



# The ALICE FoCal

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On behalf of the ALICE FoCal Project

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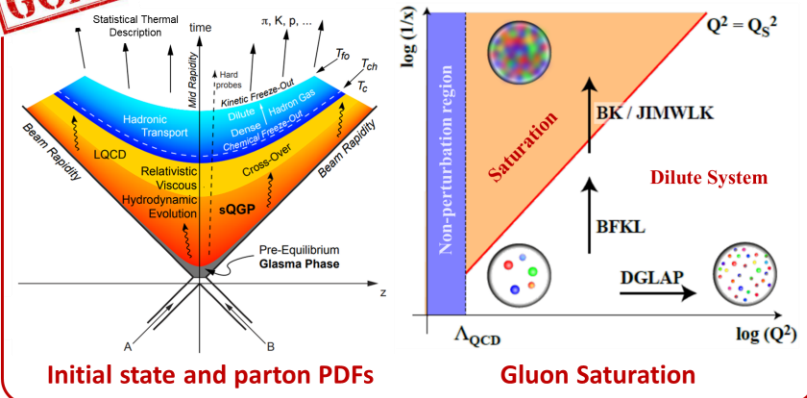
*The 20th International Conference on Strangeness in Quark Matter (SQM)  
13-17 June, Busan, Republic of Korea*



# Physics Program & FoCal Detector Upgrade

## Physics Program

**GOAL**

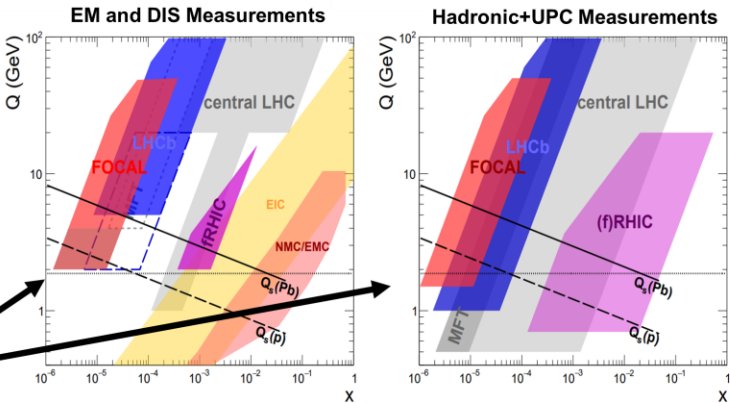
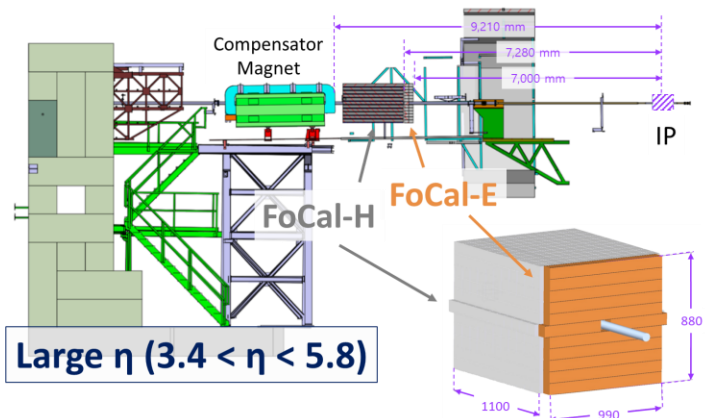


**NEED**

Explore small-x structure of nucleons down to  $10^{-6}$   
(Observable) Main: direct photons  
Complementary:  $\pi^0$ , Jets, Quarkonia,  $Z^0$ ,  $W^\pm$

**FoCal uniquely placed to explore low-x physics over a broad range in  $Q^2$  (Higher energy & Large  $\eta$ )**

## FoCal Detector Upgrade



$$Q_s^2 \approx \frac{x g_A(x, Q^2)}{\pi R_A^2} \propto A^{1/3} x^{-\lambda} \quad x \approx \frac{2p_T}{\sqrt{s}} \exp^{-\eta}$$

