

Detector Innovation for High Energy Physics

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Sales Engineer

Research and Life Science

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1. Who are we?

- Introduction to Hamamatsu Photonics

2. What do we do?

- Detectors for high energy physics

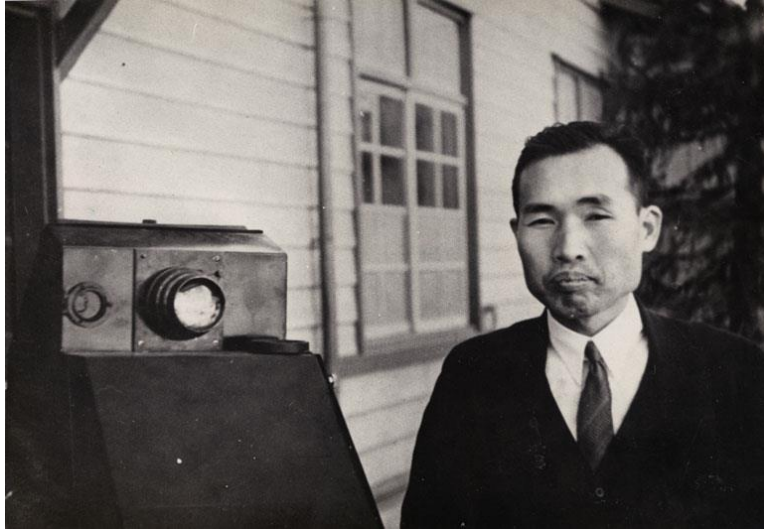
3. Why talk to us?

- Our expertise and how we can help you

Who are we?

Pursuing another “イ” that will change the world

- 1899 – Dr. Kenjiro Takayanagi was born in Hamamatsu, Japan
- 1924 – Dr. Kenjiro Takayanagi begins research on television technology
- 1926 - the Japanese katakana “イ” was electronically transmitted and displayed for the first time on a cathode ray tube



Dr. Kenjiro Takayanagi (1899 to 1990)



The Japanese character “イ” displayed on a cathode-ray tube.
(The photograph shows a device reproducing the character in the Hamamatsu Science Museum.)

