Shintake-monitor : upgrade & requirement

Taikan SUEHARA

Dept. of Physics, The Univ. of Tokyo

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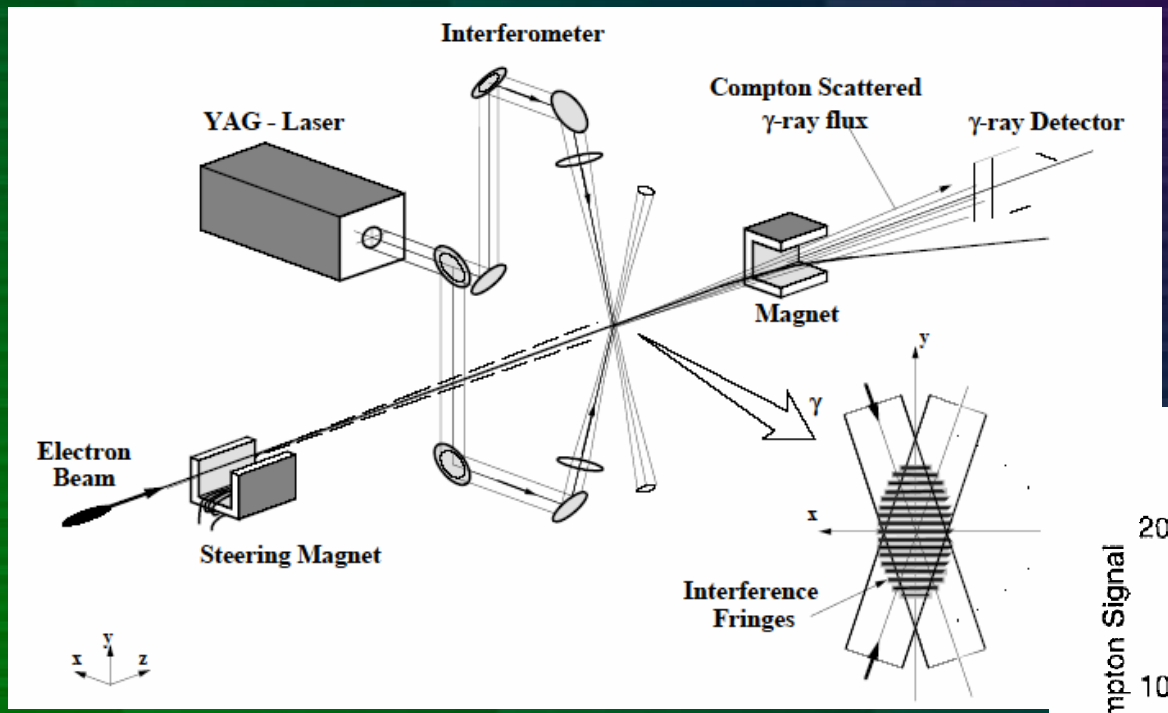
Overview of Shintake-monitor

Taikan SUEHARA, 2nd ATF2 project meeting @ KEK, 2006/5/31

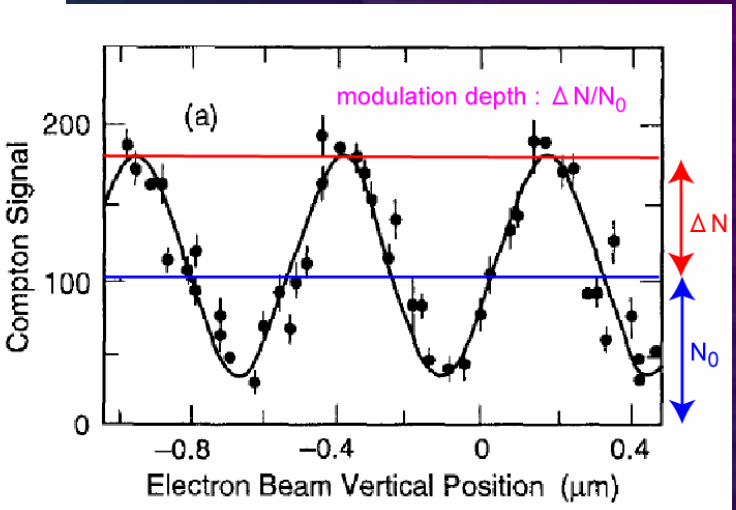
ATF2 Shintake-monitor group

- Students
  - Taikan SUEHARA (Univ. of Tokyo, D2)
    - Optics (main table, laser table)
    - Overall design,etc.
  - Hakutaro YODA (Univ. of Tokyo, M1)
    - Gamma detector
- Staffs
  - Tatsuya KUME (KEK)
    - Optics support (fringe stabilization etc.)
  - Yosuke Honda (KEK)
    - Support (optics etc.)
  - T.Tauchi (KEK), T.Sanuki (Univ. of Tokyo)
    - Advisor (ATF2, overall)