## Electromagnetic: FoCal-E

High-granularity & Compact Si-W sampling sandwich calorimeter

- 20 layers, each including
- 3.5 mm Tungsten ( $\sim 1 X_0$ )
- Silicon Sensors

## FoCal-E Hybrid Design

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

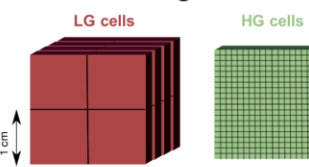
## Hadronic: FoCal-H

Conventional metal-scintillator sampling Calorimeter

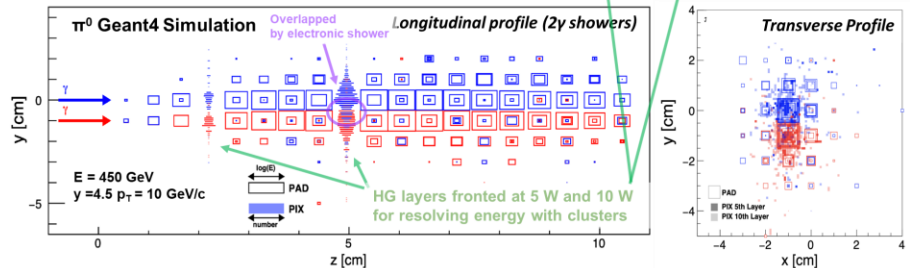
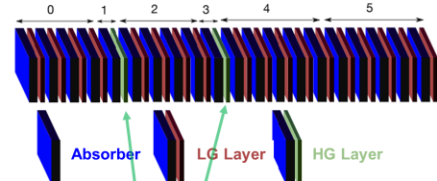
**CHALLENGE**

Separate  $\gamma$  from  $\pi^0$  at large momentum

## Transverse Segmentation



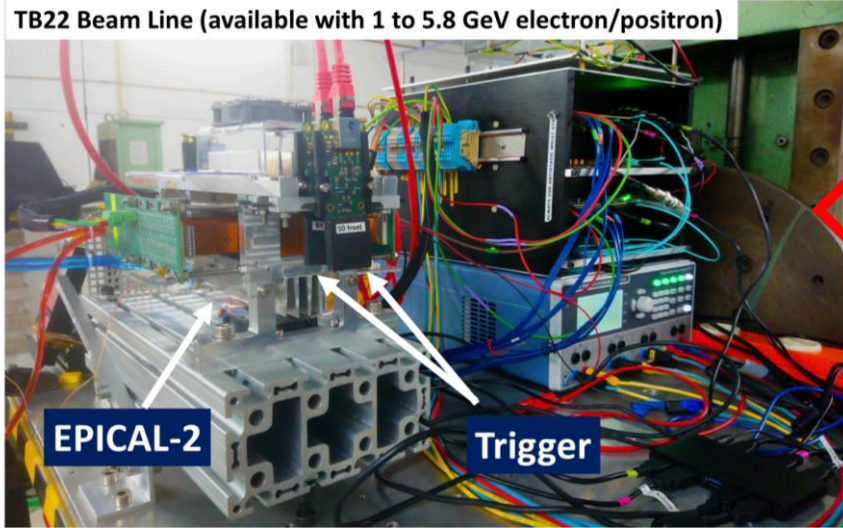
## Longitudinal Segmentation



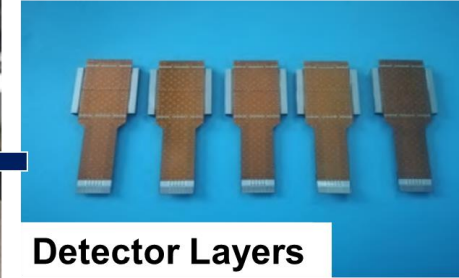
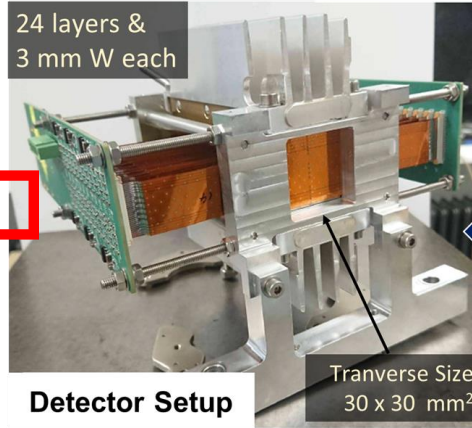
# Prototype Test – Beam Test at DESY

