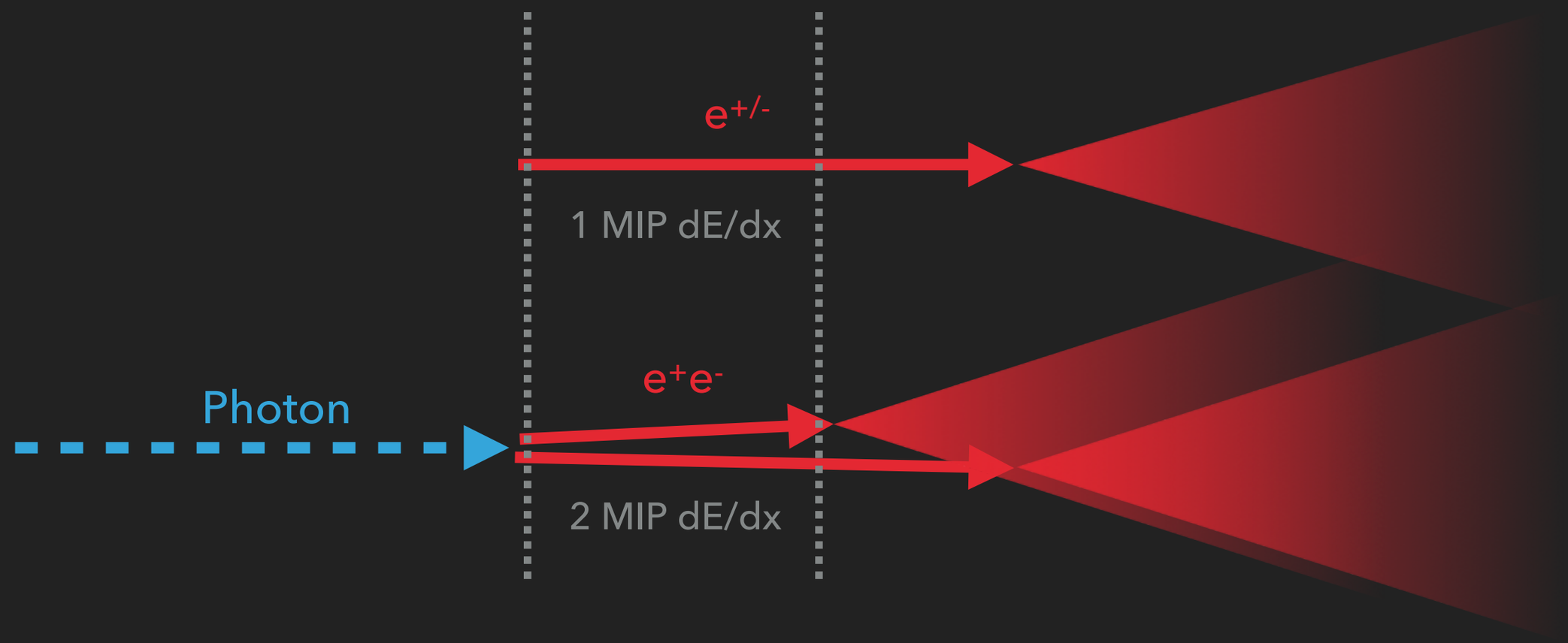
MILO VERMEULEN 2-4-2020

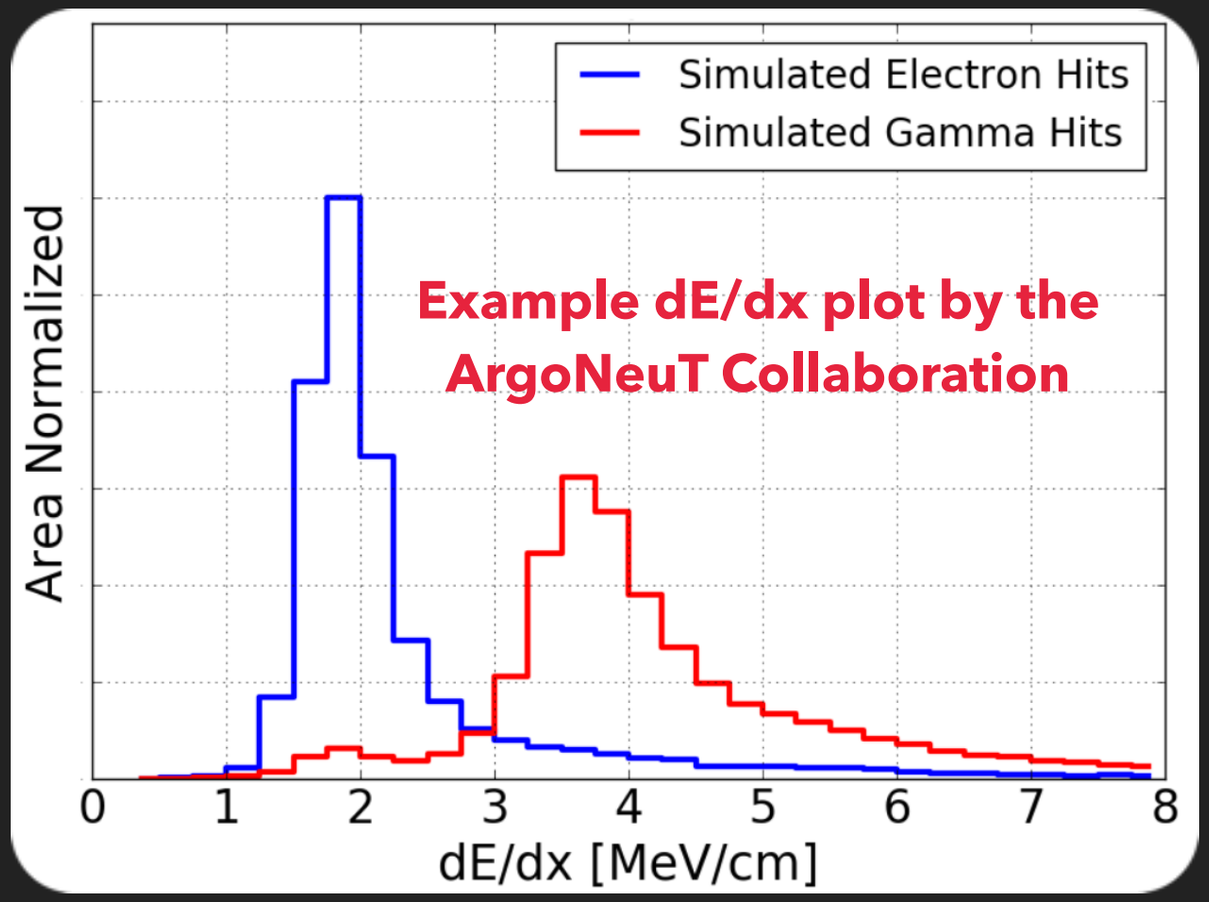
PHOTON SHOWER DE/DX UPDATE

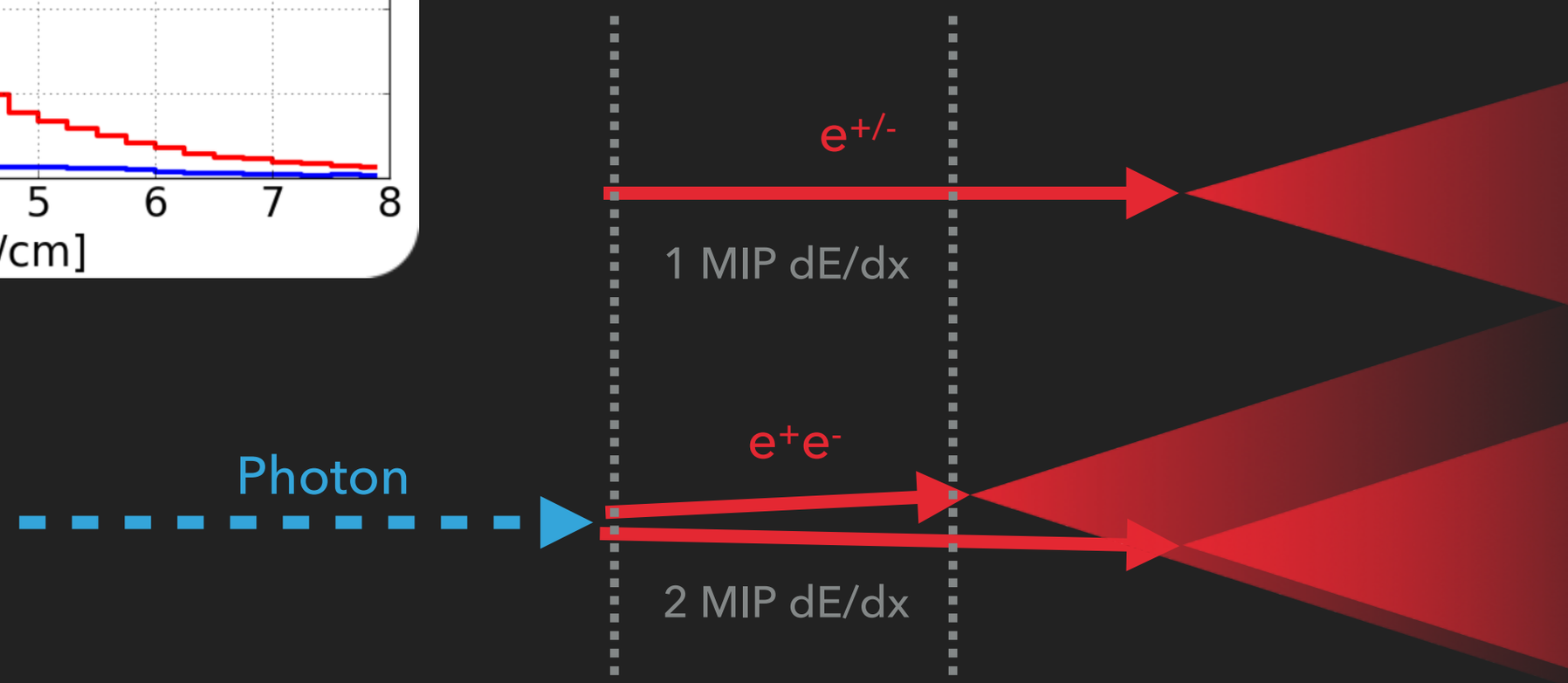
PREVIOUSLY…

- Distinguish electron/positron shower and photon shower



