

SRM

Current Status

Gaku Mitsuka (KEK, Acc. Lab)

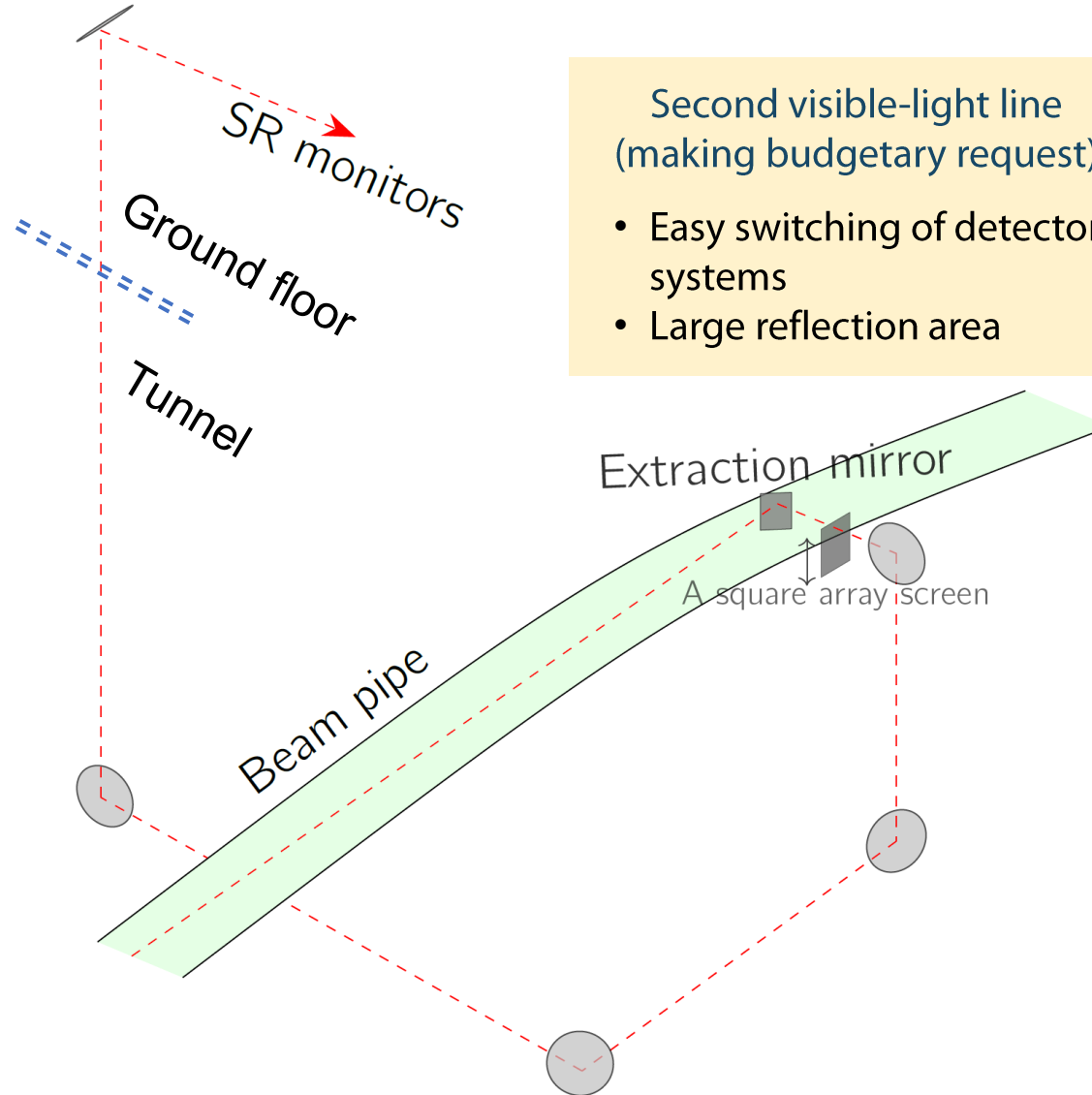
US-Japan Beam Monitor Workshop
University of Hawaii, 19 Feb. 2025

