

Technology transfer: Another contribution from High Energy Physics

Efforts in KEK

Junji Haba

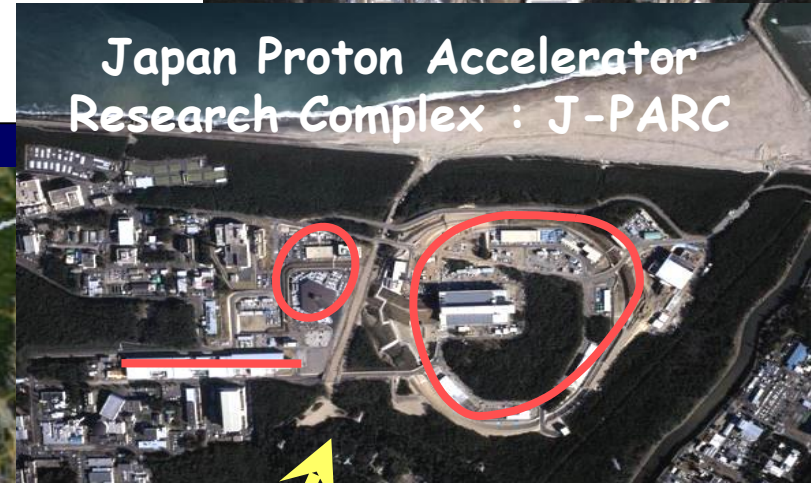
Head of Detector Technology Project and

Deputy director of IPNS

KEK

KEK : Center for High Energy Accelerator / Science Research

Japan Proton Accelerator Research Complex : J-PARC



e^-/e^+ Collider
B-Factory

ILC-Test Facility

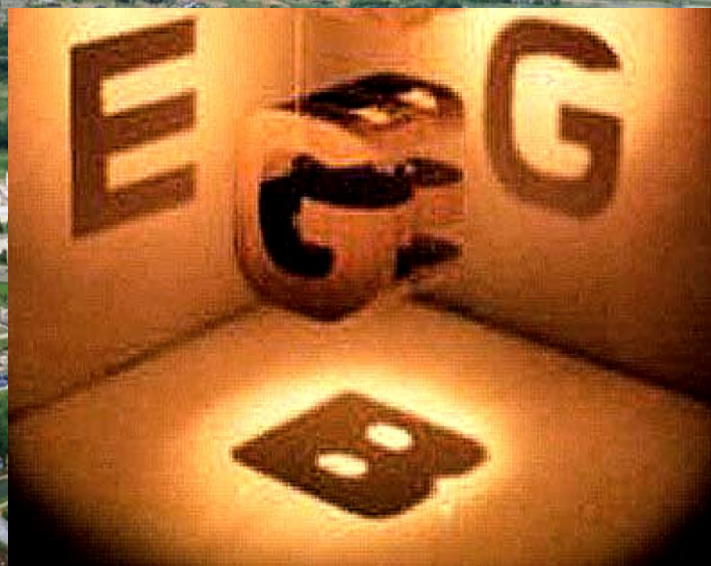
Photon-Factory



KEK : Versatile Research Institute for Particle, Nucleus, Materials and Life-Science , utilizing diverse beams of

e^-e^+

SuperKEKB
and
ILC



γ

KEK-PF



n, μ, K, ν

J-PARC

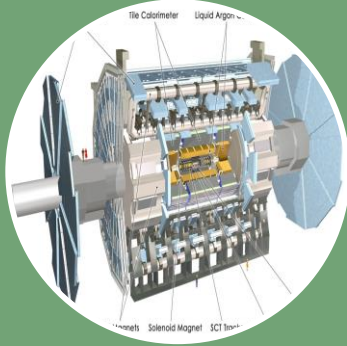


~~Tall~~
Small



~~Grande~~
Medium

From Science to Society

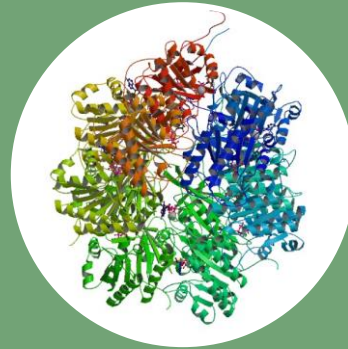


Fundamental Science (Big Science)

- Advanced Accelerator
- Innovative detector
- HP Computing/Network/
- ASIC development

Only one

Ultra high performance



Variety of Sciences (medium/small scale)

- Material, Life Science
- Photon and neutron
- Compact accelerator
- Compact detector system

~100

Competitive performance/
Reasonable cost



Industrial , medical ,commercial applications

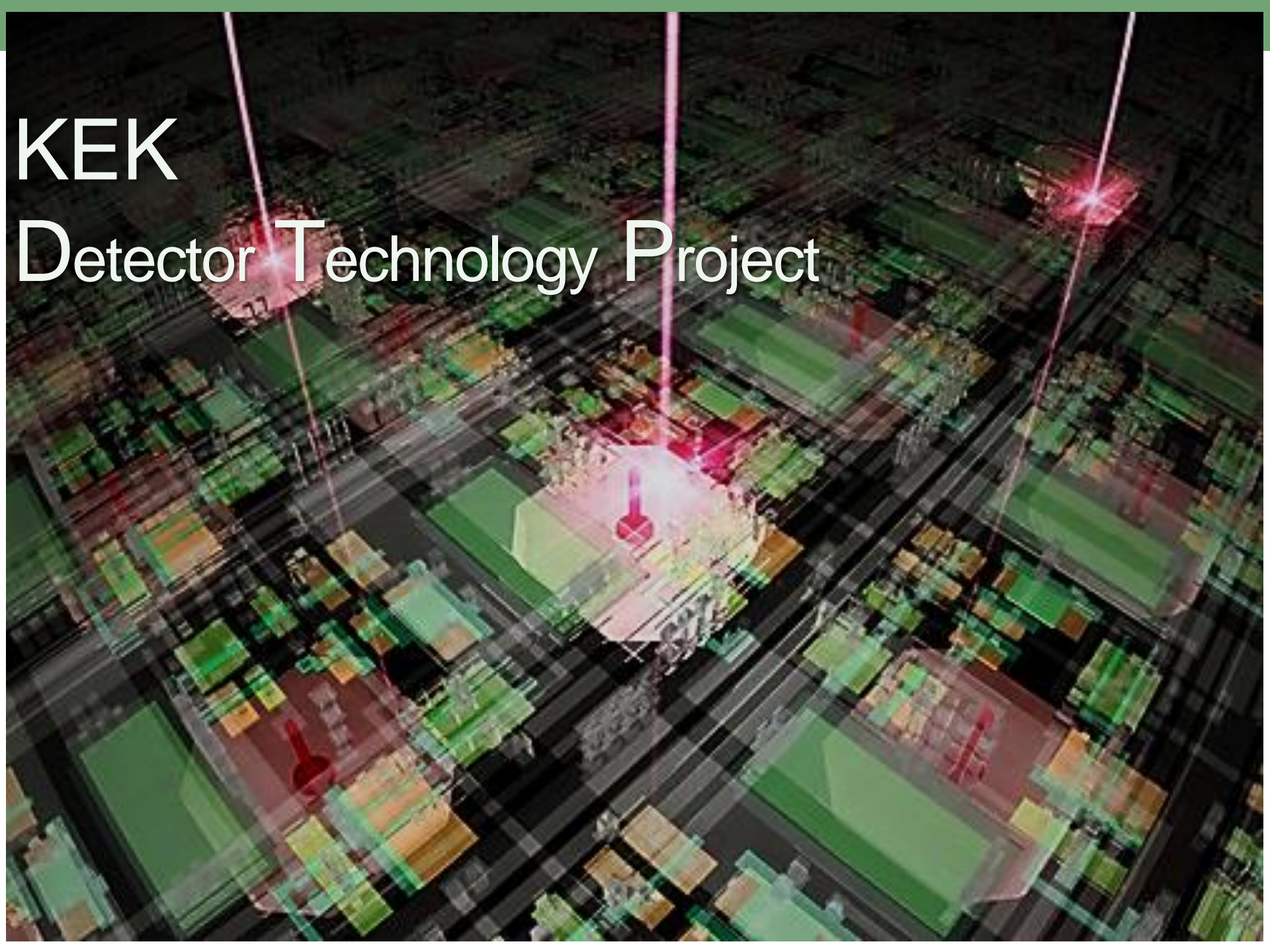
- Reliable, High Yield
- Cost effective
- Mass productive

