Mechanical structure for technological SDHCAL prototype

Goals :

1- To conceive and build a self-supporting mechanical structure.

2- The concept can be extended to ILD and SiD

3- Keep cost as low as possible without deteriorating the performance.

We have a baseline structure and we are improving on

DHCAL m3 module and for ILD

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Arlington
11 March 2010

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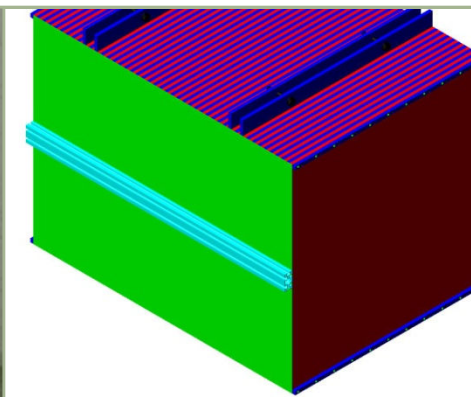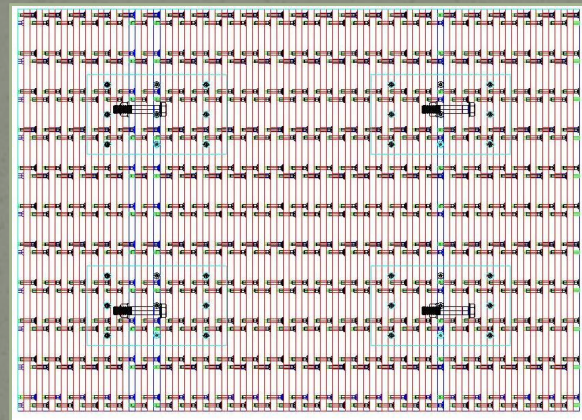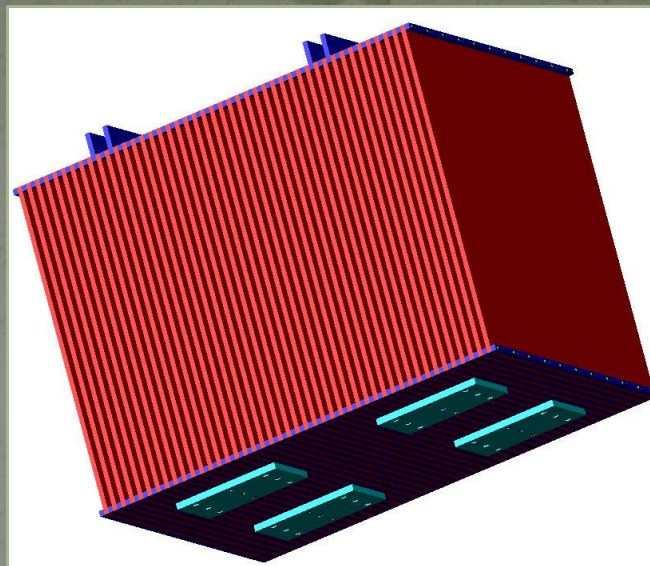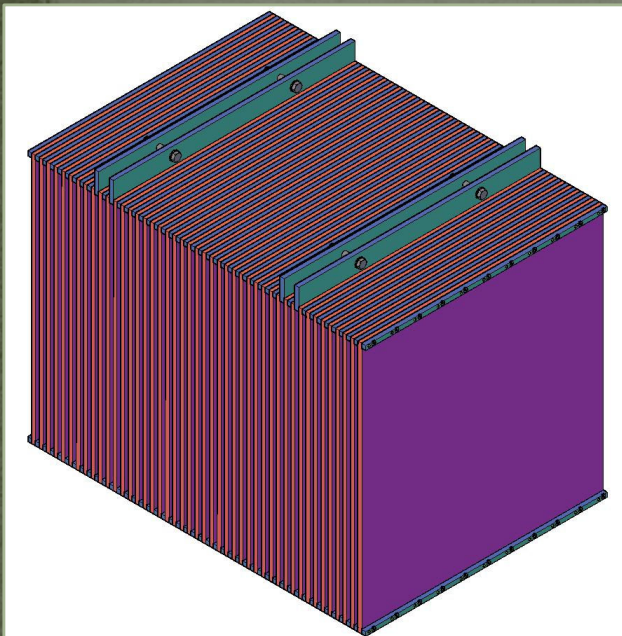
Mechanical structure assembled, parameters:

