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

Impact of the various HCAL mechanical designs on its physics performance (second look)

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In2p

Objective

Find the optimal mechanical design for HCAL which takes into account engineering as well as physics aspects

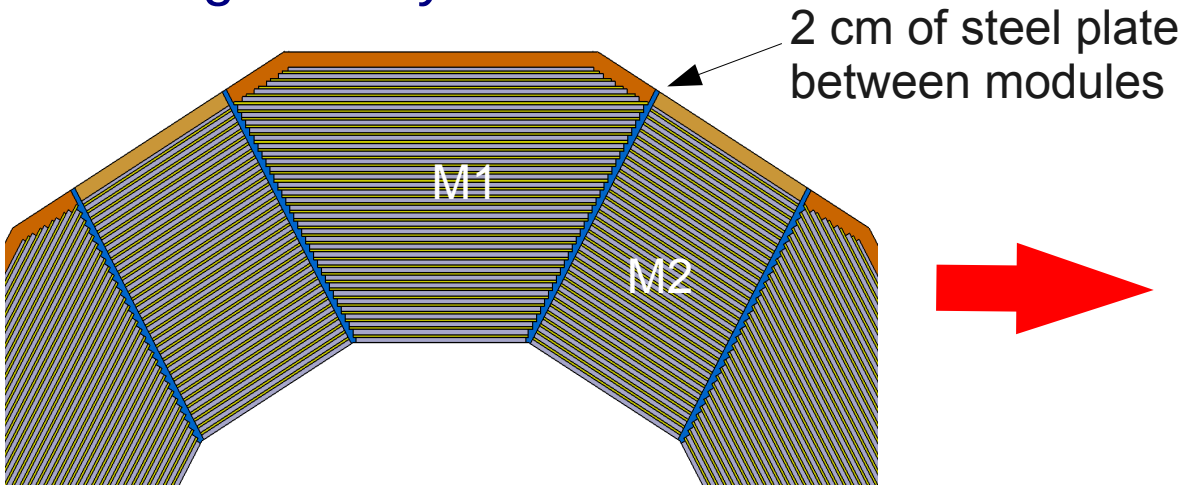
Evaluate the impact of various HCAL mechanical design on its physics performance

Study is focused on hadronic showers behavior close to the boundary between two HCAL modules for

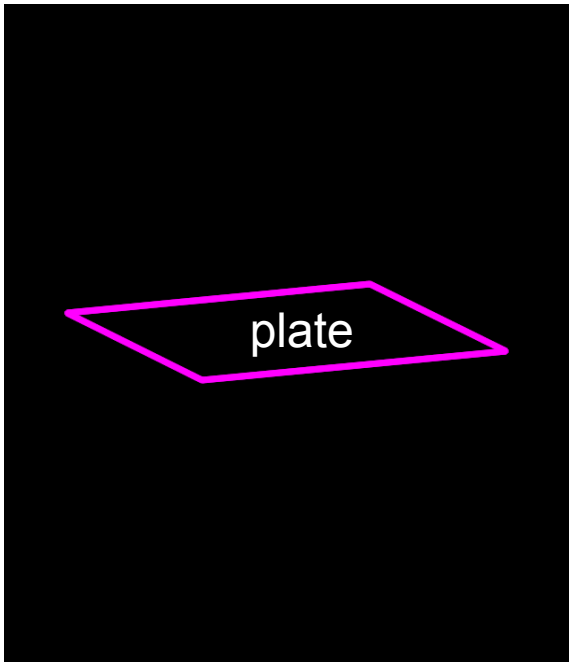
- projective and non-projective geometry
- with and without supporting plate

Considered geometries

SiD LoI geometry



2 HCAL Modules



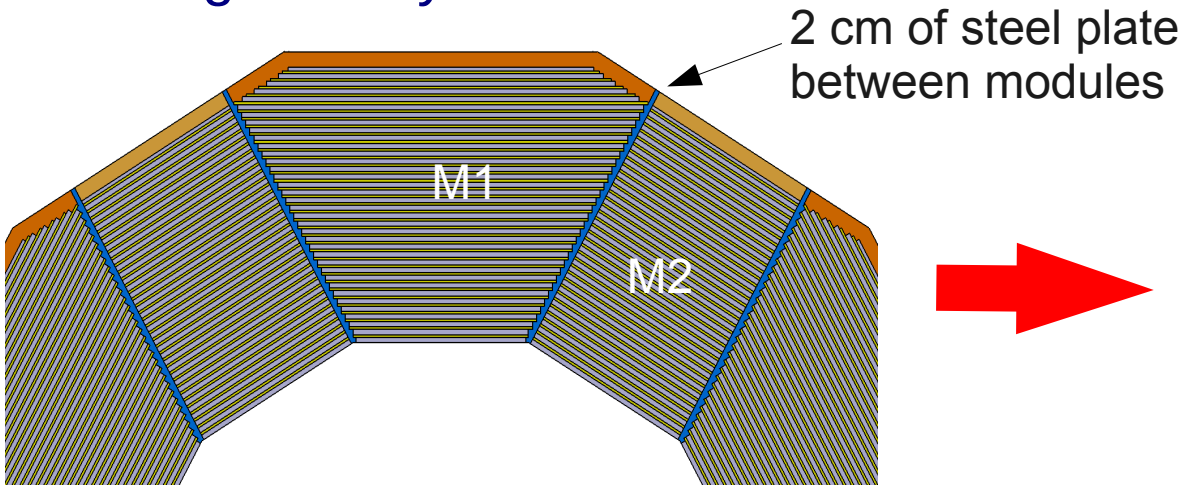
Geometries:

- sid2Modules_FeAbs_NoFeP (ref. geometry without supp. plate)
- sid2Modules_FeAbs_1cmFeP (1cm supporting plate)
- sid2Modules_FeAbs_2cmFeP (2cm supporting plate)
- sid2Modules_FeAbs_2cmFeP_WE - (2cm supporting plate and ECAL)

N.B. Detectors have double SiD depth (80 layers). Analysis has been performed for both 40 and 80 layers detectors

Considered geometries

SiD LoI geometry



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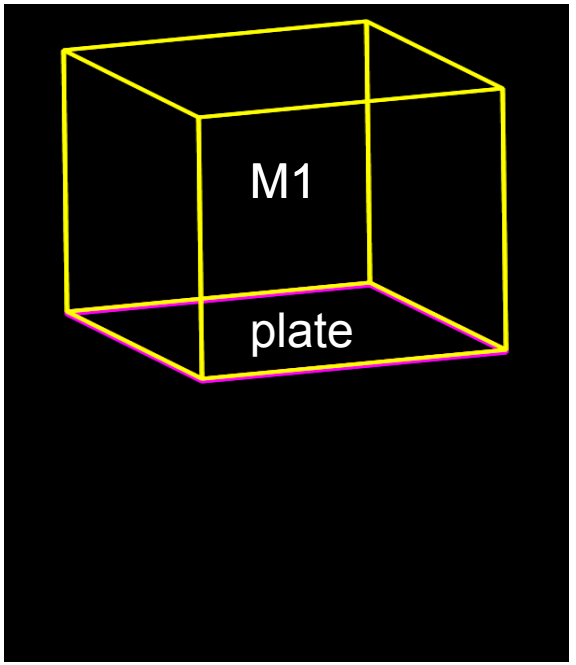

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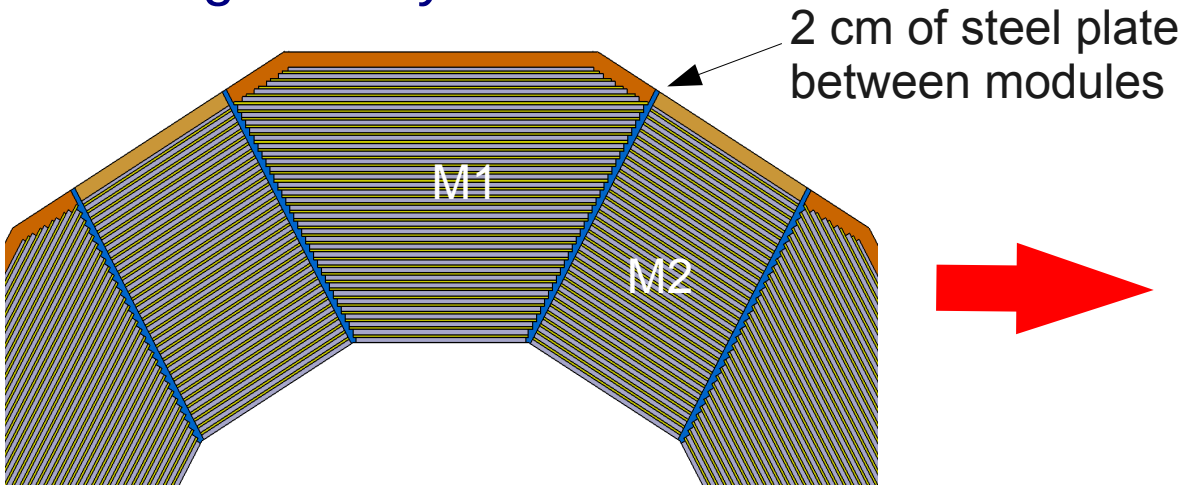
SiD LoI geometry



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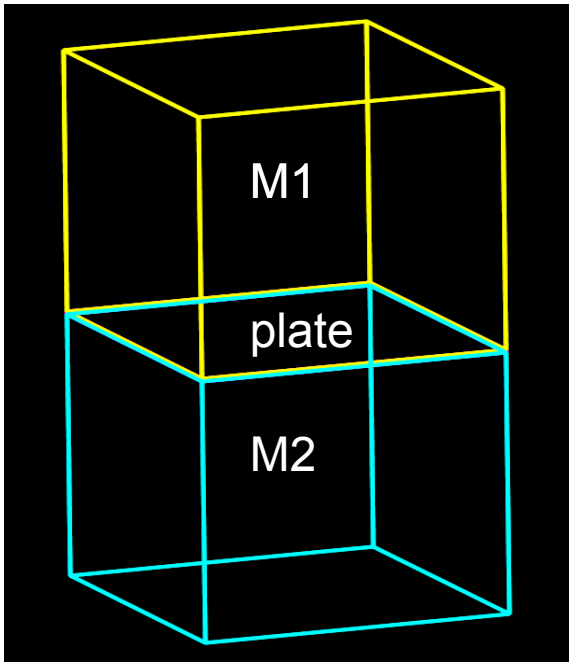

