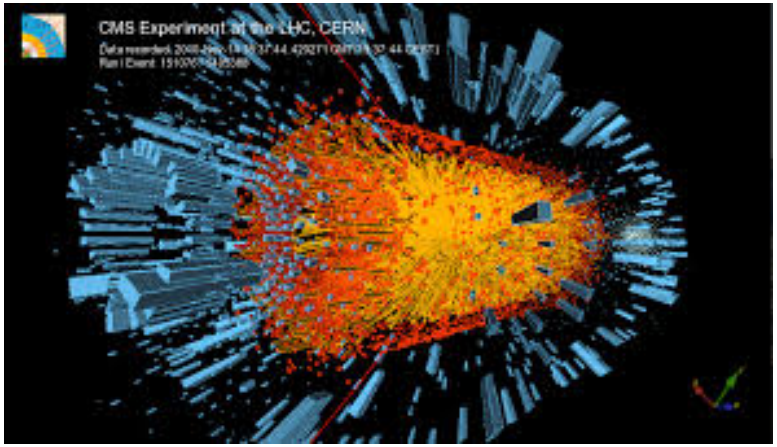

# Korean activity for hardware developments

Yongsun Kim
(Sejong Univ.)

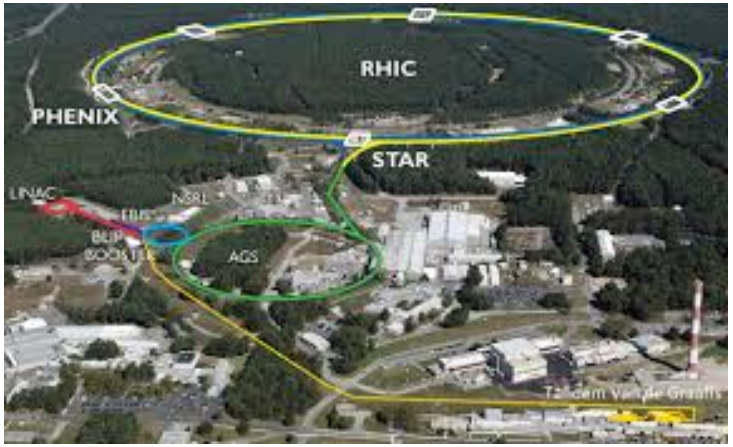
RHICf-RHICf2 collaboration meeting
2022.01.28

