Configuration, Installation, & Schedule Issues of Shintake Monitor

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Topics

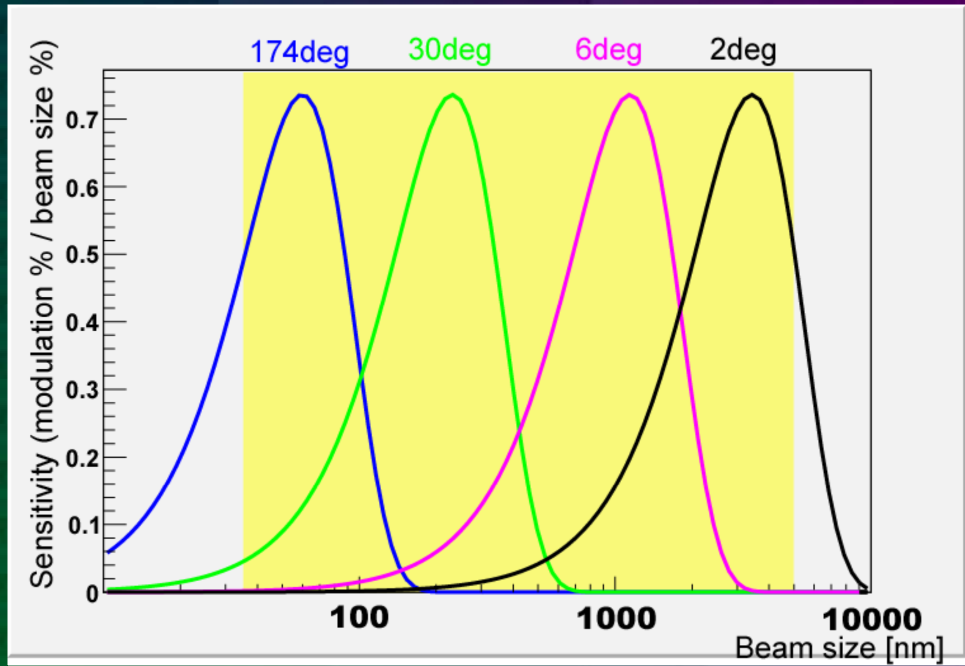
1. New Optical Table
   1. Overview
   2. Laser crossing angle (for σ_y)
   3. σ_x measurement by solid or laser wire
2. Layout
3. Schedule
   1. Installation / before commissioning
   2. Commissioning strategy

New Optical Table

- As Tauchi-san said, we decided (as new baseline) to design and make a new optical table instead of using existing FFTB optical table.
- Features of new optical table are:
  - Increasing power (>100mJ+100mJ)
    Mirrors for laser crossing angle that is not used is simply taken out from beam line
  - New crossing angles for wider σ_y measure range
  - σ_x measurement by solid or laser wire if necessary
  - Smaller table size if possible
  - Better stabilization origin (phase and position)
  - etc.

