

# Hamamatsu Photonics

## Enabling groundbreaking discoveries



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Application Engineer

HC Hamamatsu

Sponsor Presentation for Virtual Photonics for Quantum 2

# Hamamatsu Photonics World-wide

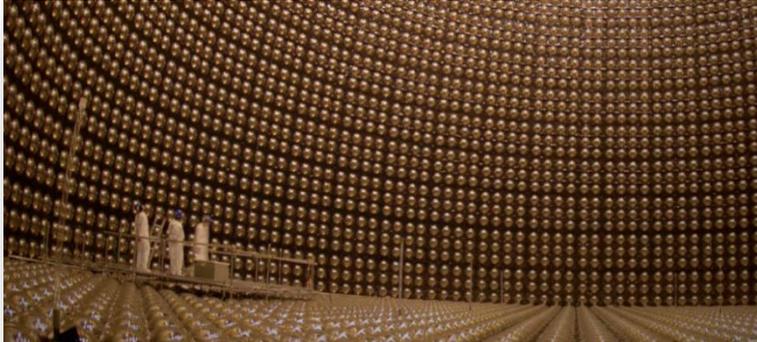


## Hamamatsu Photonics K.K.

- Established 1953
- Offer over **+15,000 products** (units, devices & systems)

## Hamamatsu Photonics K.K. Divisions

- Electron Tube Division
  - Photomultiplier Tubes, Light Sources
- Solid State Division
  - SPADs, Infrared Sensors, Spatial Light Modulators
- Systems Division
  - Scientific Cameras like CMOS, InGaAs, EM-CCD
- Laser Promotion Division
  - High Power Laser Diodes, CW Laser Diodes
- Central Research Laboratory
  - Fundamental research from biophotonics, to energy

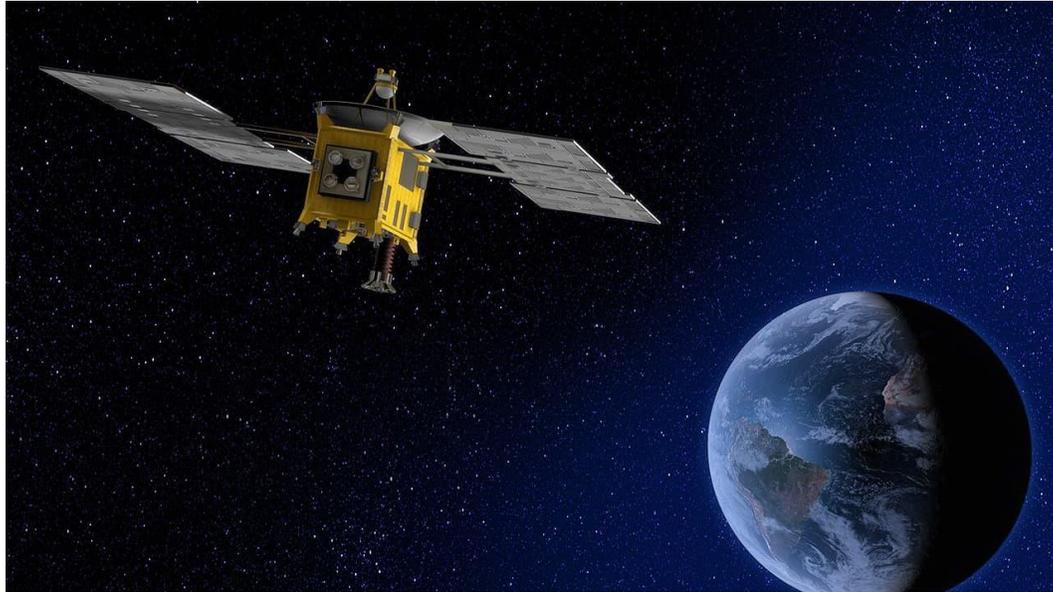


- **Kamiokande:** in 2002 Prof. Masatoshi Koshiba was awarded the Nobel Prize in physics for history's first observation of neutrinos that were released from a supernova explosion captured by the world's largest 20-inch diameter PMT.

- **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.

