IPBSM
- Stability of the laser system -

Nobuhiro Terunuma

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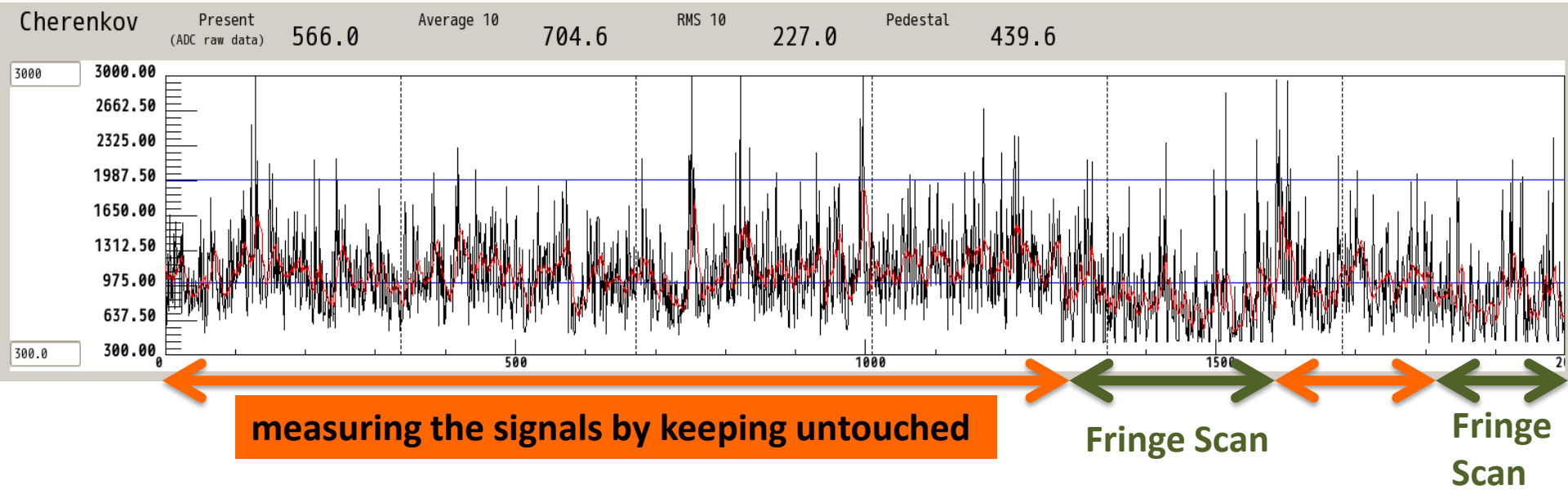
Drift of the Compton signal

- In Jan/Feb runs, the beam size measurement by IPBSM was very difficult especially for the “fringe scans”.
- **We observed the unacceptable level of drift (50% or more) of the Compton signal. It destroyed the modulation profile.**
- Periodic drop about several tens of seconds was observed.
- In addition, the jitter was relatively bigger than before.

Cherenkov Signal (ADC raw data)



Drift of the Compton signal - continued -

- **The laser is suspected as a main contributor of the drift because of the following results.**
- No significant improvement was obtained by surveying …
  - **the electron beam**; orbit FB, 1000βx, QD0 etc.
  - **the Compton line**; collimation of the signal? by the movable collimator
  - **the stability of the Cherenkov detector**; high voltage, gate and signal, ADC soundness
- It seems that the situation is getting worse globally and changing day by day.
- The laser tuning had been repeated so often then stability was recovered temporary but could not keep it.

