Targetry Plans and Status

MUTAC Review

FNAL

March 17, 2006

Harold G. Kirk
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International Scoping Study

Question: Given a "Green Field" what are the most favorable parameters for a proton driver to a Neutrino Factory?

A related question: Liquid or Solid Target

Can a solid target survive a >1MW proton driver beam?

(Nick Simos → Solid Target Studies)

Is a liquid target for a >1MW proton driver technically feasible?

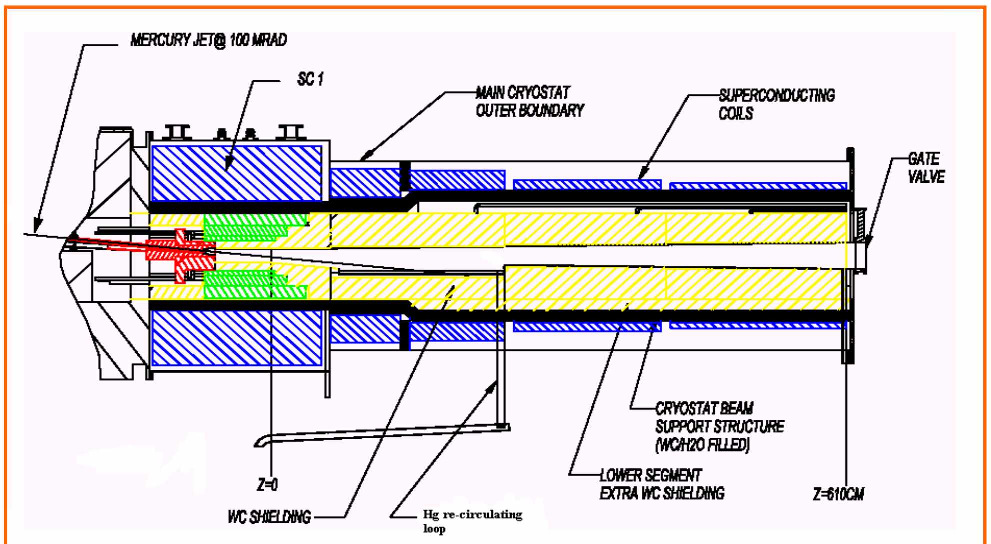
(MERIT target experiment at CERN)

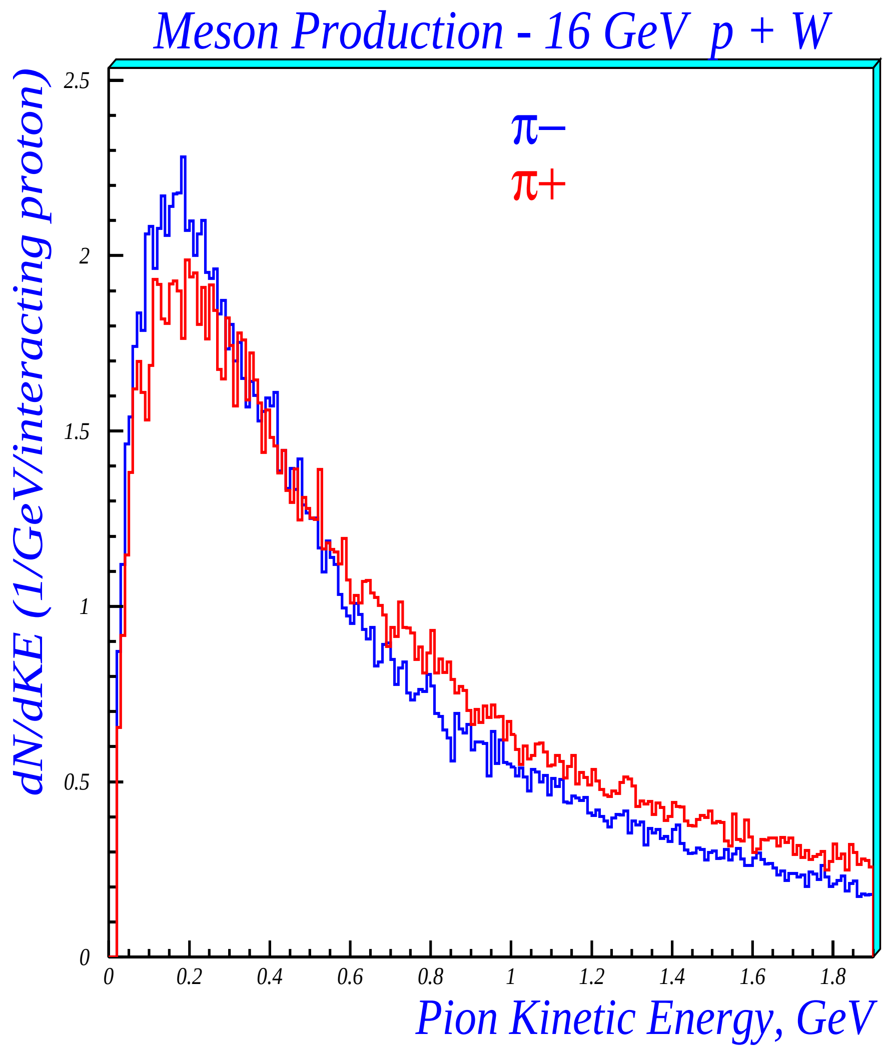
What is the "preferred" proton driver energy?

Achieving Intense Muon Beams

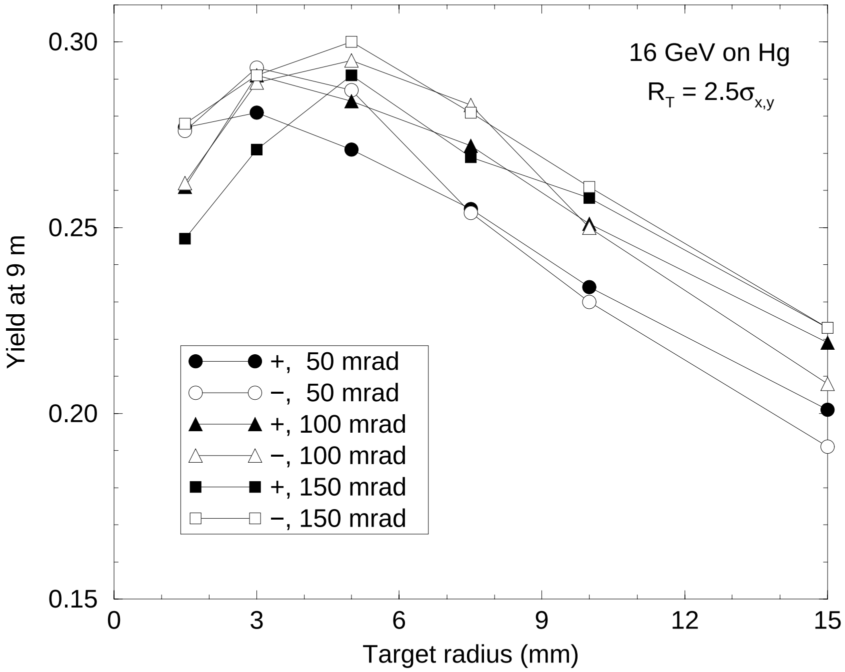
Maximize Pion/Muon Production

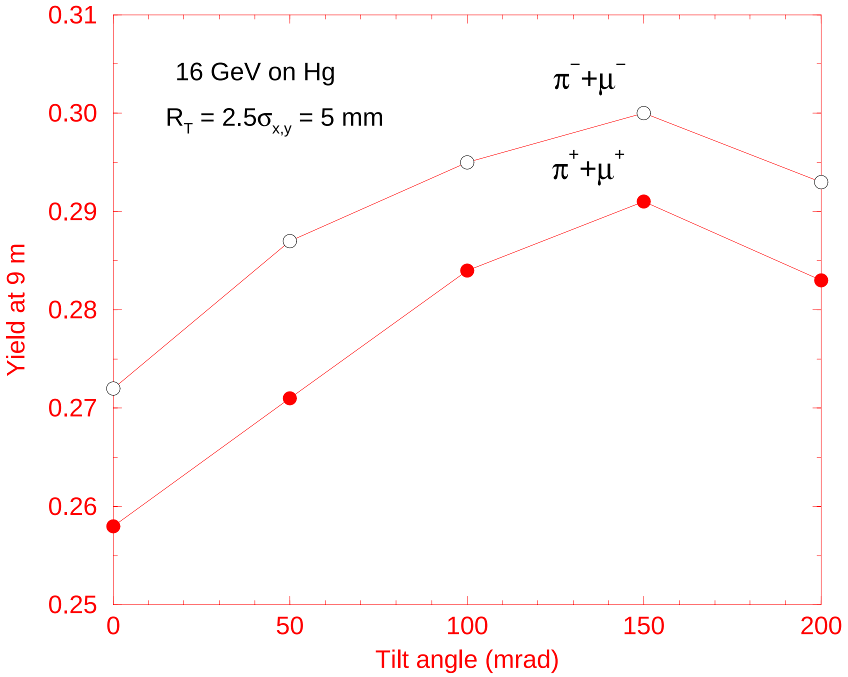
- Soft-pion Production
- High Z materials
- High Magnetic Field