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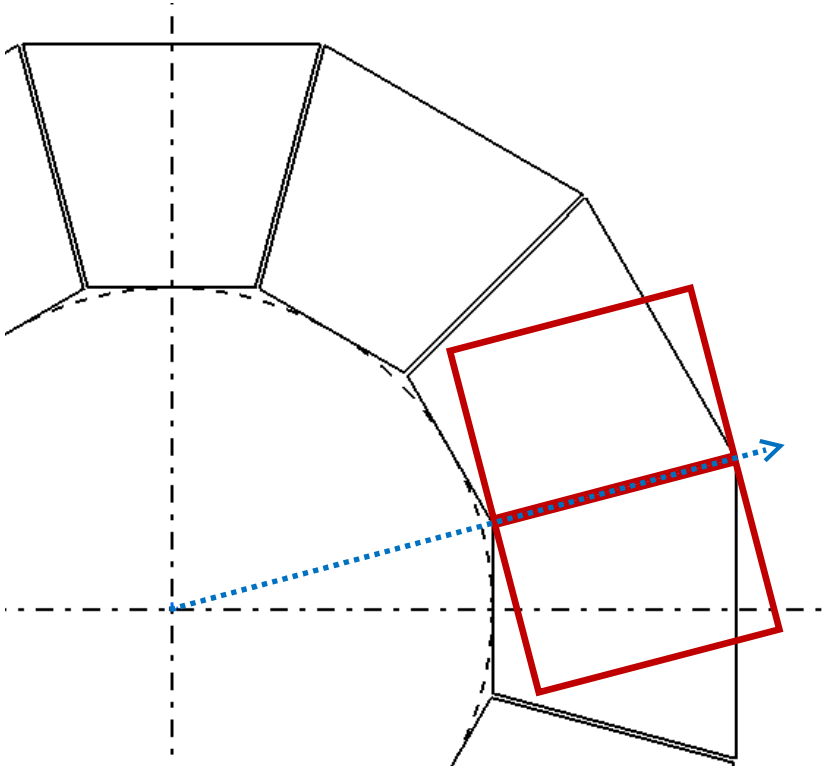
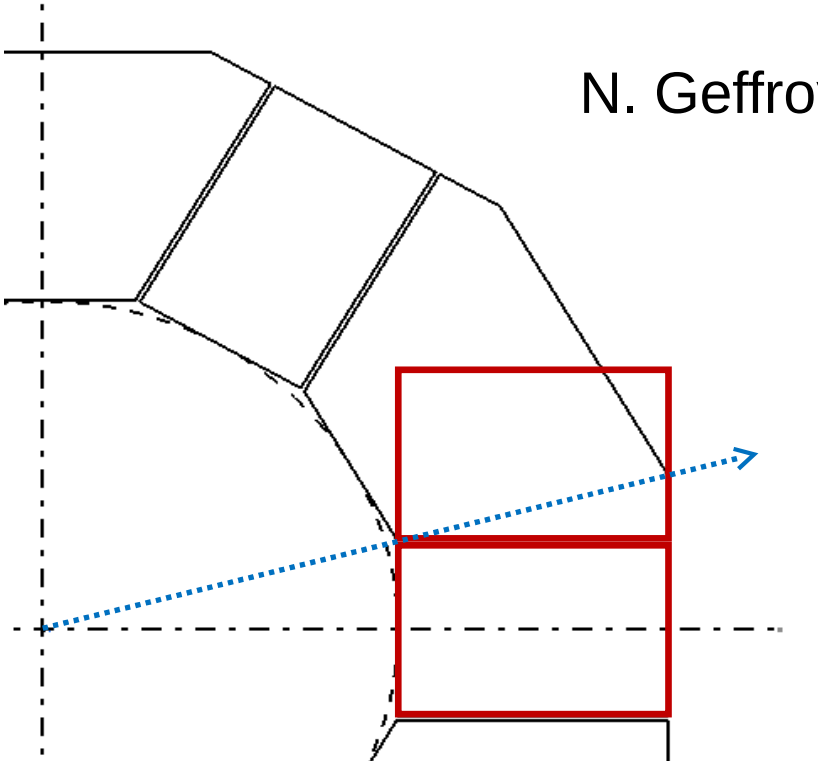
Projective and non-projective geometry

Projective geometry



Non-projective geometry

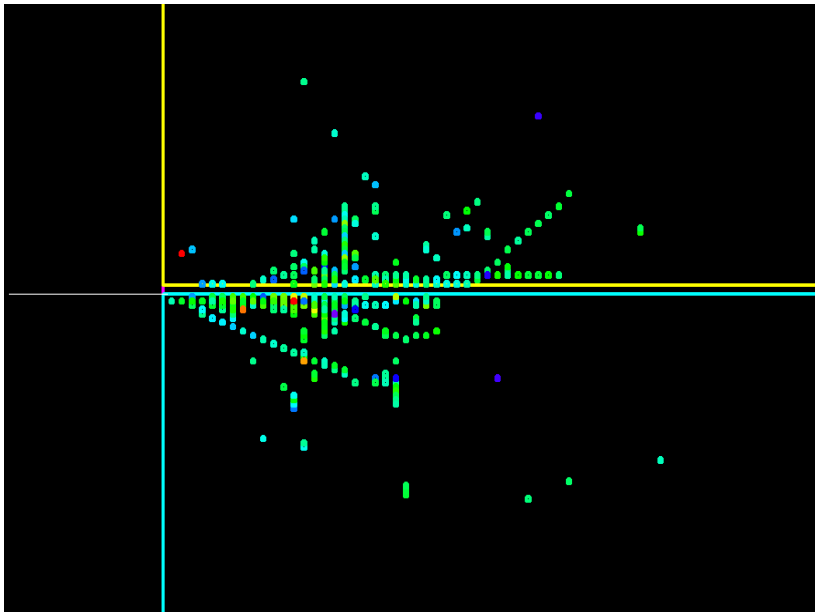


N. Geffroy

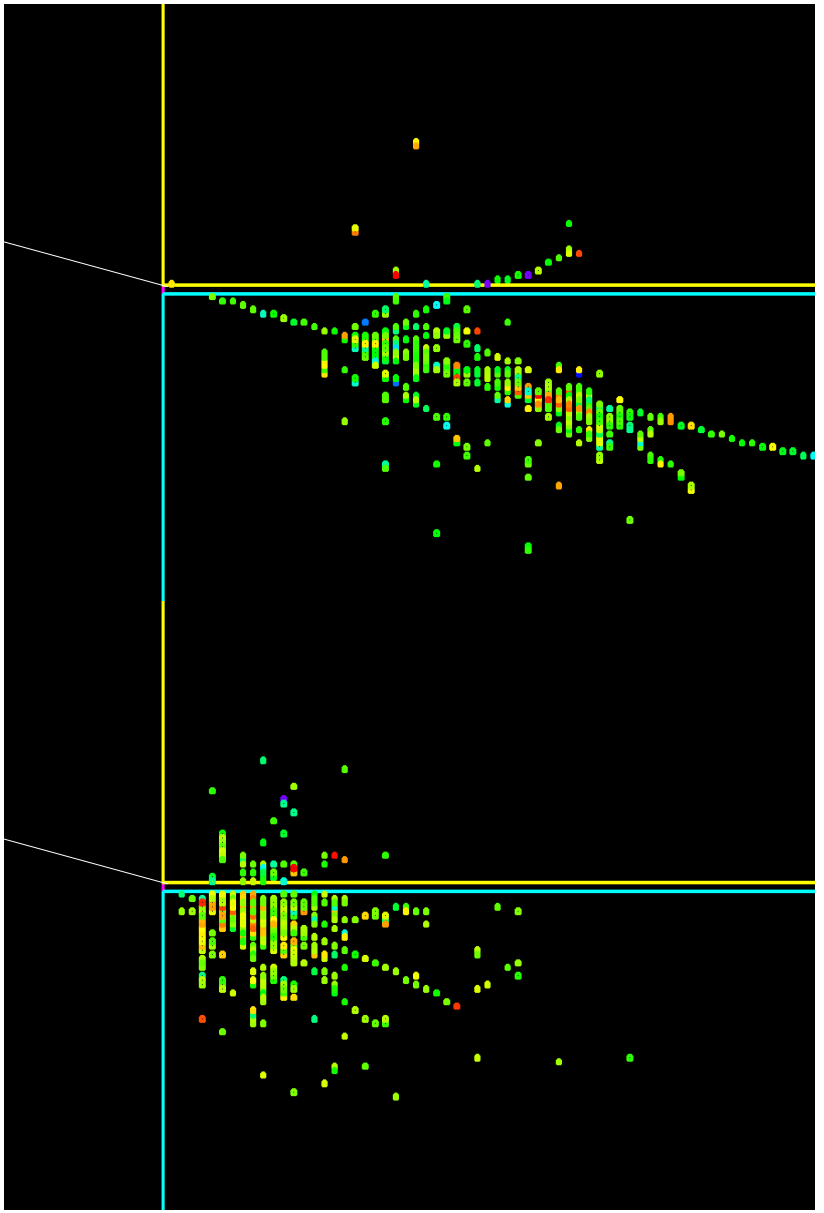
- HCAL SiD baseline geometries:
  - Projective geometry – 12 identical calorimeter modules
  - Non-projective geometry – 6 reqtangular and 6 trapezodial modules
- Two rectangular modules are considered as a good approximation for simulation study

