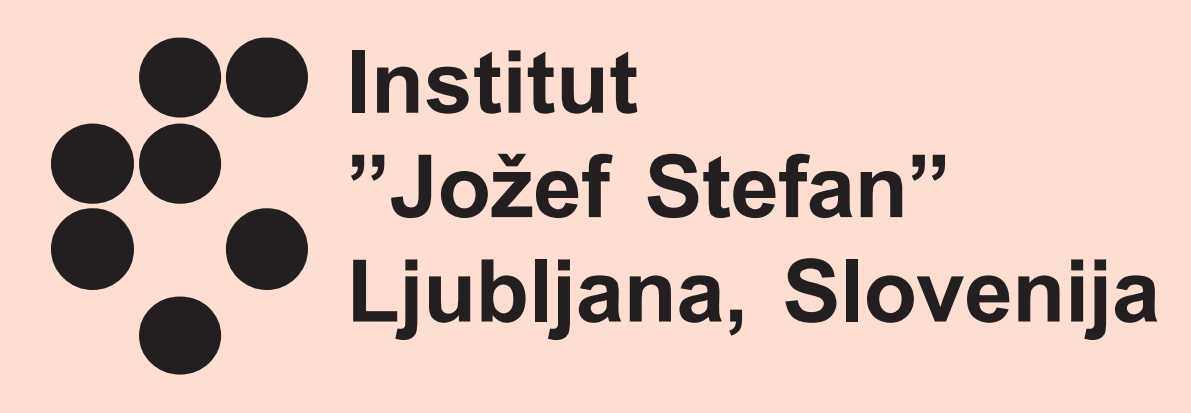


# Studies for the Upgrade of Belle II Aerogel RICH

Shunsuke KUROKAWA (Tokyo Metropolitan University)

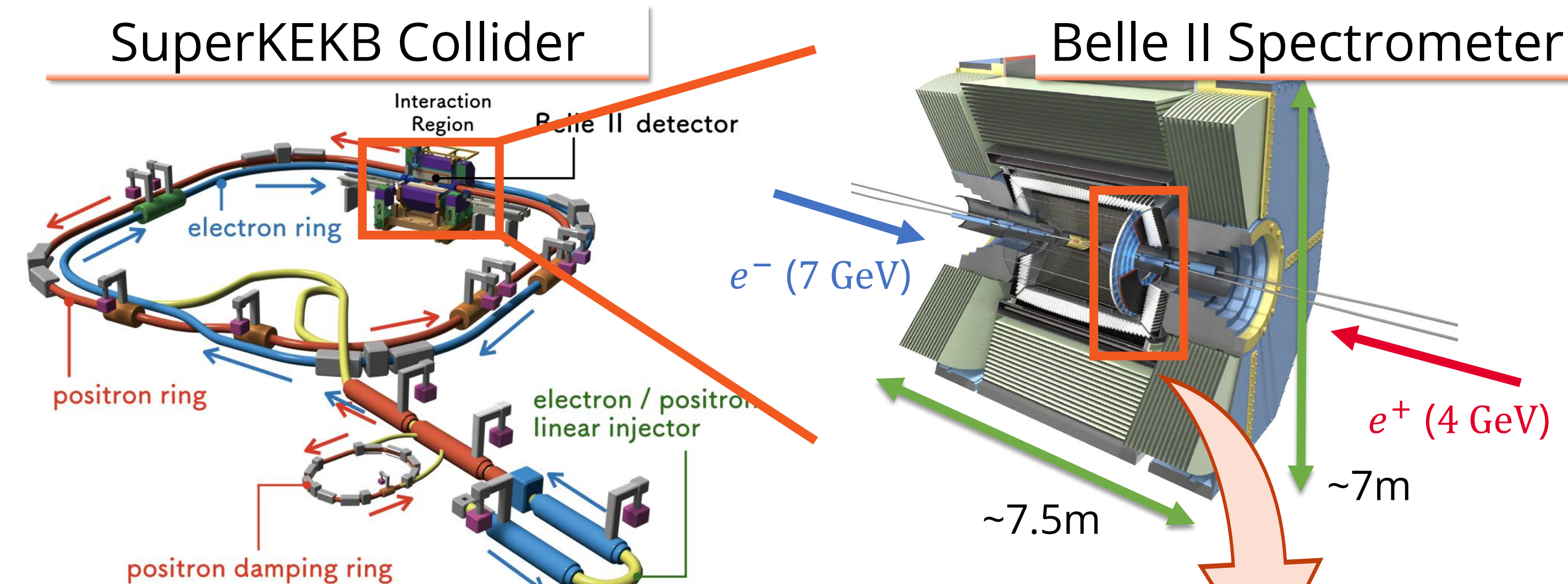
Hidekazu KAKUNO (TMU), Shohei NISHIDA (KEK),