Optimizing Soft-pion Production





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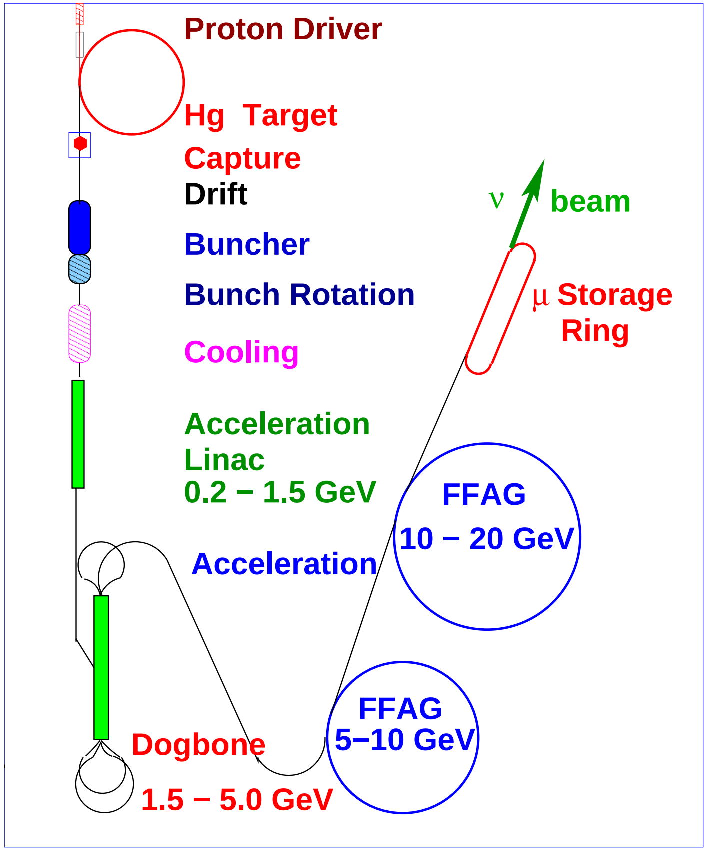
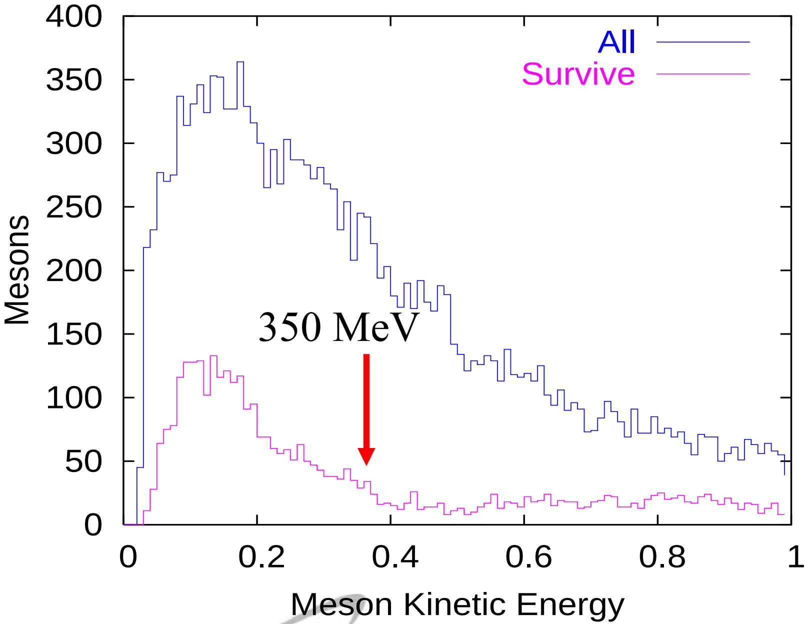
Process mesons through Cooling

Consider mesons within acceptance of $\varepsilon_\perp = 30\pi$ mm and $\varepsilon_L = 150\pi$ mm after cooling





Use meson count with KE < 350 MeV as a figure of merit.

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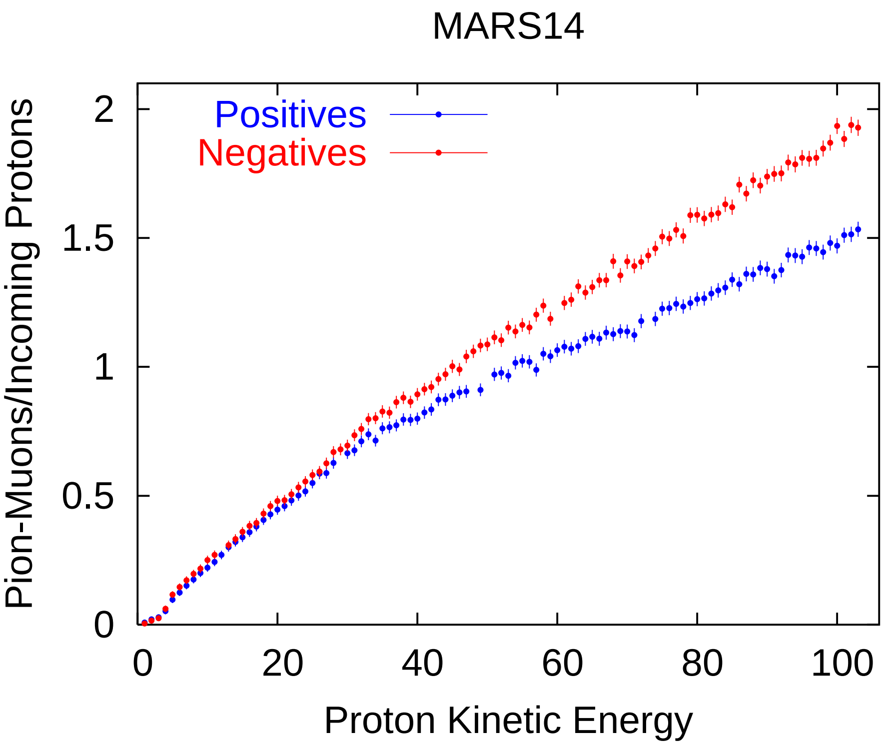
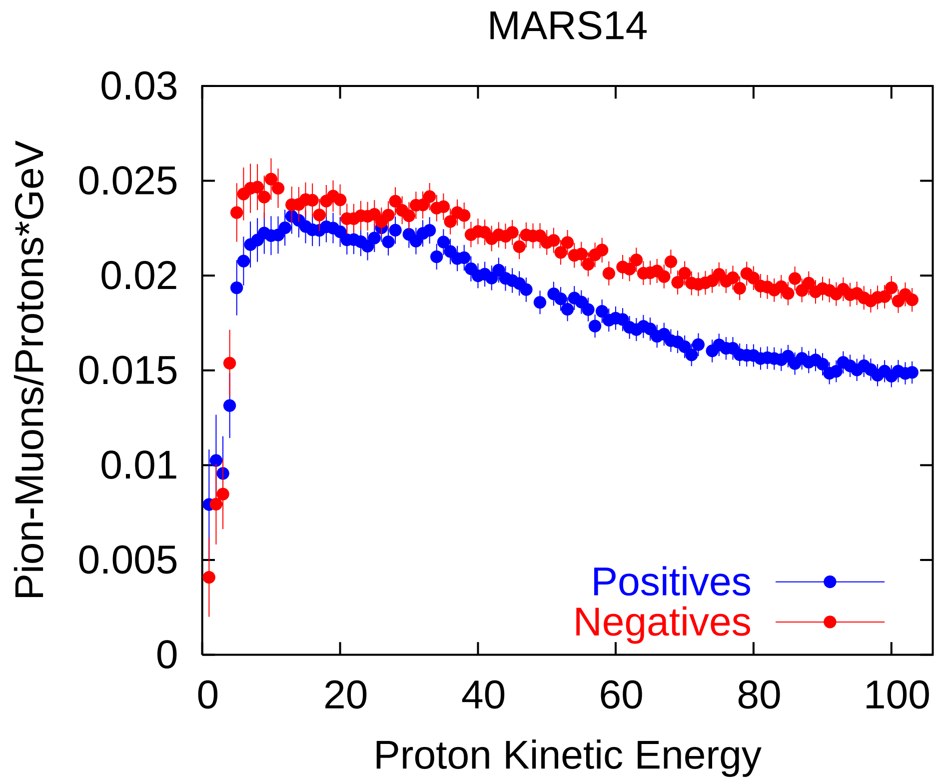
Meson KE < 350 MeV at 50m



