype

- Esatablish a coherent, engineered design concept
  - Design and test an improved nozzle
  - Design an Hg handling system
  - Design and test a CW Hg delivery system
- Design, fabricate and beam test a target prototype

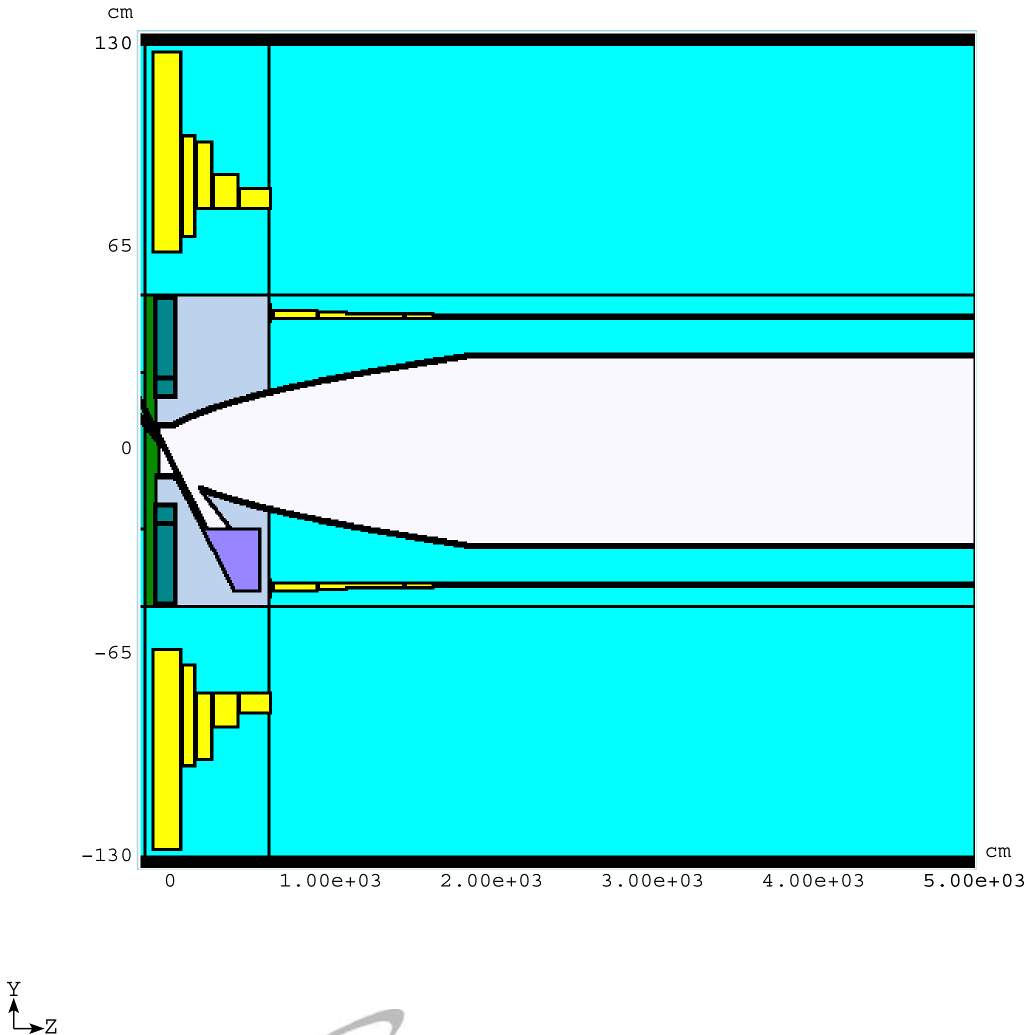