- 44 slots can host 44 detectors.
- Structure is composed of only 2 different kinds of pieces. Attachment is done using M8 screws, 11+11 bolts between layer.
- Base support pieces and the manipulation fixations (By 2 bolts of M20) to fix on the stage
- A cover and/or a piece to position the modules.
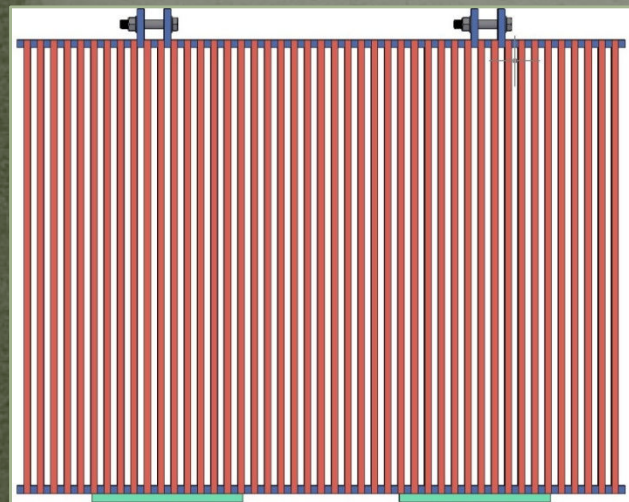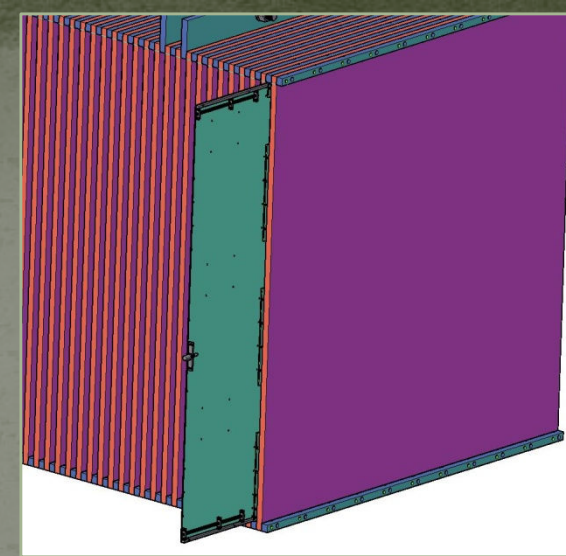
GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN
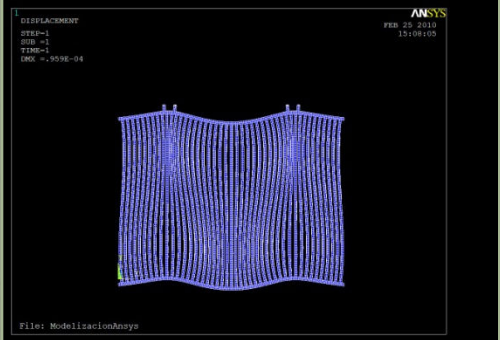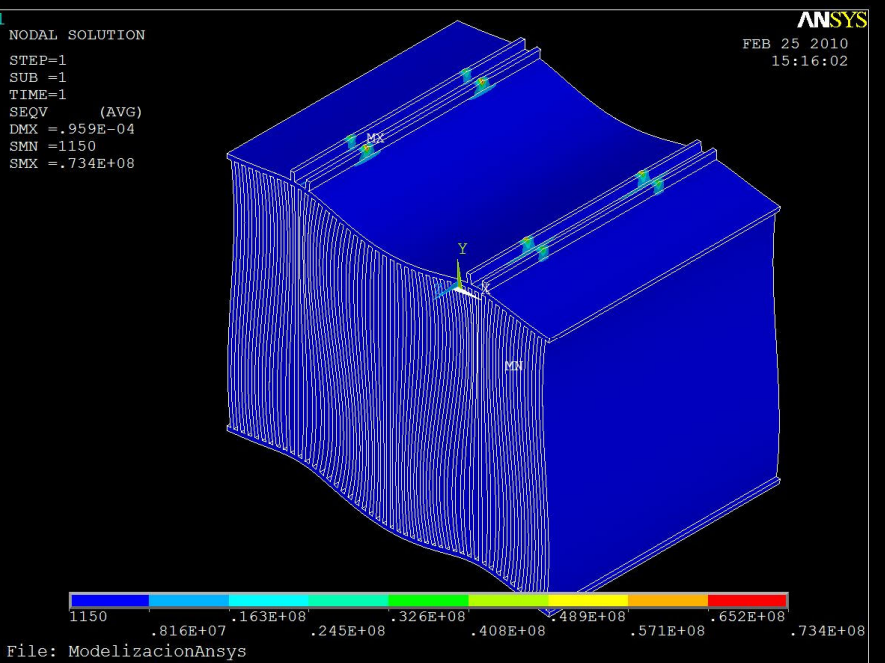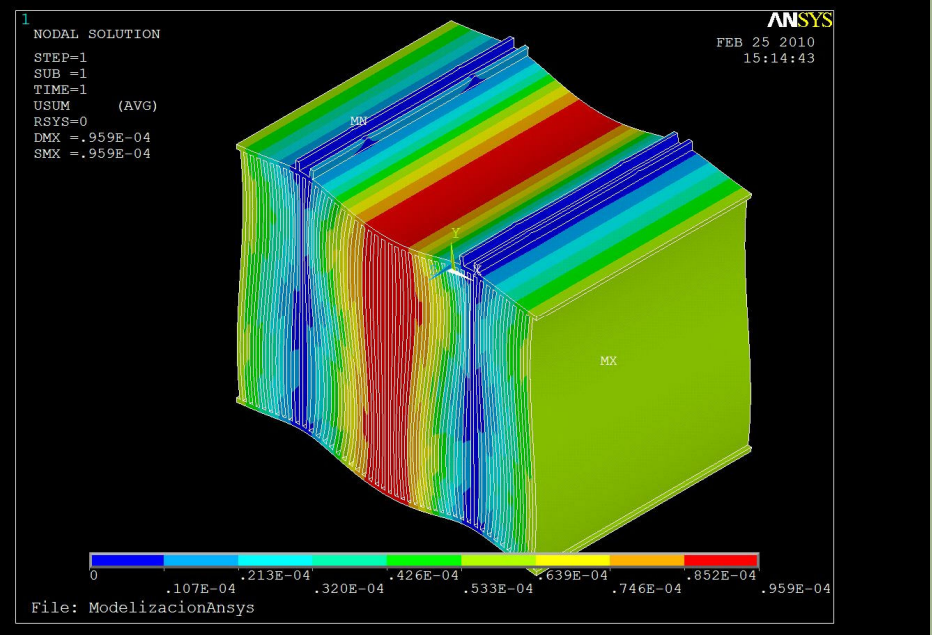
Ciemat
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

