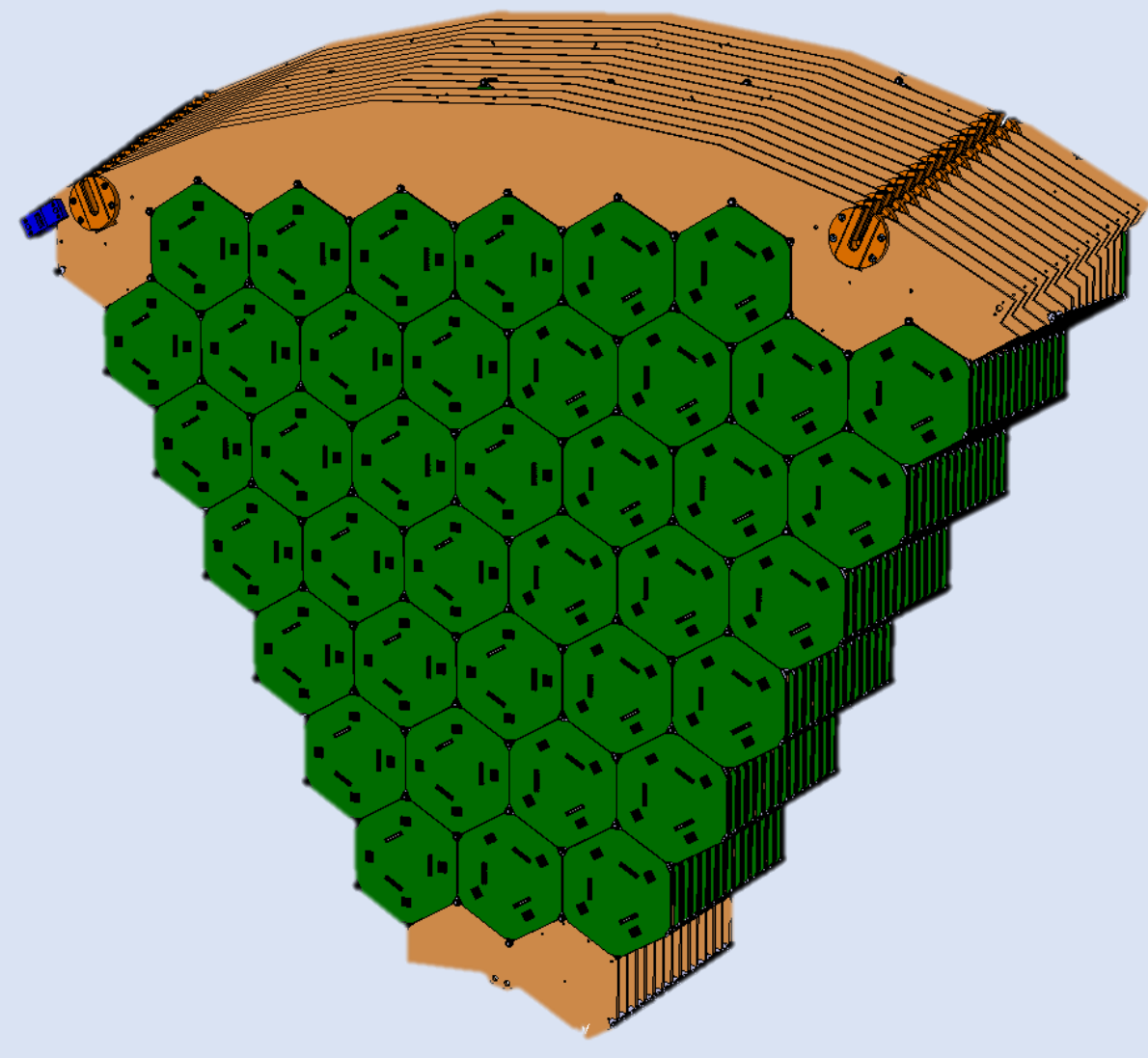


CMS HGCAL 'High Granularity Calorimeter' Engineering overview

DETECTOR OVERVIEW

The HL-LHC will integrate 10 times more luminosity than the LHC, posing demanding challenges on CMS calorimetry such as high radiation tolerance and unprecedented in-time event pileup.

To meet these challenges, the current CMS endcap calorimeters will be replaced by HGCAL (High Granularity Calorimeter) in Long-Shutdown 3.



