

EIC activities in Korea

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EIC-ASIA group meeting

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Experimental background Korean nuclear physics society



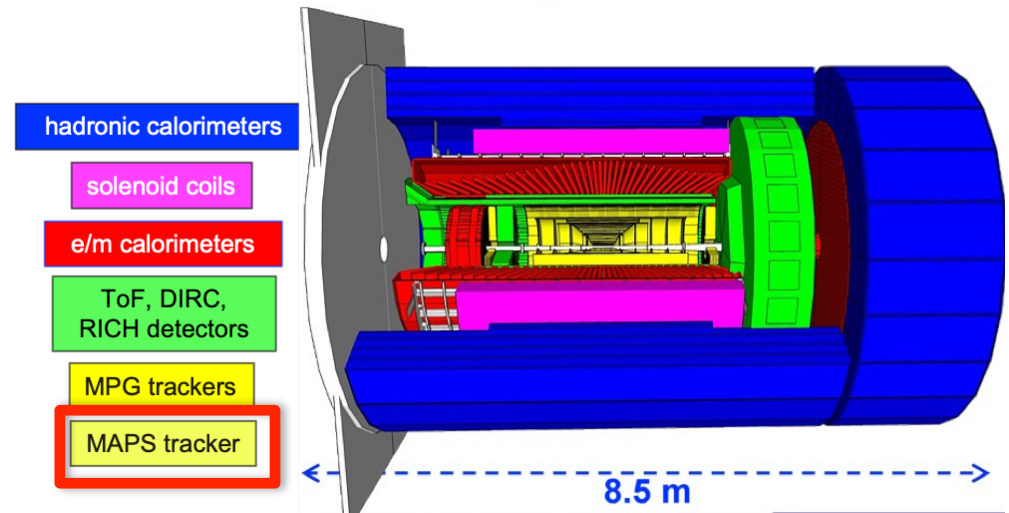
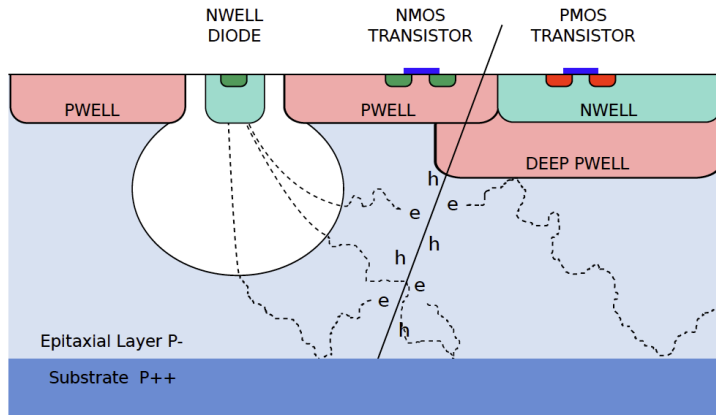
- * ~10 groups are potential participants for EIC
- * They are mostly involved for HI experiments at RHIC, LHC, and JLab experiments
- * Some high energy researchers are also interested in EIC in terms of detector R&D

Expression of Interest to EICUG

back in 2021

Group	Devoted to	Institutions	Faculties
A	Forward Calorimeter	Korea University	Byungsik Hong Jung Keun Ahn
		Sejong University	Yongsun Kim
		Chonnam National University	Dongho Moon
B	Pixel Tracker	Jeonbuk National University	Eun-Joo Kim
		Pusan National University	Sanghoon Lim
		Yonsei University	Youngil Kwon
		Inha University	Minjung Kweon
C	Dual-Readout Calorimeter	Kyungpook National University	Hyon-Suk Jo Sehwook Lee
		University of Seoul	Jason Lee
		Yonsei University	Hwidong Yoo

