Introduction to NML

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FNAL

Some History

- The building ("The New Muon Lab") originally housed a large fixed target experiment as part of the Fermilab Tevatron Fixed Target HEP program, long defunct.
- It is now being refurbished and is called the "Superconducting RF Beam Test Facility at the New Muon Lab". We prefer "NML".
- There have been several iterations on the design of this facility. The original layouts accomodated 2 or 3 RF cryomodules with minimal beamlines.
- With the promise of ARRA funds, the design has recently been expanded to accomodate 6 ILC-type RF cryomodules and additional beamlines.
- The first use of this facility will be for testing RF cryomodules, however the expanded layout provides extensive opportunities for Advanced Accelerator R&D.

Building Exterior

Overall Layout

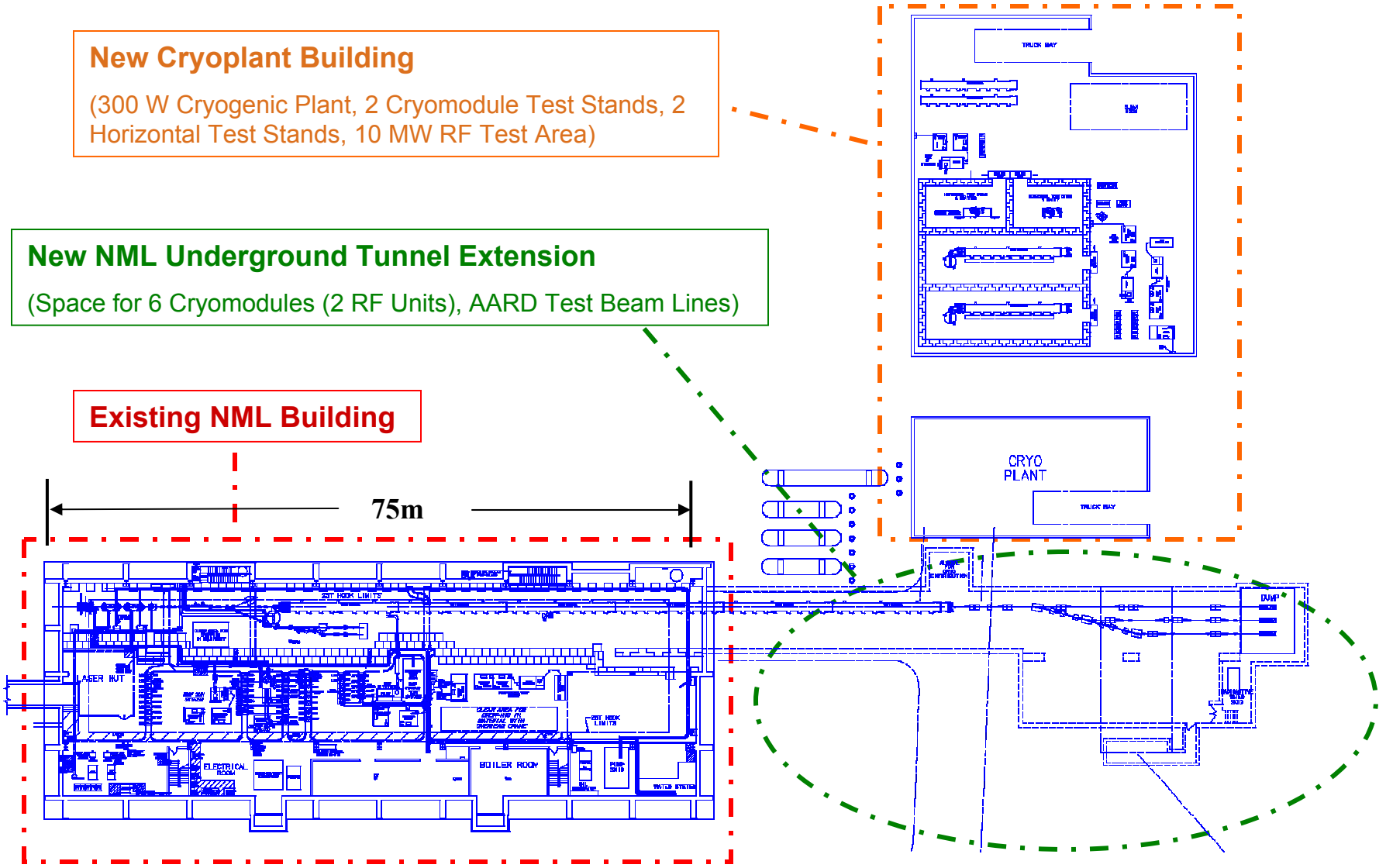
New Cryoplant Building

(300 W Cryogenic Plant, 2 Cryomodule Test Stands, 2 Horizontal Test Stands, 10 MW RF Test Area)