## Beam Test at DESY (2019/2020)

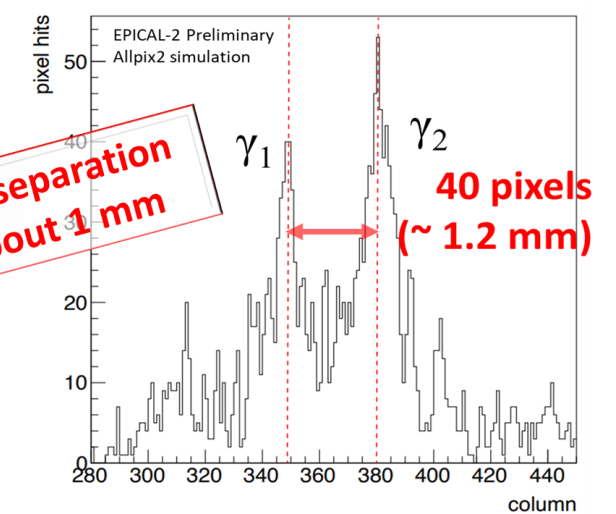
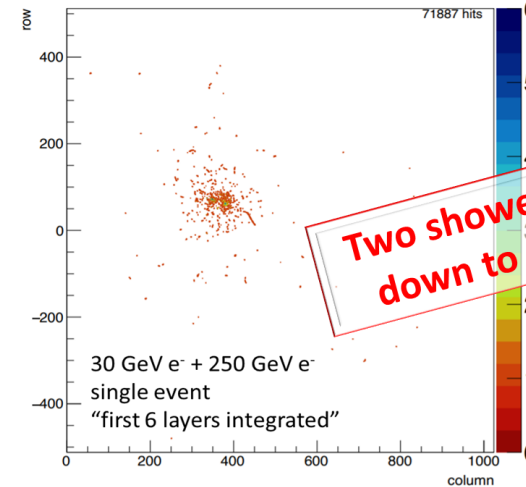
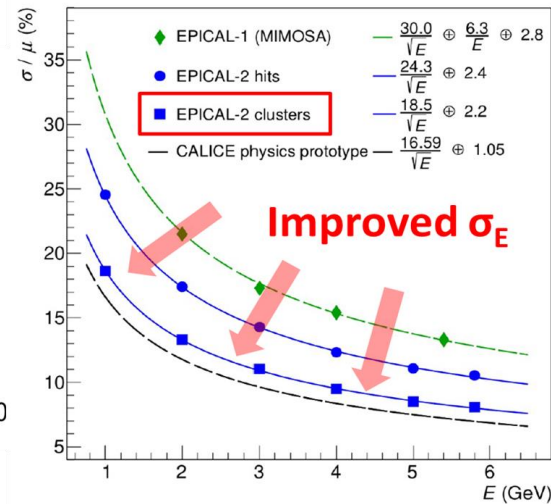
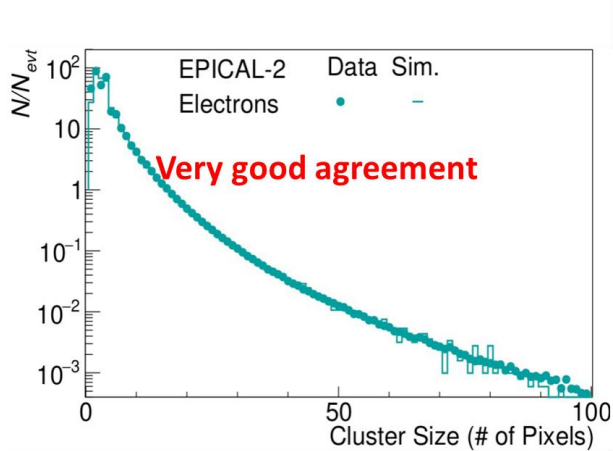
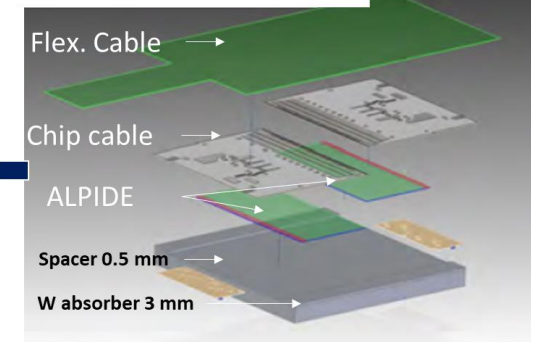
TB22 Beam Line (available with 1 to 5.8 GeV electron/positron)