# Experimental background Korean nuclear physics groups

CMS, ALICE

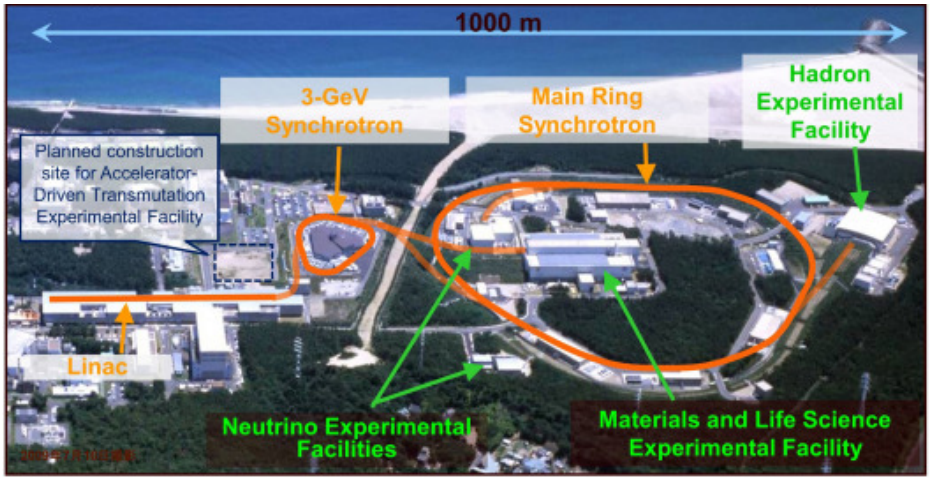



PHENIX, sPHENIX, RHICf




JLab

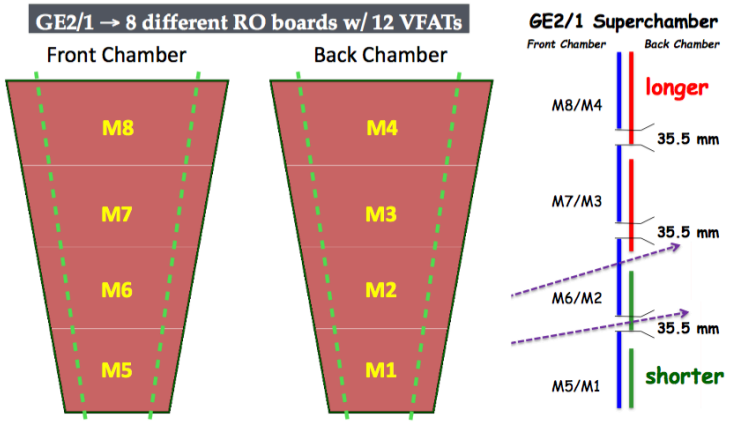

J-PARC



# Ongoing hardware works for international collaboration

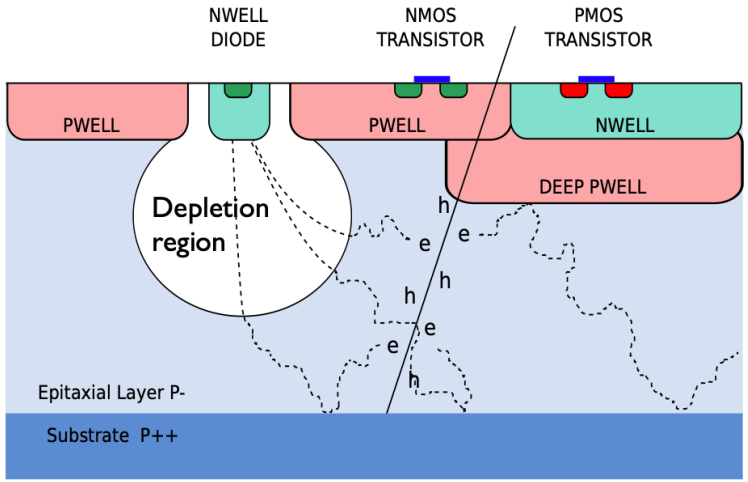
## RPC gap production

- A longstanding hardware activity from 1990s for CMS muon chamber
- Korea Univ.




## GEM foil

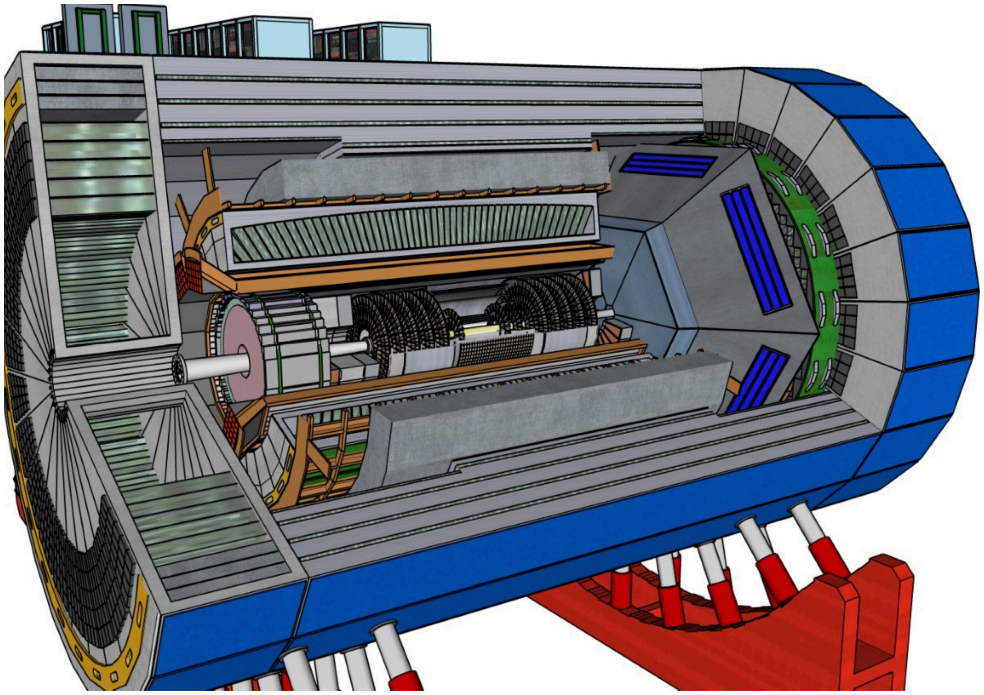
- R&D since 2014 for CMS phase-2 upgrade
- Ko-CMS groups: Univ. of Seoul, Seoul Natl' Univ.




