Laboratoire d'Annecy-le-Vieux de Physique des Particules

Hcal

Geometry and Assembly

Phone Meeting

December 2007, 12th

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

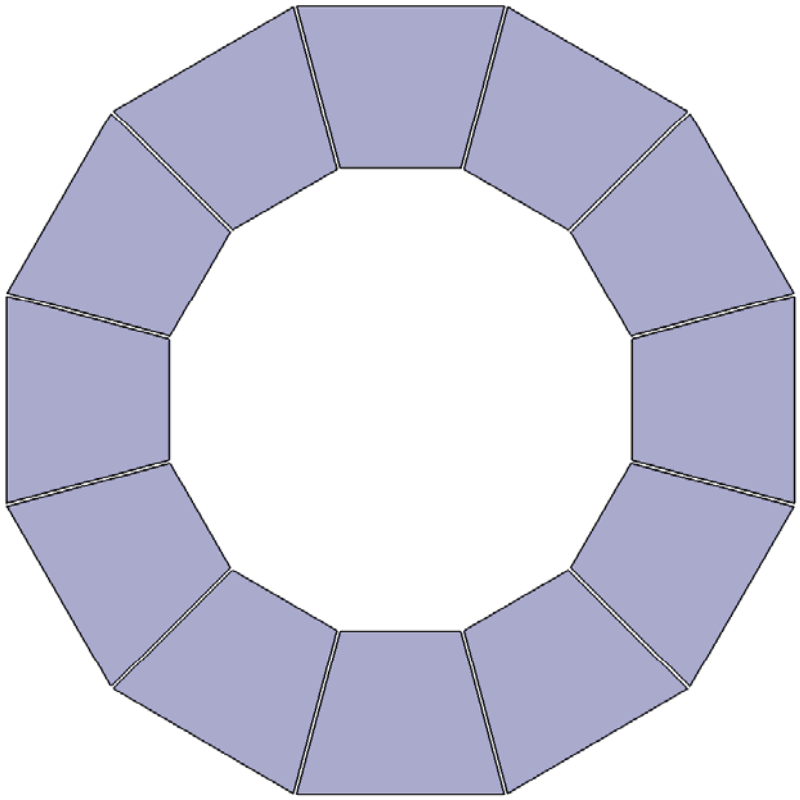
IN2P3 INSTITUT NATIONAL DE PHYSIQUE NUCLÉAIRE ET DE PHYSIQUE DES PARTICULES

UNIVERSITE CHAMBERY ANNECY SAVOIE

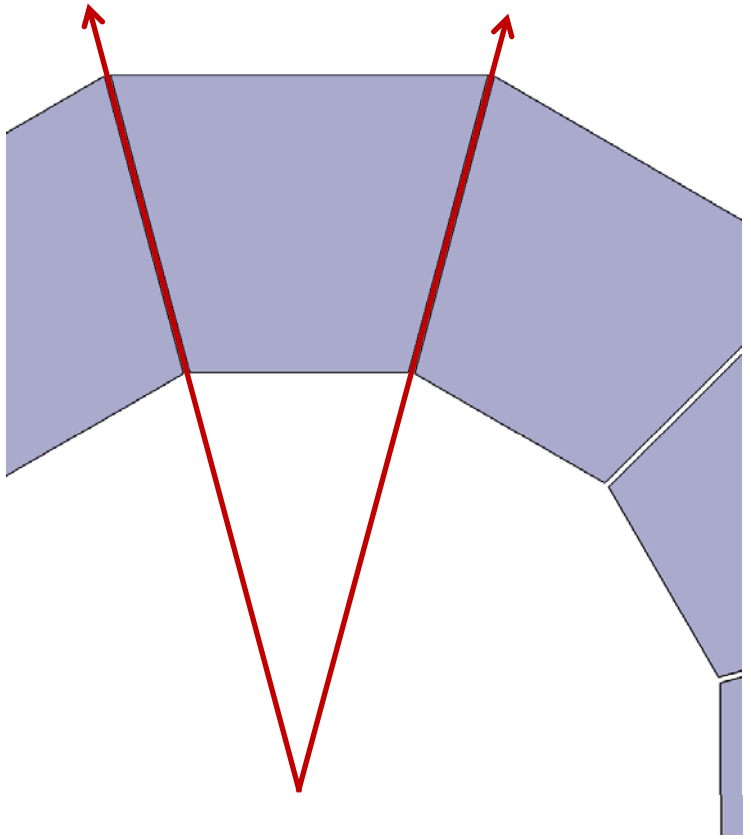
Study of a new Hcal geometry…

…motivation: « cracks » in the calorimeter

(muons are lost, hadrons ?)



