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

Update on alternative HCAL designs study

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UNIVERSITE CHAMBERY SAVOIE ANNECY

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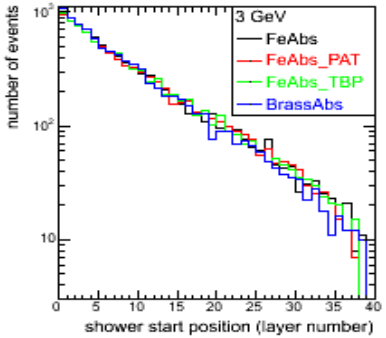
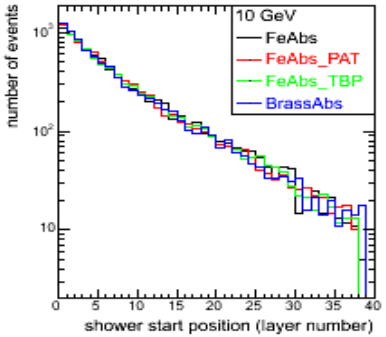
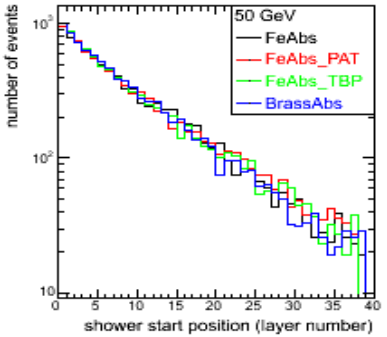
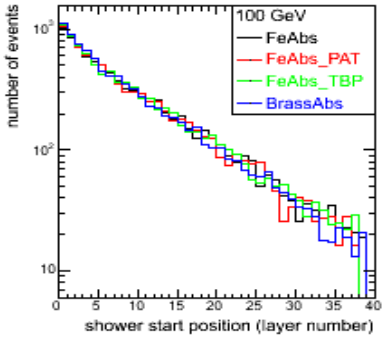
In2p3

