ATF2-IN2P3-KEK kick-off meeting (Oct. 9, 2006)

Mount stabilization for Shintake monitor

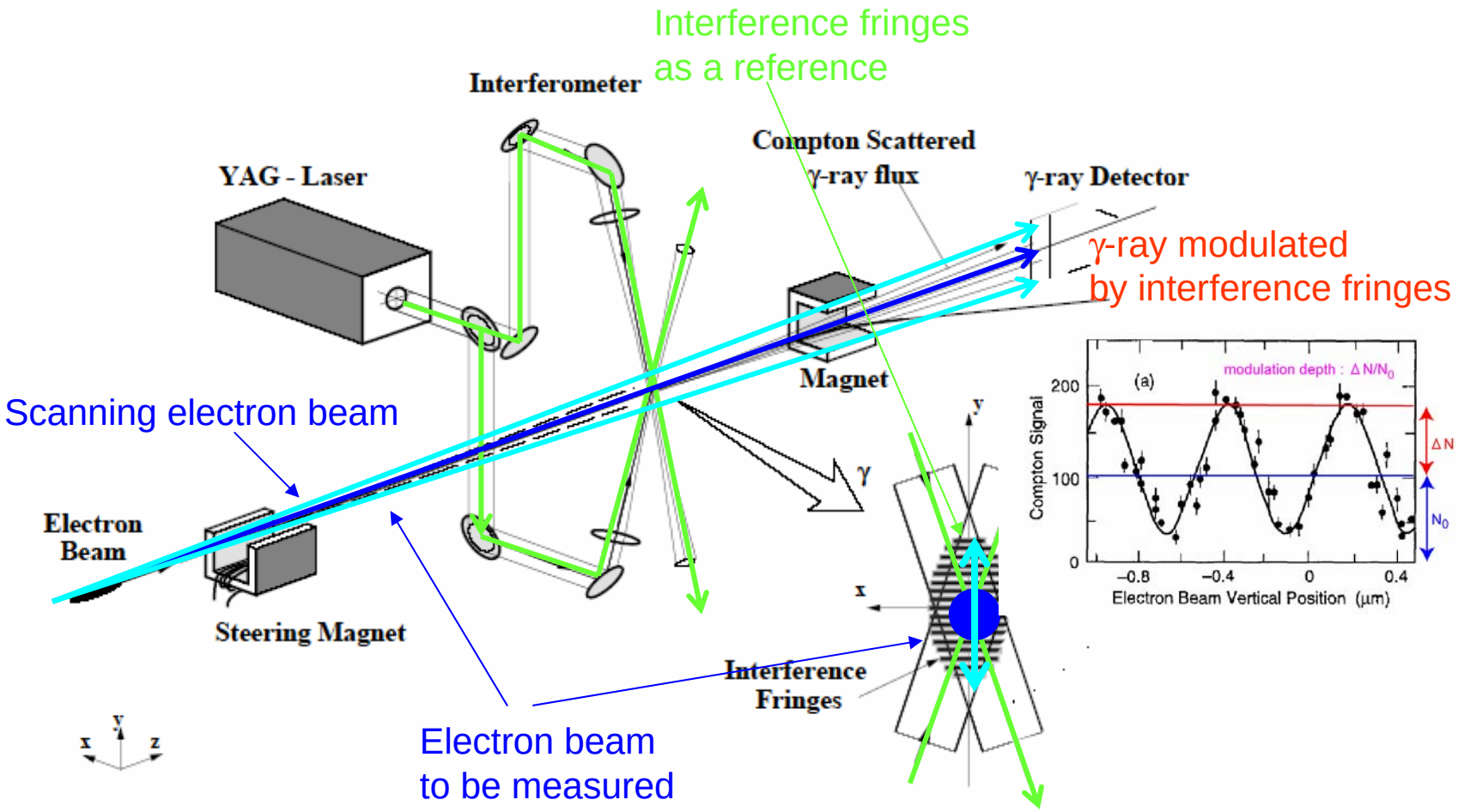
Tatsuya KUME
Mechanical Engineering Center,
High Energy Accelerator Research Organization (KEK)