Pursuing another “イ” that will change the world



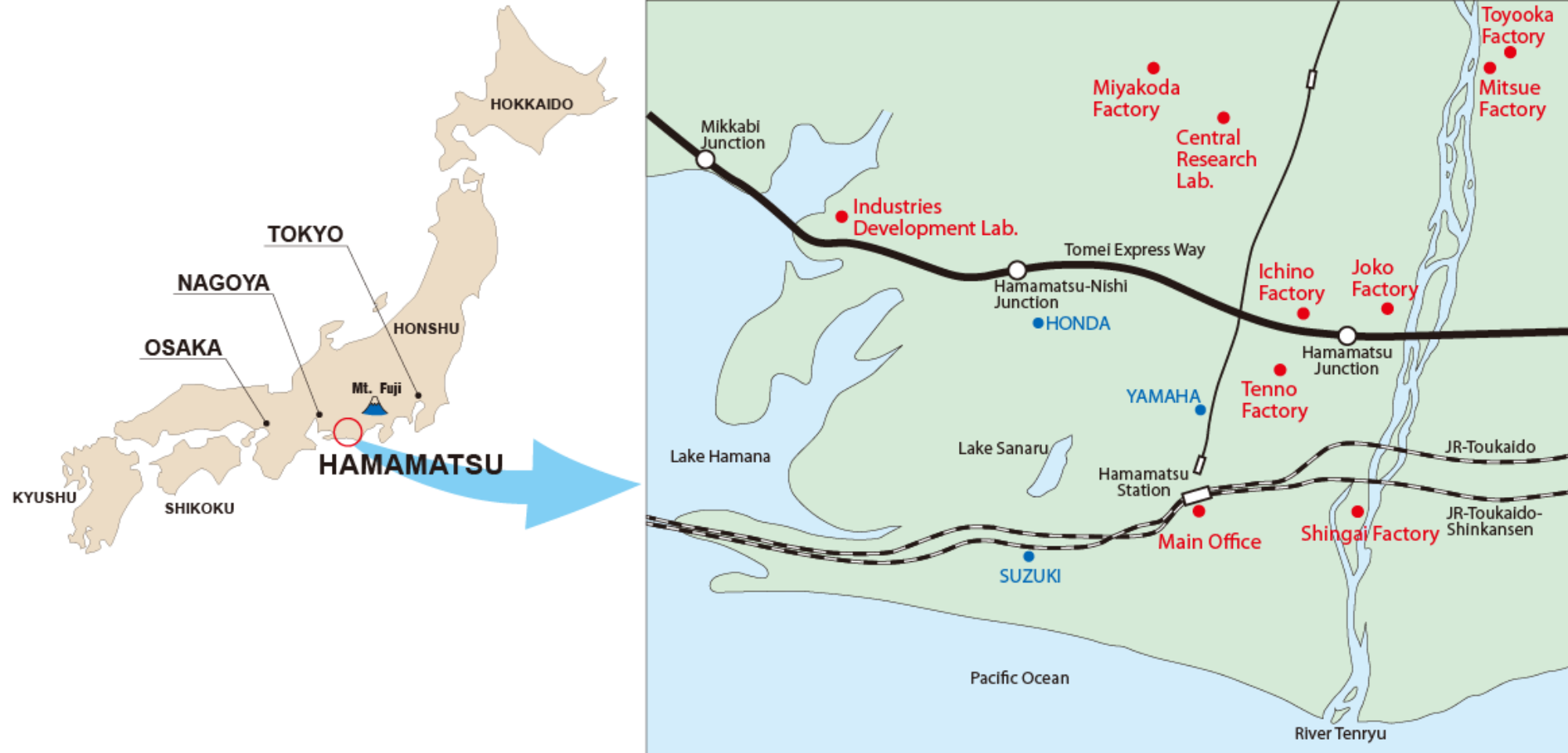
Heihachiro Horiuchi (1915 to 1997) with a vidicon in hand.



Selenium photocathode vidicons

- Heihachiro Horiuchi studied under Dr Takayanagi, who inspired his pursuit of light-based technologies
- In 1948, Heihachiro Horiuchi founded the Tokai Electronics Laboratory
- In 1953, he established Hamamatsu TV Co., Ltd.
- Since then, Hamamatsu has continued its pursuit of technologies involving light in all its forms

Where is Hamamatsu?



World-wide Sales Organization

Americas

1 PHOTONICS MANAGEMENT CORP.

HAMAMATSU CORPORATION

- 1 Main Office
- 2 California Office

3 ENERGETIQ TECHNOLOGY, INC.

Europe, Middle East, and Africa

4 PHOTONICS MANAGEMENT EUROPE SRL

5 HAMAMATSU PHOTONICS EUROPE GMBH

HAMAMATSU PHOTONICS DEUTSCHLAND GMBH

- 5 Main Office
- 6 Netherlands Office
- 7 Poland Office
- 8 Israel Office (HAMAMATSU PHOTONICS ISRAEL LTD.)

HAMAMATSU PHOTONICS FRANCE S.A.R.L.

- 9 Main Office
- 10 Swiss Office
- 4 Belgian Office
- 11 Spanish Office

HAMAMATSU PHOTONICS UK LIMITED

- 12 Main Office
- 13 South Africa Contact

HAMAMATSU PHOTONICS NORDEN AB

- 14 Main Office
- 15 Danish Office

HAMAMATSU PHOTONICS ITALIA S.R.L.

- 16 Main Office
- 17 Rome Office

NKT PHOTONICS A/S

- 18 Headquarters

Asia and Oceania

HAMAMATSU PHOTONICS (CHINA) CO., LTD.

- 19 Main Office
- 20 Shanghai Branch
- 21 Shenzhen Branch
- 22 Wuhan Branch

BEIJING HAMAMATSU PHOTON TECHNIQUES INC.