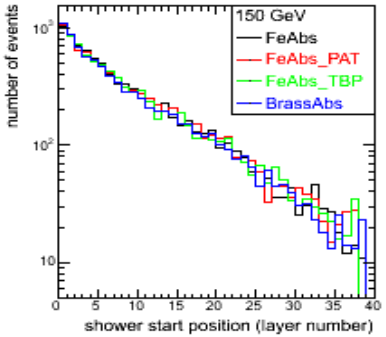
Probability of the shower start

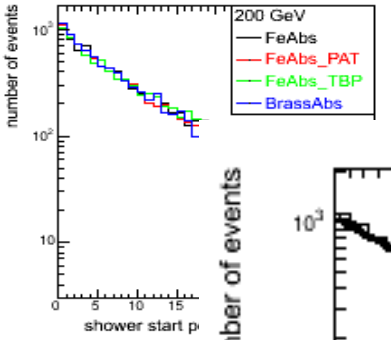




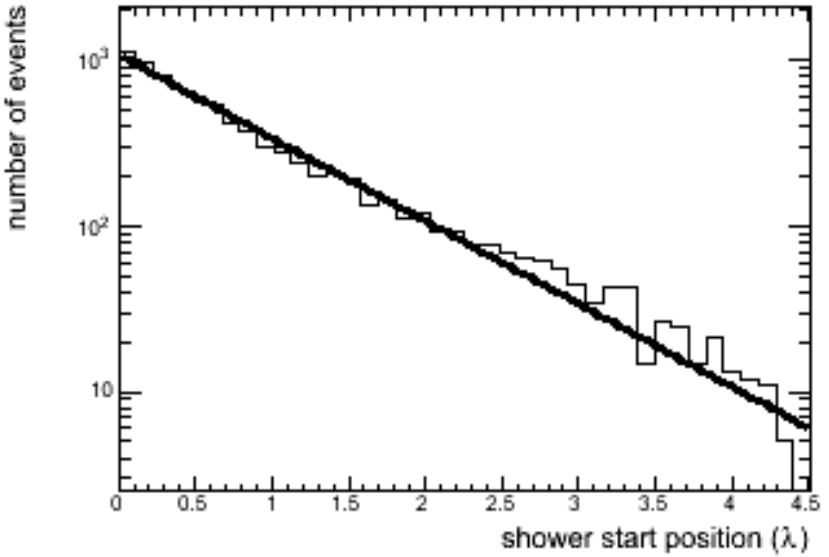








