Laser and Undulator Radiation For CeCPoP Experiment

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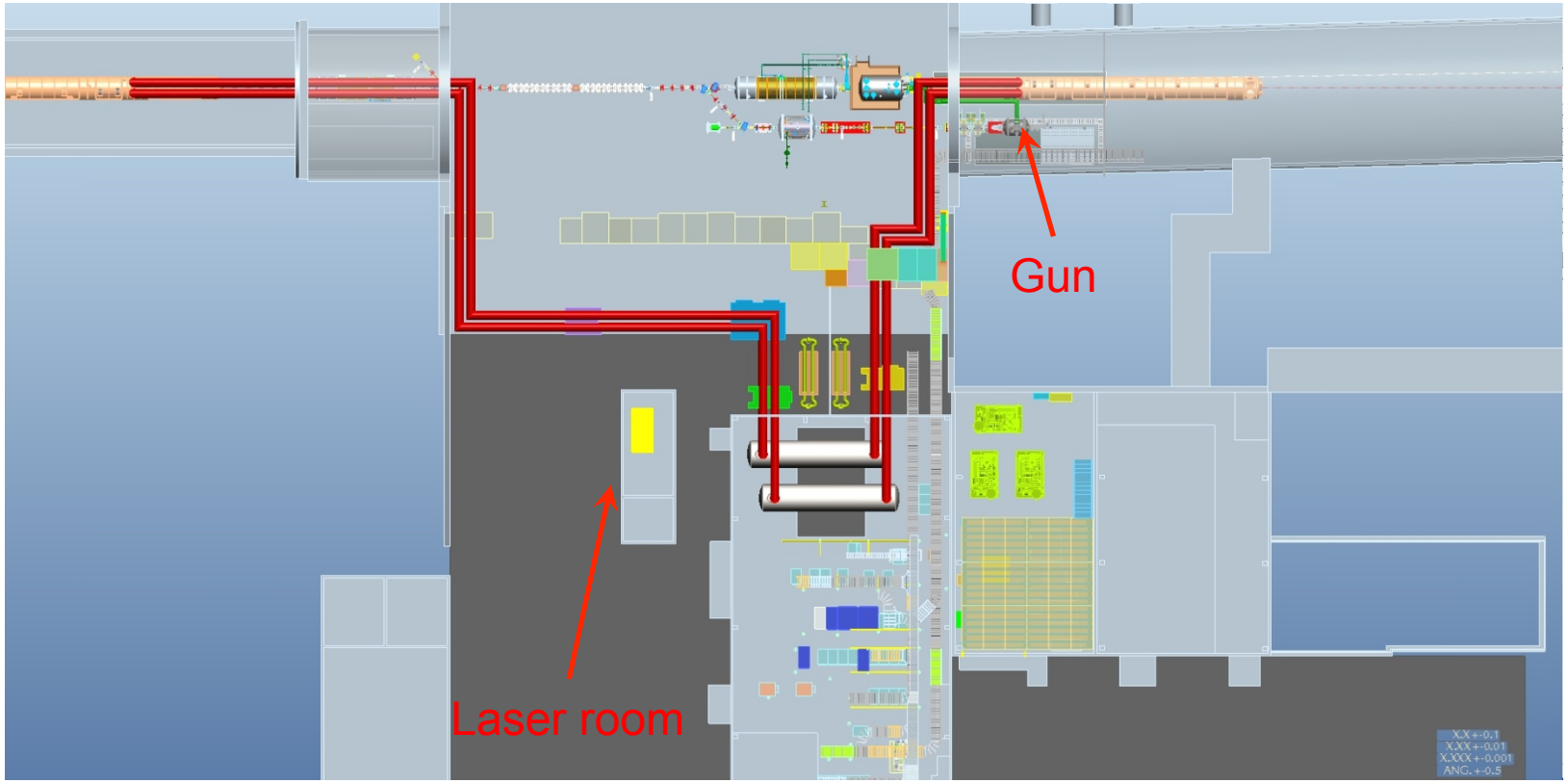
Overall Layout



~ 30 - 40 meter path between Laser room and Gun location, with multiple bends required. Light will be transported in an optical fiber

