More on single pion calibration

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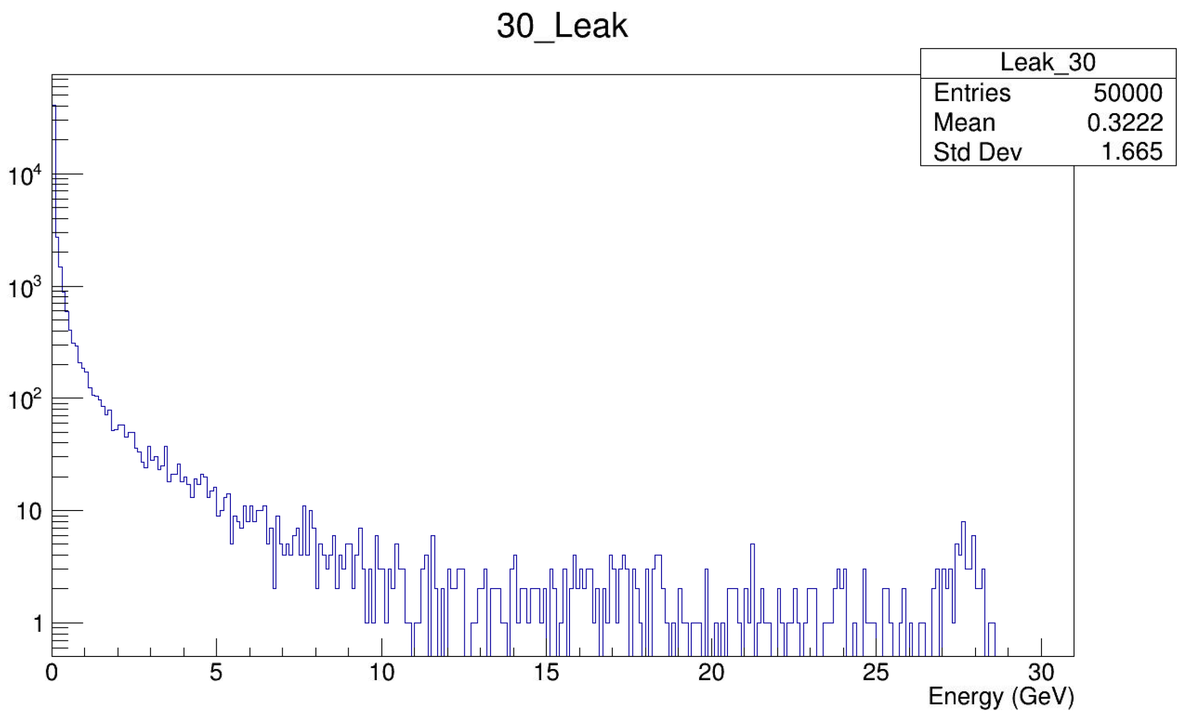
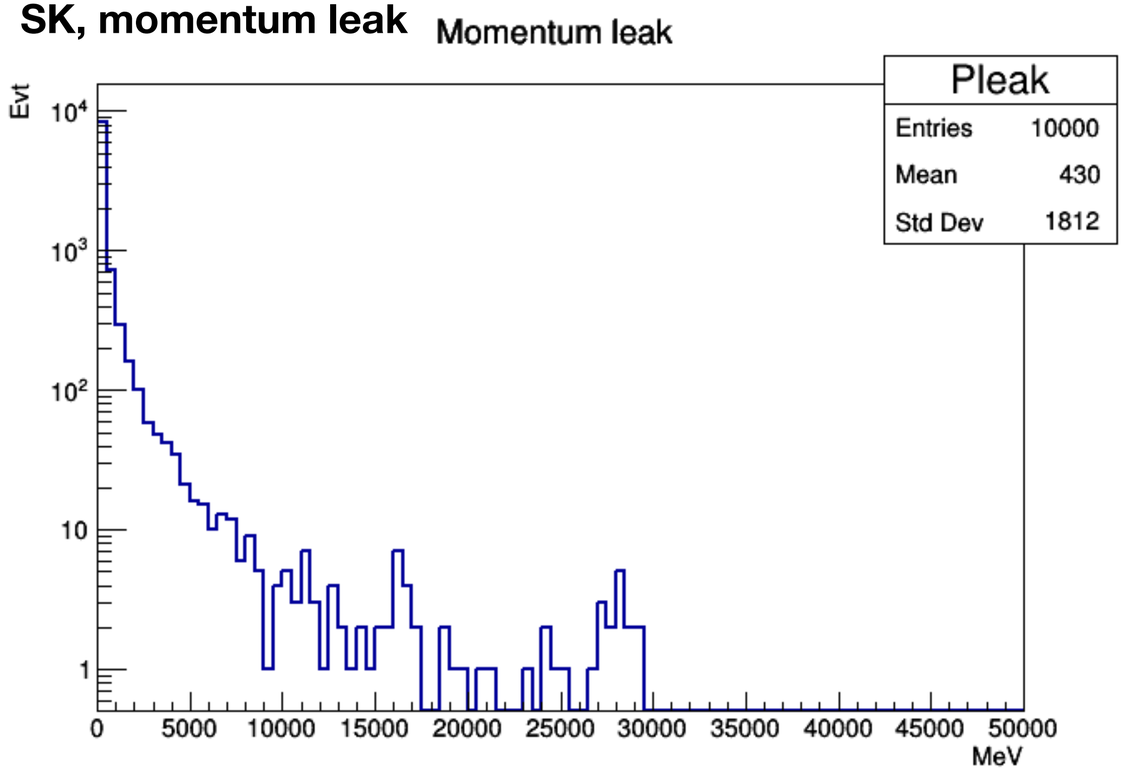
Leakage comparison