Hg Jet Target Geometry



Previous results: Radius 5mm, θ_{beam} =67mrad

$\Theta_{crossing}$ = 33mrad

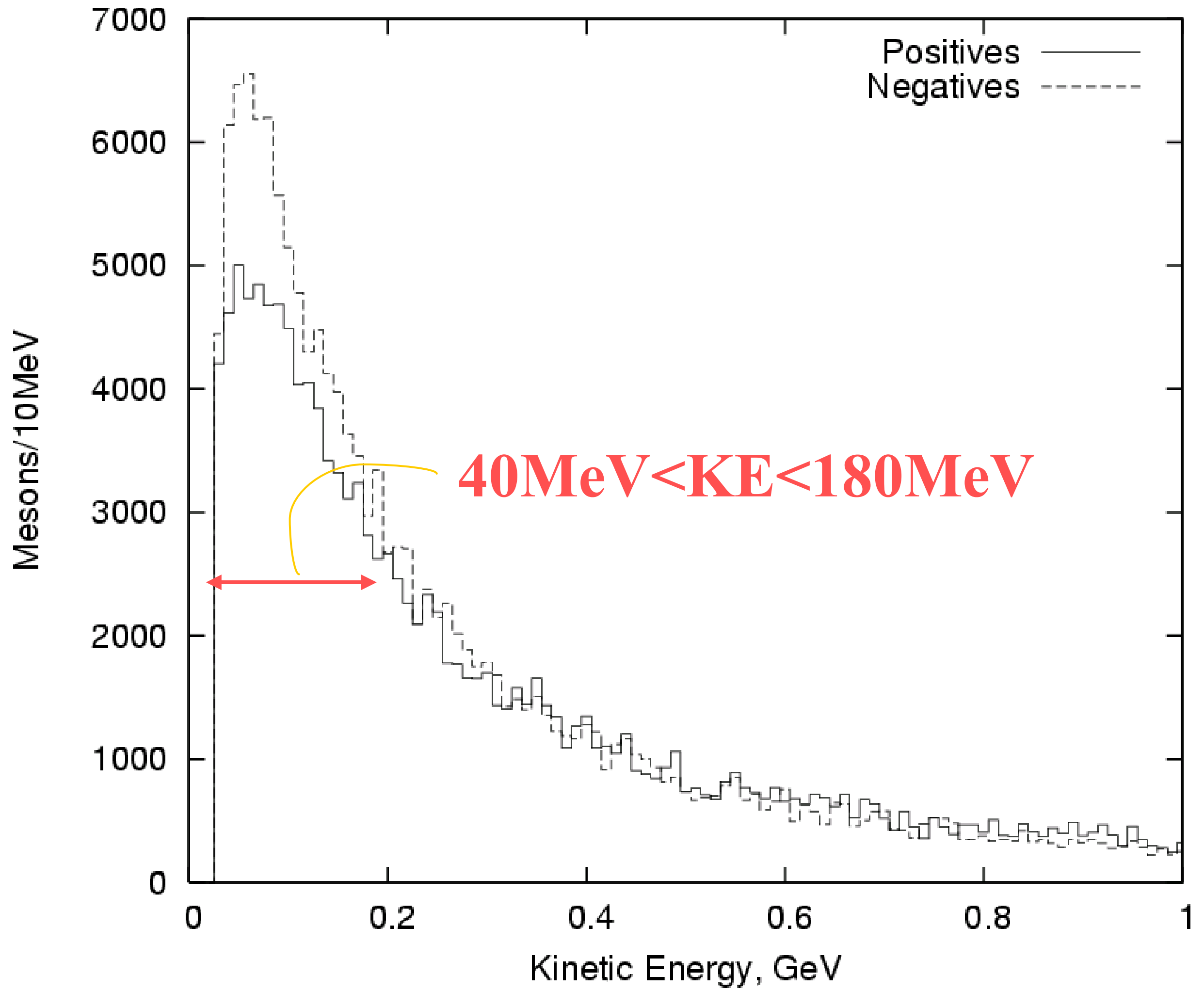
The Target/Collection System



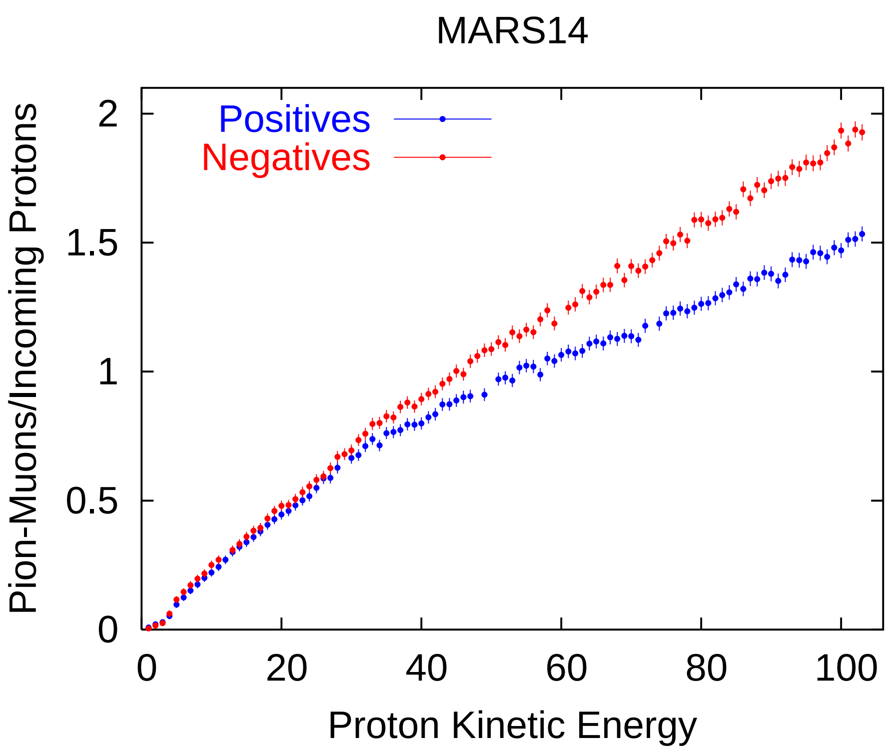
Count all the pions and muons that cross the transverse plane at z=50m.