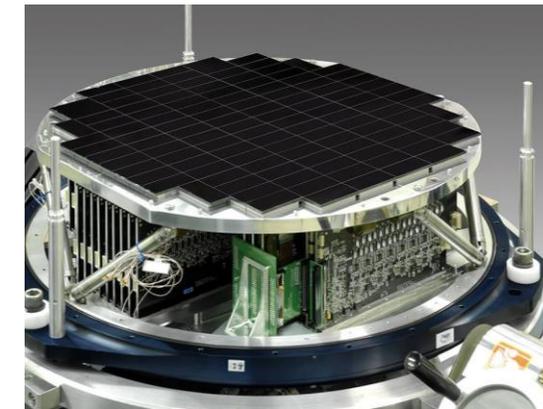
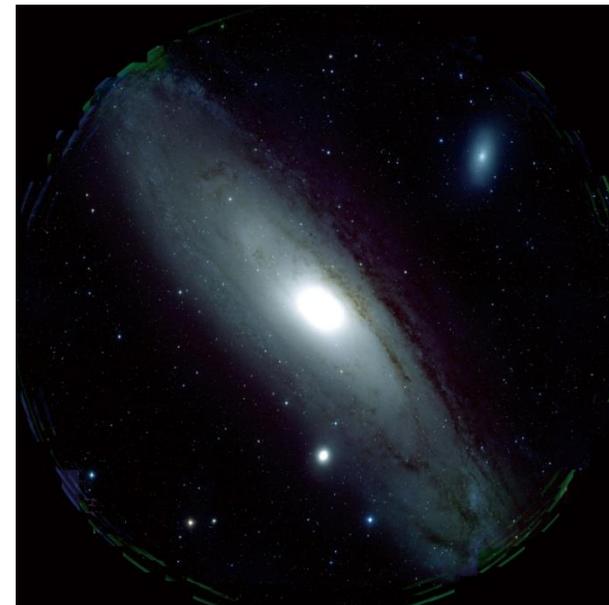


- **Super Kamiokande:** in 2015 Professor Takaaki Kajita, University of Tokyo, was awarded the Nobel Prize in Physics for the discovery of neutrino oscillations that indicate a neutrino has a mass. This breakthrough was the result of research at Super Kamiokande where our photomultiplier tubes were installed.

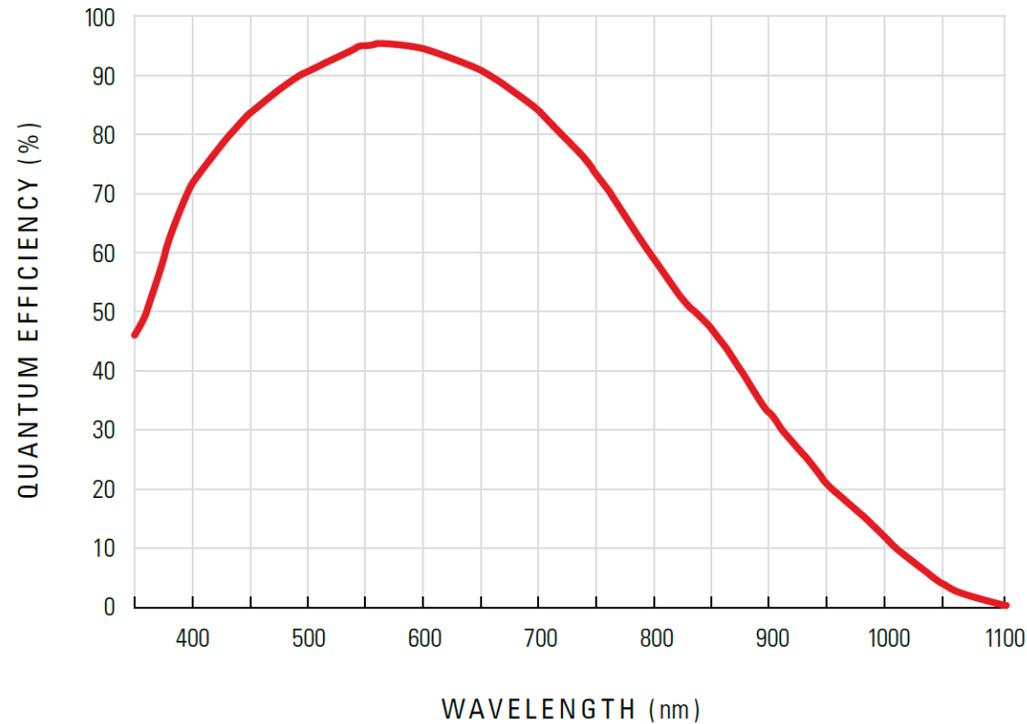


- **Hayabusa probe:** returned to Earth after a seven-year mission to learn more about the composition of the distant asteroid Itokawa. Our InGaAs image sensors were an integral part of the Hayabusa 2's infrared spectrometer, helping to analyze and identify minerals present on the asteroid.