10 GeV pions

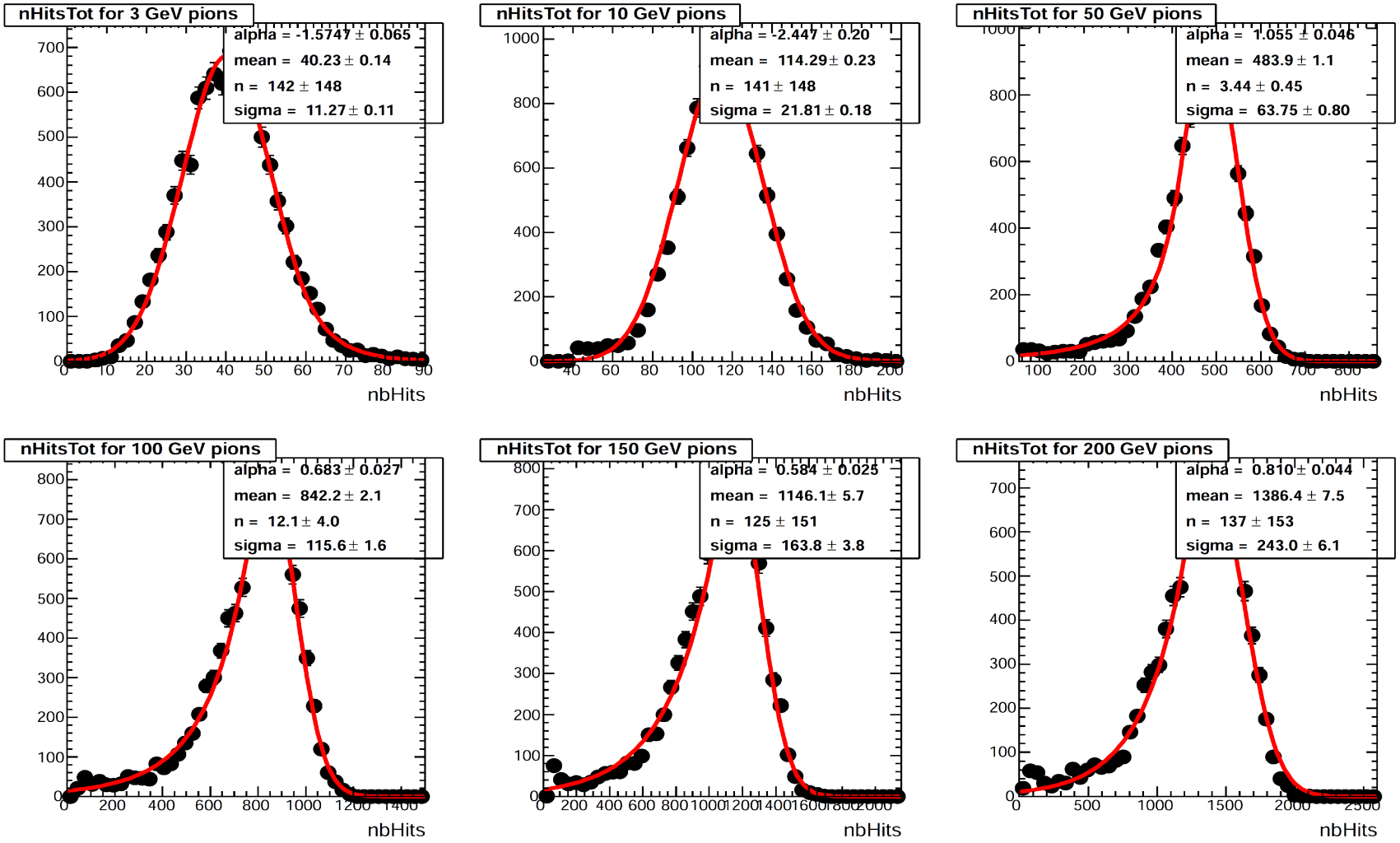


NO.	NAME	VALUE	ERROR
1	Constant	6.97403e+00	1.72347e-02
2	Slope	-1.15055e+00	1.56926e-02

