Updating the dd4hep ECAL driver for ILD

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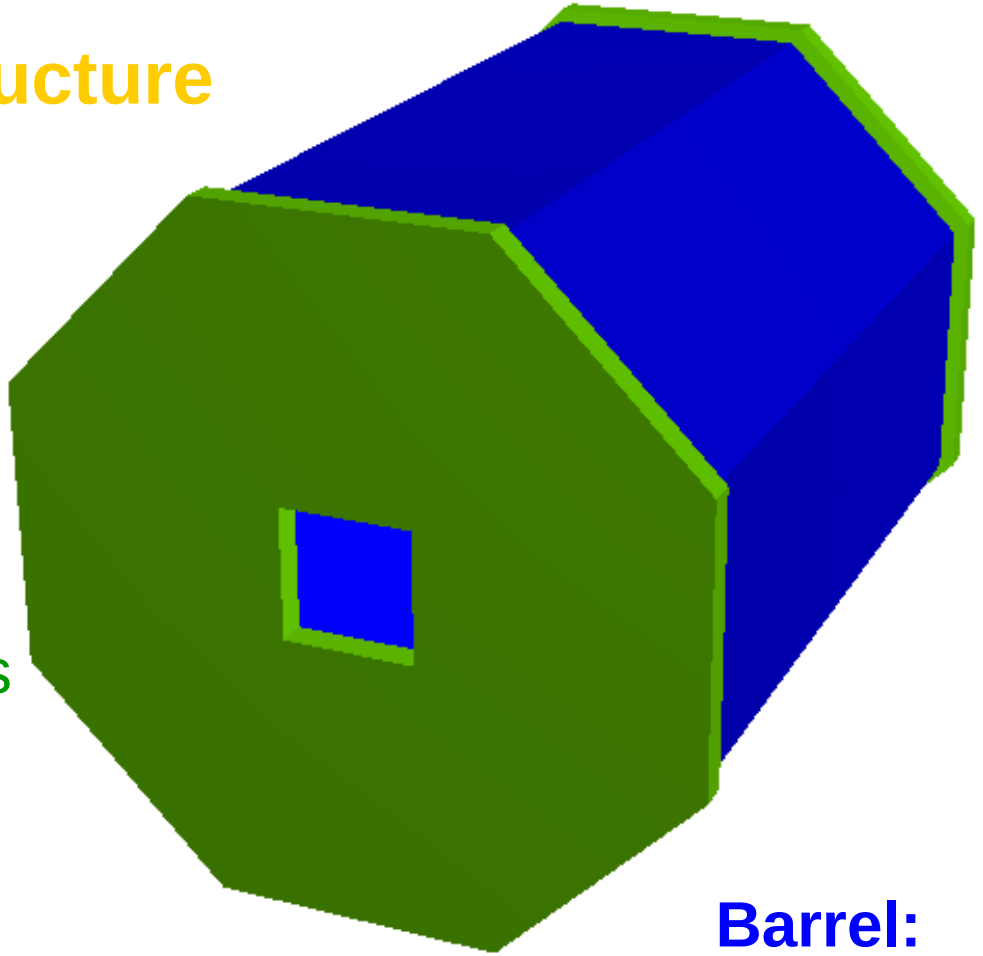
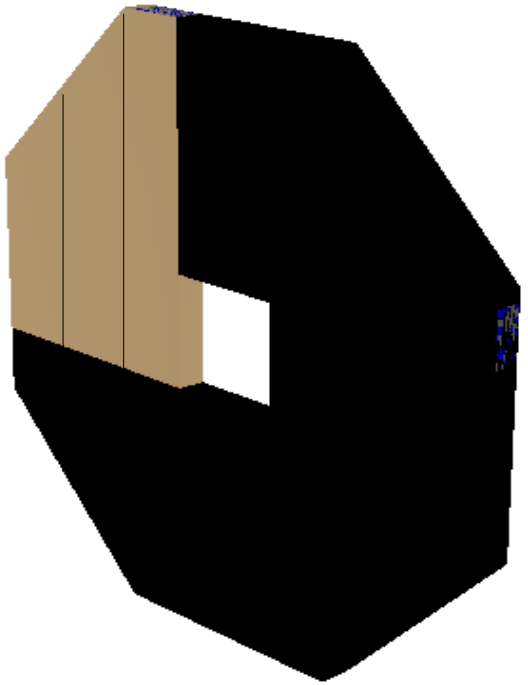
Morioka