## FoCal-E Prototype (EPICAL-2)

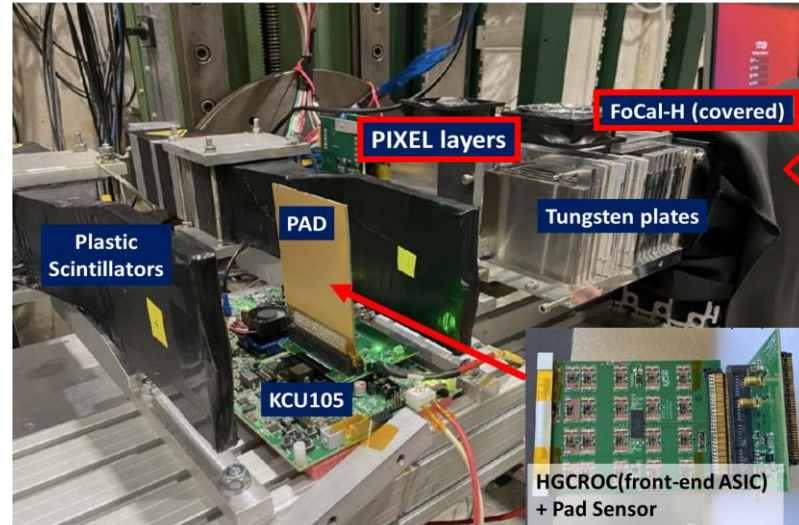


## Layer Construction

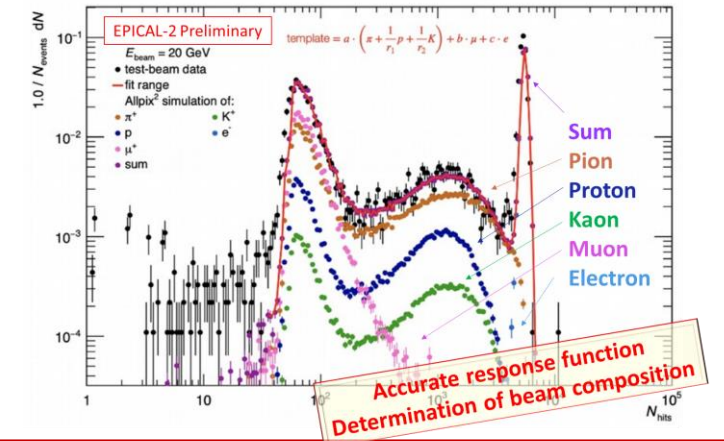
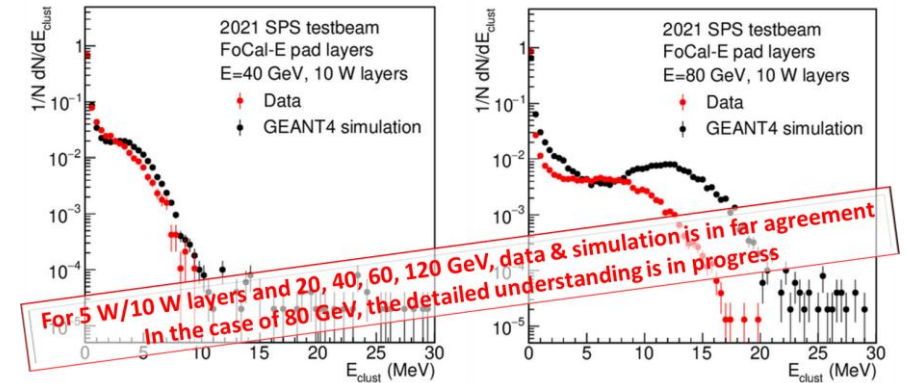
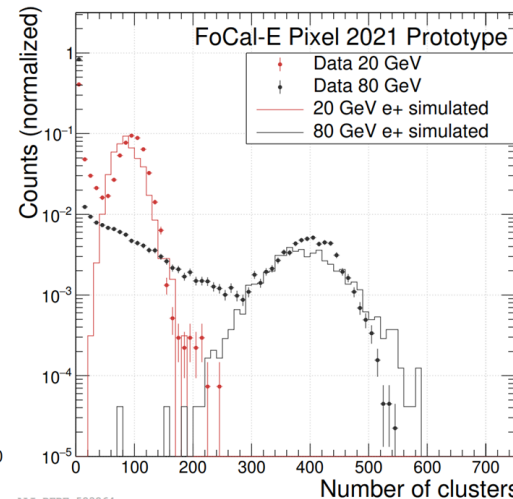