Shintake-monitor principle

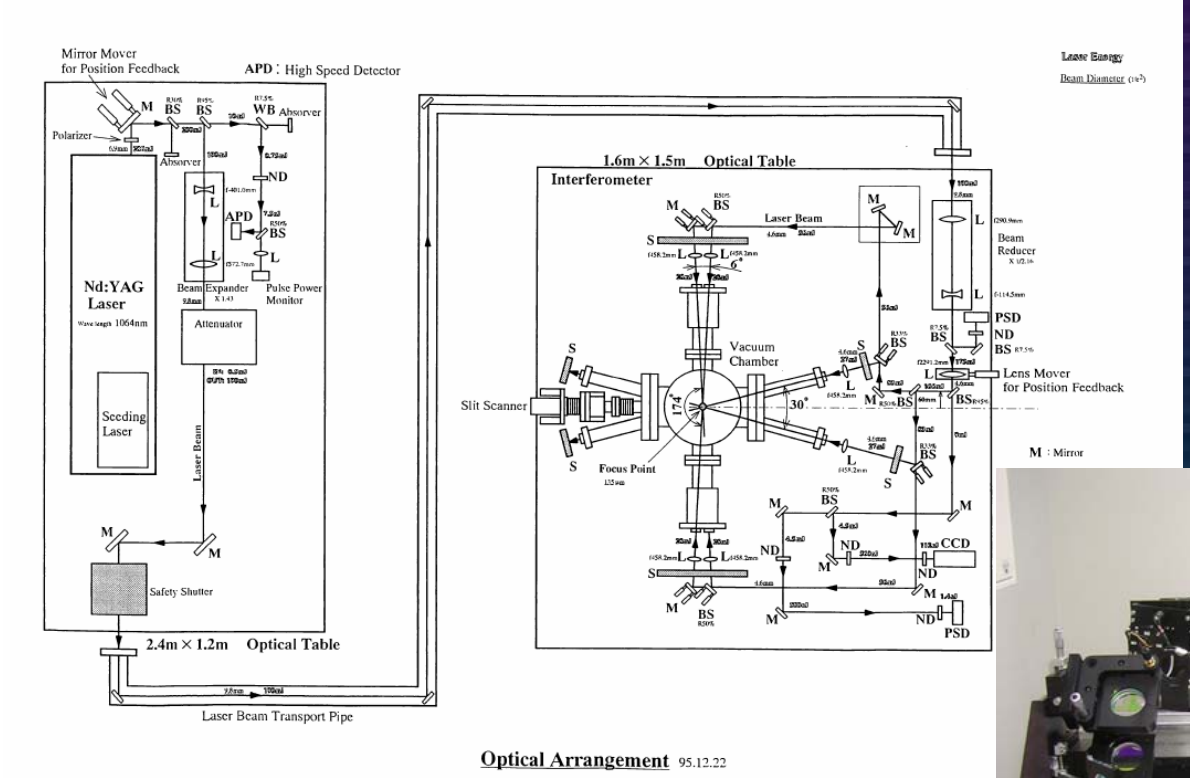


schematic



FFTB sample : σ_y = 70 nm

Table layout



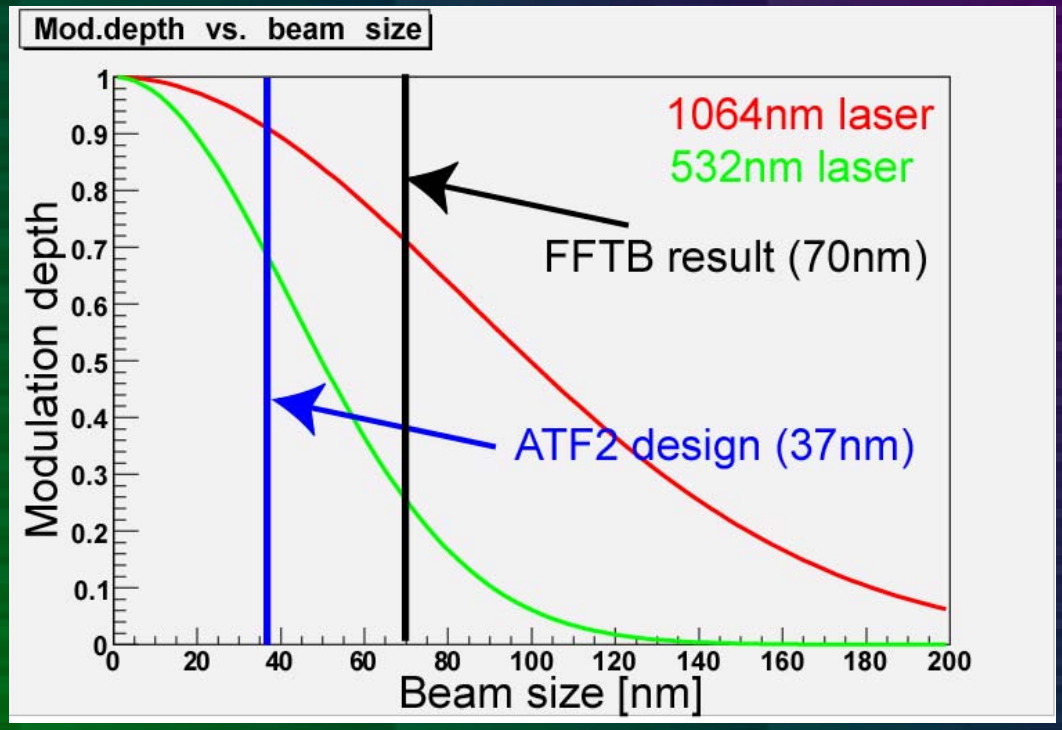
Shintake-monitor and laser table (front)