Classical geometry



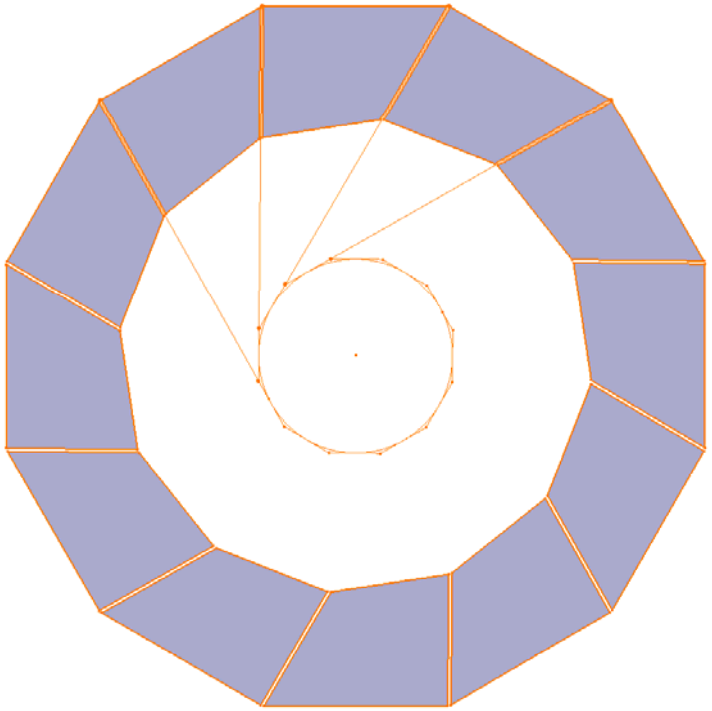
Study of a new Hcal geometry…

In order to avoid cracks, the edges should not point to the center of the barrel

➡ ***Proposal of a tilted geometry***

*The edges are **tangent to a circle**, centered on the beam axis*

*The **circle radius** is the parameter which determinates the tilt level*

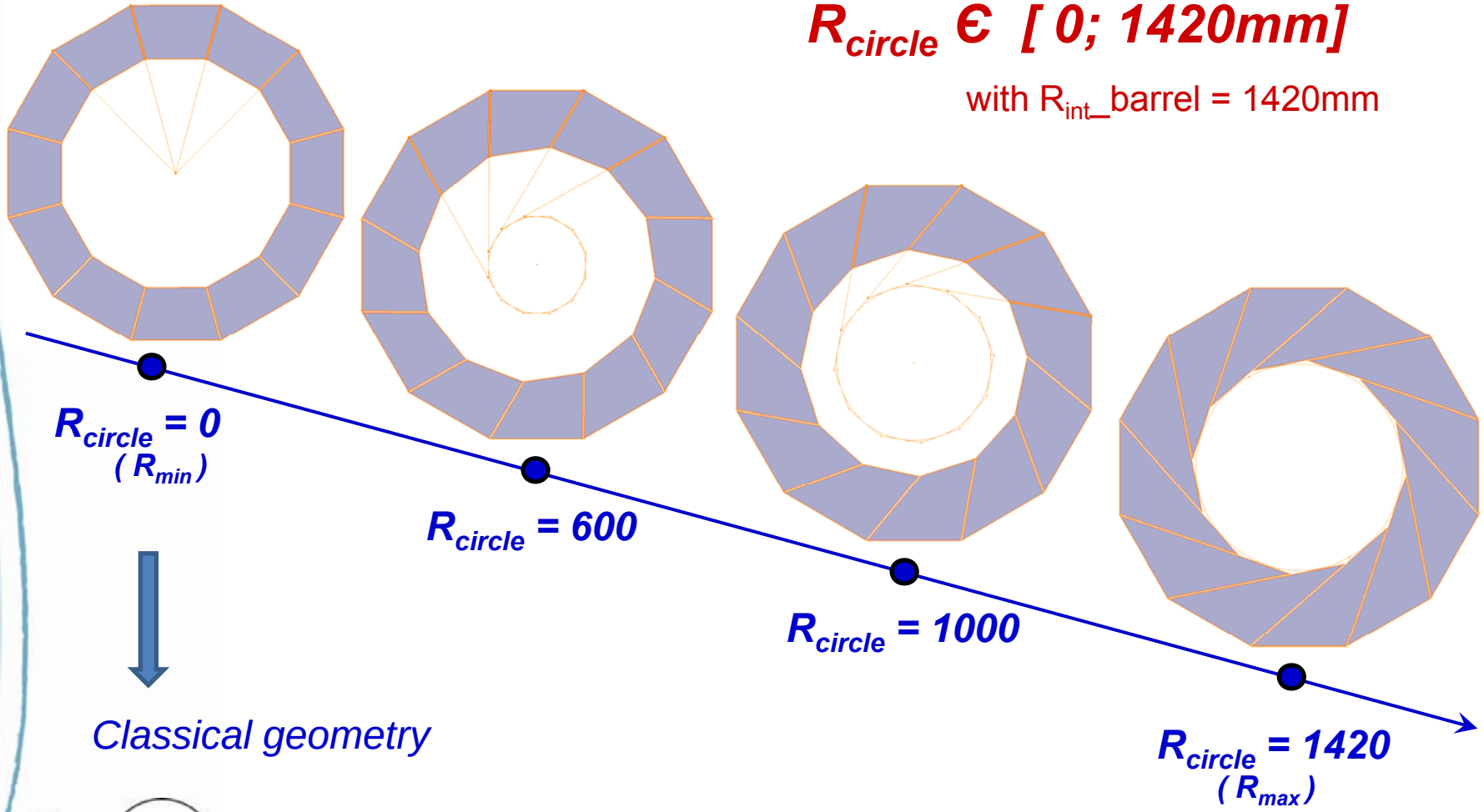


Study of a new Hcal geometry…