~100,00 to million

Standard performance/
Lower cost
High reliability

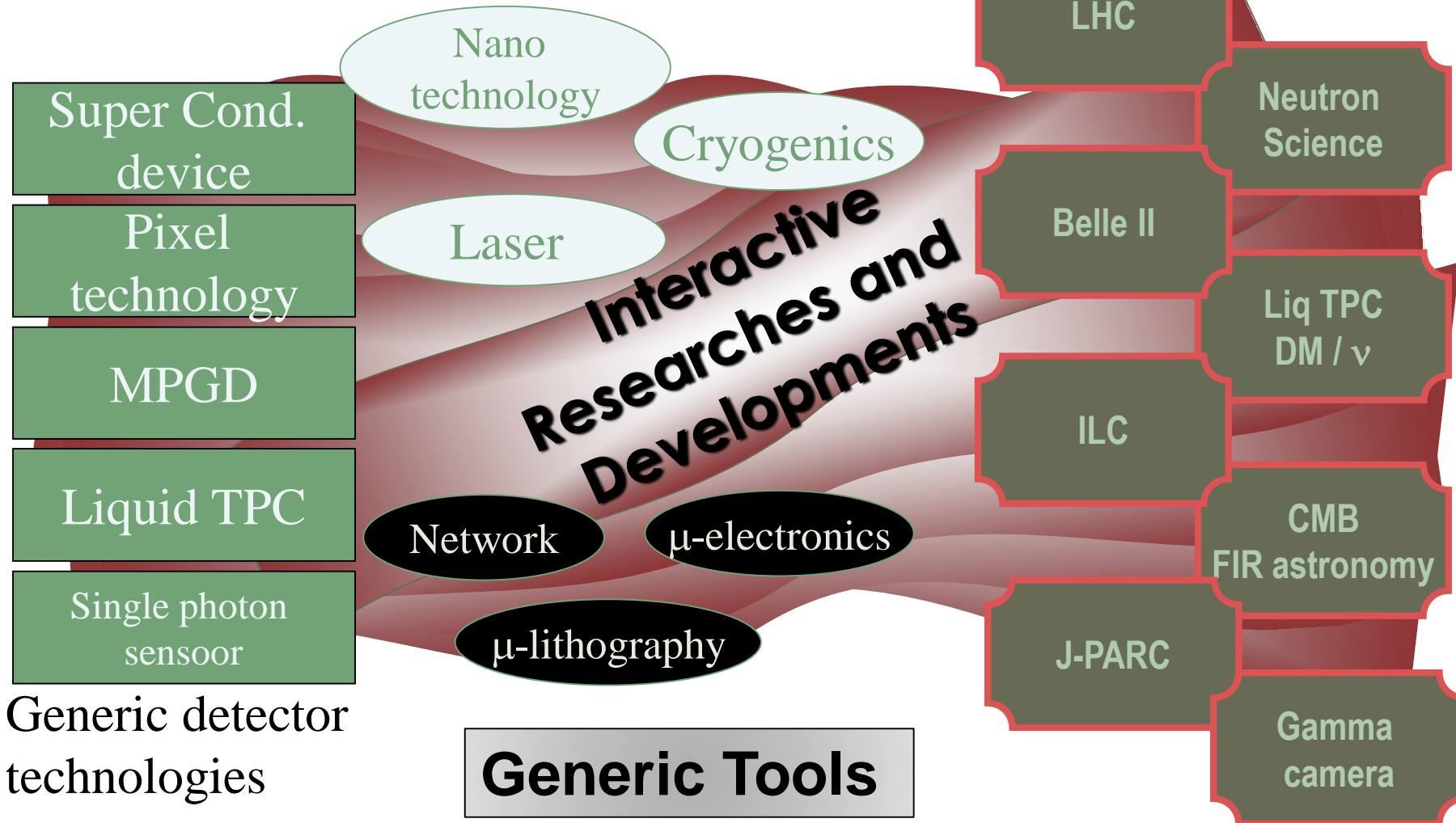
KEK

Detector Technology Project

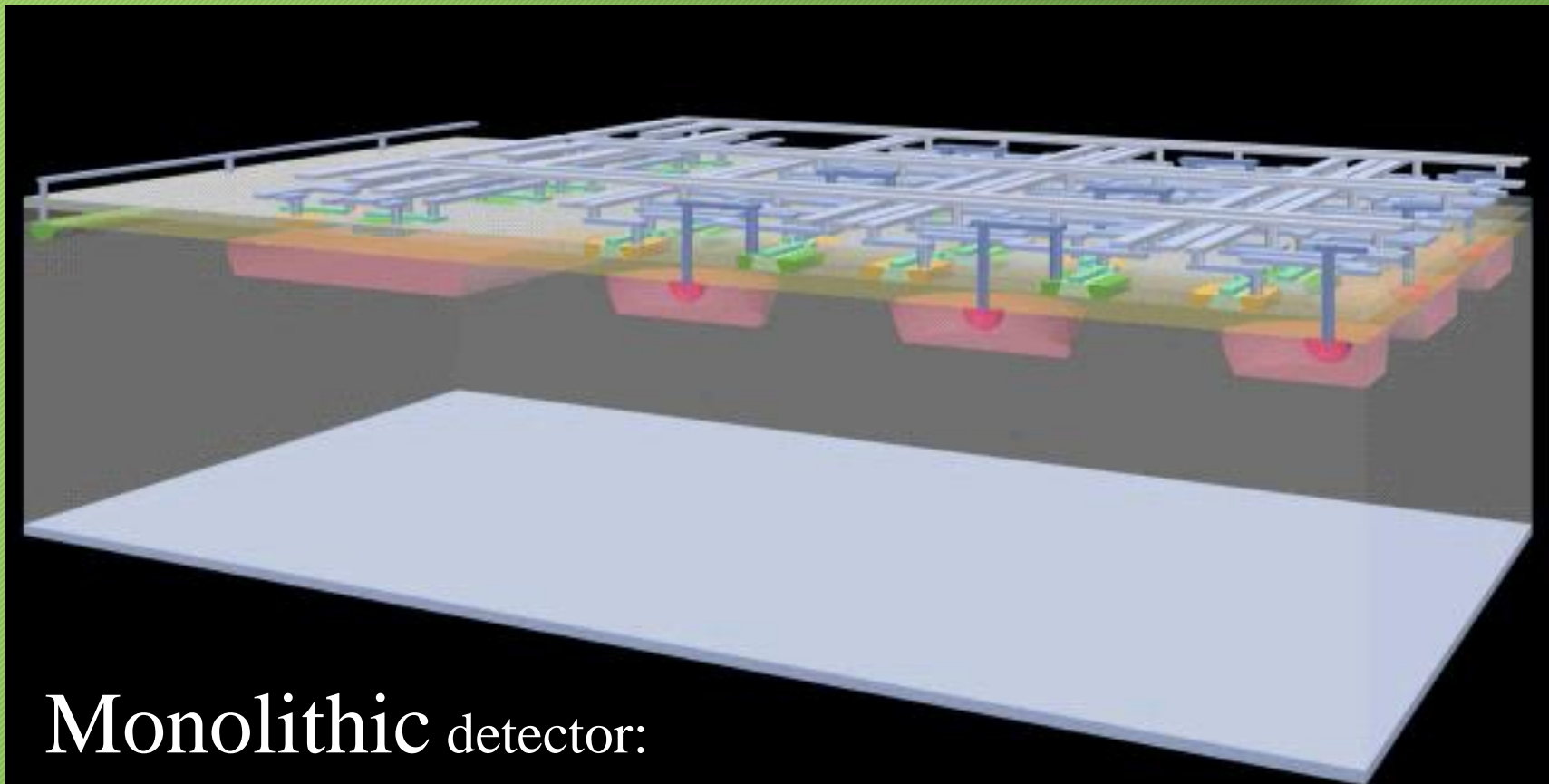


Detector Technology Development

Pure and Applied Sciences
and more ...



SOI pixel R&D started at KEK in