FFTB optical arrangement
Left: laser table
Right: interferometer table

Upgrade plan & status

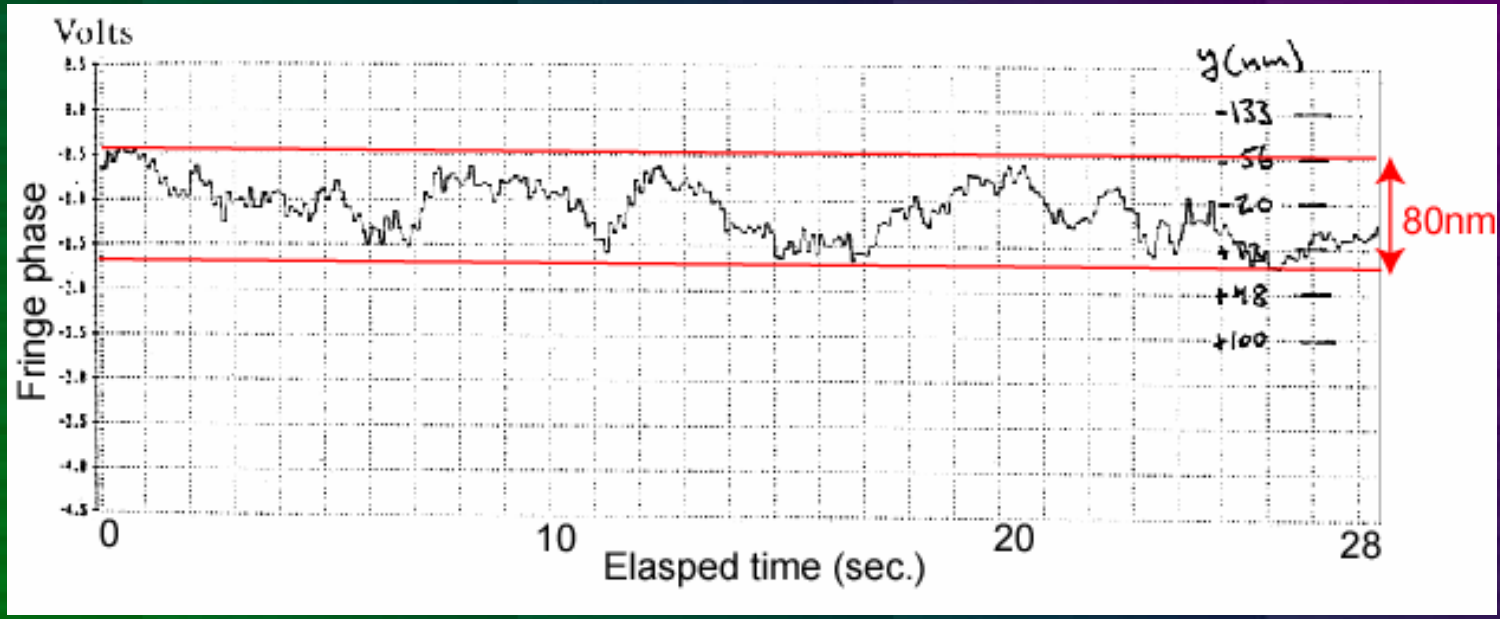
Taikan SUEHARA, 2nd ATF2 project meeting @ KEK, 2006/5/31

Change of laser wavelength (DONE)



- Laser : SHG(1064nm to 532nm) finished.
- Optics : mirrors replaced. (lenses not yet)
- Now using 532nm cw. low power laser for test