Examples of tilt level as a function of the tangent circle radius

$R_{circle} \in [0; 1420mm]$

with R_{int}_barrel = 1420mm



Classical geometry

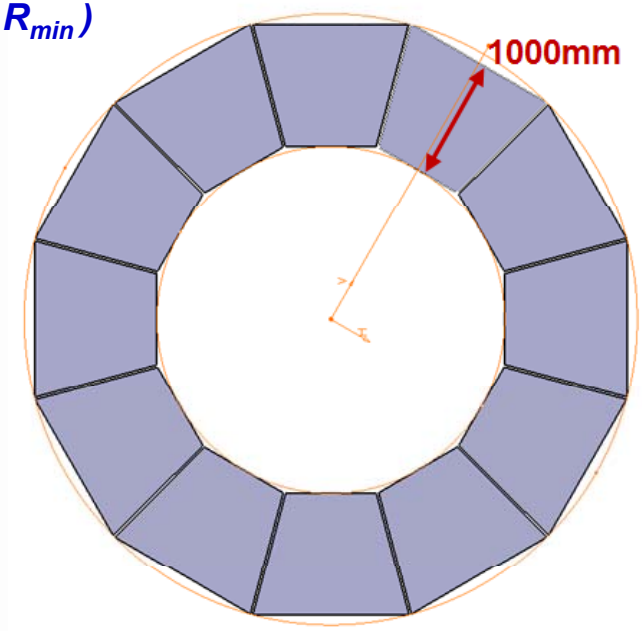
Tilt consequences

➡ ***The external radius of the Hcal is a function of the tilt…***

Comparison of R_{ext} for a given Barrel minimal thickness (= 1000mm) :

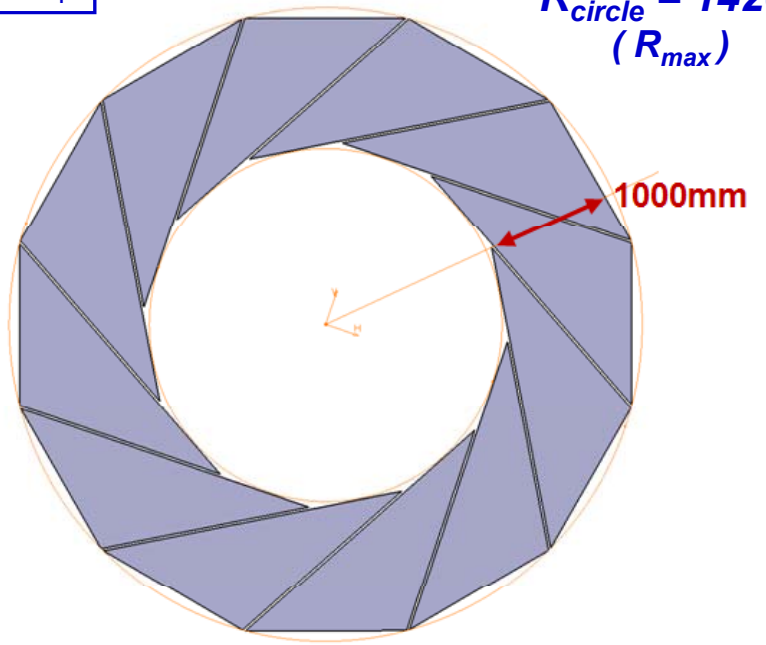
1000mm ≈ $4.\lambda_i$

R_{circle} = 0
(R_{min})



R_{ext} = 2505 mm

R_{circle} = 1420
(R_{max})