Samo KORPAR (IJS), for the Belle II ARICH Group



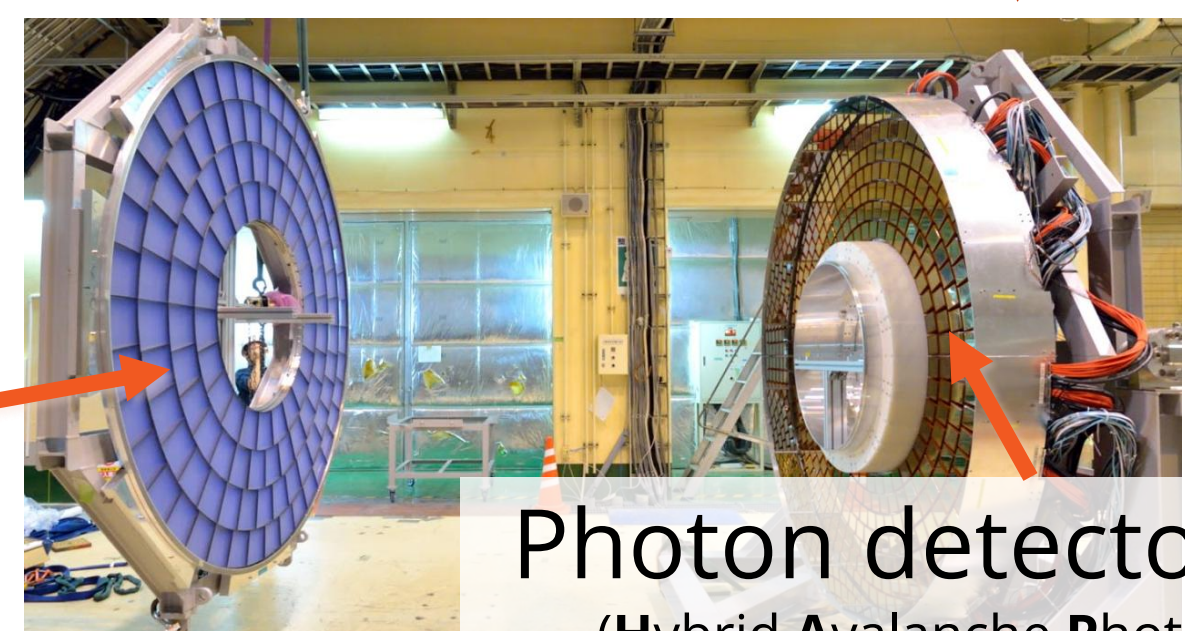
## 1. The Belle II Experiment

- Flavor physics experiment for the BSM searches @KEK



- Particle identification** takes an important role

Endcap PID : **Aerogel RICH**  
(ARICH, Aerogel Ring Imaging Cherenkov Counter)