Typical events for 50 GeV pions

Projective geometry



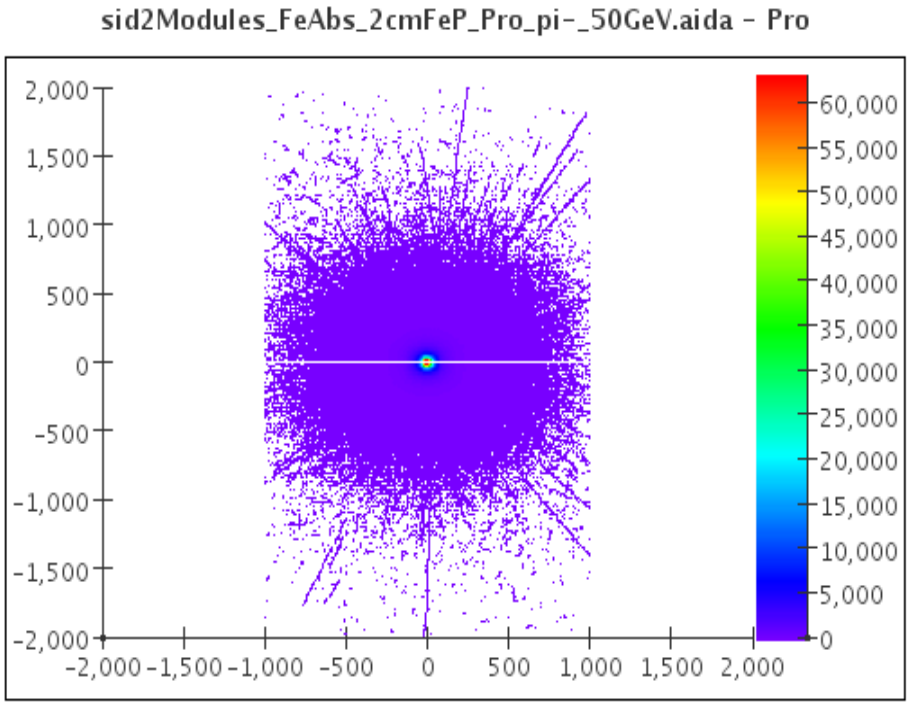
Non-projective geometry

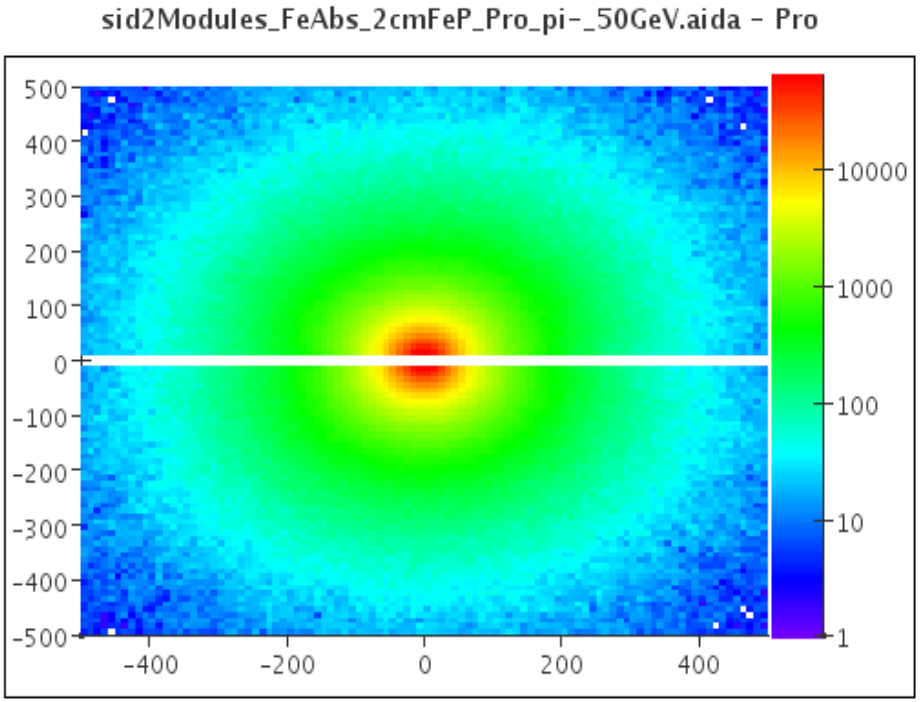


- Particles directed as from the vertex
- Impact area restricted to 5 cm diameter around the boundary at front of the detector
- For each configuration, data have been generated for pion energies between 3 to 200 GeV

Projective geometry

Number of hits versus cell id number



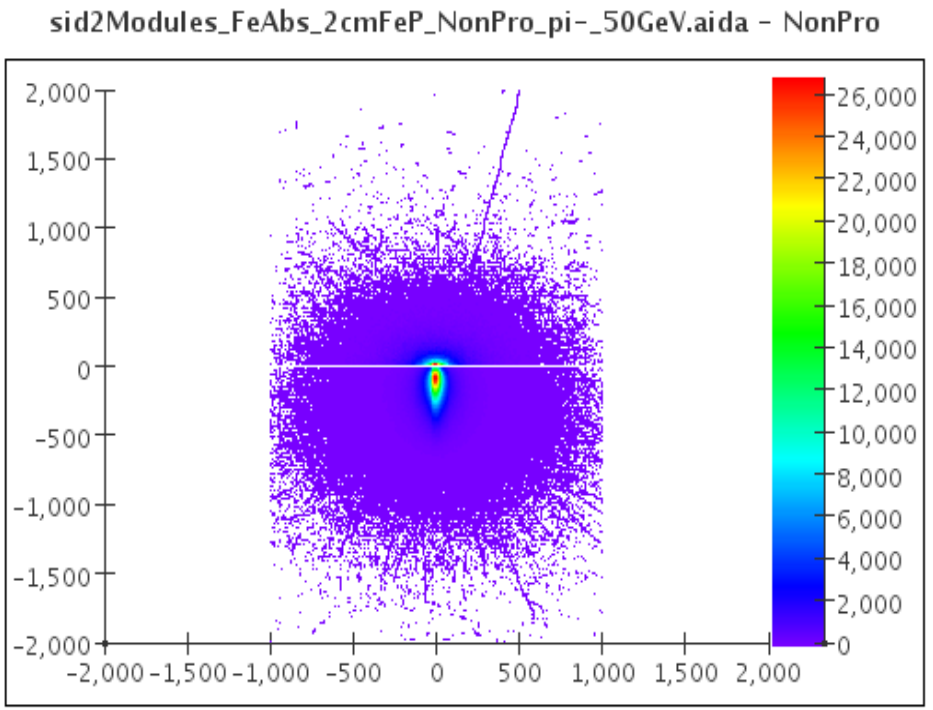


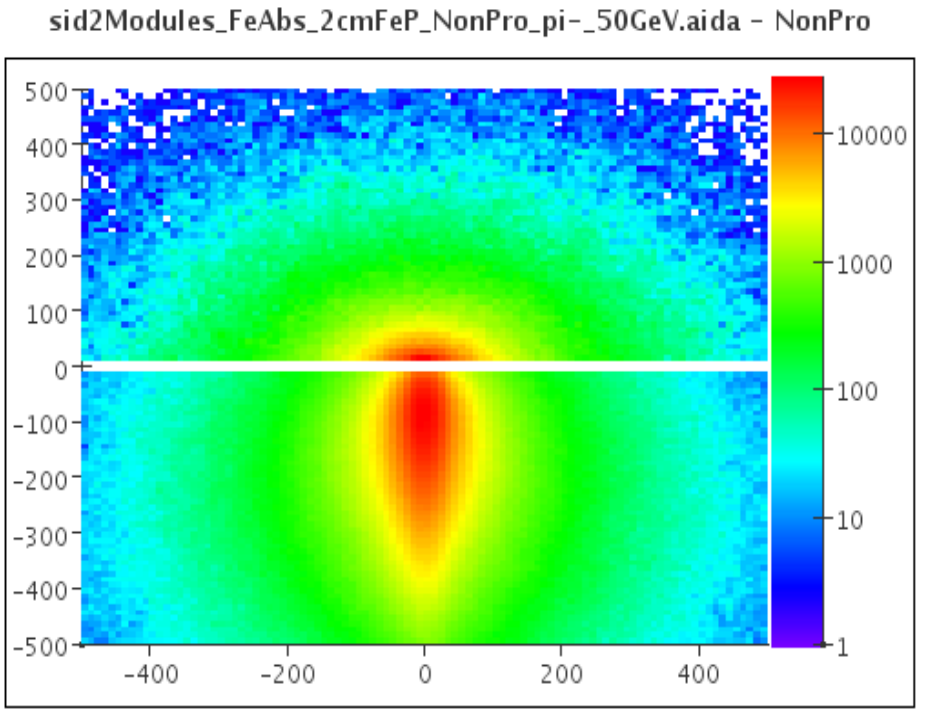
Configuration:

- 2 cm Fe plate between modules with 80 layers
- 50 GeV pions, 10k events
- 0.5 MIP readout threshold

Non-projective geometry

Number of hits versus cell id number





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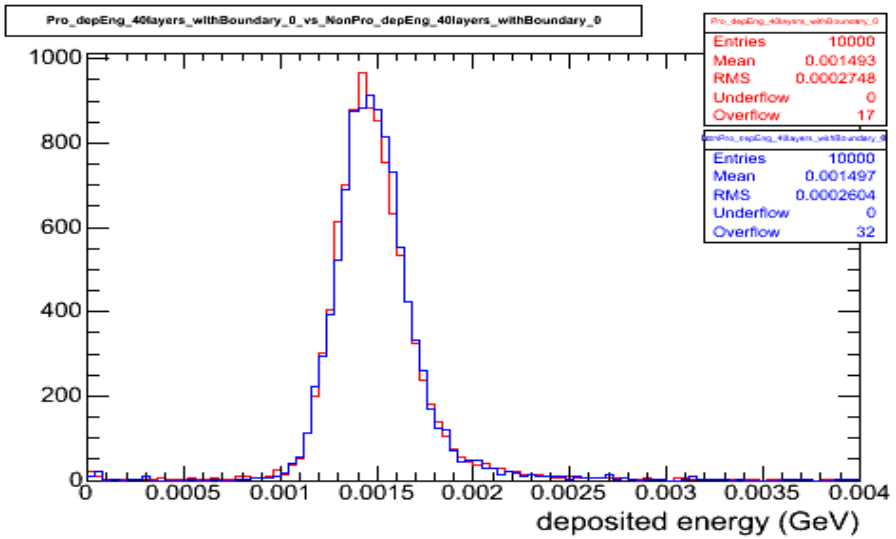
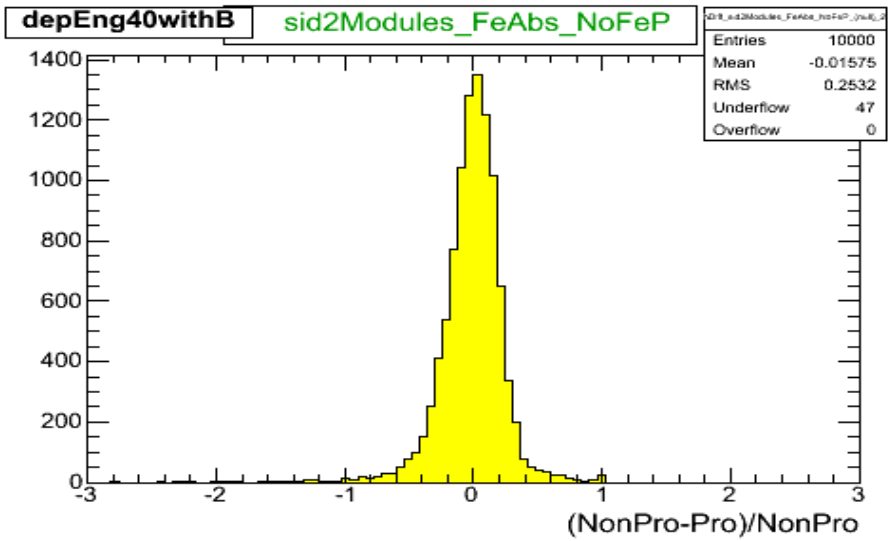
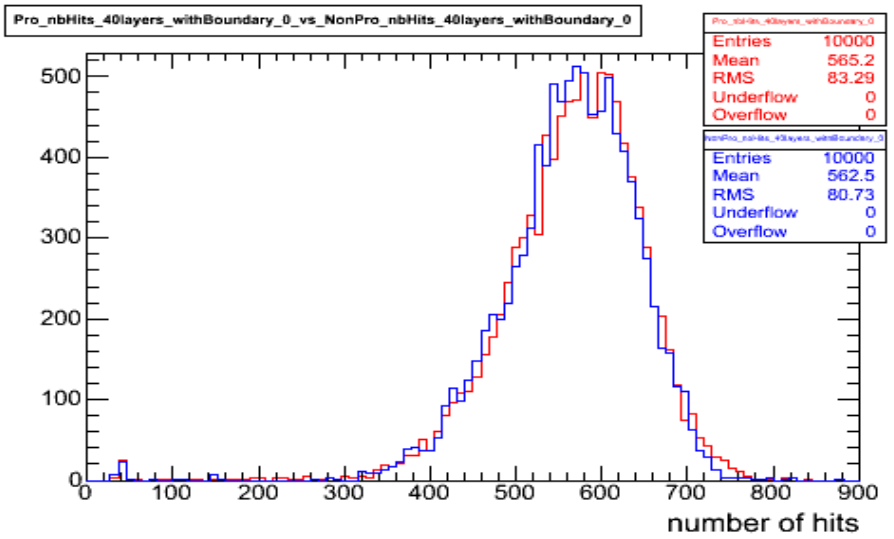
Projective vs non-projective