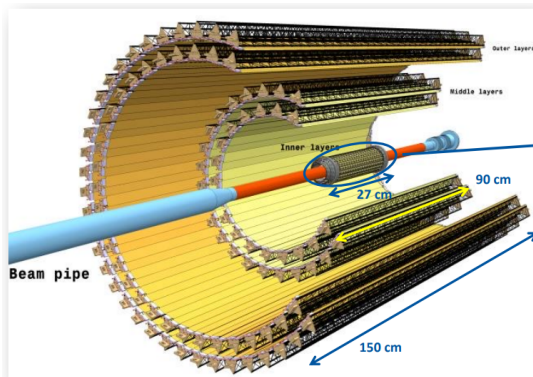
1. Silicon vertex tracker



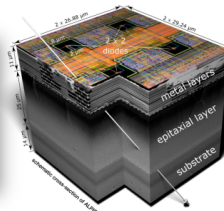
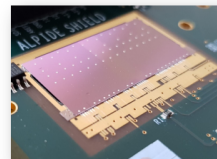
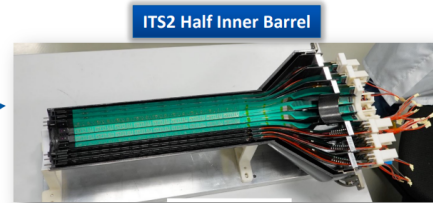
- Precise tracking and vertexing
- MAPS based silicon (STAR HFT, ALICE ITS2, sPHENIX MVTX)
- R&D for the EIC detector is in parallel with R&D for ALICE ITS3
- KoALICE group - PNU, Yonsei U., JNU
- Particularly interested in endcap disks for EIC
 - Seeking for funds for production of stitched sensor
 - Candidate foundry: TowerJazz (Israel)

1. Silicon vertex tracker

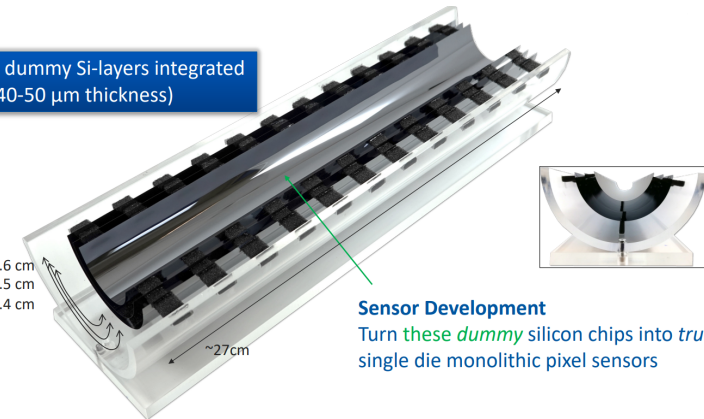
Involvement in post-processing for ALICE ITS2, ITS3



~12.5 Gpixels, 10 m² sensitive area
24120 ALPIDE Pixel Sensors (CMOS 180 nm)



3 dummy Si-layers integrated
(40-50 μm thickness)



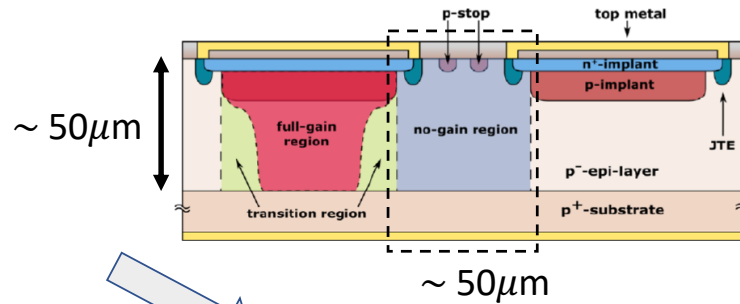
Sensor Development
Turn these *dummy* silicon chips into *true* single die monolithic pixel sensors

- Thinning & Dicing by a Korean company FUREX
- Mass production test
 - probe-card (NOTICE/EQENG), Automatic test equipment (C-On)
- Module assembly
 - Wire-bonding by a Korean company Sejung
- Also participating in ITS3 design team