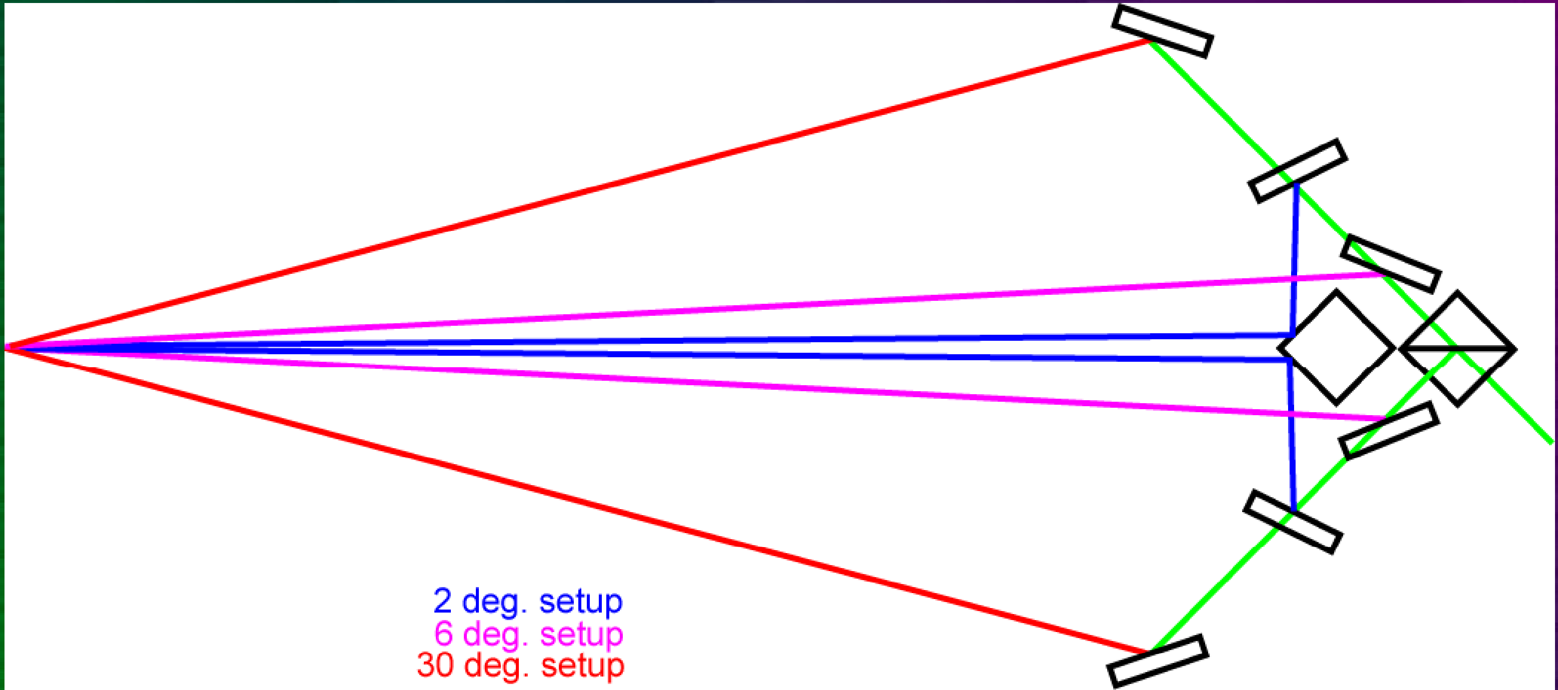
Laser Crossing Angles

- ATF2 Beamsize:
  - σ_X: down to 2.8μm: no need for interferometer
  - σ_Y: down to 37nm, wide range up to a few μm should be covered
- Variable or semi-variable crossing angle (2~30deg.) should be considered



4 crossing angles for σ_Y

Switchable Crossing Angle



Selecting crossing angle by taking out (automatically or manually) mirrors of different angles