Mesons/Proton



Mesons/Proton normalized to beam power

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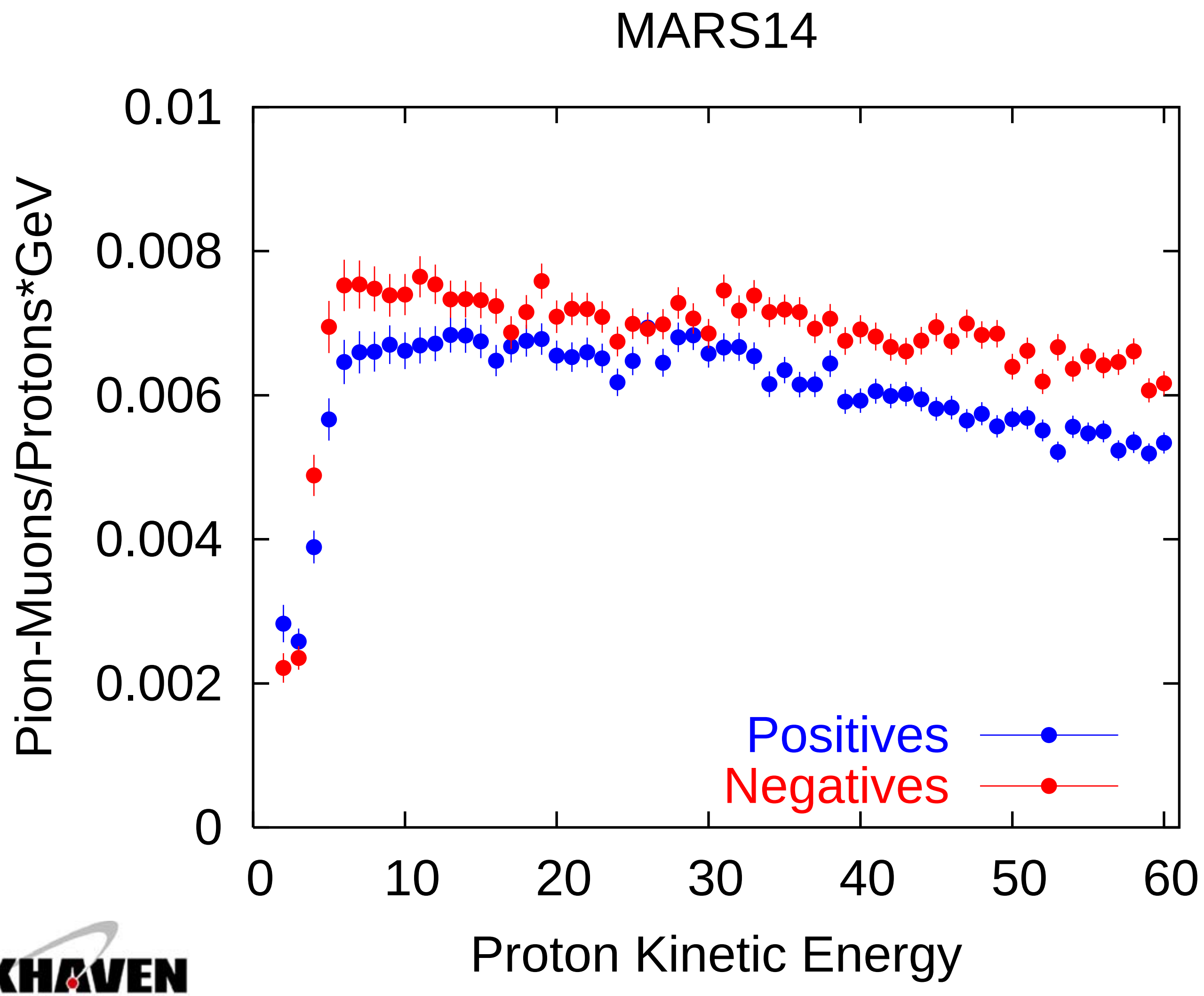
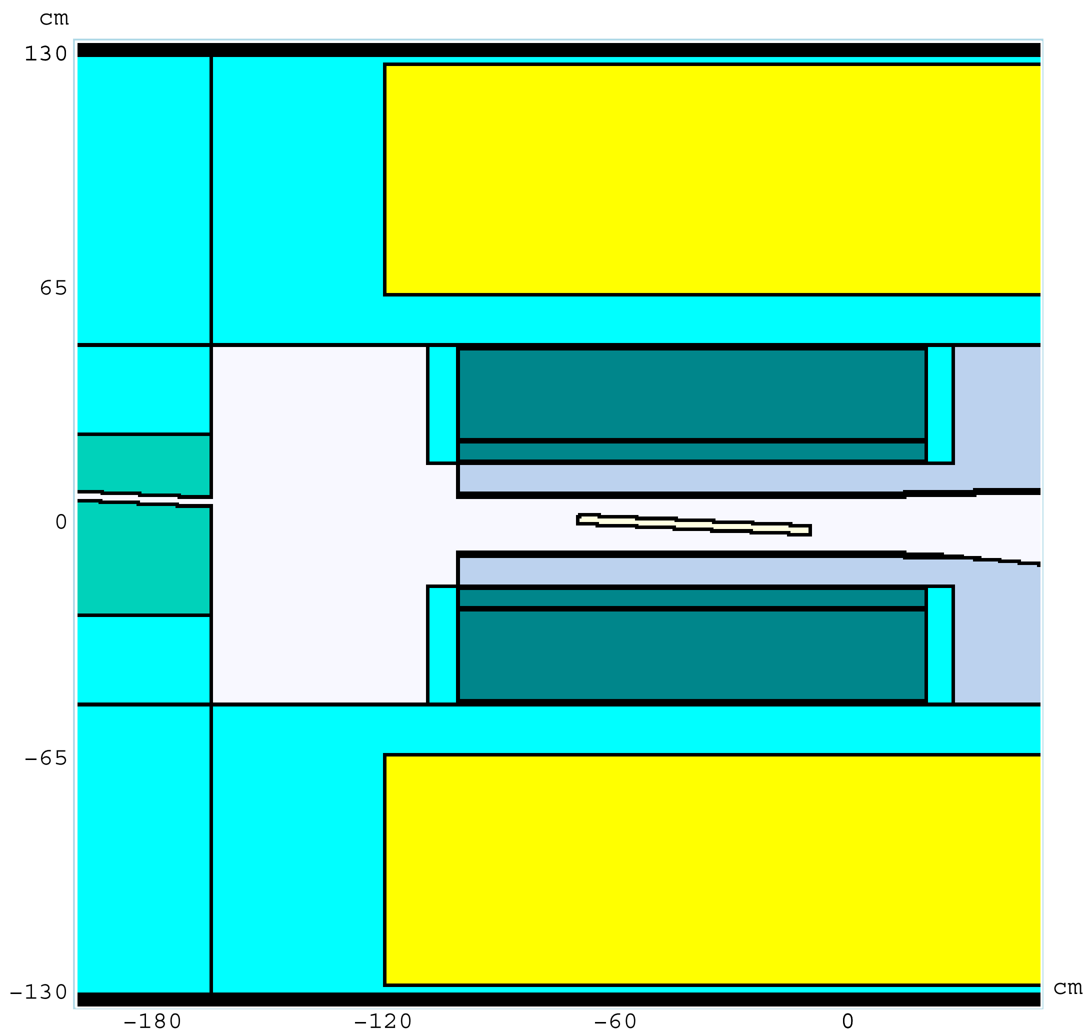
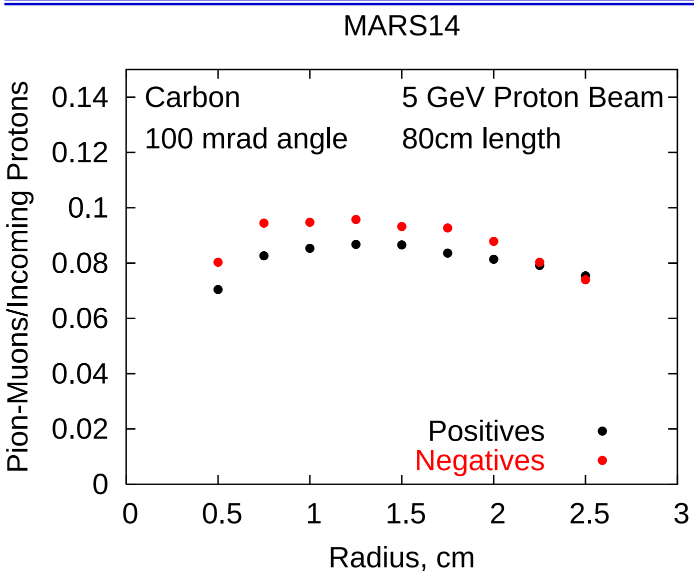
Post-cooling 30π Acceptance