2. LGAD (low gain avalanche detector)

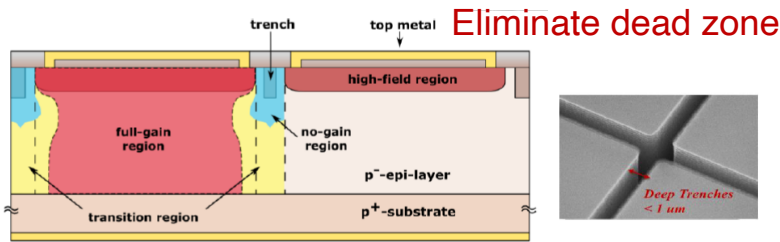
Standard LGADs at HL-LHC

- **Pixel: 1.3x1.3 mm²**
- $\sim 50 \mu\text{m}$ intrapad dead zone

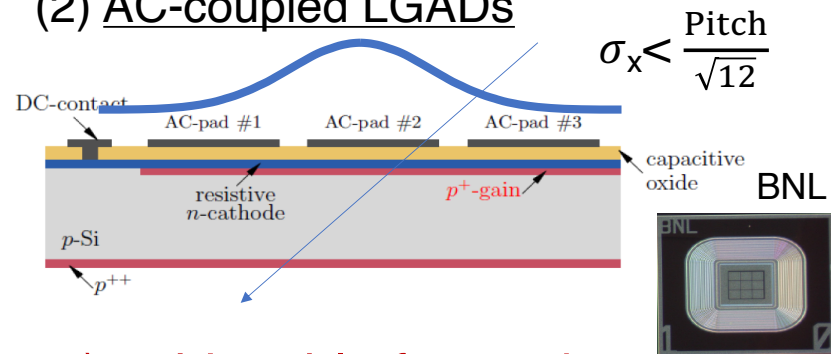


W. Lie

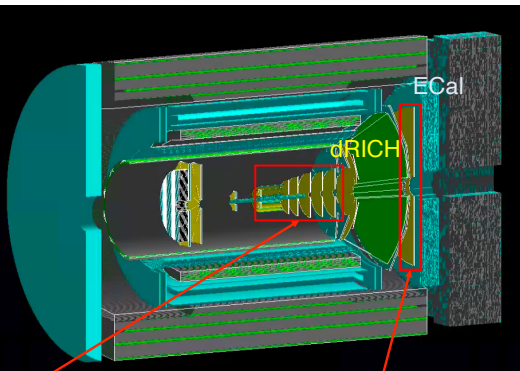
(1) Trench-Isolated (TI) LGADs



(2) AC-coupled LGADs



Fine pixelization ($\sim 100\text{-}200 \mu\text{m}$) achievable for tracker



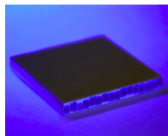
- Fast timing silicon detectors for EIC tracking system
- Key element for particle PID

2. KCMS contribution for LGAD in CMS

LGADs at the HL-LHC (2028)

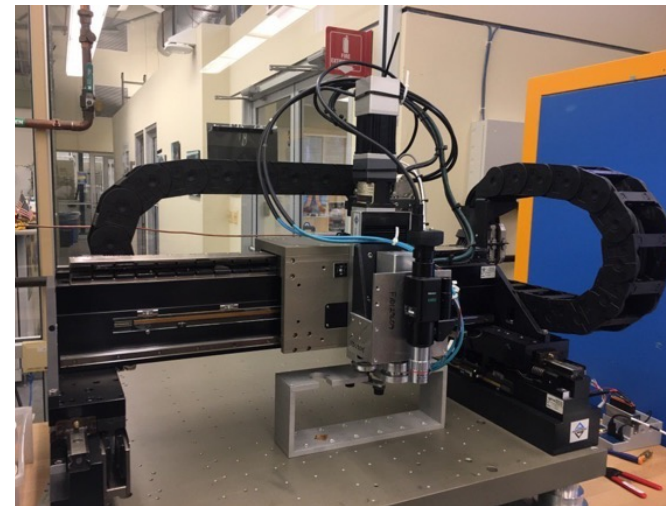
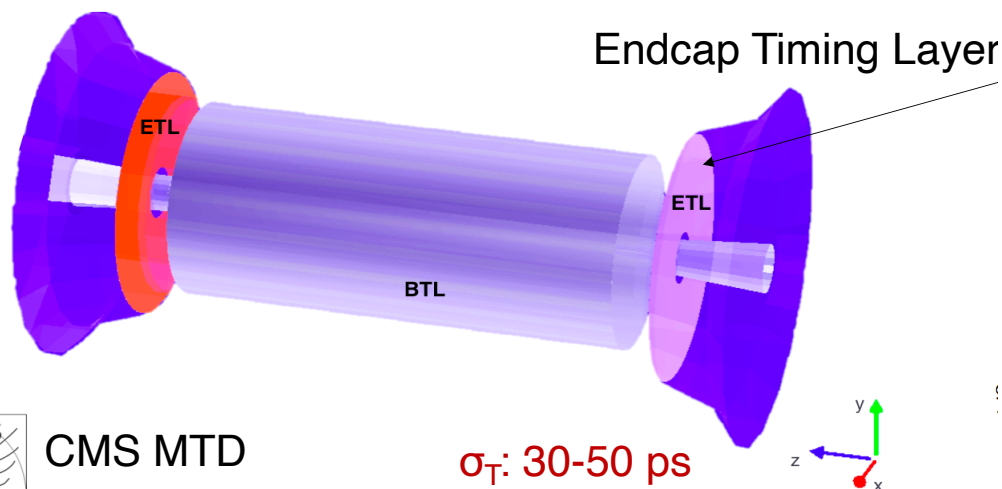
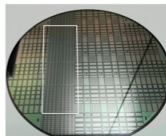
BTL: LYSO bars + SiPM readout:

- TK / ECAL interface: $|\eta| < 1.45$
- Inner radius: 1148 mm (40 mm thick)
- Length: ± 2.6 m along z
- Surface ~ 38 m²; 332k channels
- Fluence at 4 ab⁻¹: 2×10^{14} n_{eq}/cm²



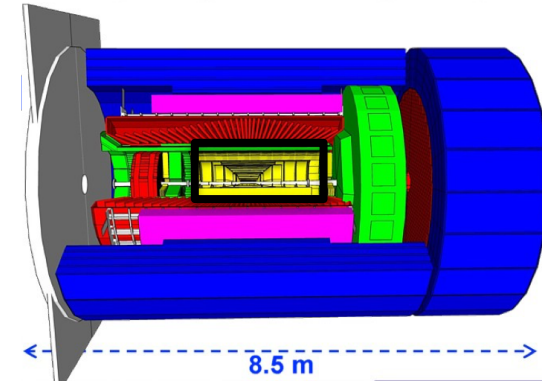
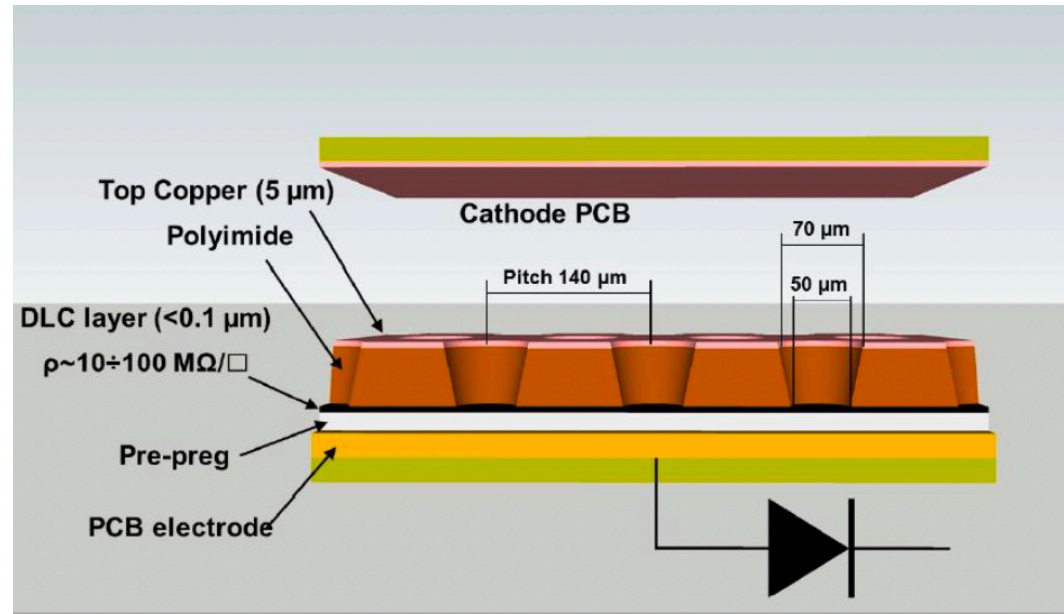
ETL: Si with internal gain (LGAD):

- On the CE nose: $1.6 < |\eta| < 3.0$
- Radius: $315 < R < 1200$ mm
- Position in z: ± 3.0 m (45 mm thick)
- Surface ~ 14 m²; ~ 8.5 M channels
- Fluence at 4 ab⁻¹: up to 2×10^{15} n_{eq}/cm²