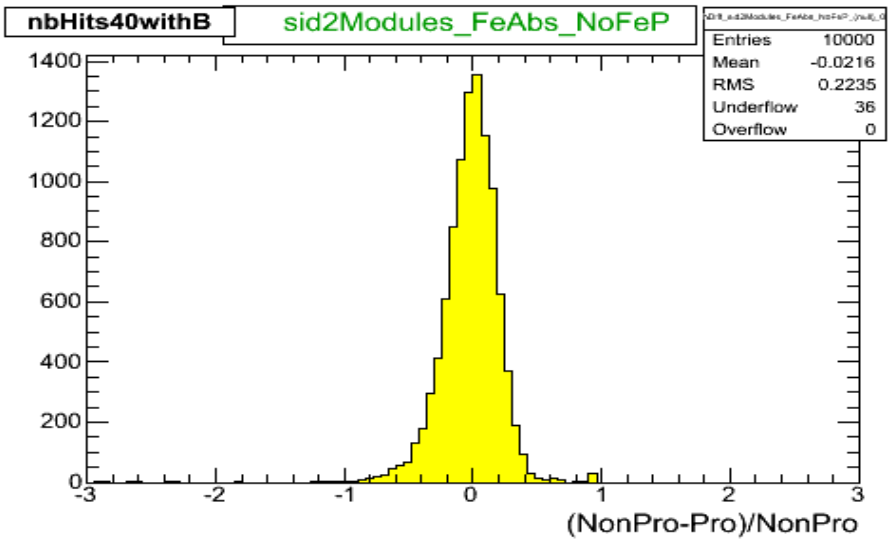
Analog readout





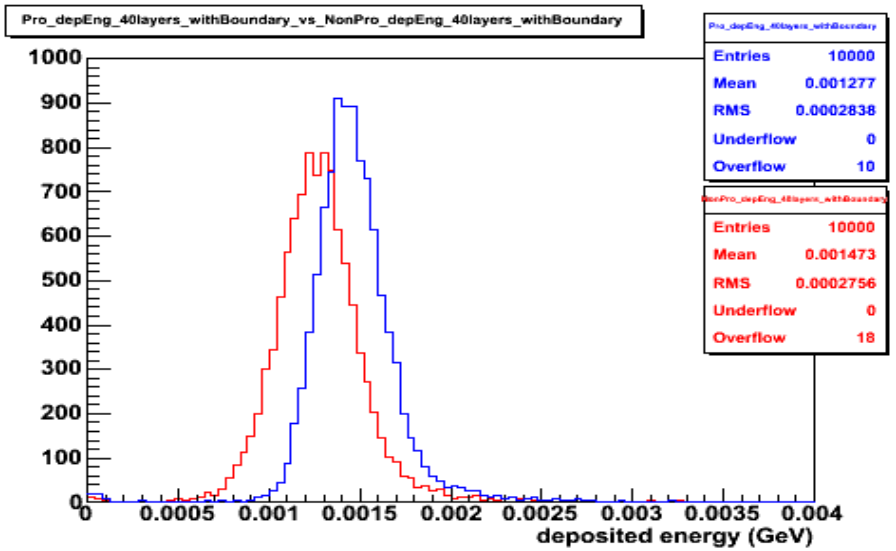
Digital readout

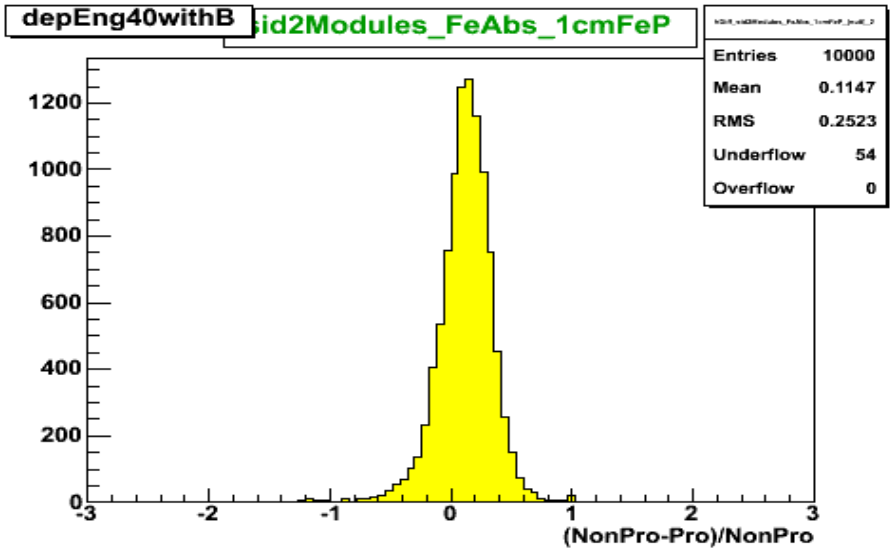




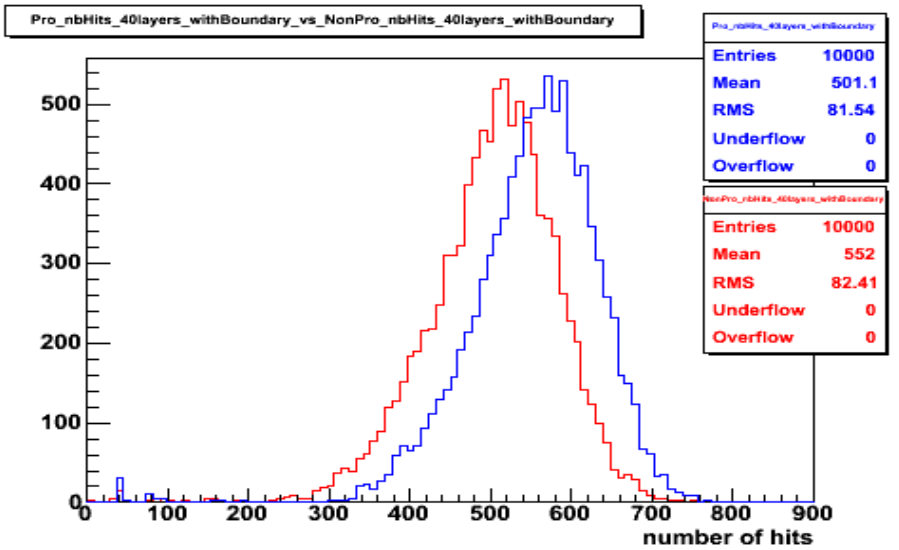
Projective vs non-projective

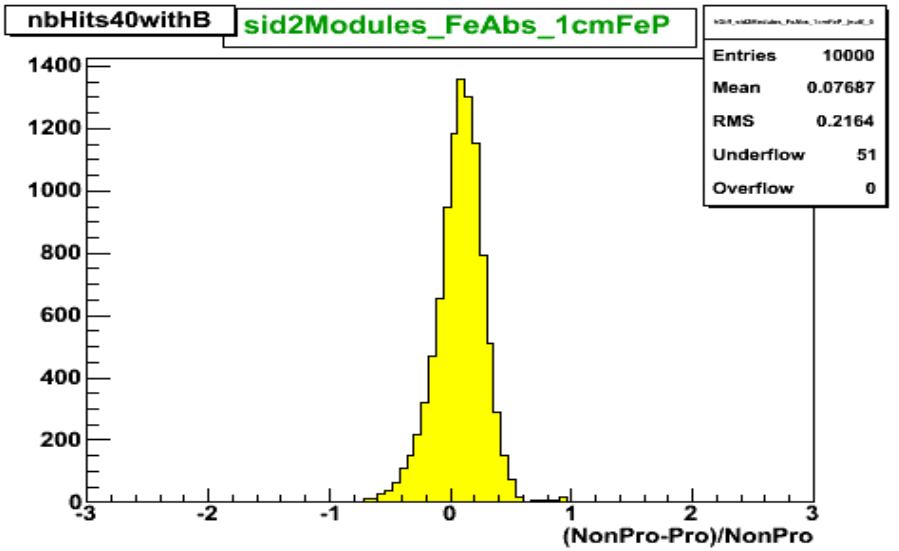
Analog readout





Digital readout