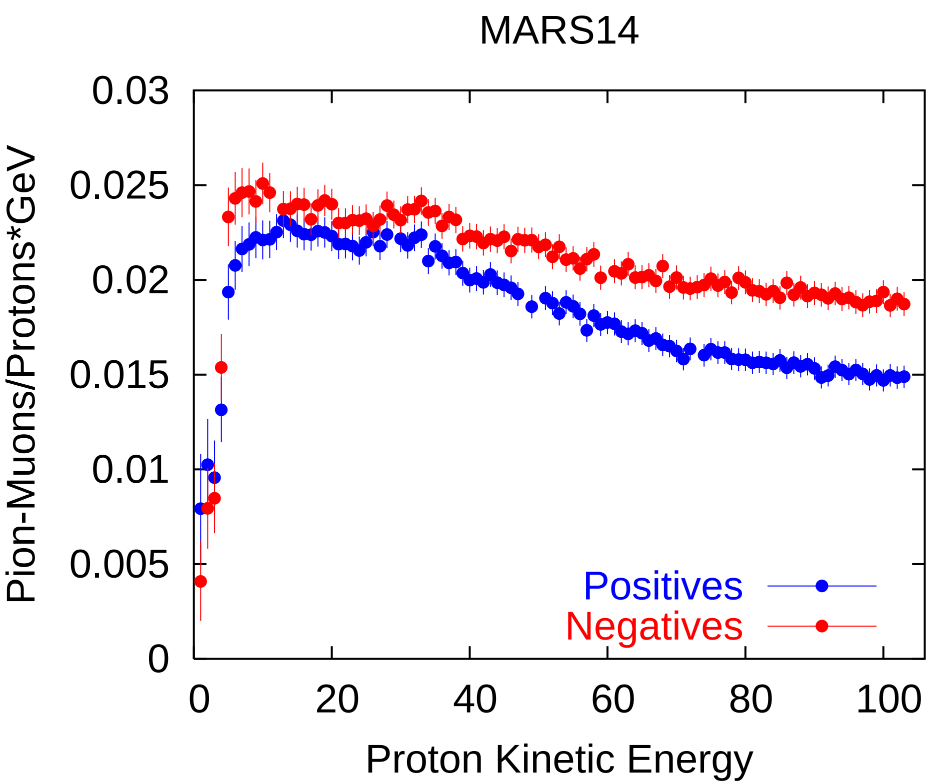
For this analysis we select all pions and muons with 40 < KE< 180 MeV.