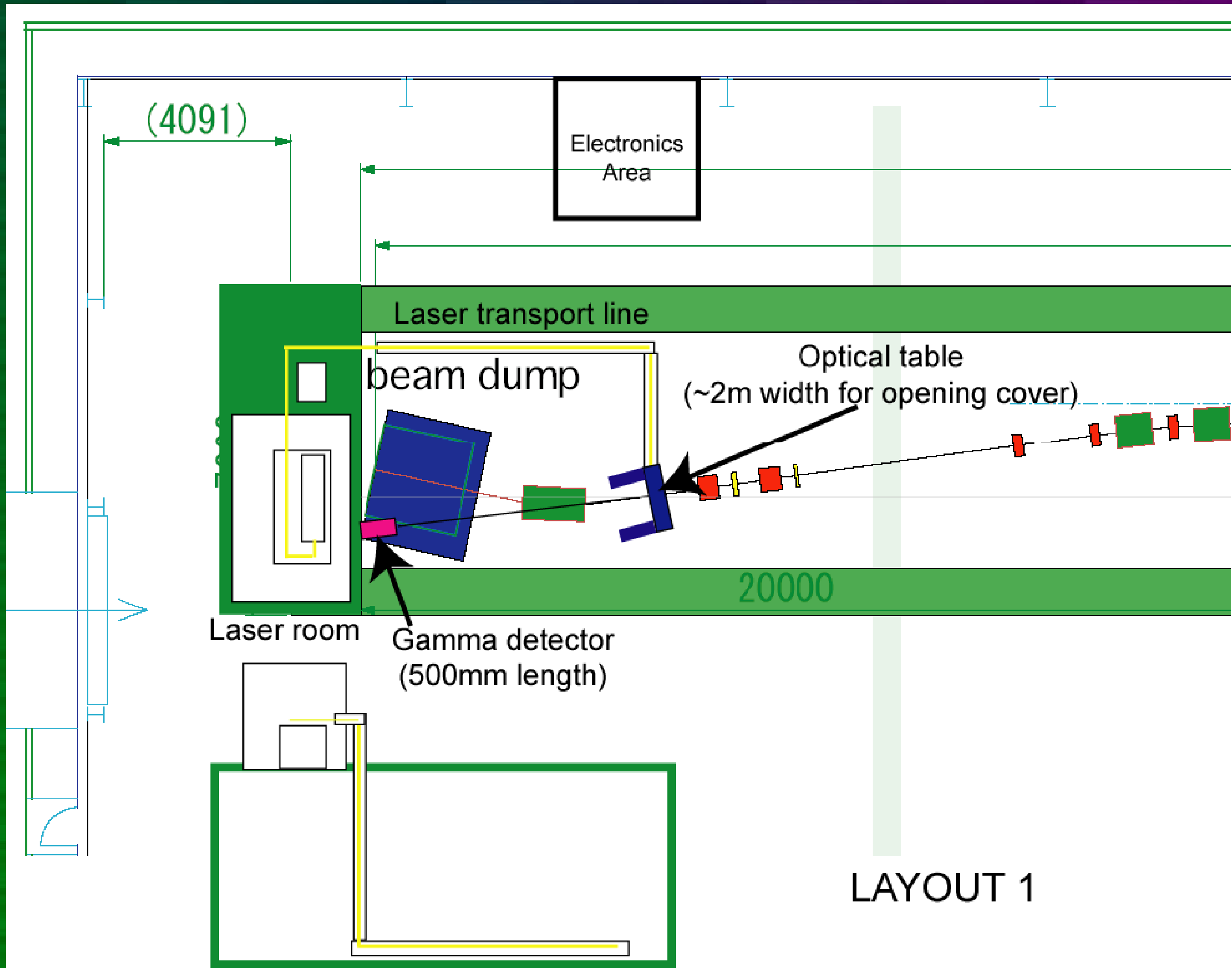
Issues

- Vacuum port
- Laser beam dump
- Detailed layout
- Phase monitor location
- Actuators for mirror tuning (manual tuning?)