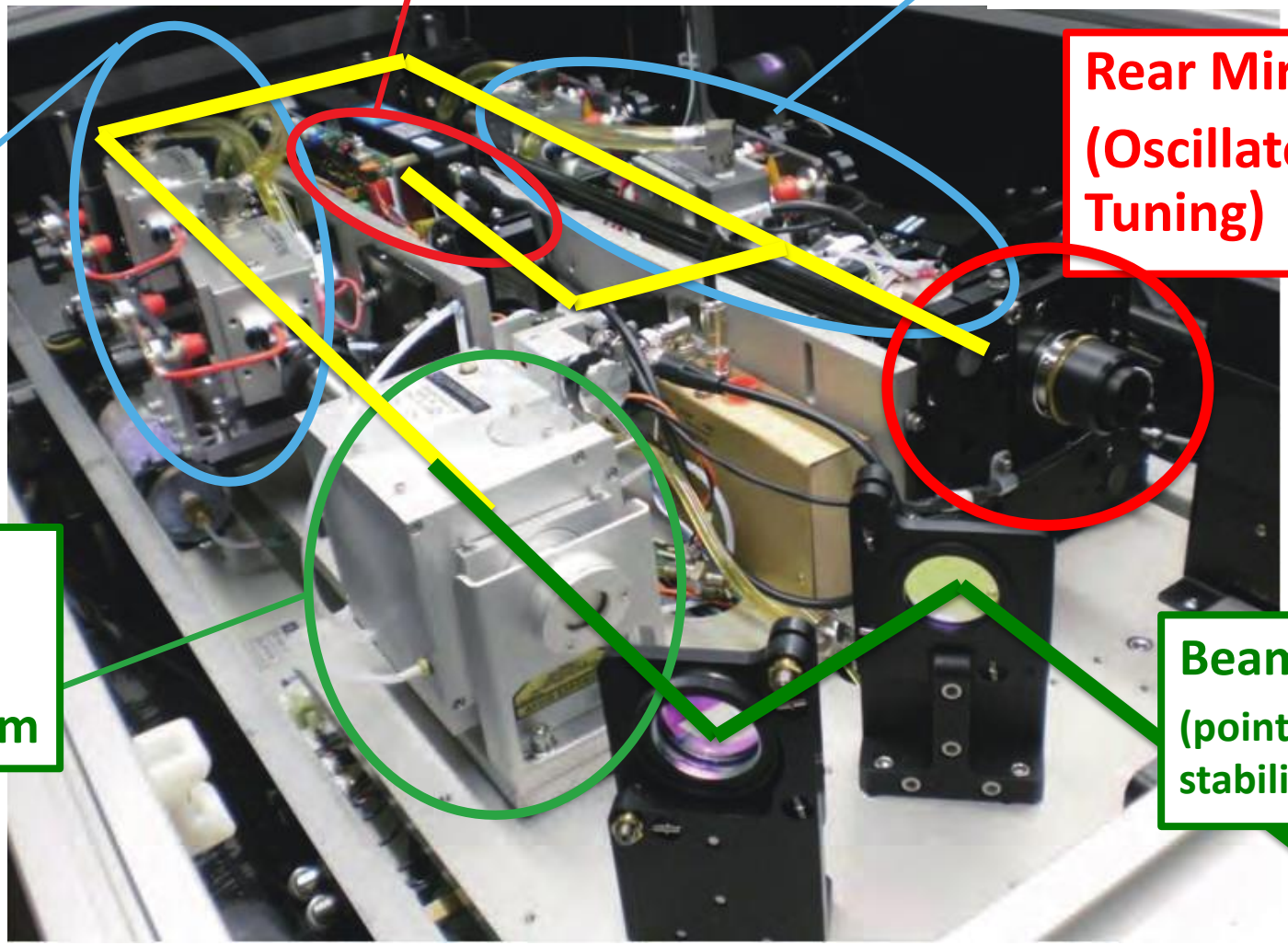
What is a source of the drift?

We suspected the temperature related sources because of the drift interval, several tens of seconds.

- **Cooling water;** both external and internal
- **Clean booth Air conditioner**

No significant improvement was obtained.

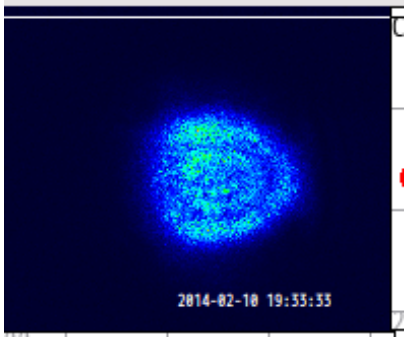
IPBSM Laser


Injection seeder
Oscillator
Water cooled
Amplifier
Water cooled
Rear Mirror
(Oscillator
Tuning)
Harmonic
Generator
1064→532nm
Water cooled
N2 purged
BeamLok
(pointing
stabilization)