Contents

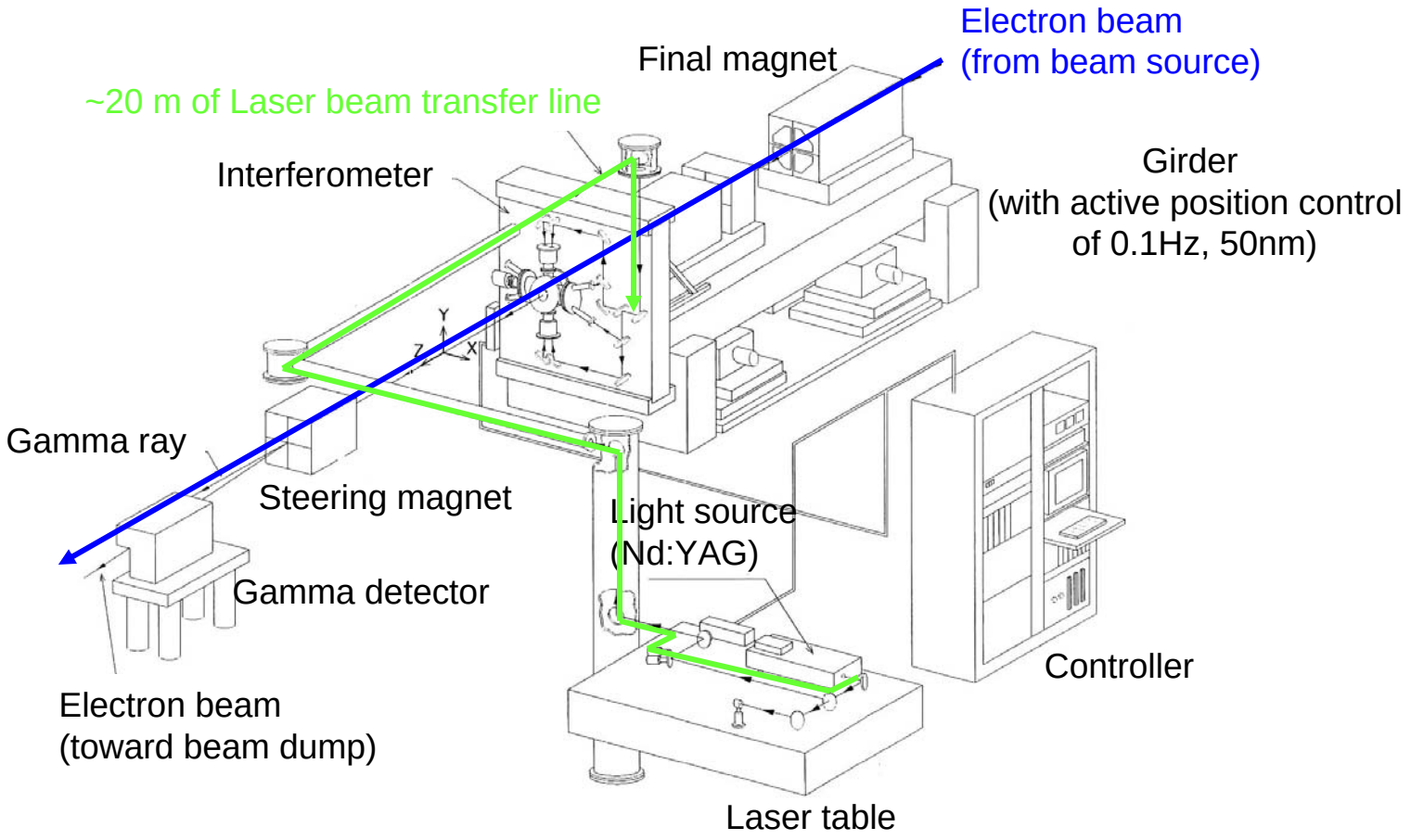
- About Shintake monitor and results in FFTB
- Stability expected for Shintake monitor
- Proposal for mount of Shintake monitor (2 kinds of proposals)
  - –Individual rigid mount
  - –Stabilized common table mount

Schematics of Shintake Monitor

Laser fringe(/Compton) beam size monitor



System schematics of Shintake monitor in Final Focus Test Beam (FFTB)



Results of Shintake monitor in FFTB (1993-1997)

- Experimentally measure size of the converged electron beam to be 70 nm in radius (σ).

- Measure beam size with/without active guider control*

  (*0.1Hz-speed, 50nm-torelance for compensation of position change by temperature drift)

  cf. N. Ishihara, et.al., “Position control table for FFTB lenses”, XVth International Conference on High Energy Accelerators, July 20-24(1992), Hamburg, Germany

- Measure beam size without any anti vibration equipments (active control, air suspension table, etc.)