- 23 Main Office
- 24 Langfang Factory

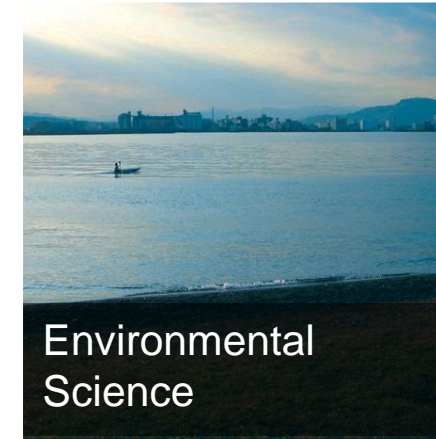
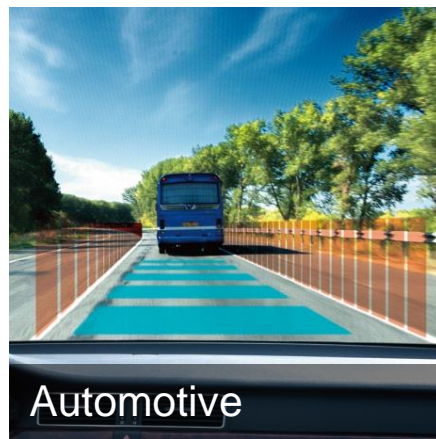
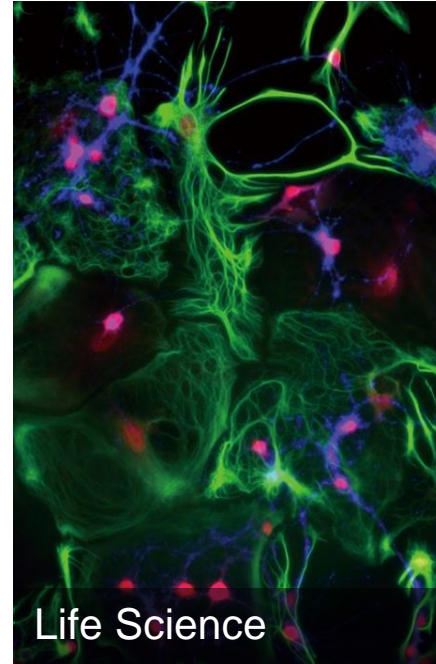
HAMAMATSU PHOTONICS TAIWAN CO., LTD.

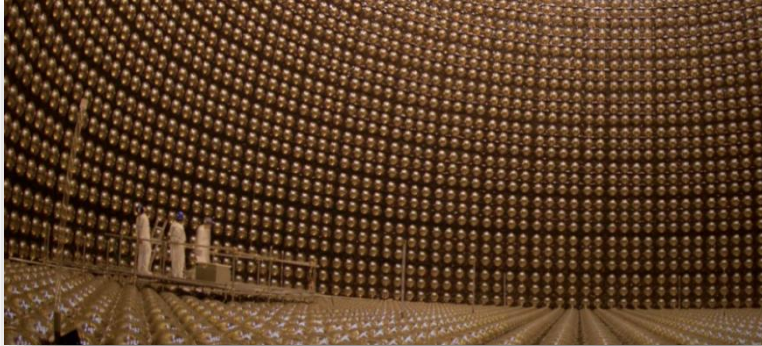
- 25 Main Office

HAMAMATSU PHOTONICS KOREA CO., LTD.