- **Subaru Telescope:** mounted atop Mauna Kea on the Island of Hawaii this new generation telescope offers epoch-making high observation performance. Its ultra-wide-field prime focus camera contains CCD area image sensors that boast the highest sensitivity in the world.



### Back-thin Boosted QE of ORCA-Fusion BT



## Features

- Q.E: **95% @ 550nm**, 83% @ 700nm , 72% @ 400nm , 58% @ 800nm
- Readout noise: 0.7 electrons rms
- Dark signal non-uniformity (DSNU) : 0.06 electrons rms

# ORCA-Fusion Digital CMOS camera & InGaAS Camera



ORCA-Fusion Digital CMOS camera

## Features

- Q.E: 65% @ 400nm , **80% @ 550nm**, 70% @ 700nm , 50% @ 800nm
- Readout noise: 0.7 electrons rms
- Dark signal non-uniformity (DSNU) : 0.3 electrons rms
- Effective no. of pixels: 2304(H) × 2304(V)
- Pixel Size: 6.5μm x 6.5μm

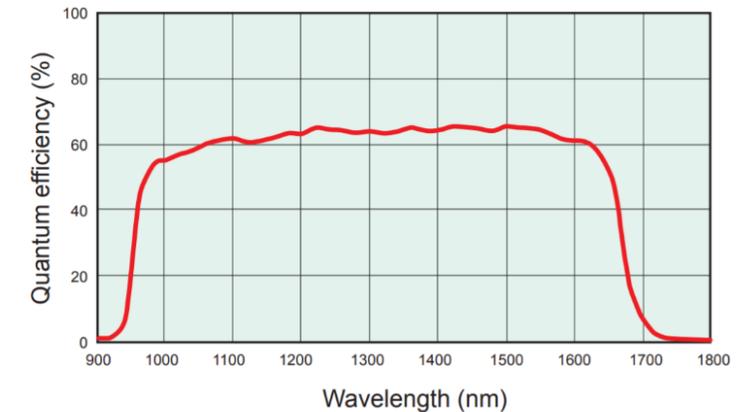


InGaAS Camera

## Features

- High sensitivity in the near infrared region from 950 nm to 1700 nm
- Low noise and high stability with cooling
- Effective no. of pixels: 320 (H) × 256 (V)
- Pixel Size: 20 μm x 20 μm