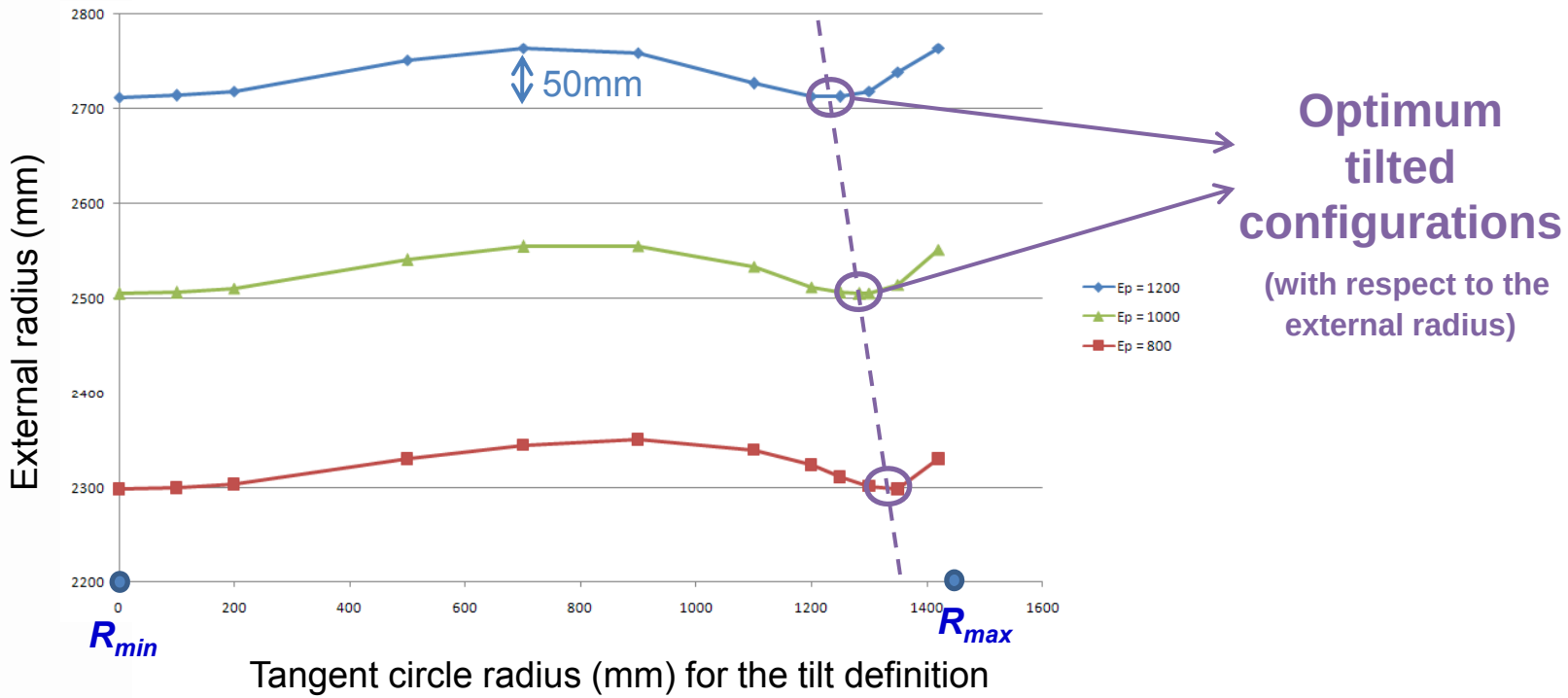


R_{ext} = 2552 mm

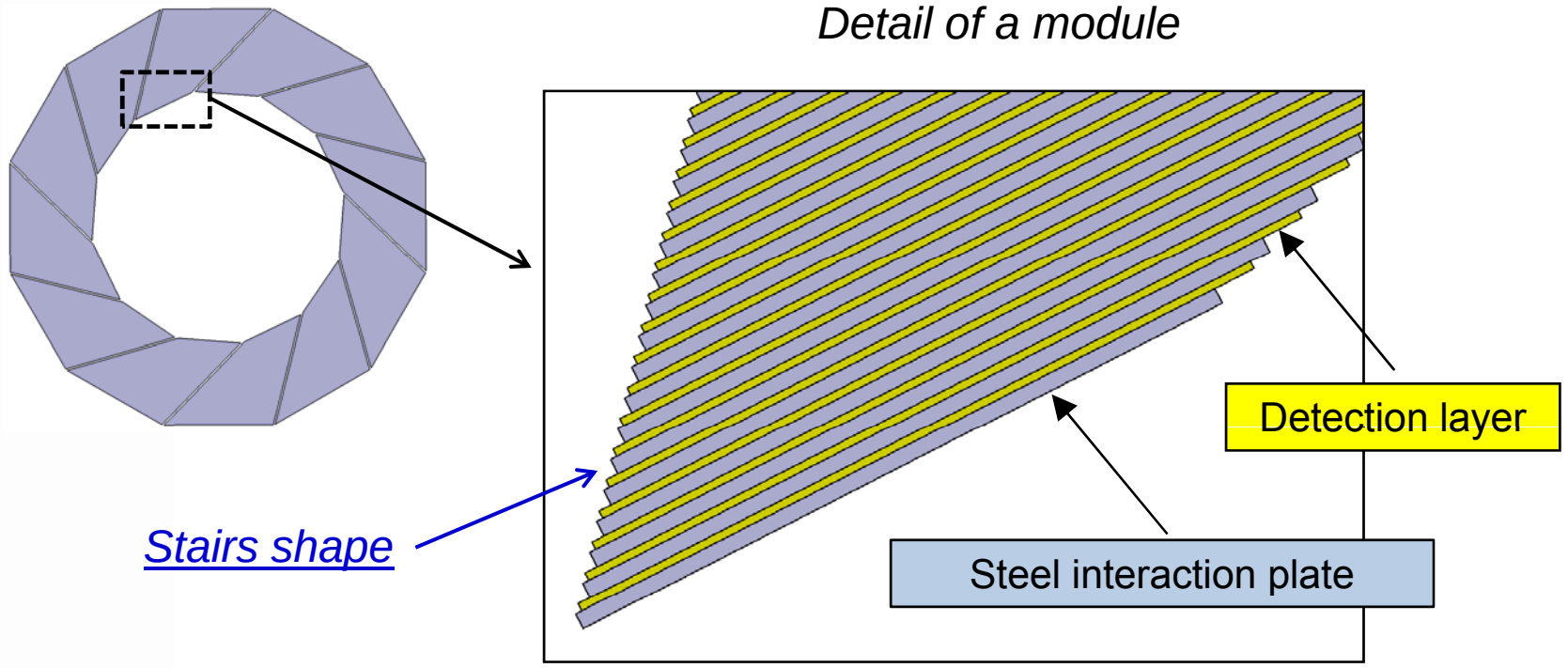
Tilt consequences

The external radius of the Hcal is a function of the tilt…

Evolution of R_{ext} for three Barrel minimal thickness (1200, 1000, 800 mm) :