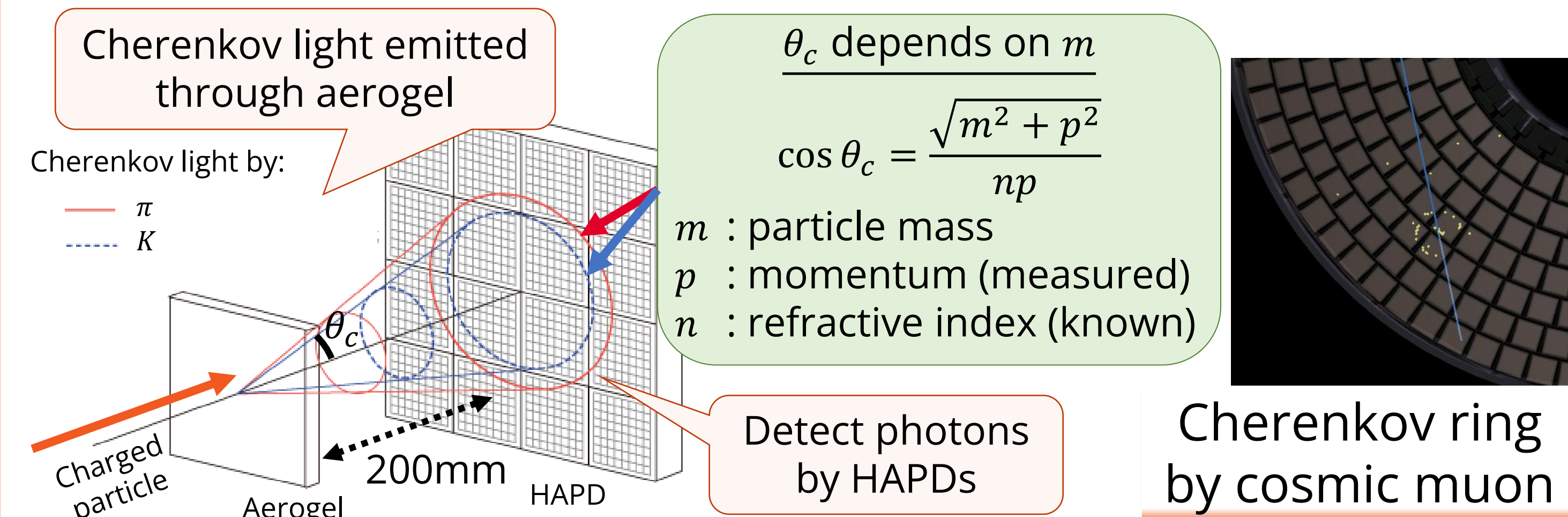


Aerogel radiator

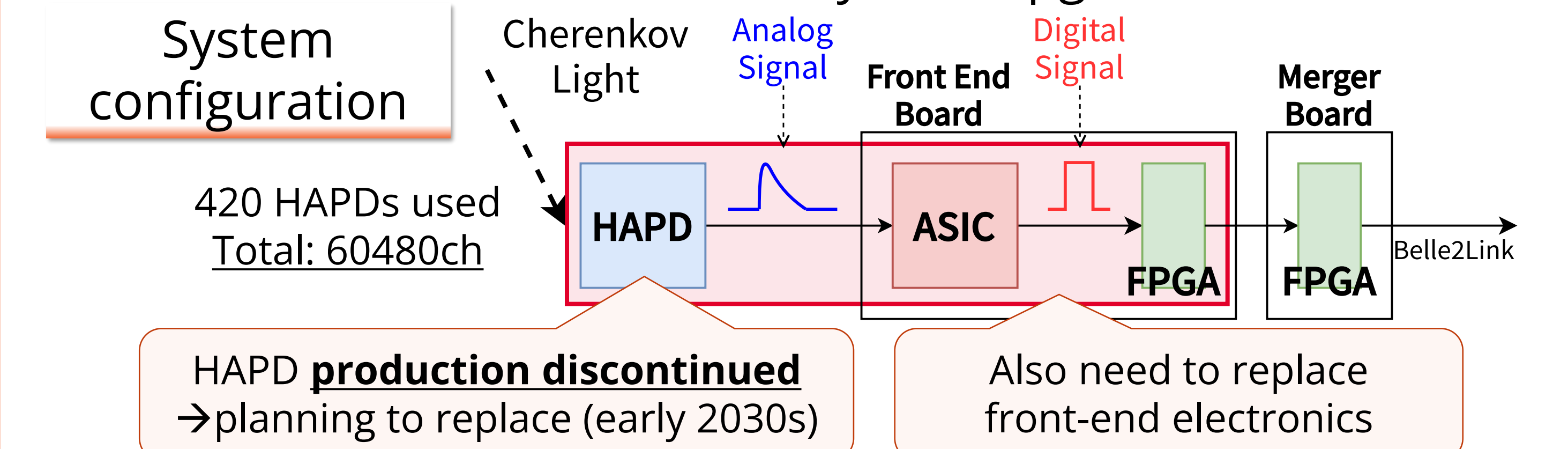
(A photo taken during construction)