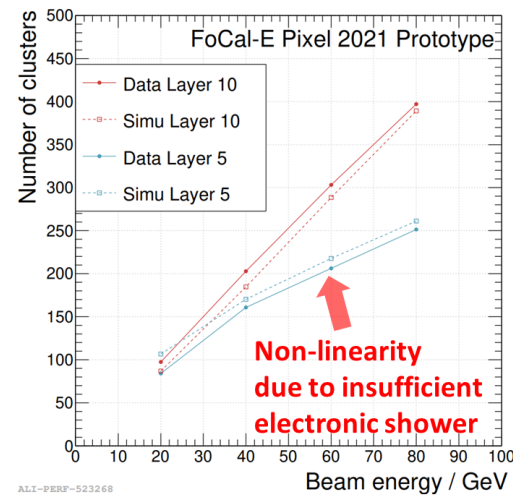
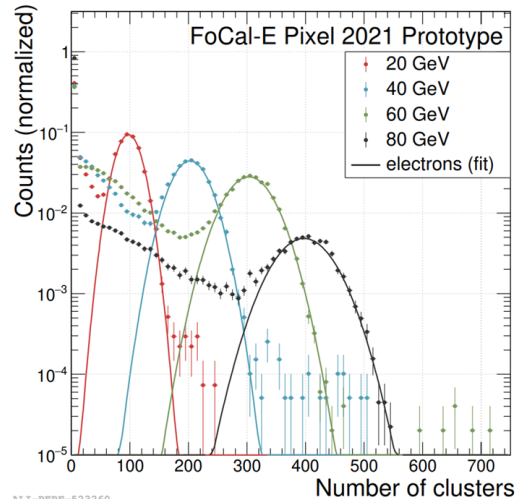
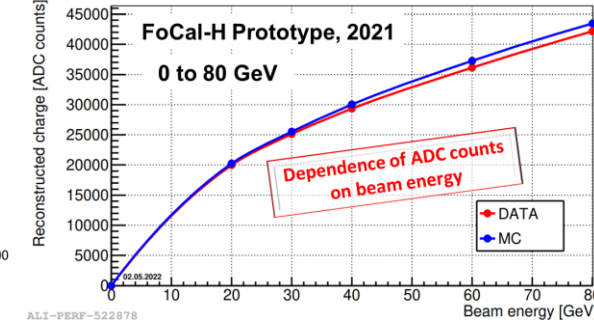
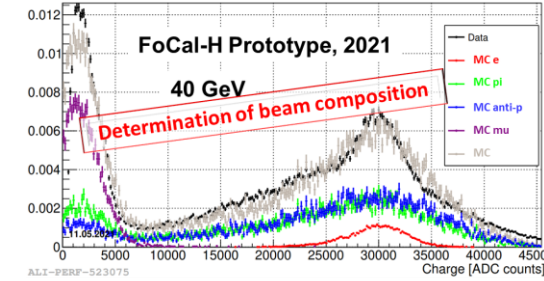
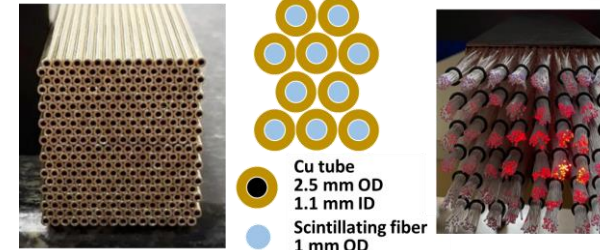
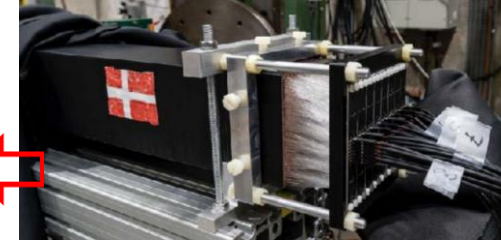