General ECAL structure



Endcap:
2x4 identical quadrants
each with 3 modules



Barrel:
40 identical modules

Introduction

ILD moving to a **dd4hep**-based geometry description

First set of dd4hep ECAL models translations of Mokka code ("SEcal04*")

separate drivers for ECAL Barrel, Endcap, Endcap Ring
→ a lot of duplication

single large subroutine for each driver
difficult to understand in places (even for semi-experts like myself)

various hard-coded assumptions:
e.g. square readout cells, pre-shower layer

+ second set of drivers for scintillator strip ECAL
largely copies of square-cell driver
→ even more duplication

re-written simulation driver attempts to improve on these features

common tasks moved to single “Helper” class

module structure, layer structure, readout segmentation, ...

→ less duplication

“Helper” used by dedicated “Barrel” and “Endcap” drivers:

type, configuration, and position of modules

no new driver for Endcap Ring, for which no engineering design exists

assumptions

barrel: octagonal, some number of identical trapezoidal modules

endcaps: identical quarters,

each made up of one or more modules

same layer structure in barrel and endcaps

active layer (mostly) made up of square “megatiles”

almost all parameters defined at run time (XML description)

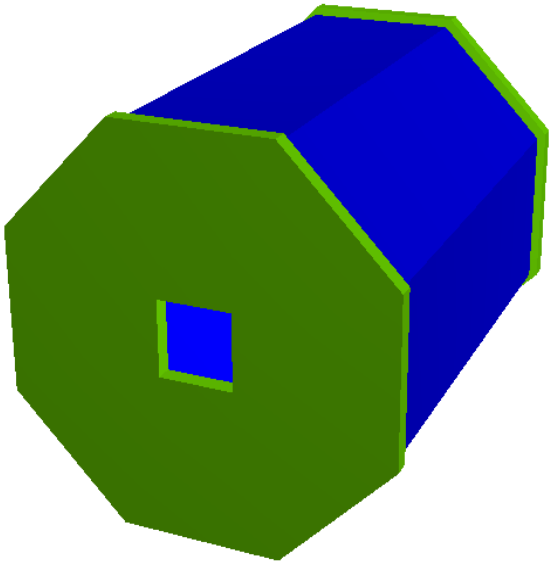
e.g.

easy configuration of “pre-shower” layer

square cell- or strip-based readout (or a mixture)

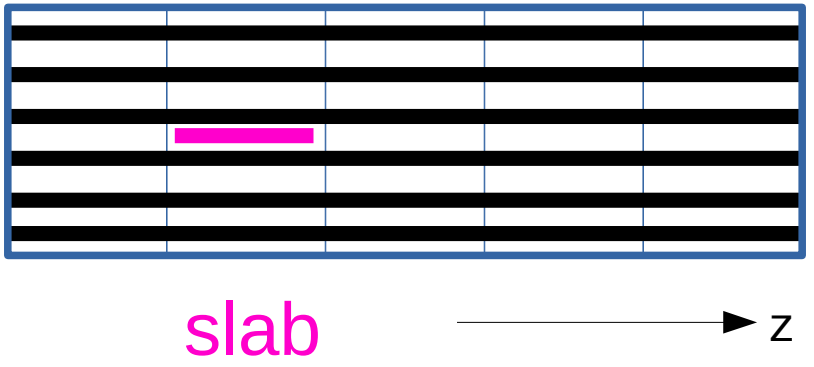
materials, thicknesses, segmentation

size of barrel module is defined by:
- total length of ECAL in z
- number of ECAL barrel modules
- inner radius of ECAL
- thickness of ECAL



mechanical structures instrumented with
- detection elements “slabs”