Electromagnetic (CE-E) cassettes stack

Key Parameters:

HGCAL Covers $1.5 < \eta < 3$
~230 tonnes per endcap

Active Elements:

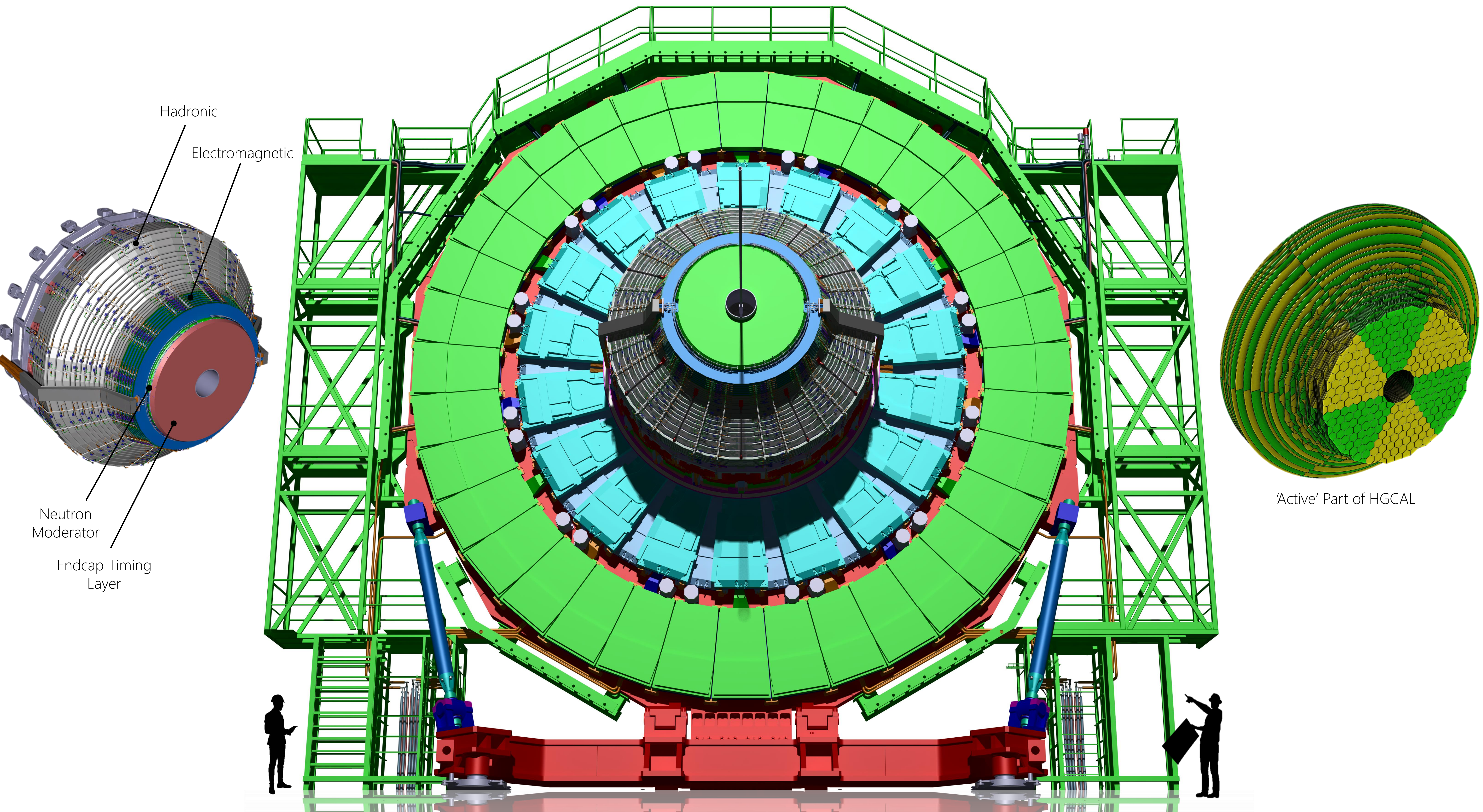
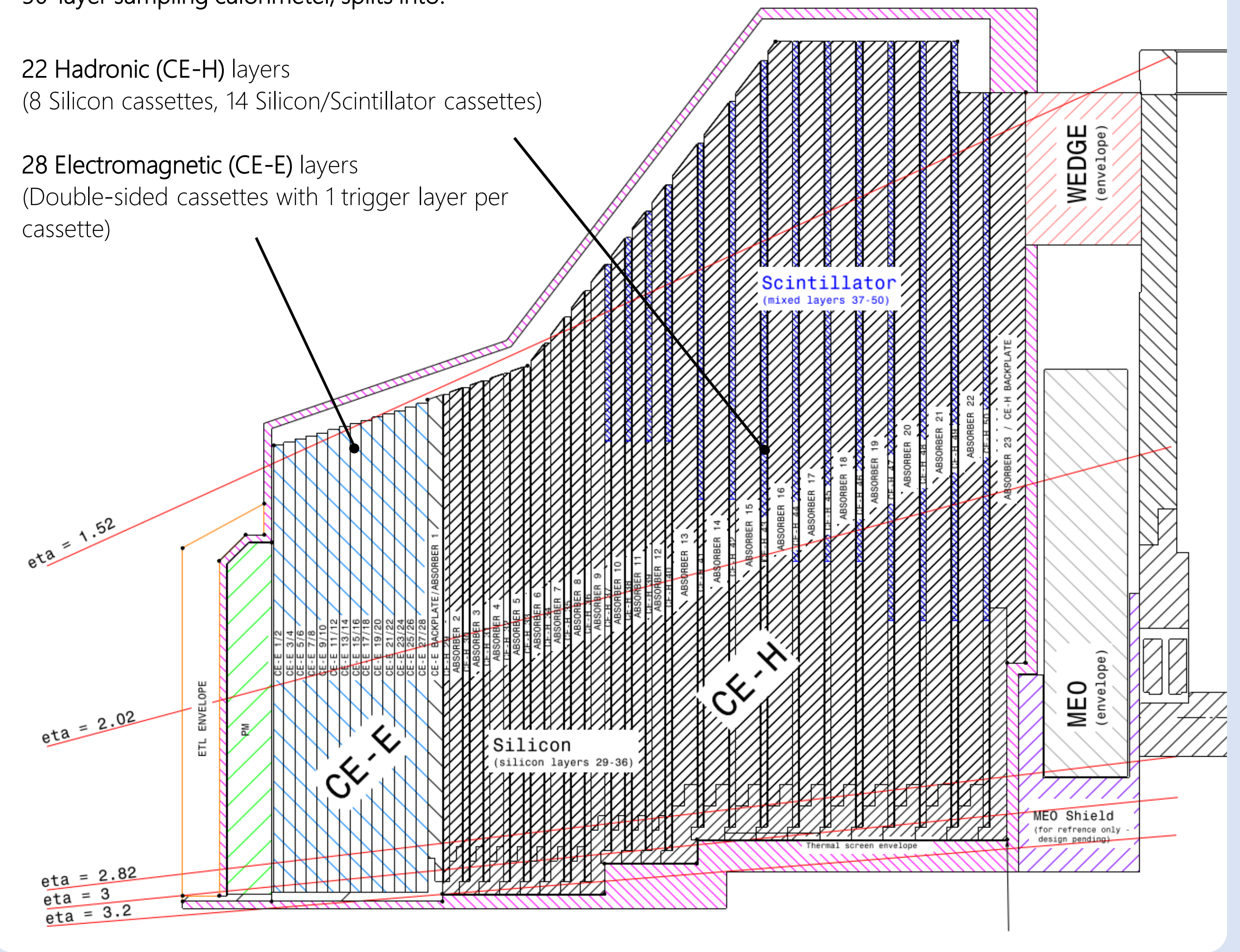
- Hexagonal modules based on silicon sensors in the high-radiation regions of the detector.
- Scintillating tiles with SiPM (Silicon Photo-Multiplier) readout in the lower radiation regions.