- Probability of the first interaction degrease as -1/λ

Total number of hits in calorimeter

Example for Brass abs., 0.1 MIP MPV

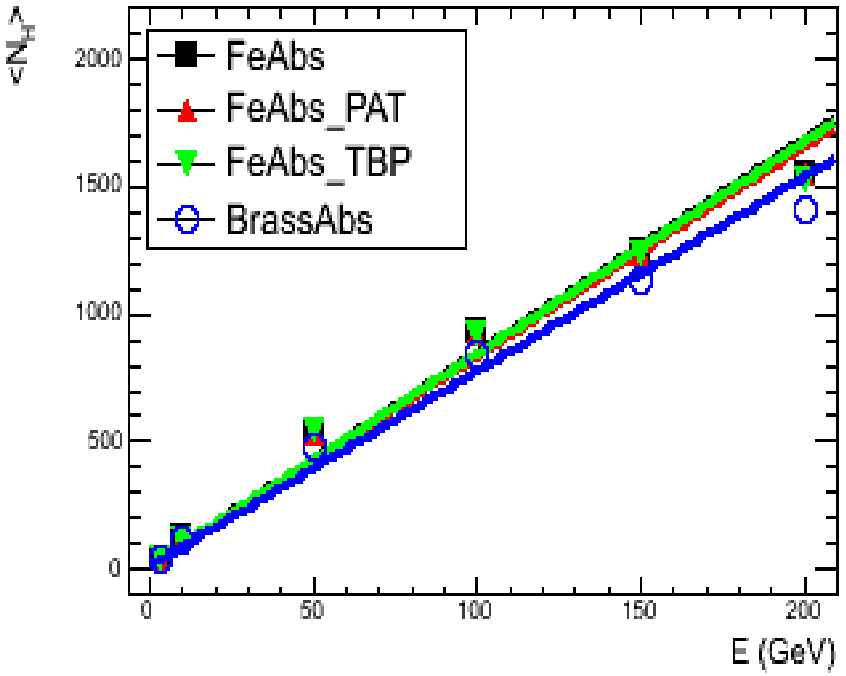


- Fit with the crystal ball function to extract mean value and sigma

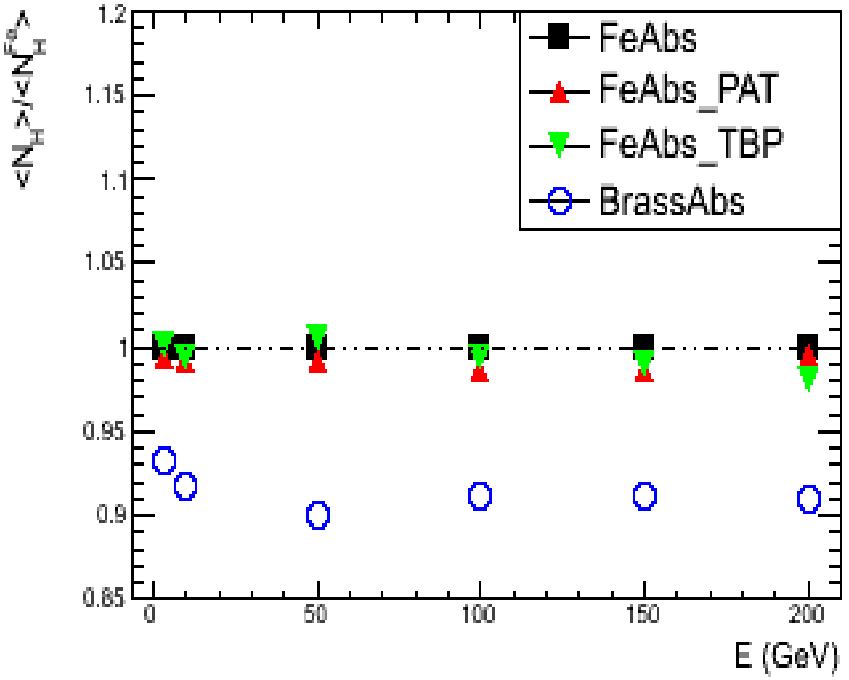
Calorimeter response

Digital readout with 0.1 MIP MPV threshold

Calorimeter response



Difference w.r.t. the standard geometry

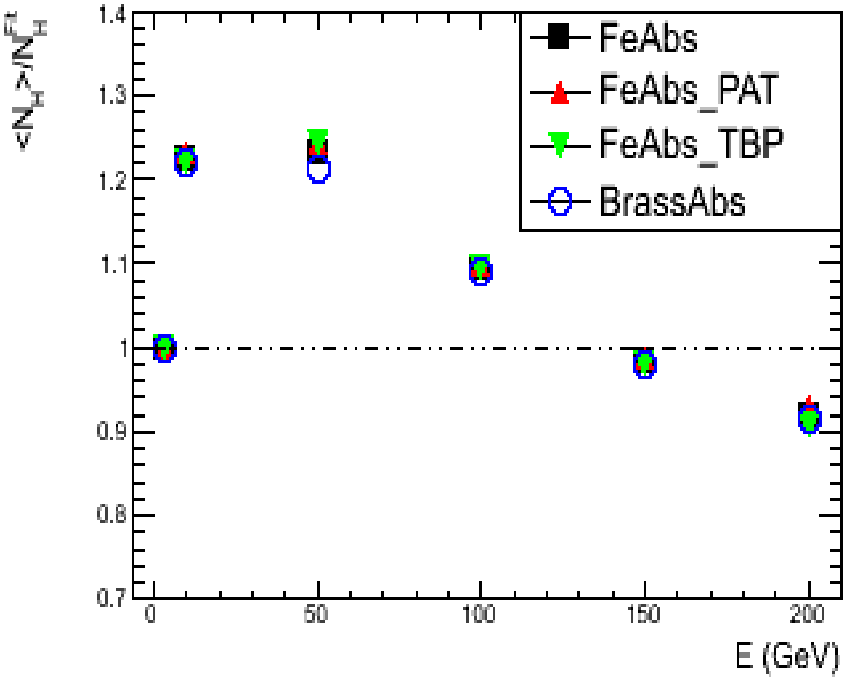


- Saturation and leakage effects in response clearly seen for higher energies
- Same response for Fe based calorimeters and about 10% lower for Brass calorimeter