σ_x measurement by solid or laser wire

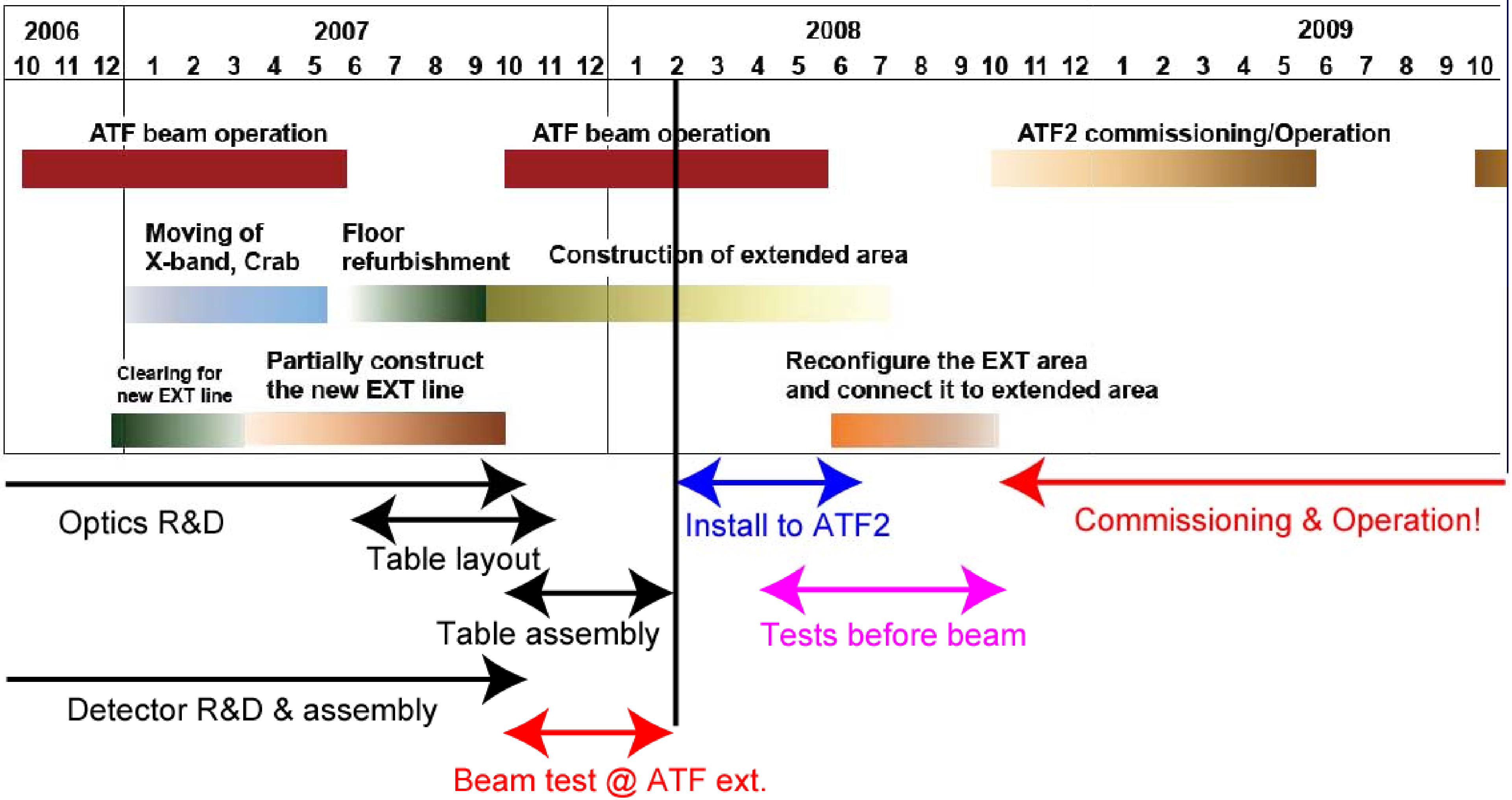
- σ_x design beam size is 2.8μm
  - Too large for interferometer
  - Can be measured by solid or laser wire
- Solid wire scanner
  - We need a sliding mover for slit alignment, we can attach a solid wire to the slit mover for σ_x measurement (because moving direction is same)
- Laser wire
  - σ_x measurement by laser wire method is available if we can reduce laser spot size to 2~3μm
  - Laser spot size at IP can be selective by multiple lens setup (15μm for interferometer baseline, 5μm for interferometer enhanced signal, 2~3μm for laser wire mode)
- Or we don't need any σ_x monitor?