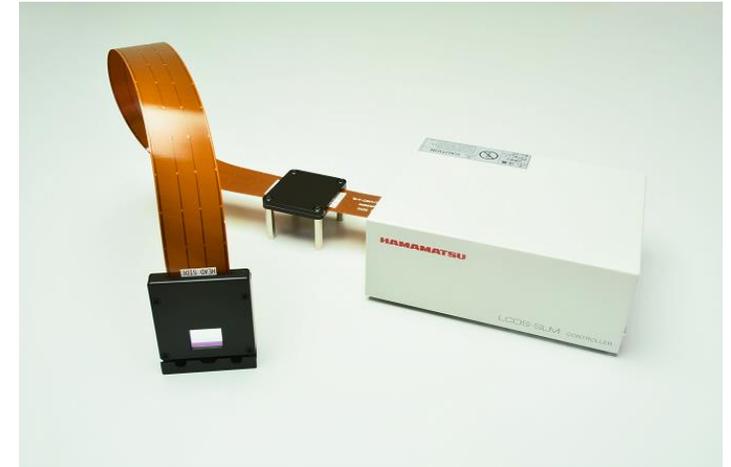
SPECTRAL RESPONSE



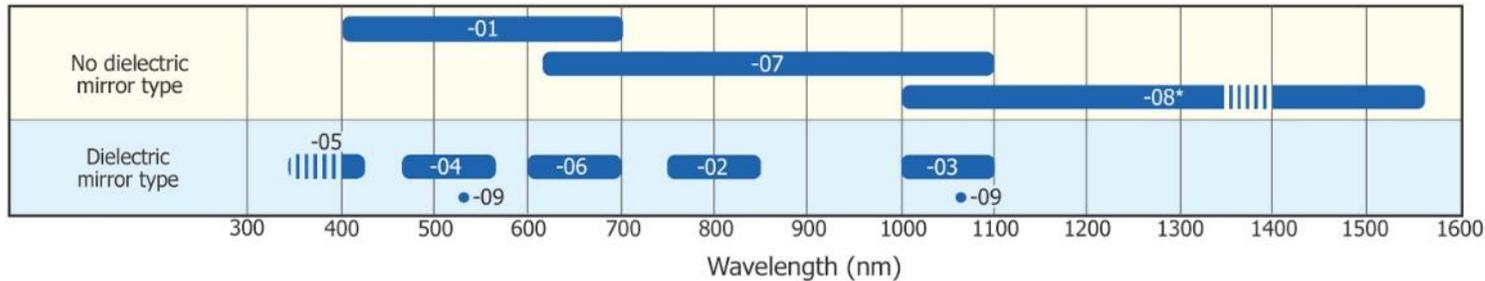
# LCOS SLM – Spatial Light Modulators

## Features:

- High Diffraction Efficiency up to 98%
- High Phase Stability
- Offering new LCOS SLM head & controller with improved driver circuitry and smaller form factor.



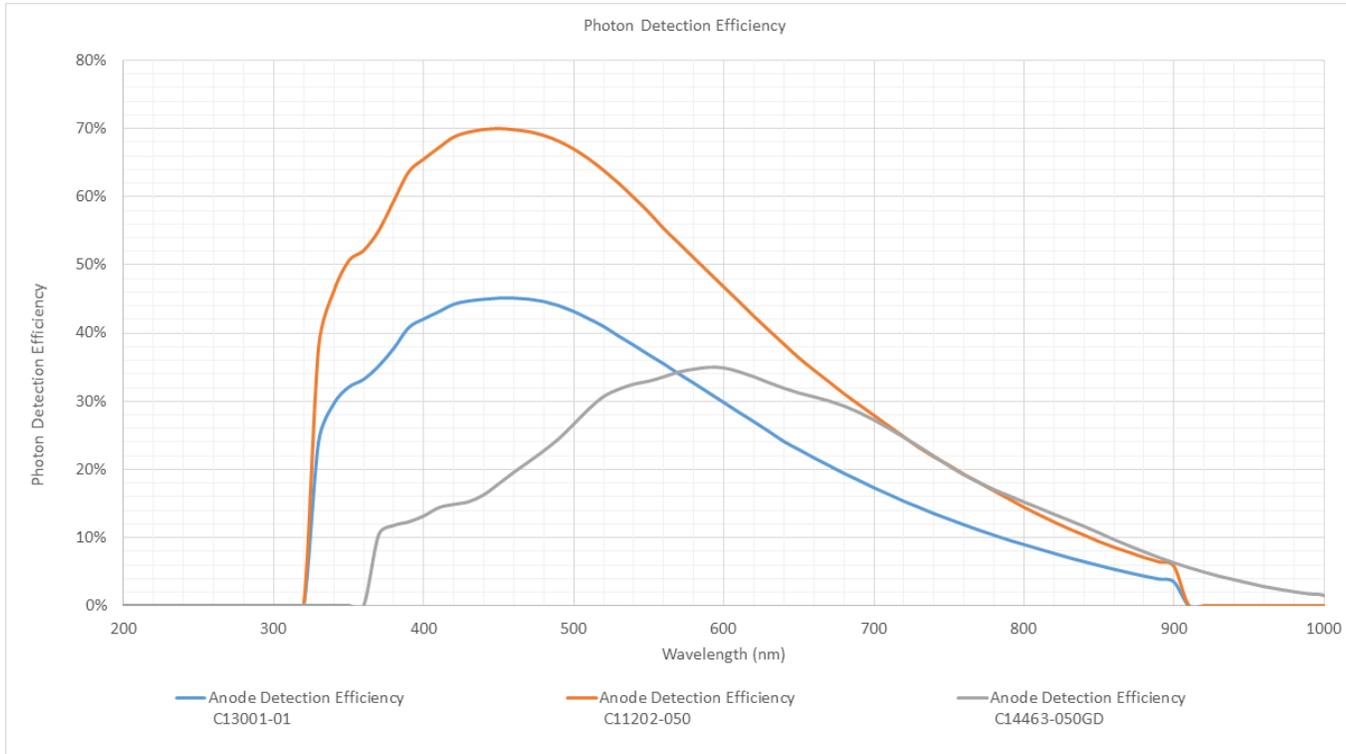
## > Spectral response



\* For the wavelength band between 1350 and 1400 nm on the -08 type, the reflectance degrades about 5% due to the absorption by the glass substrate.



