Measurement of the systematic error for the IC electron analysis.

Calet TIM, 2020/02/03, Firenze

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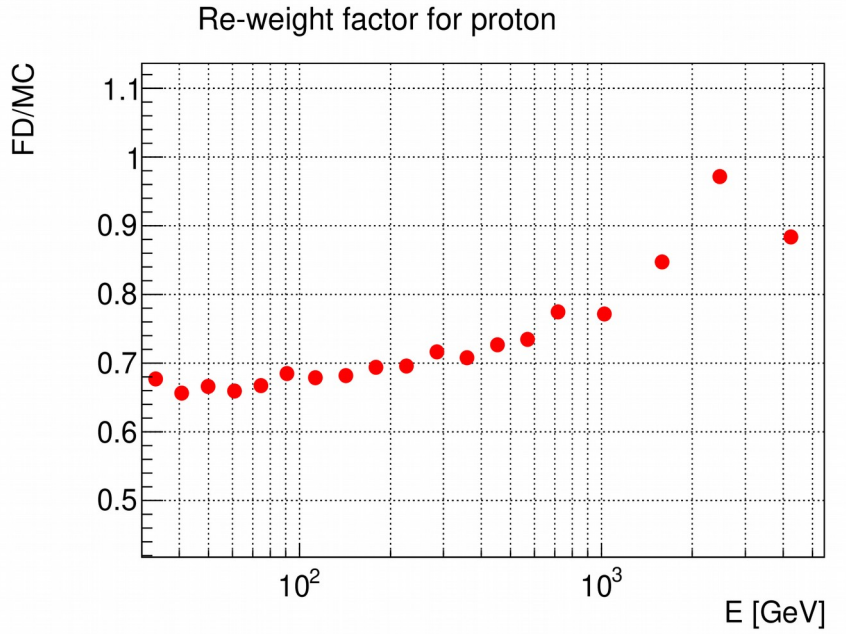
Analysis parameters

- Flight data:
  - L2, PASS 3.1, 201511 – 201807 (we are downloading the PASS4 now)
- MC Data:
  - EPICS with X0 adjusted for the main analysis
  - GEANT4 and EPICS with standard X0 are employed for the systematic errors.
  - MC electron and proton spectra weighted according the AMS + CREAM fluxes.
  - The number of protons is corrected according to the distribution in FD.



Base selections

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- Software HET (more restrictive than hardware HET):
  - TASCX1 > 100 MIP, IMCX4,IMCY4 > 40 MIP.
- Good tracking with Kalman filter (IMCfitflag=3).
- **Track reconstructed within acc. E (Eugenio definition).**
- TASC layer concentration (see Pisa TIM)
- Consistency of the track in TASC (<2cm).
- Consistency between shower axis computed with the momentum method with the KF track (see KYOTO TIM for description).
- CHD cut, where the CHD peaks in proton MC are adjusted to match FD
- IMC shower concentration of last X and Y layer > 0.5.

Rejection cut

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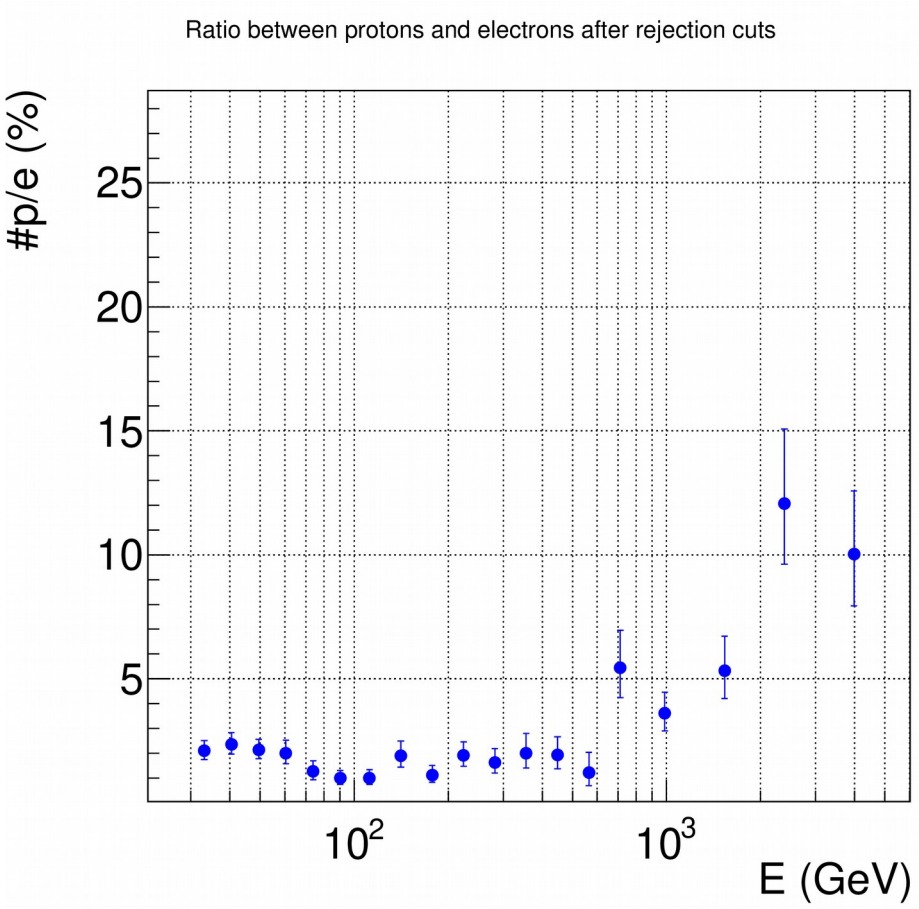
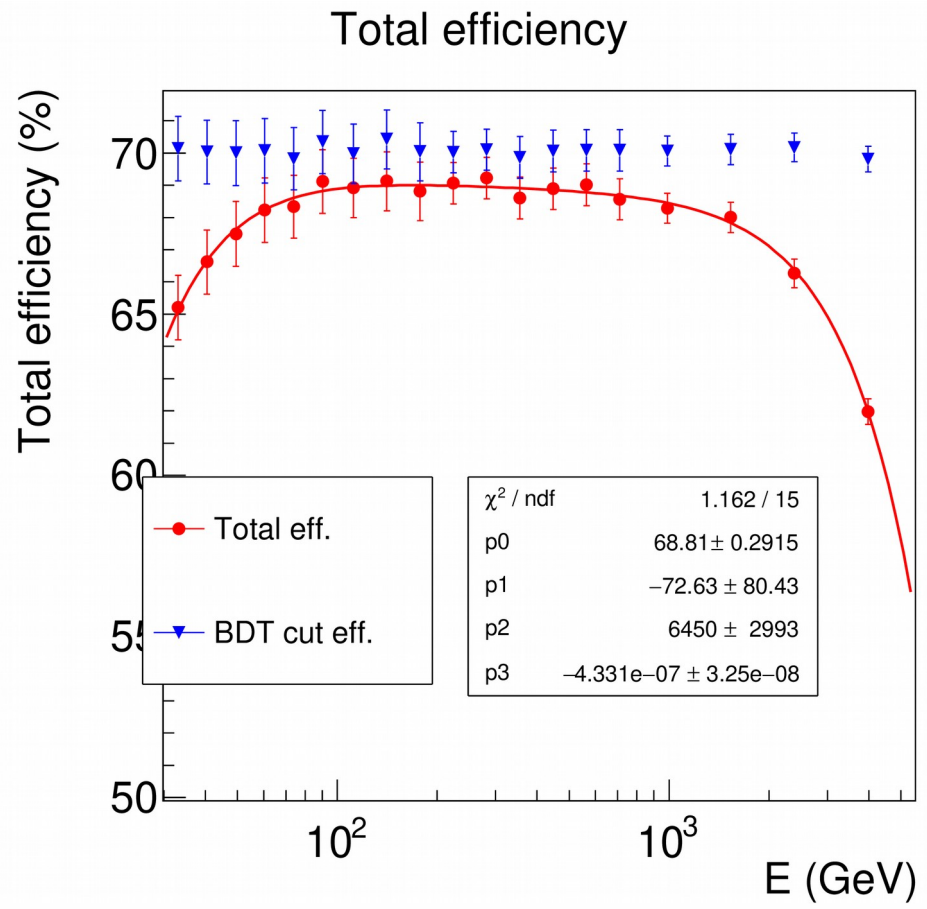
- Expected efficiency and contamination using MVA BDT with 70% efficiency.