50GeV Beam-Mesons at 50m



Mesons at 50m





Mesons/Proton **Mesons/Proton normalized to beam power**

Fixed Parameters: R=5mm; Beam Angle=67mrad; Jet/Beam = 33mrad

ISS Results reported April, 2006

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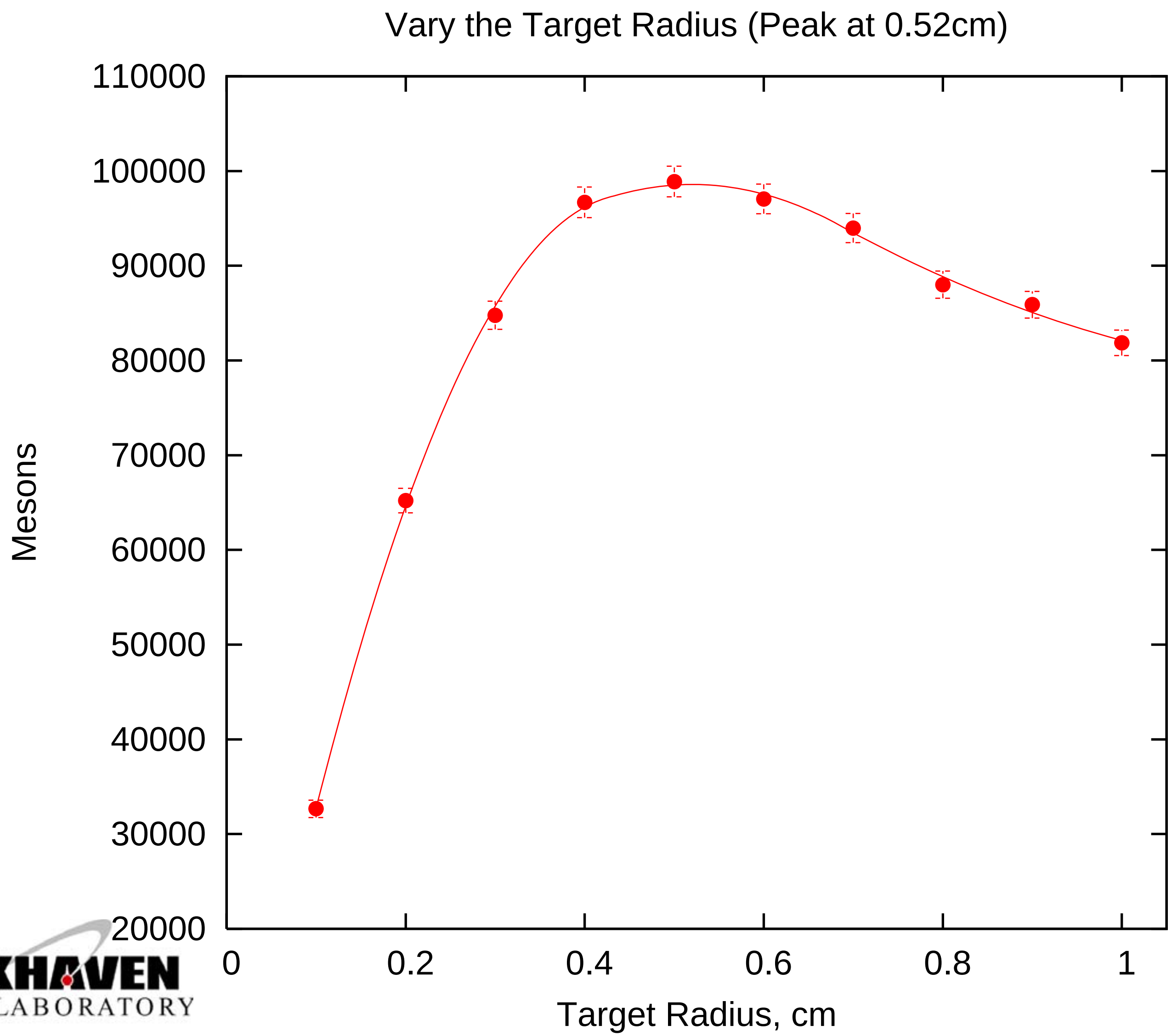
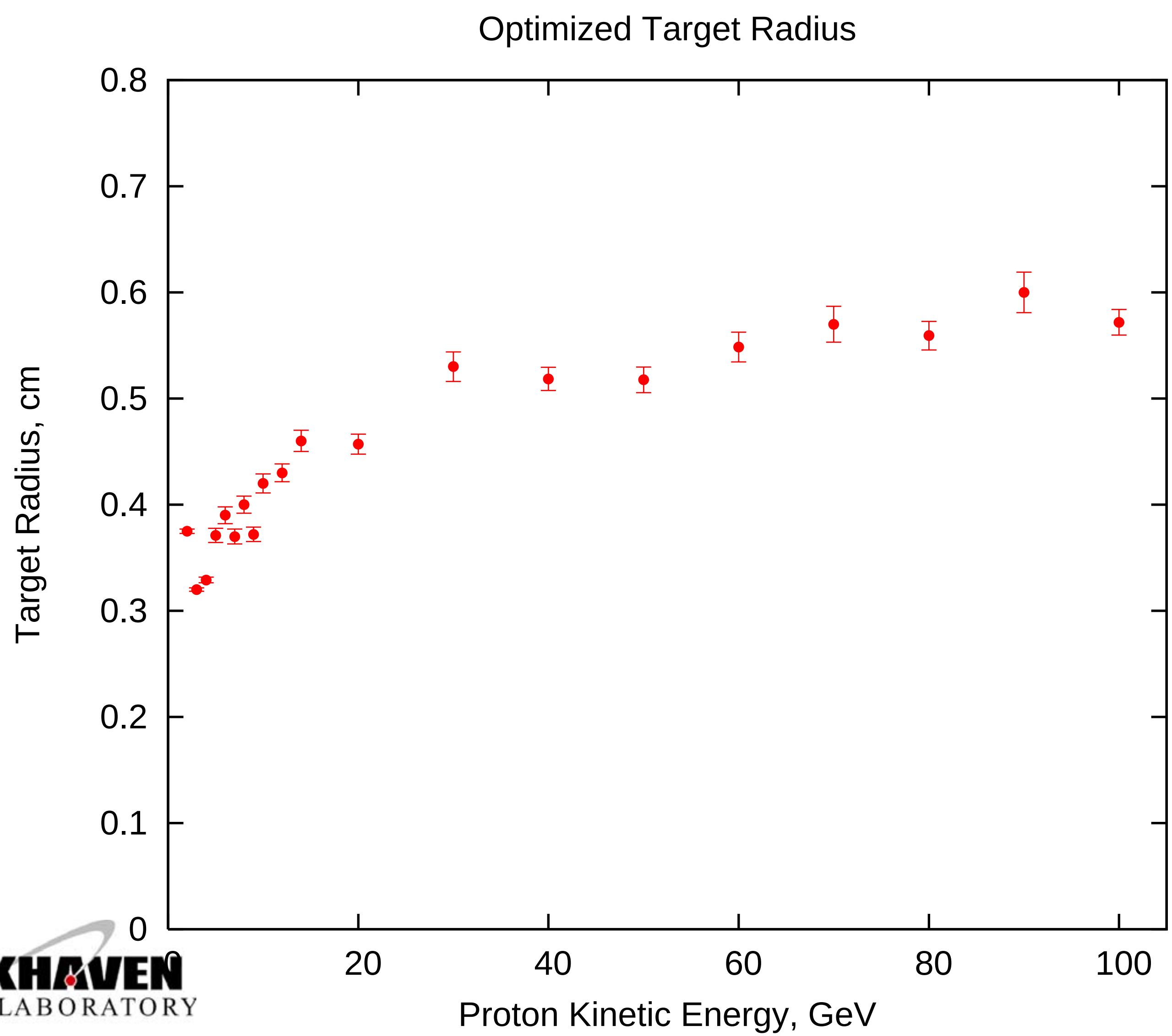
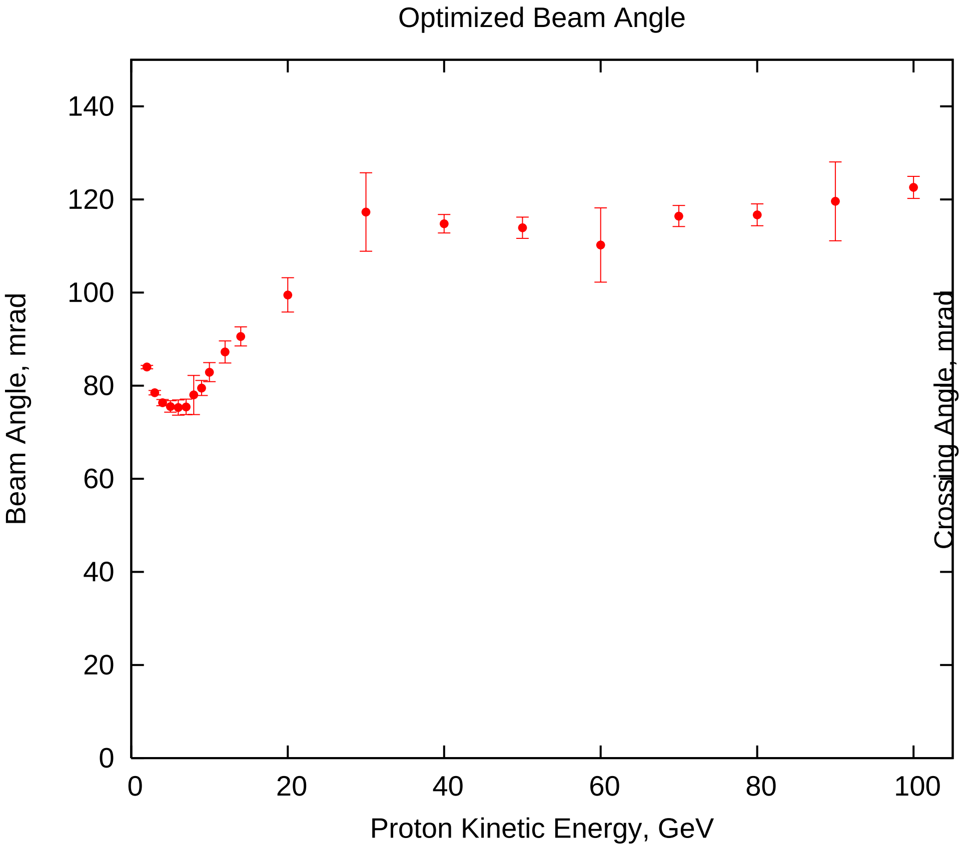
Vary the Target Radius