Beam profile/size measurements at SuperKEKB

- X-ray beam size monitor (XRM)
 - Scintillator screen and CMOS camera placed in the SuperKEKB tunnel
 - Primary vertical (high-res) & horizontal (low-res) beam size monitor
 - Additionally, turn-by-turn beam size measurements with ultrafast CMOS camera
 - R&D of the bunch-by-bunch detector (SiXRM) is ongoing.
 - Pros: strong light intensity, Cons: strong X-ray irradiation
- Visible light beam profile monitor (SRM)
 - Visible light extracted from the vacuum chamber relayed to ground floor huts
 - Streak camera (bunch length), gated camera (x-y profile), interferometer (x-y size)
 - Additionally, turn-by-turn beam size measurements with ultrafast CMOS camera
 - Pros: easy to access and free from radiation, Cons: relatively poor light intensity

Visible light relay system

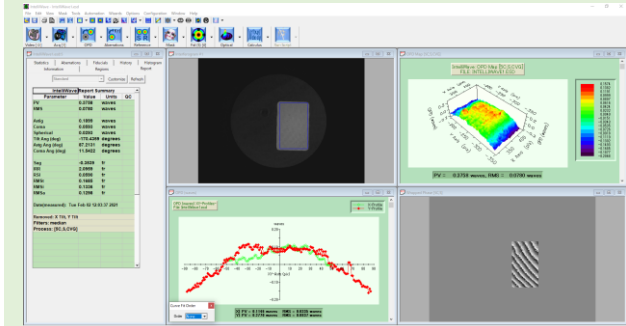
Mirror tilt-angle feedback
(on-going R&D)



Second visible-light line
(making budgetary request)

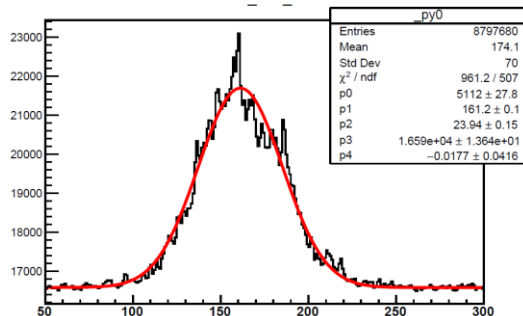
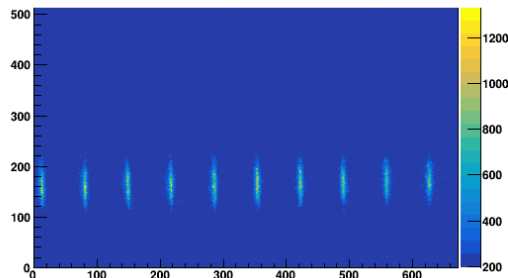
- Easy switching of detector systems
- Large reflection area

Novel CVD diamond mirror
(IPAC2022, MOPOPT031)

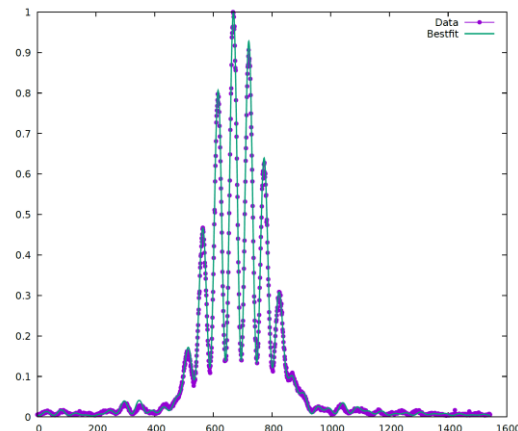
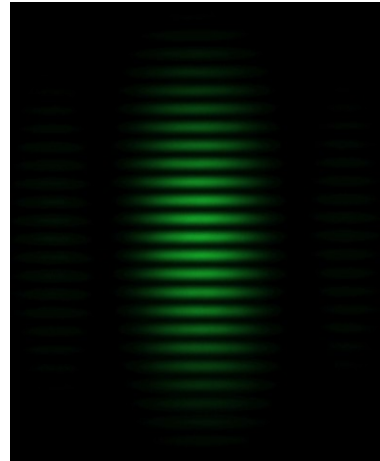


