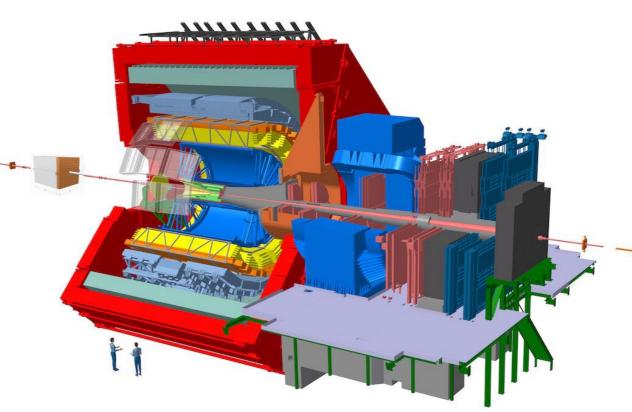
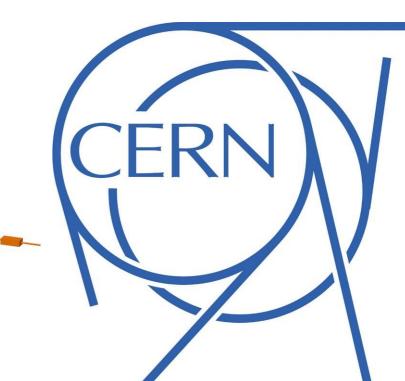
SQIVI 2022