~30000 modules containing 620m² silicon sensors (8" hex wafers).
~4000 boards containing 370m² of scintillators.
~6M si channels

50-layer sampling calorimeter, splits into:

22 Hadronic (CE-H) layers
(8 Silicon cassettes, 14 Silicon/Scintillator cassettes)

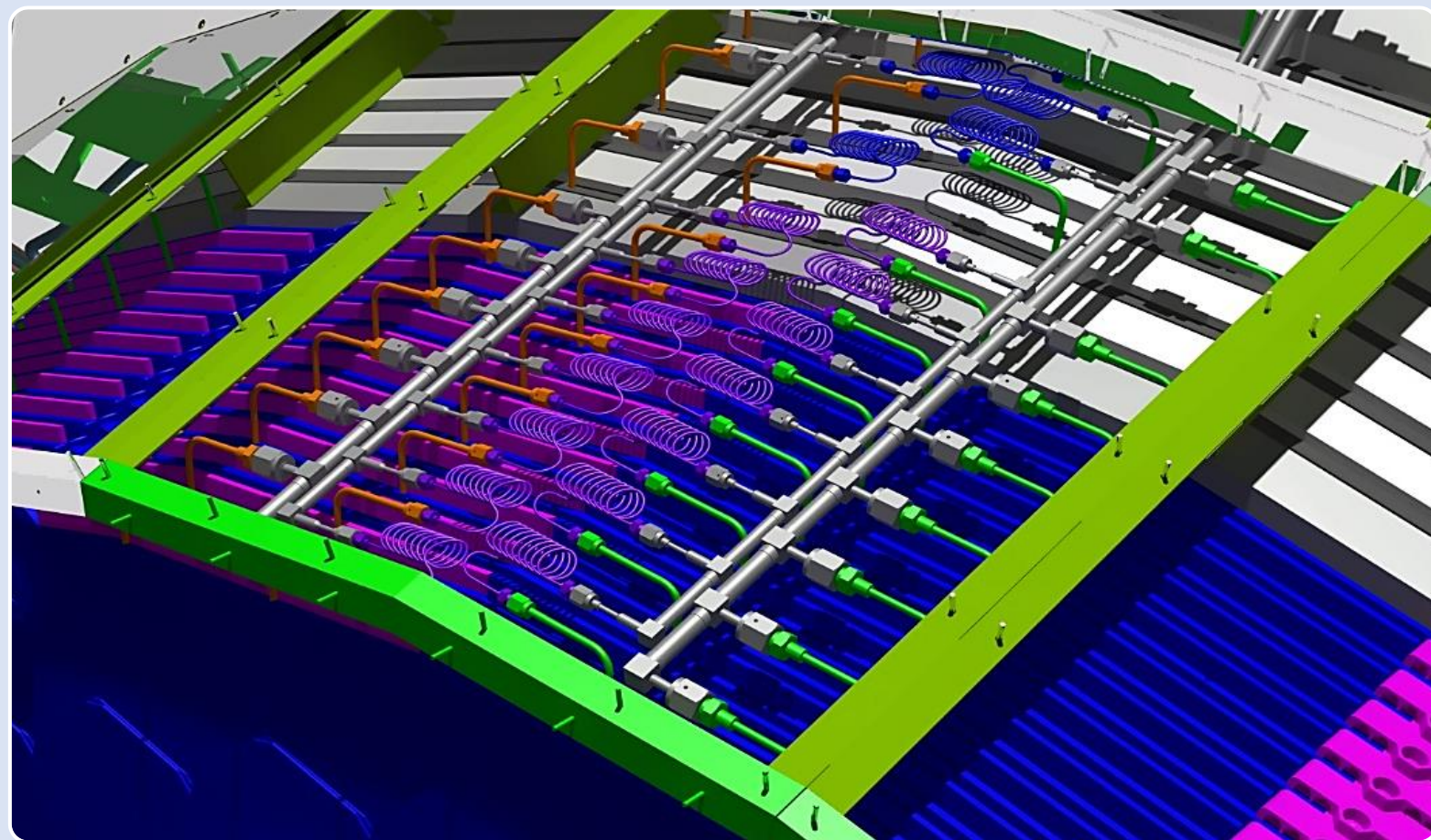
28 Electromagnetic (CE-E) layers
(Double-sided cassettes with 1 trigger layer per cassette)