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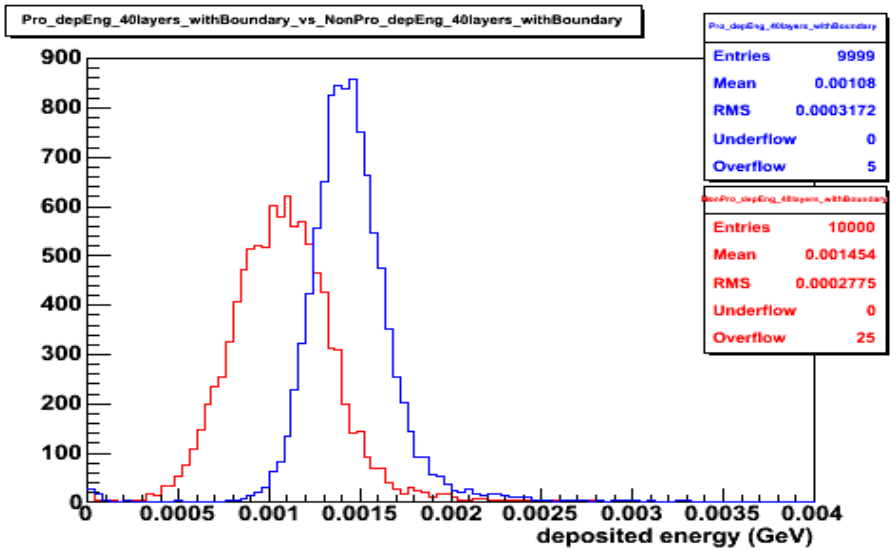
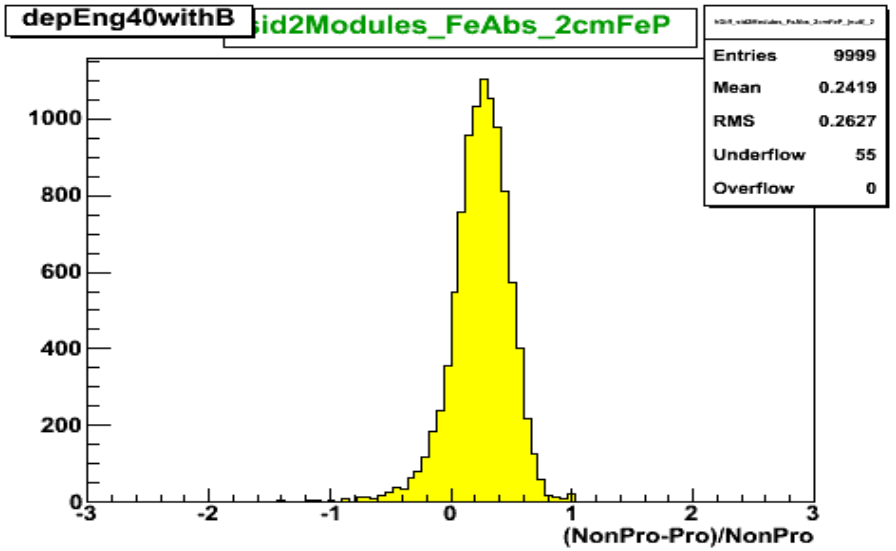
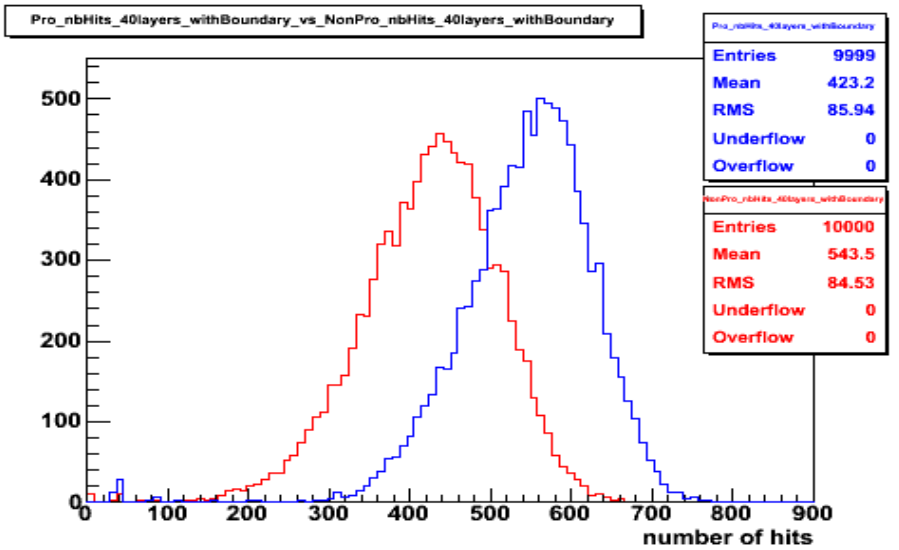
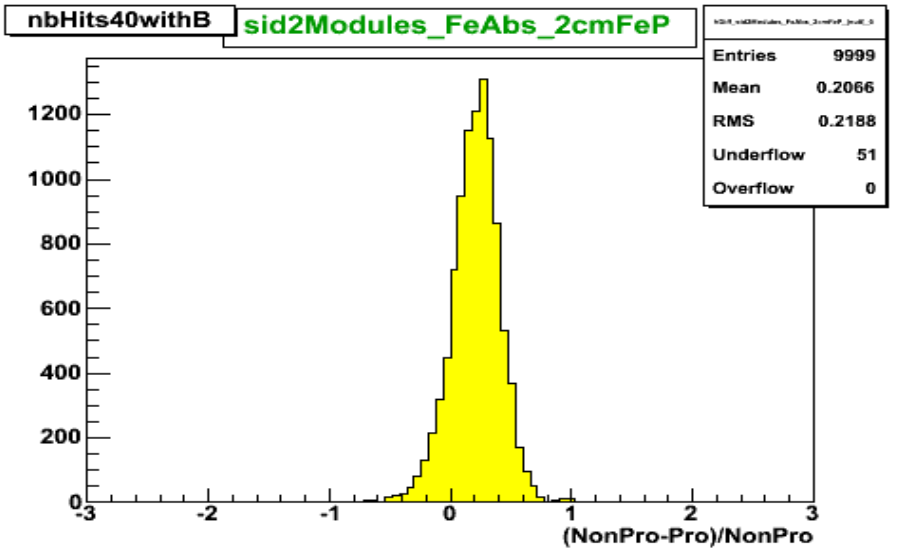




Digital readout





Projective vs non-projective

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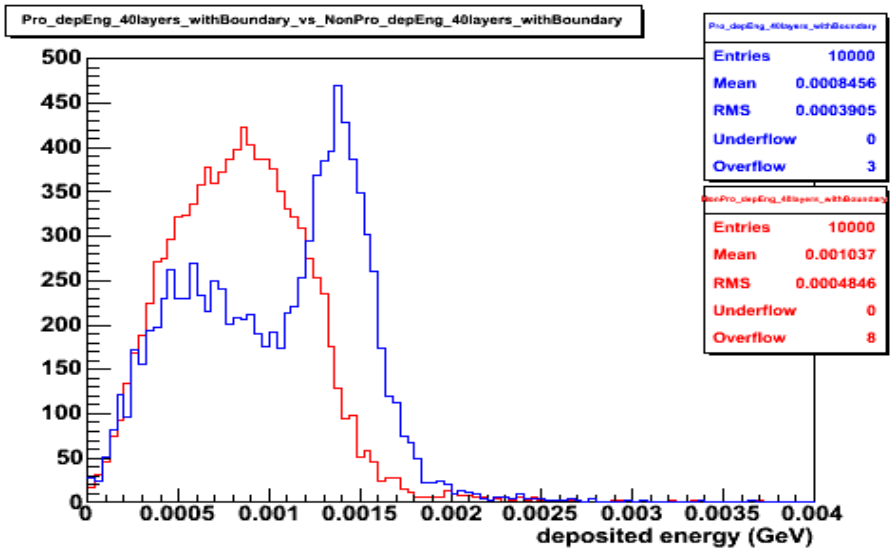