## MAPS upgrade for ALICE ITS

- R&D for Pixel chip design and beam test
- Ko-ALICE groups: Inha Univ., Yonsei Univ., Pusan Natl. Univ.

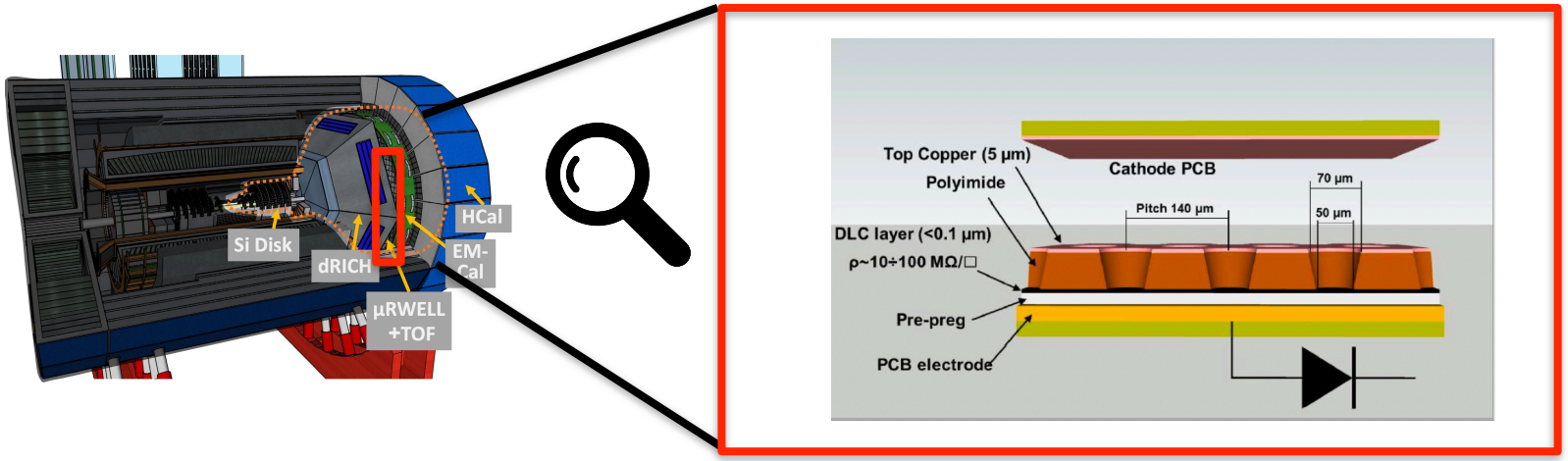
# Participation in ECCE consortium




- **E**IC **C**omprehensive **C**hromodynamics **E**xperiment [ecce-eic.org](ecce-eic.org)
- 15 faculties from 10 Korean institutes submitted EoI to ECCE
  - BusanNU, ChonnamNU, InhaU, JeonbukNU, KoreaU, KyungpookNU, SejongU, SeoulNU, USeoul, YonseiU,