30 GeV charged pions
Using same macro card, FTFPBERT PL and geant4.10.5.p01

INFN, kinetic energy leak



SK, momentum leak

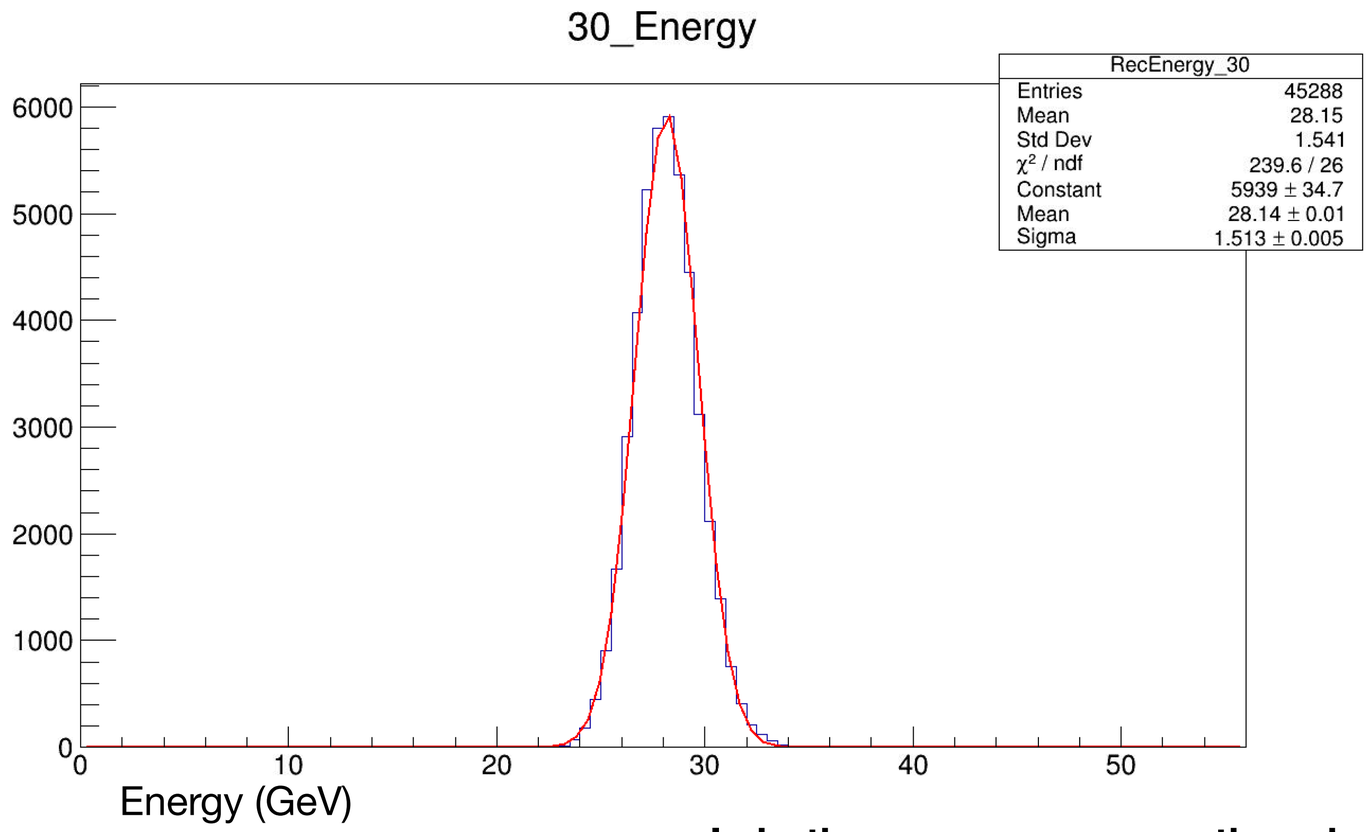


An excess of events with almost all energy carried by particles escaping the calorimeter is observed in both cases.