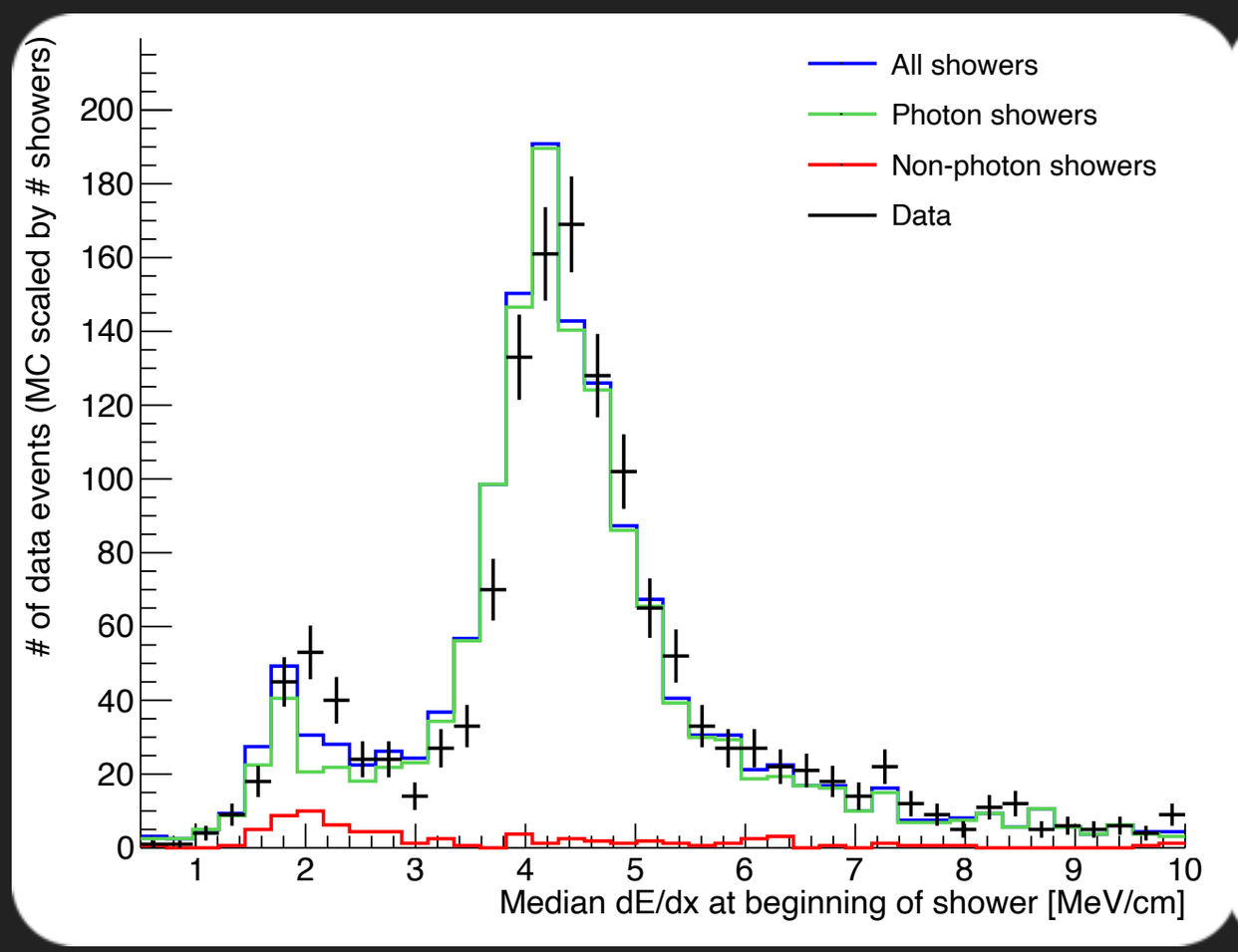
PREVIOUSLY…

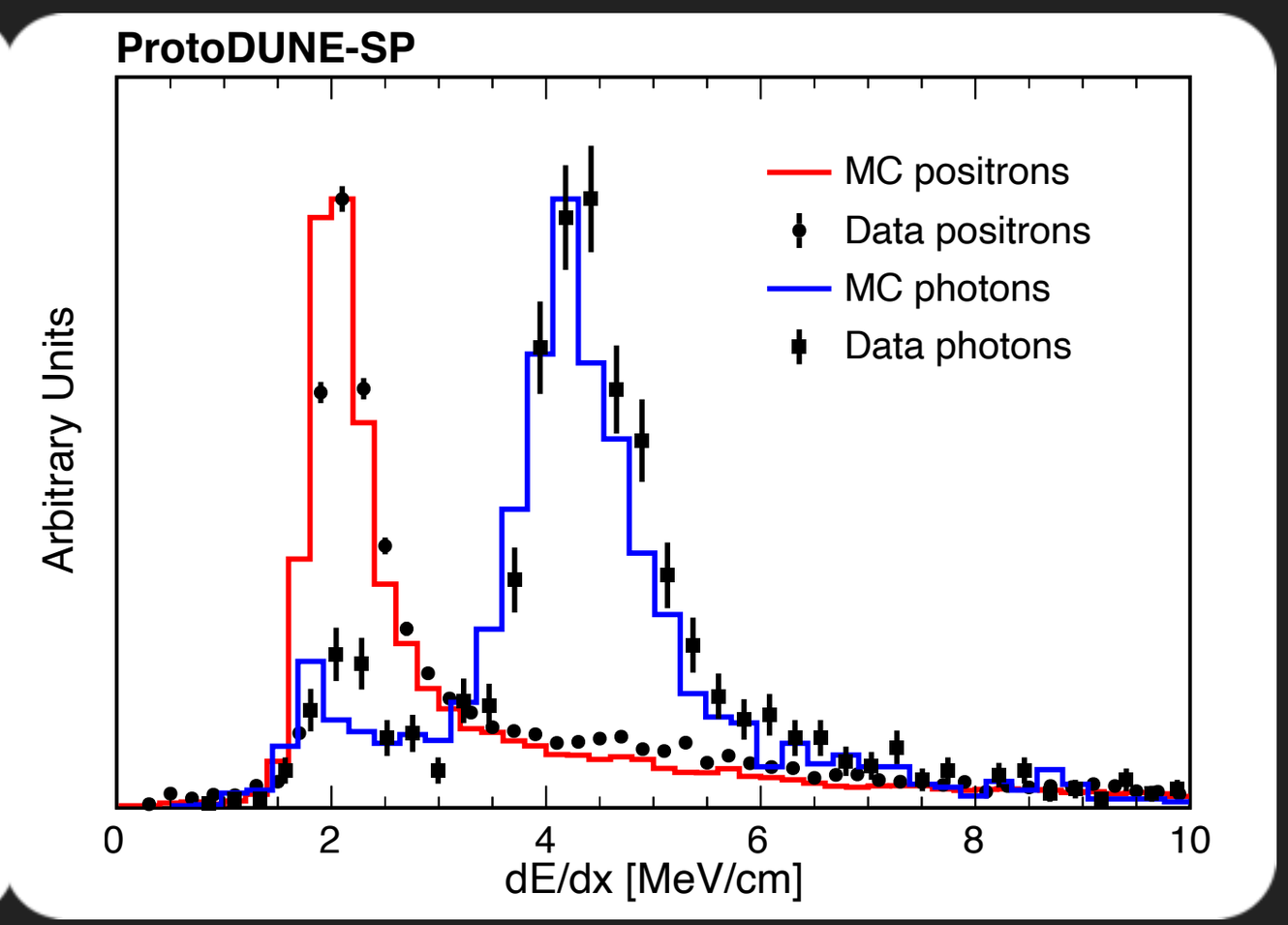

Simulated Electron Hits
Simulated Gamma Hits
Example dE/dx plot by the ArgoNeuT Collaboration
Area Normalized
0
1
2
3
4
5
6
7
8
dE/dx [MeV/cm]


e+/-
1 MIP dE/dx
e+e-
Photon
2 MIP dE/dx

PREVIOUSLY…

- Promising results looking at 6 GeV/c beam sample





SINCE THEN

- Long road to determining calorimetry constants in newest version software and for all beam runs
  - Lots of bugs, outdated wiki instructions, etc…

Beam momentum	Normalisation factor	Calibration factor
1	1.14753	0.0053601
2	1.00847	0.0053954
3	1.02747	0.0053982
6	1.07119	0.0053948
7	1.14753	0.0053601
MC	0.9947	0.00486

+ YZ and X space charge effect correction maps

SINCE THEN

$$\frac{dQ}{dx} = \frac{Q_{hit}}{\text{pitch}/\cos\theta} \text{ norm } \sigma(\vec{x}) \text{ / calib}$$