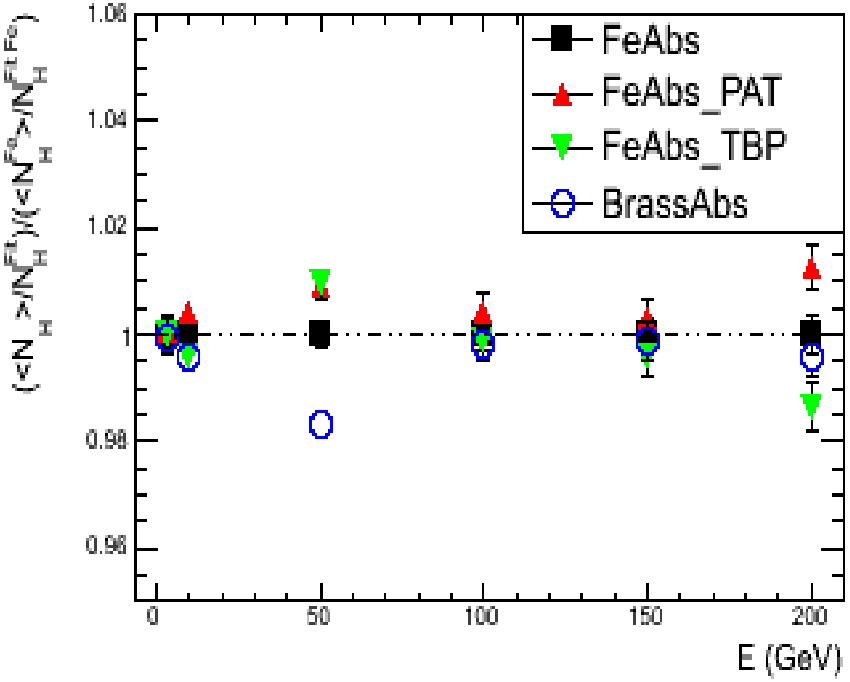
Calorimeter linearity

Digital readout with 0.1 MIP MPV threshold

Calorimeter linearity



Difference w.r.t. the standard geometry

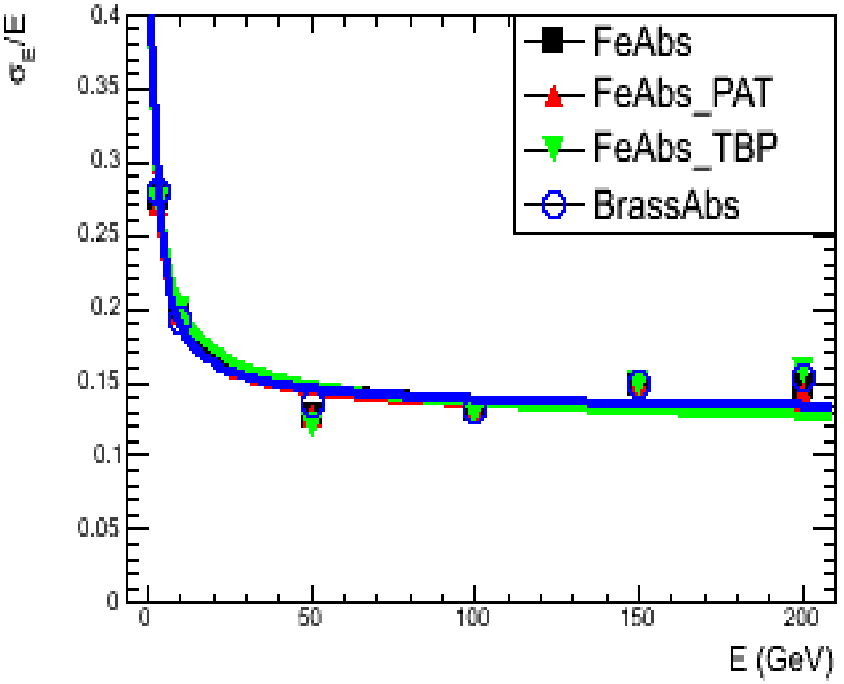


- Calorimeter nonlinearity is within 20 % due to the saturation effect and leakage
- Small difference in linearity (less than 2 %) among various calorimeter configurations