SRM detector systems

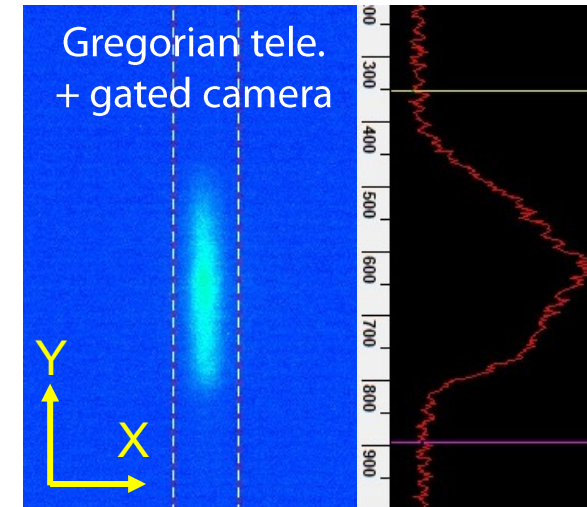
Streak camera
(bunch length)



Interferometer
(X or Y size)



Gated camera
(X-Y profile)



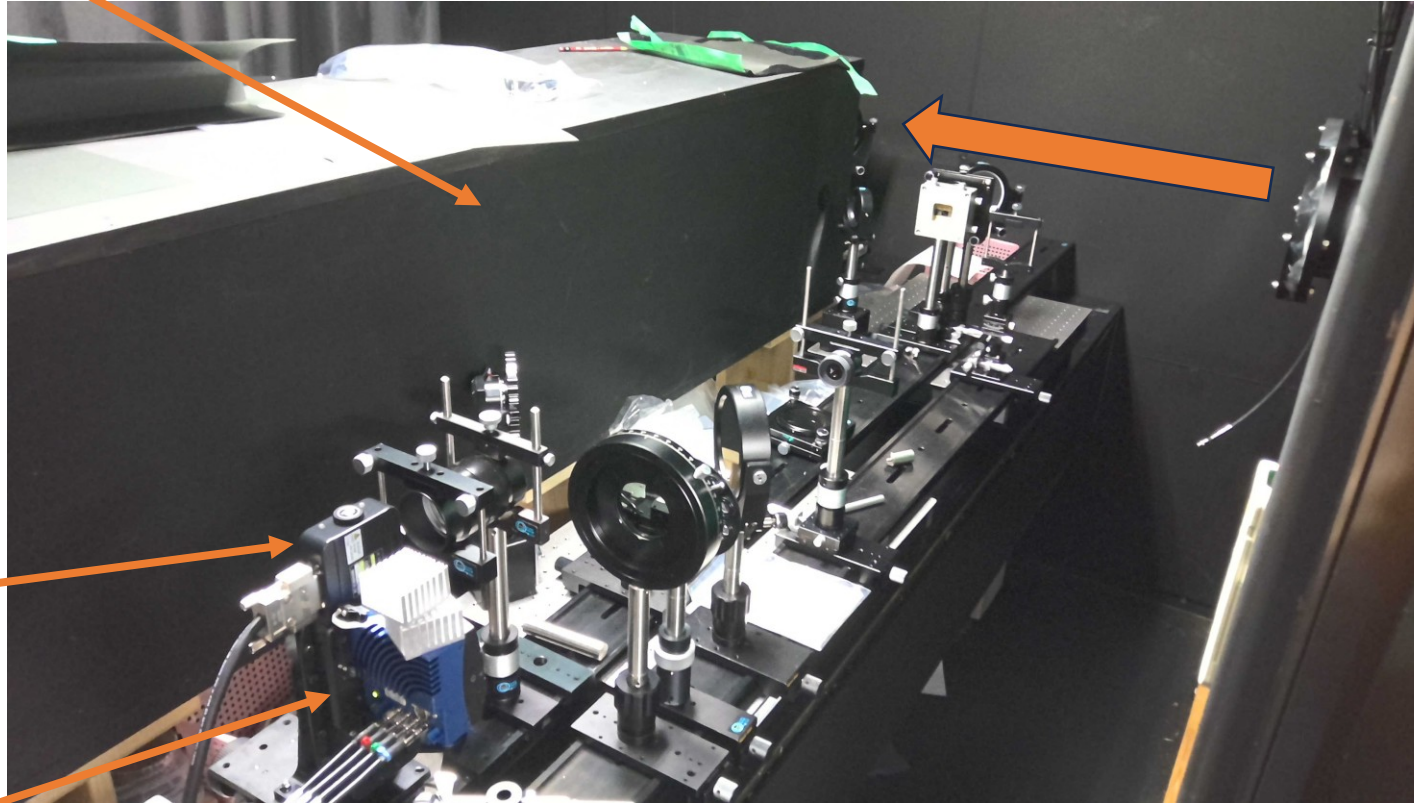
Fast CMOS camera
(X-Y profile)