Layout



(4091)
Electronics Area
Laser transport line
beam dump
Optical table
(~2m width for opening cover)
20000
Laser room
Gamma detector
(500mm length)
LAYOUT 1

Schedule



Extra several months for new table layout & assembly

Installation will begin at Feb. 2008 (after table assembly)

Commissioning Schedule

- 1~2 months for system commissioning
  - Laser beam alignment
  - Background measurement
  - Software commissioning
- Low crossing angle operation for tuning
  - Available by end of 2008
    (if beam will arrive at IP soon after beam on)
- Full operation for 37nm
  - Schedule depends on beam

Summary

- New optical table is under design.
  - Laser power is improved to >100+100mJ.
  - 37nm ~ a few μm σ_y can be measured.
  - Solid or laser wire is available if ATF2 need σ_x measurement.
  - We need comments from optics group about required σ_x / σ_y measurement range.
- Layout – is not changed.
- We need additional months to design and construct a new table. Installation will begin Feb. 2008.
- Operation will be ready by end of 2008.

Thank you.

New Optical Table (Why?)

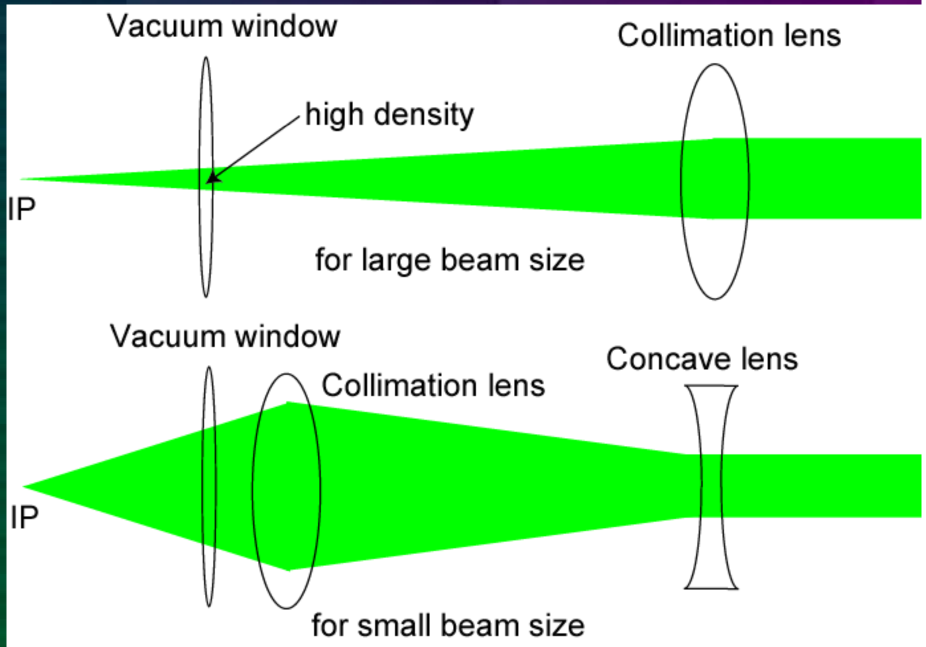
- Merits
  - Better for vibration suppression.
    existing optical table is too thin.
  - We can perform various optimization for new table, including described above.
  - We need no additional cost, because company we ordered vibration analysis will make it without any additional cost.
- Demerits
  - We need a lot of work to redesign optical table.
  - There may be troubles because the new optical table is not tested (while existing table was already tested and modified in FFTB).

Laser Spot Size on IP

IP BS [um] 1 sigma	average photons	divergence [rad.]	beam size [mm] @ optics			power density [J/cm2] @ optics			
			50	100	200	50	100	200	distance from IP [mm]
15	2894	0.0113	0.56	1.13	2.26	11.16	5.58	2.79	
10	4341	0.0169	0.85	1.69	3.39	7.44	3.72	1.86	
5	8683	0.0339	1.69	3.39	6.78	3.72	1.86	0.93	↑ interferometer
2	21707	0.0847	4.24	8.49	16.97	1.48	0.74	0.37	↓ laser wire
1	43413	0.1693	8.55	17.10	34.20	0.74	0.37	0.18	