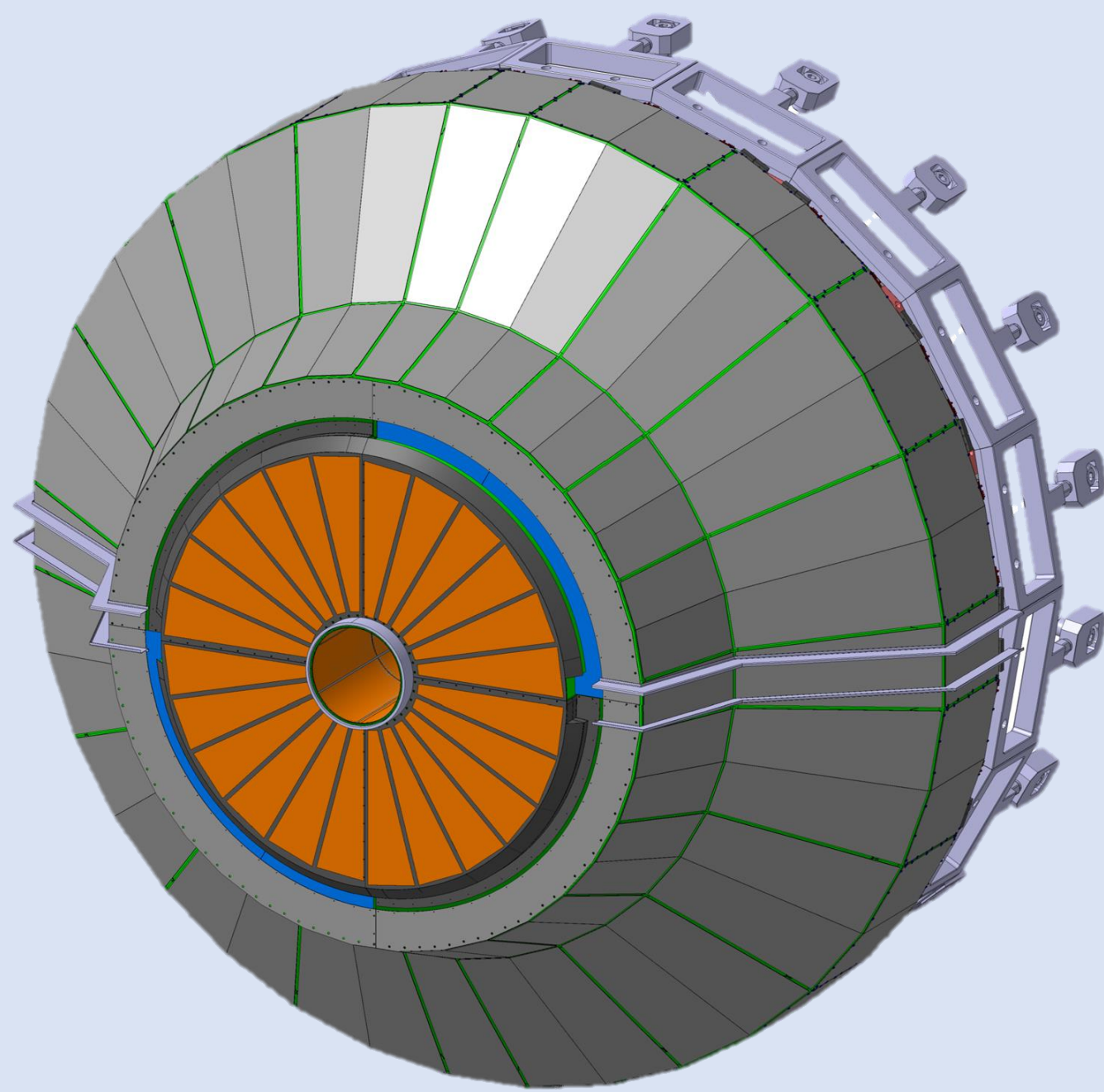
COOLING / THERMAL SCREEN

A 2-phase CO₂ cooling system will provide up to 140 kW of cooling power per endcap, with 1kg/s of flow. 12 on-detector manifolds will feed one cooling pipe per 30° cassette, maintaining the silicon sensors at -35°C and prolonging their working life under high irradiation.

A thermal screen, consisting of 120+ individual panels with electric heating foils and internally flushed with dry nitrogen gas, will protect the delicate detector electronics from humidity and external forces and prevent condensation on the outer surface.



2-Phase CO₂ Cooling



Thermal screen

HEAVY MECHANICS

The weight of a single endcap is estimated to be 230 tonnes. This poses serious challenges on the detector support system design. To meet these challenges a variety of supports with a different key features will be used.