# Potential contribution from Korea

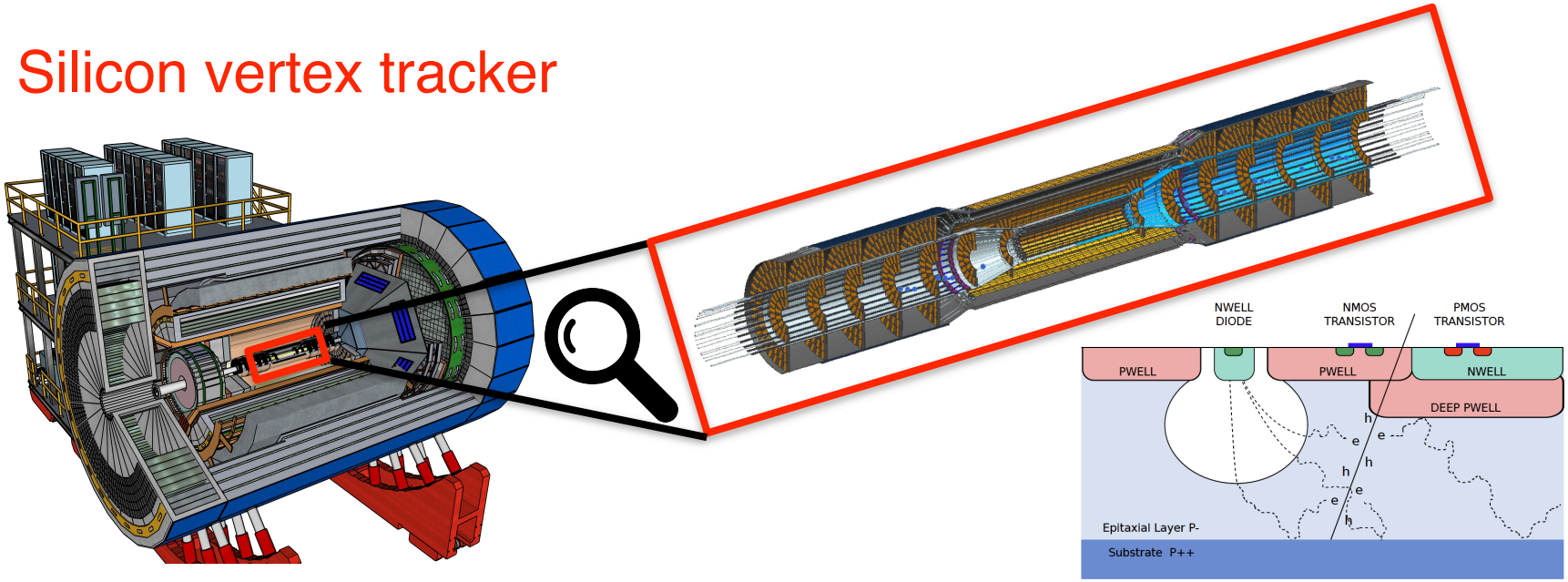
## 1. $\mu$RWELL micro pattern gas detector (MGPD)




- Part of forward trackers
- Operating principle is combination of GEM and RPC, both of which are the expertise of Korean groups
- Given infrastructure of KCMS provides a great opportunity for mass production of MGPD -> great interest by ECCE consortium
- Seoul National University, University of Seoul