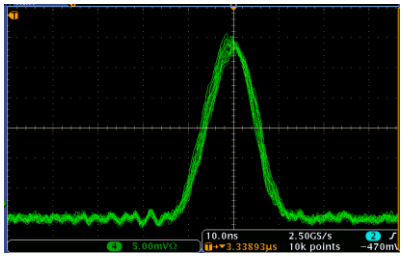
Laser Monitors

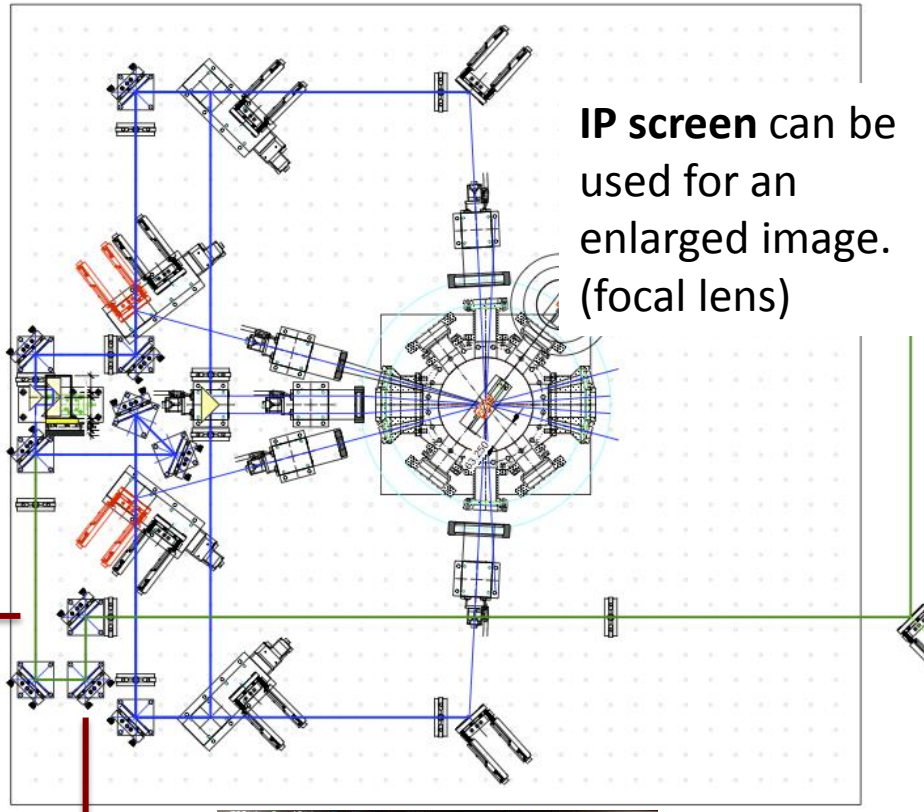
Laser hut

Laser image (CCD camera)



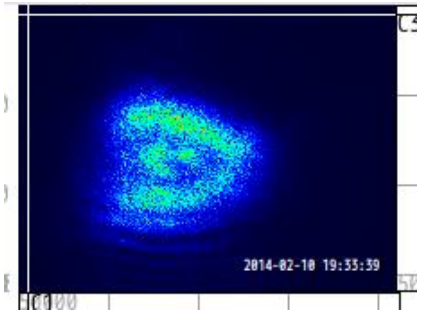
Laser time structure
(PIN-Photo Diode)



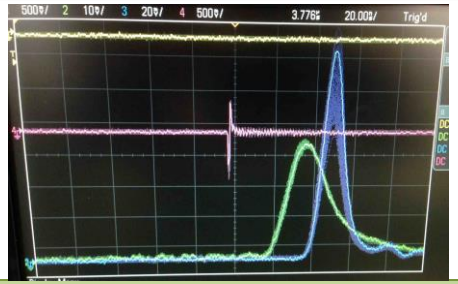


IP screen can be used for an enlarged image. (focal lens)

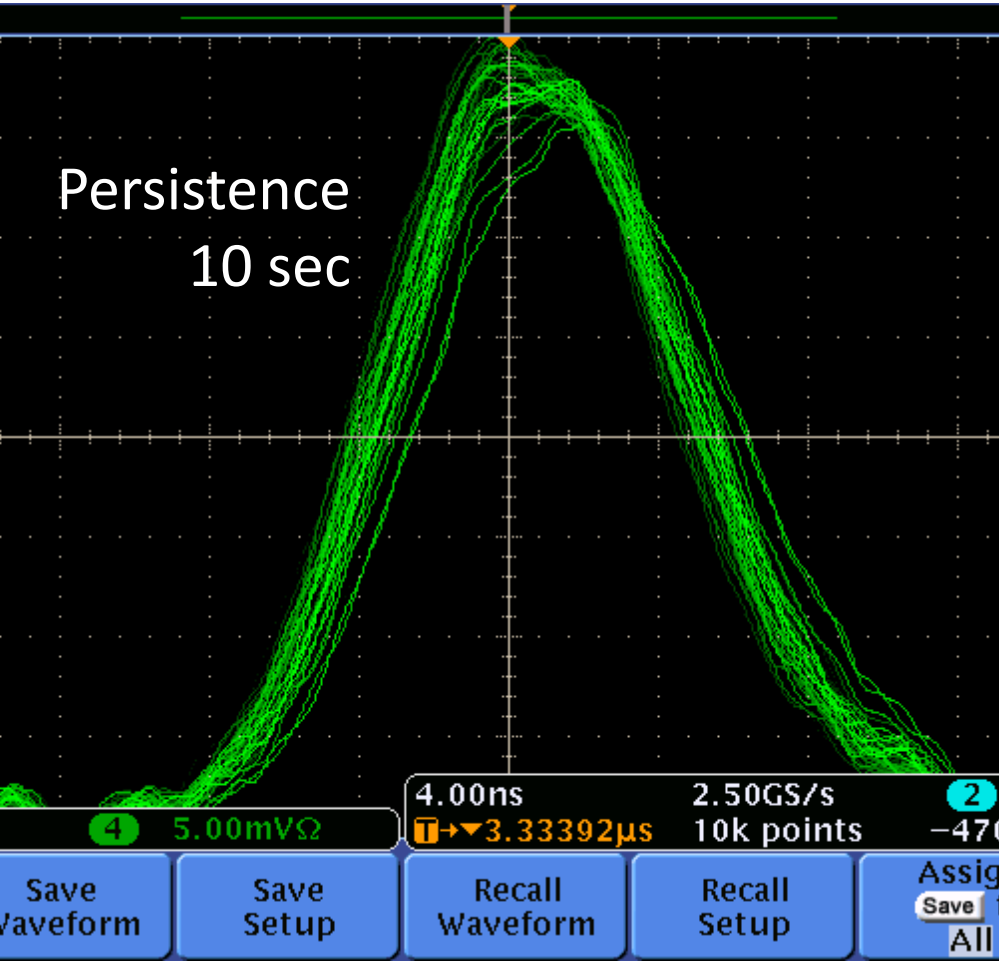
Laser image (CCD camera)