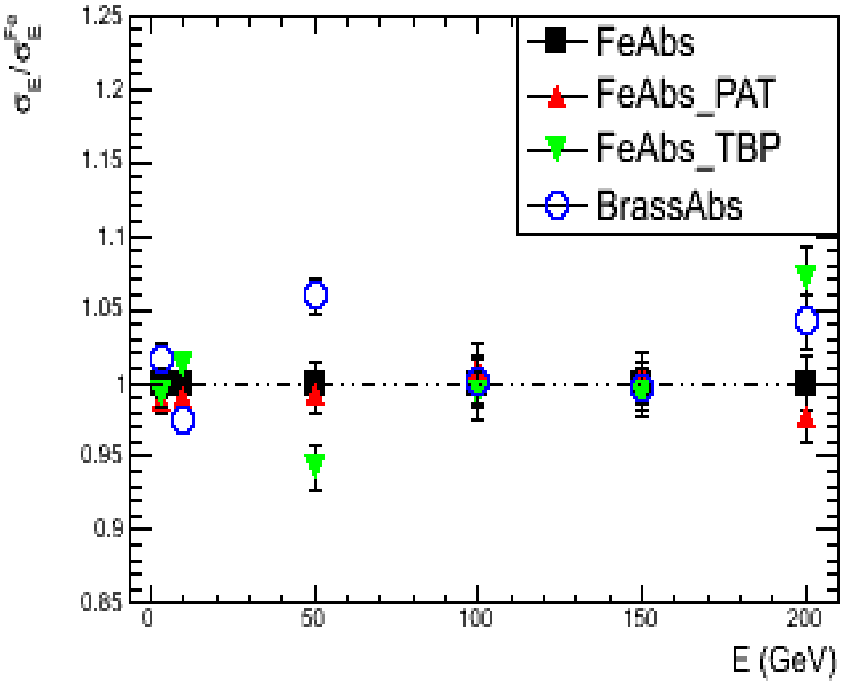
Energy resolution

Digital readout with 0.1 MIP MPV threshold

Calorimeter resolution



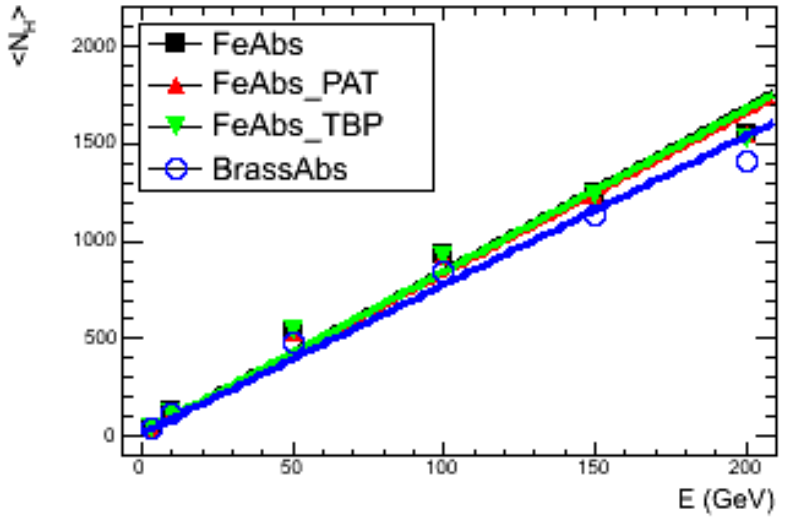
Difference w.r.t. the standard geometry

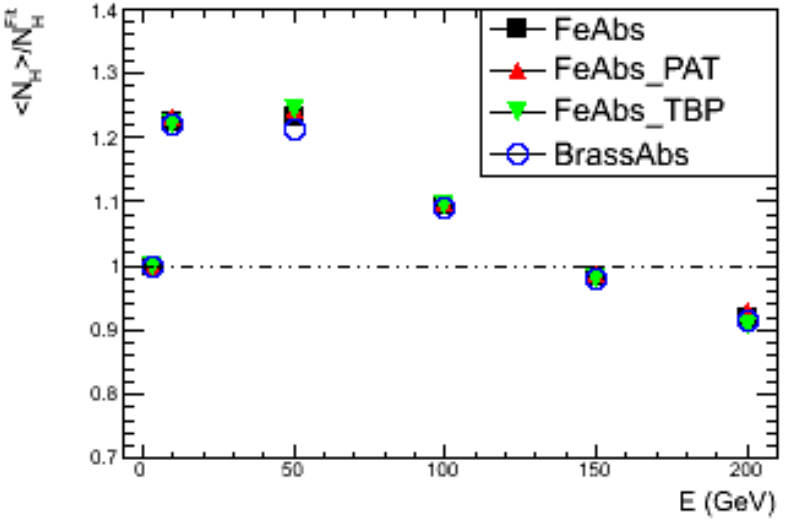


- Clear degradation of the energy resolution for higher pion energies (> 100 GeV)
- Small difference in resolution (less than 8 %) among various calorimeter configurations