# Potential contribution from Korea

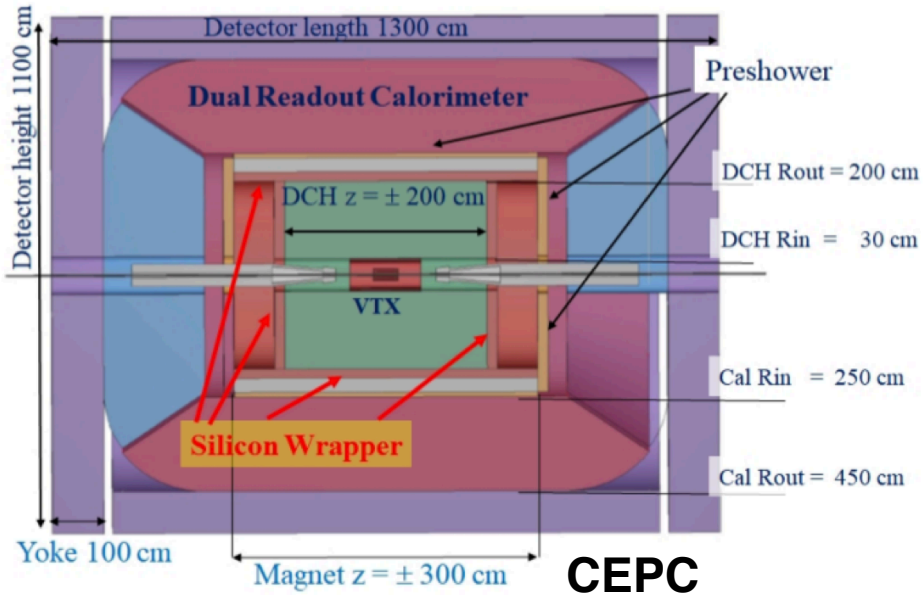
## 2. Silicon vertex tracker



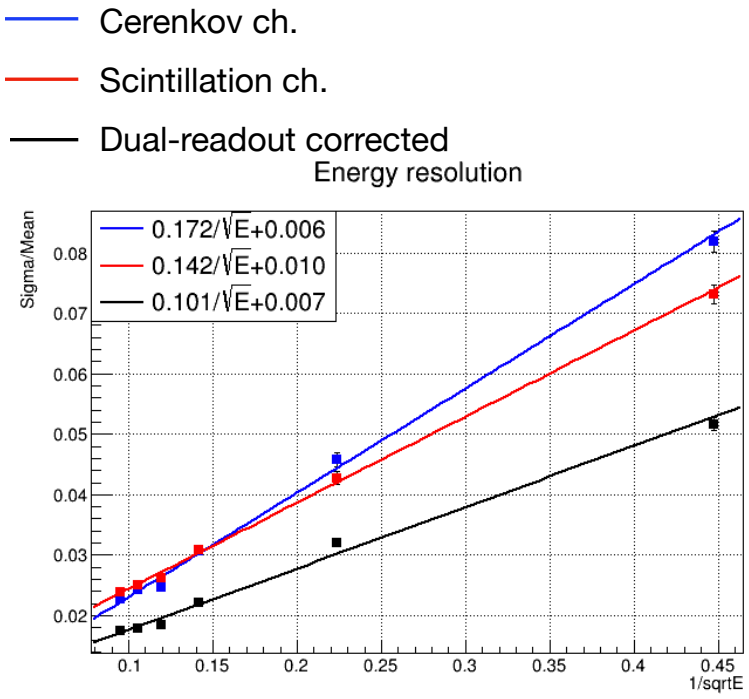

- MAPS based silicon used for STAR HFT, ALICE ITS2, sPHENIX MVTX
- Inha$^{U}$, Pusan$^{NU}$, Yonsei$^{U}$, Jeonbuk$^{NU}$, Sungkyunkwan$^{U}$ (Ko-ALICE)
- Mass chip & wafer probing test, and readout module assembly are availlable
- Wafer thinning/dicing process, chip pick-and-place, and wire bonding are carried out by local companies (FUREX and MEMSPACK)