Laser time structure
(PIN-Photo Diode)



Stability at the exit of laser head



PIN Photo Diode located 0.5m from the exit of laser head

- **for timing adjustment**
- **for tuning of the laser oscillator**

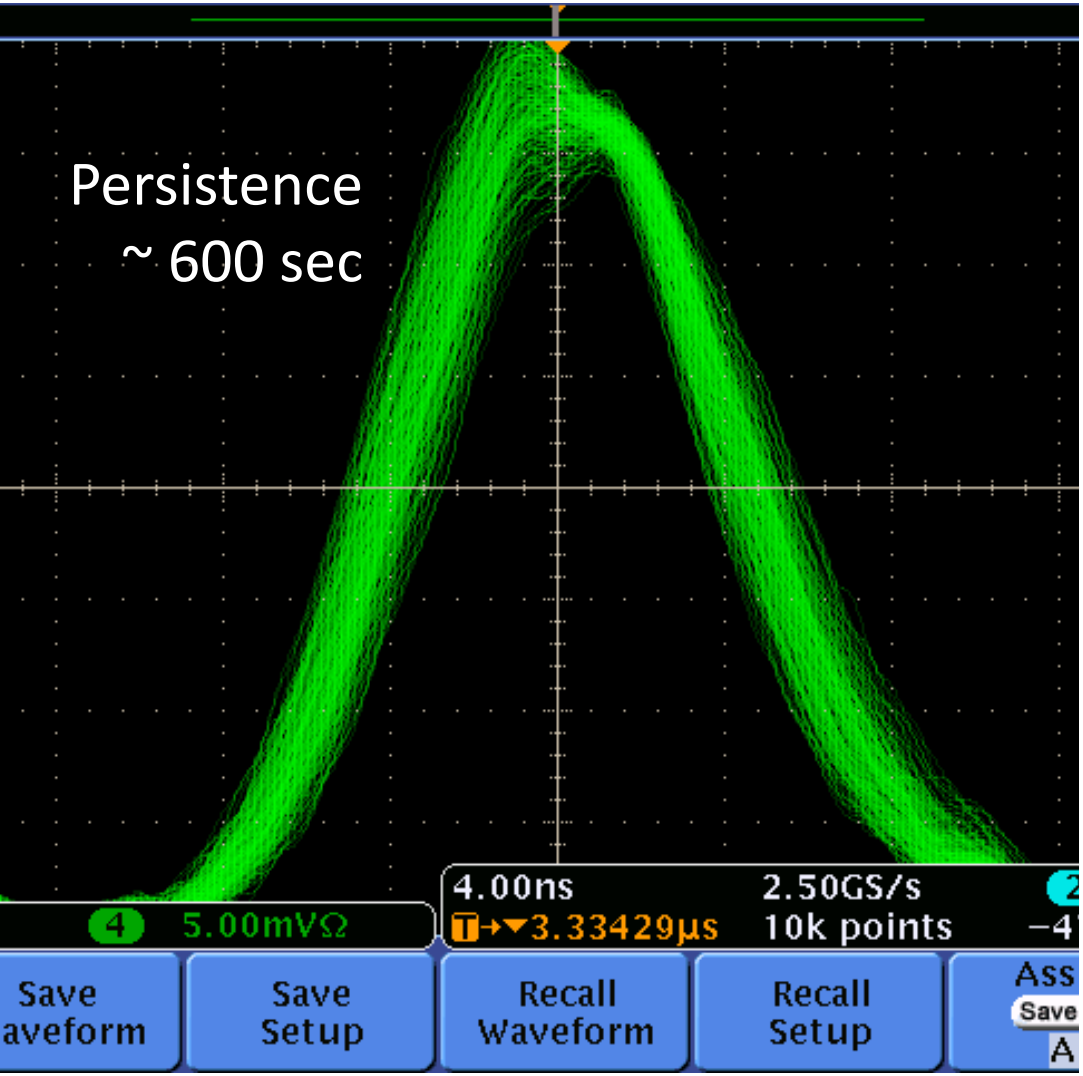
Note: It measures a part of laser profile because a laser is 10 mm but a sensor is only 0.5 mm.