# Prototype Test – Beam Test at CERN SPS

## Beam Test at CERN SPS (2021)



## FoCal-H Prototype (Scintillation fibers + SiPM)

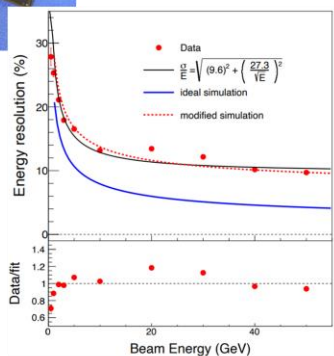


# FoCal R&D Local Effort

## Si Pad(n-type)/W Prototype

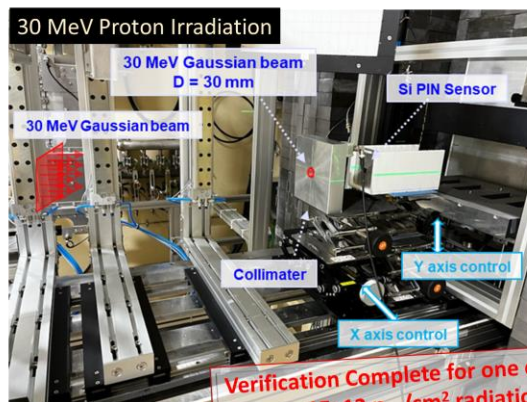
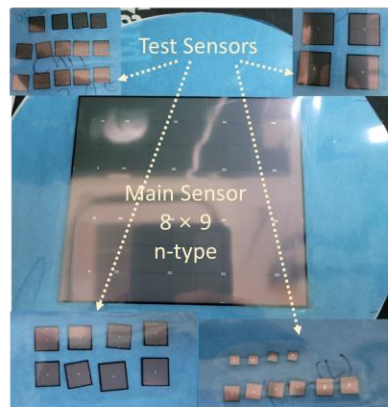
NIM A 988 (2021) 164796

Analog sum of 4-layers  
and read out by  
APV + SRS system

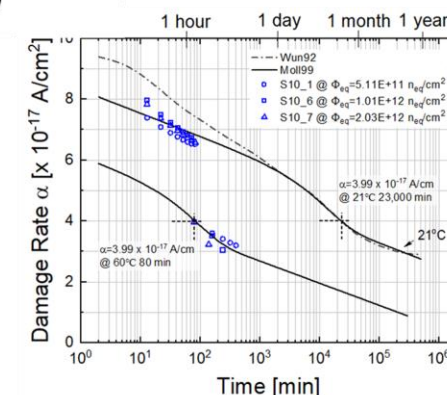
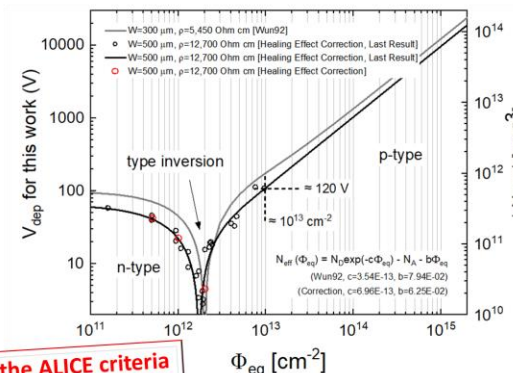


## ◆ FoCal R&D Local Effort

- ✓ (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)



Verification Complete for one of the ALICE criteria  
 $1E+13 \text{ n}_{eq}/\text{cm}^2$  radiation hardness



Surface effect & crosstalk of main sensor  
will be tested by 2.5 MeV electron irradiation

## ◆ Summary & Outlook

- Strong low-x program enabled by the forward measurements with FoCal
- Various R&D efforts toward TDR 2023

## ● Outlook

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