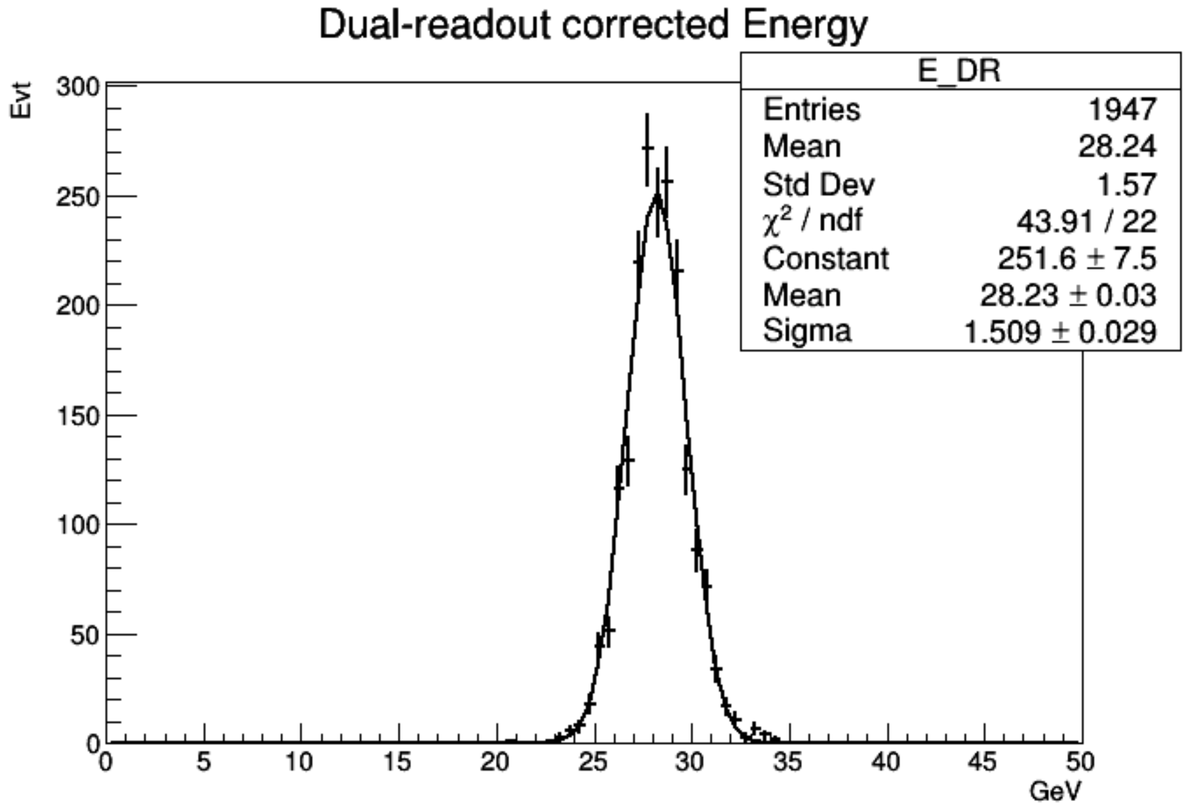
Reconstructed energy comparison

30 GeV charged pions
Using same macro card, FTFPBERT PL, geant4.10.5.p01 and Chi = 0.29

INFN



SK

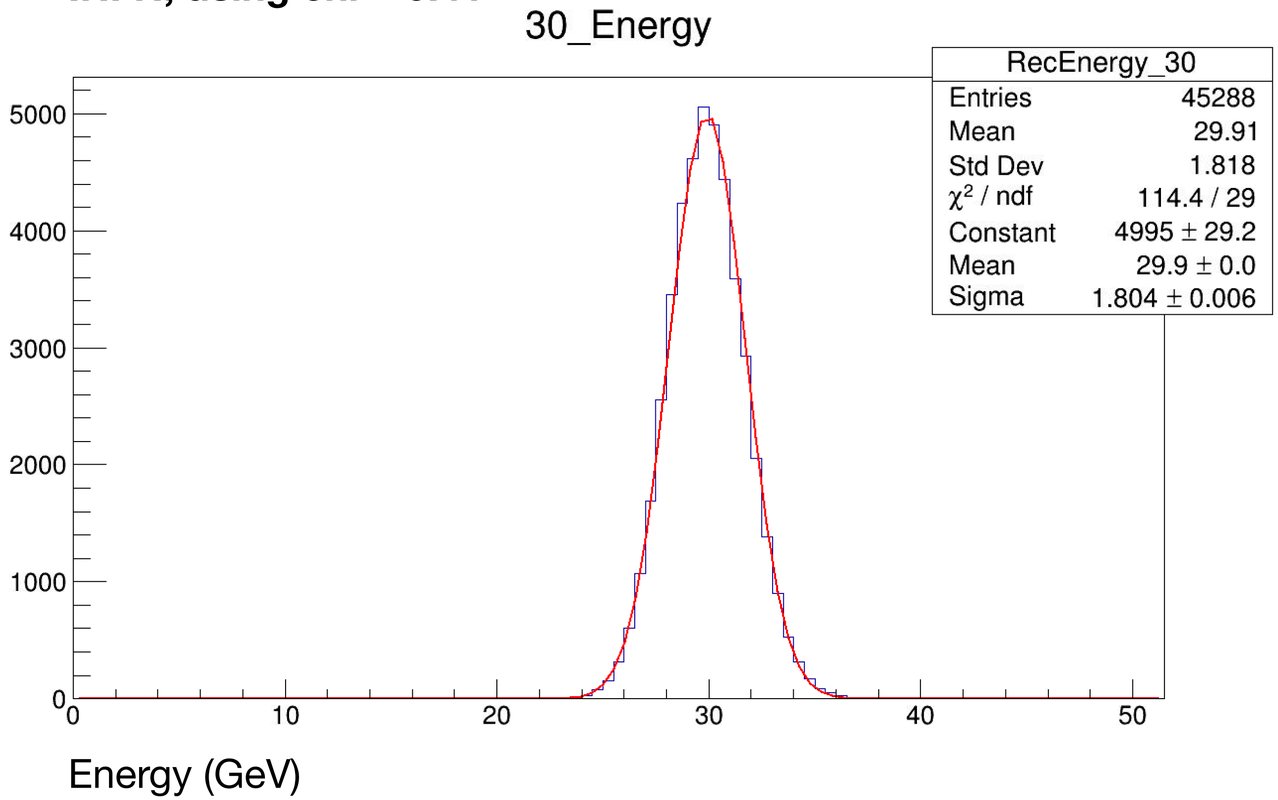


In both cases, on average the primary pion energy is underestimated.