- 26 Main Office
- 27 Hwaseong Plant

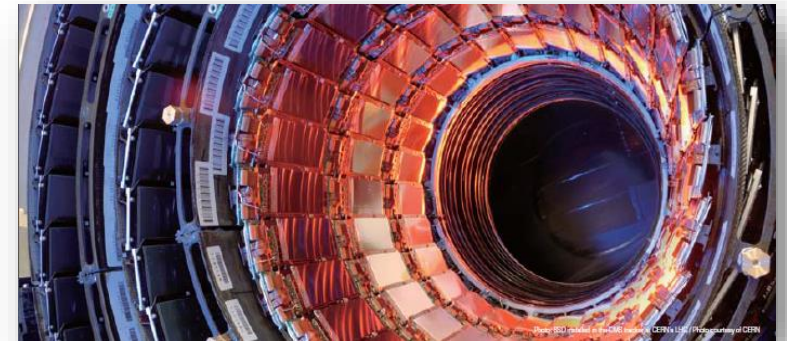
Markets





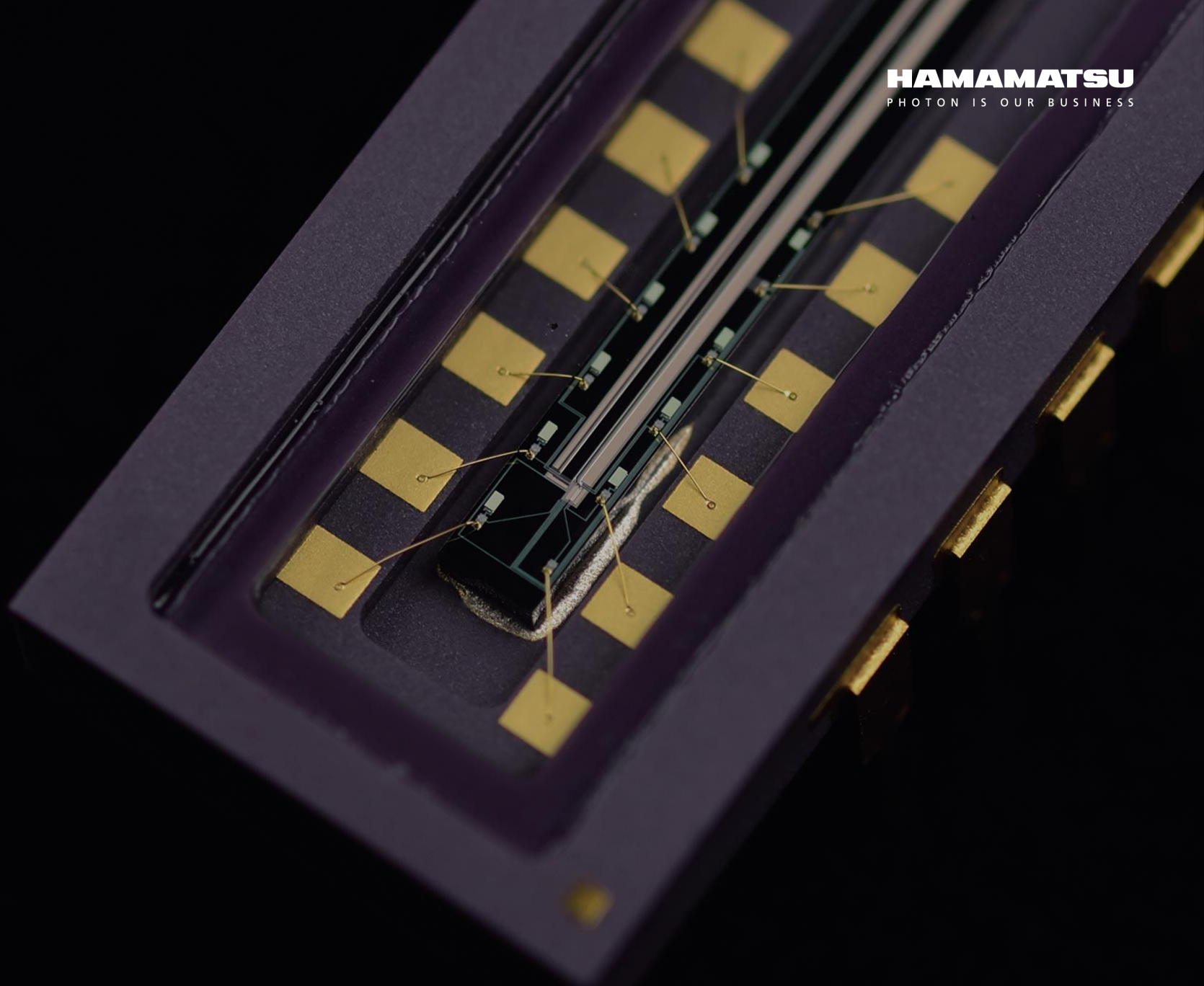
- **Kamiokande:** in 2002 Prof. Masatoshi Koshiba was awarded the Nobel Prize in physics for history's first observation of neutrinos that were released from a supernova explosion captured by the world's largest 20-inch diameter PMT.