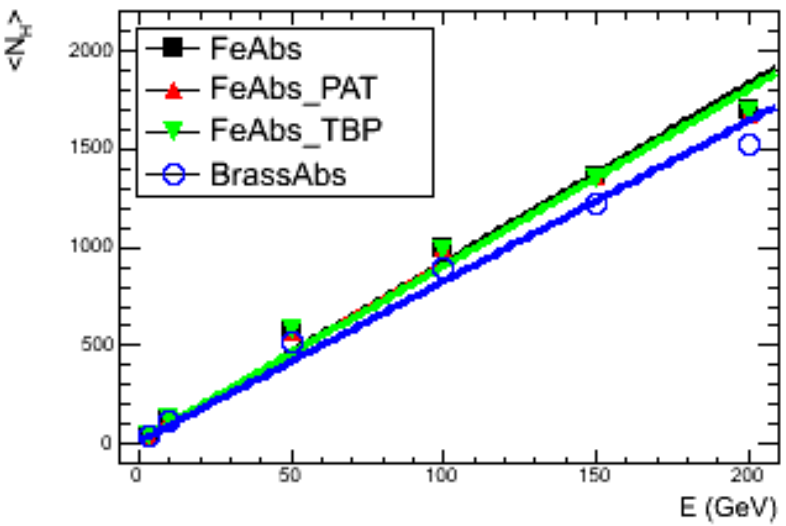
Leakage corrections: response

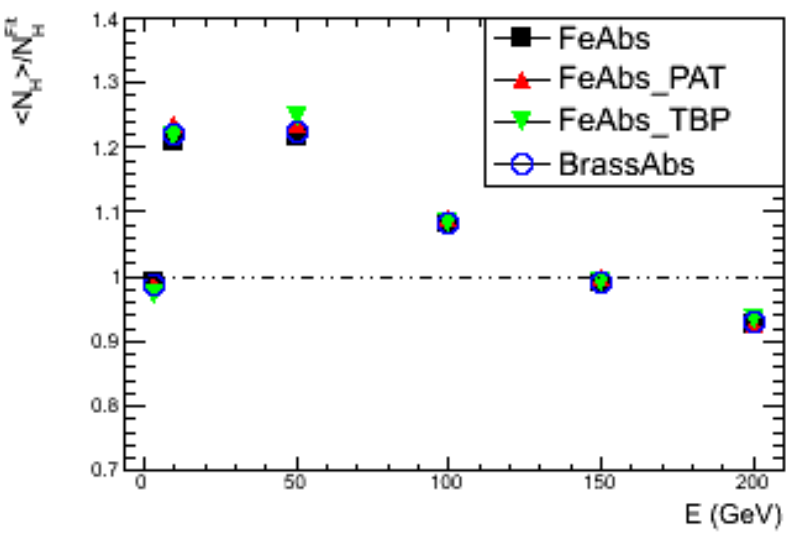
No corrections





With corrections

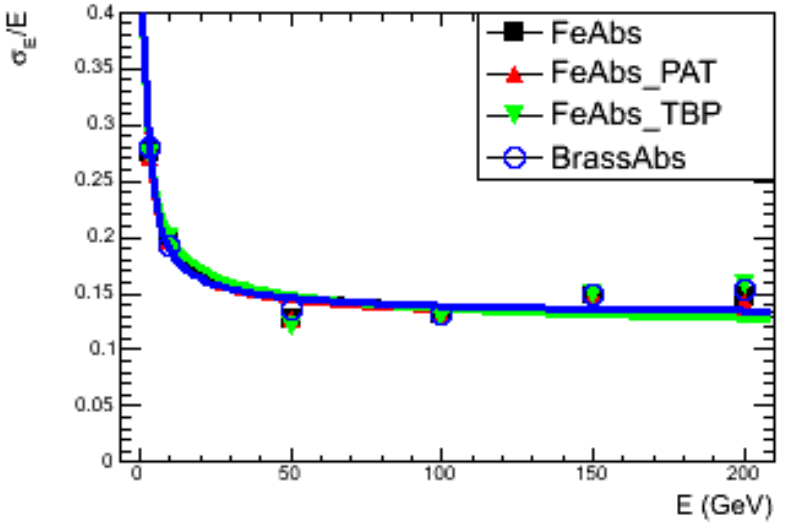


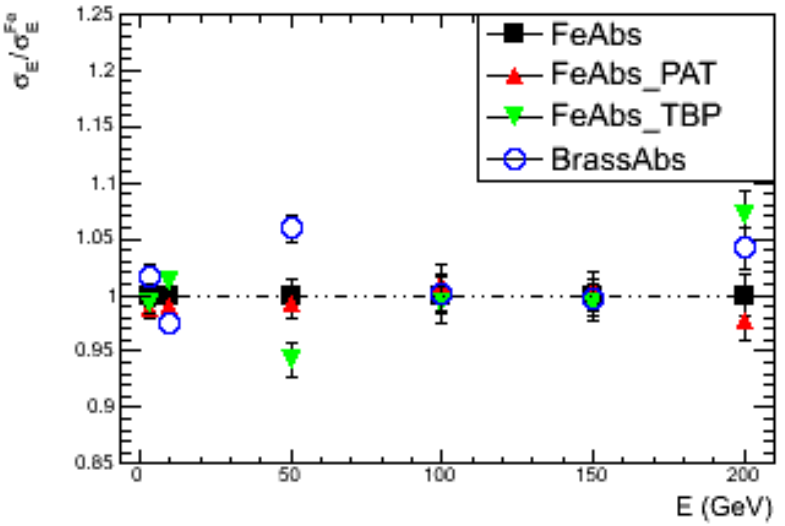


- For higher energies the number of hits are recovered, but the linearity stays the same (the saturation effect is dominant)

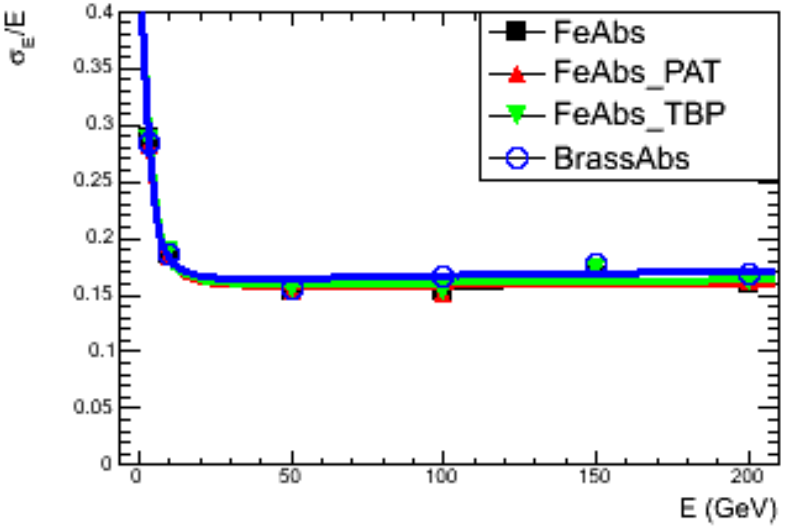
Leakage corrections: resolution

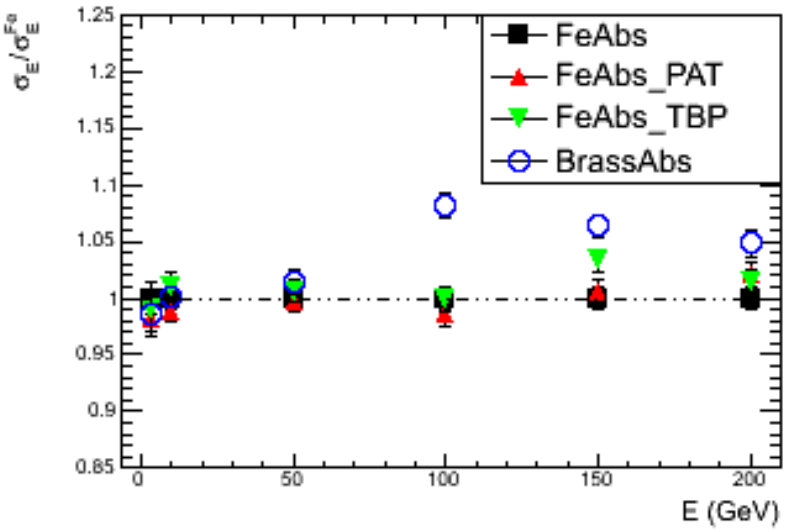
No corrections





With corrections





- No improvement in energy resolution has been found

Conclusions

- Basic characteristics such as lateral and longitudinal shower profiles, energy containment and leakage, calorimeter response, linearity, and energy resolutions have been evaluated for four various calorimeter designs
- Calorimeters with Fe absorber show practically same behavior for all measured quantities. The calorimeter with brass absorber has (due to the material properties) shorter shower profile and lower response, but perform same w.r.t. the calorimeter resolution and linearity
- It can be concluded that the alternative configurations, which have certain advantages from mechanical point of view, do not affect calorimeter physics performance and thus should endure further consideration for HCAL design