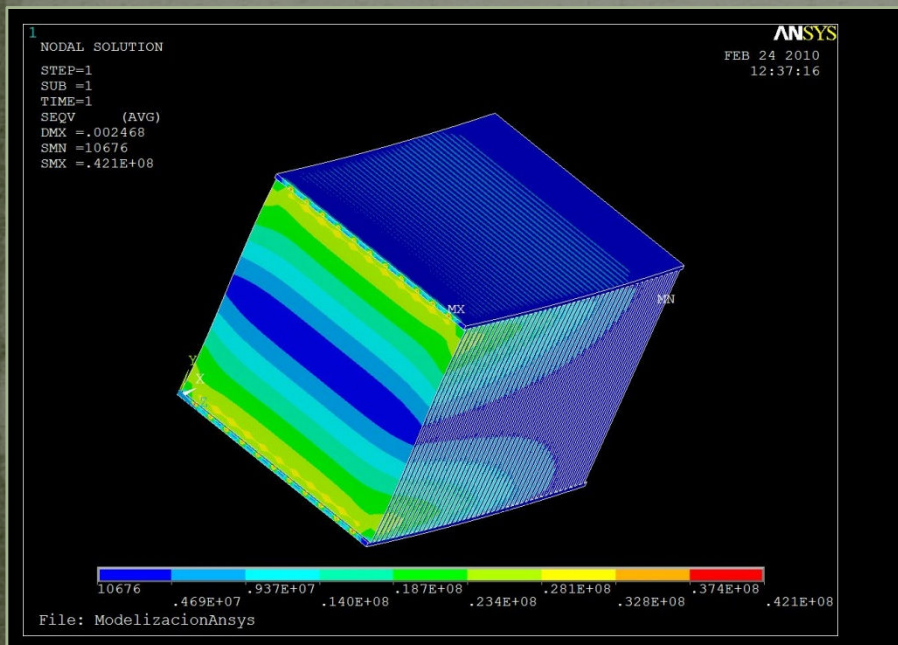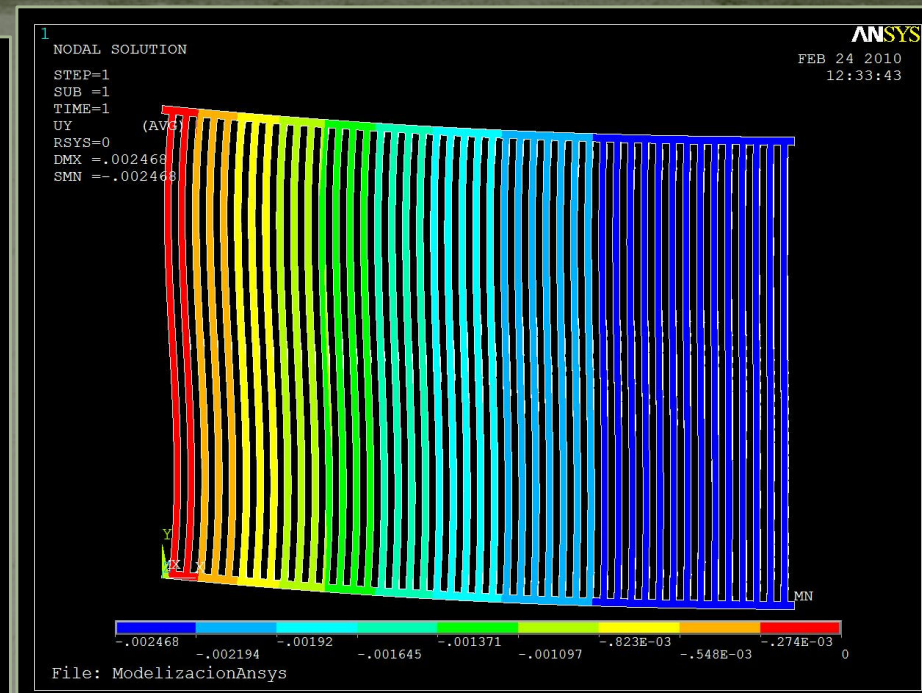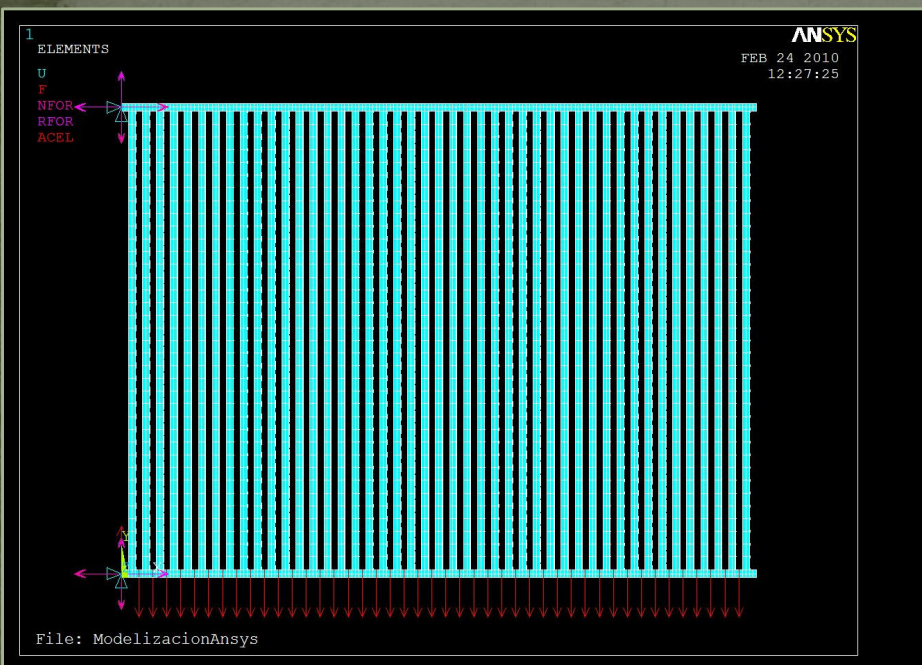# 2.- Numerical simulations for a m3 module.
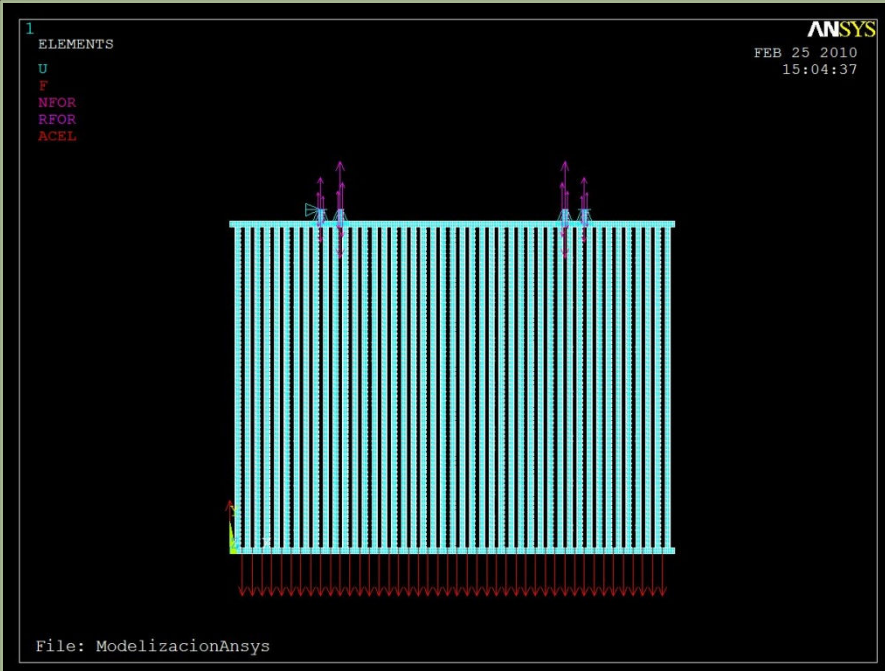
Deformation and stress:

- Calorimeter supported on the 4 big bolts on the top.
- Charged with 44 modules of about 50 kg.
- Max. deformations are about 100 microns.
- The punctual max. stress it is only 74 Mpa, well away from the elastic limit of the material (stainless steel)
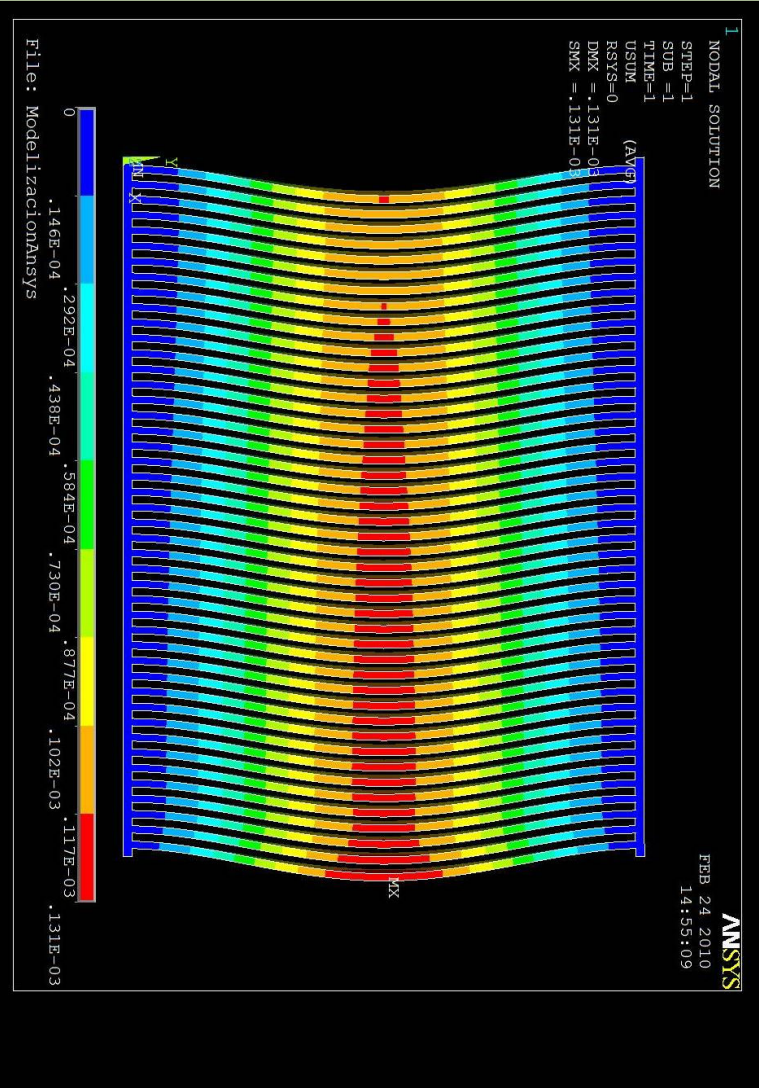
2.- Numerical simulations for a m3 module.