one Barrel module: split into towers



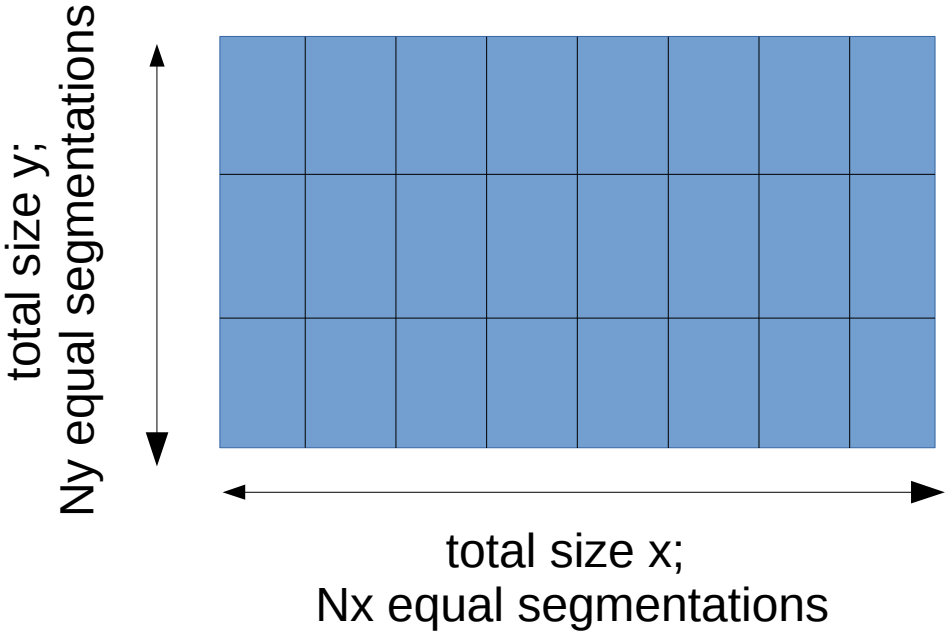
width of slab in barrel defined by
- barrel module size in Z
- number of towers per module
- thickness of module walls, gaps

assume Endcap slab width is the same as barrel:
- adjust number of slabs to ~ fill available space

new segmentation class (provides segmentation of sensitive readout)

MegatileLayerGridXY in dd4hep/DDSegmentation

A megatile is a rectangular surface of size x * y,
which can be segmented into Nx * Ny tiles