System performance expected for Shintake monitor in ATF2 project

- Measure size of electron beam converged to 37 nm of radius (σ)

Measures to realize expected performance

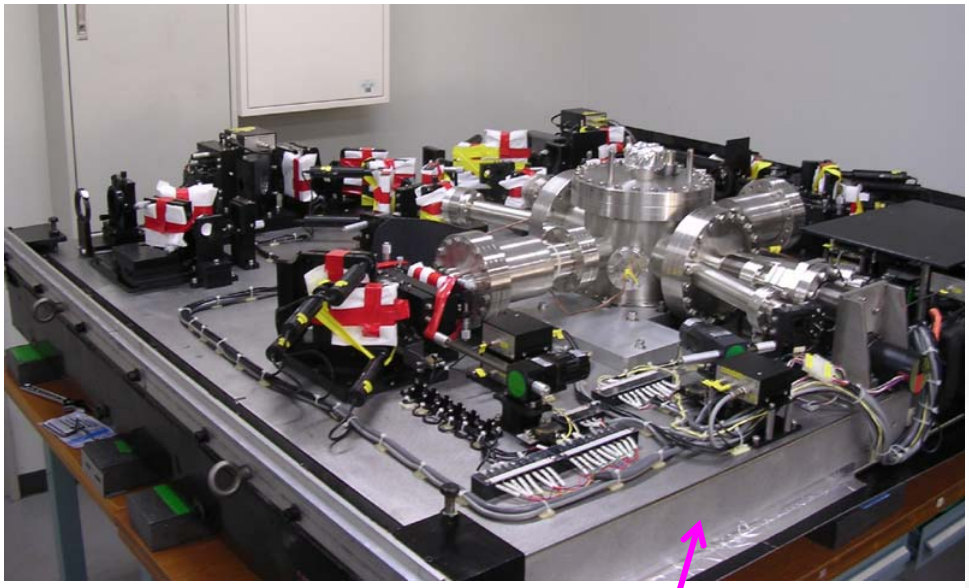
- Use shorter (1064->532 nm) wavelength of laser
  ->Obtain higher modulation of γ-ray for narrower (60->37nm-in design) electron beams

- Observe and control interference fringes
  ->Stabilize phase and visibility of interference fringes

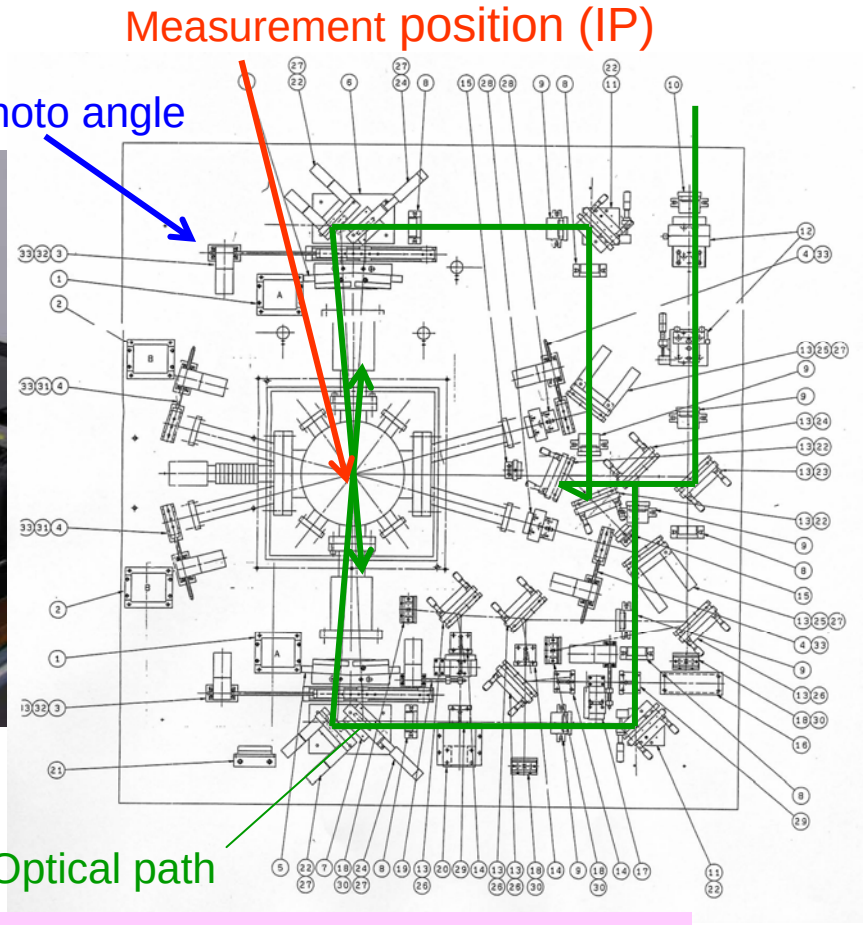
- Analyze structure and mount of interferometer
  ->Stabilize and improve rigidity for mount and body of interferometer