- **Large Hadron Collider:** in 2013 Prof François Englert and Peter W. Higgs was awarded the Nobel Prize in physics for the discovery of the Higgs boson often called the God particle that gives mass to matter particles. Our Silicon Strip Detectors contributed to this great discovery.



- **Super Kamiokande:** in 2015 Professor Takaaki Kajita, University of Tokyo, was awarded the Nobel Prize in Physics for the discovery of neutrino oscillations that indicate a neutrino has a mass. This breakthrough was the result of research at Super Kamiokande where our photomultiplier tubes were installed.

What do we do?

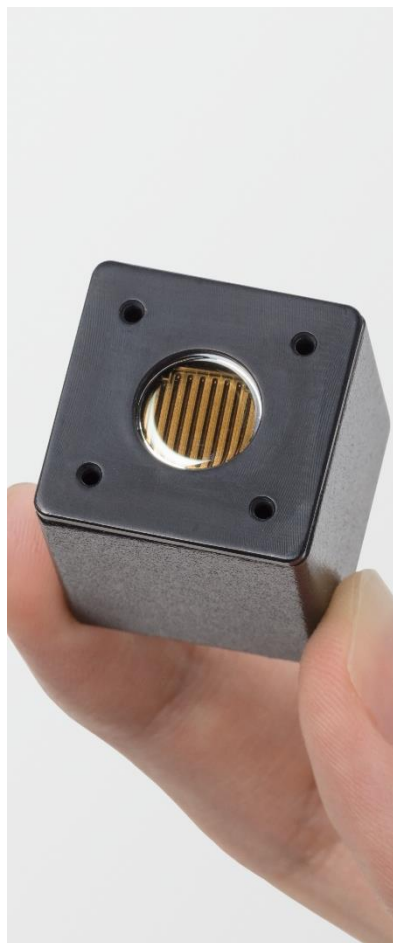


Detectors for High Energy Physics

Photomultiplier tubes (PMTs)



PMT modules



Si photodiodes, APDs, MPPC®

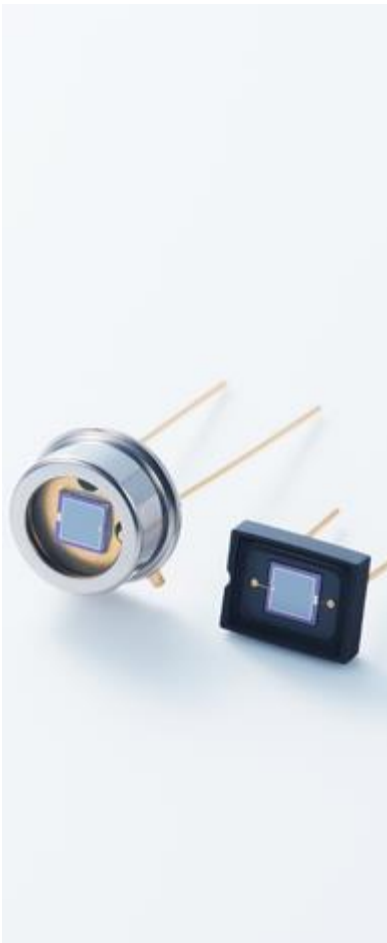
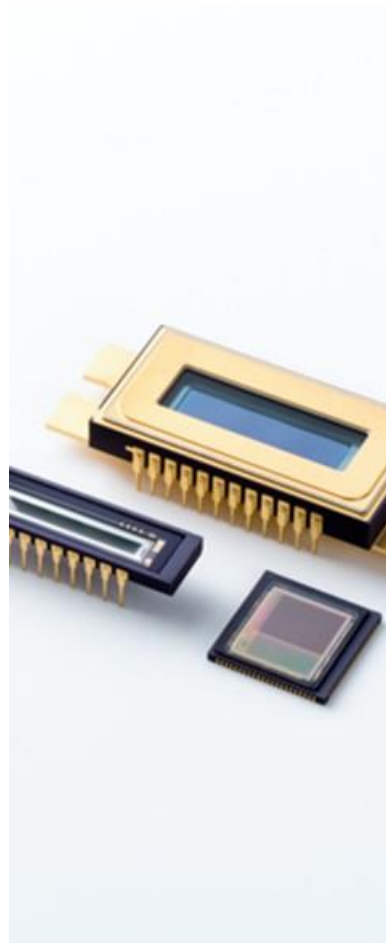