2006



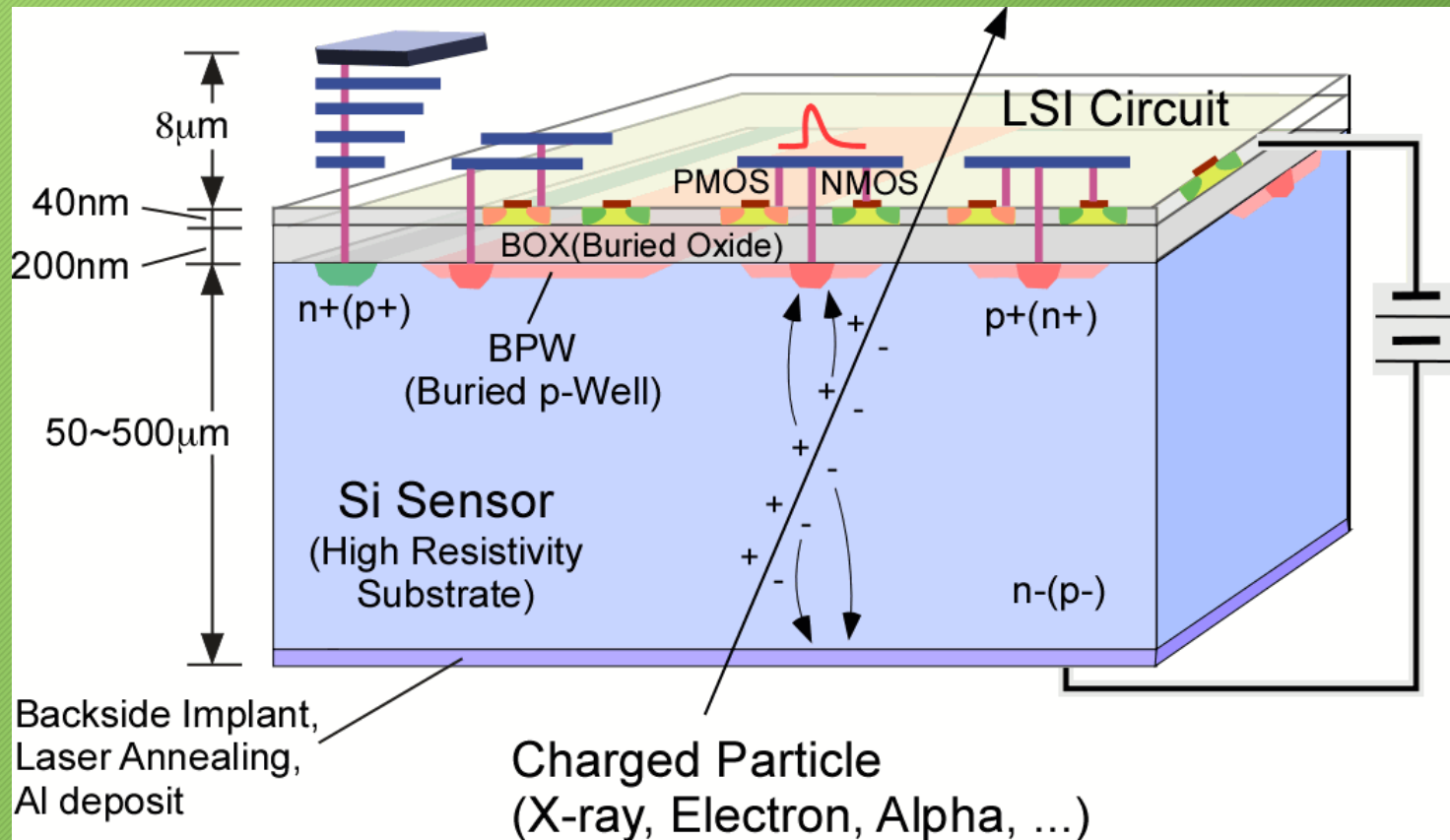
Monolithic detector:

Sensor and electronics fabricated on a single wafer

SOI Pixel Detector (SOIPIX)

Monolithic Detector having fine resolution of silicon and data processing power of CMOS LSI by using Silicon-On-Insulator (SOI) Technology.