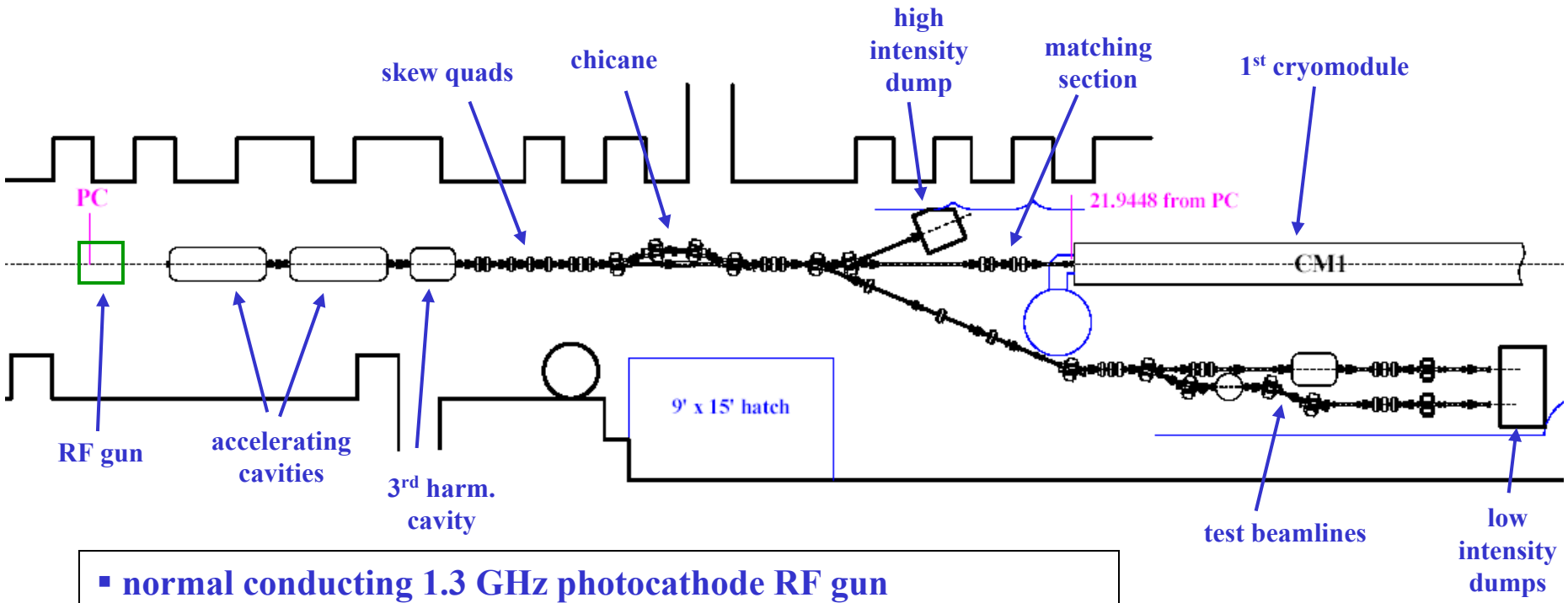
New NML Underground Tunnel Extension

(Space for 6 Cryomodules (2 RF Units), AARD Test Beam Lines)