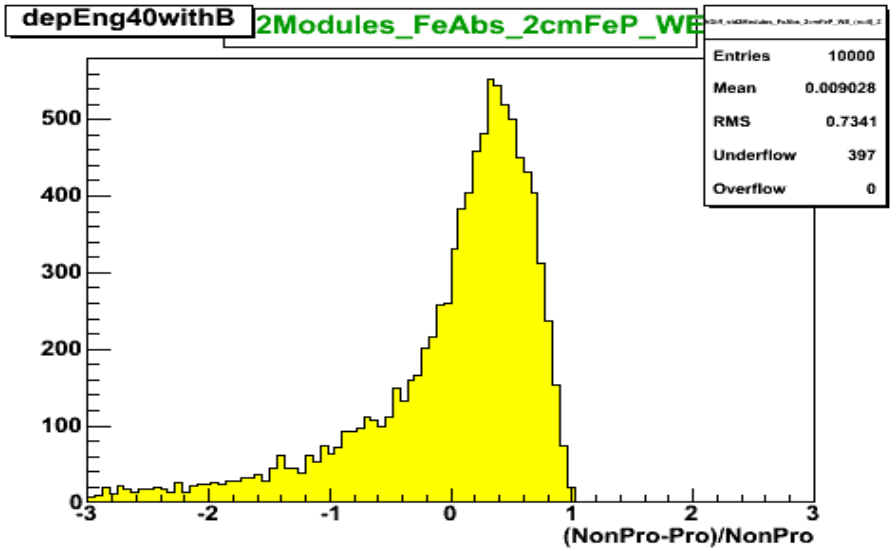

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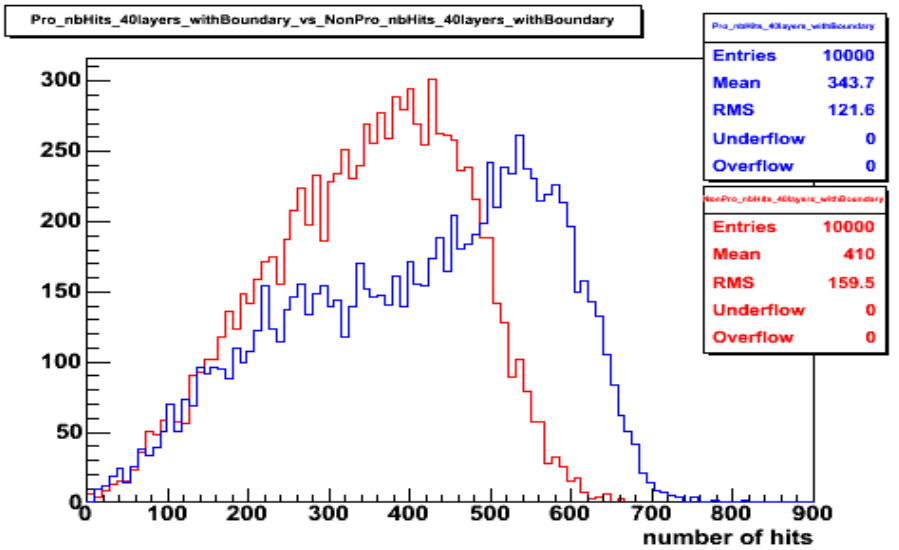
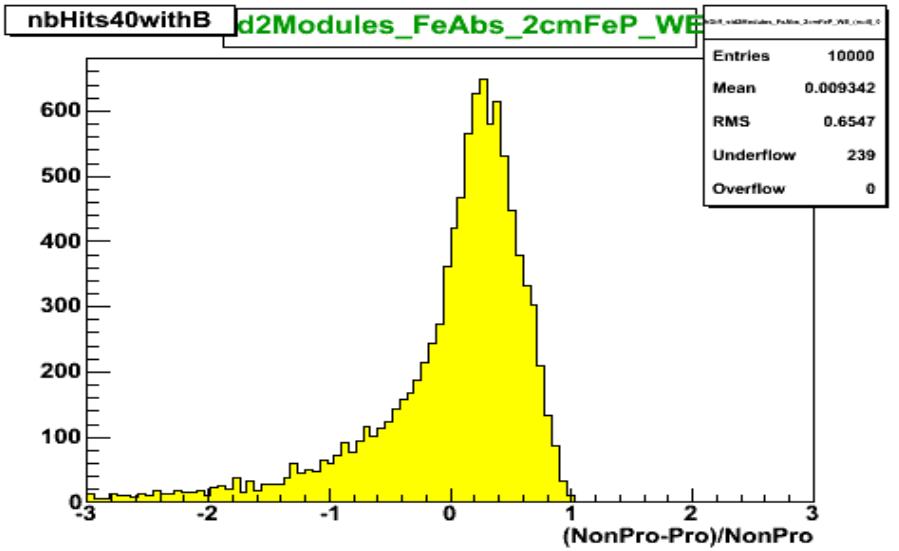
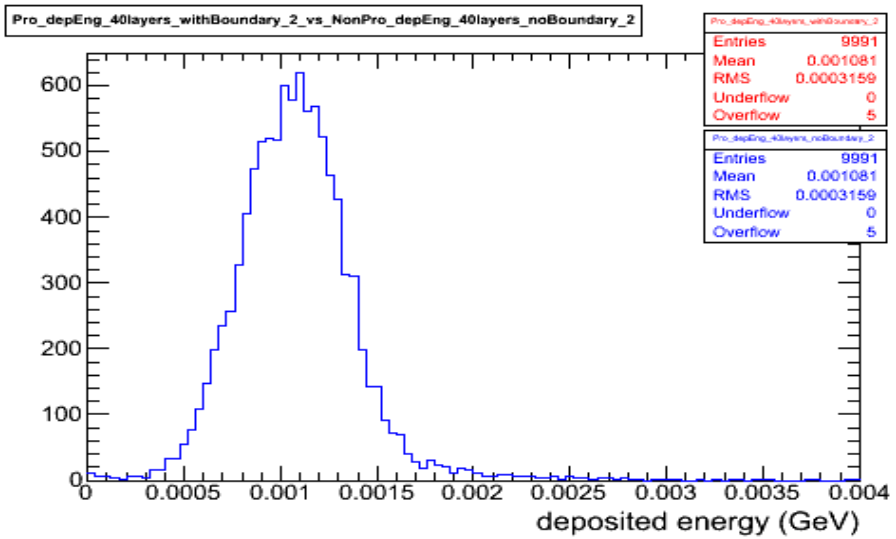
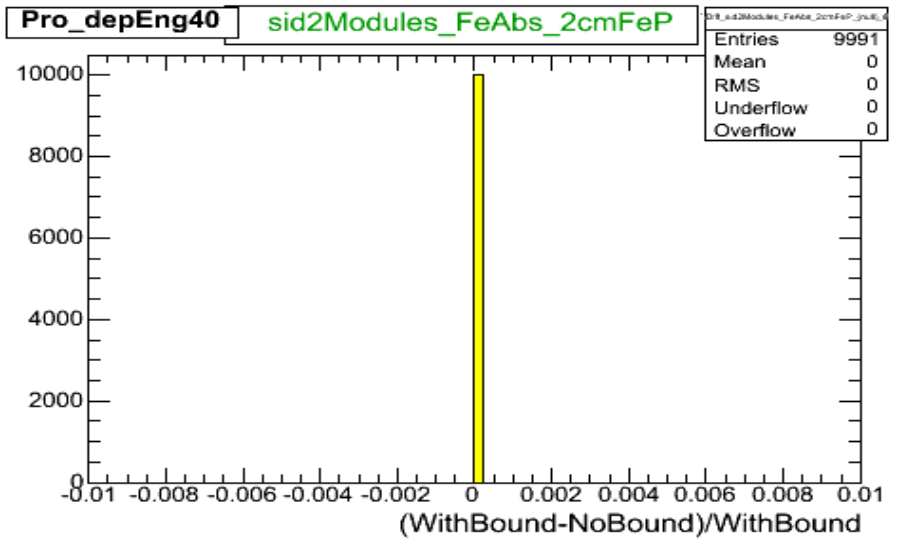




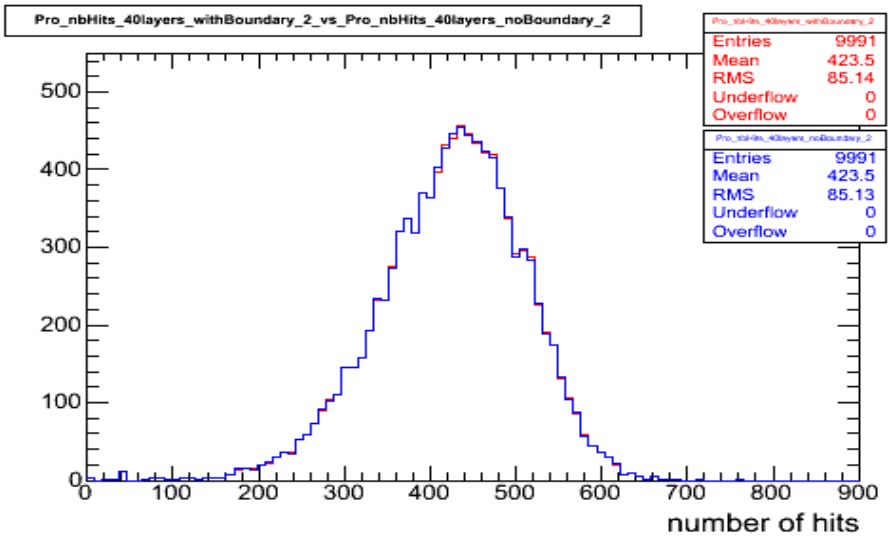
Pads close to the boundary vs no pads along the boundary, projective