- Endcap layers for CMS MIP Timing Detector (MTD) to be made of LGAD
- KCMS groups - KNU, CNU, KU - are actively involved
 - Prototype assembly, sensor tests with beams and lasers
- A huge synergy can be expected by collaboration with Asian groups
 - Open with various kinds of collaboration
 - Will be great to draw attention from Korean high energy people

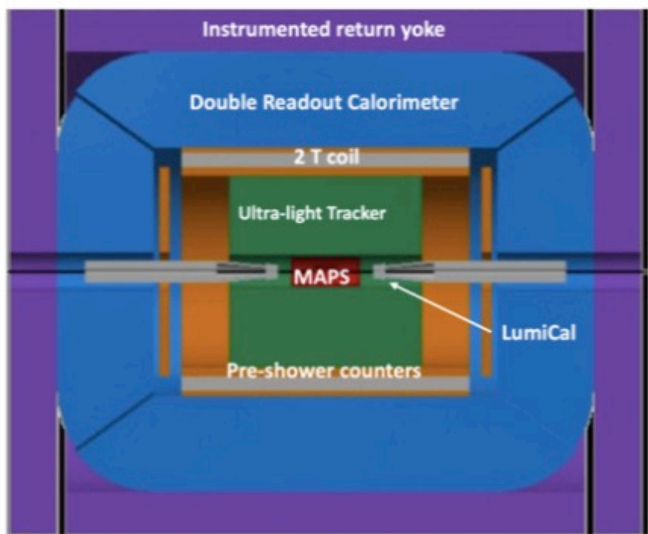
3. μ RWELL (MPPGD)



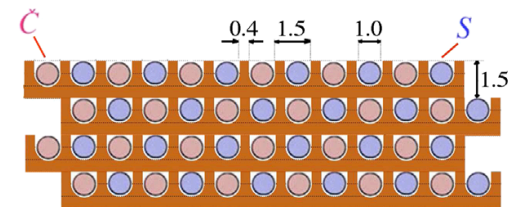
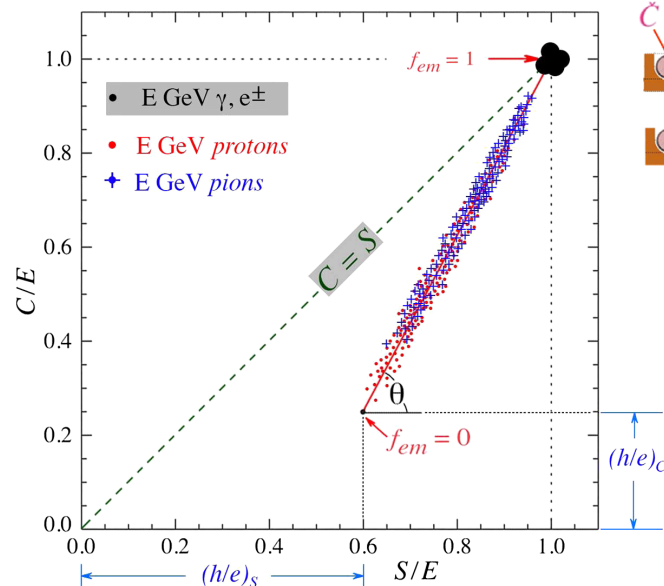
- Used for charged particle tracking
- Operating principle is combination of GEM and RPC, both of which are the world best expertise of Korean groups
- The infrastructure of KCMS is the great opportunity for mass production of MPPGD
- Possible to produce prototypes late this year
- Seoul Nat'l Univ., Hanyang Univ.

4. Dual Readout Calorimeter

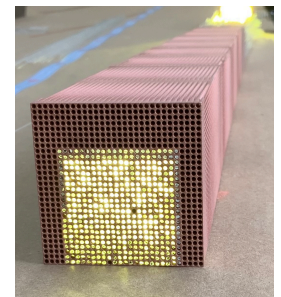
- Cherenkov and scintillation fibers combined in **dual**
 - offers high-quality energy measurement for **both EM particles and hadrons**
- Proposed for FCC and CEPC
- KNU, Yonsei U. PNU
- Candidate for both barrel and forward calorimeters
- Ongoing collaboration with Argonne lab to apply dual readout for Imaging Barrel Electromagnetic Calorimeter