File: ModelizacionAnsys

NODAL SOLUTION
STEP=1
SUB =1
TIME=1
UY   (AVG)
RSYS=0
DMX =.002468
SMN =-.002468

File: ModelizacionAnsys

NODAL SOLUTION
STEP=1
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SEQV   (AVG)
DMX =.002468
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SMX =.421E+08

File: ModelizacionAnsys
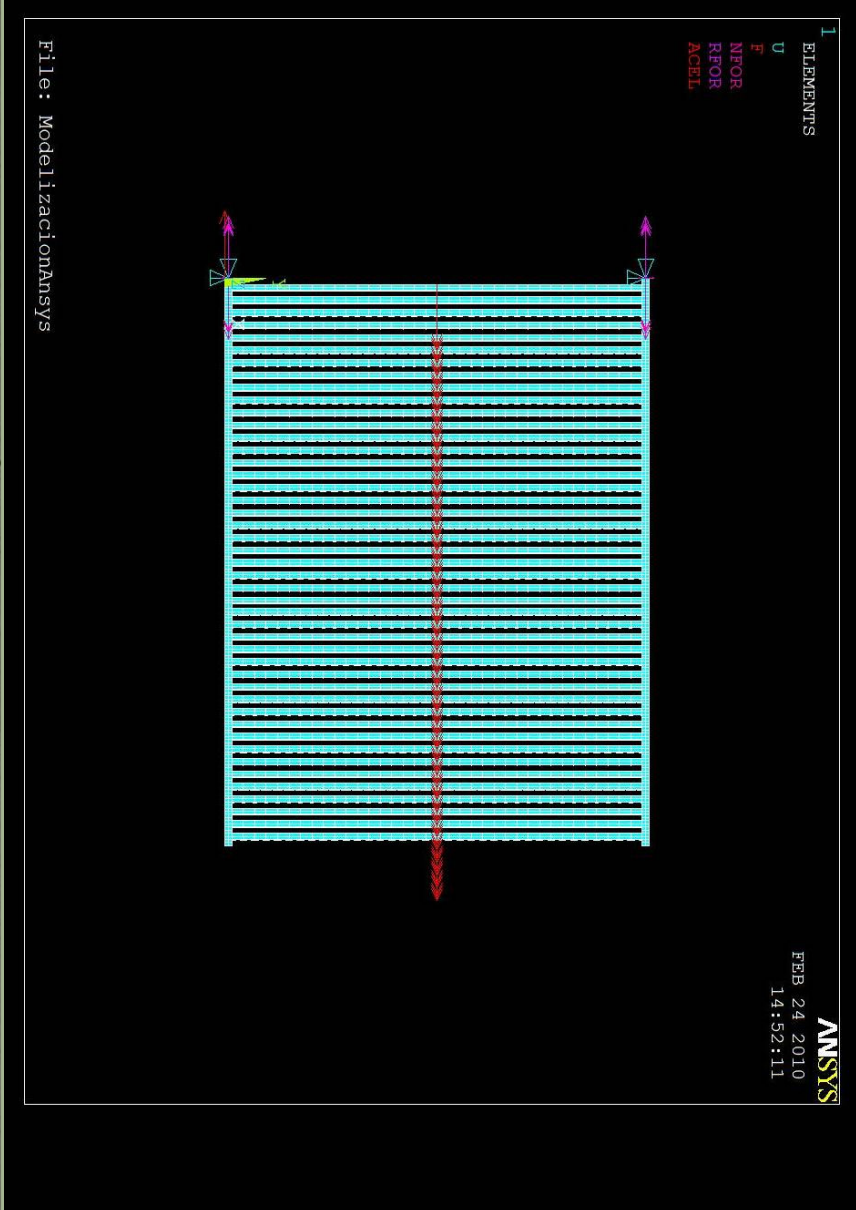
Deformation and stress with several suppositions:

- *fixed on the one lateral side from the M8 bolt.*
- Charged with 44 modules of about 50 kg.
- The max. reactions on the M8 bolts on the lateral side are:
- Fx= +/- 5257 N
- Fy= - 3980 N
- Fz= +/- 300 N
- M8 bolt have the elastic limits, function of the material, between about 10000 N to 40000 N.
- And the pre-stressed forces are between 8200 N to 27000 N.
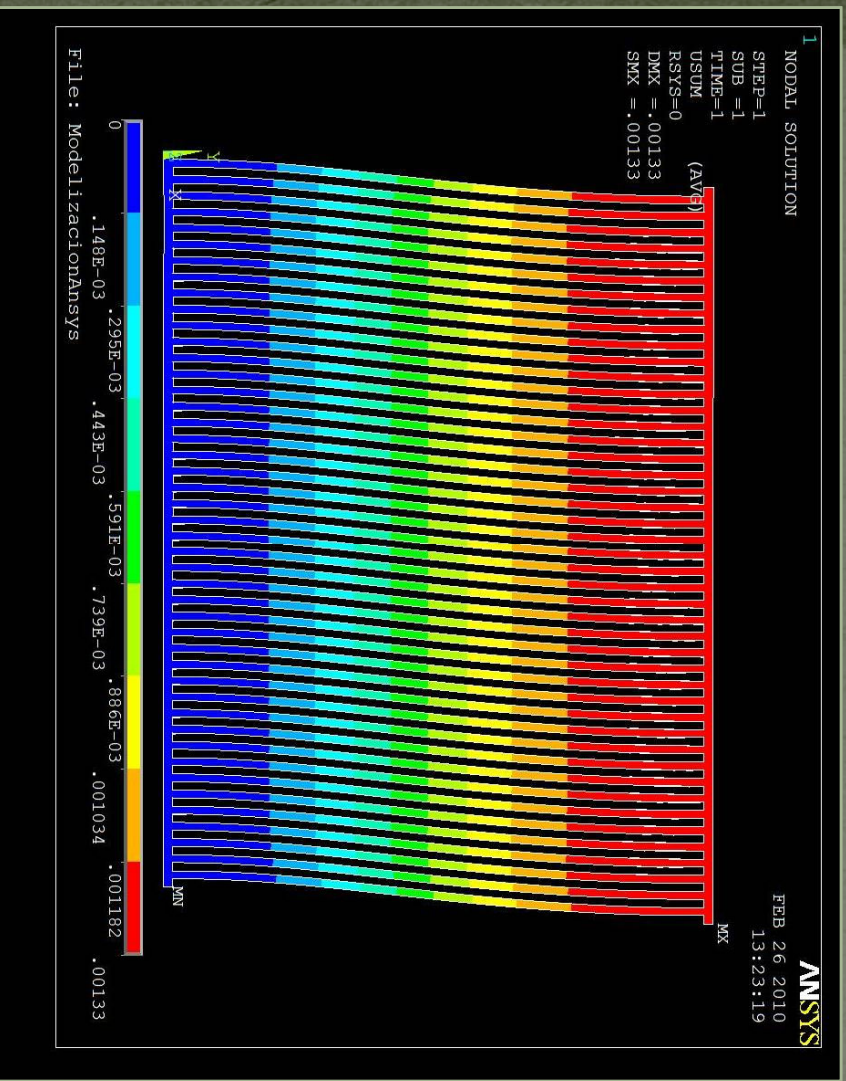
2.- Numerical simulations for a m3 module.