## 2. ARICH Counter and Its Upgrade Plan

- Identify charged  $K, \pi \rightarrow$  Single photon detection required



- Photon detector and readout system upgrade



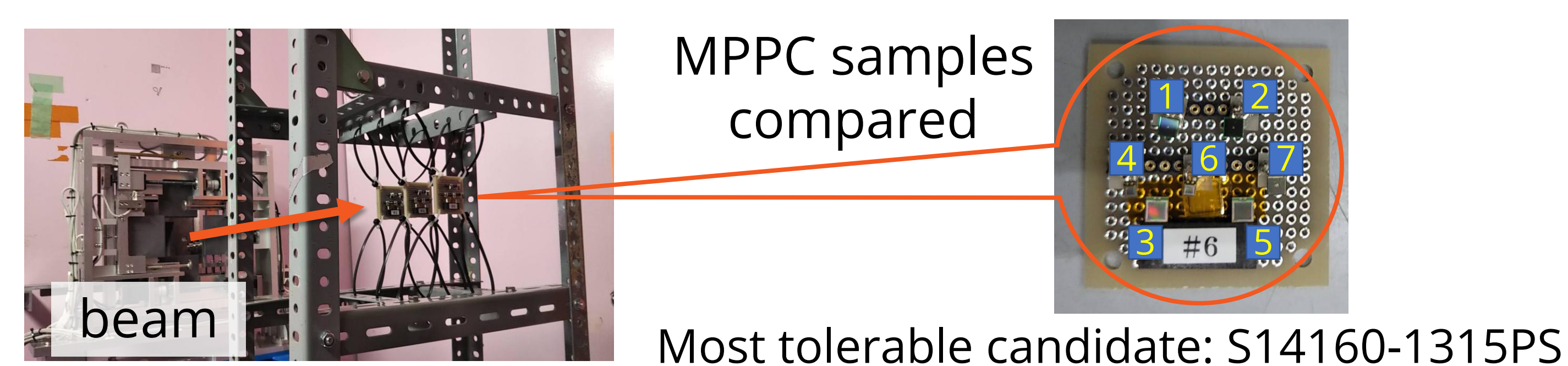
Photon detector candidates			
HAPD	MPPC	LAPPD	
~7cm	HAMAMATSU (S13361-3075AE)	INCOM	~20cm
144ch	3cm		
	+	- Low operation voltage	- Low dark count rate
		- PDE improvement	- Tolerant of neutron irradiation
	-	- High dark count rate	- Hardly fit in a circular sector
		- Requires countermeasure for neutron damage	
Status	Readout development	Under performance evaluation	

Planning **beam tests** using prototype ARICH systems to evaluate these candidates & readout electronics