Interferometer of Shintake monitor

using table (1.6×1.5×0.11 m) to mount optics, total weight of ~740kg



Photograph of the interferometer laid for adjustment,
The optical table is supported vertical in usage.



Optical table is consisted of 5~6 mm-t top and bottom plate made of stainless steel and ~100 mm-t aluminum honeycomb core (AL3/8-5052-003)

Floor vibration of assembly hall for ATF/ATF2

cf. M.Masuzawa, et.al., "Floor tilt and vibration measurements at the ATF," Second Mini-workshop on Nano Project at ATF, 11 Dec. 2004

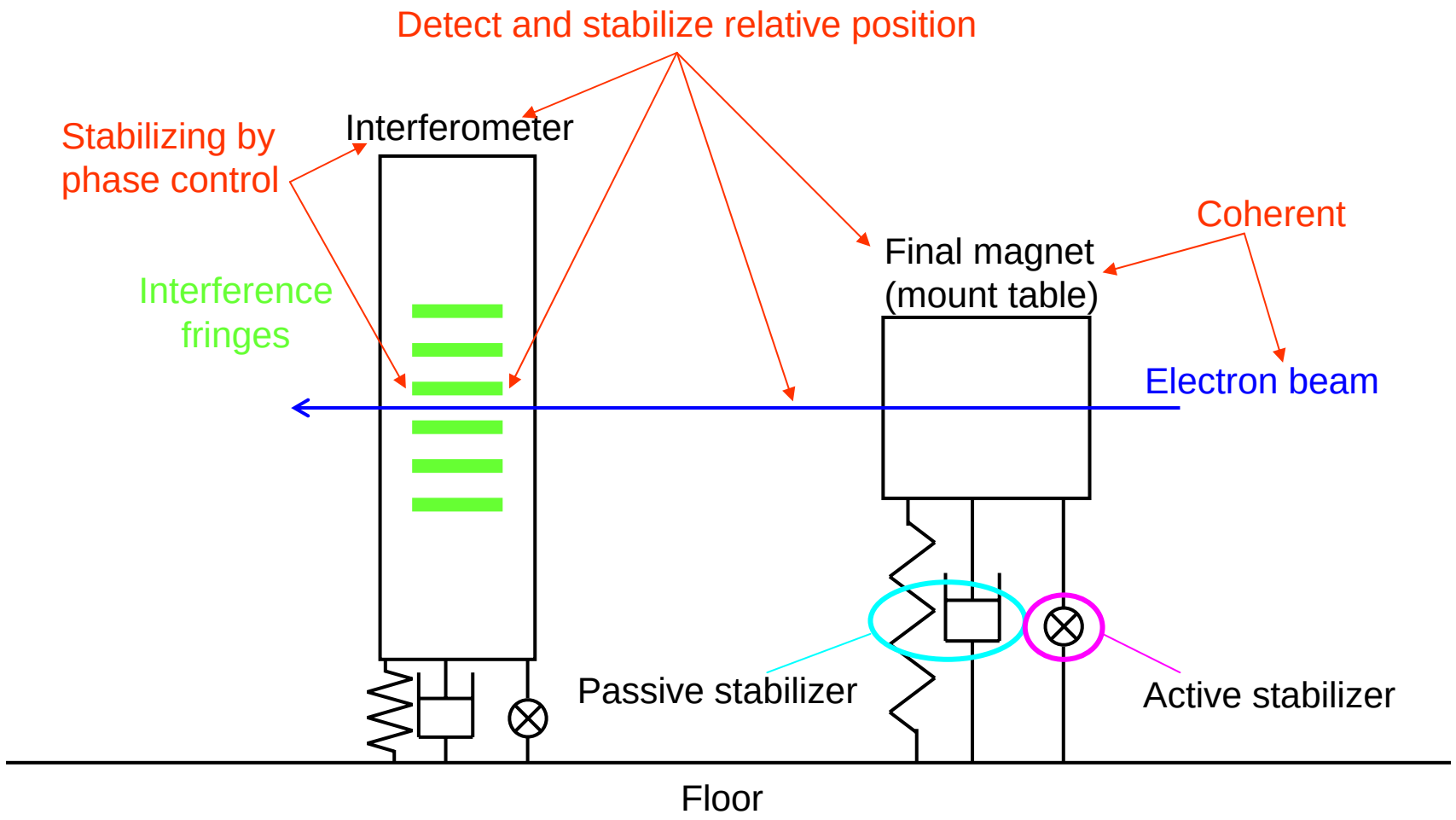
Table. Amplitudes of floor vibration at assembly hall
(integrated value of measurements of acceleration meter)