# Potential contribution from Korea

## 3. Daul Reaout Calorimeter



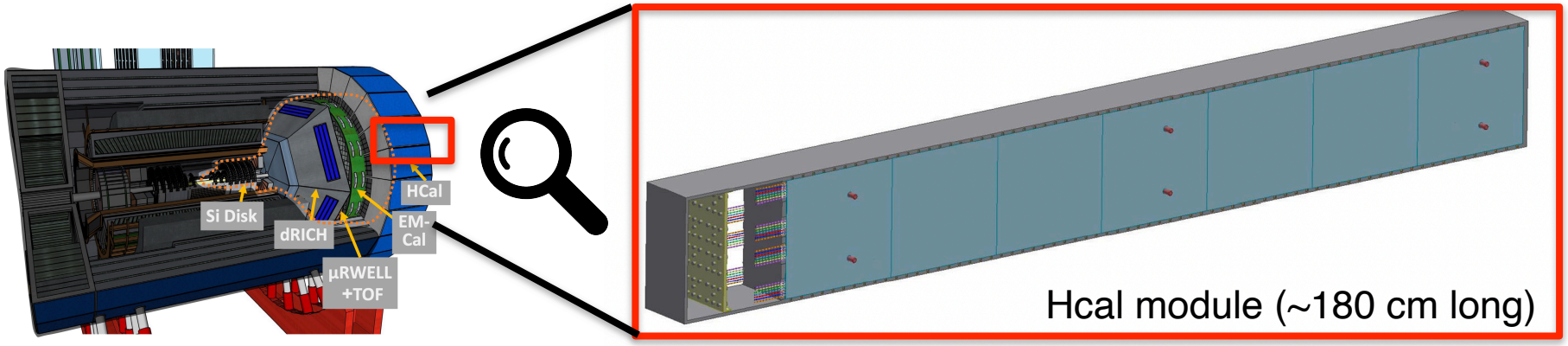

**CEPC**

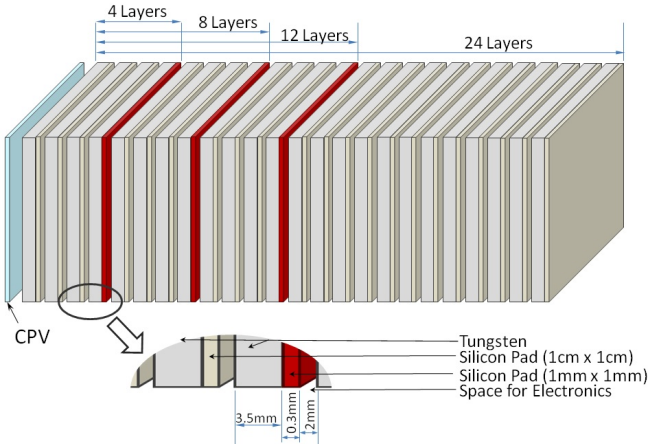



- Combines Cherenkov and scintillation fibers in HCal
- R&D initiated by CERN RD52 for CEPC and FCC-ee
- Proposed for the upgrade plan of ECCE
- Kyungpook Nat'l,, Pusan Nat'l, Sejong, Yonsei University