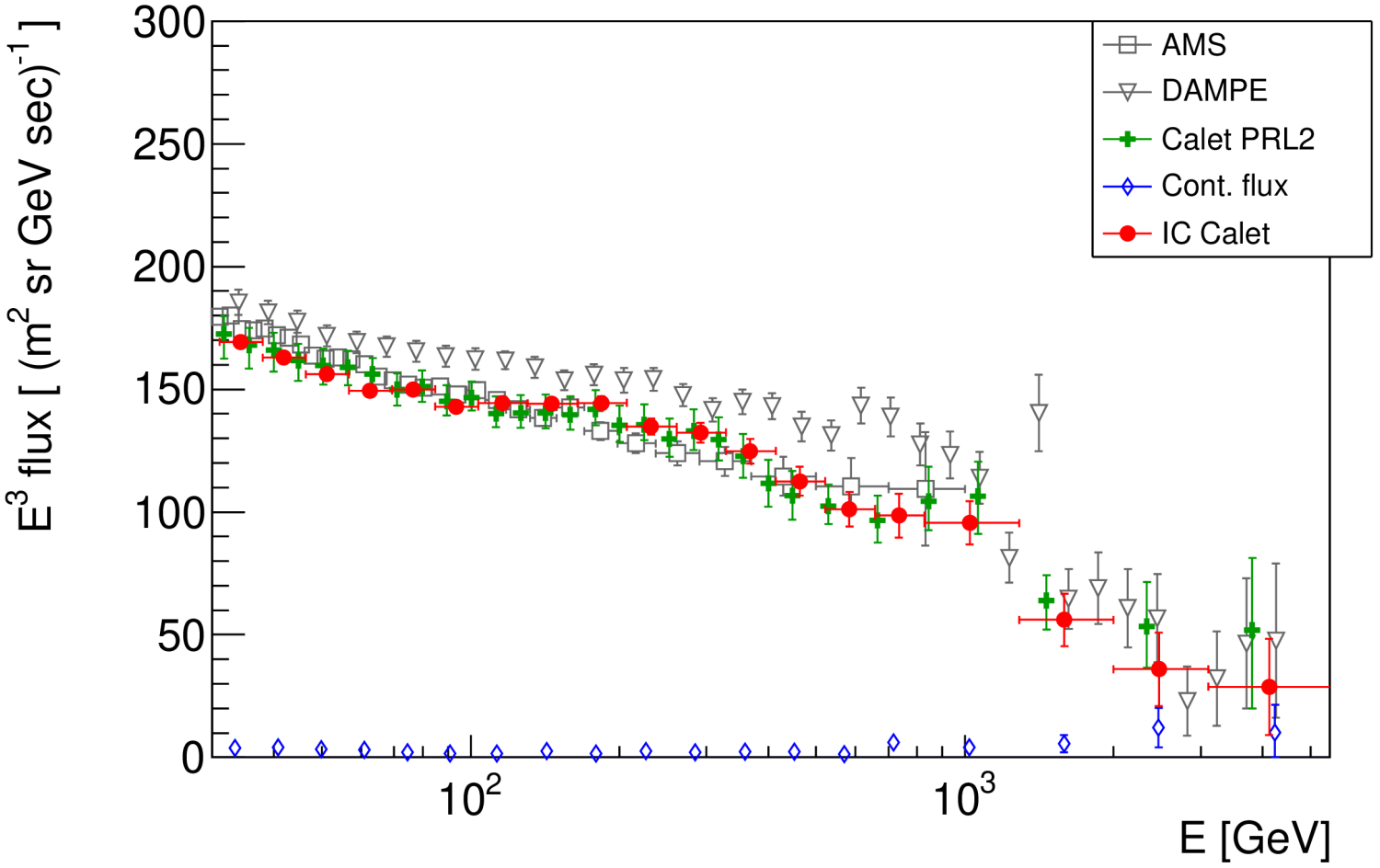




- Efficiency decreases due to the CHD and IMC show. conc. cuts.

Flux w/o systematic errors

- Good agreement with published result:
  - analysis diff.: all BDT, K cut is not used, RE shift is not applied so far.



Systematic calculation

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- Systematic errors calculated as the ratio between different fluxes: for each analysis a new BDT training is performed, this is also a test of the BDT stability with respect to slightly different data samples.
- Systematic study so far (only energy dependent systematic are discussed here):
  - Selections: CHD, IMC shower concentration, SW trigger
  - Rejection cut efficiency: BDT, K cut used only below 1 TeV
  - MC model: EPICS w/o X0 adjusted, GEANT4
  - Different FD periods.