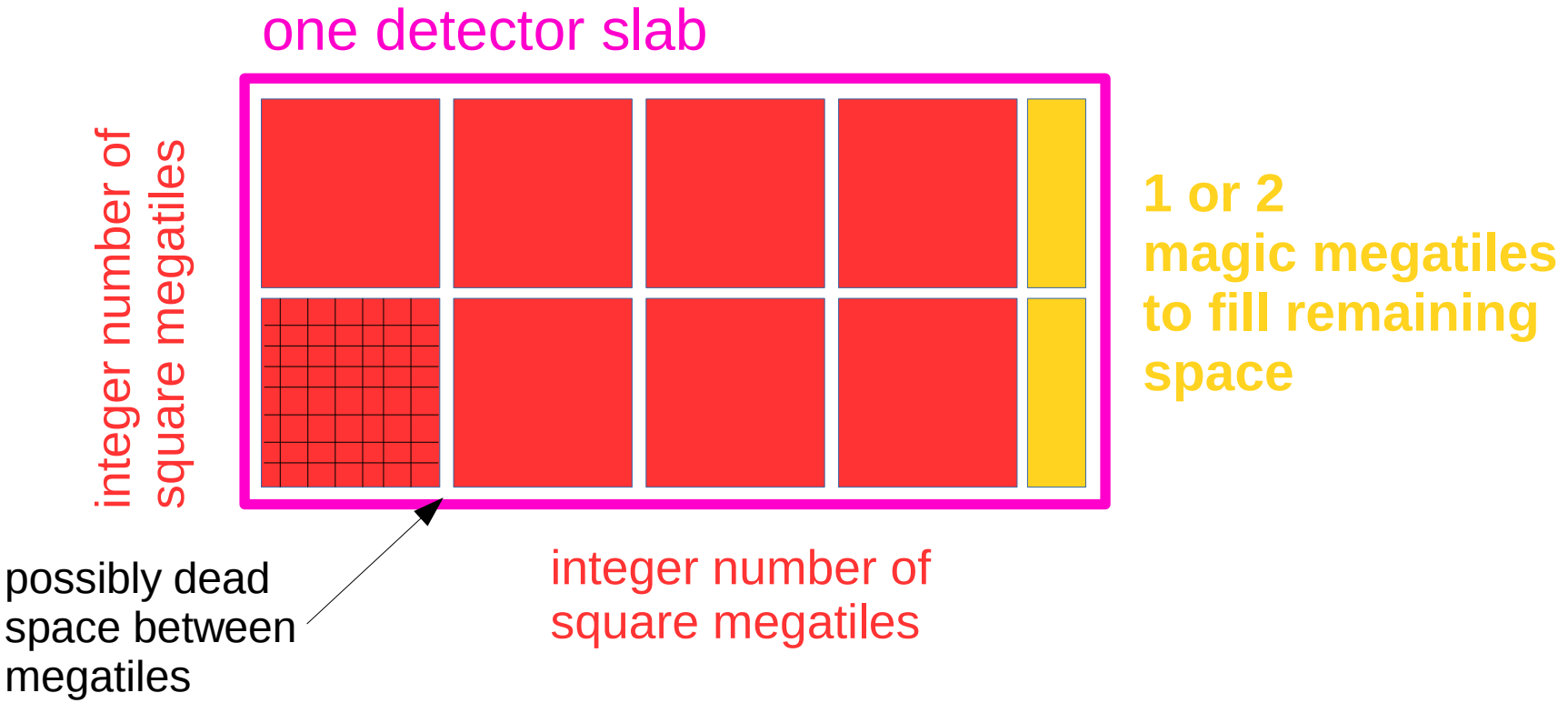


A megatile could be applied to
- a silicon sensor with segmented readout
- an array of scintillator strips
- a gas volume with segmented readout
- …..

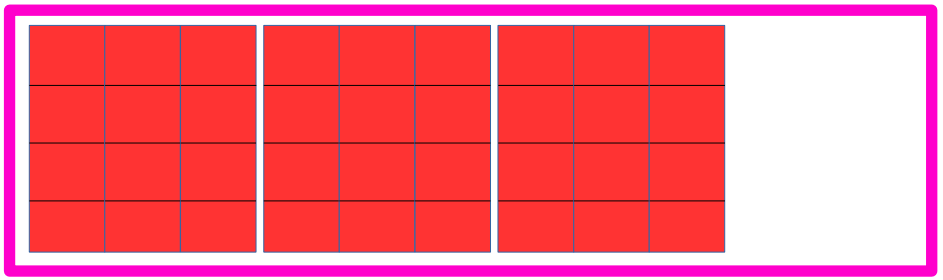
MegatileLayerGridXY assumes that
- most megatiles have
  - the same size x*y
  - layer-specific values of (Nx, Ny)
- a number of additional non-standard megatiles are allowed

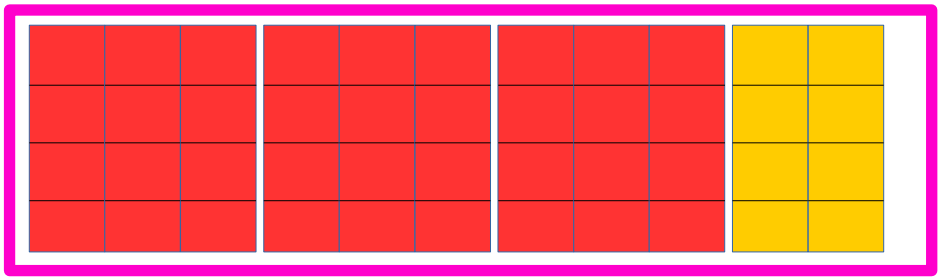
n.b. previously (in Mokka), user specified a cell size, which was internally adjusted to give an integer number of cells per “megatile”