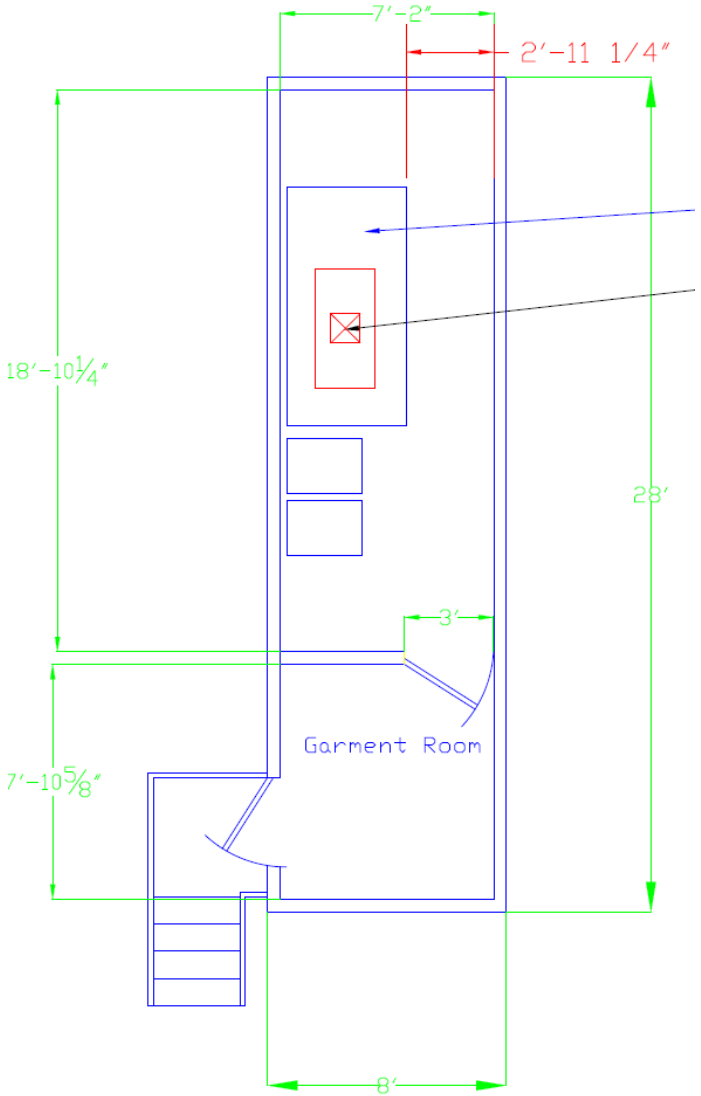
Gun Laser Parameters

Parameter	Unit	Value
		Requirement
Center wavelength λ	μm	532
Center wavelength stability (24 hour)	nm	<0.1
Bandwidth	nm	<0.1
Repetition rate	kHz	78.2±0.5
Peak Power	kW	≥1
Average power	mW	8-40
Pulse width	psec	100-500
Pulse rise time	psec	<100
Pulse contrast		≤1e-6
Polarization extinction	dB	20
Transverse mode beam quality factor	M^2	≤ 1.3
Jitter relative to trigger clock	psec	≤10

- Laser is custom project by NuPhoton
  - delivery March/April
- Fiber Master Oscillator Power Amplifier configuration, followed by a doubling module
  - 1064 nm fundamental, 532 nm doubled
- Class IIIb
- 532 nm is produced in free space, then coupled into a transport fiber for transmission to the gun