- Gated camera
 - High dynamic range
 - Exposure ~ O(10) ns
 - Repetition < 100 Hz
- Fast CMOS camera
 - Low dynamic range
 - Exposure > 1 μ s
 - Repetition < 100k Hz

Measurements for sudden beam loss events

Gregorian telescope

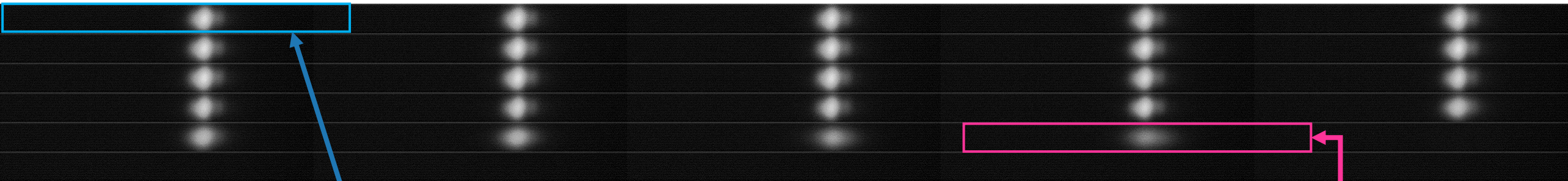
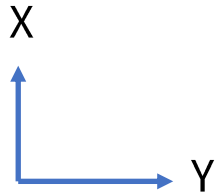


Visible light entrance

Vertical stage
(position feedback)