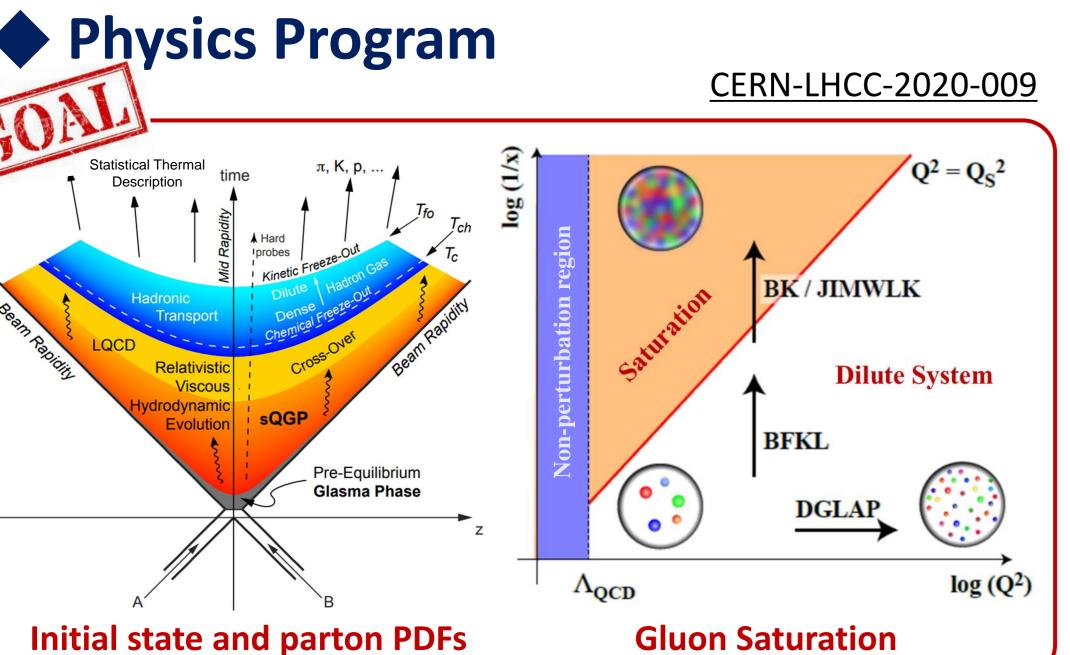
The ALICE FoCal

Dong Geon Kim (Hanyang University, Korea) On behalf of the ALICE FoCal Project



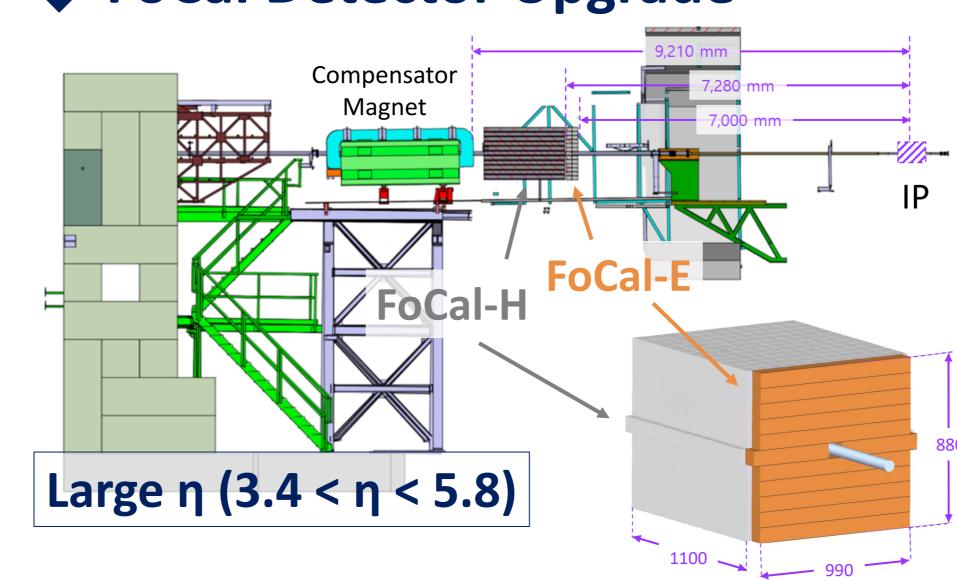






FoCal Detector Upgrade

EM and DIS Measurements



Electromagnetic: FoCal-E

Hadronic: FoCal-H High-granularity & Compact Si-W sampling Conventional metal-scintillator sampling Calorimeter