Frequency range	Amplitude [μm] (Horizontal)	Amplitude [μm] (Vertical)
>1Hz	~1	~1
>5Hz	~0.05	~0.07
>10Hz	~0.01	~0.04

Floor condition for vibration seems equal to (~ a little worse? than) FFTB in SLAC

Stabilize interference fringes and electron beam

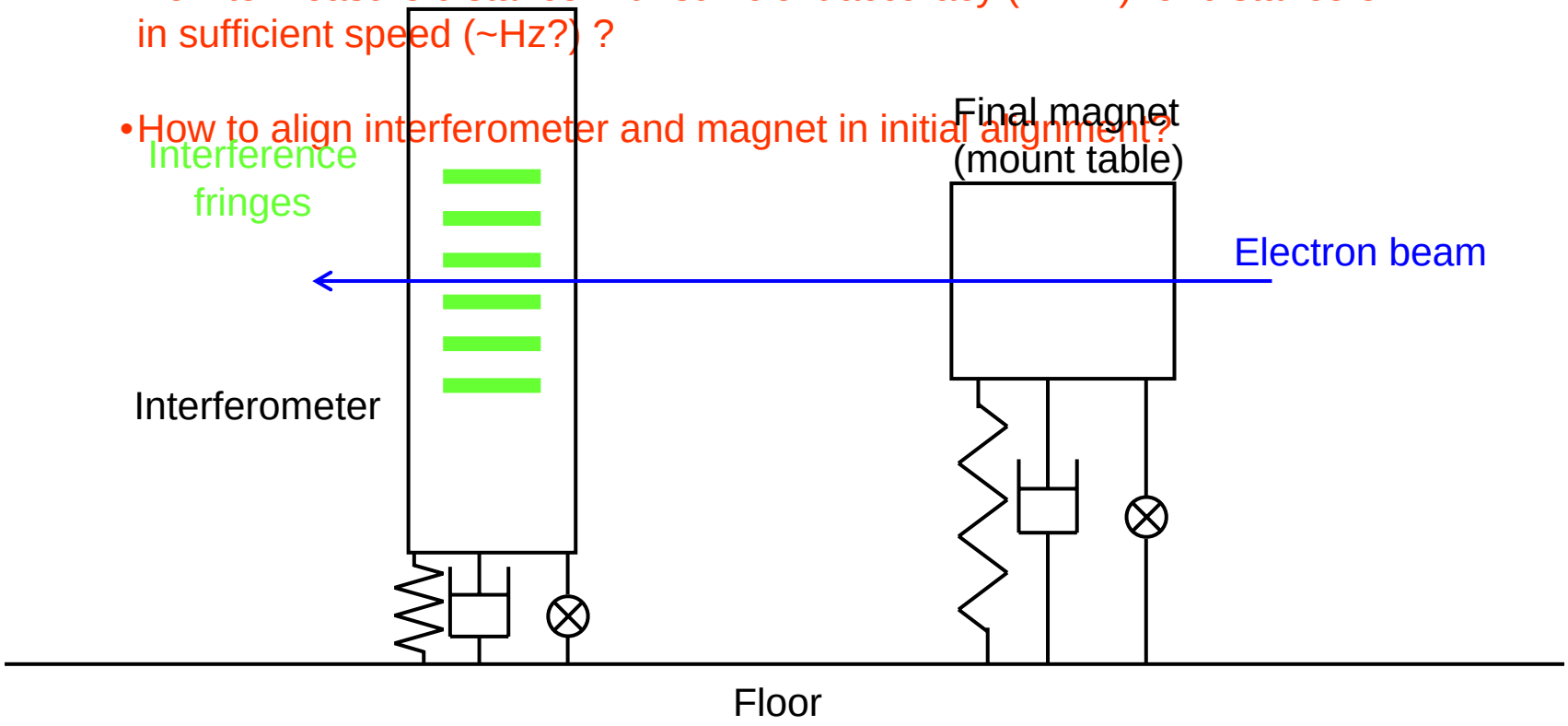
How stabilize relative position between interference fringes (as a reference)
and electron beam (to be measured) for accurate(=low deviation) measurement?