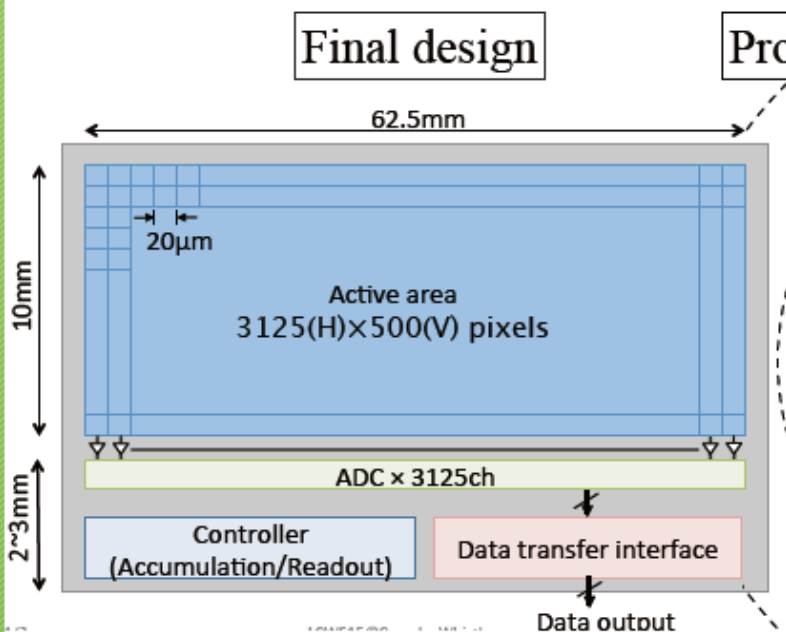
8



SOI monolithic chip, SOFIST proposed for ILC with rad. hard

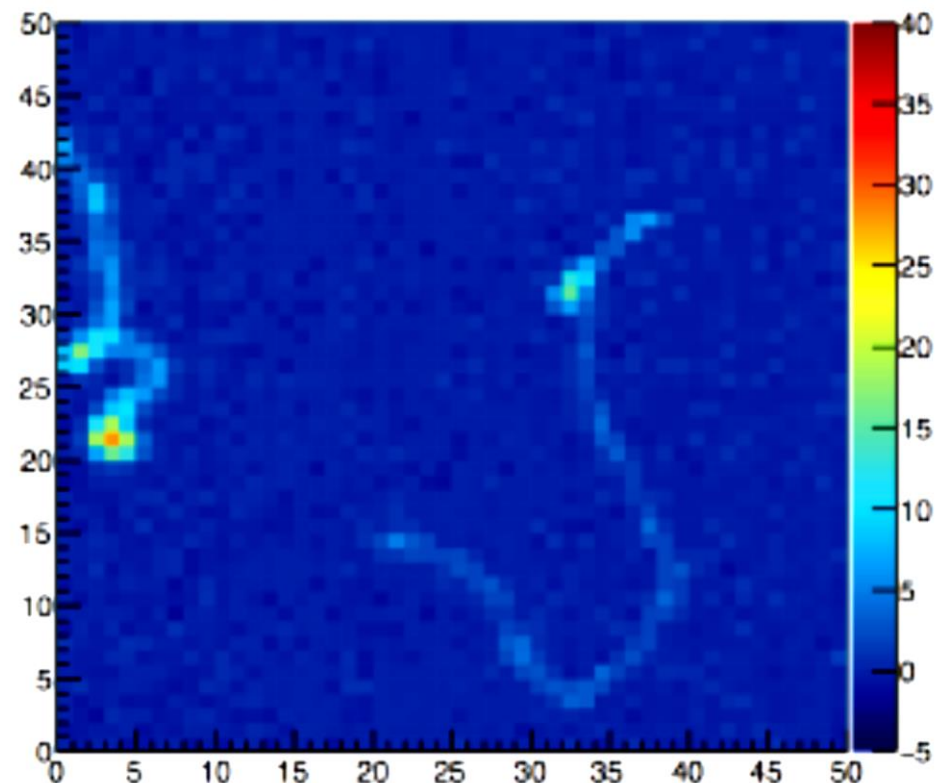
SOFIST

SOFIST
(SOI sensor for Fine measurement)

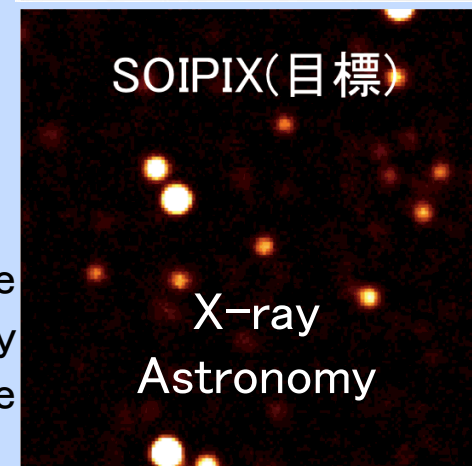
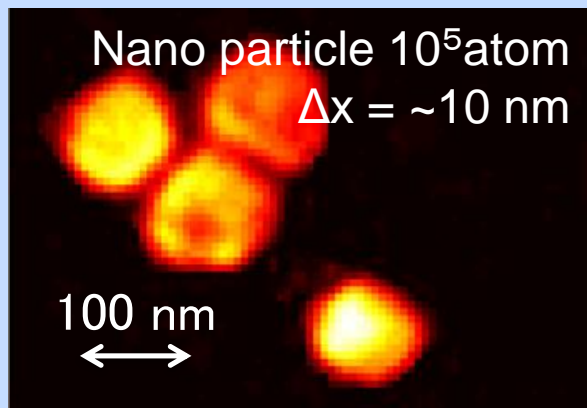
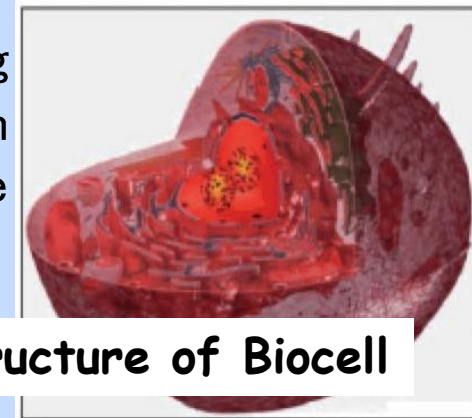
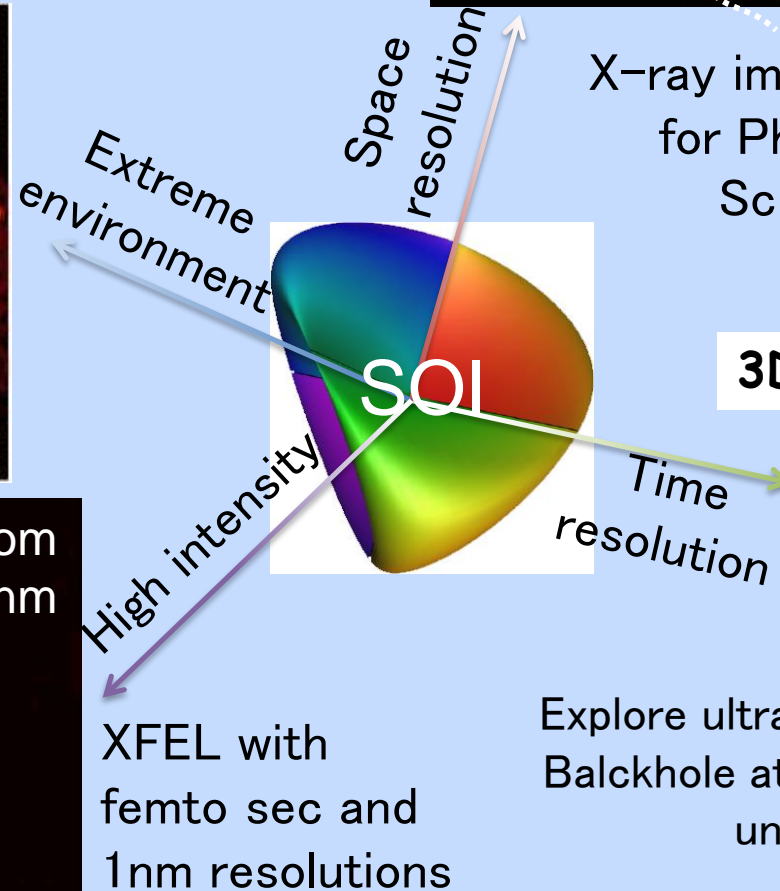
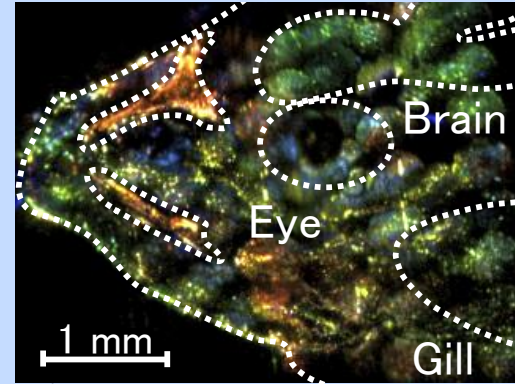
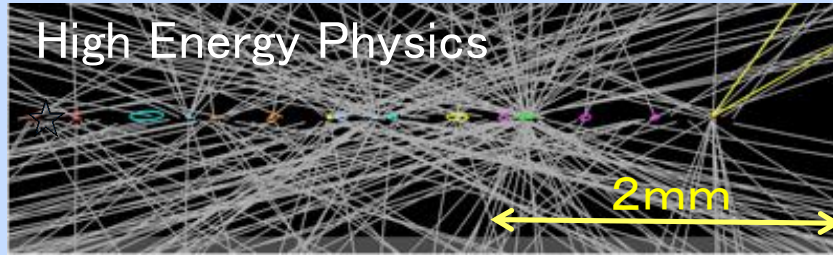