# SPAD Modules

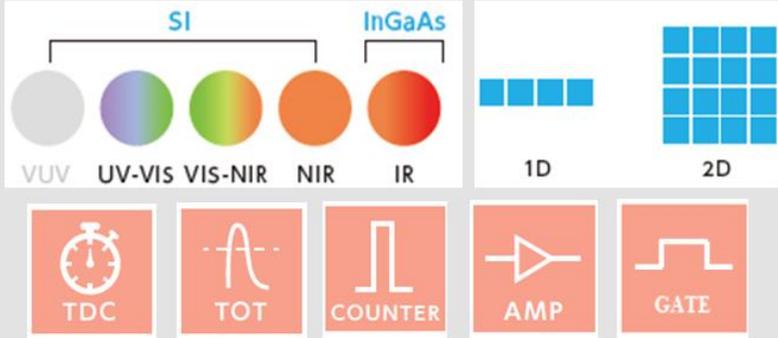


## Features of SPAD Module

- Low Dark Counts as low as 7 cps (Typical)
- Short Lead time

# 1D & 2D SPAD Arrays

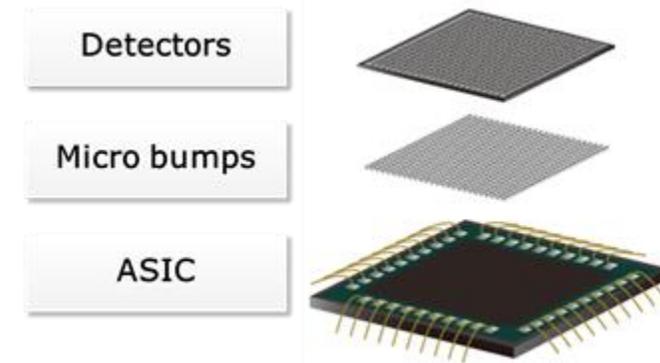
New

	Hybrid Structure (HPK)	Monolithic Structure (Other companies)
<b>Design flexibility</b>	<ul style="list-style-type: none"> <li>Optimum combination of detectors and ASICs</li> </ul> 	<ul style="list-style-type: none"> <li>Combination of detector and ASIC is fixed</li> <li>Detector (wavelength) is restricted by CMOS process</li> </ul>
<b>Sensitivity</b>	High	Low

## Features of Bump Bonded Structure

- High Fill Factor
- High Quantum Efficiency

Hamamatsu is offering SPAD arrays with customized electronics and ASICs. Please contact us about customized options.



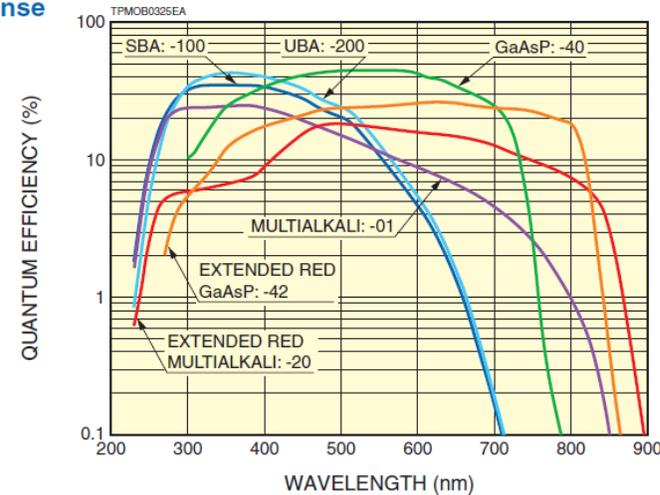
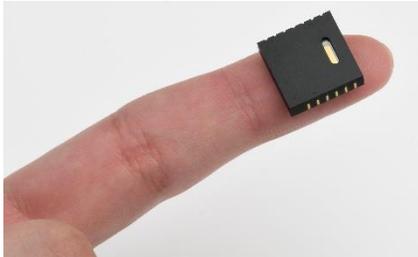
# PMTs & PMT Modules

We offer a large selection of PMTs, photon counting PMT modules, and multianode PMTs.