BDT efficiency

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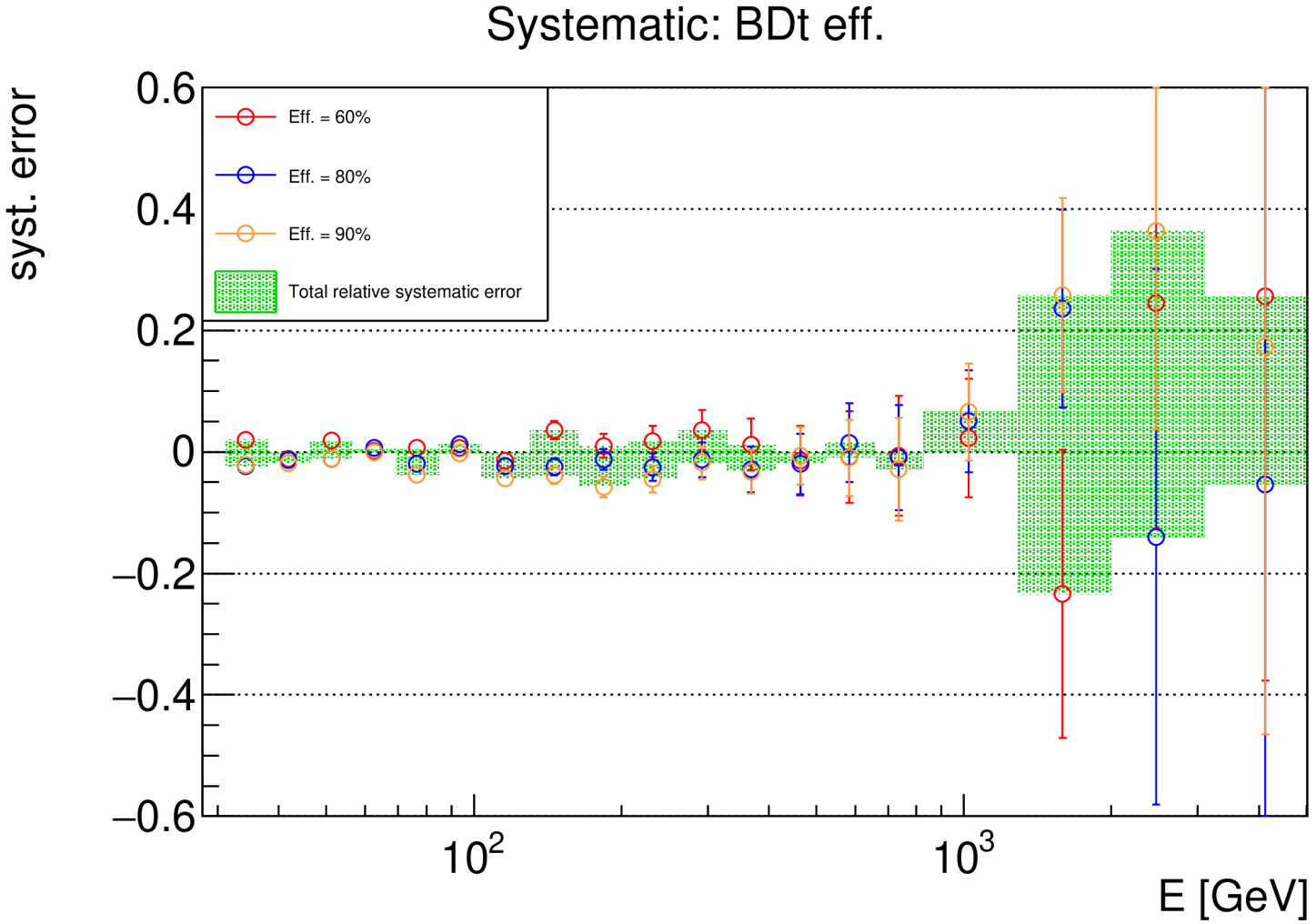
- BDT cut with 3 fixed efficiencies:



- Error bars are the stat. error of the flux

SW trigger

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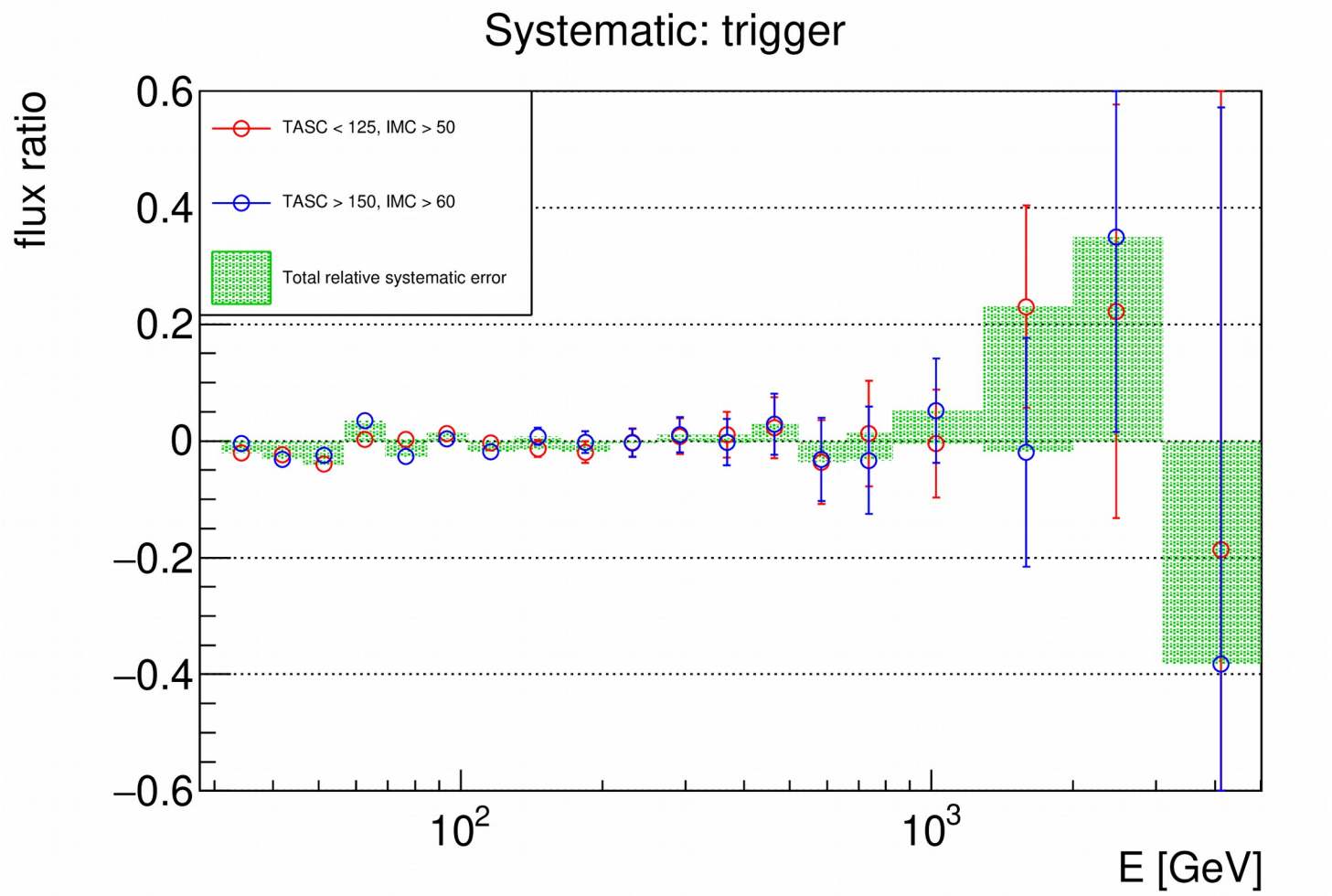
- Apply a SW trigger with higher thresholds