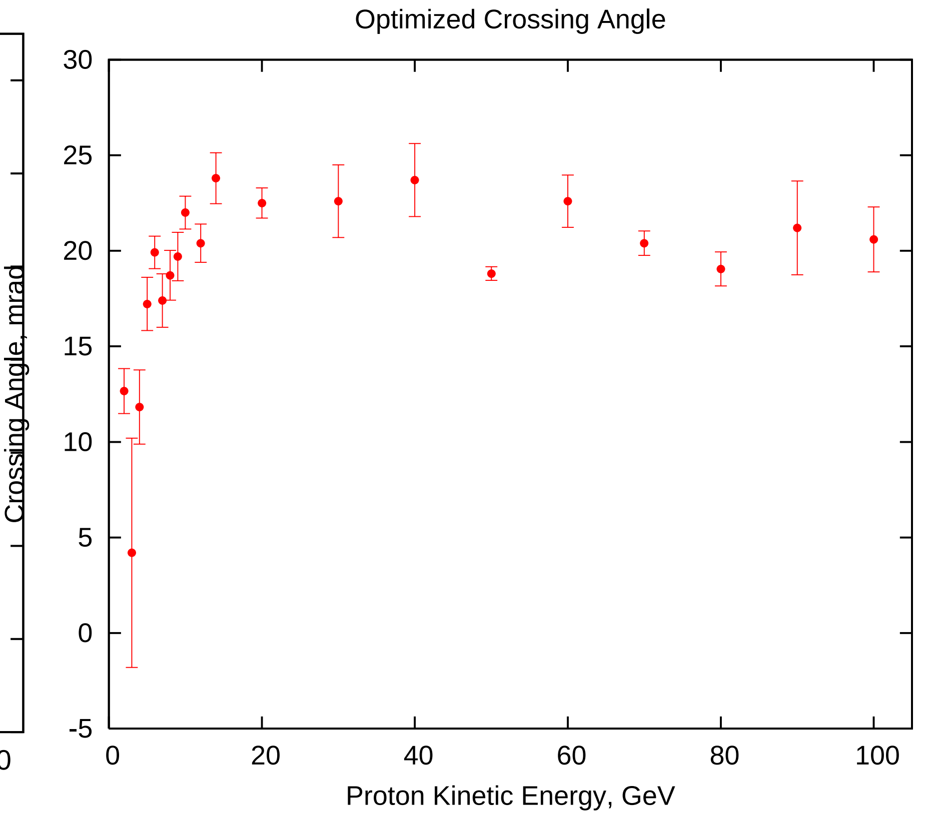
Optimized Target Radius 2 to 100 GeV



Beam Angle and Jet/Beam Crossing Angle

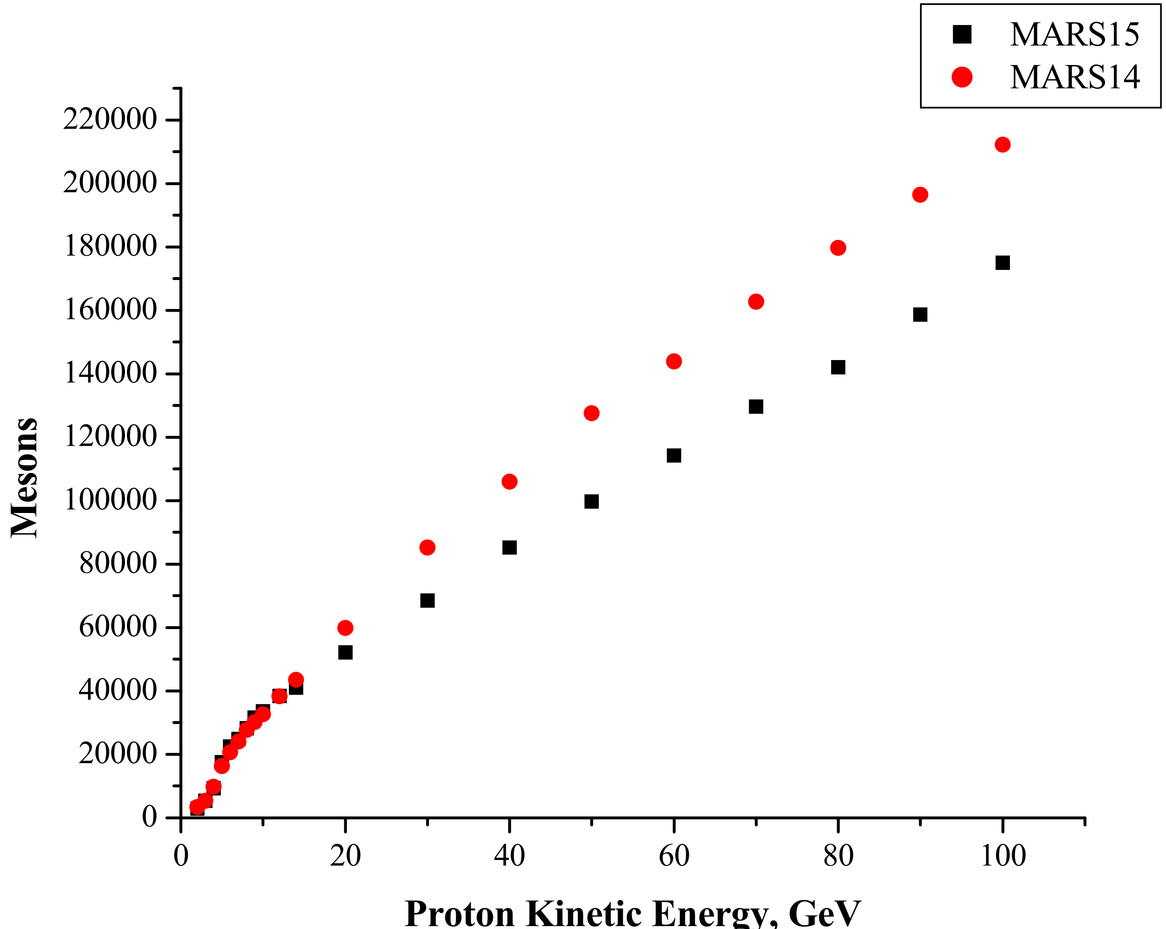


Beam Angle