Deformation and stress with several suppositions:

- *fixed on the one lateral side from the M8 bolt, rotated 90º.*
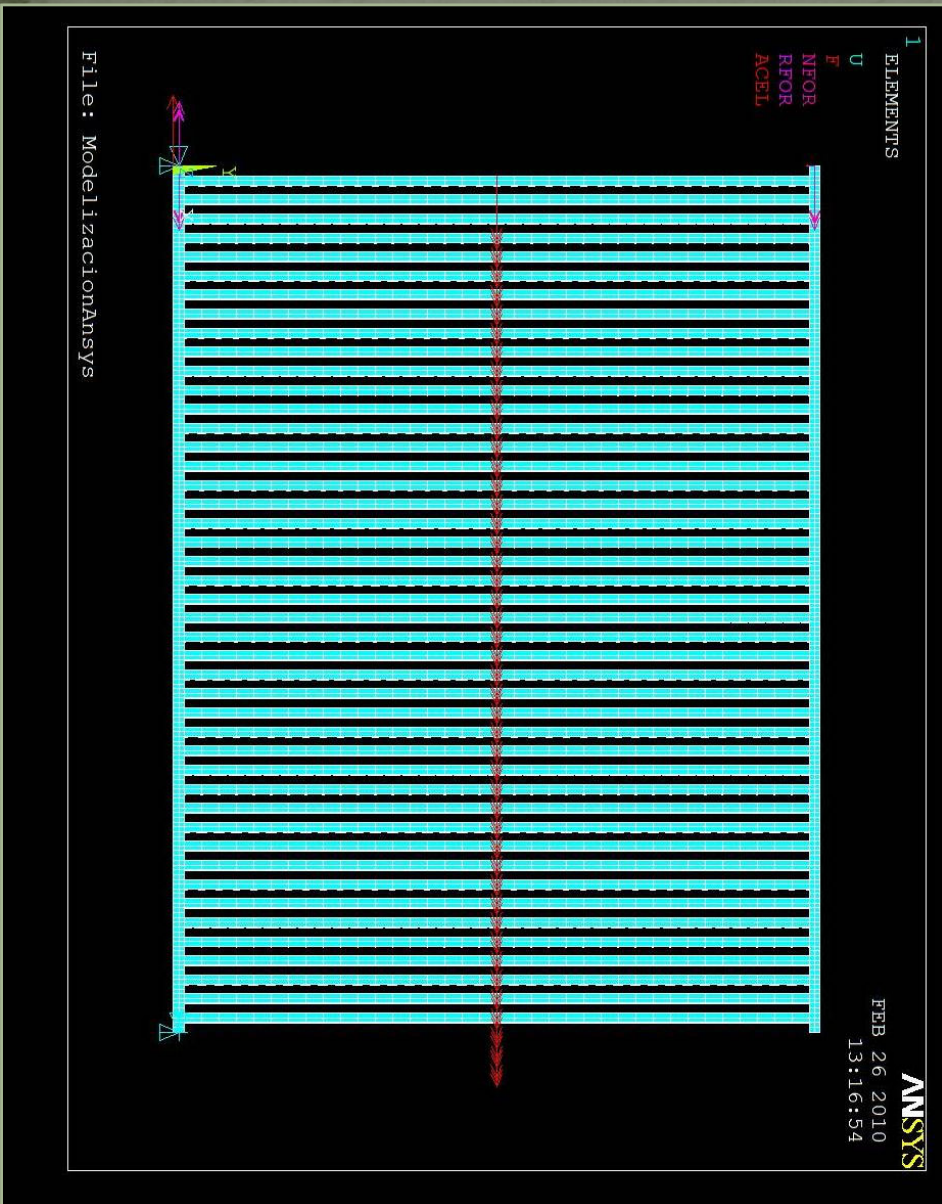- Charged with 44 modules of about 50 kg.
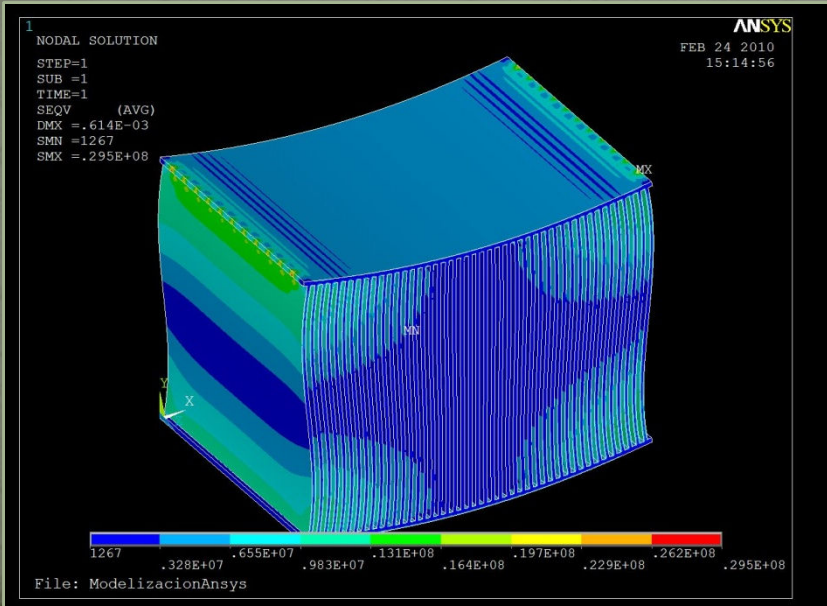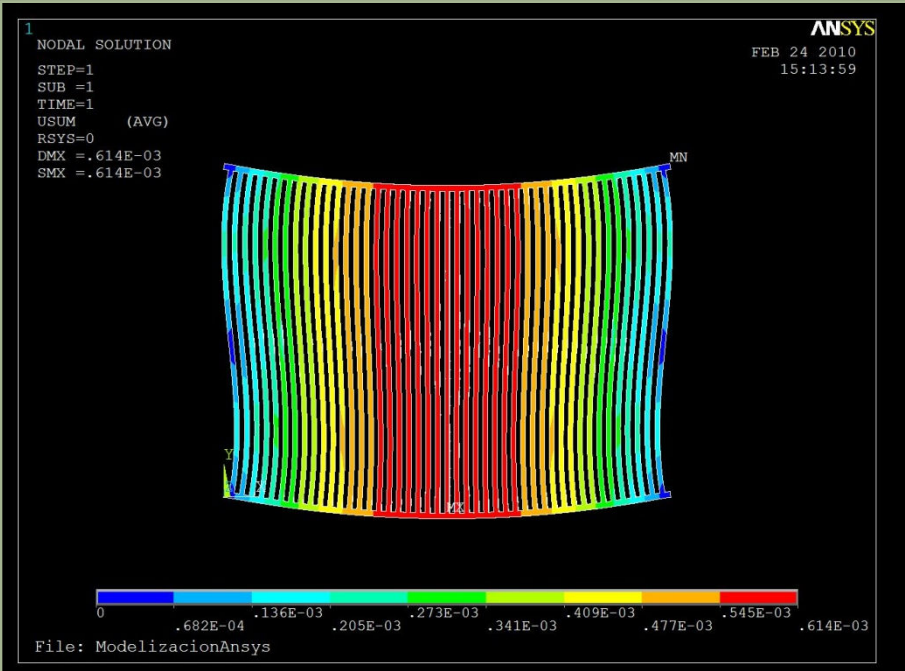
2.- Numerical simulations for a m3 module.