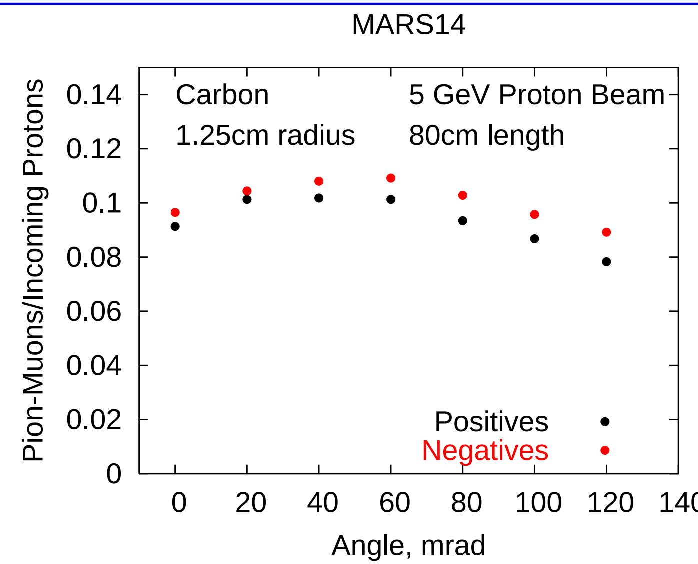


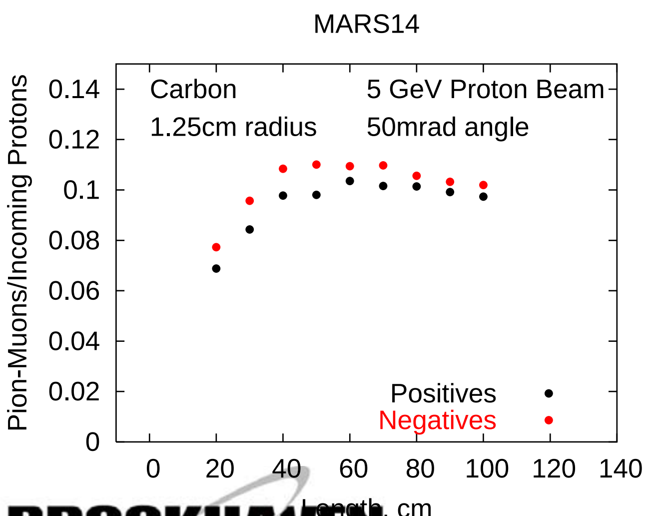
Carbon Target Parameters Search

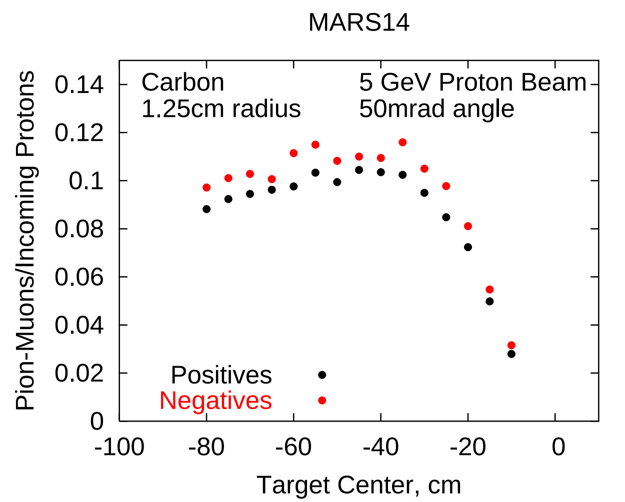


Carbon Target Optimization









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Set R=1.25cm; tilt angle = 50 mrad; Length=60cm; Z=-40cm

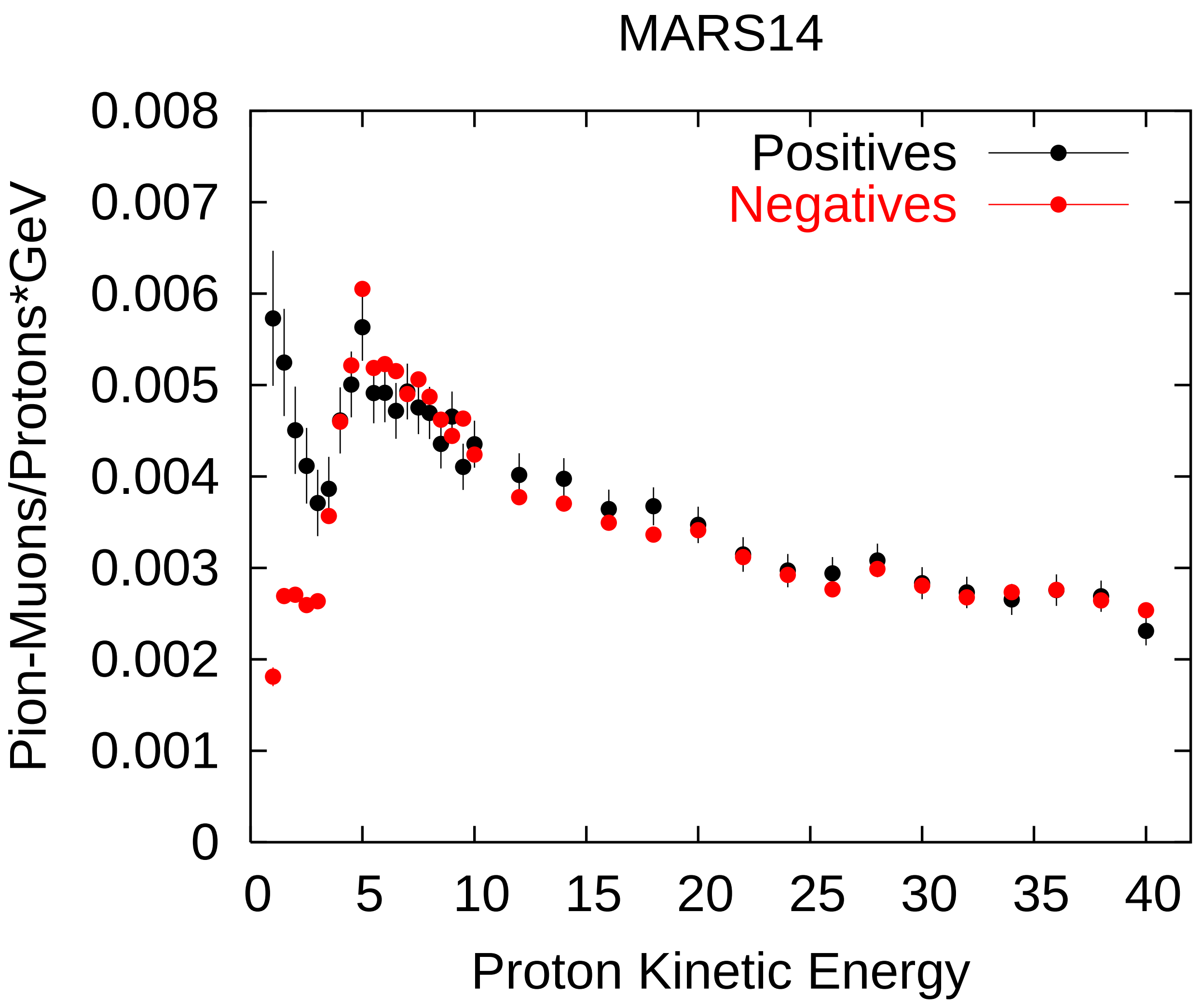
Proton KE Scan with Carbon

Count mesons within acceptance of

$\varepsilon_{\perp} = 30\pi$ mm and

$\varepsilon_{L} = 150\pi$ mm

after cooling



Summary of Results

Compare Meson production for Hg at 24 GeV and 10 GeV

$$\frac{N^{+}{}_{10GeV}}{N^{+}{}_{24GeV}} = 1.07 \qquad \frac{N^{-}{}_{10GeV}}{N^{-}{}_{24GeV}} = 1.10$$

Compare Meson production for C at 24 GeV and 5 GeV

$$\frac{N^{+}{}_{5GeV}}{N^{+}{}_{24GeV}} = 1.90 \qquad \frac{N^{-}{}_{5GeV}}{N^{-}{}_{24GeV}} = 1.77$$

Compare Meson production for Hg at 10 GeV and C at 5 GeV

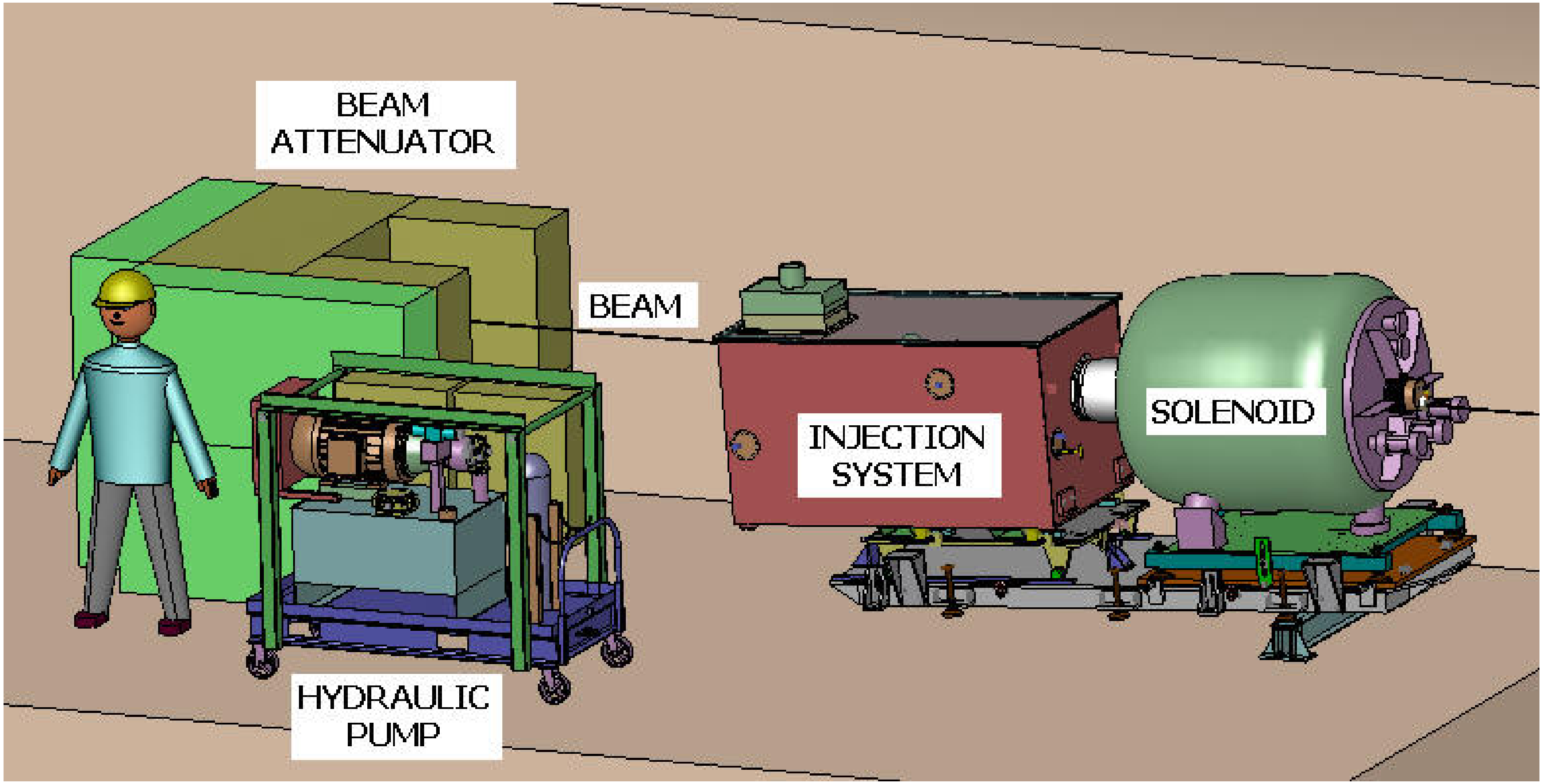
$$\frac{N^{+}{}_{Hg-10GeV}}{N^{+}{}_{C-5GeV}} = 1.18 \qquad \frac{N^{-}{}_{Hg-10GeV}}{N^{-}{}_{C-5GeV}} = 1.22$$