## 3. MPPC Performance Evaluation

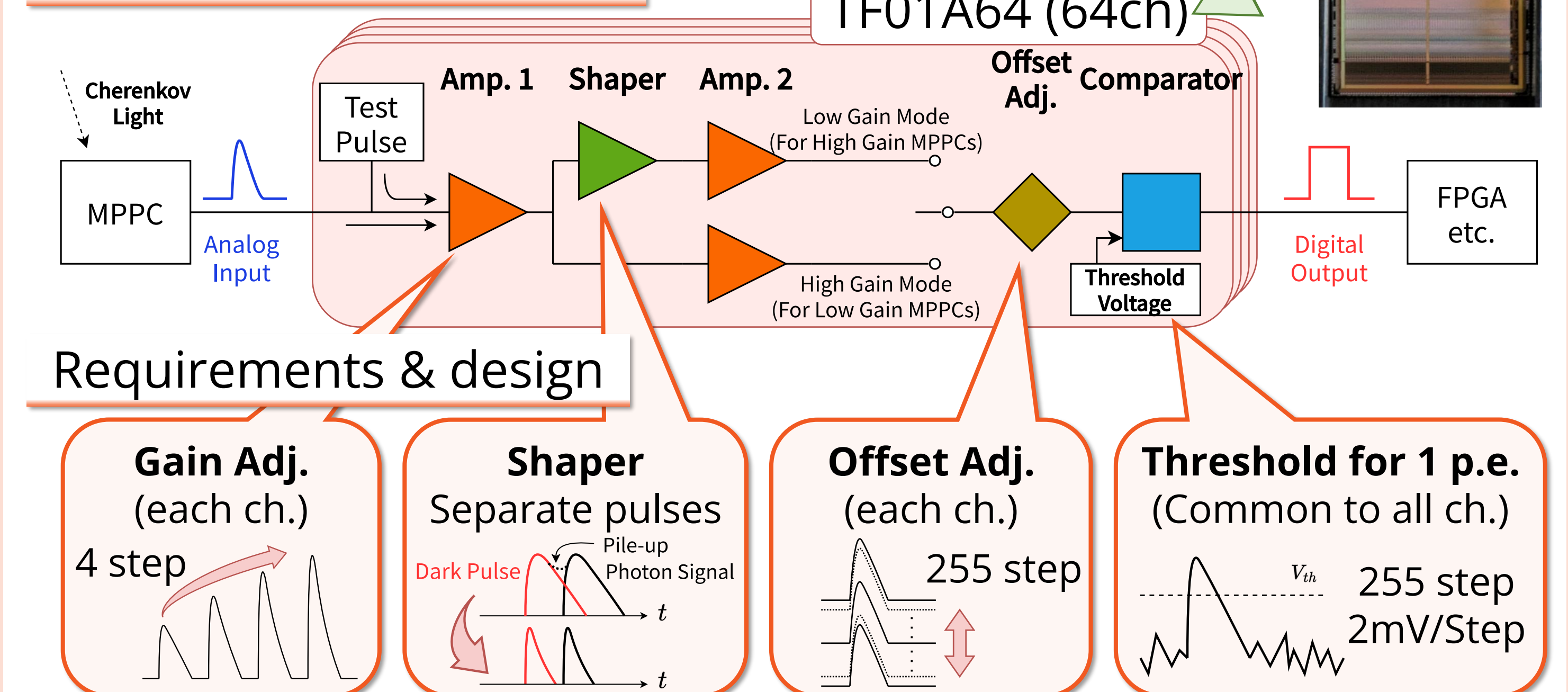
- Possible countermeasures for neutron damage
  - Cooling during operation
  - Annealing (170°C, 144h)
- Evaluation in progress: side effect by annealing on photon detection efficiency

Neutron irradiation test @ J-PARC MLF (2020)