Results

- **Timing jitter**
  - typically < 2 ns
  - sometimes < 4 ns
- **Power jitter**
  - resulting by the timing jitter
  - **for beam (if sit on peak)**
    - **typical 0.5/8div ~ 6%**
    - **sometime 1.5/8div ~ 20%**

The waveform drifts sometime but it is fast and small. It does not explain the amount of a drift measured on the Cherenkov signal.

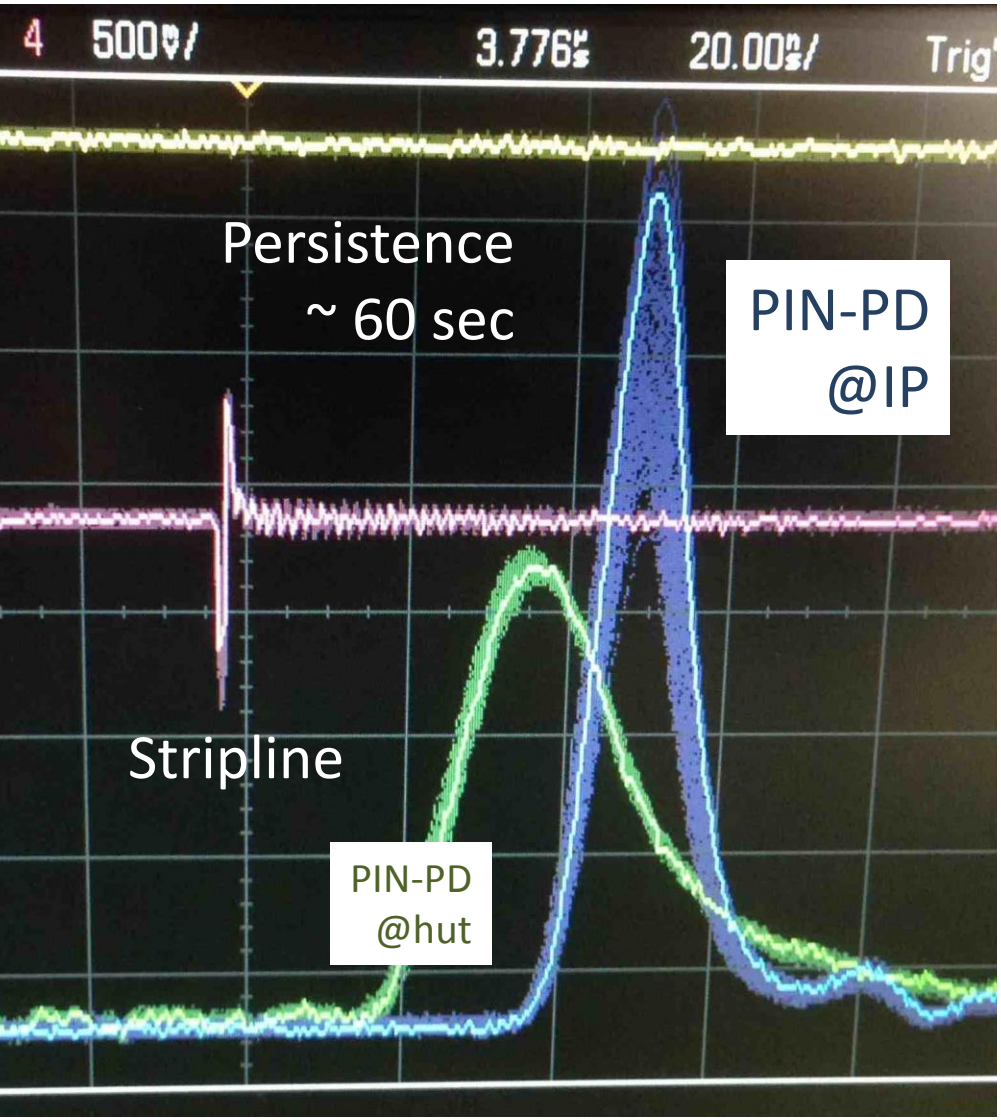
Stability at the exit of laser head –continued -



PIN Photo Diode 0.5 m from the exit of laser head

- **No significant difference to the 10 sec measurement.**
- **It looks same as before; i.e. 65 nm measurement.**
- **→ not sensitive to find the source of drift.**
- **Tuning of the laser oscillator improves/recovers the jitter level.**

Stability at the Vertical Table -



PIN Photo Diode 20 m from the exit of laser head

- Amplitude of PIN-PD signal jitters about 30% at IP but a few for @hut.

Note: It measures a part of laser profile because a laser is 10 mm but a sensor is only 0.5 mm.