Contact us to select which PMT would work for you! ■ Spectral response

## Micro PMT

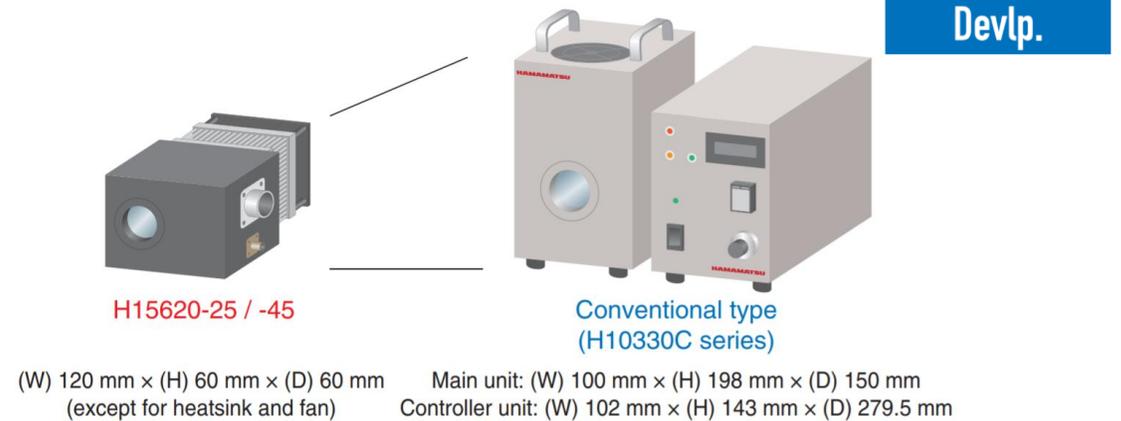
World's smallest, thinnest and lightest PMT developed by taking advantage of our unique advanced technologies in MEMS.



## For NIR Detection

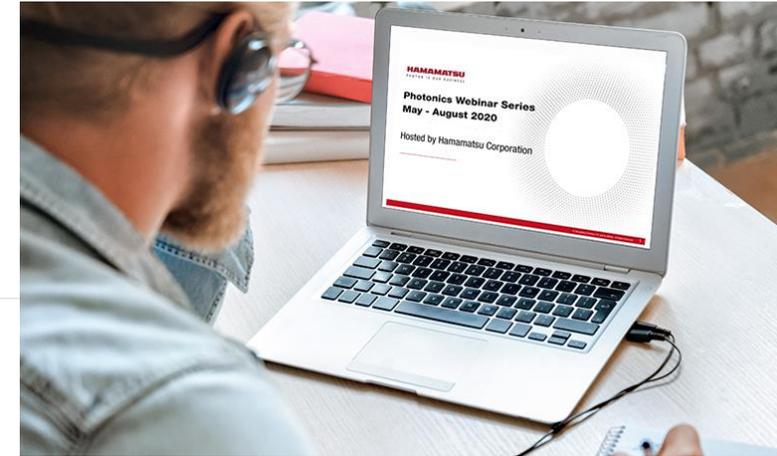
We do currently offer R5509-73, H10330C-25/-45/-75, H7422-61 H15620-25/-45 (In Development)

- Compact Photosensor Modules (InP/InGaAsP Photocathode)
- Spectral Response: 950nm -1400nm
- Low Noise



# Hamamatsu Photonics Webinar Series

Keep up with photonic technologies while social distancing.  
Check it out on our [website!](#)



## Week #8 (week of July 20th) - Image sensors and cameras

July 21st, Tuesday at 1 PM: [Challenge of circuitry to a successful image sensor implementation](#), presenter Lu Cheng.

July 23rd, Thursday at 1 PM: [Do dim things: why low light imaging capabilities enable advances in research and medicine](#), presenter Stephanie Fullerton.

## Week #10 (week of August 10th) - MPPC/SPAD

August 11th, Tuesday at 1 PM: [MPPC & SPAD: future of photon counting detectors](#), presenter Slawomir Piatek.

## Week #11 (week of August 17th) - SNR Simulation

August 18th, Tuesday at 1 PM: [Using SNR simulation to select a photodetector](#), presenter Dino Butron.

Thank you for your attention!

Please contact Hamamatsu for more specifications and details.  
Feel free to contact me at [kdhimitri@hamamatsu.com](mailto:kdhimitri@hamamatsu.com)