Ultra fast CMOS camera

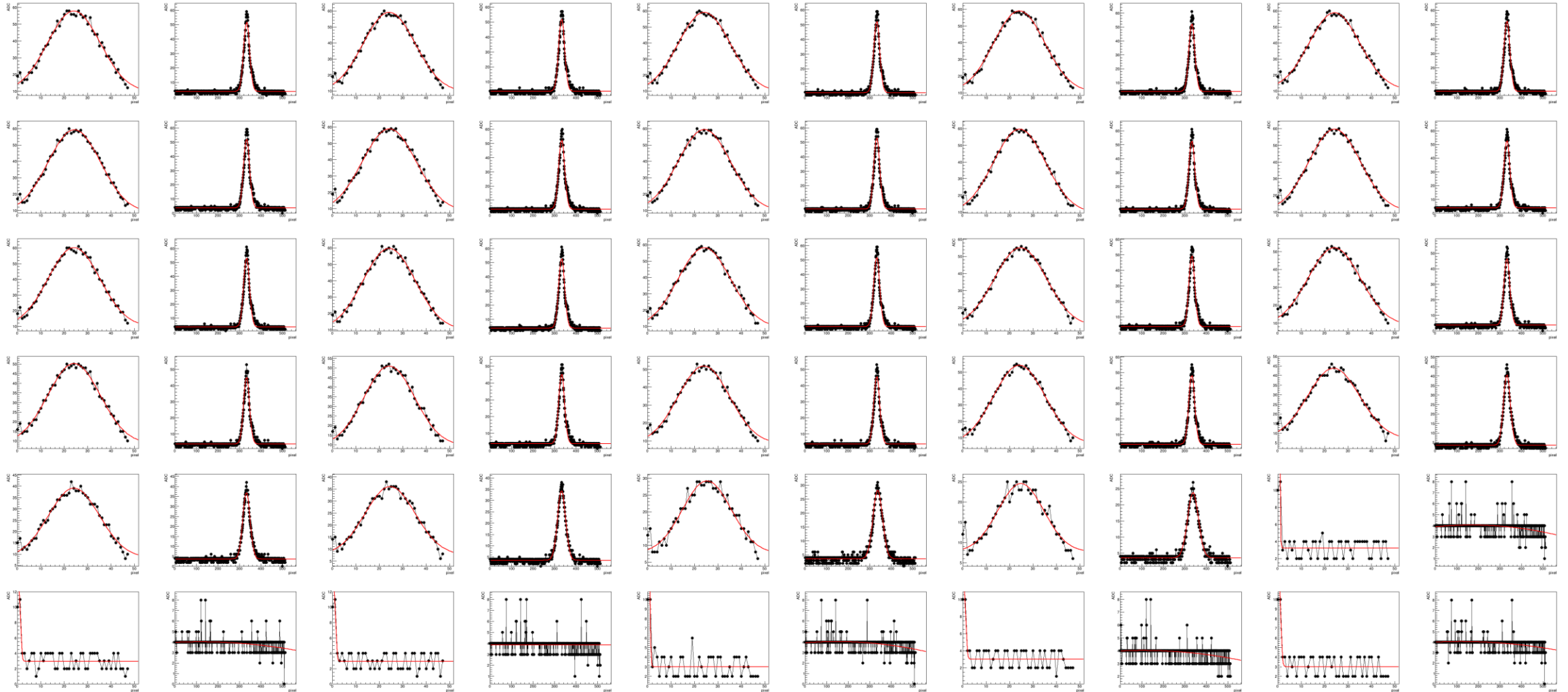
LER 2024/06/18 12:12:52



LER 2024/06/18 12:12:52

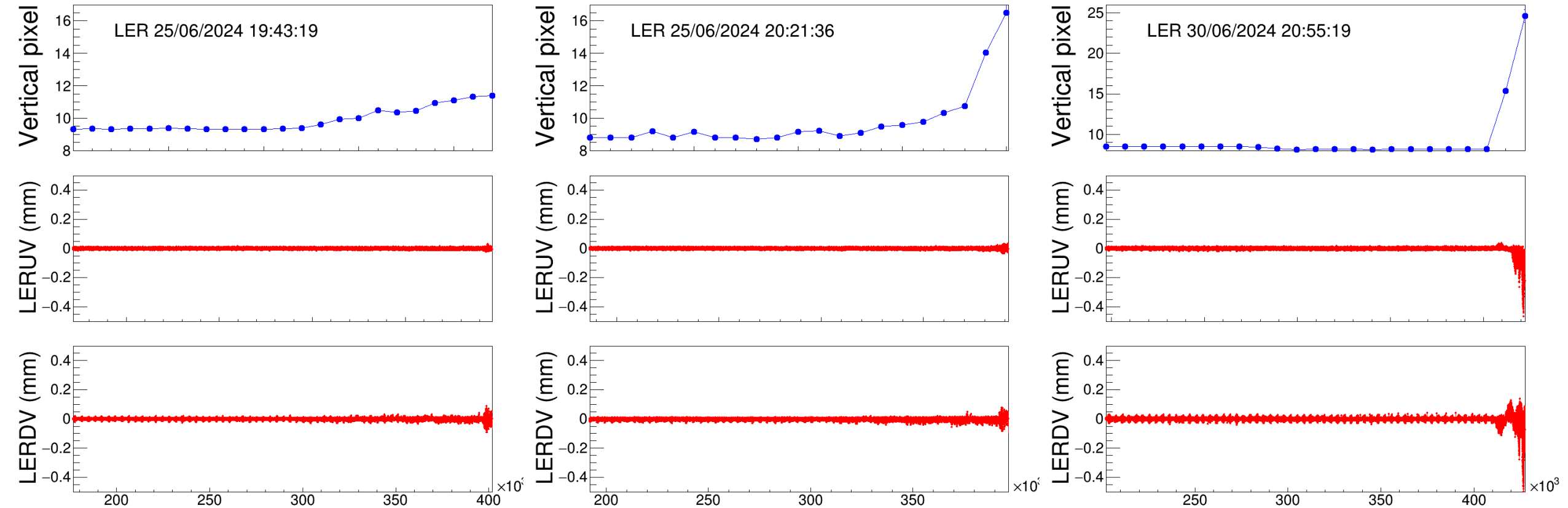
X axis

Y axis



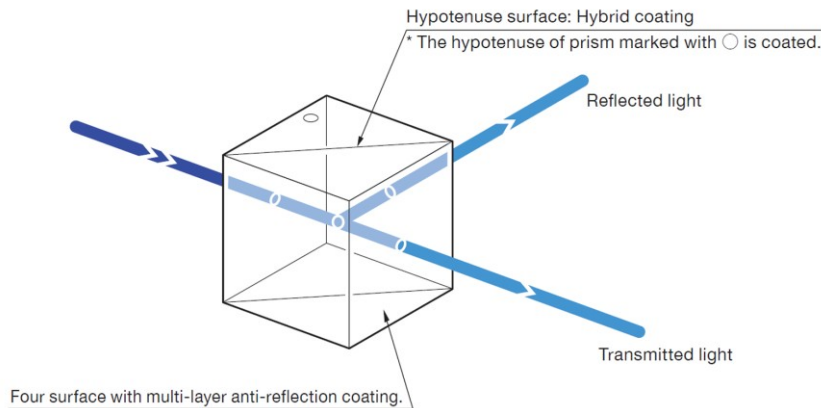
Black points: data, Red curves: best-fit double gaussian

Comparisons with the beam position meas.

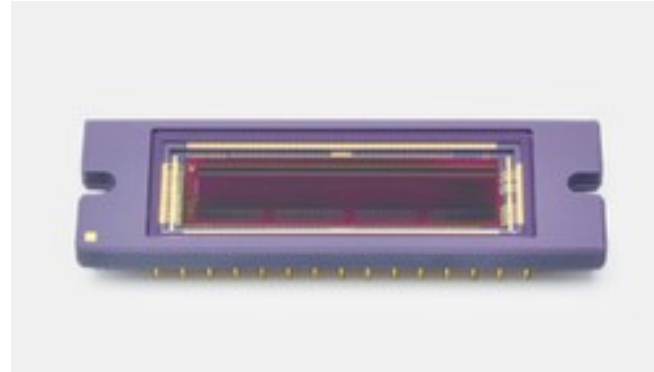


R&D plan: Visible light turn-by-turn monitor

X-Y simultaneous diagnostics



Hamamatsu Photonics
CMOS Linear Image Sensor S13774



- PCIe interface through LVDS outputs
 - On-board circular buffer
 - Direct transport to GPU
 - Synchronization with BOR
 - Etc.

Features

- Pixel size: $7 \times 7 \mu\text{m}$
- Number of pixels: 4096
- High-speed readout: 100 klines/s
- Simultaneous integration of all pixels
- 3.3 V power supply operation
- SPI communication function
- Built-in 10-bit/12-bit A/D converters