Image sensors



Cameras



X-ray related products



Photomultiplier Tubes (PMTs)

Wavelength range

- Choice of window and photocathode material e.g. UV windows, high QE photocathodes, extended green options

Size and shape

- Photocathode shapes and sizes e.g. square or circular, 8mm to 20" options

Multiplication method

- Classic dynode structure, metal dynodes, multichannel plates (MCPs), hybrid detectors

Anode readout

- Single channel and multianode array options

Accessories

- Sockets, power supplies, amplifiers, coatings, shielding etc.



Silicon Photomultipliers (SiPMs)

Wavelength range

- UV and NIR enhanced options

Photosensitive area

- 1.3mm to 6mm

Pixel size

- 10 μ m to 75 μ m pixel pitch

Single-channel or multi-channel

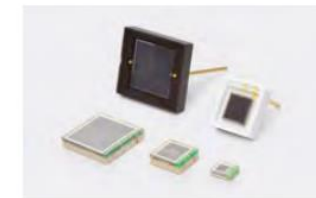
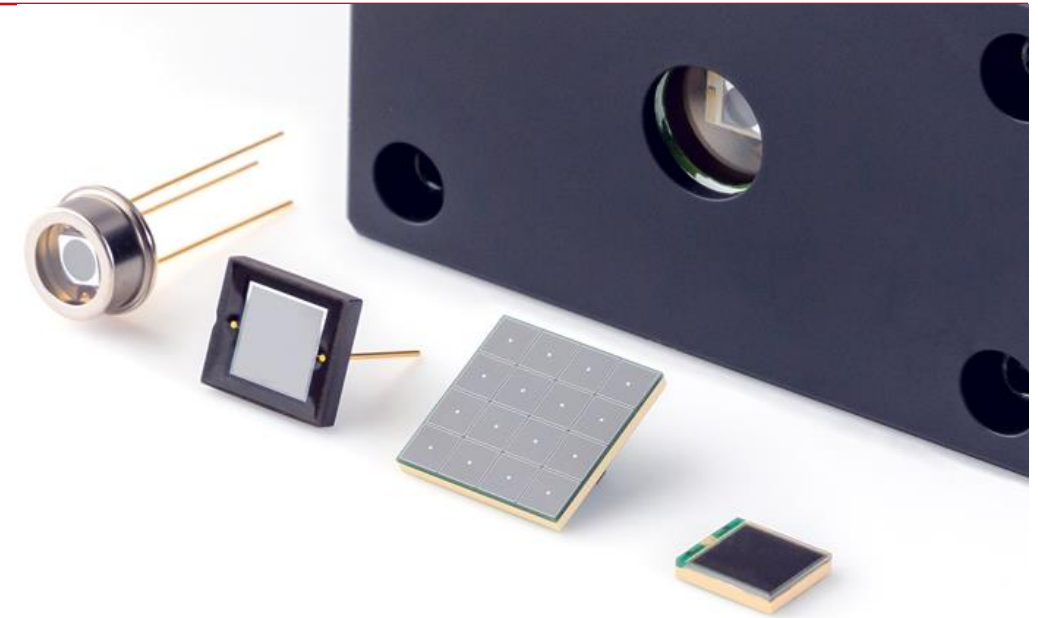
- Single-element and array options