Existing NML Building

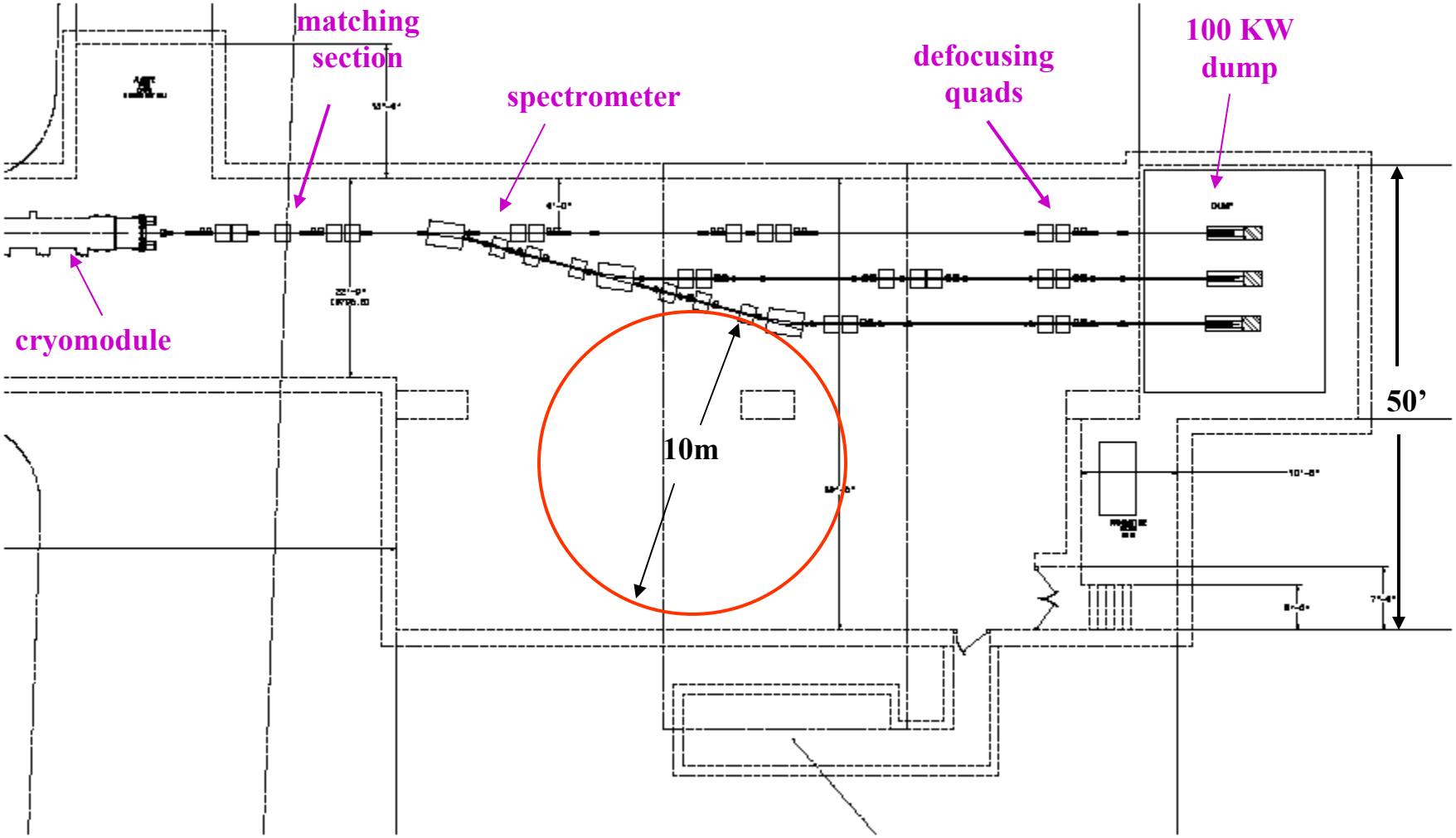


Injection Beamlines Layout (~40 MeV)



- normal conducting 1.3 GHz photocathode RF gun
- 2 superconducting 1.3 GHz accelerating cavities
- 1 superconducting 3.9 GHz cavity for bunch linearization
- 3 skew quads for flat beam generation
- 4-dipole chicane for bunch compression
- 2.5 KW dump
- area for two additional low energy test beamlines

High Energy Beamlines Layout (~1500 MeV)