Pixel size = $20 \times 20 \mu\text{m}^2$
Thickness = $50 \mu\text{m}$

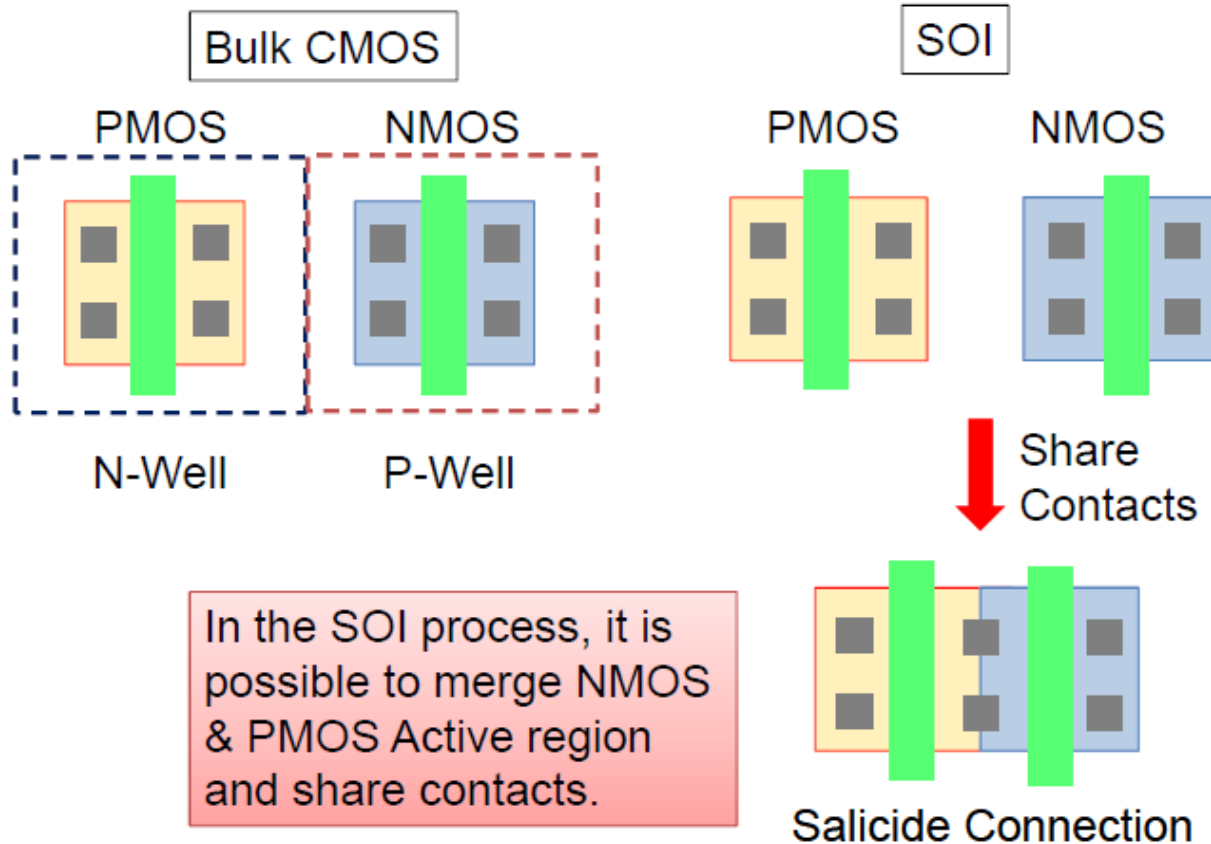
Signal data - offset



Invoke innovations in wide range field of Basic Science

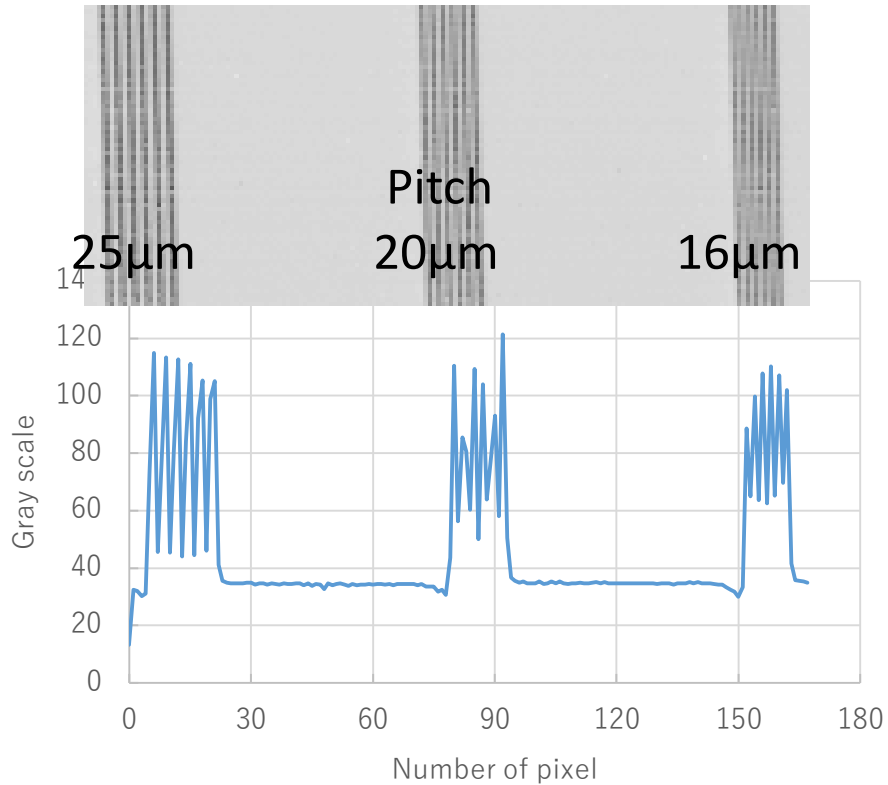


SOI can hold more complicated circuit without separating wells

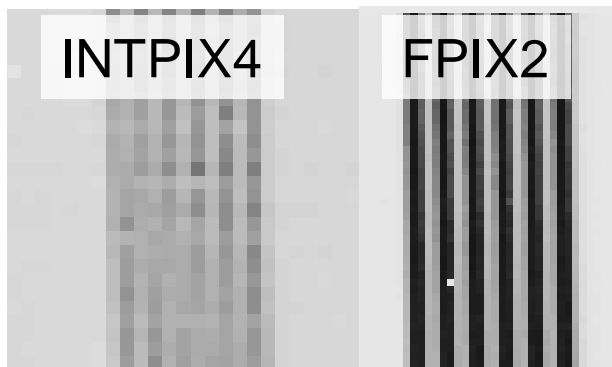
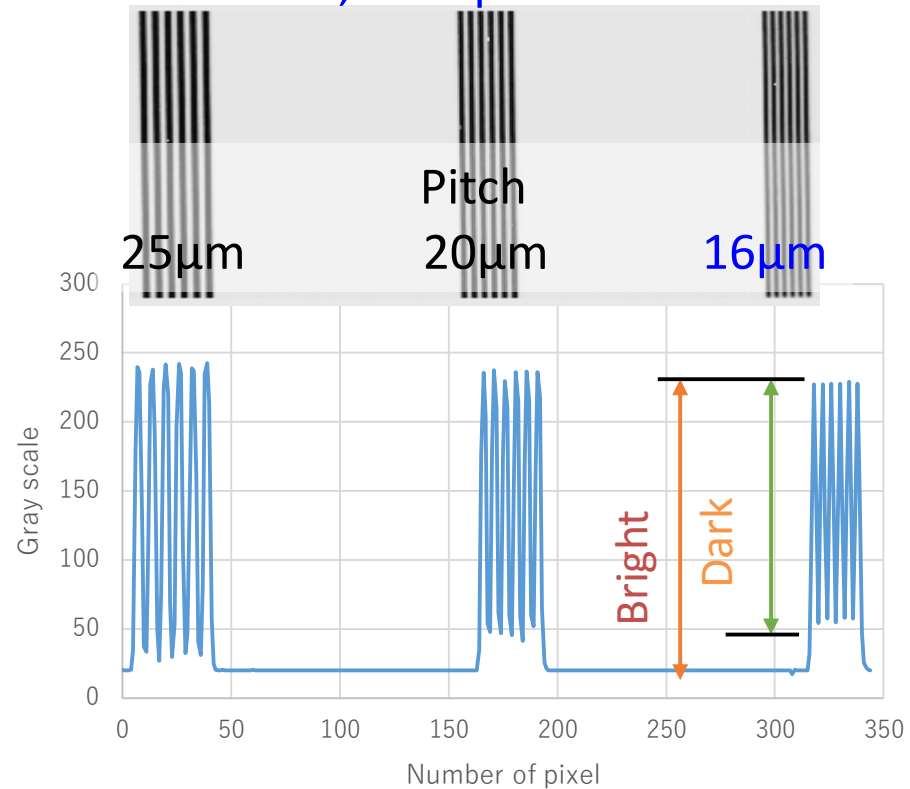


Looking Fine Pattern with X-ray

INTPIX4 FZn, 17 μ m pixel



FPIX2 FZn, 8 μ m pixel