# Potential contribution from Korea

## 4. FEMC:Hadron End-Cap Electro-magnetic Calorimeter

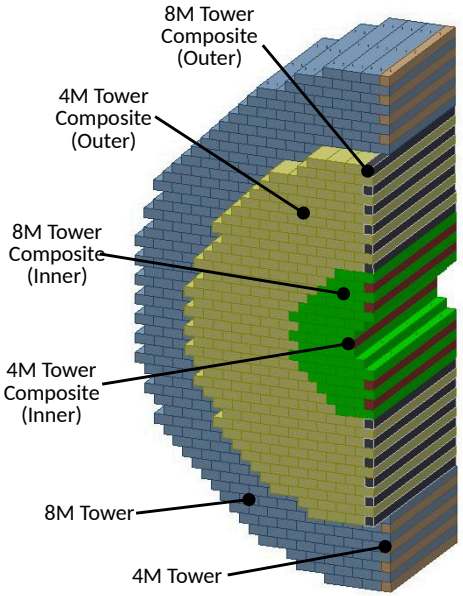


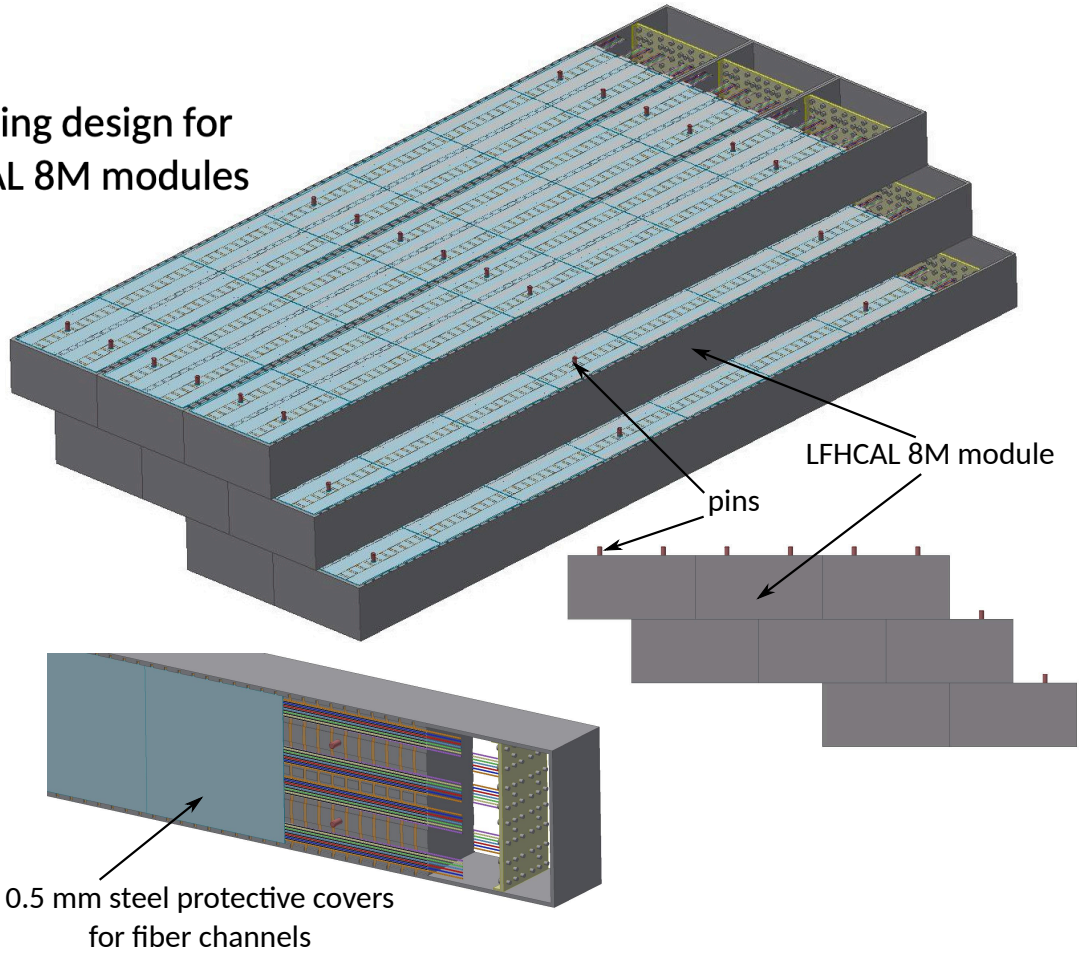

(Ref.) ALICE FoCal

- Measure longitudinal profile of EM shower to enhance e/$\gamma$/$\pi^0$ separation in forward region
  - $\Delta z$ = 37 cm, 20 < r < 183 cm, $1.24 < |\eta| < 3.5$
- Similar technique with ALICE FoCal
- Korea Univ., Sejong Univ.
- Seeking for collaboration with EIC-Japan groups

# FEMC (Hadron End-cap EMCal)




| | |
|---|---|
| inner radius (envelope) | 17 cm |
| outer radius (envelope) | 170 cm |
| $\eta$ acceptance | $1.3 < \eta < 3.5$ |
| | |
| x, y ($R < 0.8$ m $/ R > 0.8$ m) | 1 cm/ 1.65 cm |
| z (active depth) | 37.5 cm |
| z read-out | 5 cm |
| # scintillor plates (0.4 cm) | 66 |
| # Pb sheets (0.16 cm) | 66 |
| weight | $\sim$ 6.4 kg |
| # towers (inner/outer) | 19 200/ 34 416 |
| # read-out channels/ SiPM | 53 616 |
| radiation lengths $X/X_0$ | 18.5 |
| Molière radius $R_M$ | 5.2 cm |
| Sampling fraction $f$ | 0.220 |