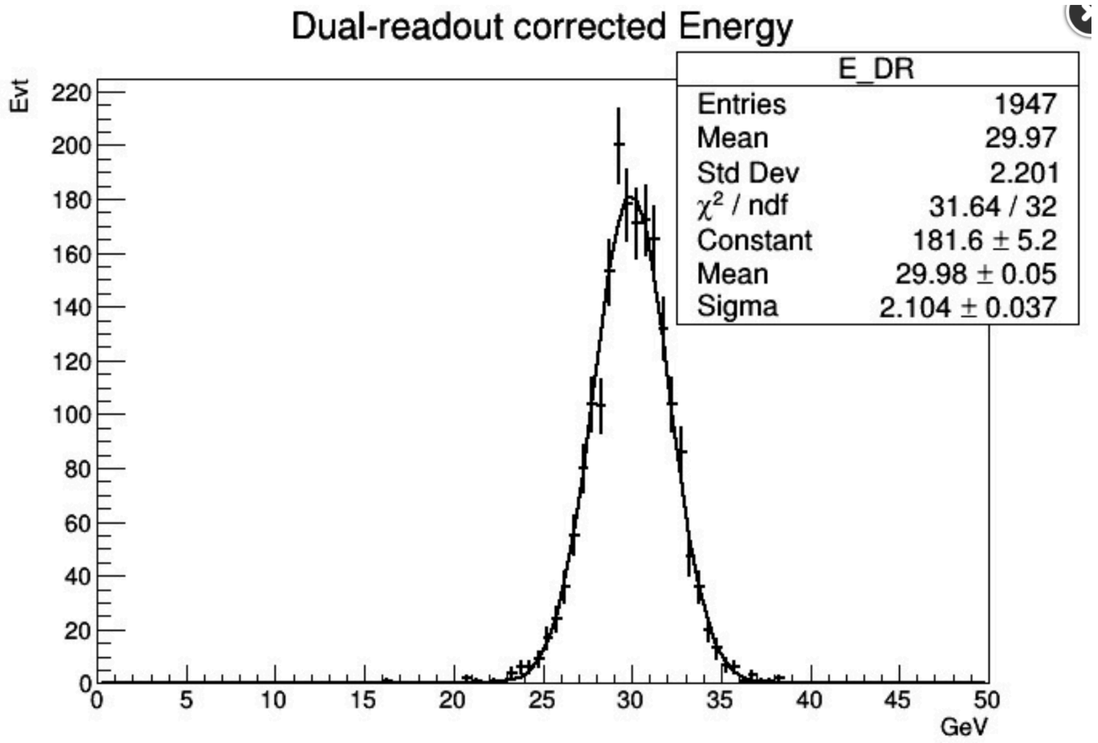
Reconstructed energy comparison

30 GeV charged pions
Using same macro card, FTFPBERT PL and geant4.10.5.p01

INFN, using chi = 0.41



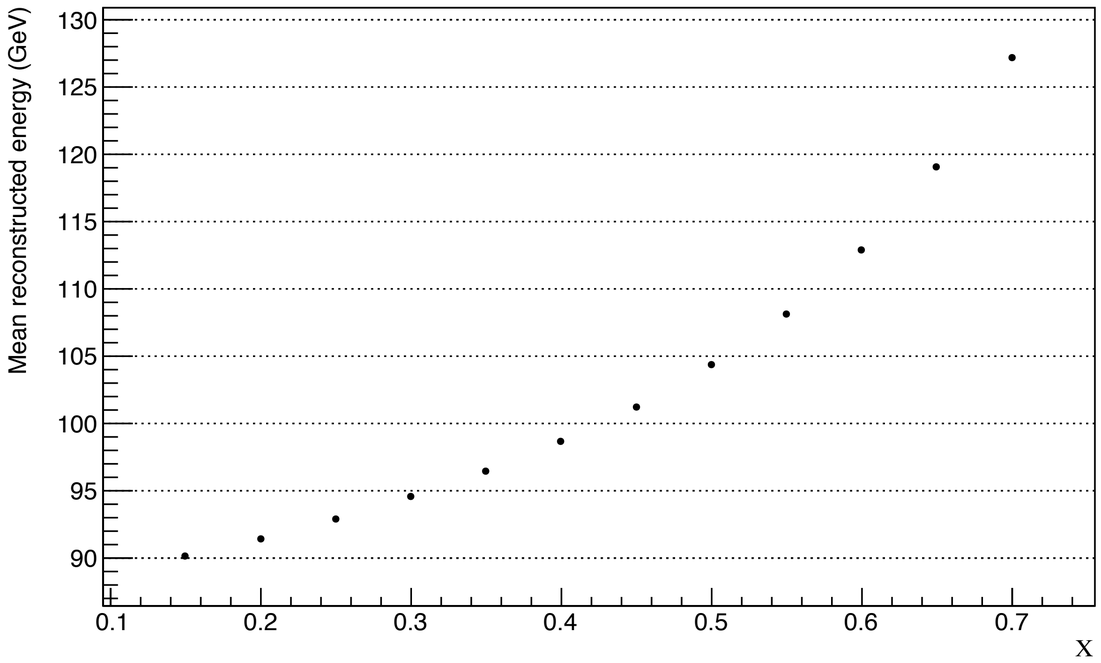