- Error bars are the stat. error of the flux

CHD cut

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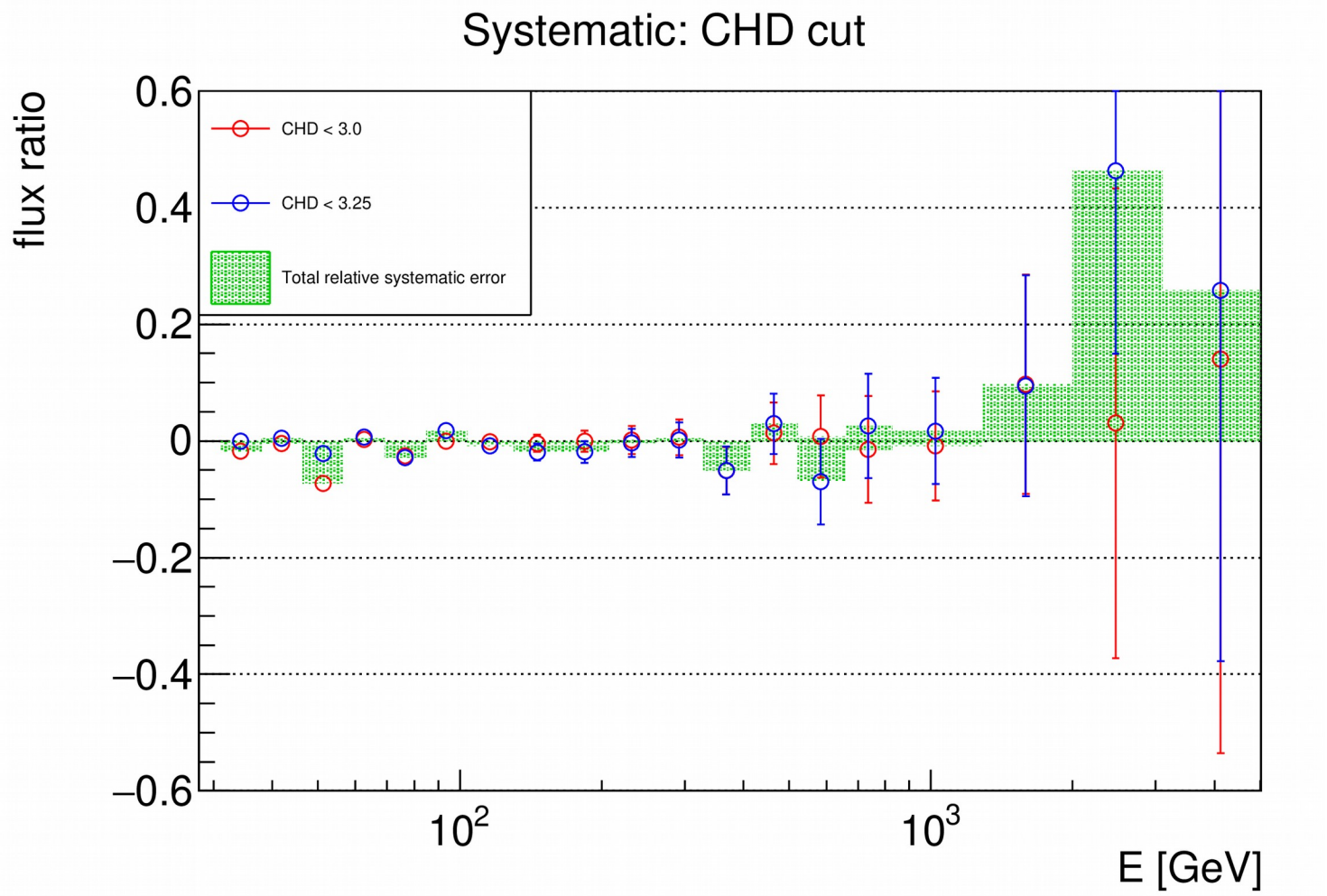
- Charge cut with smaller thresholds.



- Error bars are the stat. error of the flux

IMC show. Con.

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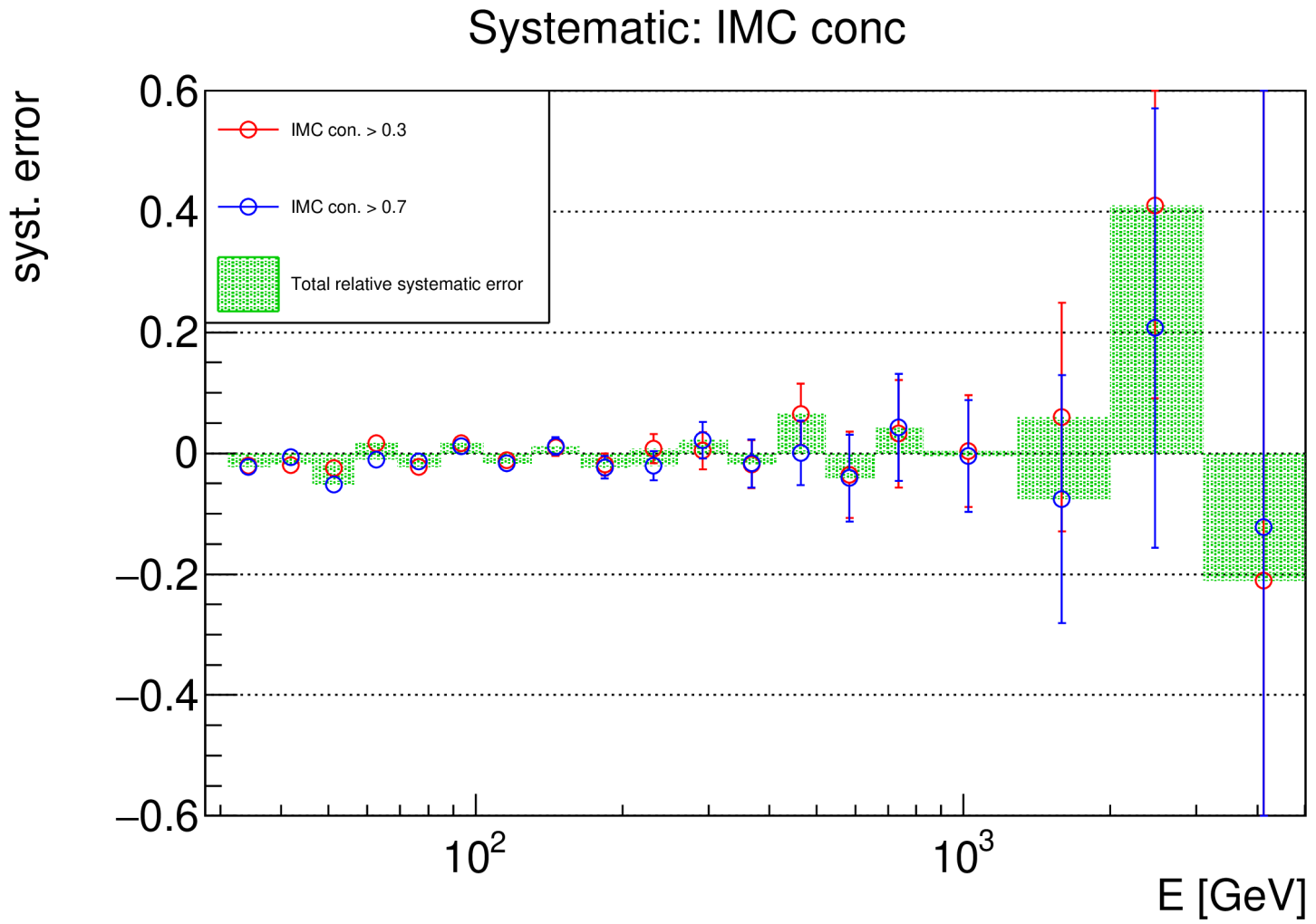
- IMC shower concentration with different thresholds