Package type

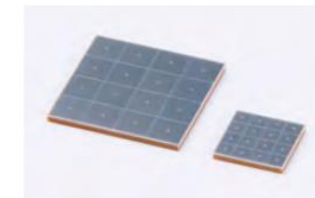
- Ceramic, metal, and surface mount

Cooling

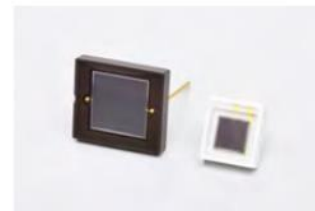
- Options for lowering dark noise



Single-channel MPPC



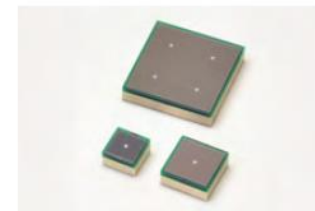
Multi-channel MPPC



Ceramic package



Metal package

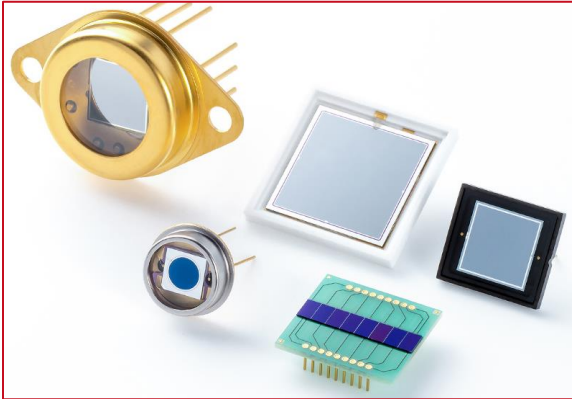


Surface mount



With flexible cable

Anything else?



Photodiodes

- Large area devices
- Arrays
- High speed options



Imaging solutions

- Low noise camera
- Quantitative CMOS
- X-Ray TDI

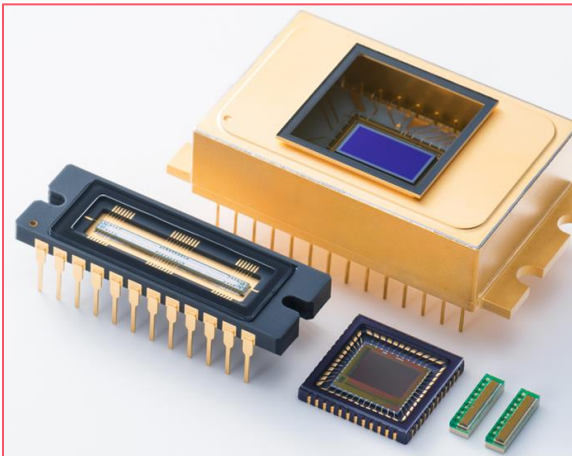
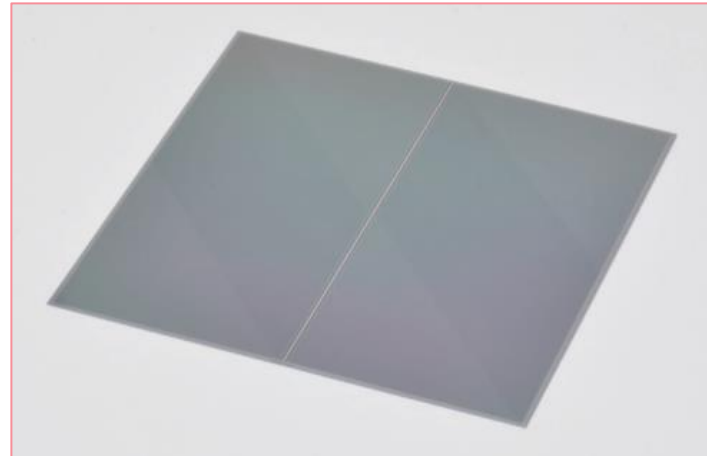


Image sensors

- Linear devices
- Area devices
- Readout solutions



Silicon array detectors

- Photodiode arrays
- Segmented photodiodes
- Silicon strip detectors

Why talk to us?

Why Hamamatsu?



Experience



Customization

Collaboration



To summarise...

- Who are we?
- What do we do?
- Why talk to us?