SK, using chi = 0.432

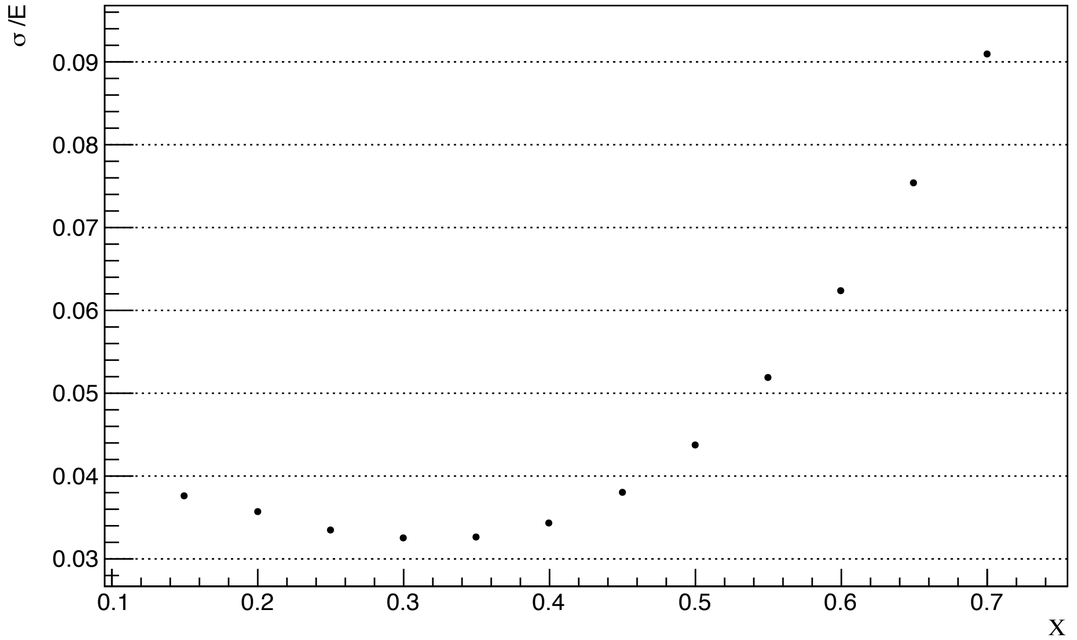


In both cases, to on average reconstruct the correct energy, a higher Chi factor is needed, at the cost of a poorer resolution.