- It suggests the enhanced jitter after the transport.
  - **pointing jitter**
  - **laser profile jitter**

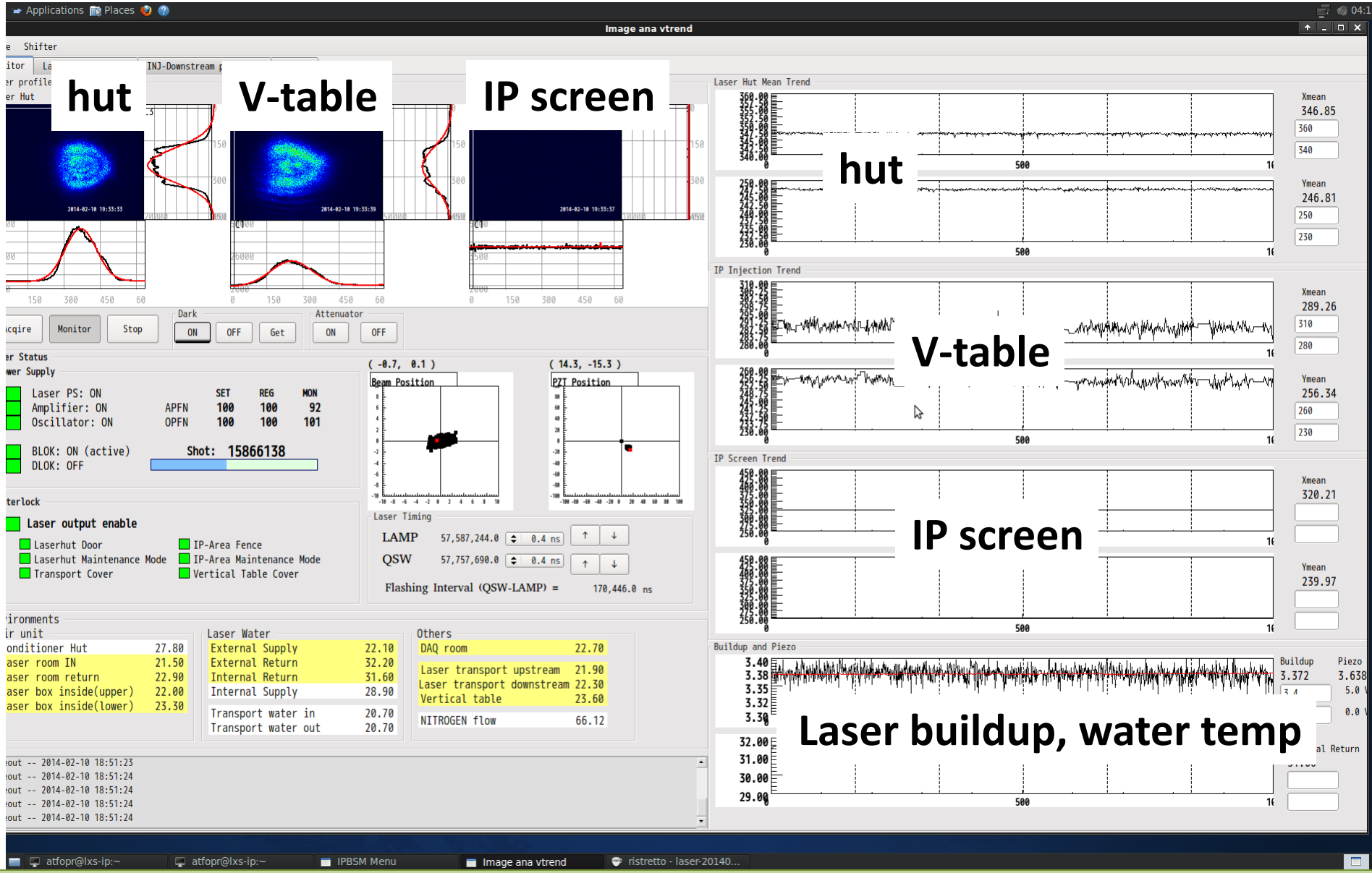
Survey with Engineer, Feb 10th

We called the detail survey by the laser company. It was done on Feb/10th. A CCD tool to monitor the laser profile at IP was prepared and helped this survey.

- **Setting of the laser oscillator is fine as expected.**
- **The cooling water unit is also working well and stale.**
- **Retuning the temperature controller of the Harmonic Generator (1064→532nm) reduced the amplitude of the drift about a half.**
- **Other laser components are passive and may not be candidates of the drift source.**

- We also discussed about other possibility and suspected the air turbulence in the laser transport.