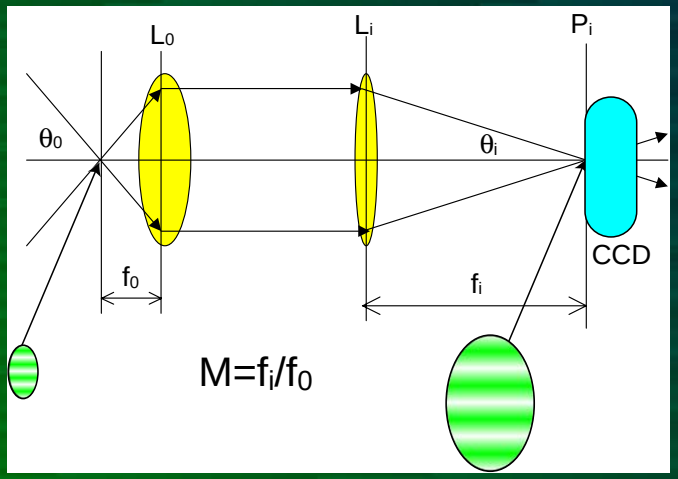
Phase detection & control



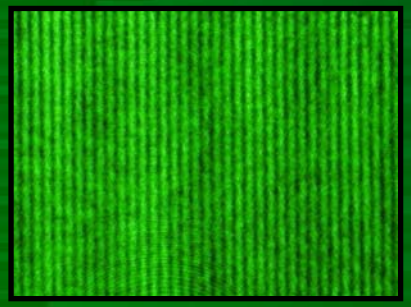
M.Woods et al., "Stability and modulation depth of Interference Fringes of the FFTB BSM", FFTB note 98-02

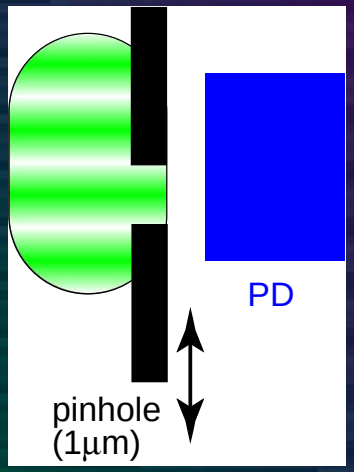
FFTB : 22nm(σ) 80nm(p-p) vibration observed.
ATF2 goal : <10 nm order phase stabilization / control

Phase detection method

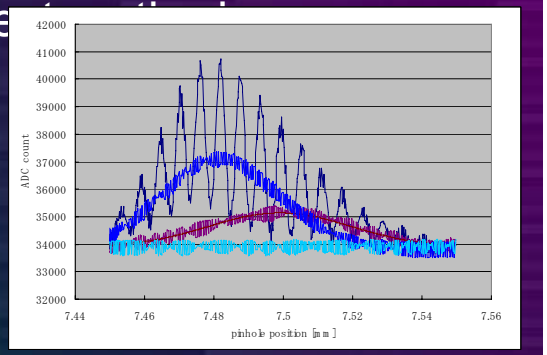


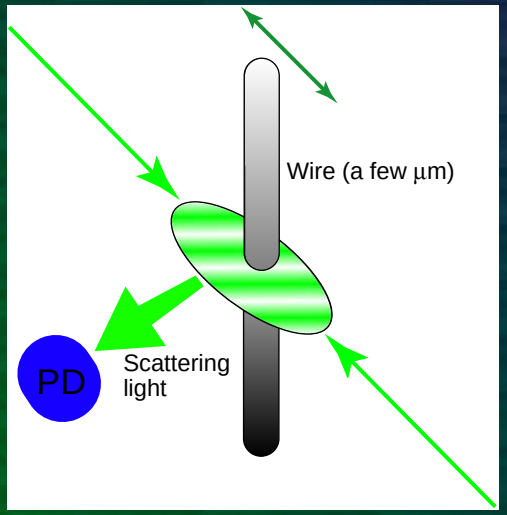
CCD with fringe magnify optics
(using microscope lens)
> 1μm fringe (6° ,30° setup)
single shot (usable for online monitor)
indirect method (need to check responsibility)