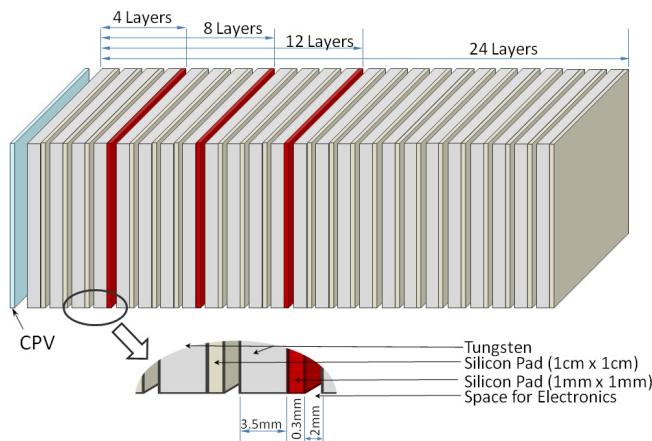
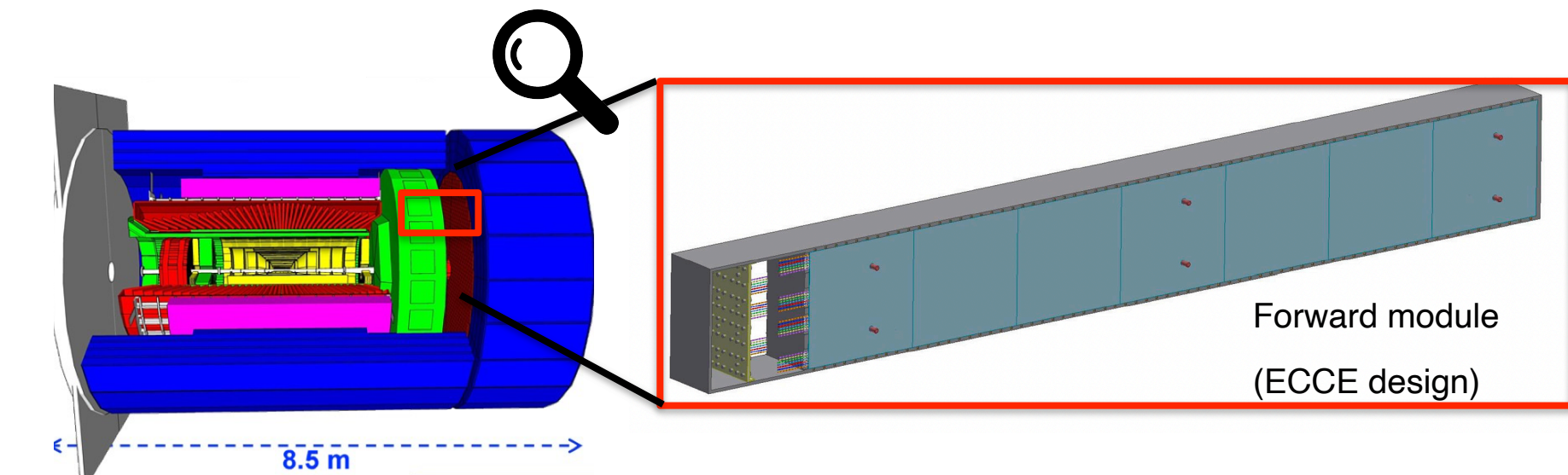
IDEA



Fiber pattern RD52



5. Readout for EMCal



(Ref.) ALICE FoCal

- Adaptation of CMS HGCROC for EIC EMCal
- Development of PIN type HGCROC v3
- Similar attempts ongoing with ALICE FoCal
- Korea Univ., Sejong Univ., Yonsei Univ.
- Caveat: manpower largely overlaps with MVTX project

Summary

- **Five subgroups interested in detector R&D**
 - LAGD
 - μ RWELL micro pattern gas detector
 - Dual readout calorimetry for imaging barrel calorimeter
 - Silicon pixel tracker for electron endcap disk
 - electronics for FoCal
- To realize the EoI, we are...
 - Seeking for substantial funding for long-term R&D and significant contribution for EIC detector construction
 - Initiating discussion in the nuclear physics division of KPS for the coordination of EIC participation and for the inflow of new manpower