Stability monitoring of the laser profile



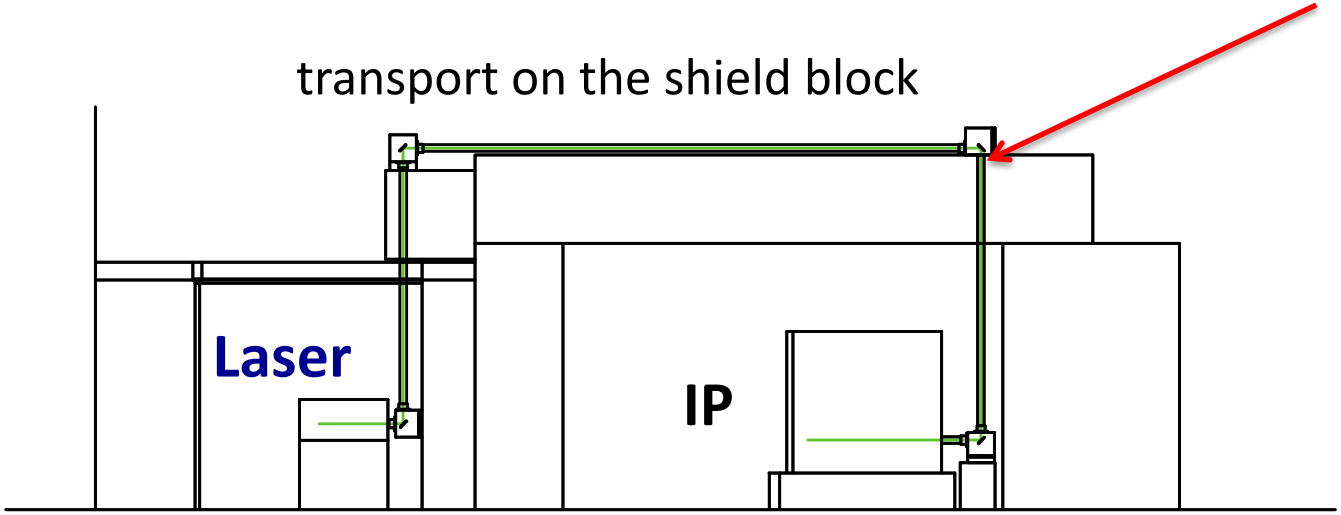
Air turbulence in the transport?

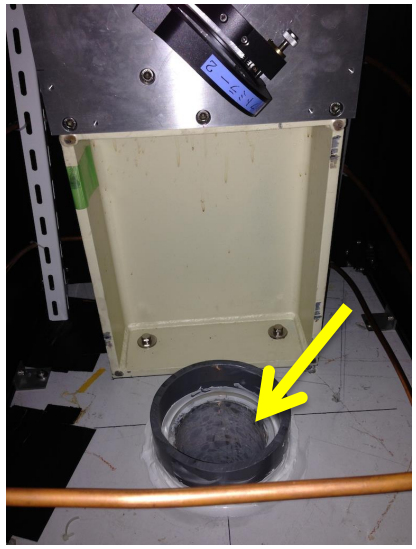
The laser transport is structured as a closed pipe and may act as a guide of air flow.

- **Is there an air turbulence between the IP and the laser hut?**
- **Is it caused by the difference of pressure or temperature?**
- **Amount of flow may vary by the condition of IP room or laser hut.**

I had put a optical-flat window (viewport for the previous IP chamber) to shut the possible air flow through a hole between the laser transport and the accelerator room.