representative amplifier module only

Laser Room

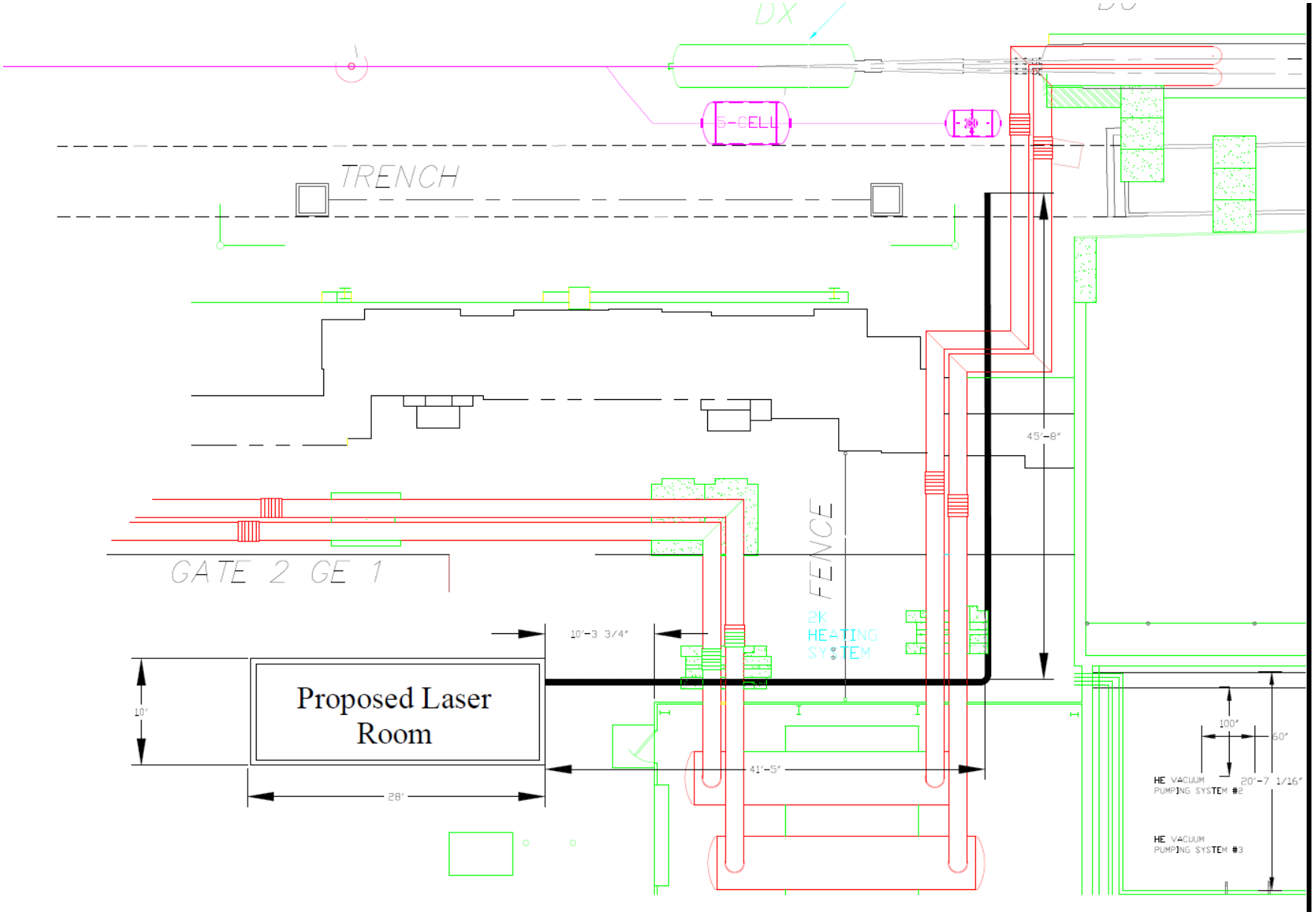


- Laser is contained in a modular building, which will be an interlocked Laser Controlled Area as per SBMS Laser Safety subject area, ANSI standard & CAD requirements
  - Training & medical surveillance requirements
  - unauthorized entry terminates emission
    - LSS system allows key or code entry
  - Standard Operating Procedure, reviewed
  - PPE required

- Undulator radiation, which could attain Class IIIb/ IV levels, will also be transported here for analysis
  - 12 um wavelength, max 1 Watt, usually significantly lower
    - depends on e beam parameters
  - can only be generated when e-beam is running