Impact of χ, INFN

INFN, 100 GeV charged pions

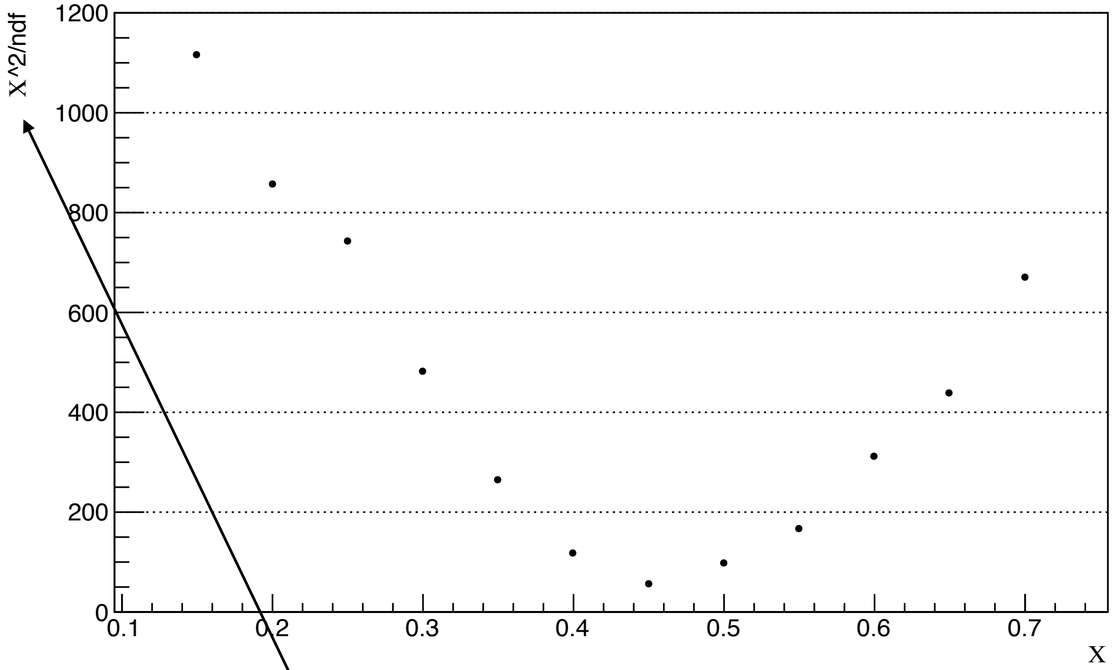


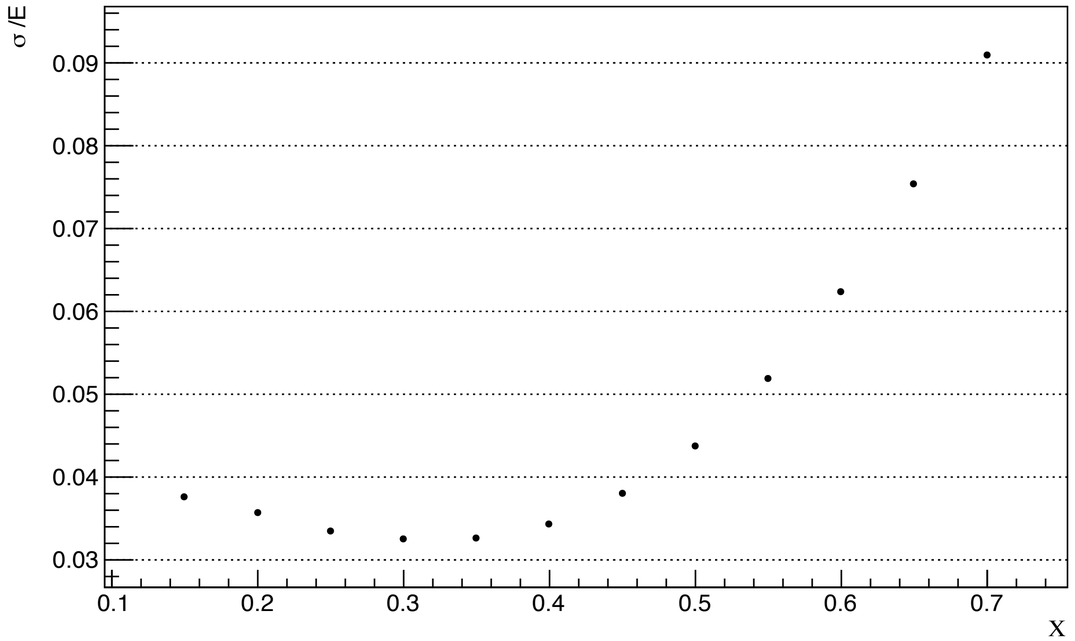


Deliberately increasing the Chi factor boosts the S-C difference and so the reconstructed energy.
However, event-by-event fluctuations are boosted too and the resolution is spoiled.