Building Interior

RF Cryomodule

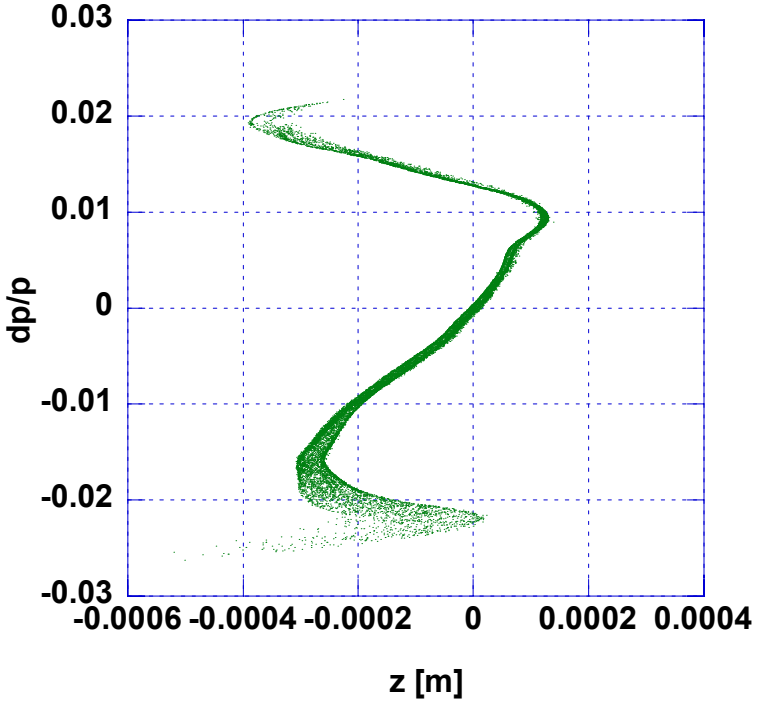
Klystron

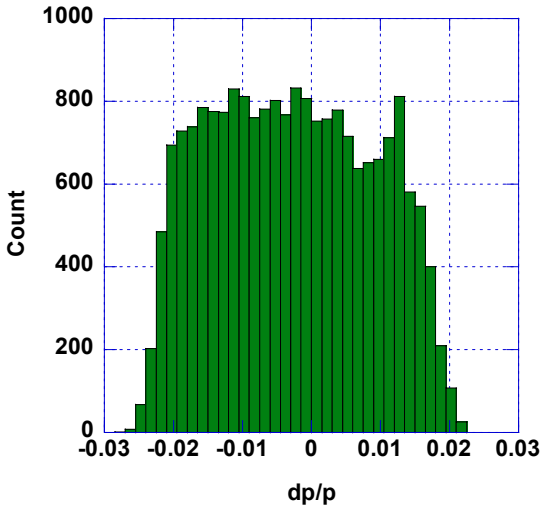
CC2 (2nd accelerating module)

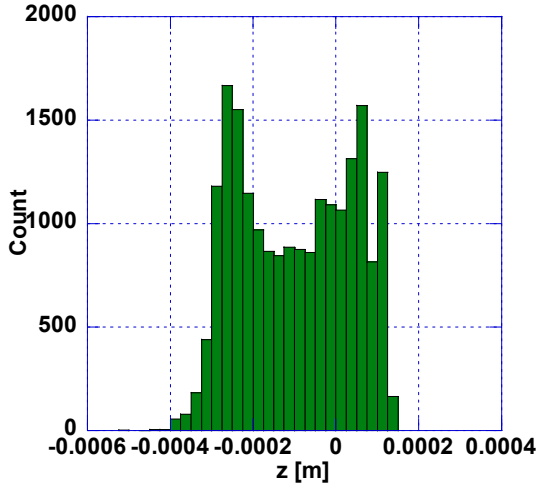
Beam Parameters

- Capable of ILC-like beam parameters:
  - 3.2 nC/bunch; 3 MHz bunch rate; 1 ms long bunch train; 300 μm RMS bunch length; 5 Hz operation
- normalized transverse emittance ~6 μm (3.2 nC, uncompressed beam)
- Peak currents 10 – 15 kA possible with compressed beam
- single bunch intensity over 10 nC possible
- pulse length of <100 fs with Ti:Sa laser exciting photocathode

Longitudinal Phase Space Simulation (low energy)