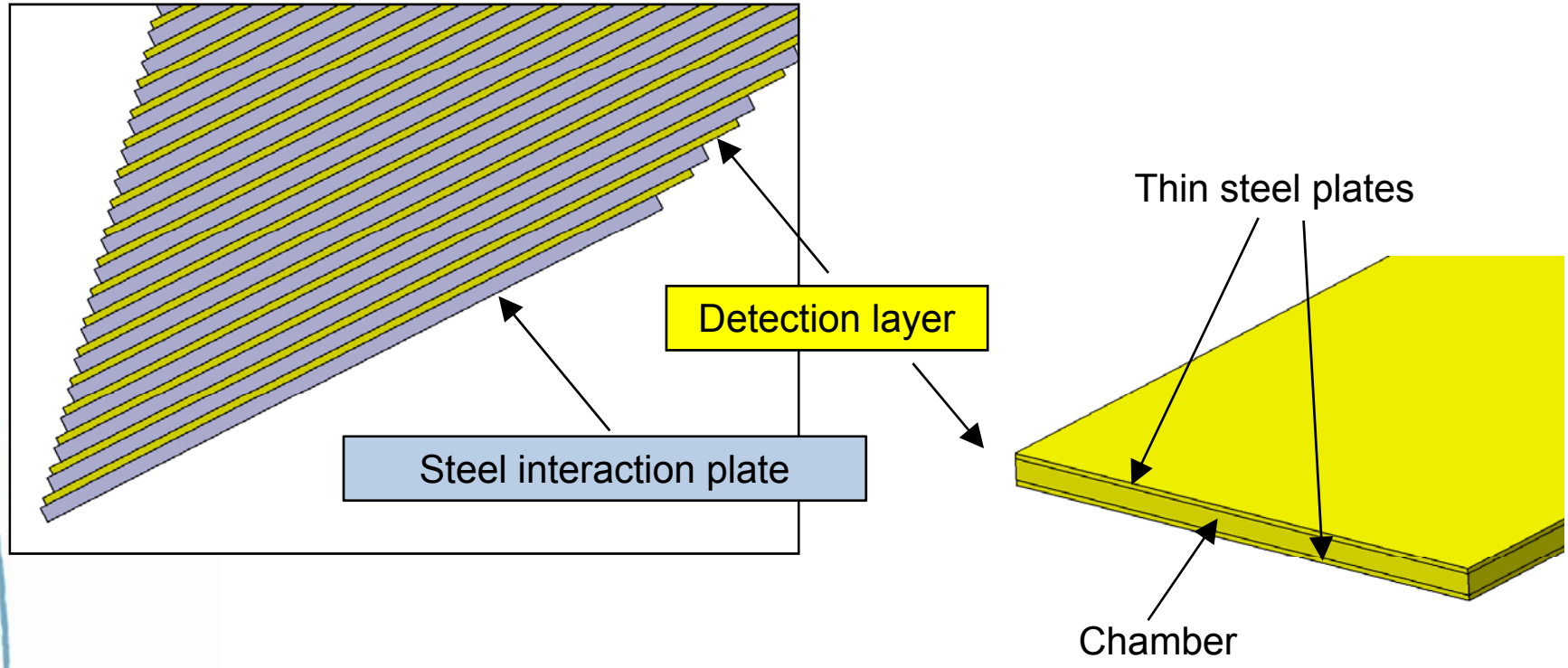
Proposal of Hcal assembly



Objective : to fix the steel plates together to obtain a structure in which the detection layers can be inserted (like drawers).

Proposal of Hcal assembly

Detail of a detection layer

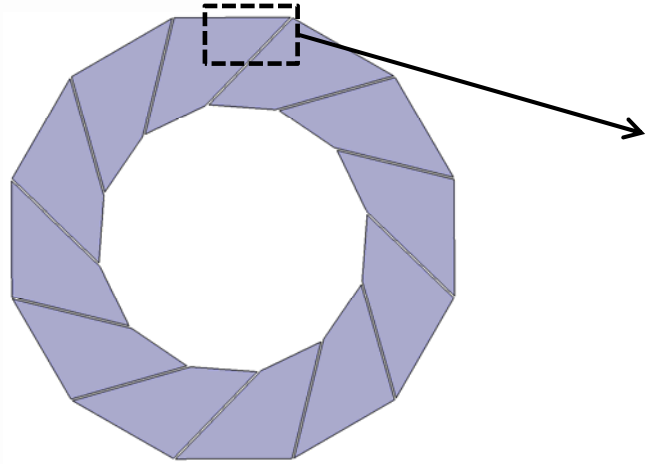


A detection layer (“composite part”) consists in a chamber rigidified with two thin steel plates.