Deformation and stress with several suppositions:

- *fixed on base side from the M8 bolt, rotated 90º.*
- Charged with 44 modules of about 50 kg.
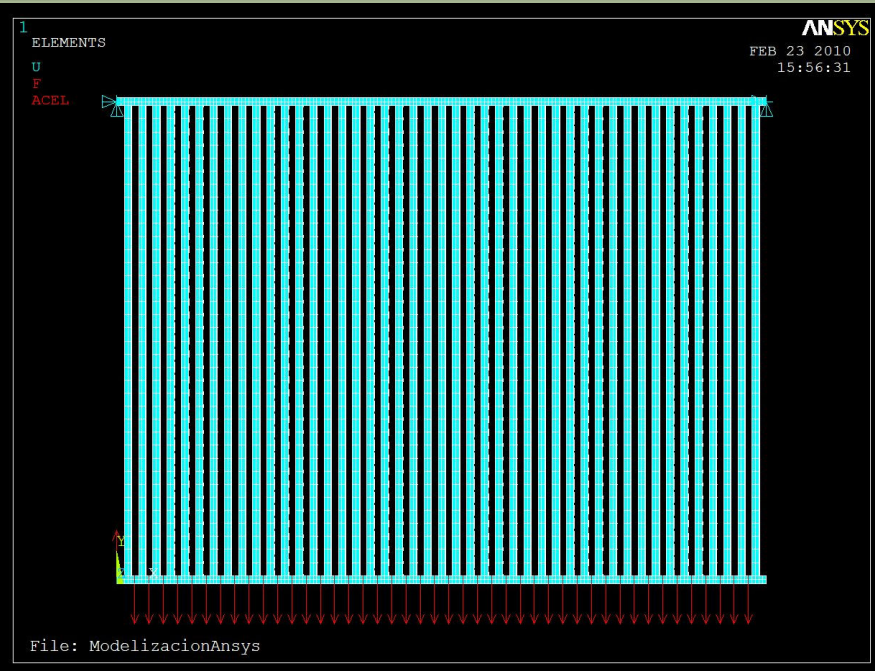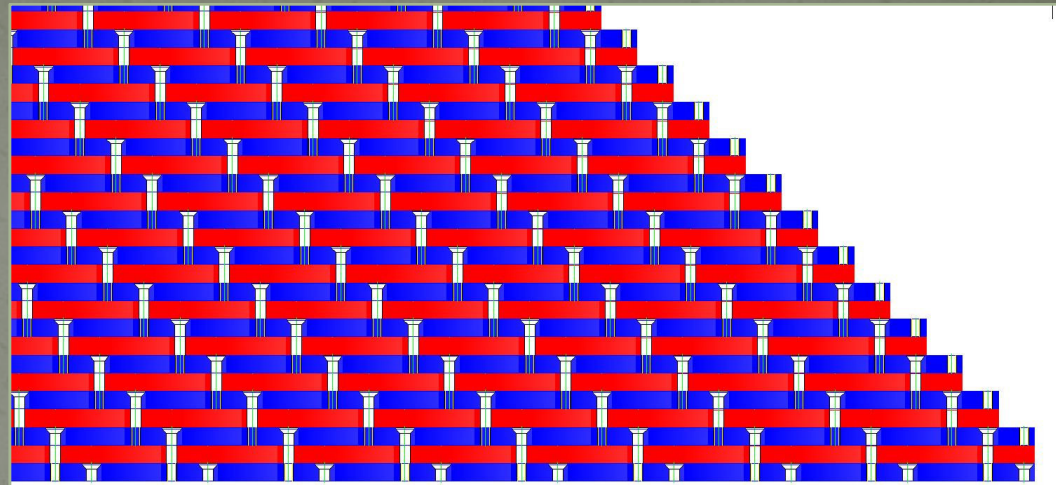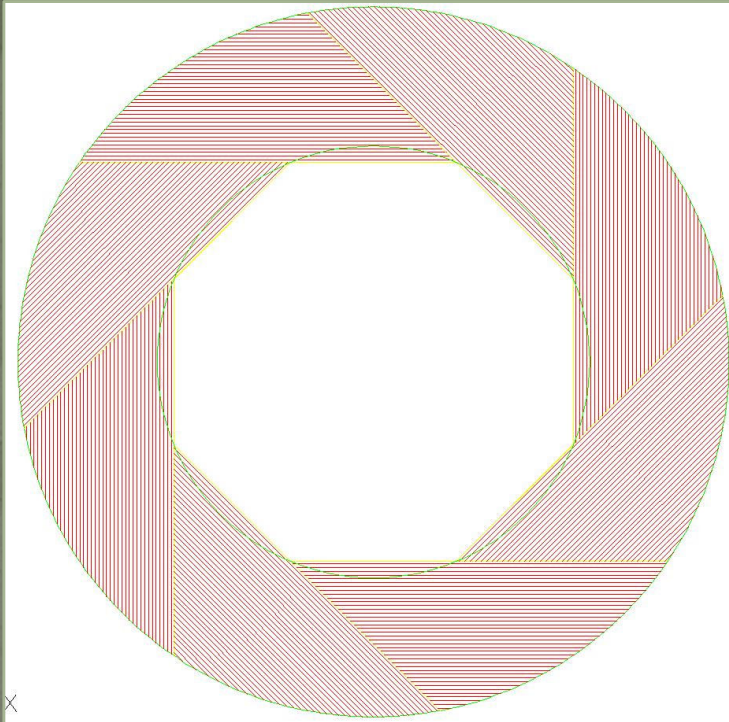
2.- Numerical simulations for a m3 module.