- Error bars are the stat. error of the flux

MC models

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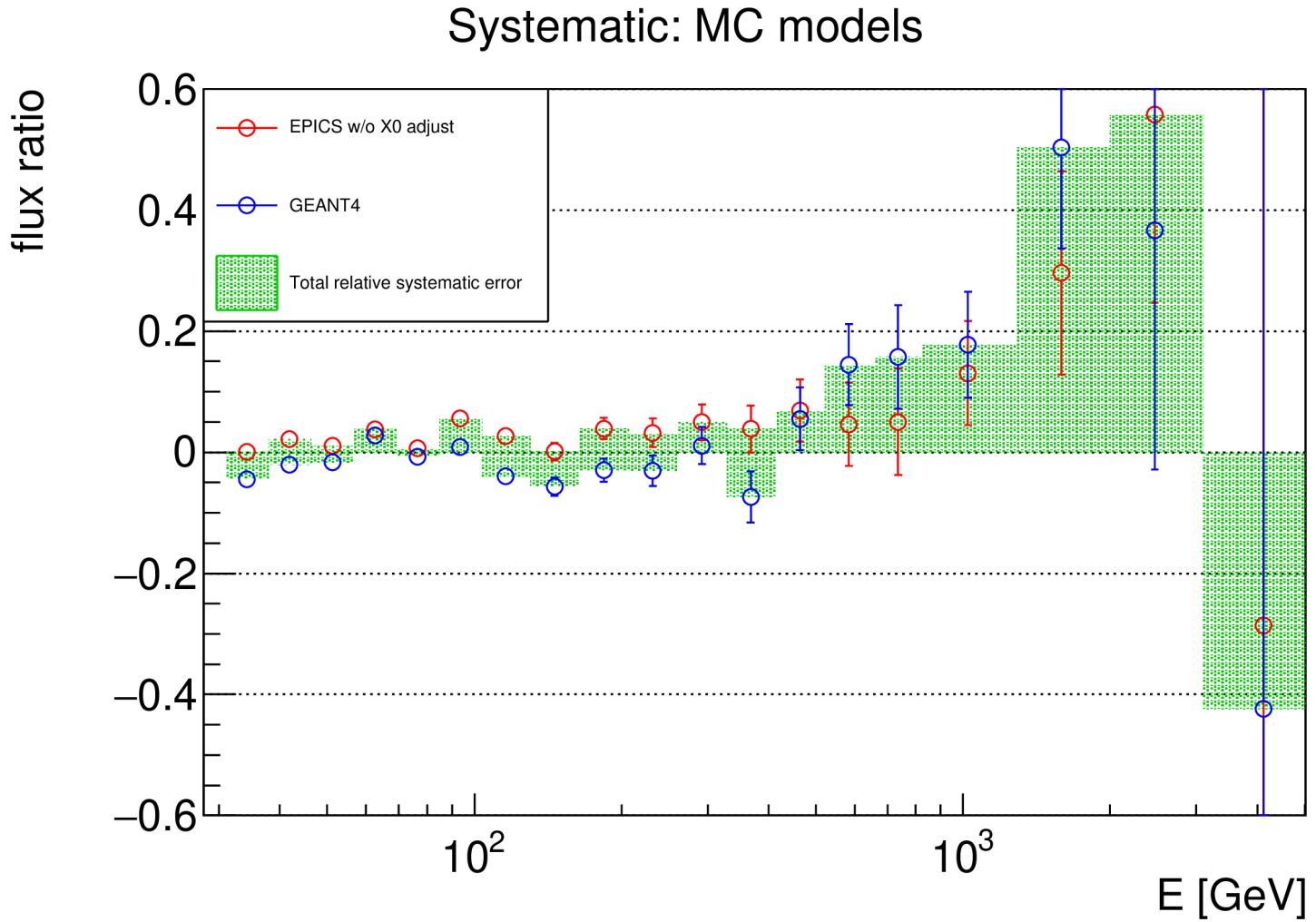
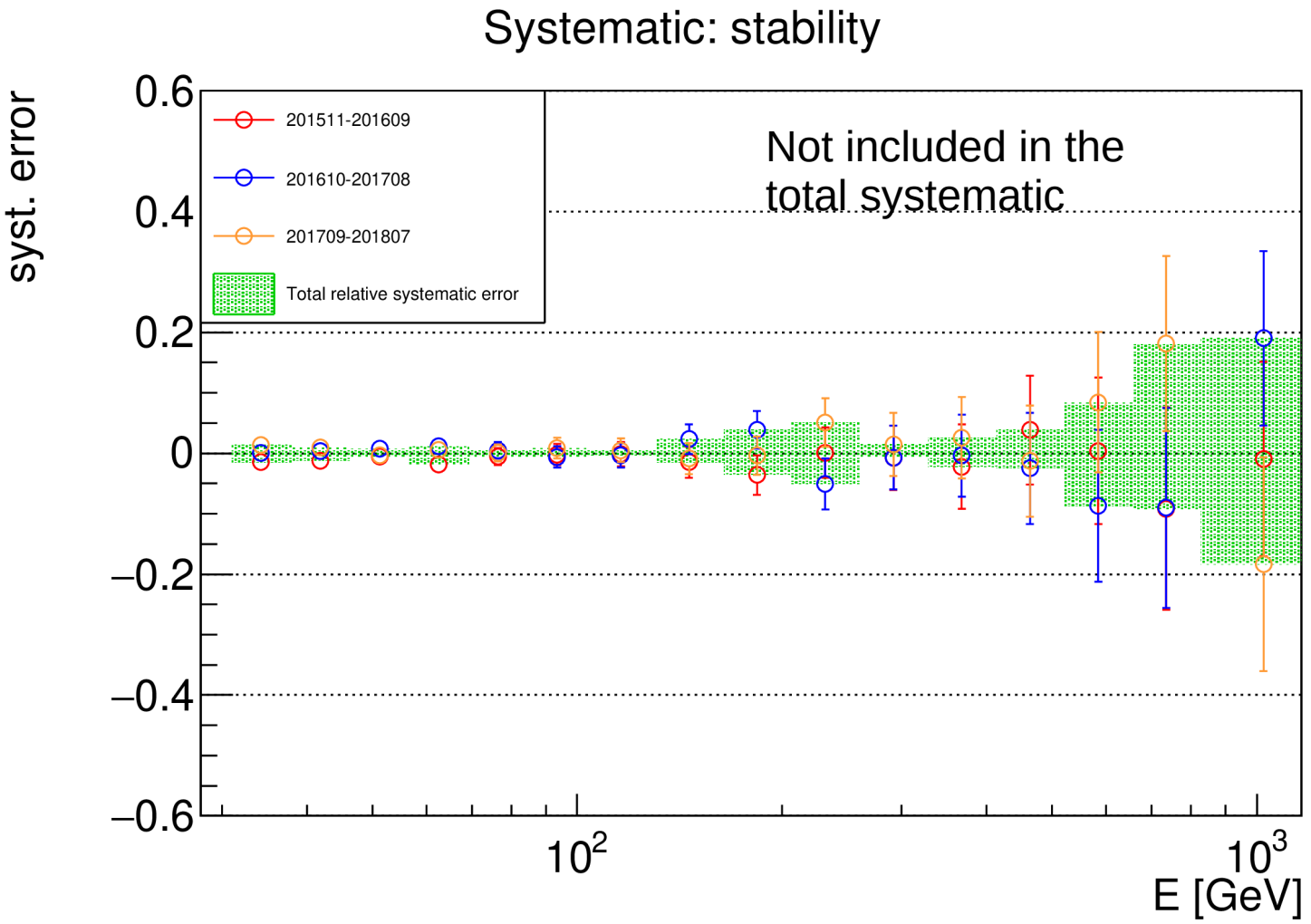
- GEANT4 and EPICS w/o X0 adjusted