sandwich calorimeter

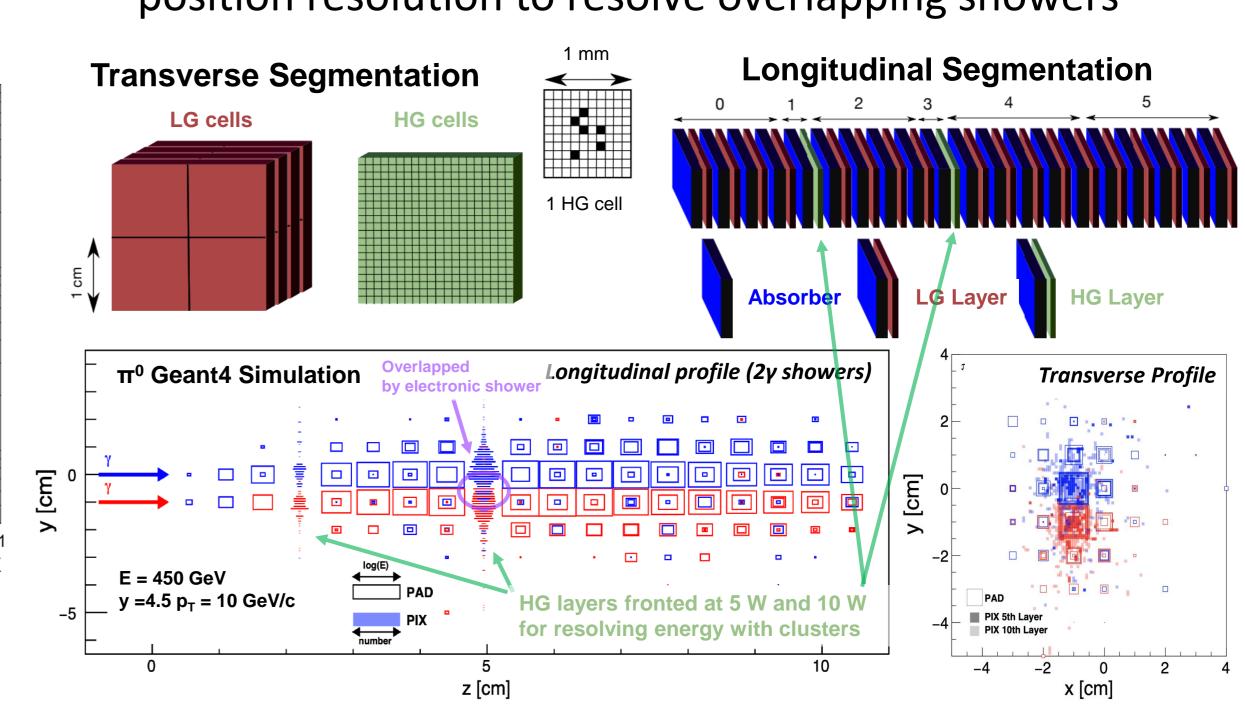
- 20 layers, each including

3.5 mm Tungsten ($\sim 1 X_0$) Silicon Sensors

CHALLENGE Separate γ from π^0 at large momentum

FoCal-E Hybrid Design

- 1. (LG cells) Silicon Pads with CMS HGCROC
- provide shower profile, E_{total}, large dynamic range 2. (HG cells) ALPIDE CMOS pixels
 - position resolution to resolve overlapping showers



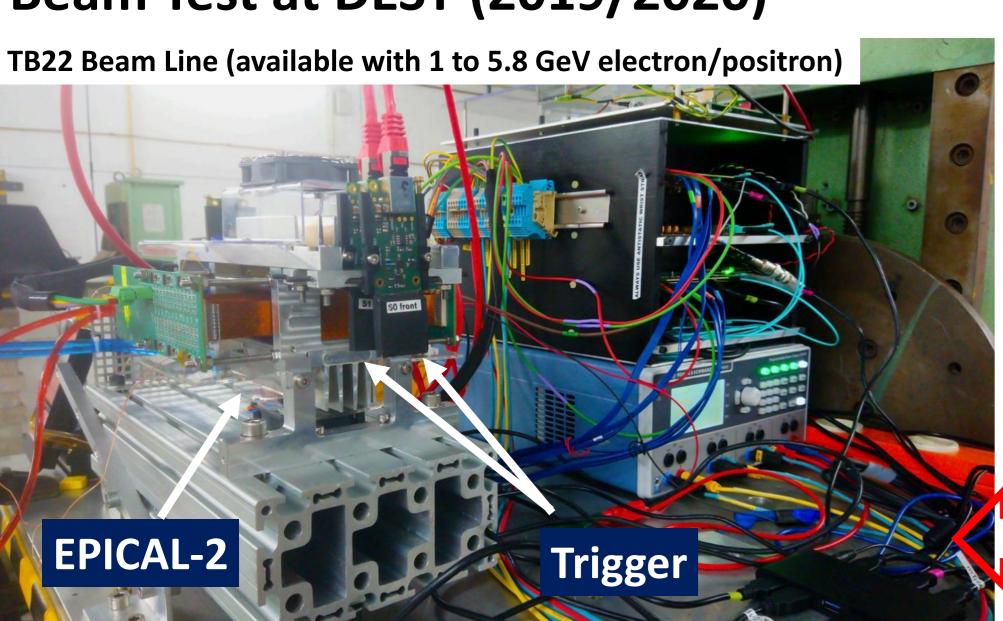


Complementary: π⁰, Jets, Quarkonia, Z⁰, W[±]

FoCal uniquely placed to explore low-x physics over a broad range in Q² (Higher energy & Large η)

Prototype Tests

Beam Test at DESY (2019/2020)



FoCal-H Prototype (Scintillation fibers + SiPM)

 $Q_{\rm s}^2 \approx \frac{x g_{\rm A}(x, Q^2)}{\pi R_{\rm A}^2} \propto A^{1/3} x^{-\lambda} \quad x \approx \frac{2p_T}{\sqrt{s}} \exp^{-\eta}$



Beam Test at CERN SPS (2021)