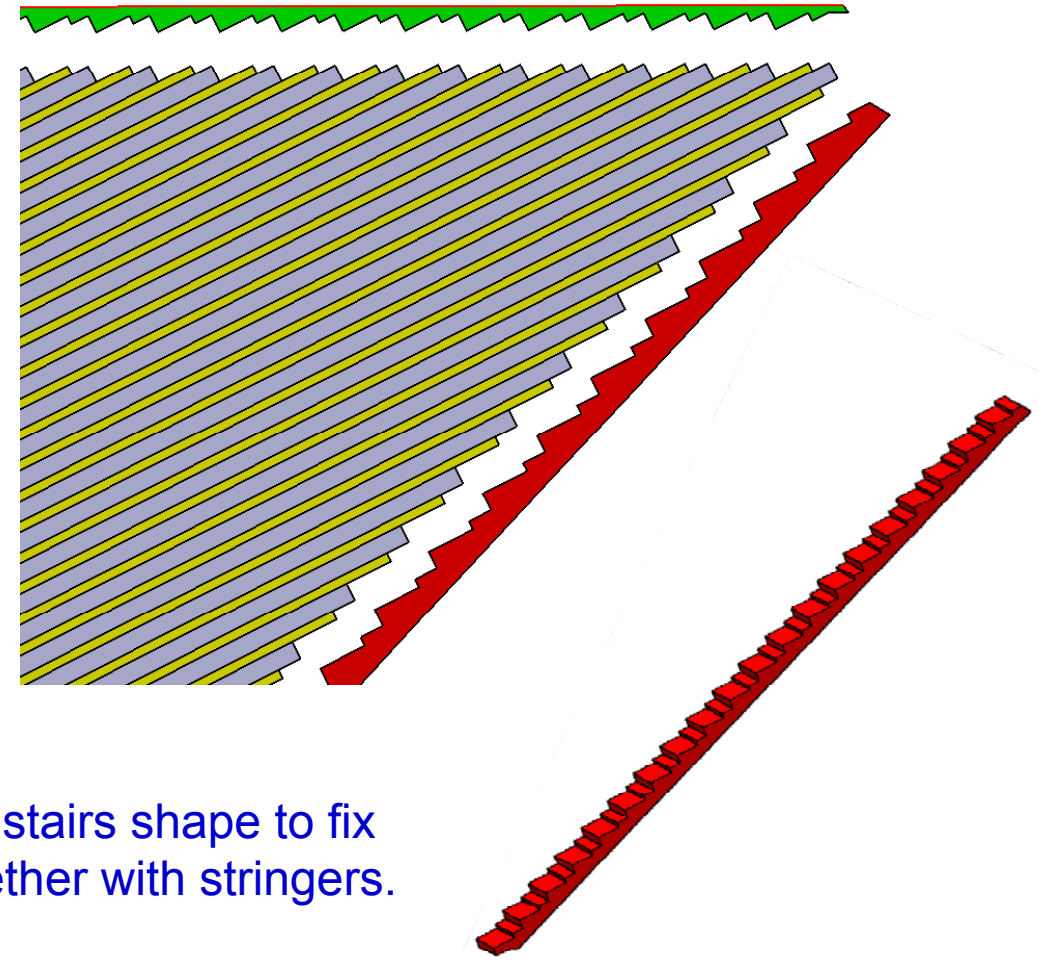
→ **Protection and stiffness !**

Proposal of Hcal assembly

Detail of a module assembly



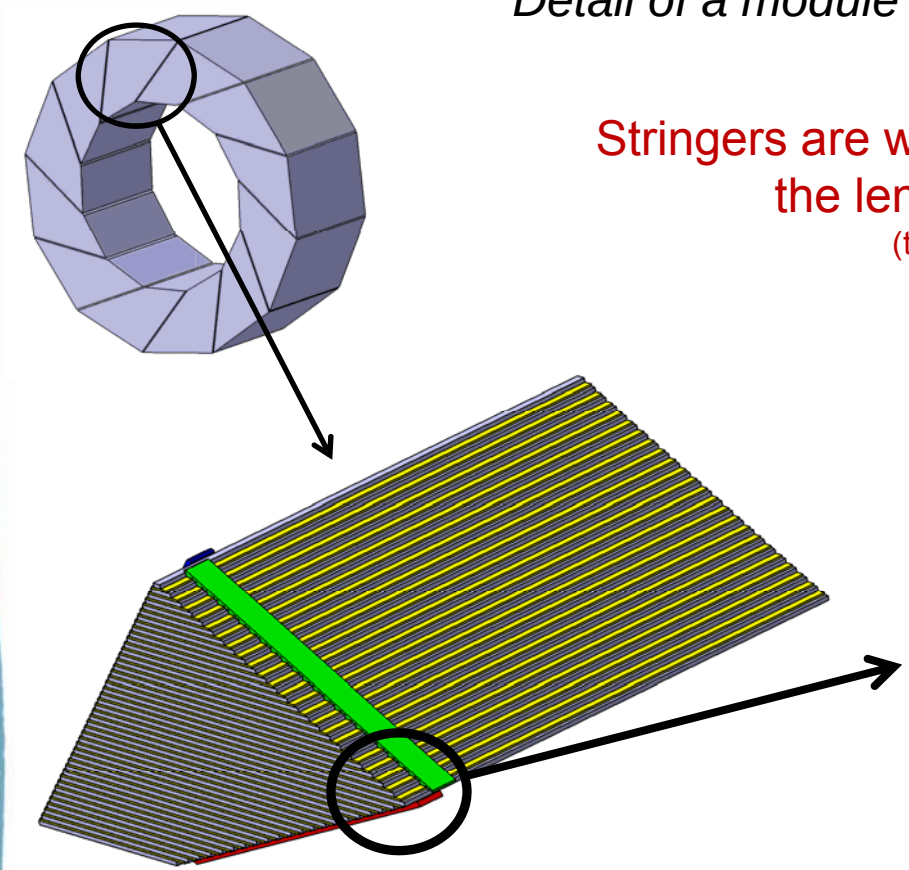
Complementary shape



Idea : to take advantage of the stairs shape to fix the steel interaction plates together with stringers.