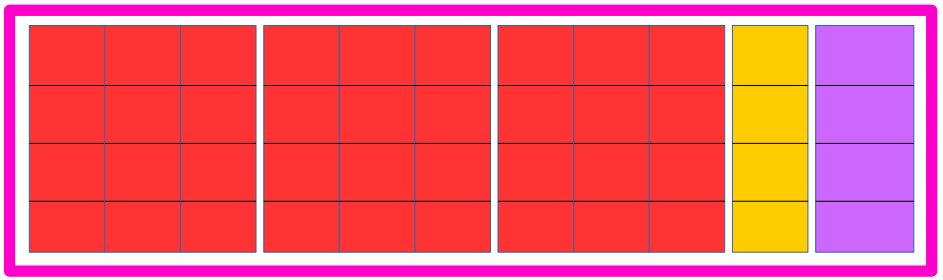
sensitive layer segmentation



Megatile size is “quantised”, length of slab is continuous







end-of-slab options

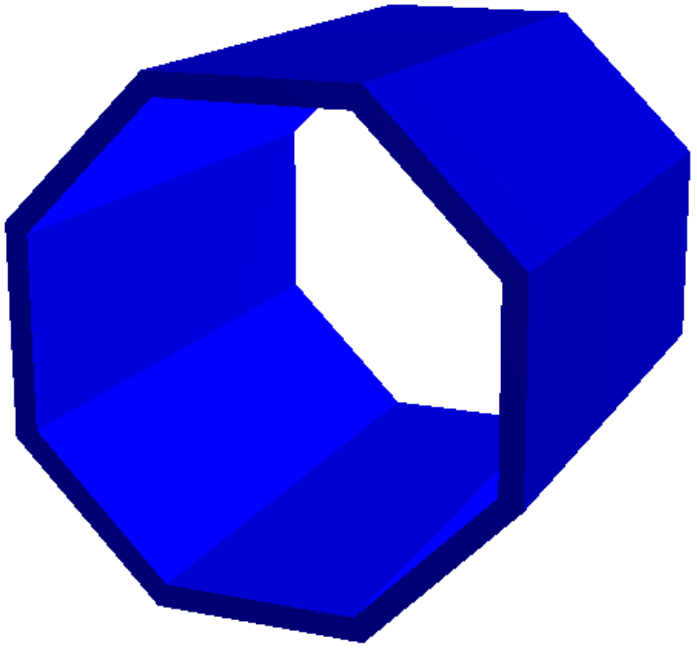
“Ecal_end_of_slab_strategy”