Deformation and stress with several suppositions:

- *fixed on top side from the M8 bolt.*
- Charged with 44 modules of about 50 kg.

Distribution propose for different DHCAL modules for the ILD:
(Not take into account the modular Length of the GRPC or MICROMEGAS, for this proposal)

Front view

Lateral view

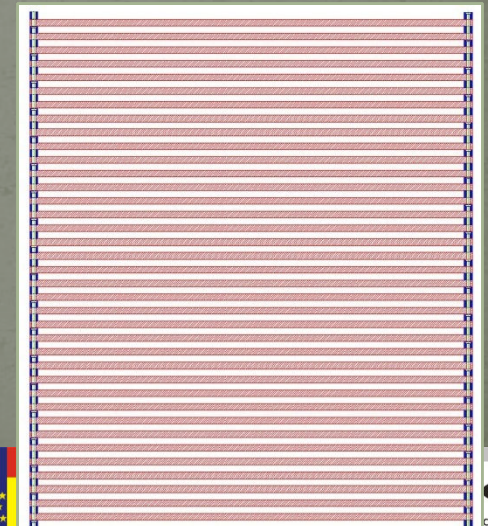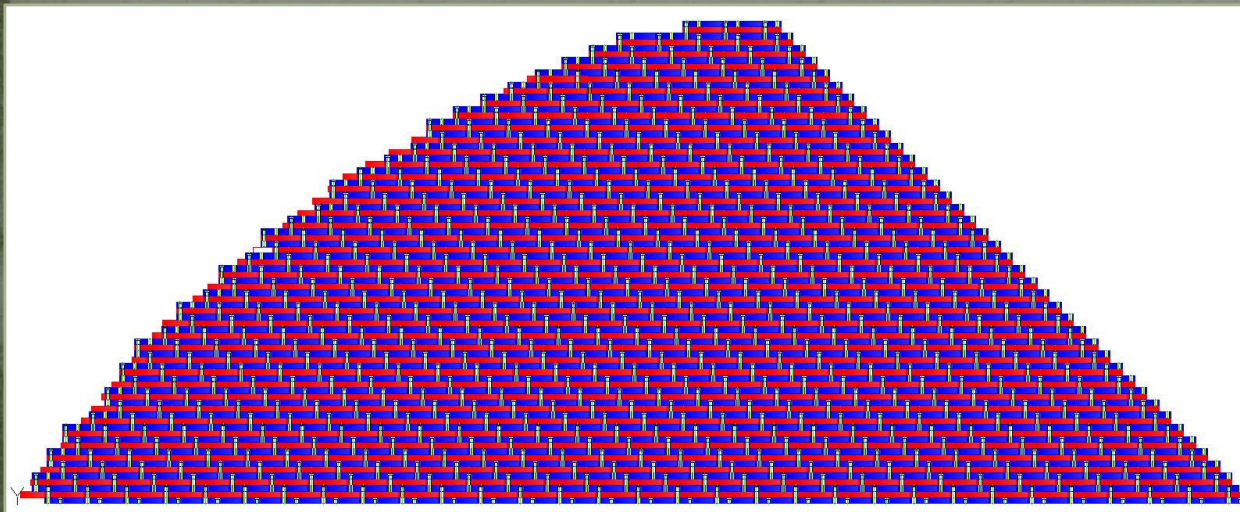# 3.- Extrapolation of the m3 module philosophy for the ILD.

Distribution propose for different DHCAL modules for the SiD:

(Not take into account the modular Length of the GRPC or MICROMEGAS, for this proposal)
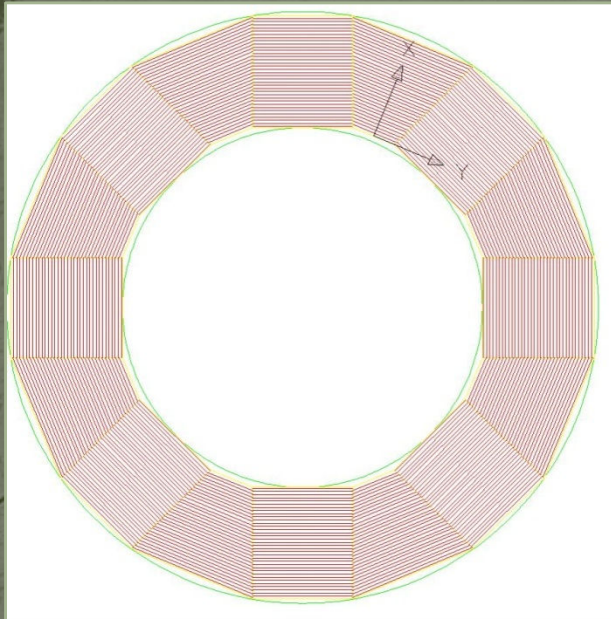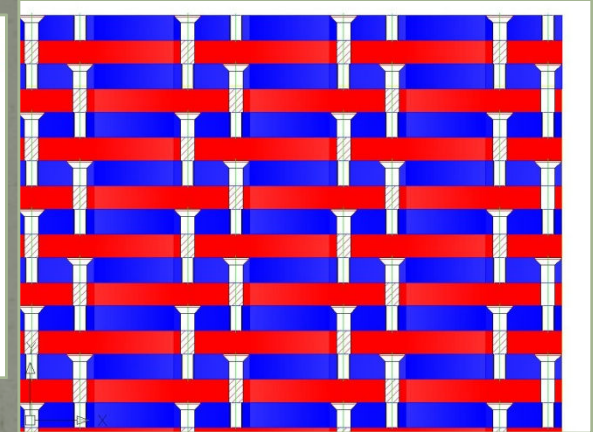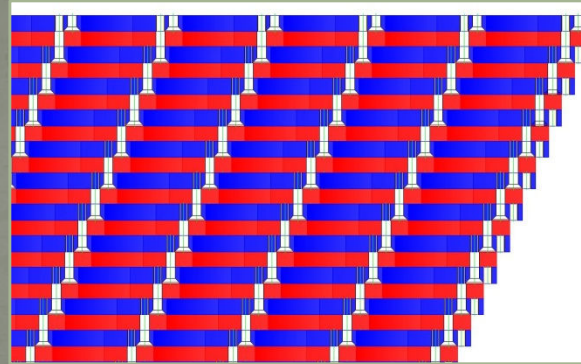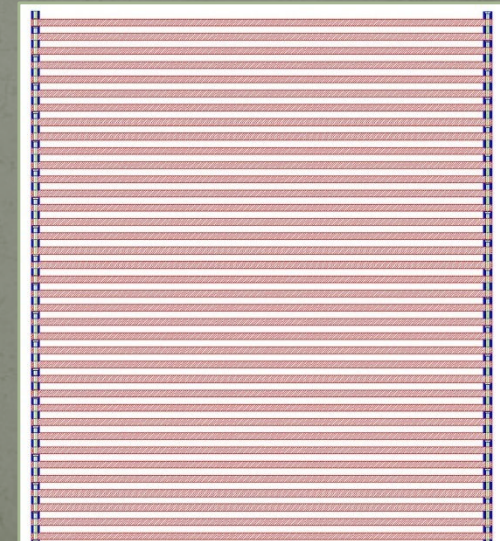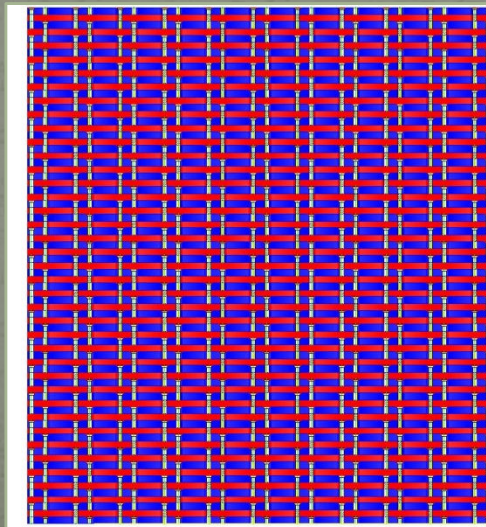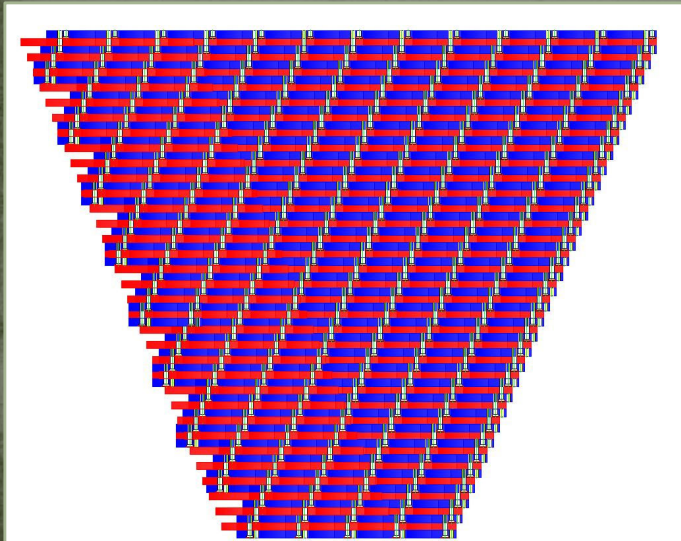