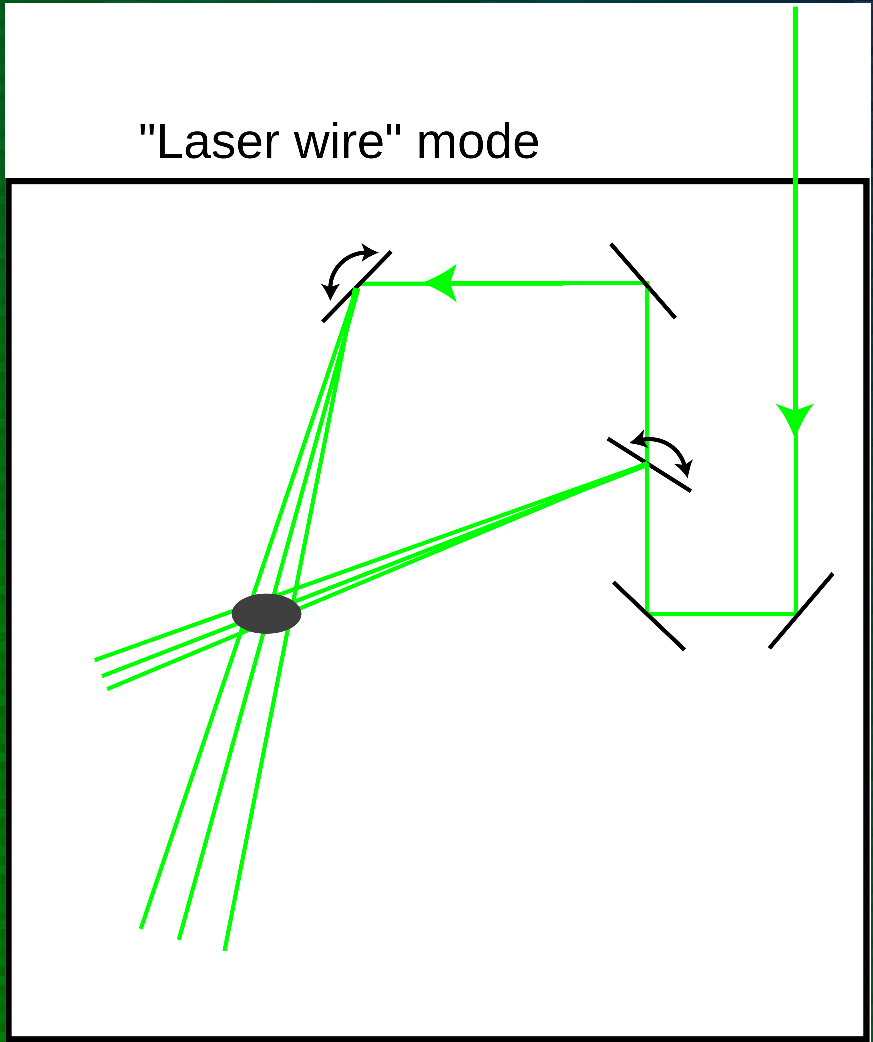
Condition: 100mJ + 100mJ laser power, 5.5ns laser pulse width, 1.6nC electron bunch population

- Power density @ optics is restricted by mirror damage threshold (10~20J/cm^2)
- Vacuum window @ 100mm from IP is moderate.
- 15 µm spot size for baseline (same as FFTB)
- 5 µm if signal power is too low (because of heavy background)
- 2 µm is possible for laser wire



Optical layout for large/small beam

Simple “Laser wire” mode



- For larger beam size, “Laser wire” mode will be available.
- A few to 100 μm beam can be measured.
- With proper change of lenses and actuators, smaller beam may be measured (but 360 nm will be very difficult)
- Signal strength become lower for larger beam size because of lower density of e- beam. (~100 μm may be limit)