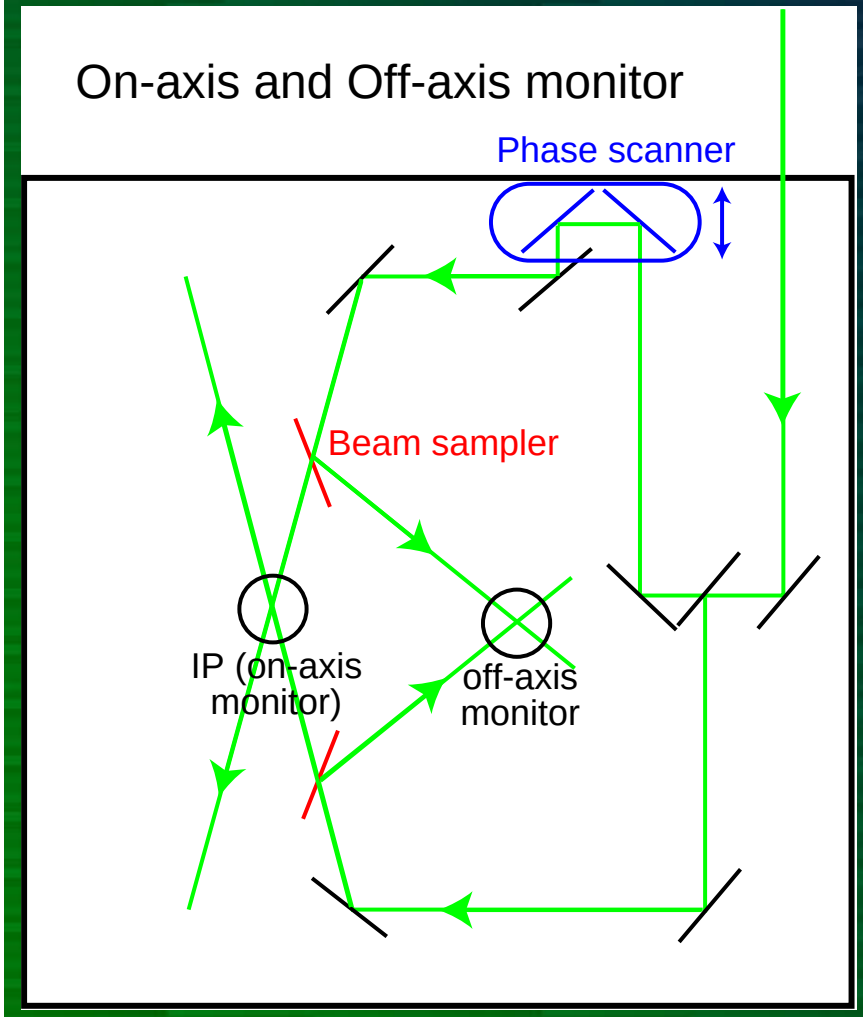
Pinhole scan
> 1μm fringe (6° ,30° setup)
not single shot
simple theory
(good for cross check)
dire





Wire scan
~ 250nm fringe
(all setup)
not single shot
tuning is difficult
direct method

Online phase monitor(off-axis)



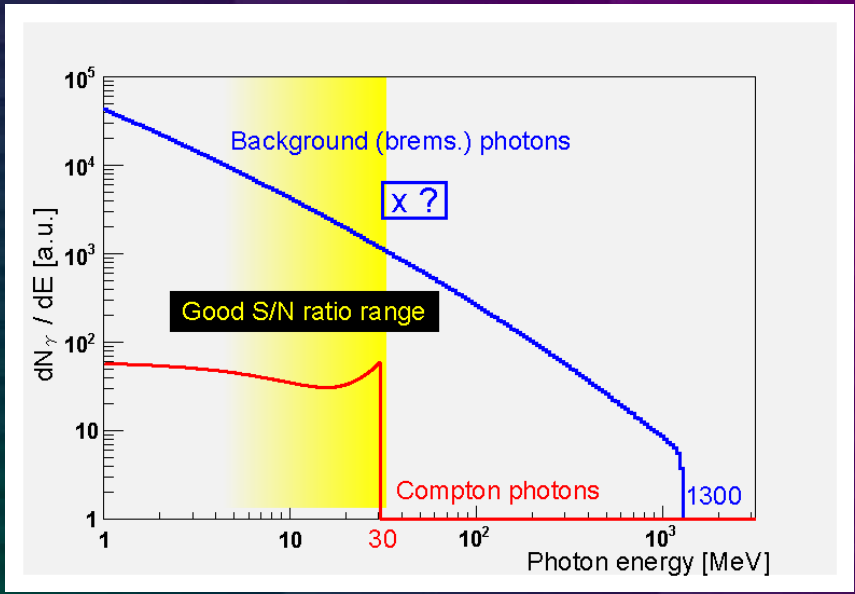
- For online monitoring, we must use off-axis monitor (we cannot put phase detector at IP during ATF2 operation !)
- Correlation between IP and off-axis monitor must be checked.
- Phase will be stabilized by phase scanner (delay line) using off-axis phase monitor data.