Problems in case adopting individual mount stabilizers

Difficult to know/align relative position between interferometer and magnet

- How to decide (define) datum (=position references) on both instruments?
- How to measure distance with sufficient accuracy (~nm?) for distance of ~m in sufficient speed (~Hz?) ?
- How to align interferometer and magnet in initial alignment?

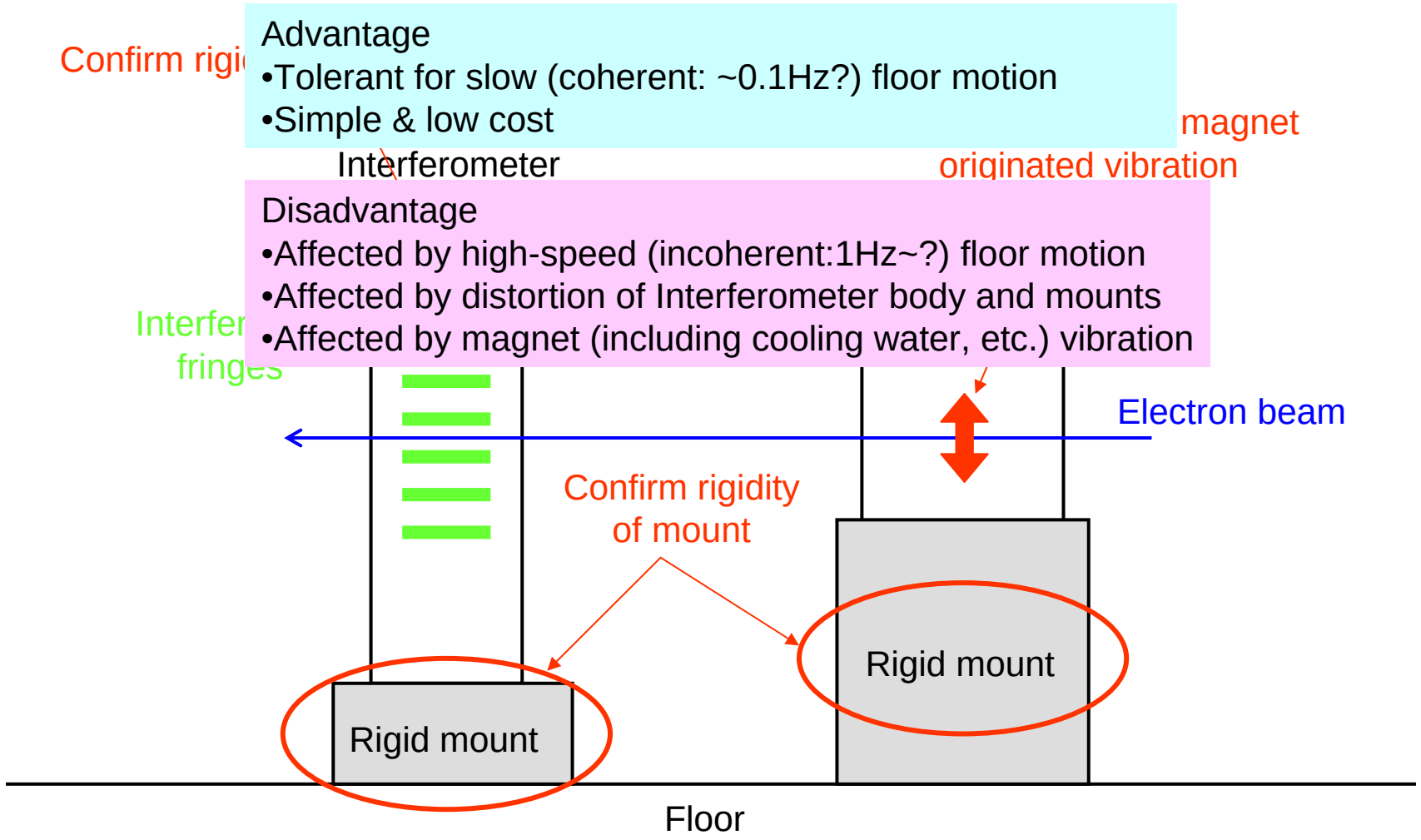


Proposal1 :Rigid mount on floor

Mount both interferometer and magnet rigidly on floor without any stabilizer

Advantage
- Tolerant for slow (coherent: ~0.1Hz?) floor motion
- Simple & low cost

Disadvantage
- Affected by high-speed (incoherent:1Hz~?) floor motion
- Affected by distortion of Interferometer body and mounts
- Affected by magnet (including cooling water, etc.) vibration

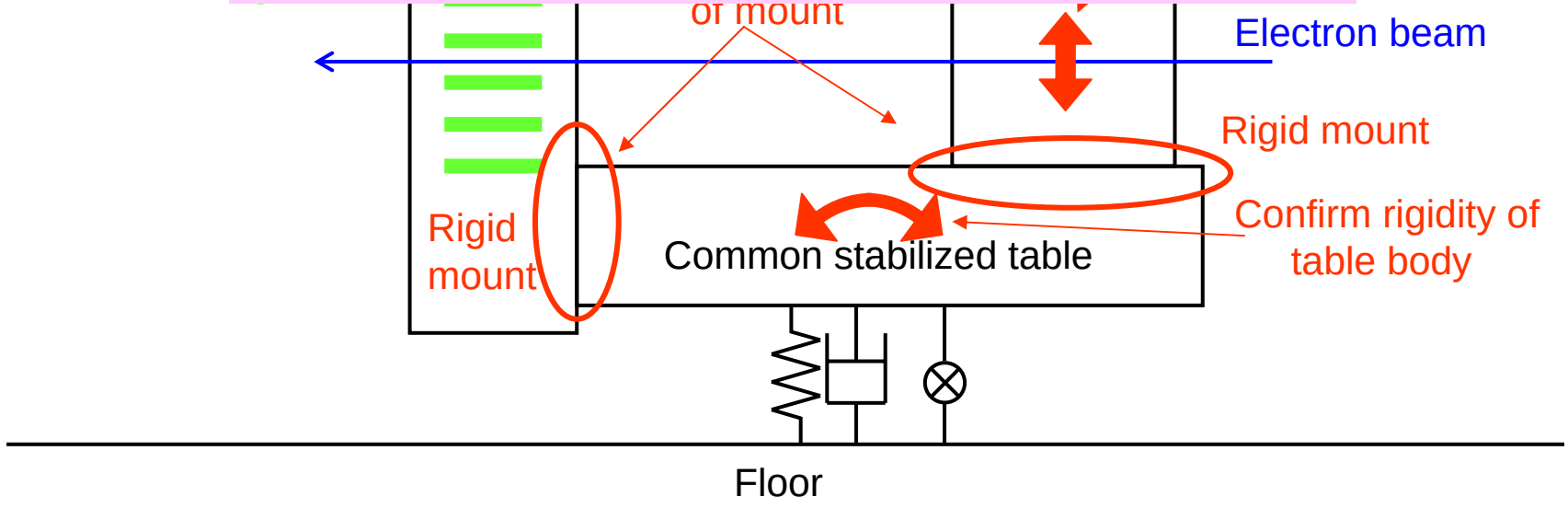


Proposal2: Mount on common stabilized table

Mount interferometer and magnet on common stabilized table

Advantage
- Tolerant for both slow (~0.1Hz) and high-speed (1Hz~) floor motion

Disadvantage
- Affected by distortion of Interferometer body, common table, and their mounts
- Affected (?) by magnet (including cooling water, etc.) vibration
- High cost -> needs modification of CLIC table



Subjects to be studied

- Analysis for rigidity of interferometer body.
- Mount design and analysis for mount rigidity of interferometer in case 1 (rigid mount) and case 2 (common table mount).
- Estimation of effects caused by floor motion (vibration) for interferometer body, common table, and their mount rigidities.
- Estimation of magnet originated (including cooling water, etc.) vibrations and their effects.