16 μ m pitch

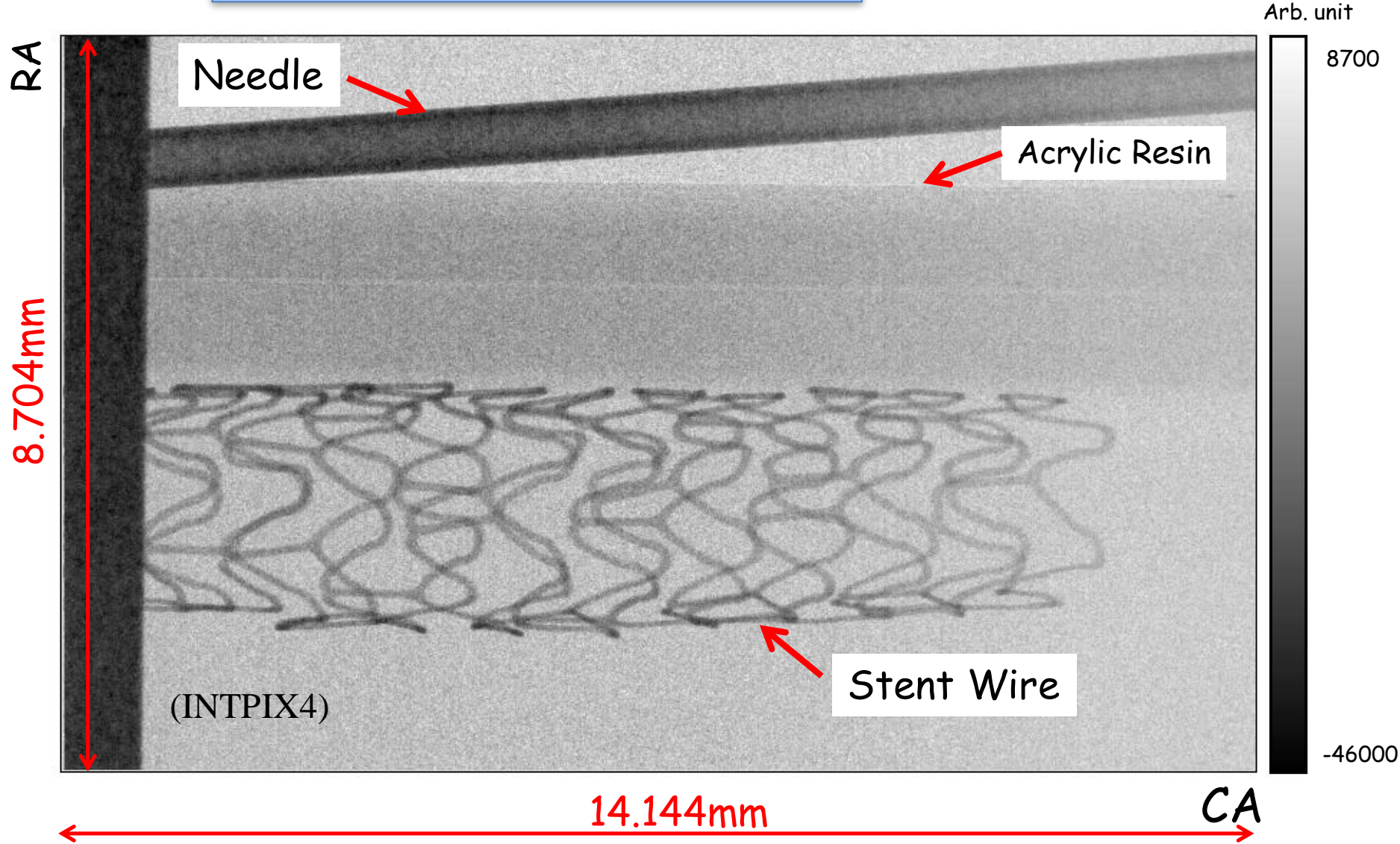
Contrast of 16 μ m Pitch Slit

INTPIX4(17 μ m pix) :
0.57、

FPIX(8 μ m pix) : 0.83

X-ray Image with the INTPIX

PF-AR NE7A 33.3keV
Acrylic resin 40mm
200us x 250 frames



Tornado research in KEK?



Quick and early detection of presage phenomenon should help a lot.

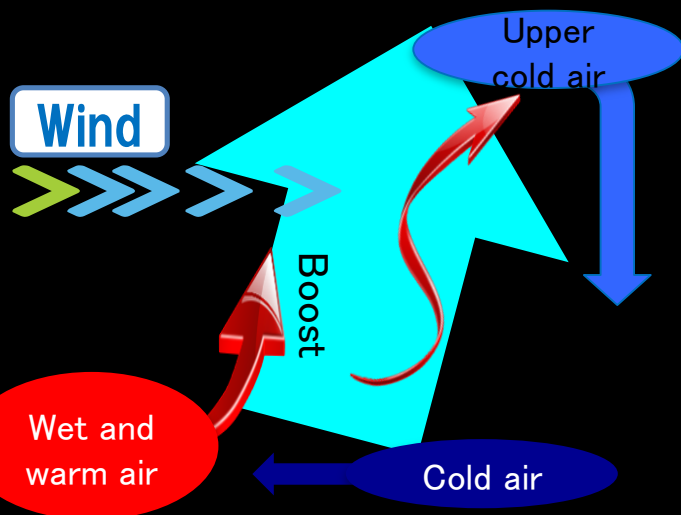
Presage detection of tornado/heavy rain storm may be possible with a slight sign...