Phase control status & plan

- Checking phase detection method ~ Jun. 2006
  - Pitch, contrast, stability
  - Correlation between pinhole & CCD (& calculation)
- Off-axis monitor ~ Aug. 2006
  - Implementation (CCD method)
  - Correlation with on-axis monitor
- Phase scan by delay line ~ Oct. 2006
- Phase stabilization by feedback ~ Dec. 2006

Gamma detector

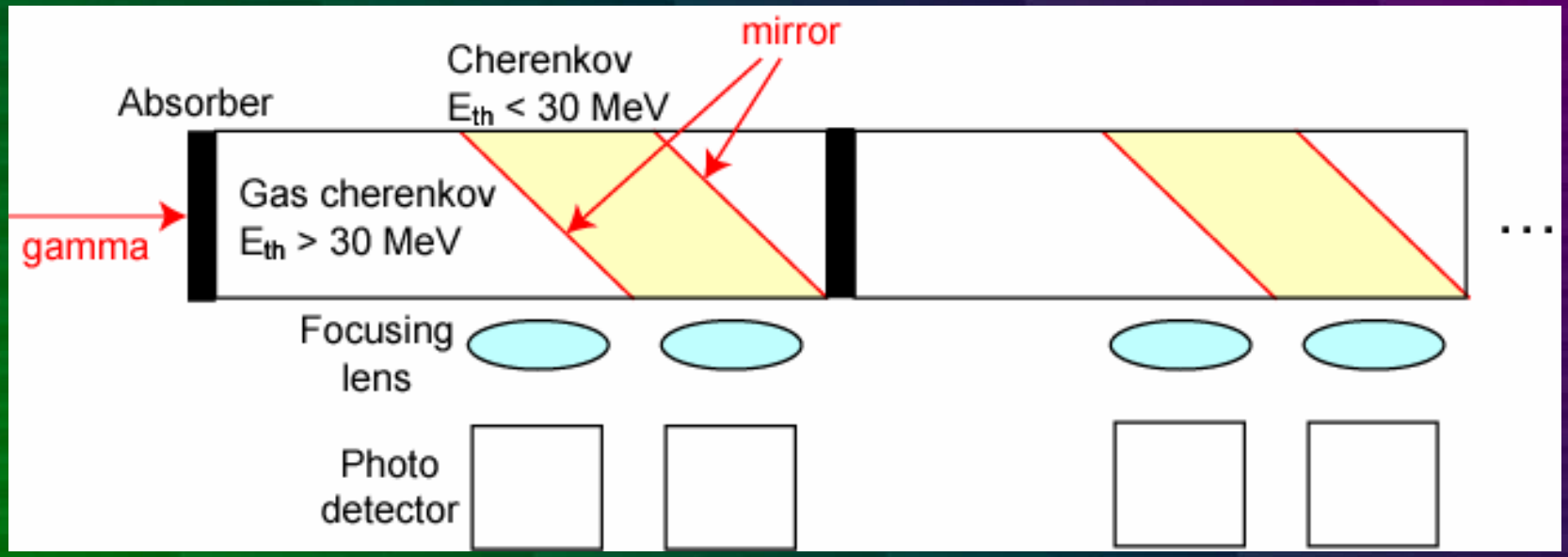
- Background sources
  - Beam halo scattering with beam pipe
  - Radiation from beam dump (can be geometrically suppressed)



- Background suppression strategy
  - On-off suppression (subtract laser-off data)
  - Separation by energy cut (by detector)

Gamma detector (1)

- Multi material cherenkov detector



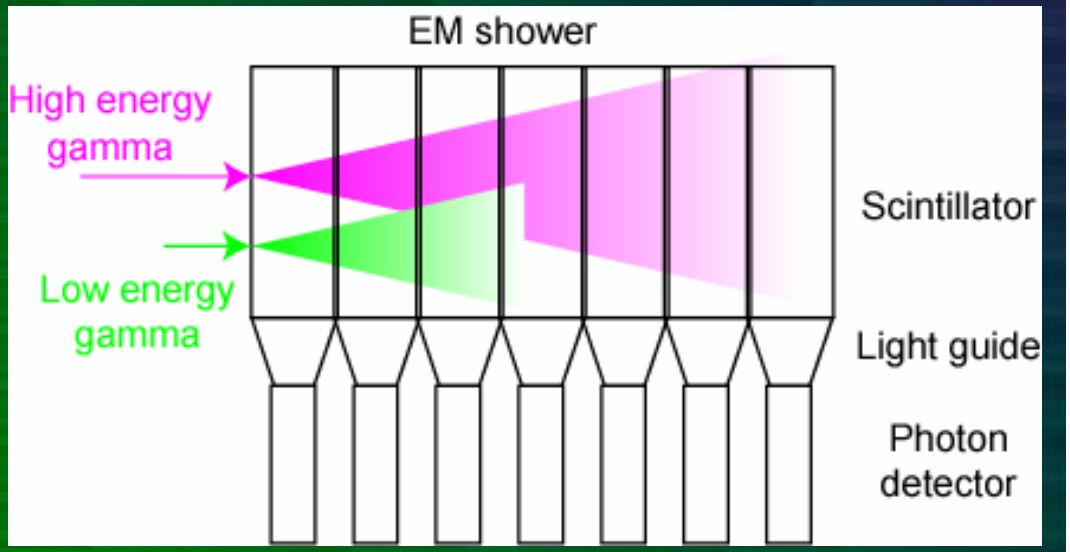
High energy subtraction by forward Cherenkov detector