The Target Experiment at CERN

"R&D on the muon production target experiment at CERN will also be funded"

Presidential FY07 Budget Request to Congress

The MERIT (nTOF11) Experiment



MERcury Intense Target

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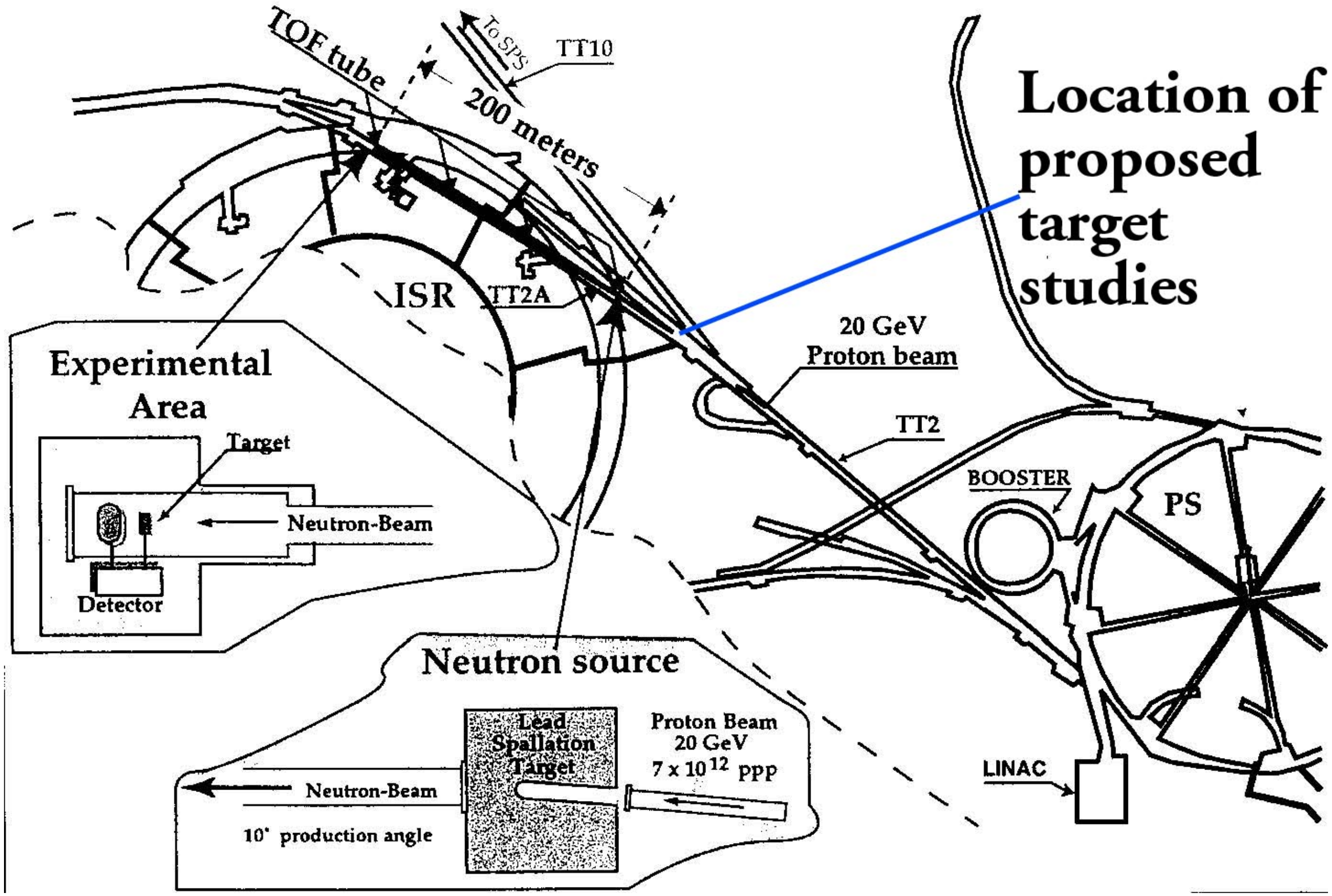
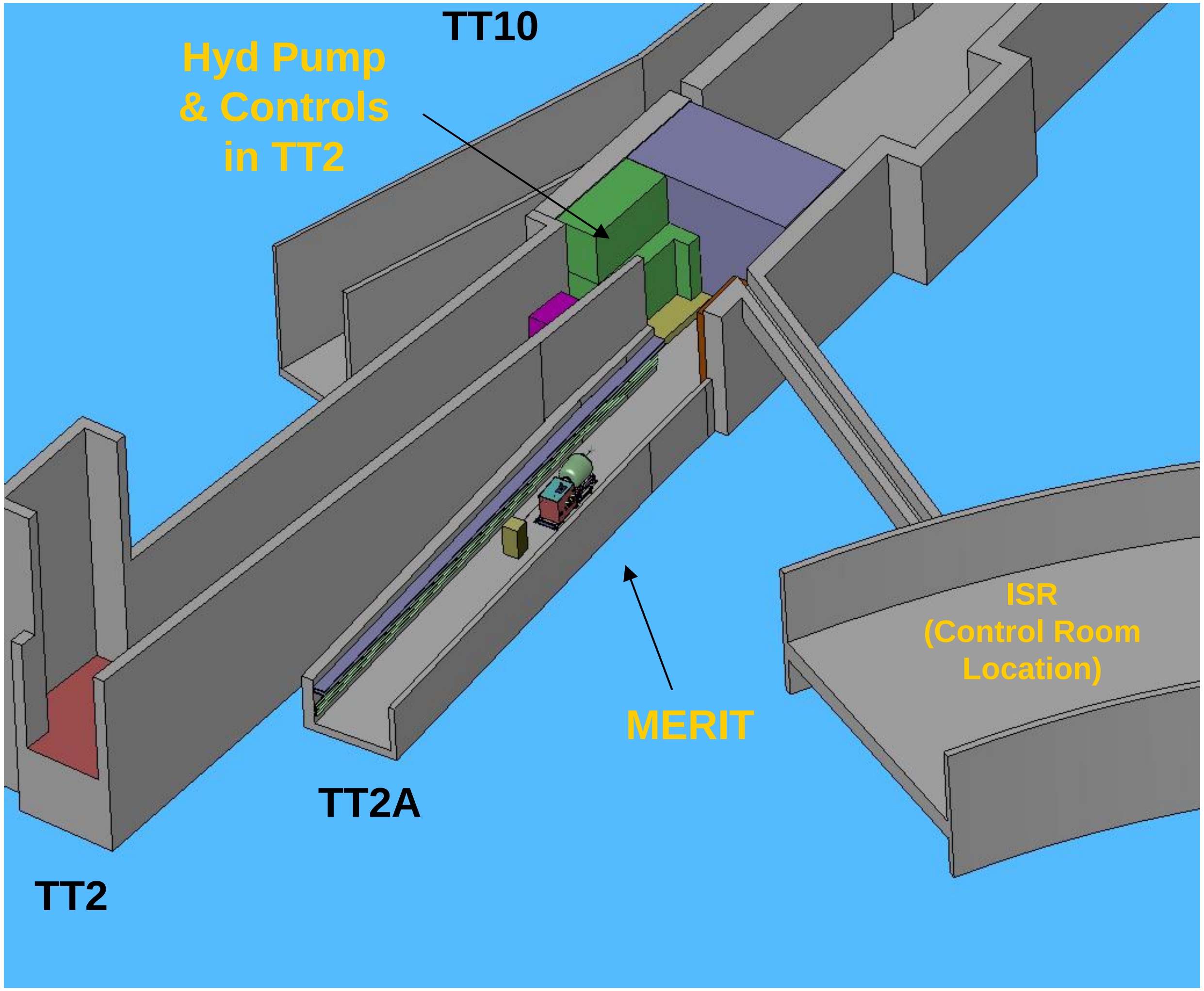
Target Test Site at CERN