- Error bars are the stat. error of the flux

Stability

- Using different periods of FD



- Consistency check is possible below 1 TeV due to the limited statistic.

Acc A and K cut

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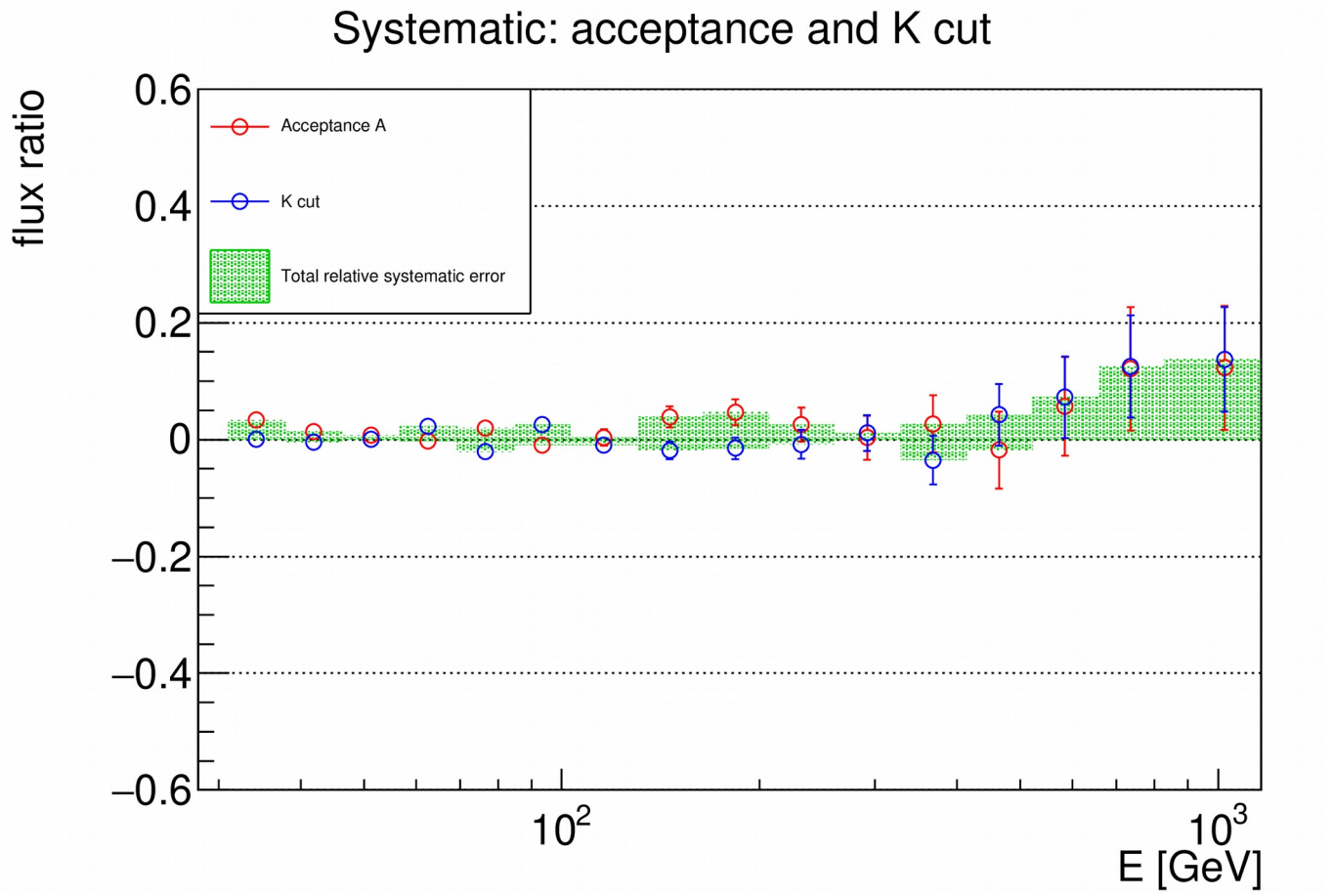
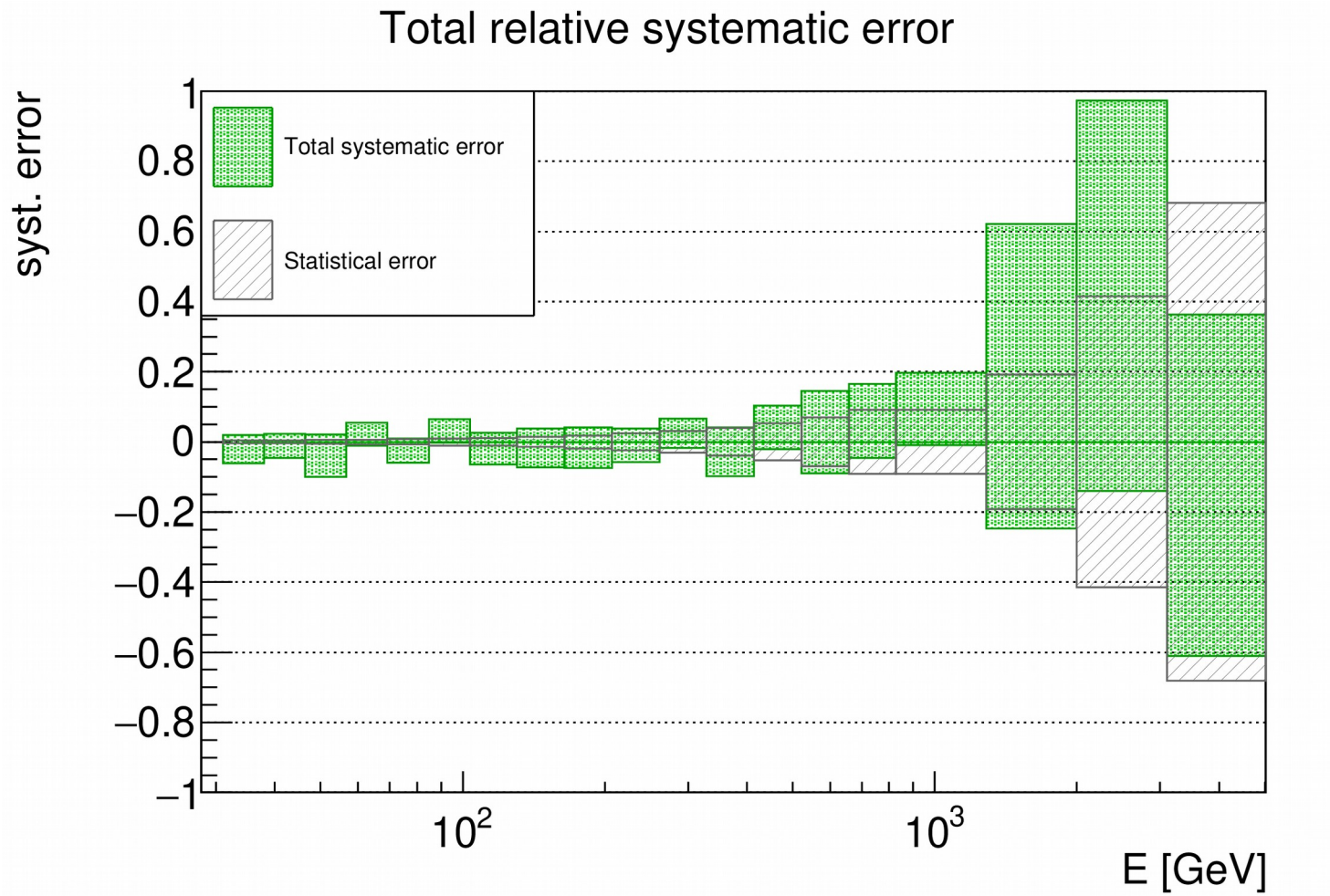
- Using the acc A and the K cut



- Consistency check is possible below 1 TeV due to the limited statistic in acc A and a big proton contamination with K cut.