Rapid increase of water vapor in atmosphere



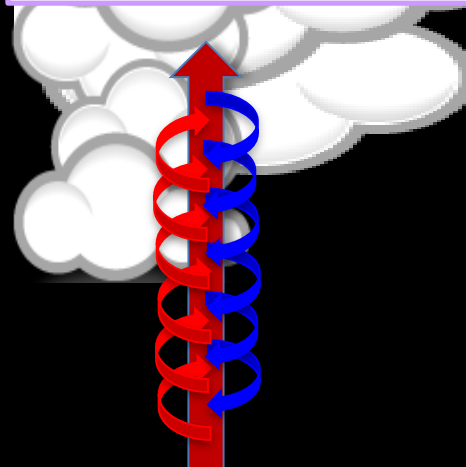
Sudden and localized

Twister: ~10 m
Heavy rain: 10km area



To be detected before cloud develops

Cumulonimbus



Twister, Rain storm

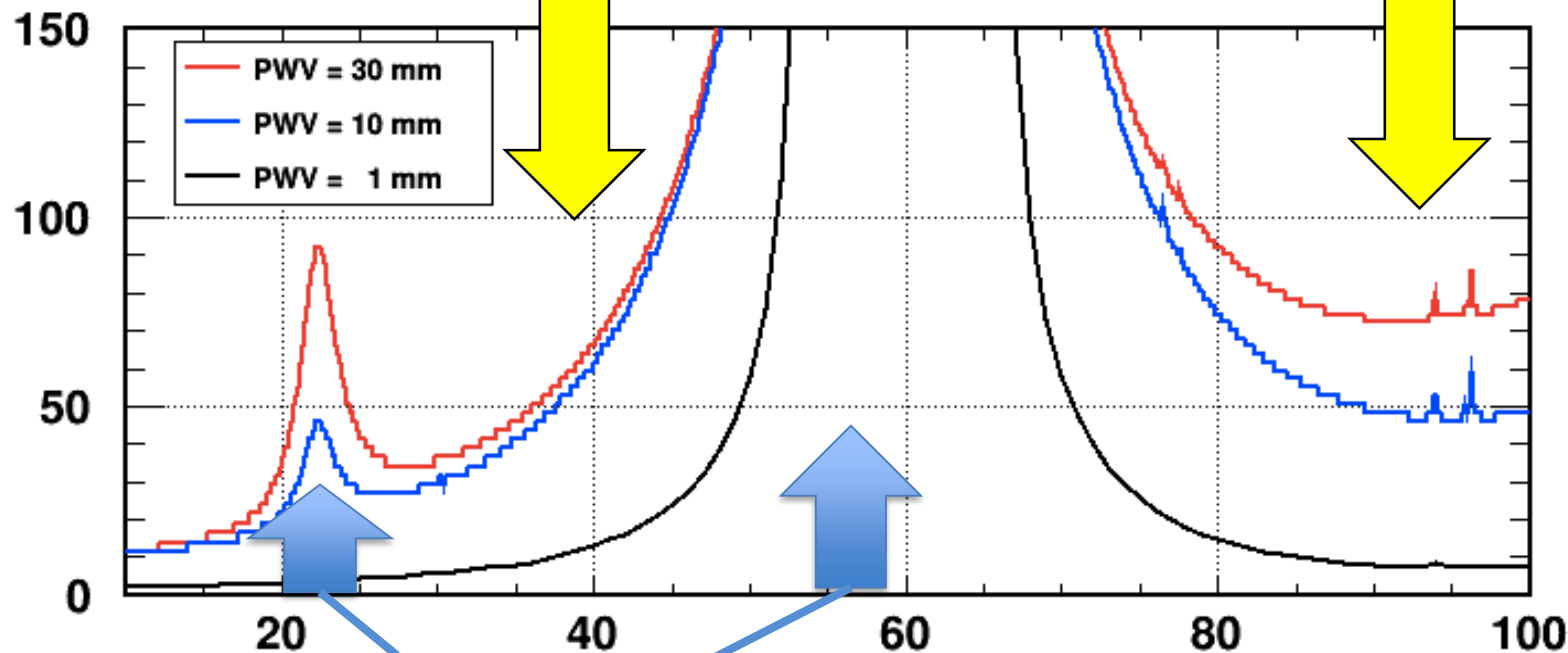


*Rapid development
In a few tens minutes*

Water vapor is a serious foreground against CMB observation

PWV: Index of water vapor in upper atmosphere

CMB observation
Frequency less affected by Water vapor

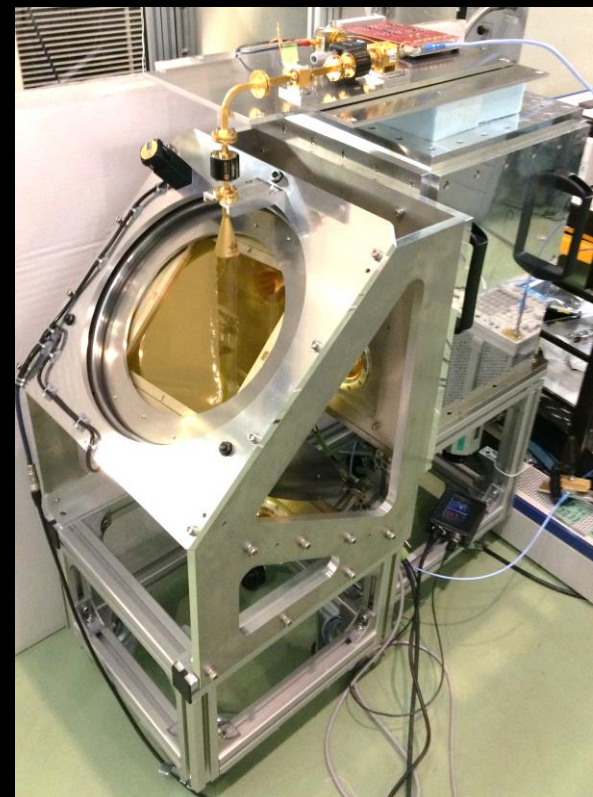
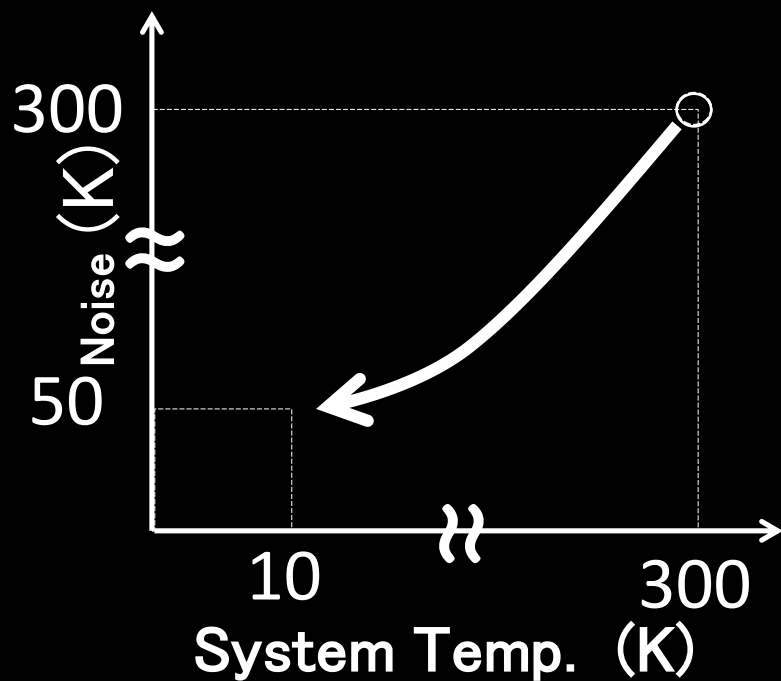
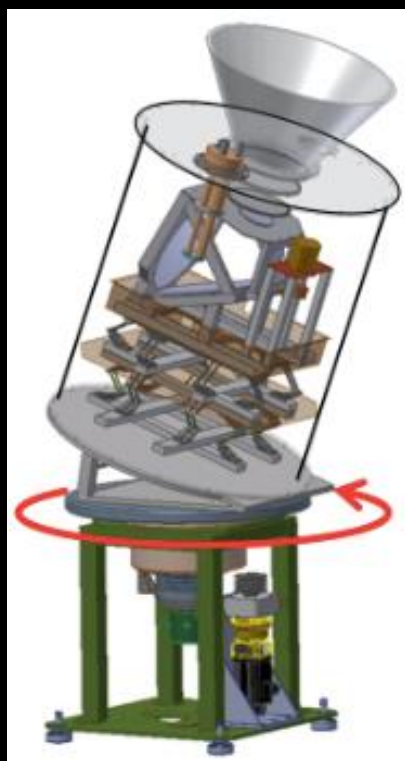
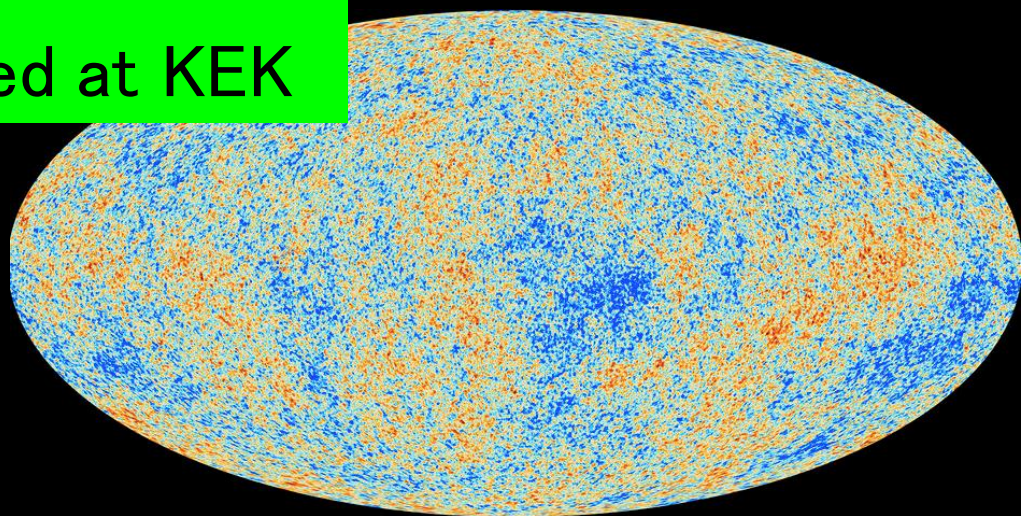