Crossing Angle

Mars14 vs Mars15 Comparison



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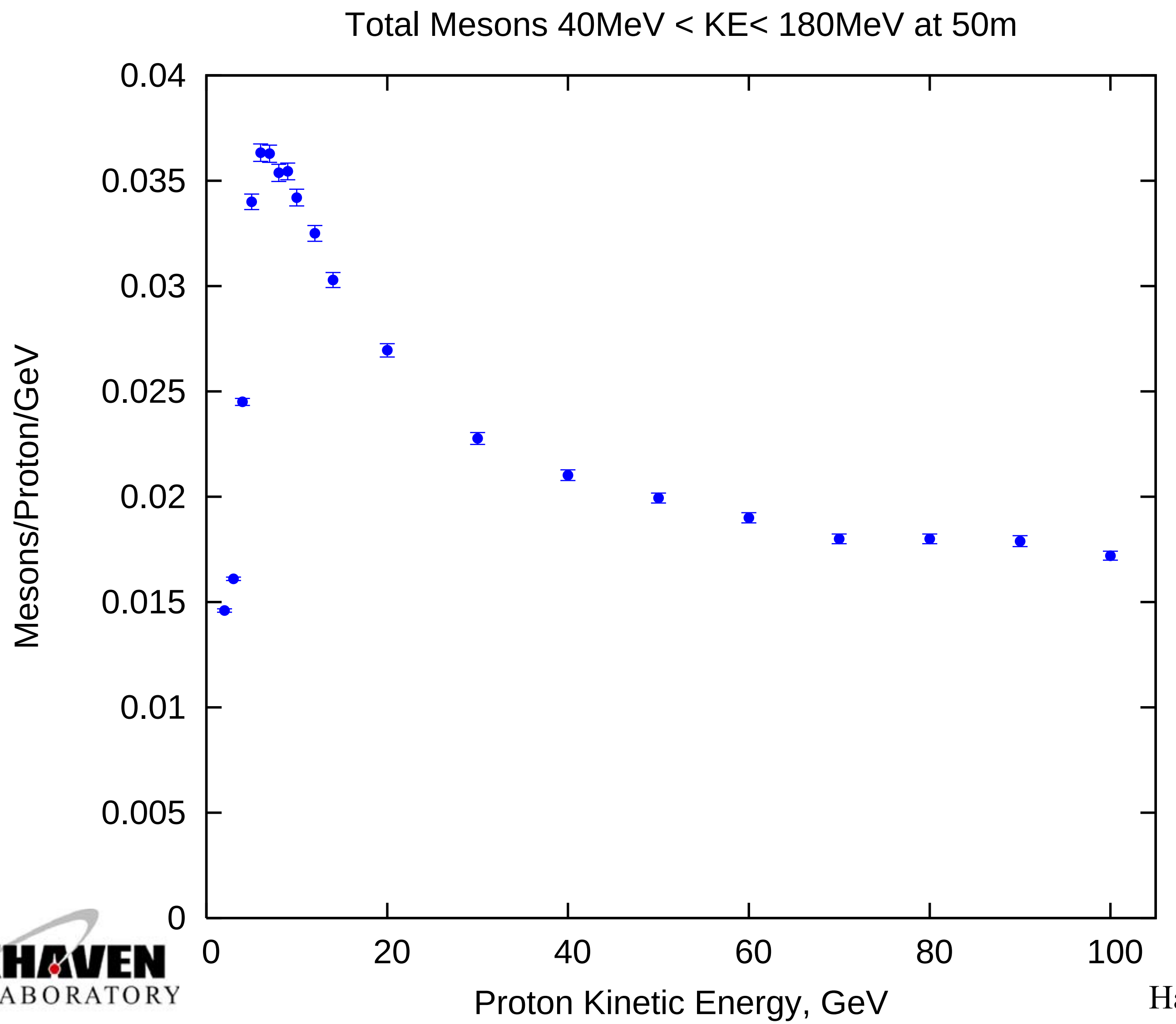
Normalized to Beam Power