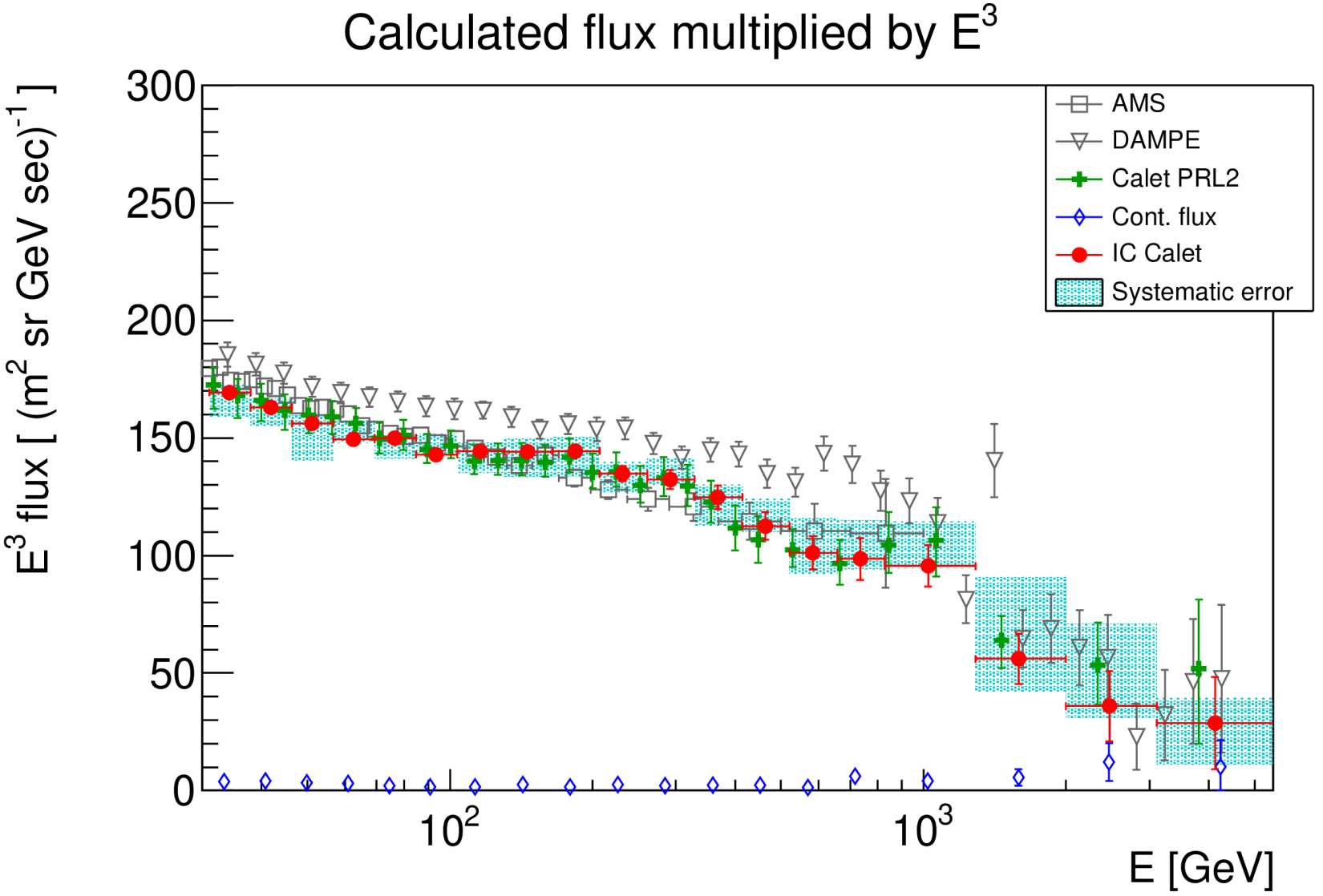
Total systematic error

- Total systematic error excluding stability and Acc A and K cut above 1 TeV



- <~10% below 1 TeV, dominated by statistical error @ high energy

Flux with systematic error



Tentative fit of the flux

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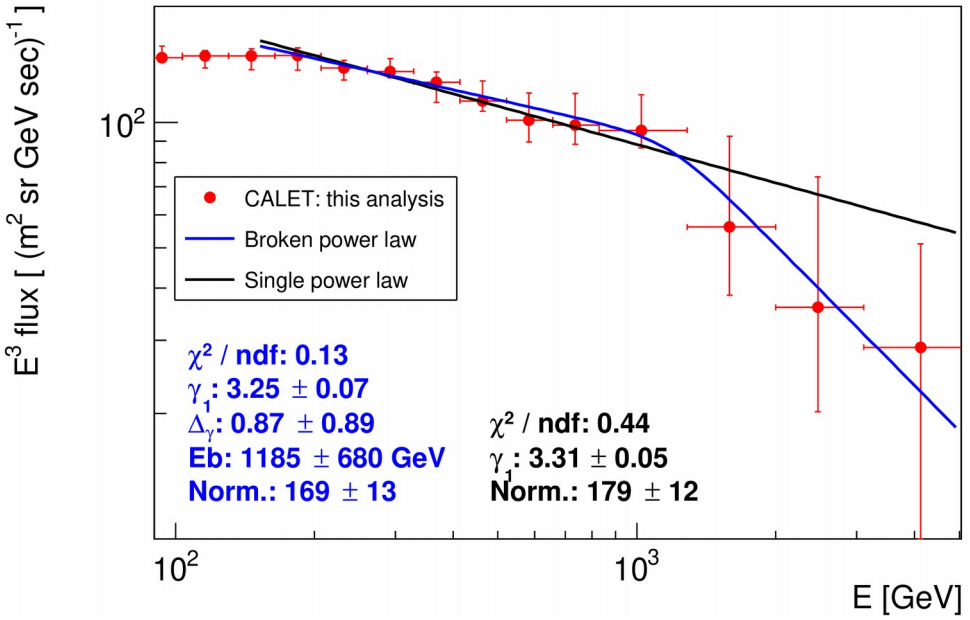
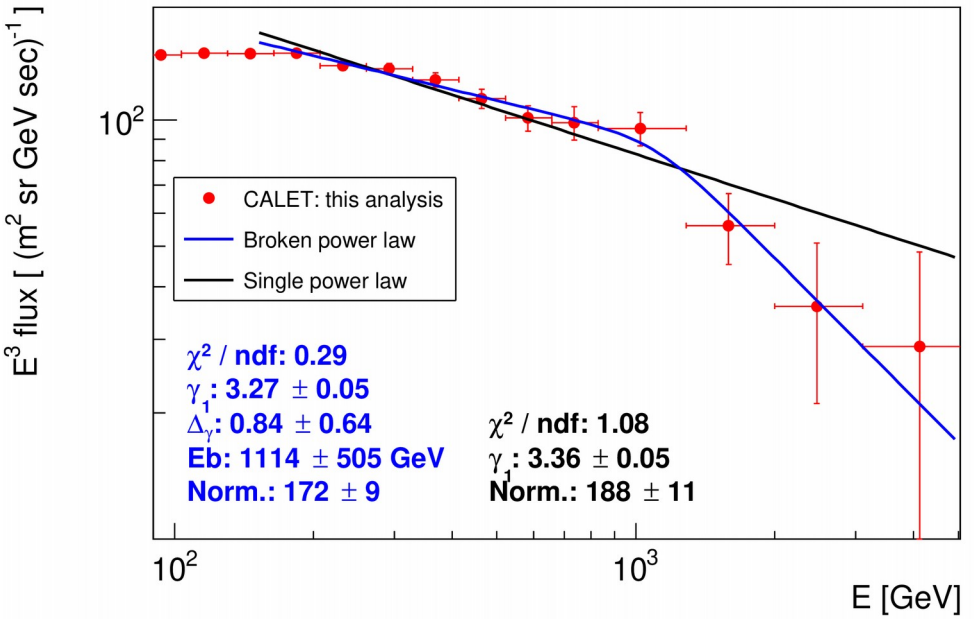
Stat. + sys. errors



Stat. errors only



- Fit with a broken power law give the spectral brake @ ~ 1 TeV with big error
- Even the single power law well fit the data: this is mainly due to the limited statistic @ high energy.

Summary and prospective

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- A consistent result with respect to the punished one is obtained with IC independent analysis even if we use a different acceptance and BDT cut.
- A preliminary version of the systematic error was discussed:
  - Consistent with the published one below 1 TeV
  - Bigger @ high energy, but the systematic evaluation is mainly dominated by the limited statistic.
- Prospective:
  - PASS 4 and more statistic
  - Increase the MC FD agreement by adjusting some variables (RE, CHD …)
  - Test new MVA algorithm with the flux. (BDT is not the best anymore)

Discussion

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- In our opinion there are two main efforts for the future electron analysis:
  - Reduce the error of the flux < 5 TeV to be able to distinguish between single power law and tentative spectral features @ 1 TeV.
    - We can start form the described analysis to decrease the systematic and statistical error.
  - Increases the energy range up to 10 TeV:
    - We think that the standard analysis is not enough thus we should employed different procedures (ev. by ev., …)