The Tunnel Complex



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Profile of the Experiment

- 14 and 24 GeV Proton beam
- Up to >30 x 10^{12} Protons (TP) per 2μs spill
- Proton beam spot with r ≤ 1.5 mm rms
- 1cm diameter Hg Jet
- Hg Jet/Proton beam off solenoid axis
  - Hg Jet 33 mrad
  - Proton beam 67 mrad
- Test 50 Hz operations
  - 20 m/s Hg Jet
  - 2 spills separated by 20 ms

PS Beam Characteristics

- PS will run in a harmonic 16 mode
- We can fill any of the 16 rf buckets with sub-bunches at our discretion.
- Each microbunch can contain up to 2.5 TP.
- Fast extraction can accommodate entire 2μs PS fill.
- Extraction at 24 GeV
- Partial/multiple extraction possible at 14 GeV
- Beam on target April 2007

Run plan for PS beam spills

The PS Beam Profile allows for:

- Varying beam charge intensity from 4 TP to > 30 TP.
- Studying influence of solenoid field strength on beam dispersal (vary B_o from 0 to 15T).
- Study possible cavitation effects by varying PS spill structure (Pump/Probe)
- Study 50 Hz operation.

Key Experimental Sub-systems

15T Pulsed Solenoid

- 8 MVA Power Supply
- LN_2 Cryo-system

Hg Jet Delivery System (K. McDonald)

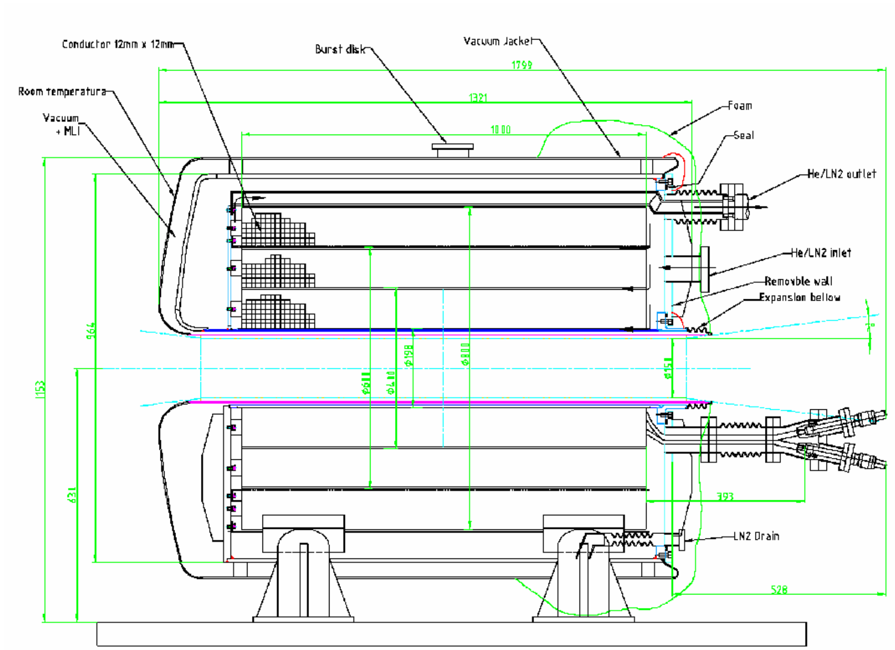
Diagnostics (K. McDonald)

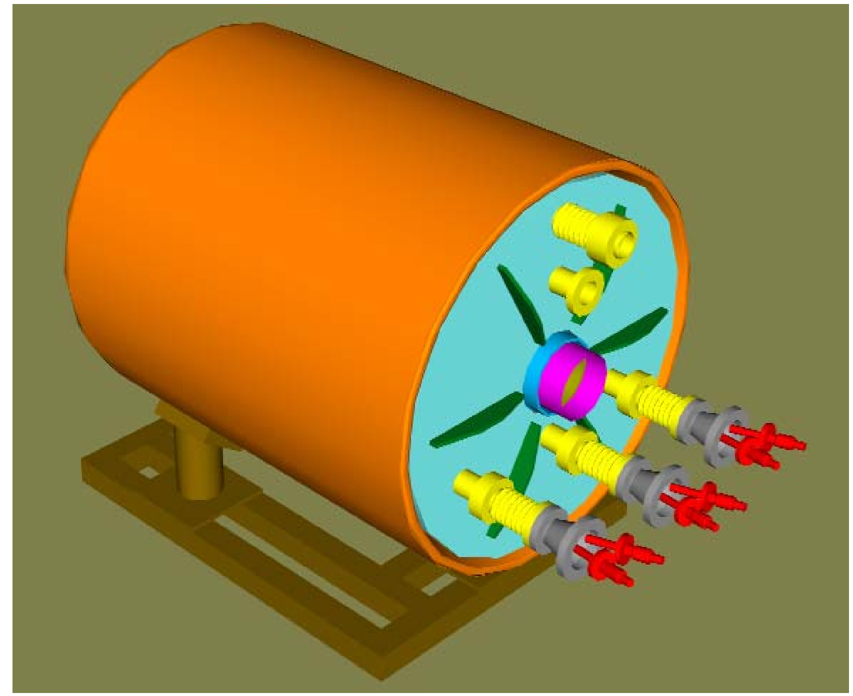
- Optical
- Particle Detection

CERN Infrastructure (I. Efthymiopoulos)

Simulations (R. Samulyak)

High Field Pulsed Solenoid





- 80º K Operation
- 15 T with 5.5 MW Pulsed Power
- 15 cm warm bore
- 1 m long beam pipe

Peter Titus, MIT

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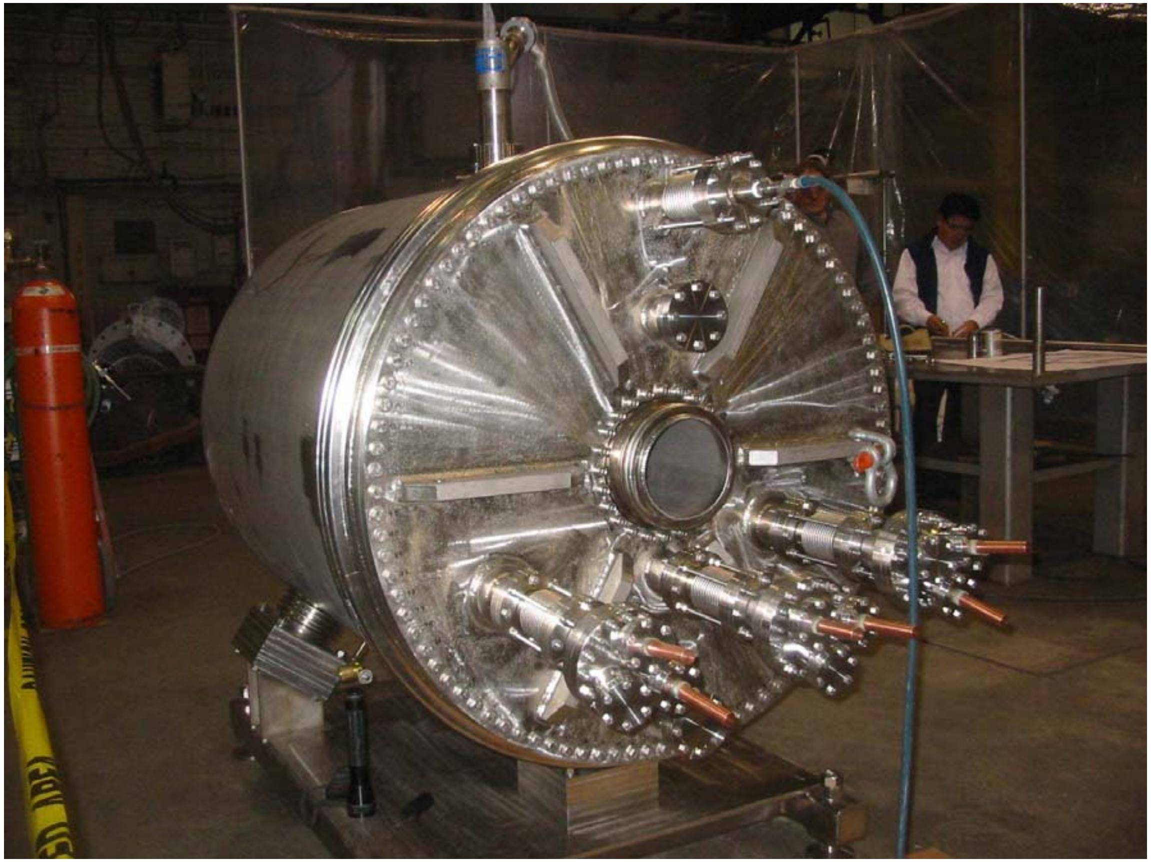
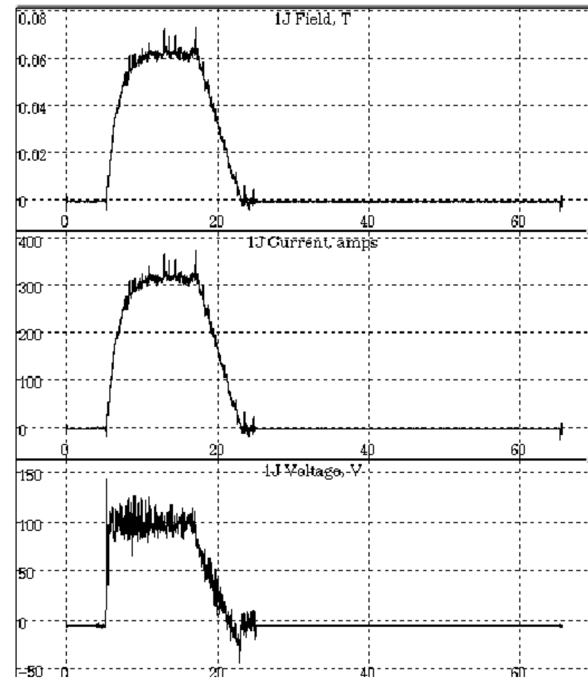
Pulsed Solenoid Milestones