Impact of χ, INFN

INFN, 100 GeV charged pions



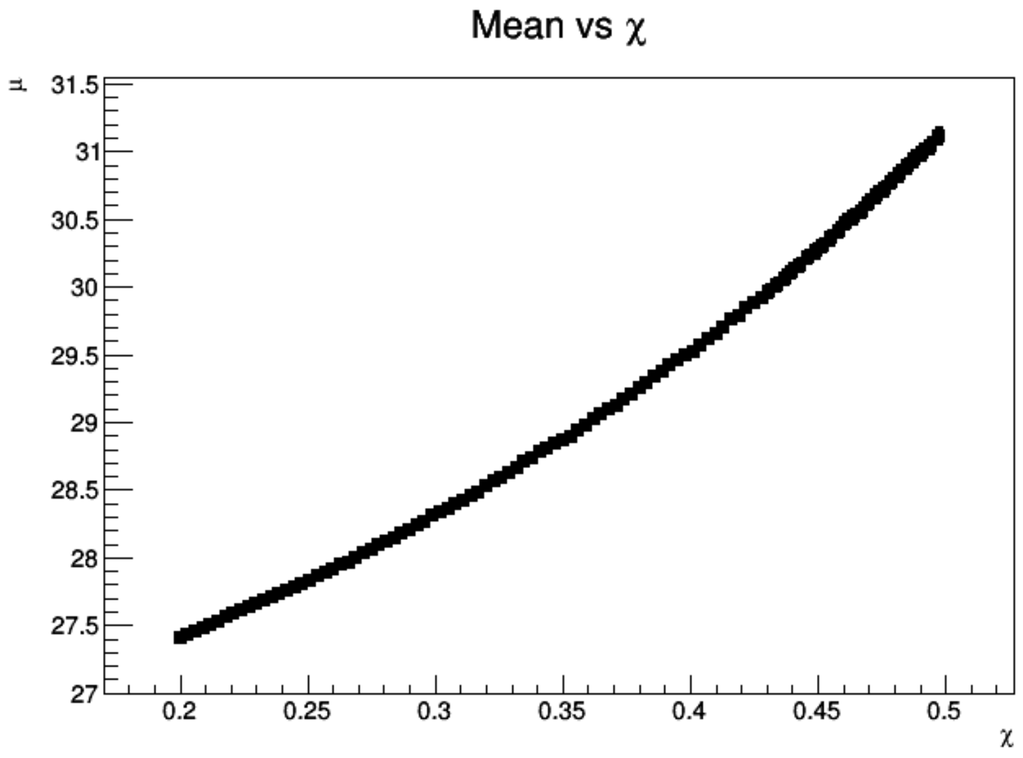


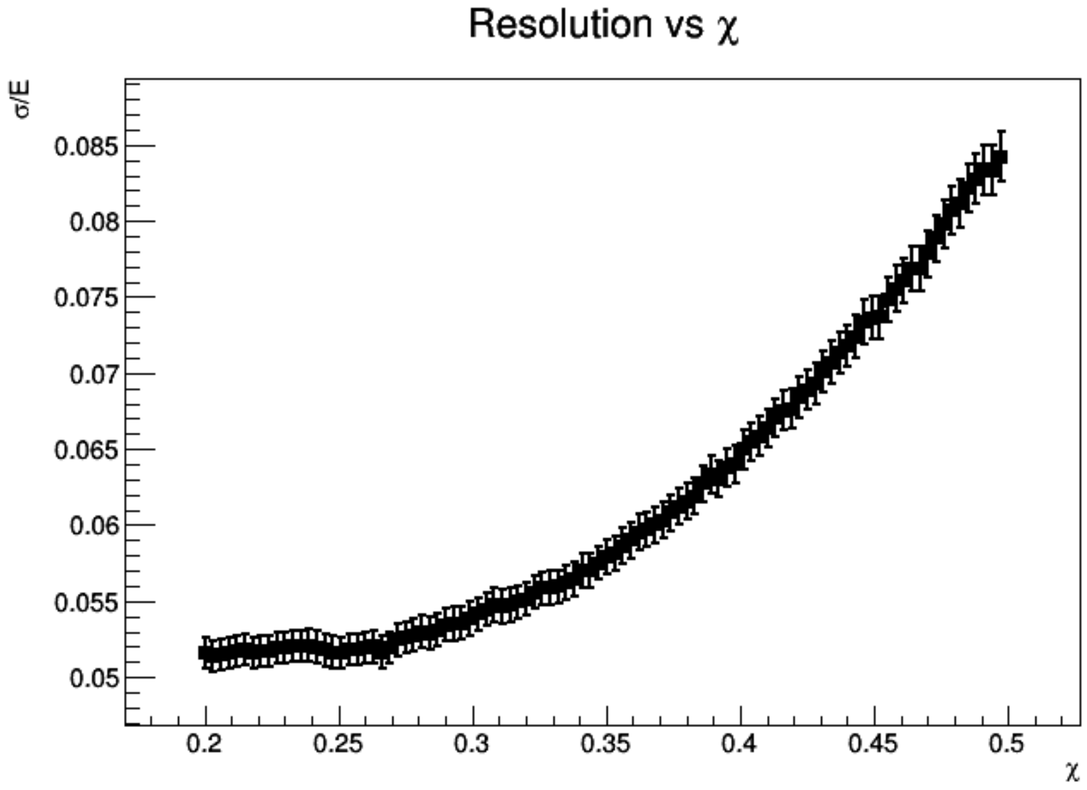
Deliberately increasing the Chi factor boosts the S-C difference and so the reconstructed energy.
However, event-by-event fluctuations are boosted too and the resolution is spoiled.

The quality of the Gaussian fit also indicates that a higher Chi factor leads to a more symmetrical distribution.