Frequency to monitor PWV

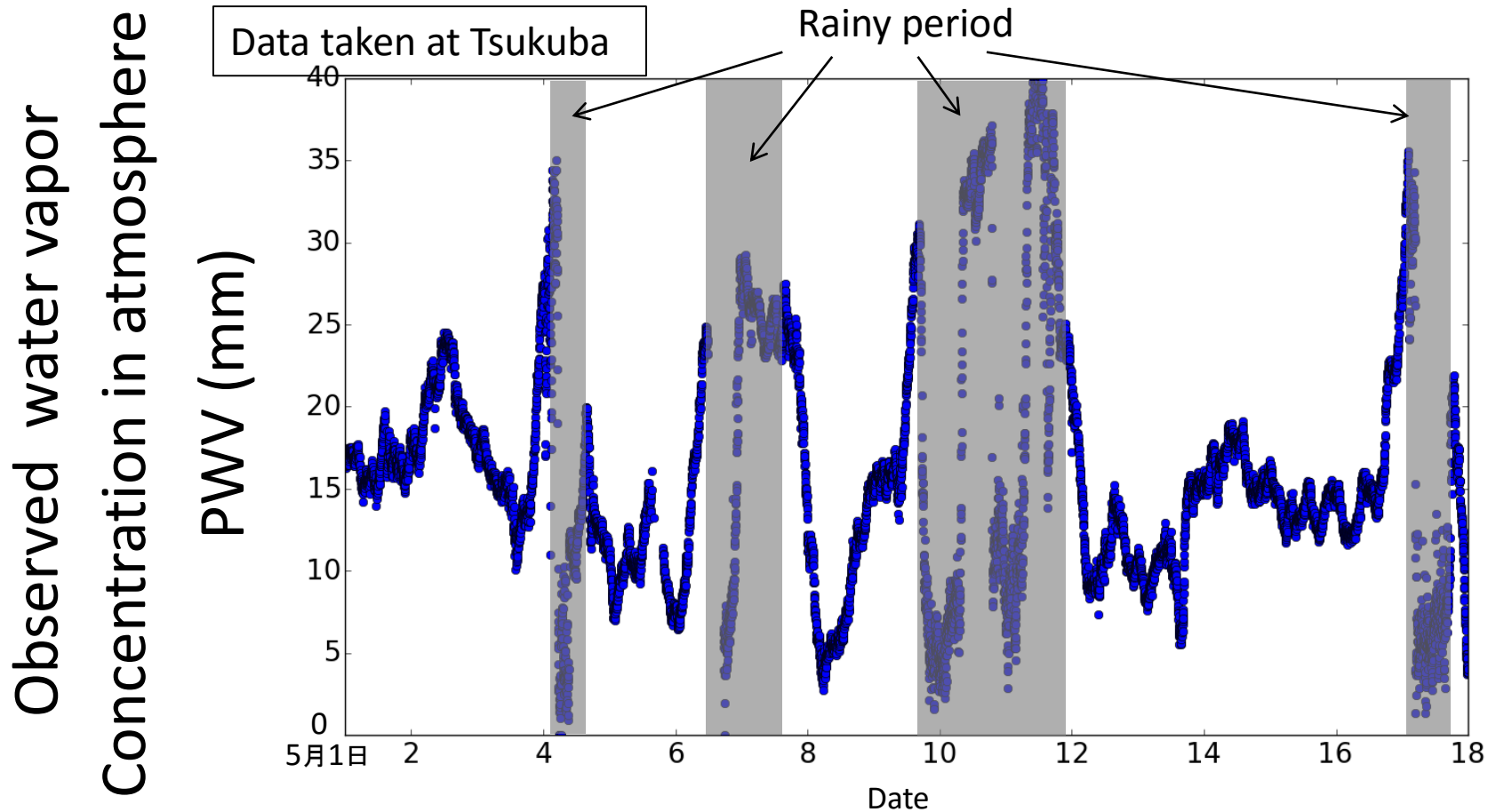
Radio Frequency (GHz)

High sensitive RF detector for
CMB observation developed at KEK

Cryogenic system
in high speed rotating
cryostat



Successful detection of presage of the coming rain



Summary

- Advanced technologies developed for huge detector system in High energy physics is essential tool for the research as well as state-of-the-art accelerators.
- Those technologies have been transferred first to smaller science in wider fields and then to the applications in industrial and medical fields.
- Ultra sensitive detector for particle physics can, for example, make a standard medical diagnose much quicker with extremely lower radiation exposure on a patient
- Advanced accelerator technologies which were not mentioned this report are also treasure for innovations in industrial and medical applications.