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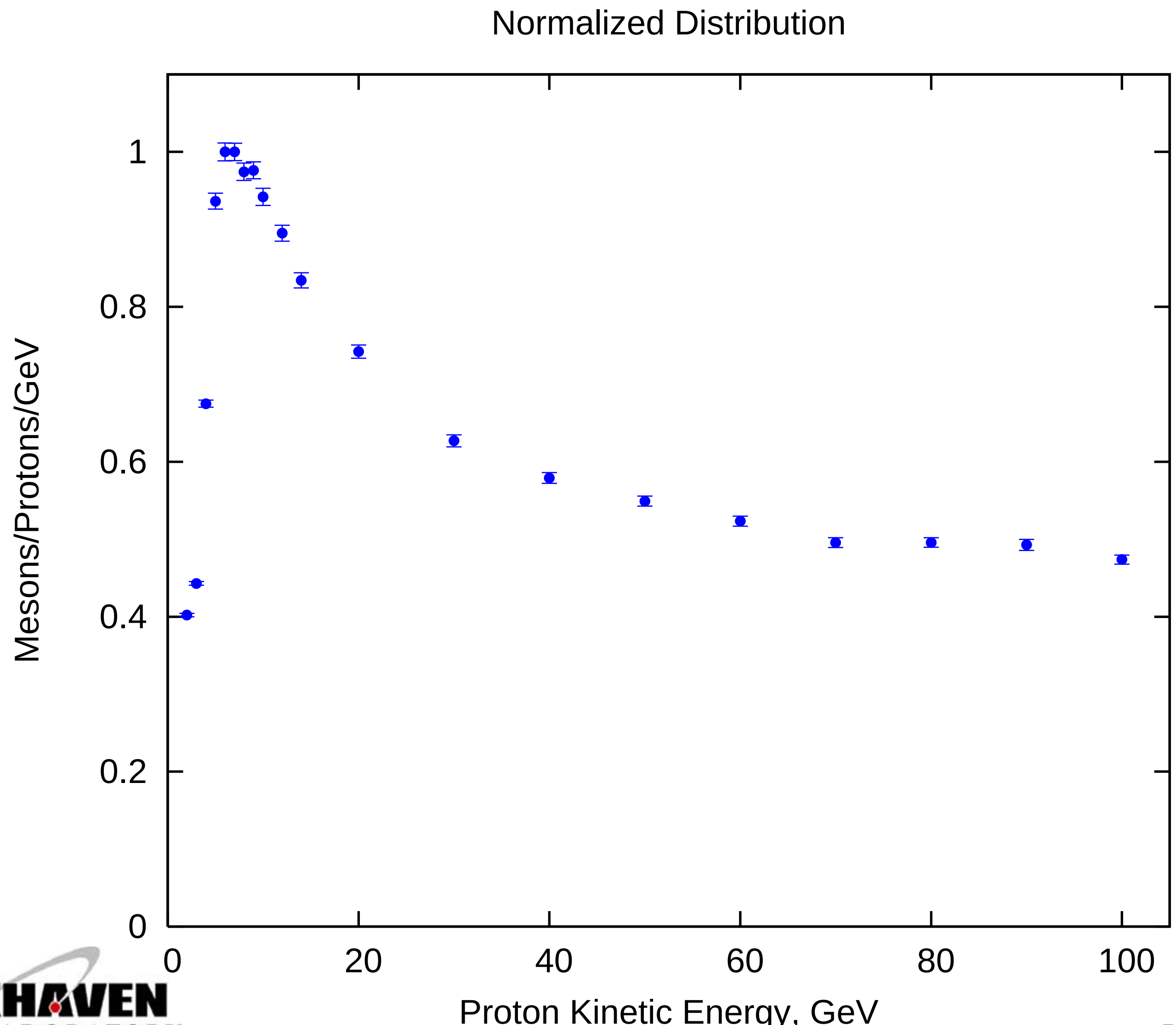
Normalized to Peak



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Summary

- Peak meson production efficiency for a Neutrino Factory Hg Target system occurs in the region of 6 to 8 GeV
- At 20 GeV we have a 25% loss in efficiency
- At 40 GeV we have a 45% loss in efficiency
- At 80 GeV we have a 50% loss in efficiency