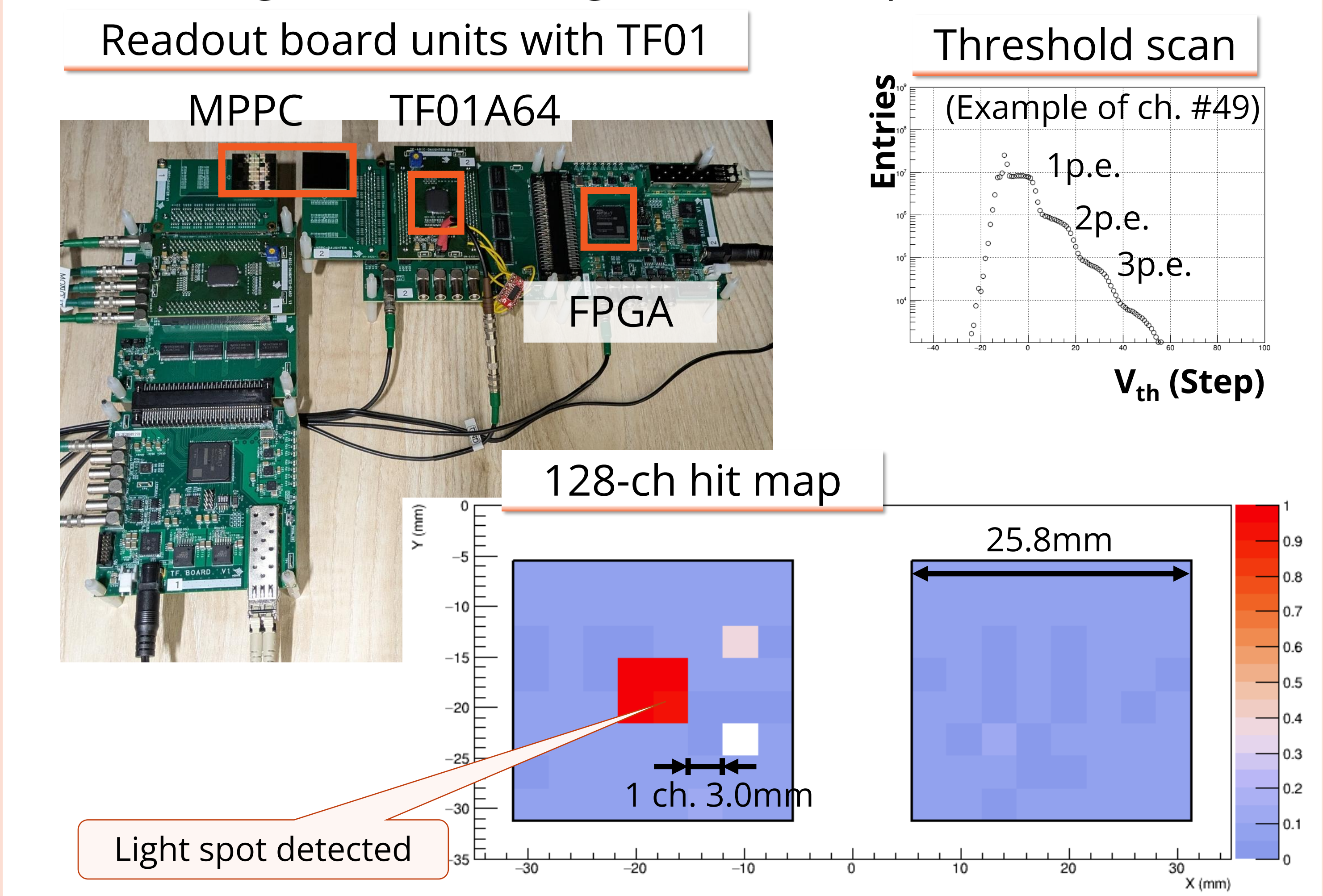


## 4. New MPPC Readout System Development

- Custom ASIC "TF01A64" developed for MPPC readout ASIC system (prototype)



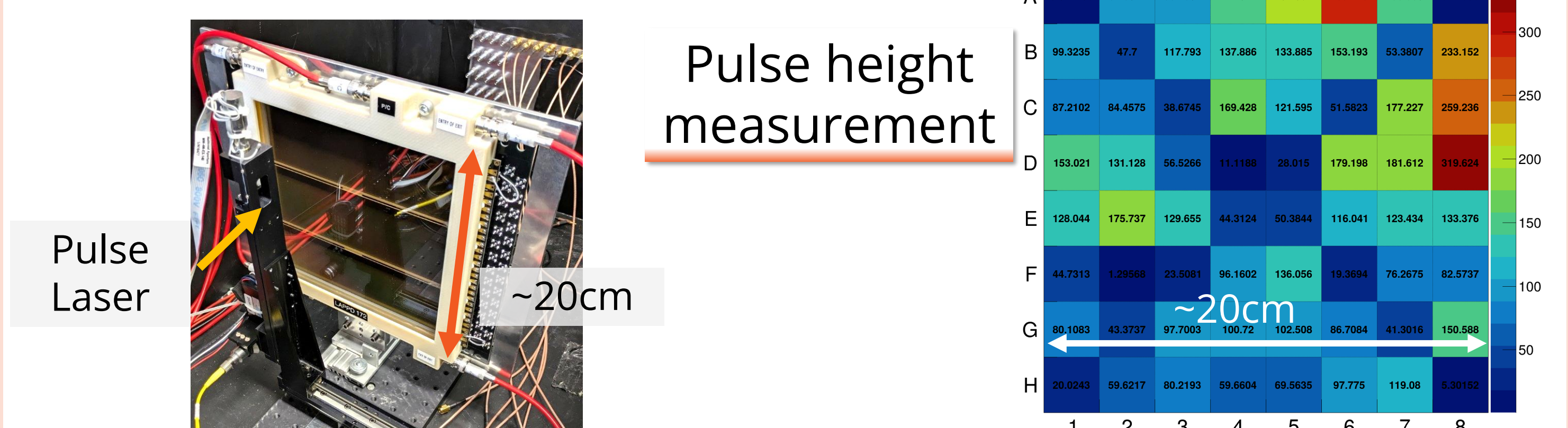
- Developed readout system with TF01 towards beam test
  - Working with TF01A64 & compatible with 64-ch array-MPPC
  - Confirmed detection of the light spot by pulse laser
  - Planning beam test using four units (in production)