Delivery to MIT	January 06
Reception Testing	March 06
Integration Testing	September 06
Ship to CERN	December 06
Installation at CERN	January 07

The Pulsed Solenoid



CVIP December 2005



First Current: MIT
March 9, 2006

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Power Supply Milestones

Site Preparations	January 06
Relocate and Install	February 06
DC Cabling	March 06
AC Cabling	March 06
Refurbish PS	March-April 06
Interlocks	September 06
Commissioning	October 06

Cryogenic System Milestones

TT10 Vent Installation	January 06
Cold Valve Box Fabrication	April-July 06
Control System Development	January-June 06
Surface Preparations	May 06
Transfer Line Installation	July 06
Cold Valve Box Testing	October 06
Heater System Installation	September 06
Cold Valve Box Installation	November 06
Commissioning	December 06

Cryosytem Layout

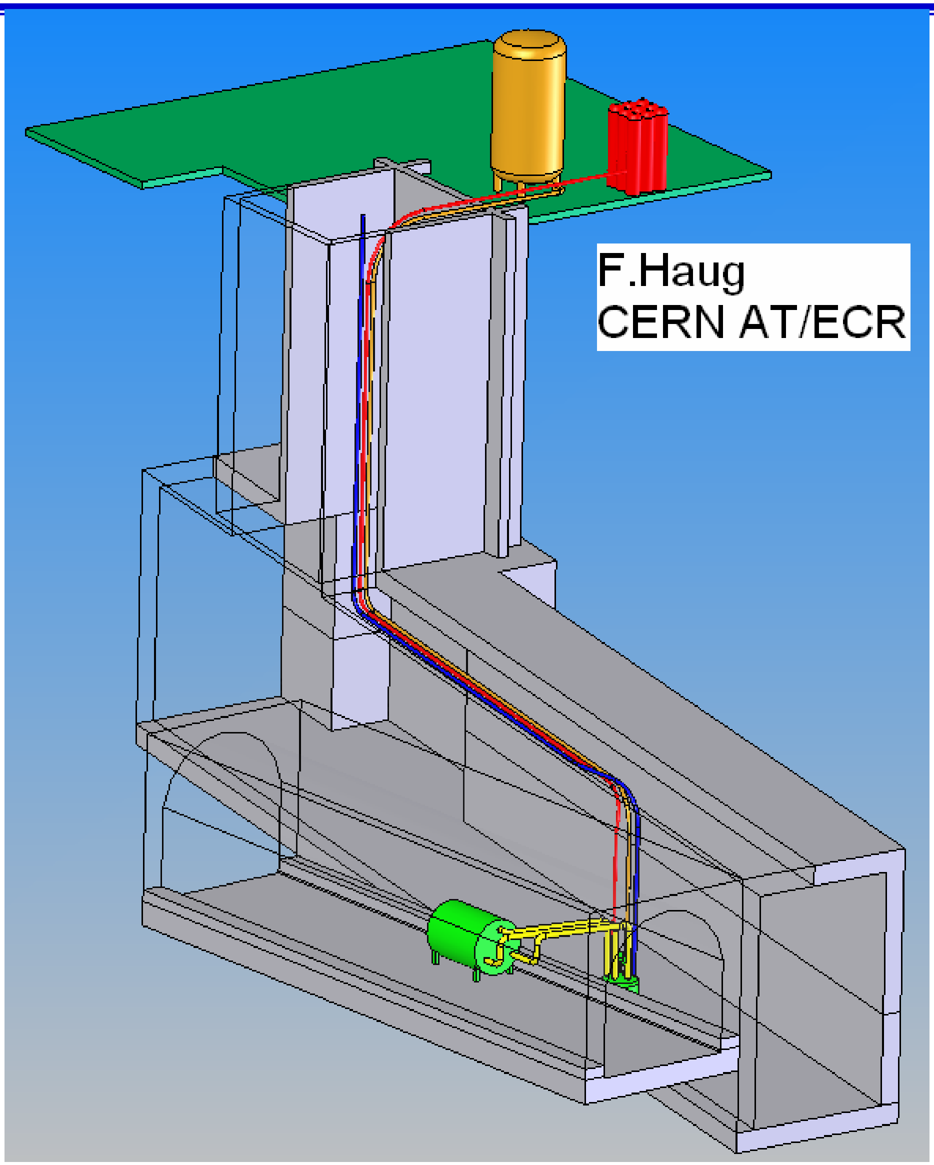
LN_2 and N_2 gas stored on the surface.

Cold valve box in the TT2 tunnel.

Exhaust gas vented into TT10 tunnel through filtration system.

~ 150 liters of LN_2 per Magnet pulse.

Magnet flushed with N_2 prior to each pulse, to minimize activation of N_2.



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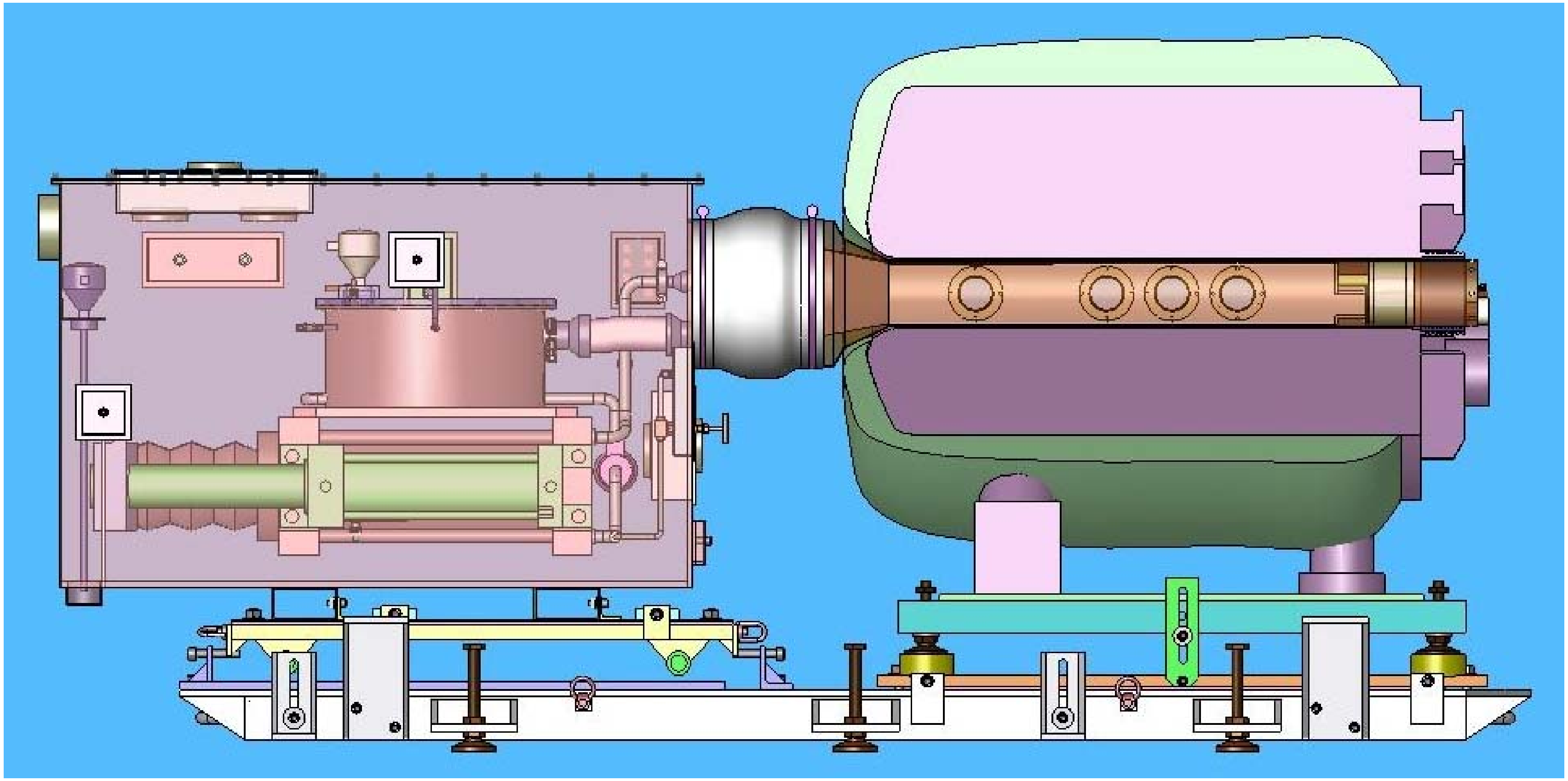
The Hg Jet System