Front view

Front view
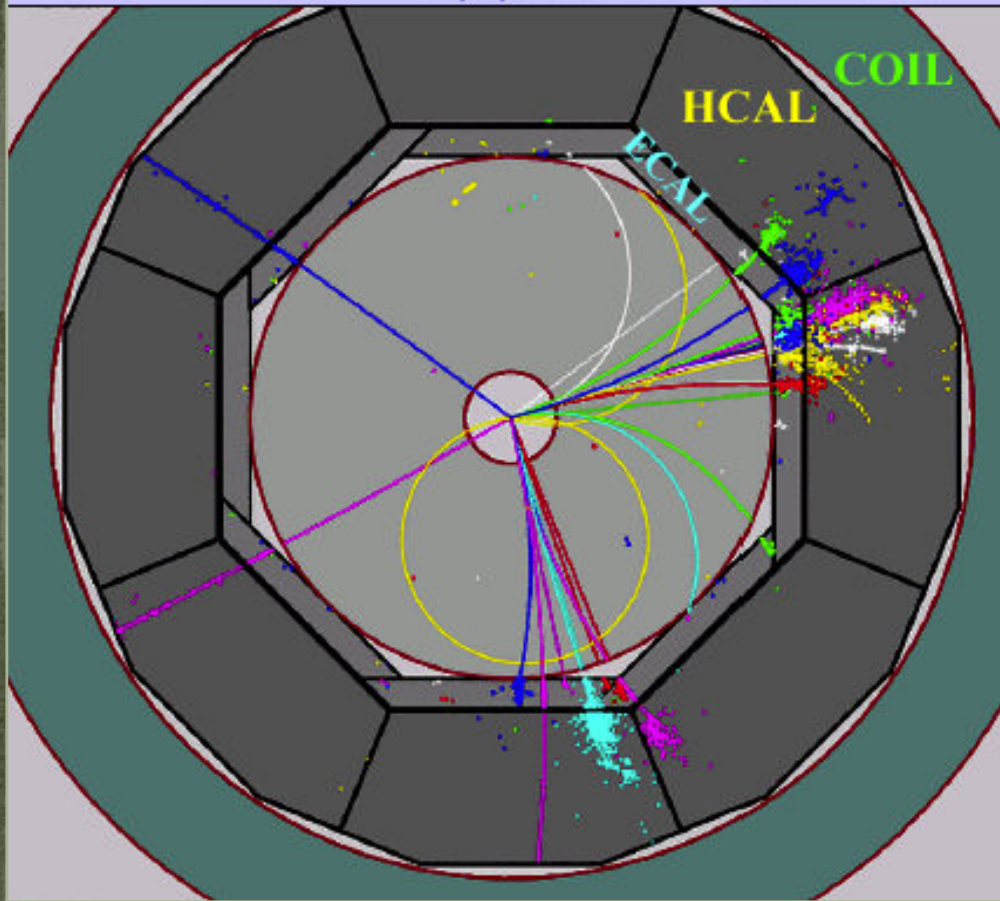
Lateral view

$e^+e^- \rightarrow ZH, Z \rightarrow \mu\mu$ at $\sqrt{s}$=500 GeV

COIL

HCAL

ECAL

Distribution propose for different DHCAL modules for the ILD:

This situation can be solved with a composition of the previous solutions.

AISI 304

- **Piece tipe 1.: ~45 pieces.**

  ~760 eur/piece (finalized)

- **Piece tipe 2.: ~92 pieces.**

  ~55 eur/ piece (Need to do holes/fillet on the milling machine)

- **Bolts. M8x40 inox : ~1000 units.**

  ~240 eur/1000 units

- **Rest of elements: Bolts M20x120+ 4 supports pieces for the top and 4 bases:**

  ~1000 eur/pack

- **Total cost 760x45+55x92+240+1000= 40500 eur.**

AISI 316L

cost of the material need to be incremented about 10%.

AISI 310-310S

cost of the material need to be incremented about 40% -100%.

Structure for a m3 module:

- Due to the standards thinness of the plates. The prices are much lowers in other kinds of stainless steel (316L or may be 310 or 310S).

- Only 2 different kinds of pieces to produce. With a minimum of machine operation on each piece. Prices and times much lowers.

- Very rigid structure, on different scenarios. 'Auto-portant' structure.

DHCAL for the ILD:

Can be adapted with the same philosophy to different modules dispositions.

Optional design

Vis M5 x 10

Vis M8 x 20 Classe 10-9

Design M3 03-03-2010 BONNEVAUX Alain IPN Lyon