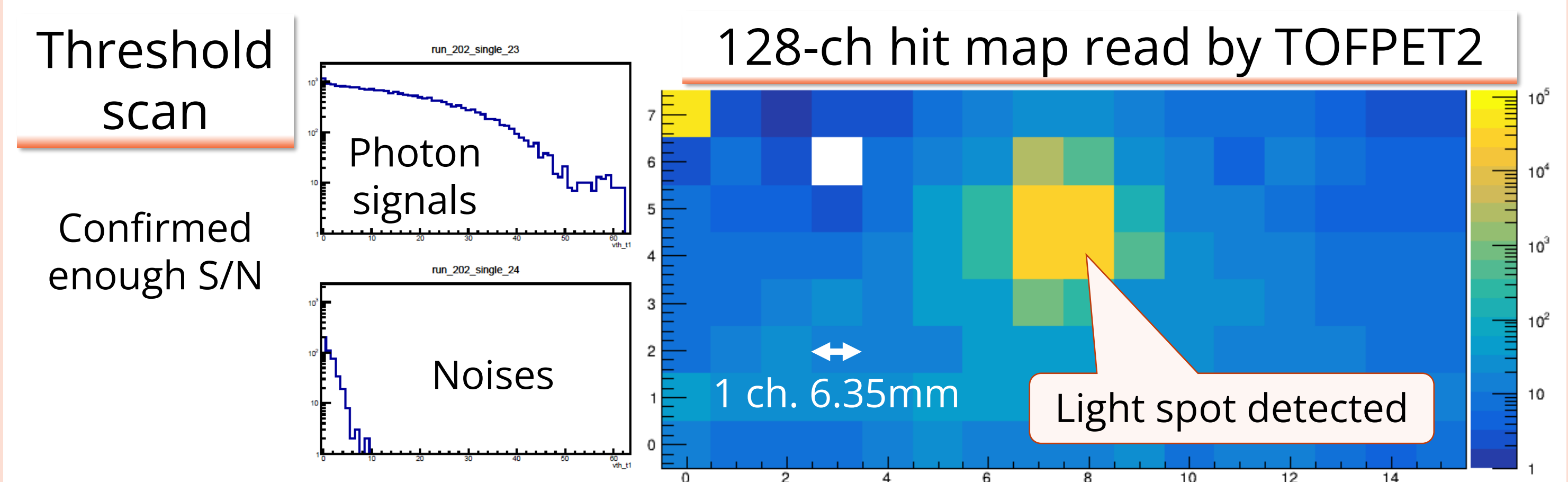
## 6. Evaluation of LAPPD & TOFPET2 ASIC

Dedicated talk: "Characterisation of LAPPD" by Rok Dolenc (Sep 18)

- Confirmed the uniformity of gain for whole sensitive area
  - Enough pulse height for single photon detection
  - Sensitive area ~92% (>HAPD)



- Readout by frontend system using TOFPET2 ASIC<sup>[1]</sup> by PETSys evaluated to be used in beam test



[1] doi: 10.1088/1748-0221/14/03/P03029

## 7. Summary and Plan

- Evaluation of photodetectors and readout systems in progress
- Both readout systems for MPPC/LAPPD seem to be **suitable for beam tests**, being planned in early 2026.