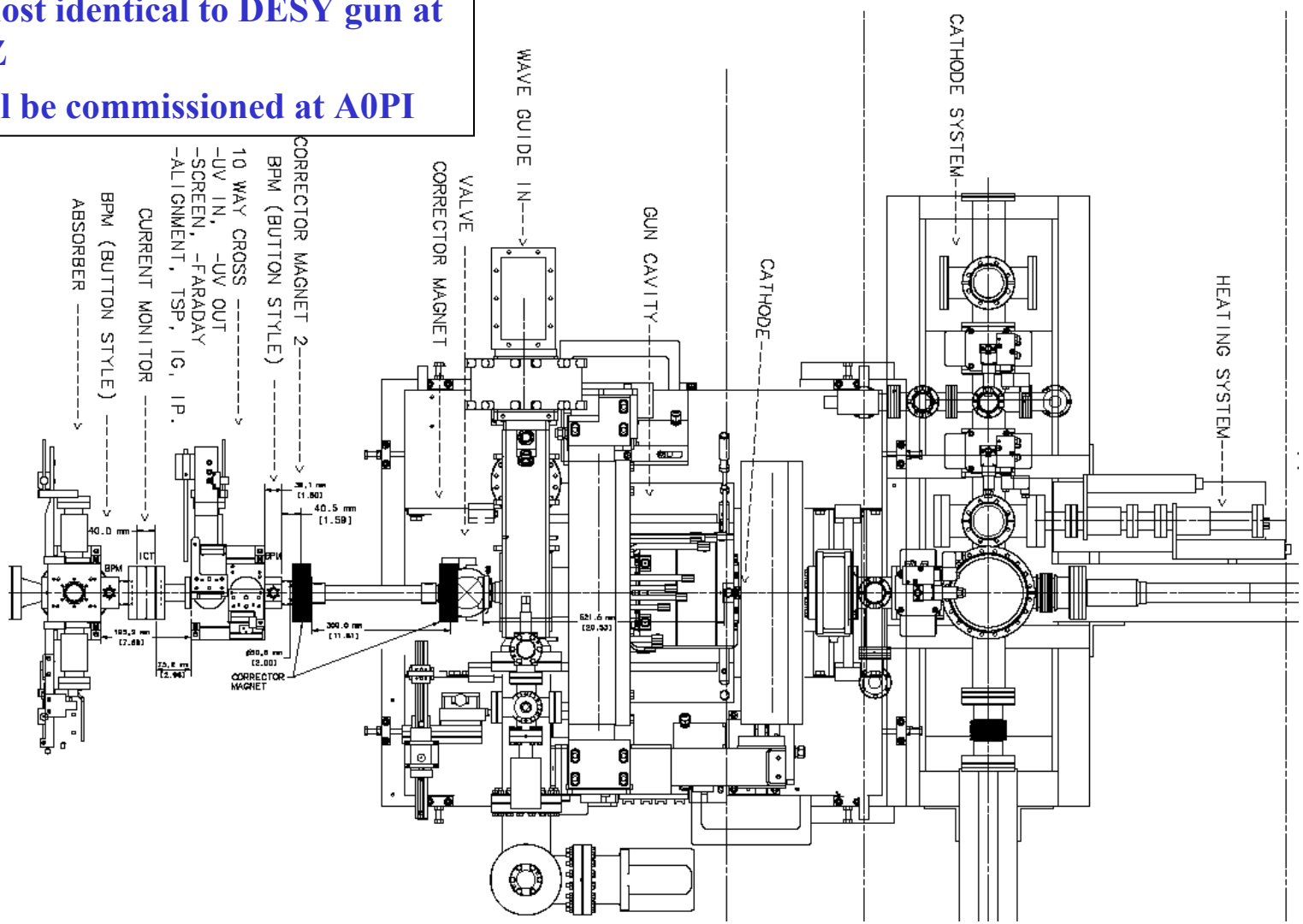




$\sigma_z = 136\mu m$; $\sigma_{dp/p} = 1.16\%$

RF Gun

- Almost identical to DESY gun at PITZ
- Will be commissioned at A0PI



Instrumentation

- Button BPMs in beamlines; cavity BPMs in cryomodules
  - Some BPMs to be used for phase measurement
- OTR/YAG screens for beam size; slits or pepperpots for emittance
  - possibly ODR in high energy beamline
  - possibly SR from chicane (and other) dipoles
- Integrating Current Transformers for beam current
- Scintillator and phototubes for Beam Loss Monitors
- Faraday cup downstream of gun
- Streak camera and M-P interferometer for bunch length measurement
  - Deflecting Mode Cavity is on our wish list
- 22.5° and 15°, dipoles (low and high energy, respectively) for energy and energy spread measurement
- laser diagnostics (hopefully) to be developed
  - 2 laser huts incorporated in the design – 1 upstream for the photocathode laser and future diagnostics; 1 downstream for future diagnostics

Schedule

- Cryomodule Ready for Cooldown (Summer 2009)
- Cold RF Testing of 1st Cryomodule (Fall 2009)
- Delivery of 2nd Cryomodule to NML (2010)
- Install Gun and Injector (2011)
- First Beam (2012)
- Full RF Unit Testing (3 Cryomodules) (2012)