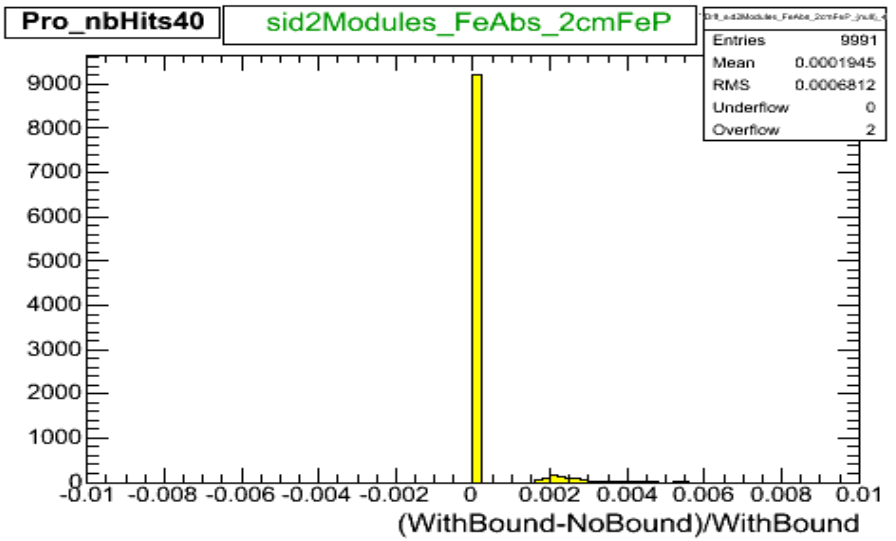
Analog readout





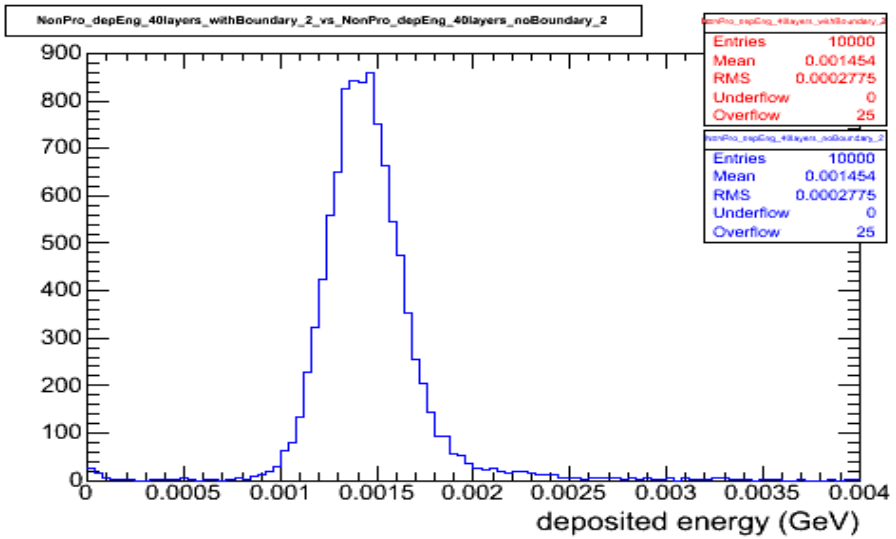
Digital readout



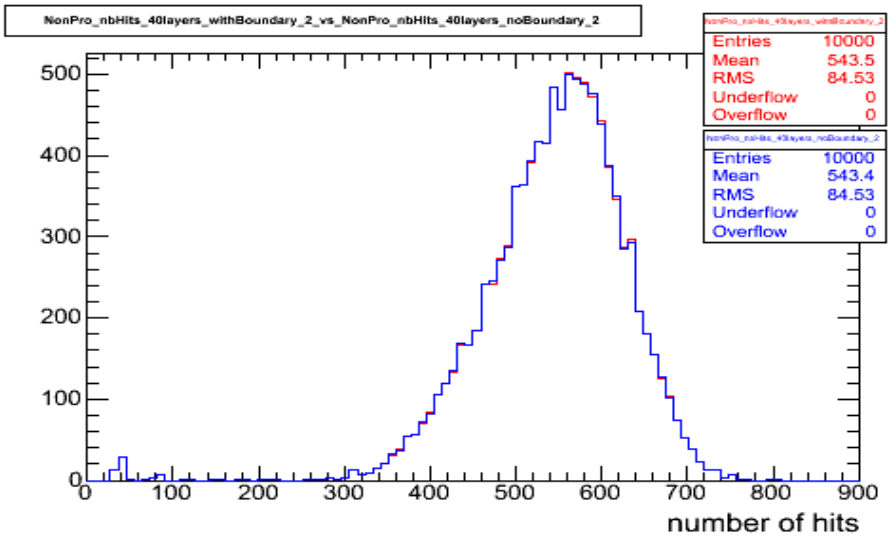


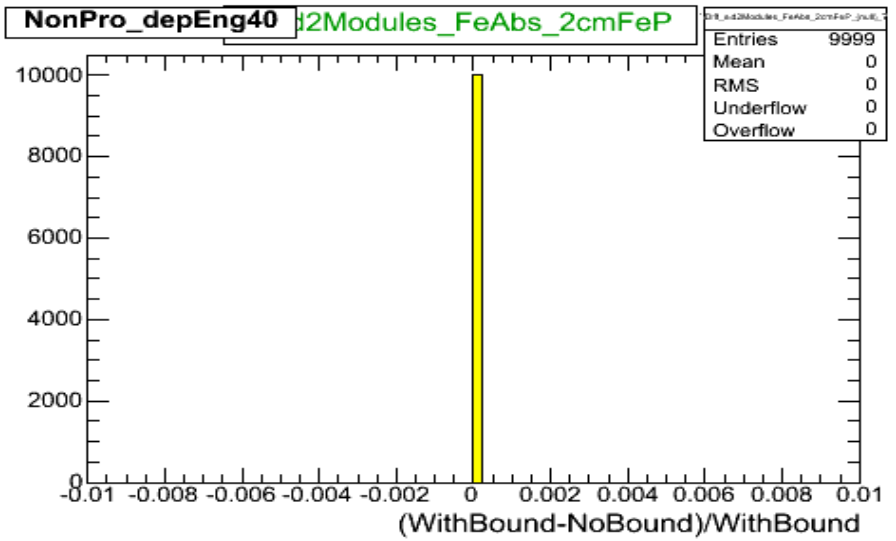
Pads close to the boundary vs no pads along the boundary, non-projective

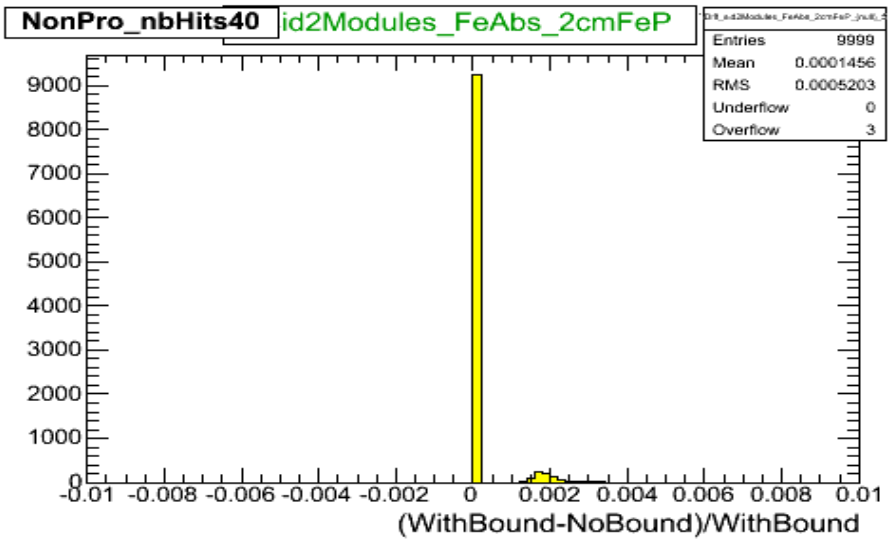
Analog readout



Digital readout

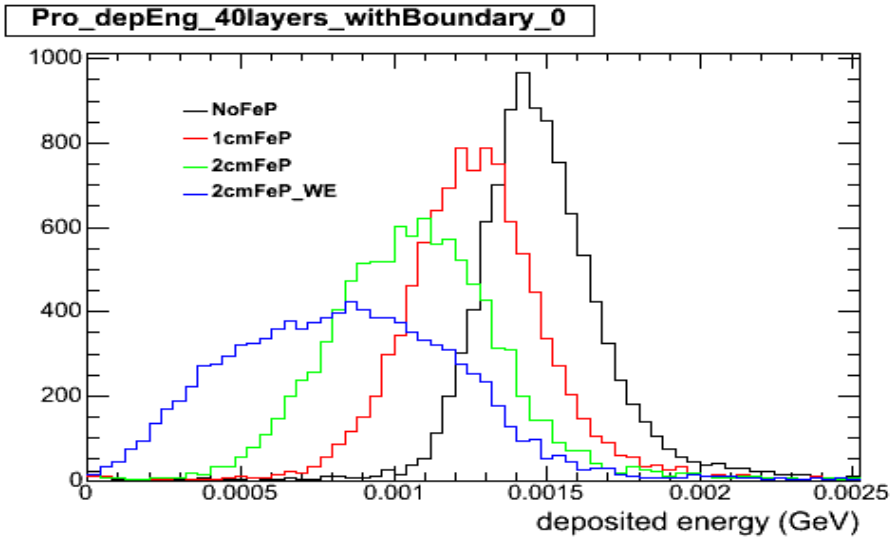


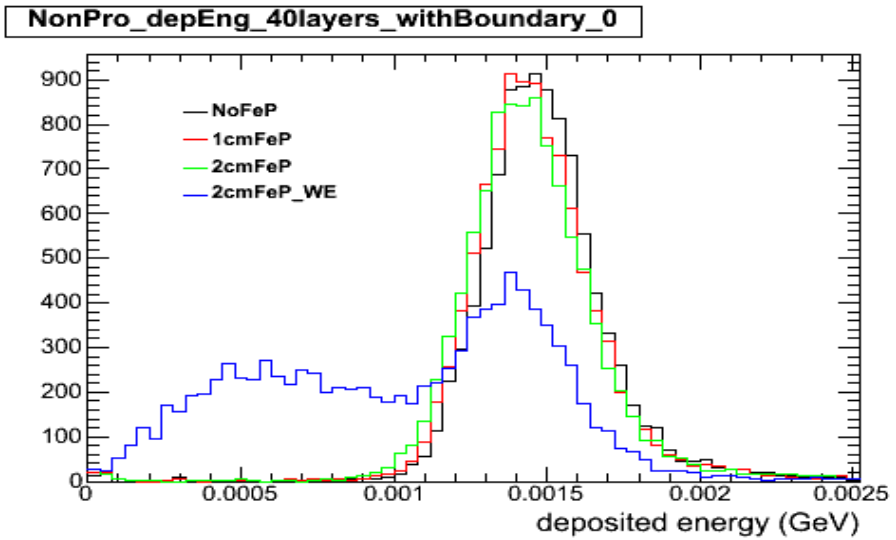




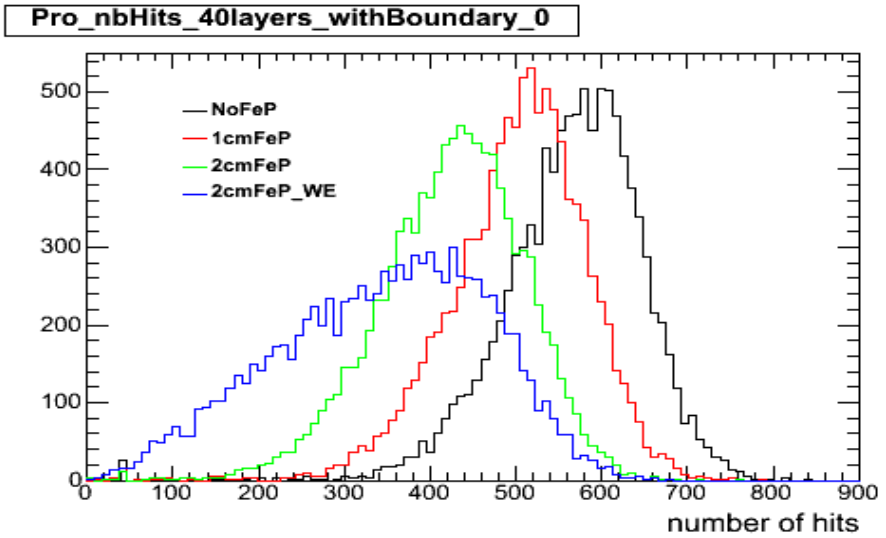
Projective vs non-projective, all the geometries, with boundary pads