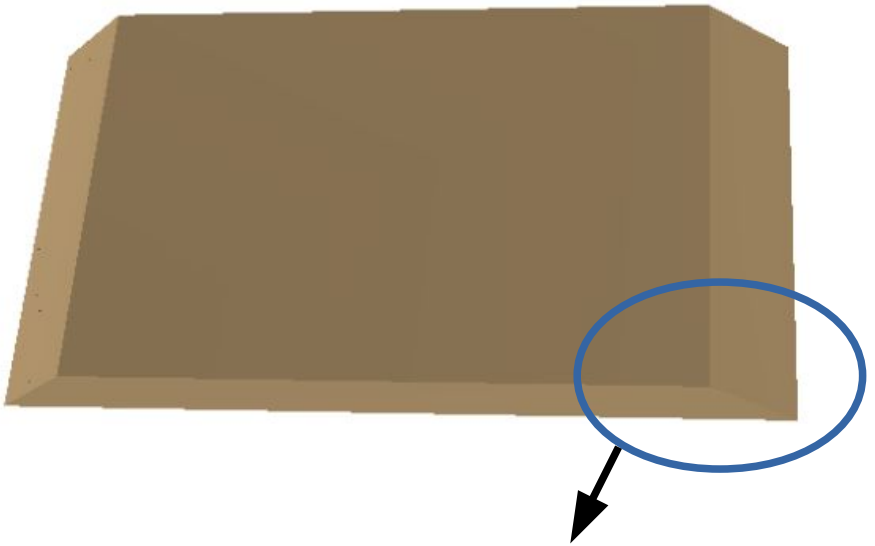
1) only standard megatiles

2) magic megatile with standard cell sizes

3) last megatile has special cell size to exactly fill space

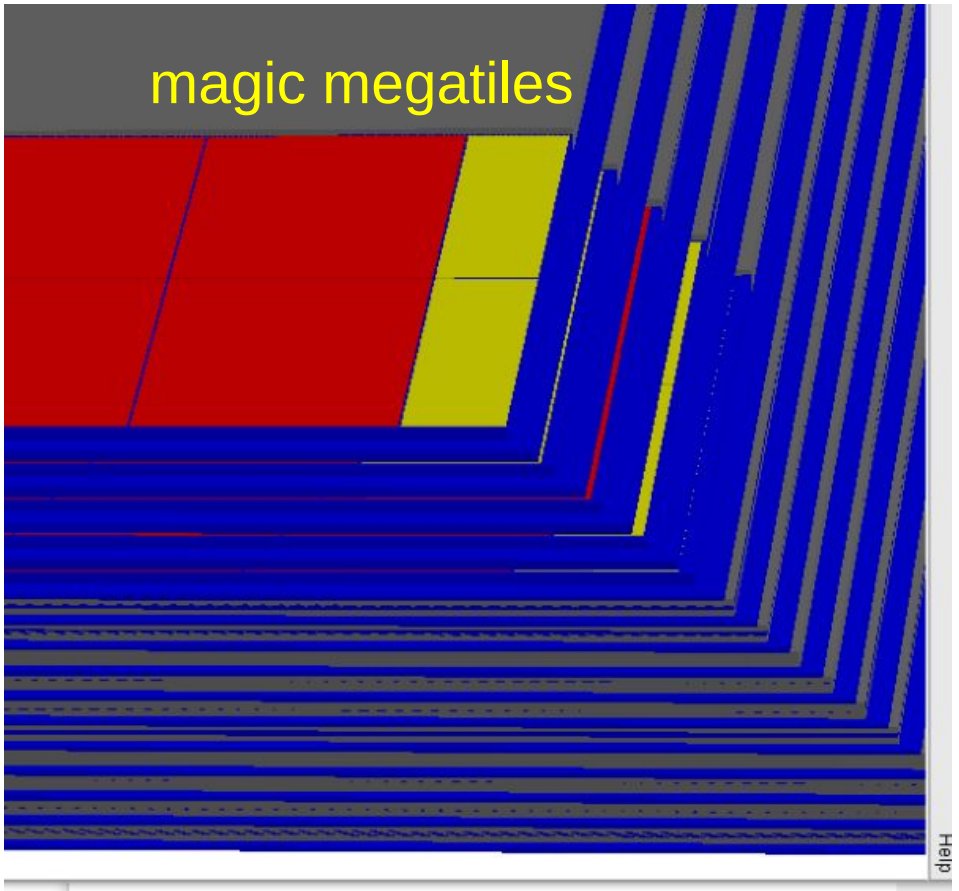
ECAL barrel





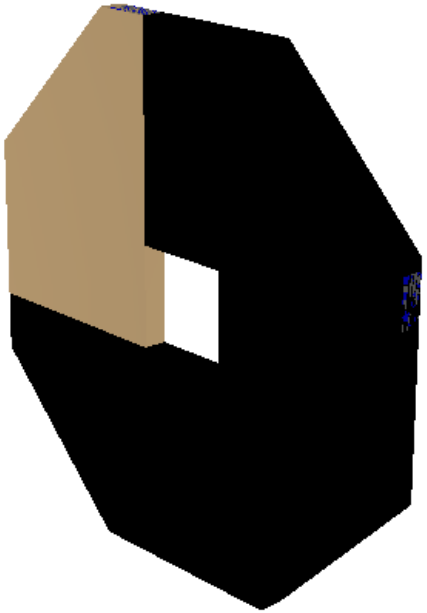
barrel module

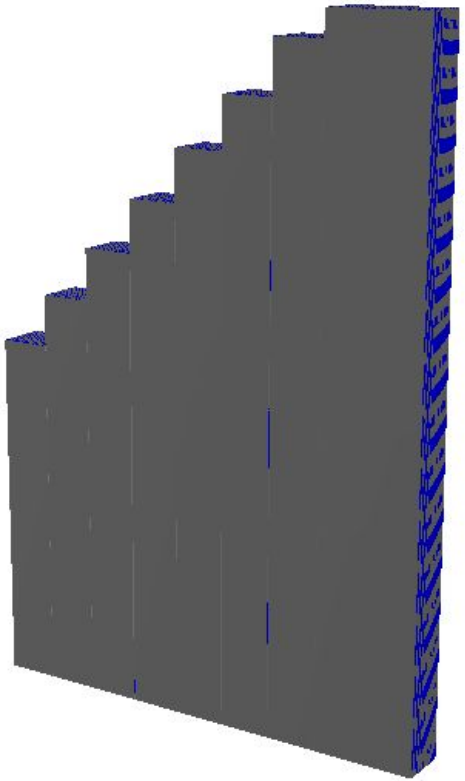
standard megatiles



layers inside module

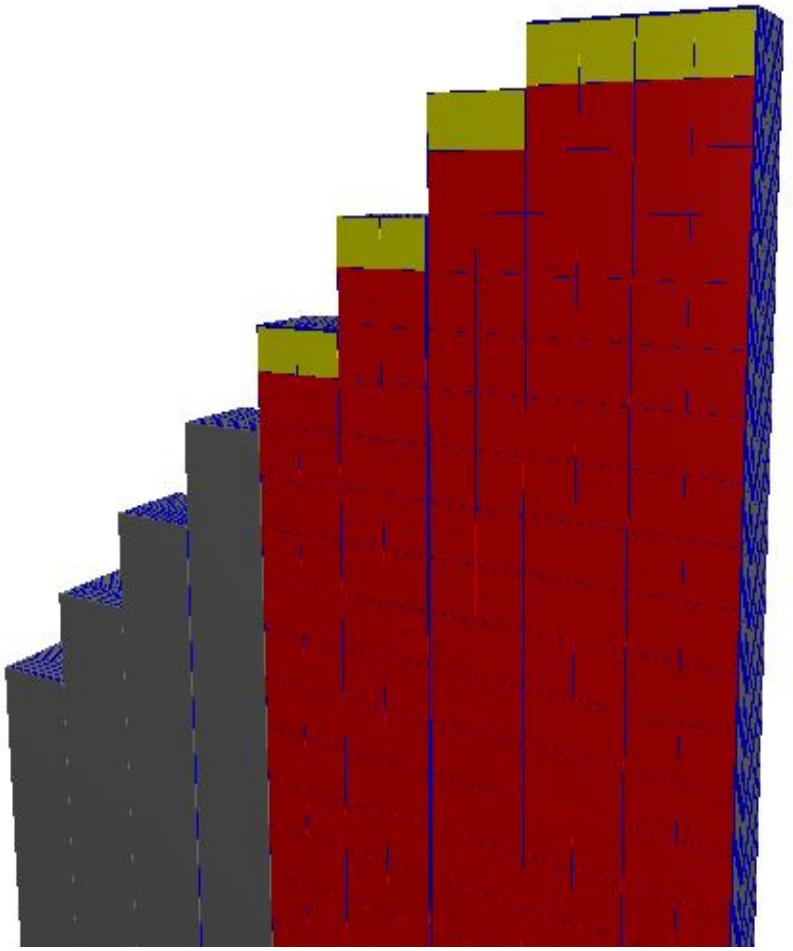
Endcap





Quadrant

megatiles



summary

ECAL driver has been re-written
- more modular code
- less duplication
- more configurable
- available in central repositories

e.g. allows easier access to
- pre-shower layer configuration
- different readout cell geometries

is being used in new ILD models
- → could also be used by others
- → additional features/flexibility could be added if requested