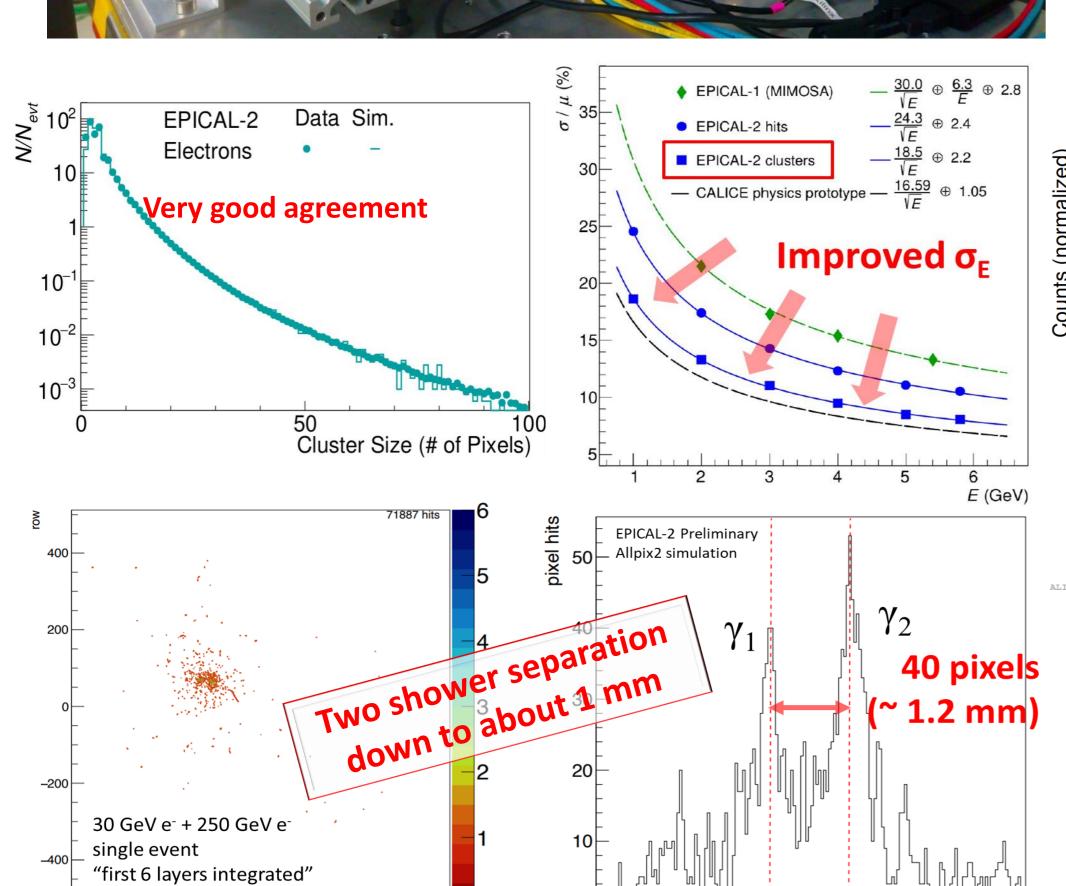
2021 SPS testbeam

FoCal-E pad layers

Data

E=40 GeV, 10 W layers

H6 Beam Line (available with 20 to 120 GeV electrons and hadrons) PIXEL layers **Plastic HGCROC(front-end ASIC)**



24 layers & **Detector Layers Detector Setup** 30 x 30 mm FoCal-E Pixel 2021 Prototype Data Layer 10 Simu Layer 10 80 GeV electrons (fit)

FoCal-E Prototype (EPICAL-2)

FoCal-H Prototype, 2021

Determination of beam composition

Spacer 0.5 mm FoCal-E Pixel 2021 Prototype Data 20 GeV Data 80 GeV Data Layer 5 Simu Layer 5 **Non-linearity** due to insufficient