Preliminary

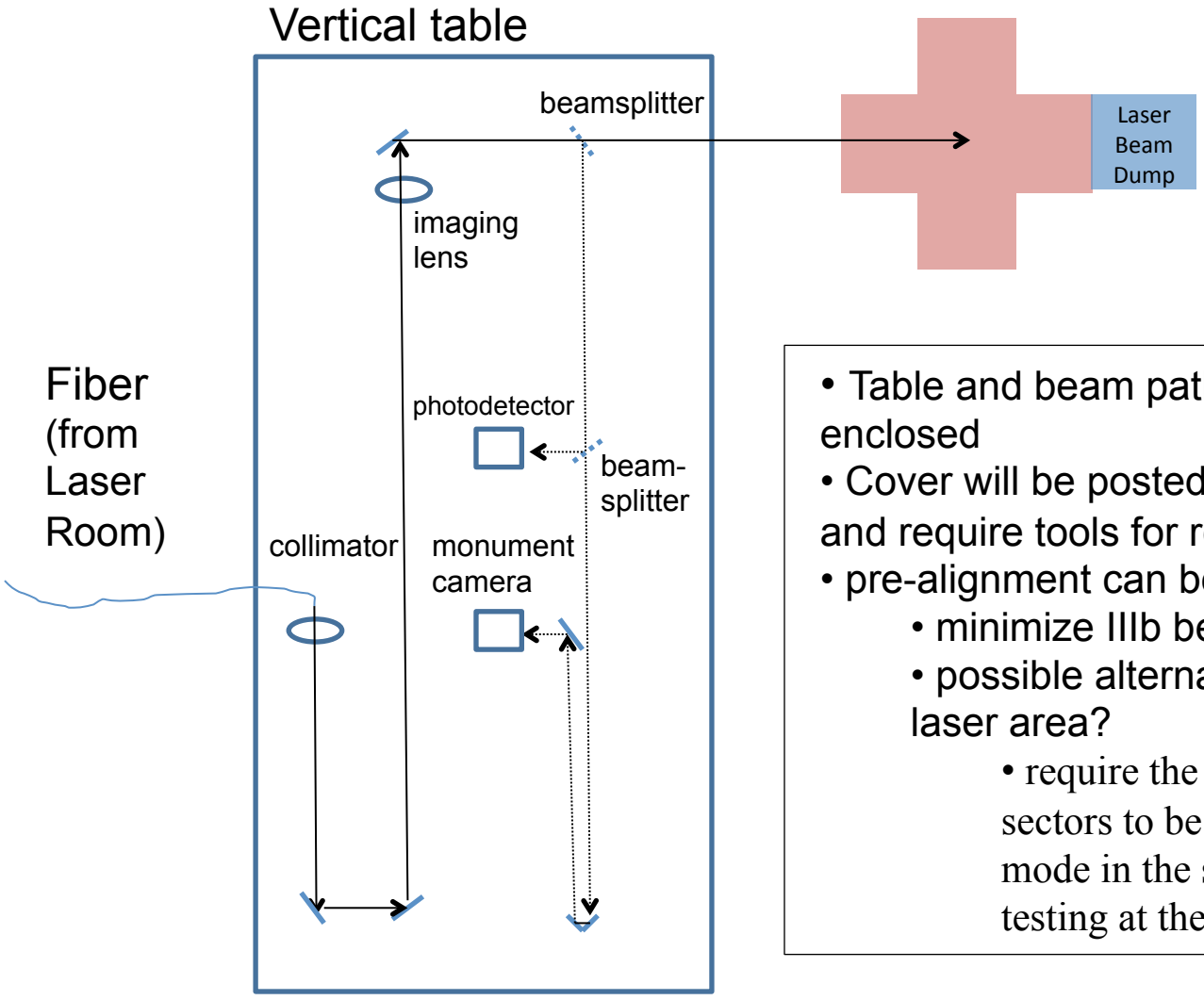
Transport route to the Gun



Optical Configuration at Gun End

(view looking upstream the electron beam direction)

Laser cross (beam enters accelerator vacuum system)



- Table and beam path through the cross will be enclosed
- Cover will be posted with appropriate warnings and require tools for removal
- pre-alignment can be done with class II/IIIa laser
  - minimize IIIb beam in gun area
  - possible alternative to separate interlocked laser area?
    - require the 02:00 IP and the adjacent RHIC sectors to be swept and in the no access mode in the same way that RHIC RF cavity testing at the 4:00 IP is done now.

Point by Point through the Hazard Tool

Rating of 3:

2b(1). Are radiation generating devices capable of creating a High Radiation Area (>100 mrem/hr at 30 centimeters)?

Radiation is only generated via the accelerator. The photocathode laser initiates the electron beam.

2c(1). Does this operation use RGDs that are built locally or are commercially available units that have been modified?

The accelerator is designed and built locally

5a. Do personnel use or have the potential to be exposed to class IV lasers?

Covered in this talk

Rating of 2:

1d. Does this operation use, generate or store flammable or combustible gases, liquids or solids, including solvents?

solvents for cleaning optics: methanol, ethanol, isopropanol, acetone

2. Are there any accelerators or other radiation generating devices involved in this operation?
2b. Are there any radiation generating devices (RGD) used in this operation?
2b(2). Are the radiation generating devices capable of creating a radiation area?
2c. Does the radiation generating device only produce radiation incidental to its primary function (such as electron microscopes, electron beam welders, ion implantation equipment)?

Radiation is only generated via the accelerator. The photocathode laser initiates the electron beam.

5. Does this operation involve the use of lasers?
5b. Do personnel use or have the potential to be exposed to Class IIIb lasers?
5d Does this operation involve Class I lasers with embedded IIIb or IV lasers? Enclosed table at Gun area
5e. Have any of the lasers involved in this operation been built locally or have any commercially available lasers been modified?

Gun laser is a commercial (custom) product. Transport is engineered locally. 12 um undulator radiation is generated from locally built devices and transport is engineered locally.

Rating of 2 continued:

11b. Will operation require work outside normal working hours?

Yes. Both commissioning and experiment require long runs and are subject to RHIC scheduling.

13. Are there any controls (i.e., ventilation, fume hoods, interlocks, personal protective equipment, HEPA filters/vacuum cleaners, medical monitoring) associated with this operation?

13b. Are interlocks used in this operation?

Laser room, as per SBMS Laser Safety requirements

13c. Is any personal protective equipment used in this operation?

PPE for laser light, as per SBMS Laser Safety Requirements

13d. Are HEPA filters in place/used?

Only for maintaining cleanliness of air in Laser room. Not for exhaust-cleaning purposes

Summary

- **Laser Hazard at 3 locations**
  - **Laser Room located outside of main building**
    - Laser Controlled Area
  - **Optics box & Laser Cross at electron Gun**
    - All beams enclosed
    - possibility of using No-access mode for final alignments instead of creating a separate Laser Controlled Area.
  - **Undulator Radiation**
    - can only be generated when area is in no-access mode
    - transported back to Laser Room
      - enclosed beams across occupied areas