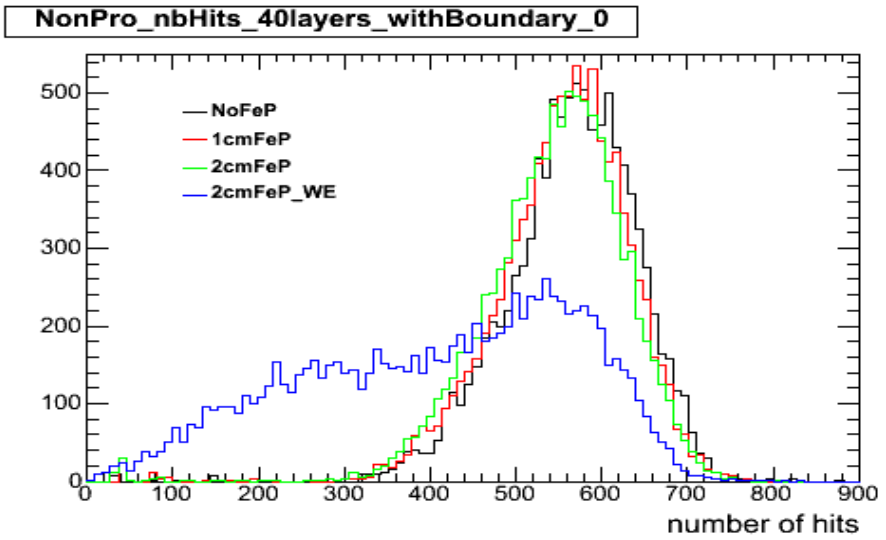
Analog readout





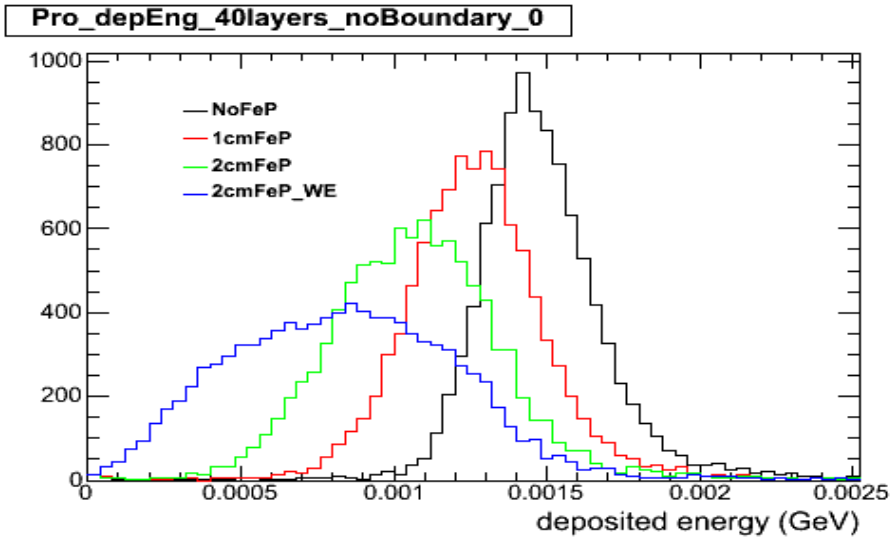
Digital readout

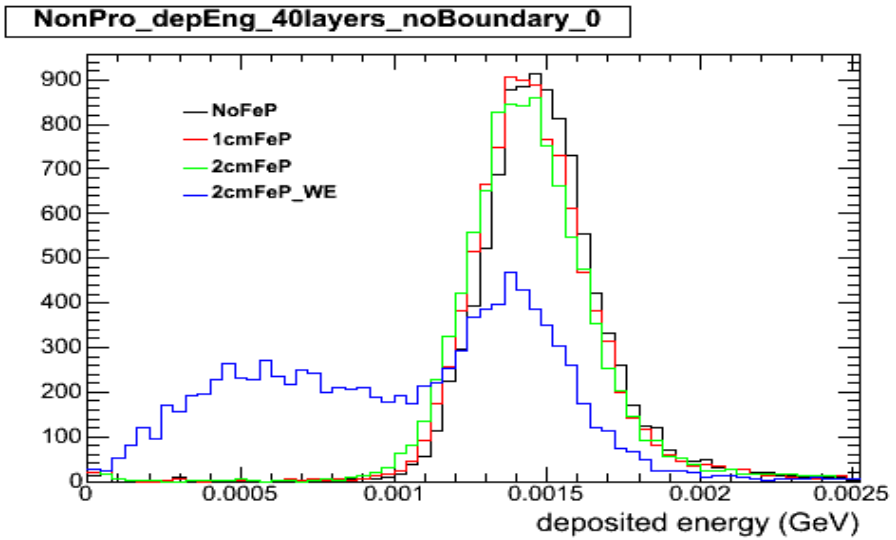




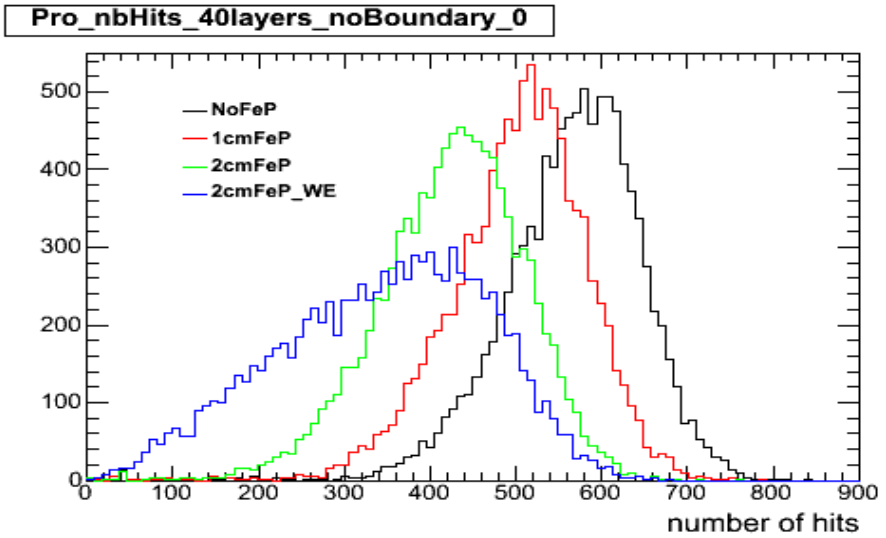
Projective vs non-projective, all the geometries, without boundary pads

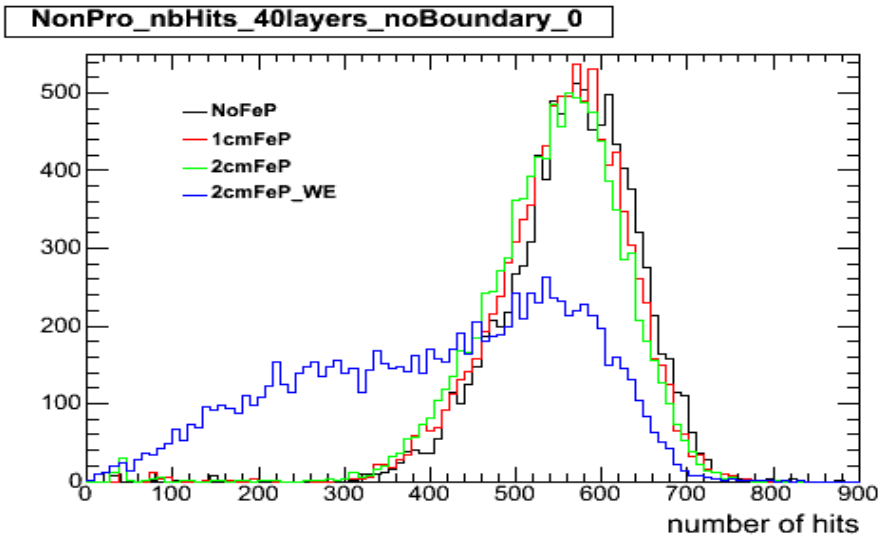
Analog readout





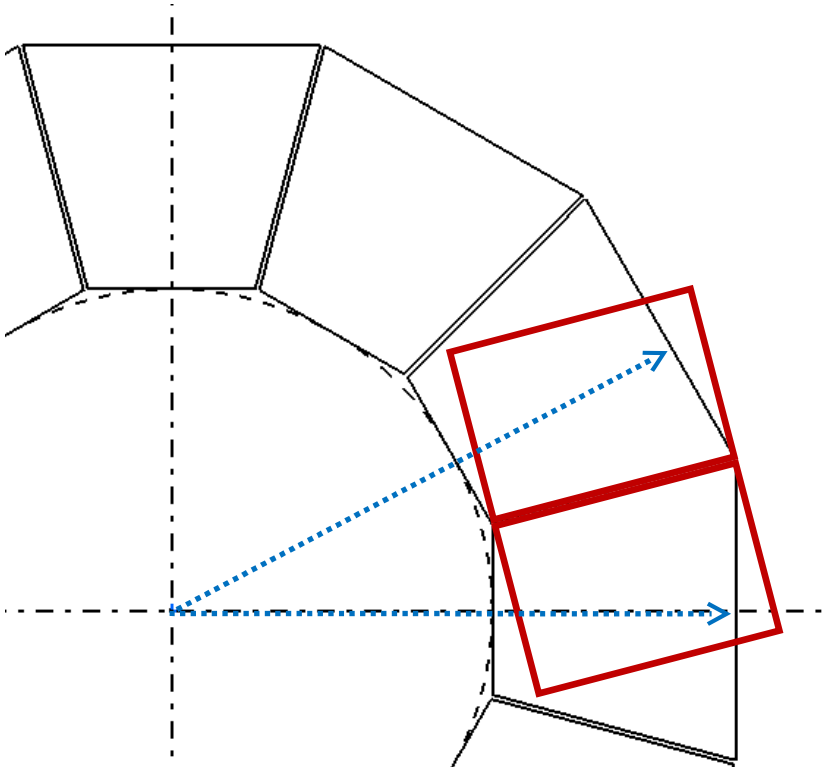
Digital readout



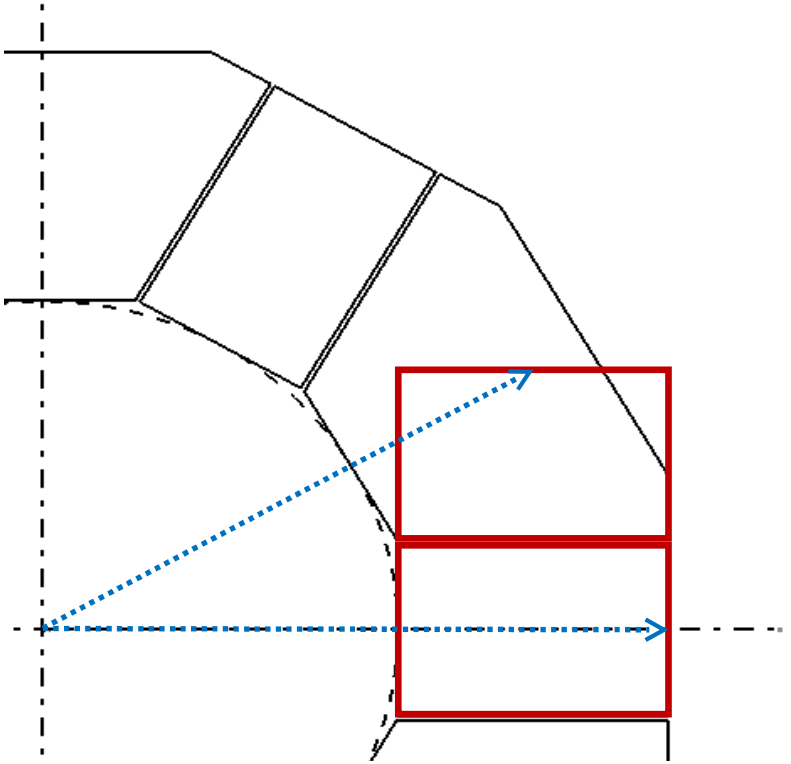


New vertex angle will be studied

Projective geometry



Non-projective geometry



- Presented study shows large difference between projective and non-projective geometry due to the plate between modules
- This depends also on the vertex angle. In case of the small angle, the projective geometry is in disadvantage
- In order to put equal conditions for both geometries, the impact angle need to be much larger as proposed on the picture

Conclusions and outlook

The impact of the iron plate between modules is clearly seen.
The effect is larger for analog readout in comparison with digital.
(This going to be check for lager vertexes angles.)

Performance degradation for configuration without readout cells close to the modules boundary, has not been seen