○Insensitive to background shower statistics

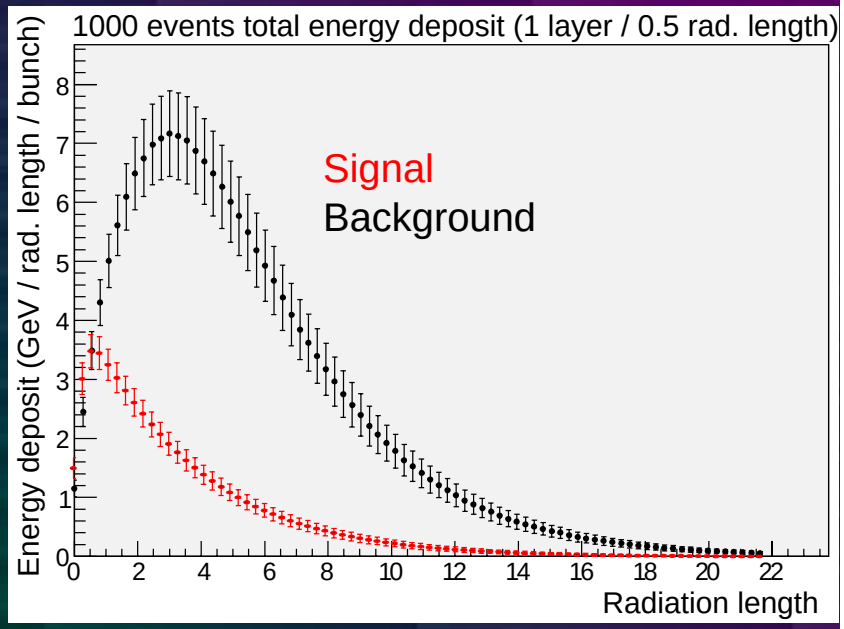
×Number of emission photons is low.

Gamma detector (2)

- Multi layer inorganic scintillator



Detector schematics



Simulated energy deposit

Using difference of shower development for energy separation

○Easy to make, sufficient light emission

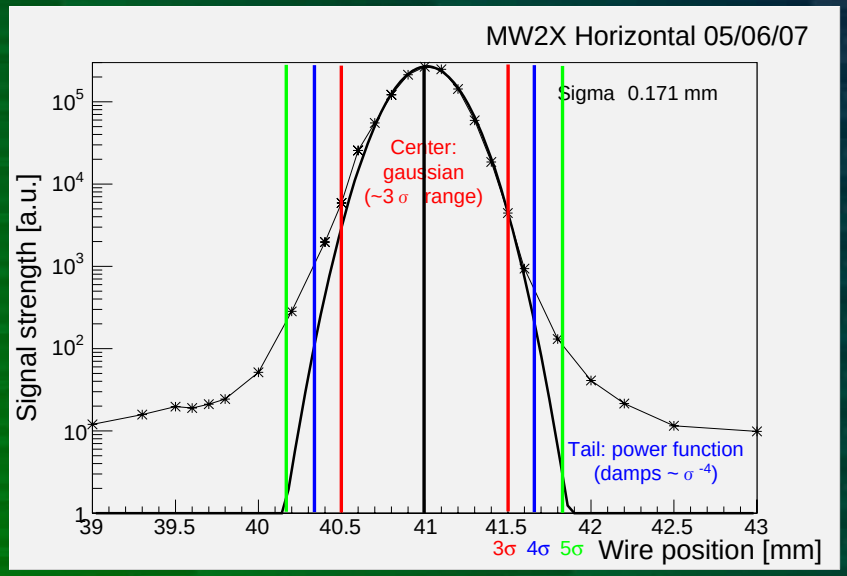
×Vulnerable to shower development fluctuation