# Summary

- The Korean nuclear physics society has great interest in EIC experiment
- Four subgroups submitted LoI to ECCE
  - Longitudinally segmented forward EMCal (FEMC) for hadronic-going side.
  - Silicon pixel tracker
  - $\mu$RWELL micro pattern gas detector
  - Dual readout calorimetry (upgrade plan)

- To realize the EoI, we seek for substantial funding for a long-term R&D
- In particular, for FEMC development, KoreaU and SejongU are want to coordinate with RHICf and other Japanese groups
  - Common tasks for FEMC and Focal-E?

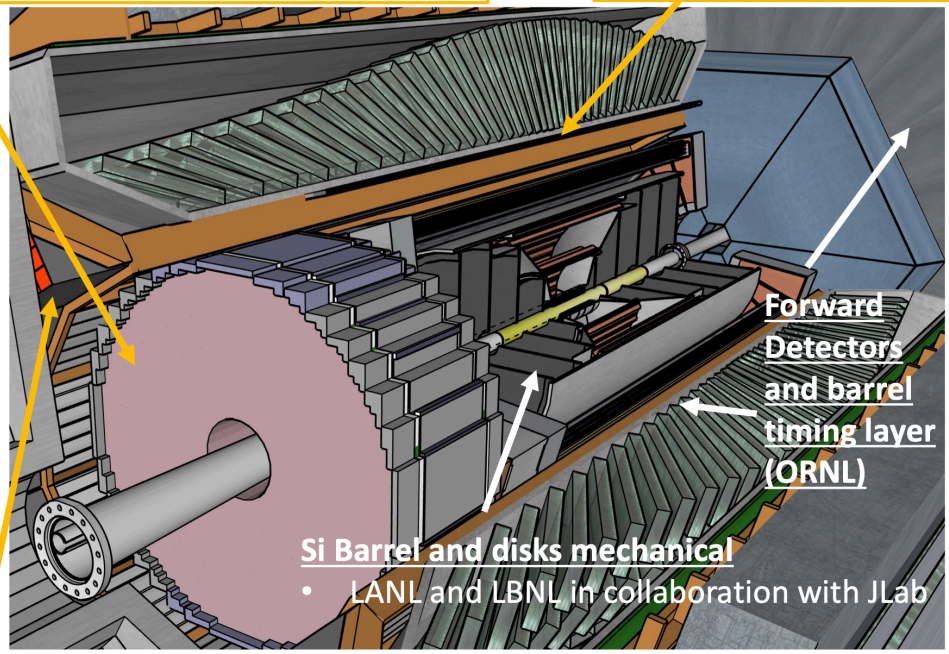
# BACKUP

# Participation in ECCE consortium

## Design/Engineering Activities and Integration

**Electron Endcap EMCal**
- Initial concept (Josh Crafts, CUA)
- Frame and cooling system (IJCLab-Orsay)

**Barrel EMCal Support**
- Various options EMCal (Josh Crafts, CUA)
- Impact on support structure and frame (MIT)




**Evaluate available space and detector placement and supports**

**Work started on integration of MPGD between Si and DIRC (e.g. https://userweb.jlab.org/~jfast/EIC/Hybrid_ECCE/Hybrid_Tracker-ECCE.pdf)**

**DIRC**
- Re-use concept (CUA, GSI)
- Support structure (GSI)

**EIC Project :**
- Support for barrel EMCal and a universal frame that holds the DIRC and detectors "within" (backward EMCAl, mRICH, etc.)
- support of forward Hadron Calorimeter, and how to split it for maintenance mode, looking at similar for the backward HCal side.