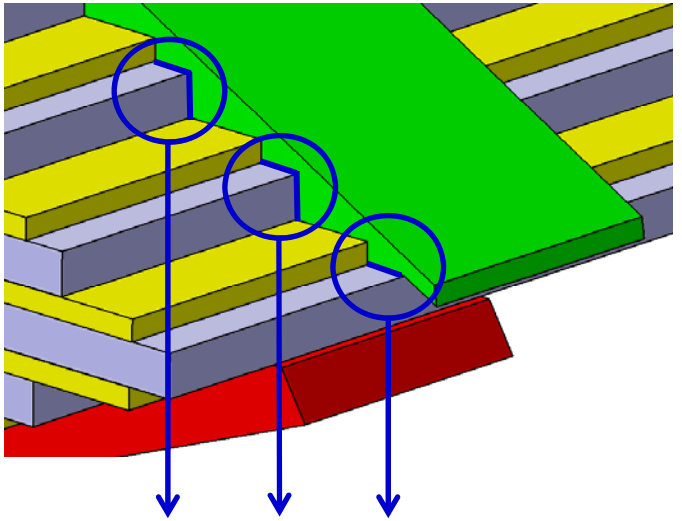
Proposal of Hcal assembly

Detail of a module assembly



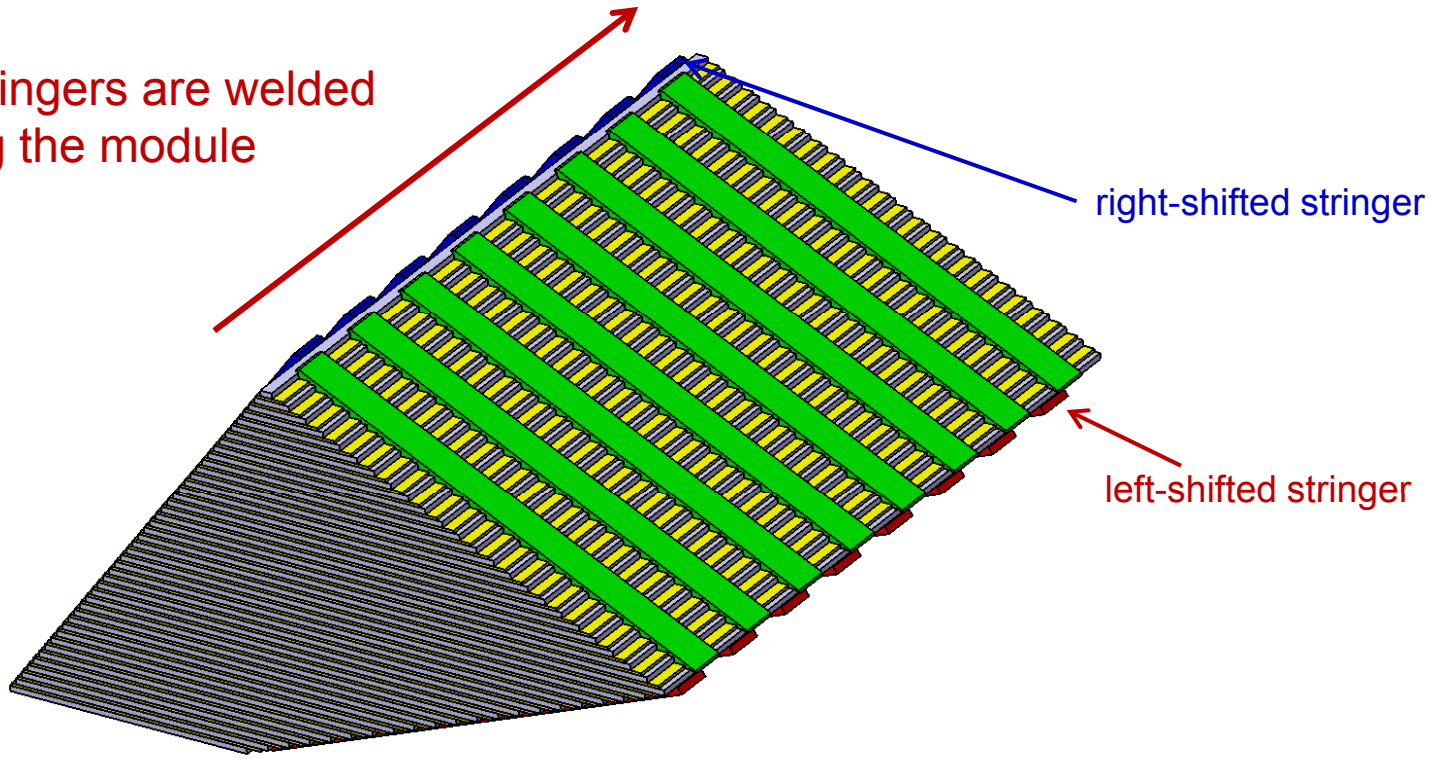
Stringers are welded on the both sides, all along the length, on interaction plates

(to screw is possible as well !)