Gamma detector status & plan

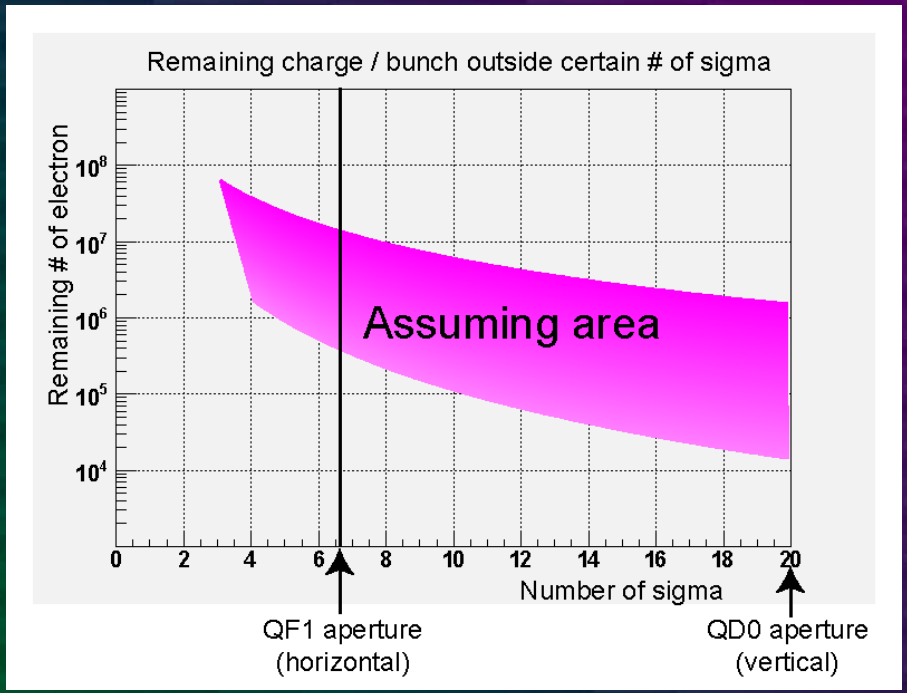
- Simulation study (~ mid Jul.)
  - Conceptual design (almost finished)
  - Prototype design (ongoing)
- Prototype making (~ Oct.)
- Prototype test (~ Feb. 07)
  - Cosmic ray
  - Background test (ATF ext. line)
  - Signal test (TERAS or ATF laser wire)
- Real detector making (Mar. 07 ~)

Requests

Charge of beam halo



Beam profile of ATF ext. line

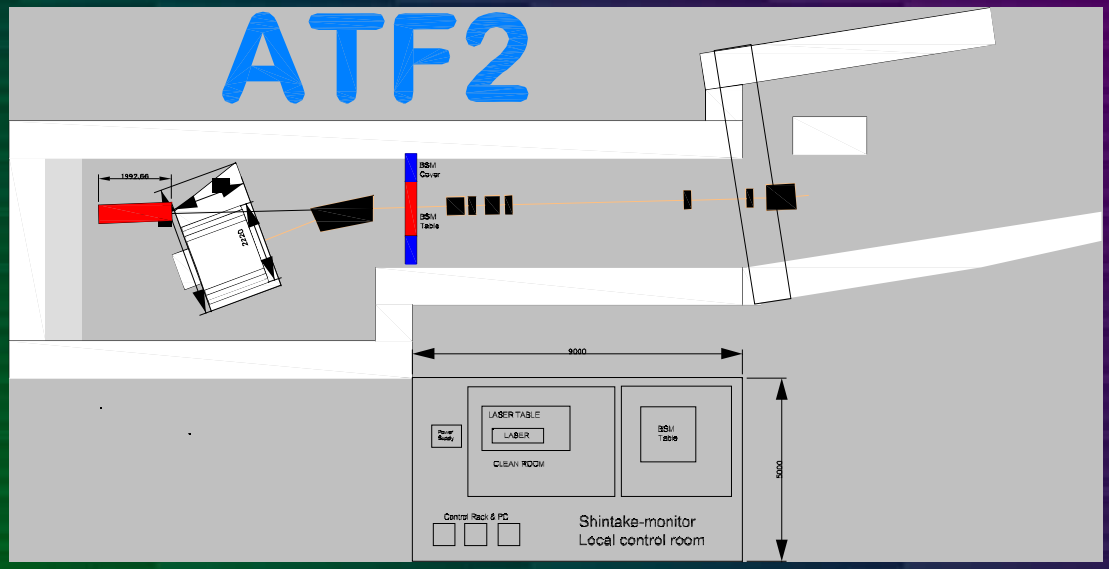


$10^{5\sim7}$ particles remain outside QF1 aperture (6.6σ)
Collimation optics are highly essential.

Request for collimators

- We need ~5σ (H), ~15σ (V) cut.
- As upper stream as possible
  (at least upper than the last bending magnet)
- Movable (for tuning)
- Thickness for cutting forward radiation
- Need to check beam profile change
  downstream of the collimator
  (tail cut may become blunted)
- Phase needs to be considered

Floor requirements



- We need 3m width for removing the cover of the optical table for maintenance.
- We need 2~3m length behind beam dump (for Cherenkov detector)
- We need 5m x 9m clean room for the laser (near the IP).
- The IP optical table should be stabilized.

Summary

- Status : Optics upgrade (fringe stabilization) & gamma detector simulation ongoing.
- Collimator : ~5σ (H), ~15σ (V) collimators needed at upstream section
- Floor requirements also shown.

Thank you !!