put an optical window on the hole



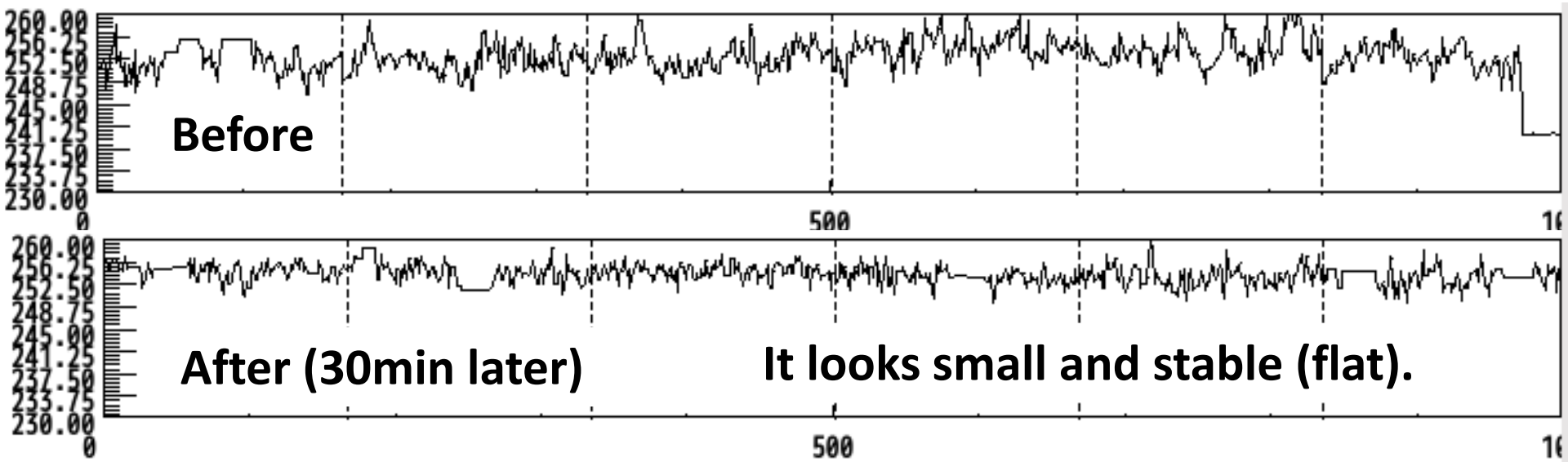


Air turbulence in the transport – continued -

- Just put a window on the hole to IP area on Feb.10th (Monday) evening.
- No tools to store the data was prepared at that time. **Monitoring only**.

- Comparing the displayed history, **It seems the CCD image was somewhat stabilized after putting a window.**
- **Try more, close other side to shut the air flow from the laser hut.**

20 min History of the laser image center on the CCD (at vertical table)



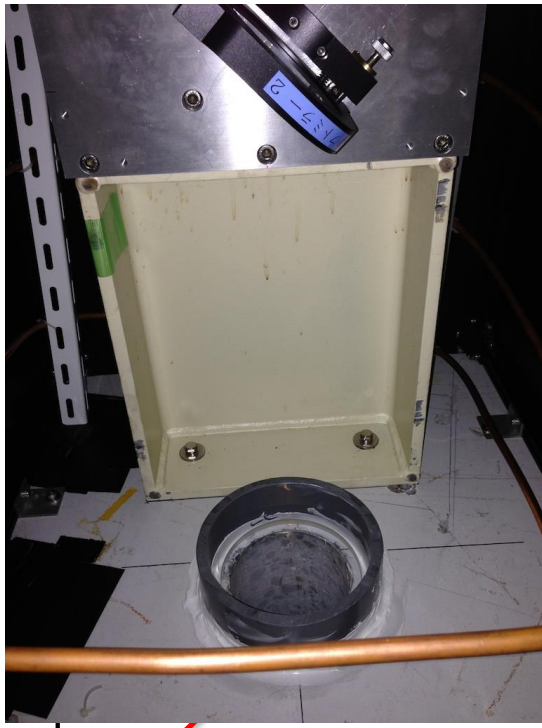
Summary

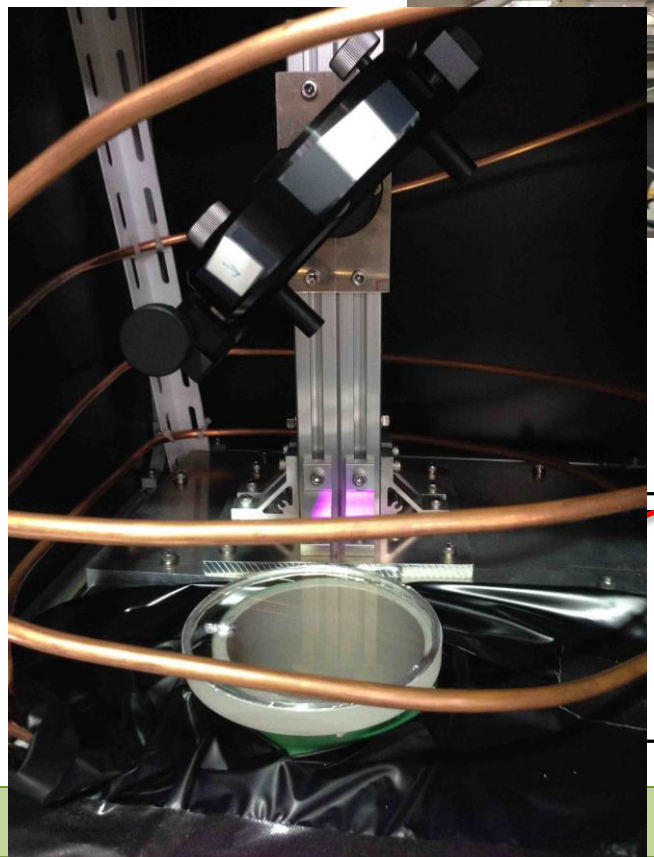
- **The drift of the Compton signal is a heavy concern on the beam size measurement.**
- A lot of surveys were done to find the source.

We obtained following facts.

- **The tuning of the temperature control for the Harmonic Generator reduces the drift of the laser image on the CCD.**
- Cutting the air flow in the laser transport seems to be effective to reduce the drift of the laser image on the CCD.
- We will put additional window to cut the air flow from the laser hut.
- **We should see how the drift of the Compton signal is reduced or not. It is the highest priority.**

Shut the air flow by optical-flat windows





transport on the shield block