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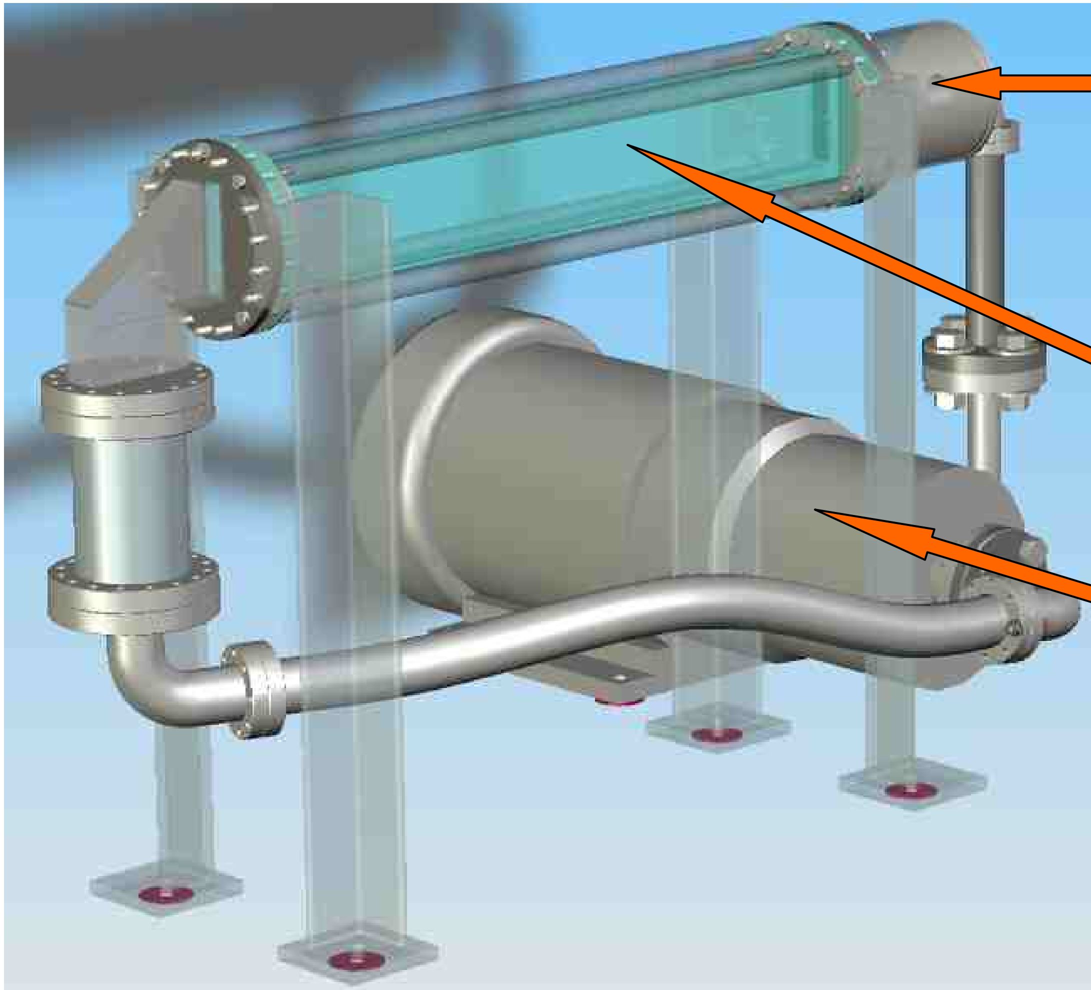
Princeton Nozzle R&D



Replaceable Nozzle Head

Lexan Viewing Channel

20 HP Pump

Summary

The MERIT (nTOF11) Experiment

- Study single beam pulses with intensities >30TP
- Study influence of solenoid field strength on Hg jet dispersal (B_o from 0 to 15T)
- Study 50 Hz operations scenario
- Study cavitation effects in the Hg jet by varying PS spill structure—Pump/Probe
- First beam expected April 2007
- **Confirm Neutrino Factory targetry concept**

Backup Slides

Budget and Funding Profile

	Tech. Board Sept. 21 2004	MERIT Review Dec. 12 2005	Spending Profile by FY FY05	FY06	FY07
Magnet Systems					
Fabrication	0	60	60	0	0
Testing	200	200	48	112	40
Cryogenics	550	385	0	250	135
Power Supply	390	210	0	160	50
Hg Jet					
Systems integration	200	200	85	75	40
Nozzle development	50	65	25	40	0
Optics components	25	100	16	74	10
Fabrication	40	170	0	170	0
Shipping	0	20	0	14	6
Operations	218	263	19	65	179
Decommisioning	60	60	0	0	60
Simulations	150	150	40	50	60
Material R&D	75	75	30	0	45
3 Year Project Cost	1958	1958			
Spending Profile			323	1010	625
Funding Profile			693	640	625

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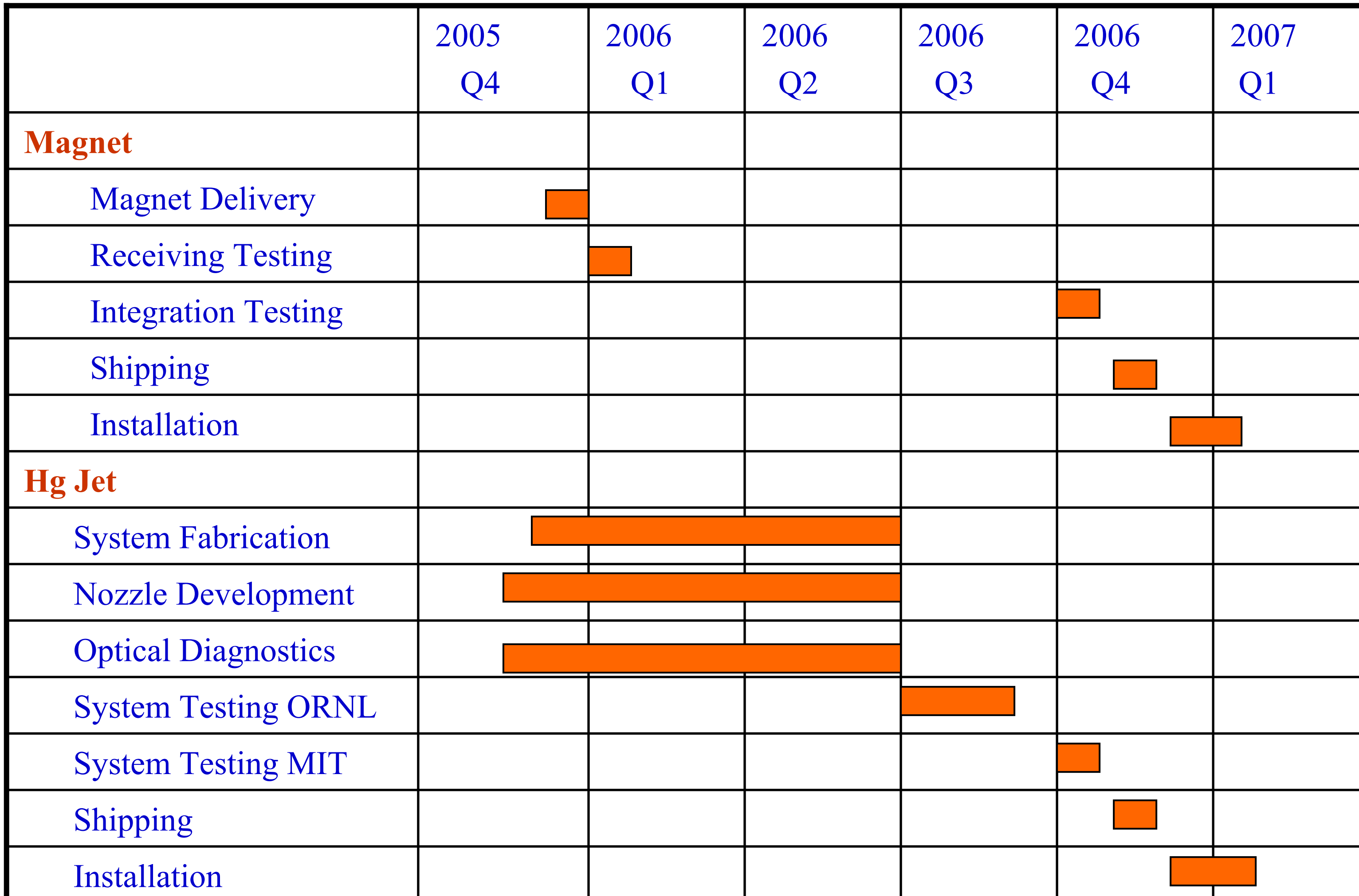
Project Major Sub-systems



CERN Infrastructure