Hadronic+UPC Measurements

FoCal-E Pixel 2021 Prototype 20 GeV e+ simulated 80 GeV e+ simulated FoCal-H Prototype, 2021 0 to 80 GeV Dependence of ADC counts

on beam energy

◆ DATA

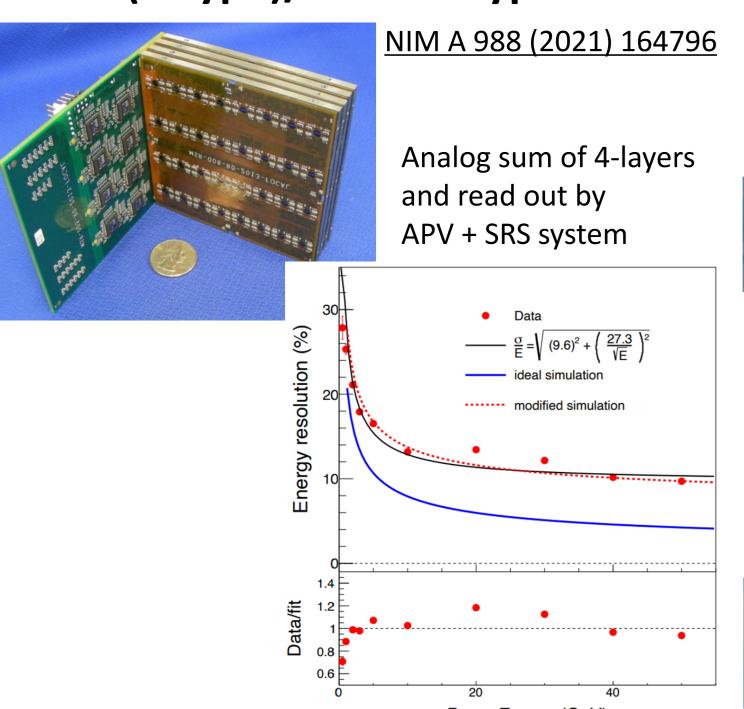
Beam energy [GeV]

Layer Construction

Flex. Cable -

GEANT4 simulation GEANT4 simulation For 5 W/10 W layers and 20, 40, 60, 120 GeV, data & simulation is in far agreement In the case of 80 GeV, the detailed understanding is in progress **Pion Proton** Kaon Muon Electron Accurate response function Determination of beam composition

Si Pad(n-type)/W Prototype



► FoCal R&D Local Effort

0.004

- ✓ (Ongoing) R&D of Si n-type pad sensor for verification of sensor performance and radiation hardness
- (2023 Korea R&D Budget Plan) R&D of Si n-type pad sensor & HGCROC (ASIC for readout)

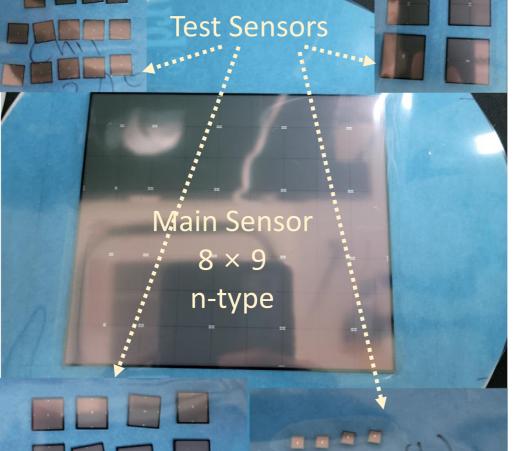
25000

20000**E**

15000E

10000E

ALI-PERF-522878



TR103 Beam Line (available with 30 MeV proton) 30 MeV Gaussian beam

type inversior n-type erification Complete for one of the ALICE criteria $\Phi_{\sf eq}$ [cm⁻²] 1E+13 n_{eg}/cm² radiation hardness

 S10_1 @ Φ_{eq}=5.11E+11 n_{eq}/cm² S10_7 @ Φ_{eq}=2.03E+12 n_{eq}/cm² 10 α =3.99 x 10⁻¹⁷ A/cm ag Time [min] **Surface effect & crosstalk of main sensor**

will be tested by 2.5 MeV electron irradiation

2021 SPS testbeam

FoCal-E pad layers

Data

E=80 GeV, 10 W layers

Summary & Outlook

Strong low-x program enabled by the forward measurements with FoCal

320 340 360 380 400

Various R&D efforts toward TDR 2023

- Outlook
 - Two test beams in 2022: June at CERN PS & Autumn at CERN SPS
 - Summer 2023: Finalization of R&D and Technical Design Report
 - LHC LS3 (2026-2028): FoCal Installation and commissioning