Welding localization

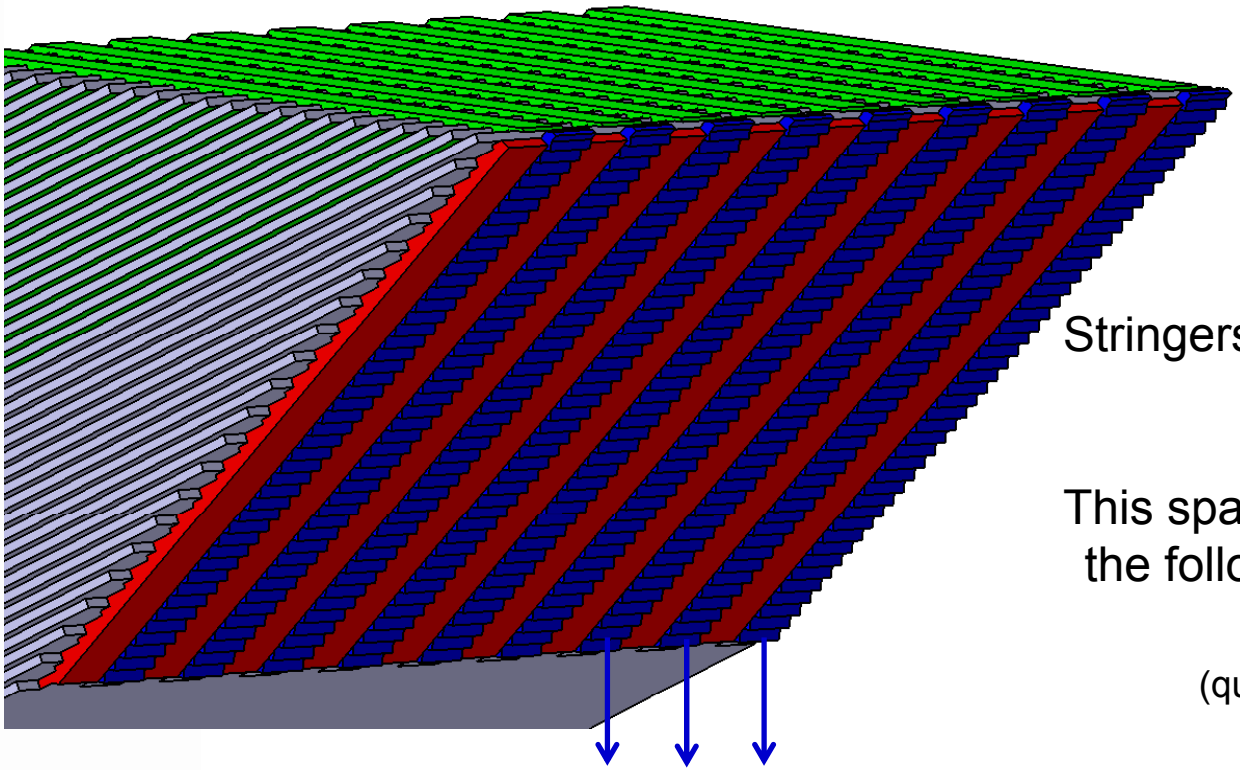
Proposal of Hcal assembly



Note that a thin protection plate welded between 2 consecutive stringers could be a good solution to protect the detection layers.

➡ Each module is thus a stiff structure in which chambers can be inserted

Proposal of Hcal assembly



Stringers of the following module (in blue)

Stringers of a module are all shifted.

This space is for stringers of the following module to be inserted

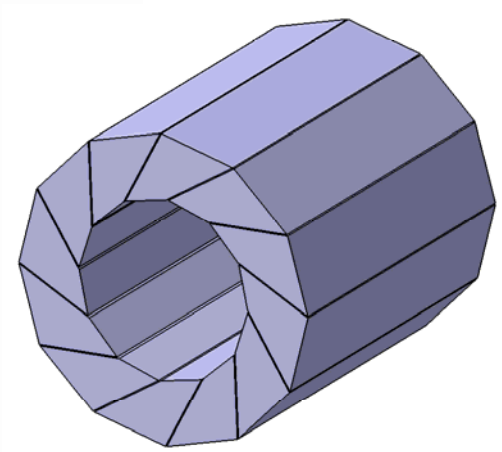
(quincunx assembly)

All the volume between two consecutive modules is filled with steel stringers

→ No “air” gaps !

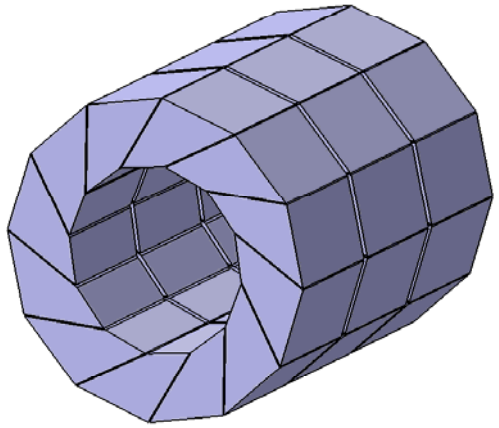
Barrel Design

Option 1:



12 modules :
length = 5560 mm

Option 2:



3 * 12 = 36 modules :
length = 5560mm / 3
(≈1850 mm)

- ***Benefit :*** Mass / module ≈10 tons (easier to mount & move)
  Smaller chambers
- ***Drawback :*** Foresee cables & pipes ways between 2 slices
  Transverse joints (à la CMS…)

Prospectives

- Physics -

Is the tilt necessary ?

Perform detector simulations (Geant 4,…)

Which tilt value ?

Perform detector simulations (Geant 4,…)
Check external radius of Hcal (geometrical issue)

Prospectives

- Mechanics -

Design (CAD) :

Assembly of the 12 modules together
Fixation of the ECAL on the HCAL structure
Fixation of the whole (HCAL + ECAL) structure

Finite Element Analyses (FEA) :

Computations of displacements/stresses of the structure
Optimization of the stringers thickness
(= maximization of the size of the chambers)