Floor tilt and vibration measurements at the ATF

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Second Mini–workshop on Nano Project at ATF

KEK

11 December 2004
Contents

- Measurement locations & sensors
- Tilt measurements
- Vibration measurements
- Summary
Measurement locations

Clean room

Entrance

ATF beam line

ATF2 extraction beam line

N

Tilt & vibration

vibration
Sensors

Tilt measurements
• Leica Nivel 20 digital tilmeter

Vibration measurements
• Servo type velocity sensor VSE355G2
  (Tokyo Sokushin Co. ,LTD.)
  For sensor resolution and huddle test results,
  →http://acfahep.kek.jp/subg/ir/nanoBPM/
• Servo acceleration sensor MG–102S
  (Tokkyo–kiki Co., LTD.)
  For sensor resolution and huddle test results,
  → R.Sugahara et.al., “Performance of an active vibration system for GLC”,
Tilt measurements

At ATF beam line 10/25(Mon)–11/1(Mon)

Access time to the beam area was limited.

X: perpendicular to the beam line (NS)
Y: parallel to the beam line (EW)
X/Y directions measured by one sensor.

Sensors on the floor, a few meters apart.
We did not have time to remove the thick floor paint before placing the sensors. And we forgot to place a weight on the sensor... A large drift is seen, which is probably fake. But if you look at #4 sensor, not much diurnal effect is seen in the floor tilt.
Tilt measurements: ATF2

At ATF2 extraction beam line
11/5 (Fri)–11/10 (Wed)

X: perpendicular to the beam line (NS)
Y: parallel to the beam line (EW)
Floor tilt at ATF2 extraction beam line
4.5 days

We did remove the thick paint before placing the sensors AND we did place weights on the sensors.
Diurnal effects (~10µrad p–p) are seen in both x and y directions.
Floor tilt comparison

ATF beam line

ATF2

10 µrad

10 µrad

KEKB tunnel floor

ATF floor tilt, similar to KEKB tunnel floor

KEKB tunnel tilt measurements
KEK preprint 03-97
Floor vibration measurements

1. Measurements at ATF beam line by J–Power using velocity sensors (February 2004).

   ←Direct comparison between the current beam area (floor) and outside the beam area (floor).

1. Measurements at ATF beam line by J-Power using velocity sensors (February 2004).

Ground Motion Measurement in Accelerator Test Facility at KEK

• KEK
• ICEPP (Univ. of Tokyo)
• J-Power

JPower data
http://acfahep.kek.jp/subg/ir/nanoBPM/
Contents of the measurement

① Huddling test

- Movement and operation of instruments

② Measurement around the beam line

- Natural frequency of the trestle?
- Ground Motion in Accelerator Test Facility?
Measurement around the beam line (1)

- Measurement Points -

2pm, Feb. 10, 2004 – 6pm, Feb. 11, 2004
30 minutes consecutive duration for 28 hours

Chigasaki Research Institute
J-Power / Electric Power Development Co., Ltd.
Measurement around the beam line (8)

Power Spectrum Density (1)
Component: X (Orthogonal to the beam line)

Nighttime (19:00-03:00)

Daytime (09:00-17:00)

Chigasaki Research Institute

J-Power / Electric Power Development Co., Ltd.
Measurement around the beam line (9)

"Power Spectrum Density (2)"

Component: Y (Parallel to the beam line)

Nighttime
(19:00-03:00)

Daytime
(09:00-17:00)

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J-Power / Electric Power Development Co., Ltd.
Measurement around the beam line (10)

"Power Spectrum Density (3)"

Component: Z (Vertical)

**Nighttime**
(19:00-03:00)

**Daytime**
(09:00-17:00)

Chigasaki Research Institute

J-Power/Electric Power Development Co., Ltd.
Measurement around the beam line (11)

"Integrated Spectrum (1)"
Component : X (Orthogonal to the beam line)

Nighttime (19:00-03:00)
Daytime (09:00-17:00)

Floor

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Measurement around the beam line (12)

"Integrated Spectrum (2)"
Component: Y (Parallel to the beam line)

Nighttime (19:00-03:00)
Daytime (09:00-17:00)

Chigasaki Research Institute

J-Power / Electric Power Development Co., Ltd.
Measurement around the beam line (13)

“Integrated Spectrum (3)“

Component : Z (Vertical)

Nighttime
(19:00-03:00)

Daytime
(09:00-17:00)

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> 1Hz

Feb. 10-12, Integrated Amplitude at 1Hz

Integrated Amplitude (m)

PM06 AM00 AM06 PM00 PM06 AM00 AM06

Time (o'clock)

Feb. 11 Feb. 12

NS-girder EW-girder V-girder NS-floor EW-floor V-floor
> 5Hz

Feb. 10-12, Integrated Amplitude at 5Hz

Integrated Amplitude(m)

1E-7

1E-8

Time(o'clock)

PM06 PM09 AM00 AM03 AM06 AM09 PM00 PM03 PM06 PM09 AM00 AM03 AM06 AM09
2. Measurement at ATF beam line & ATF clean room by H.Yamaoka using acceleration sensors at ~14:00 April 1, 2004.

**Power spectrum density**

Clean room floor vibration $\geq$ ATF beam line floor vibration

Difference is clearest in the vertical direction.
2. Measurement at ATF beam line & ATF clean room by H. Yamaoka using acceleration sensors at ~14:00 April 1, 2004.

Integrated amplitude
Difference is clearest in the vertical direction.
Comparison between yellow and green floor

![Graph showing comparison between yellow and green floor.](image-url)
Comparison between yellow and green floor
Comparison between yellow and green floor

Slight difference in vertical direction

P.S.D. (cm²/Hz)
Comparison between ATF (Jpower meas. Feb.) & ATF2 (Dec.)

Red: ATF2  
Blue: ATF  
Difference in vertical direction is largest. → agrees with Yamaoka’s measurement.

Fair comparison??  
“Noiser” around ATF2 (chiller pumps near by, other activities going on, etc.)  
Taken on different days.

Day-to-day fluctuations in ATF2 area? →
ATF2 floor vibration measurement (~5 days)

Weekend effect? Quieter

Integrated amplitude (μm)

Date

>50 Hz and above

Sunday
“Anti-weekend” effect for low-frequency floor vibration

"Anti-weekend" effect is significant (several times larger) in X and Y. Not much effect in V. Why?

Exceeds 1 µm
It was a very windy weekend

Wave height at Onahama
Two bumps appeared.

ATF2 floor (yellow)

ATF2 floor (Green)
Floor vibrates on windy days. Unfortunately no data taken over this weekend at the current ATF beam line.

0.3Hz component follows wind speed??

0.1Hz component follows wave height??

ATF2 floor vibration, wind speed and wave height
Summary

- Diurnal effect in floor tilt is a few times larger in the ATF2 extraction area than in the ATF beam line area: 10 $\mu$rad peak-to-peak in November.

- Floor vibration in the vertical direction is also larger in the ATF2 area and the clean room area.

- The floor vibrates on windy days.