Impact of χ, SK

SK, 30 GeV charged pions





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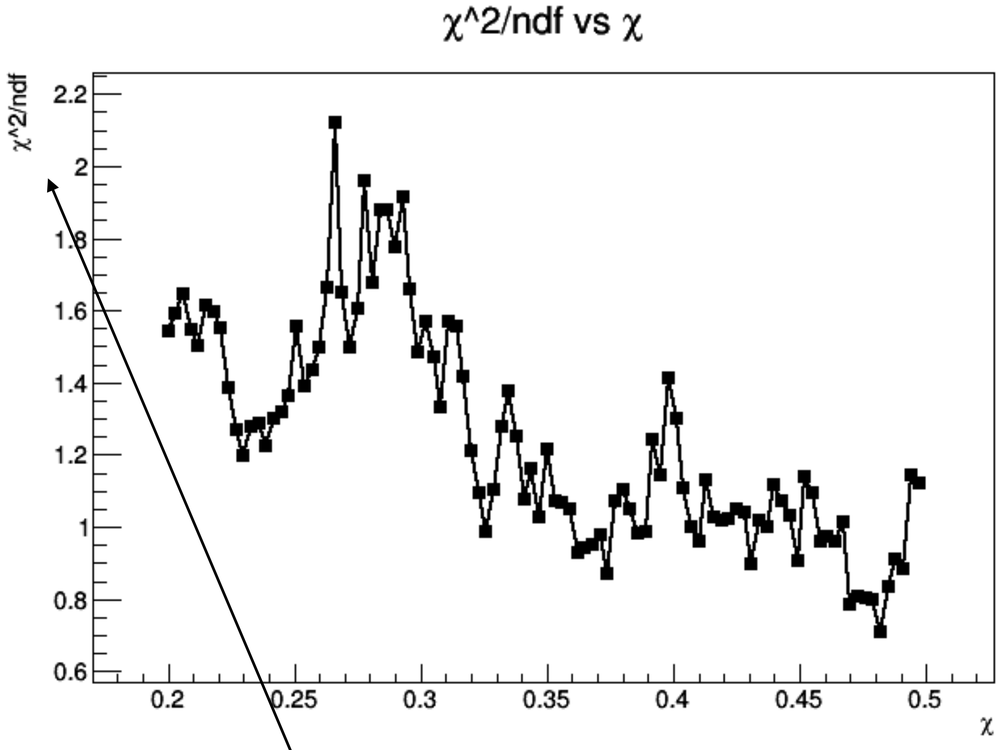
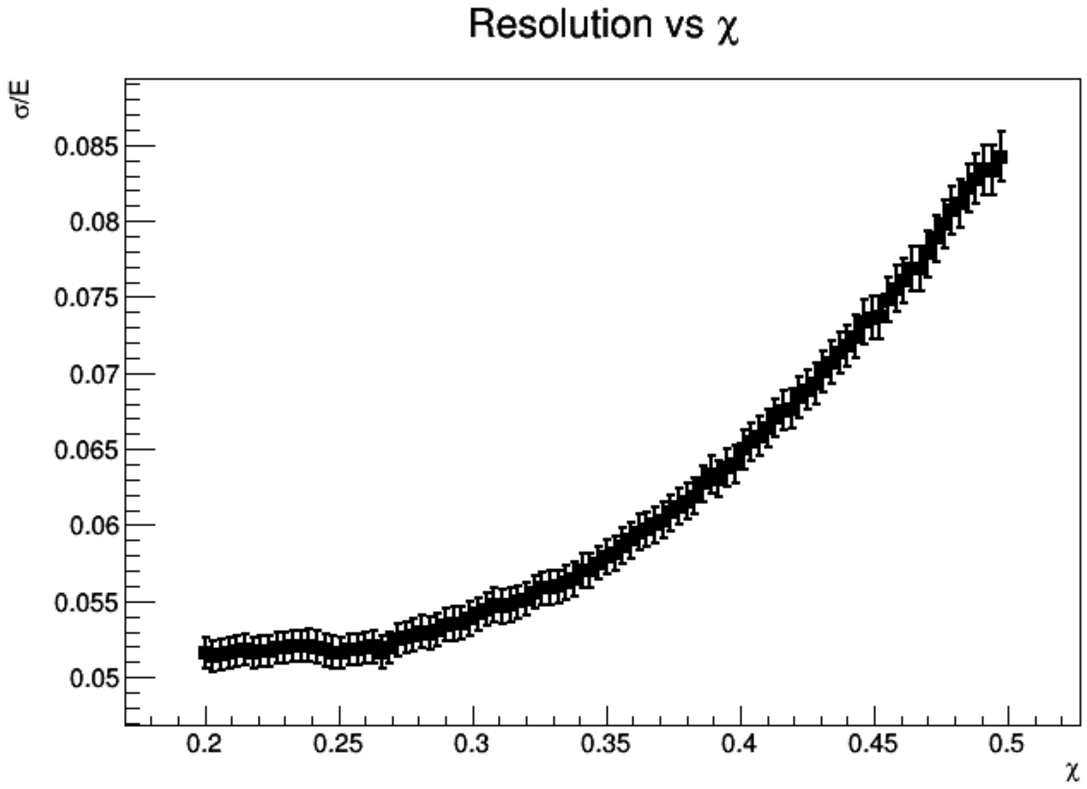
Impact of χ, SK

SK, 30 GeV charged pions





Deliberately increasing the Chi factor boosts the S-C difference and the reconstructed energy. However, event-by-event fluctuations are boost as well and the resolution is spoiled.

The quality of the Gaussian fit also indicates that an higher Chi factor leads to a more symmetrical distribution.

What we found:

- Punch through events must be taken into consideration, especially with the 2m long towers configuration.

- The χ factor has a non negligible impact on the average reconstructed energy and its resolution.
  - A higher factor leads to a linear, Gaussian calorimeter with a spoiled resolution.
  - A lower factor leads to a non-linear (less-linear), non-Gaussian (less-Gaussian) calorimeter with a better resolution.

Some considerations:

- Calibrating a calorimeter by minimizing the width has proven to be a bad idea in history.

- As a collaboration we should decide which approach to use for single hadrons and jets and try to be consistent with it when quoting any performance. As long as no test-beam data-driven indications come, we see two alternatives:

  - Using the factor that on average gives the correct primary hadron energy (safer option as it does not need any correction), or…
  - Using a smaller factor and agree on a common procedure to correct, on average, for its error.