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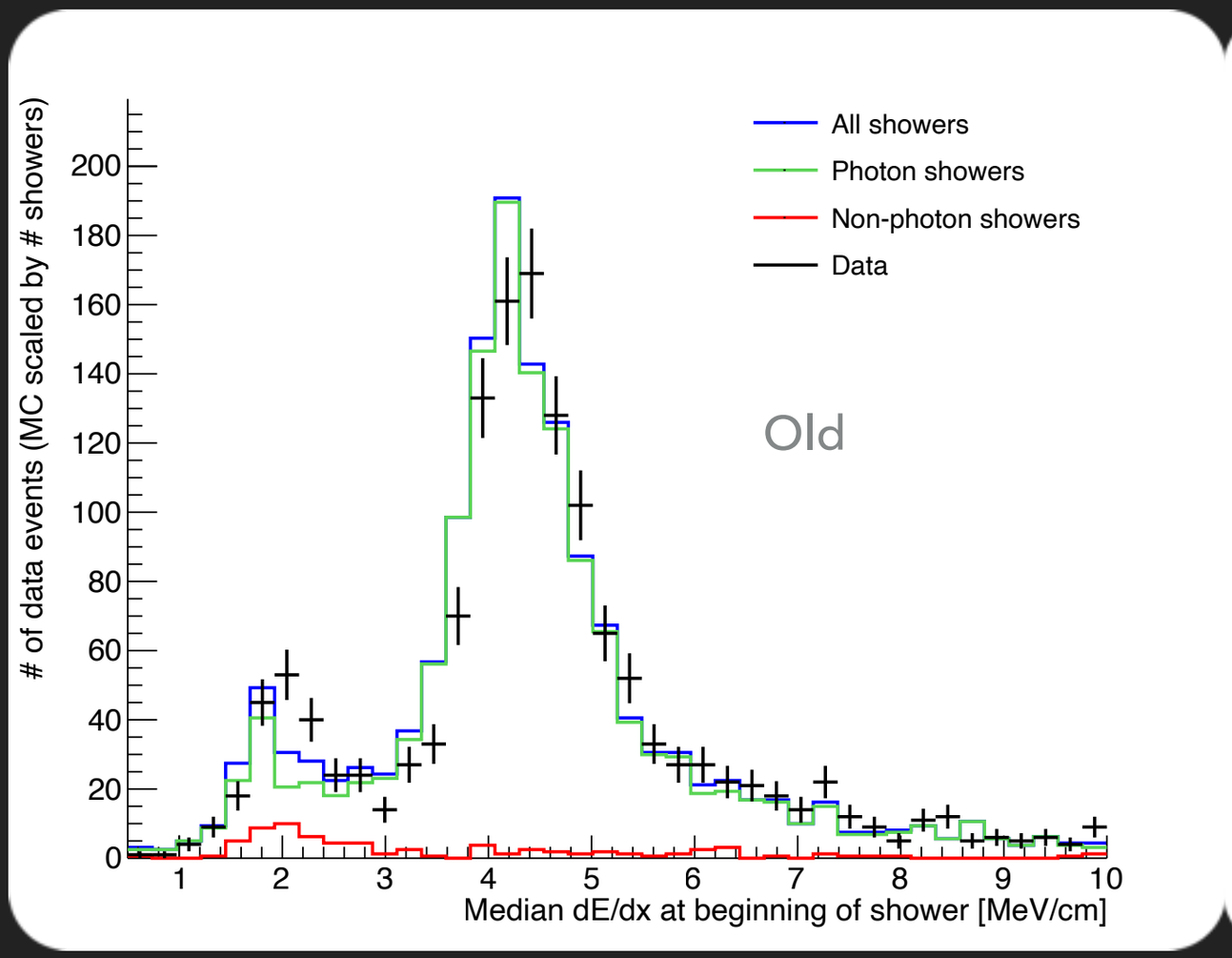
MC	0.9947	0.00486

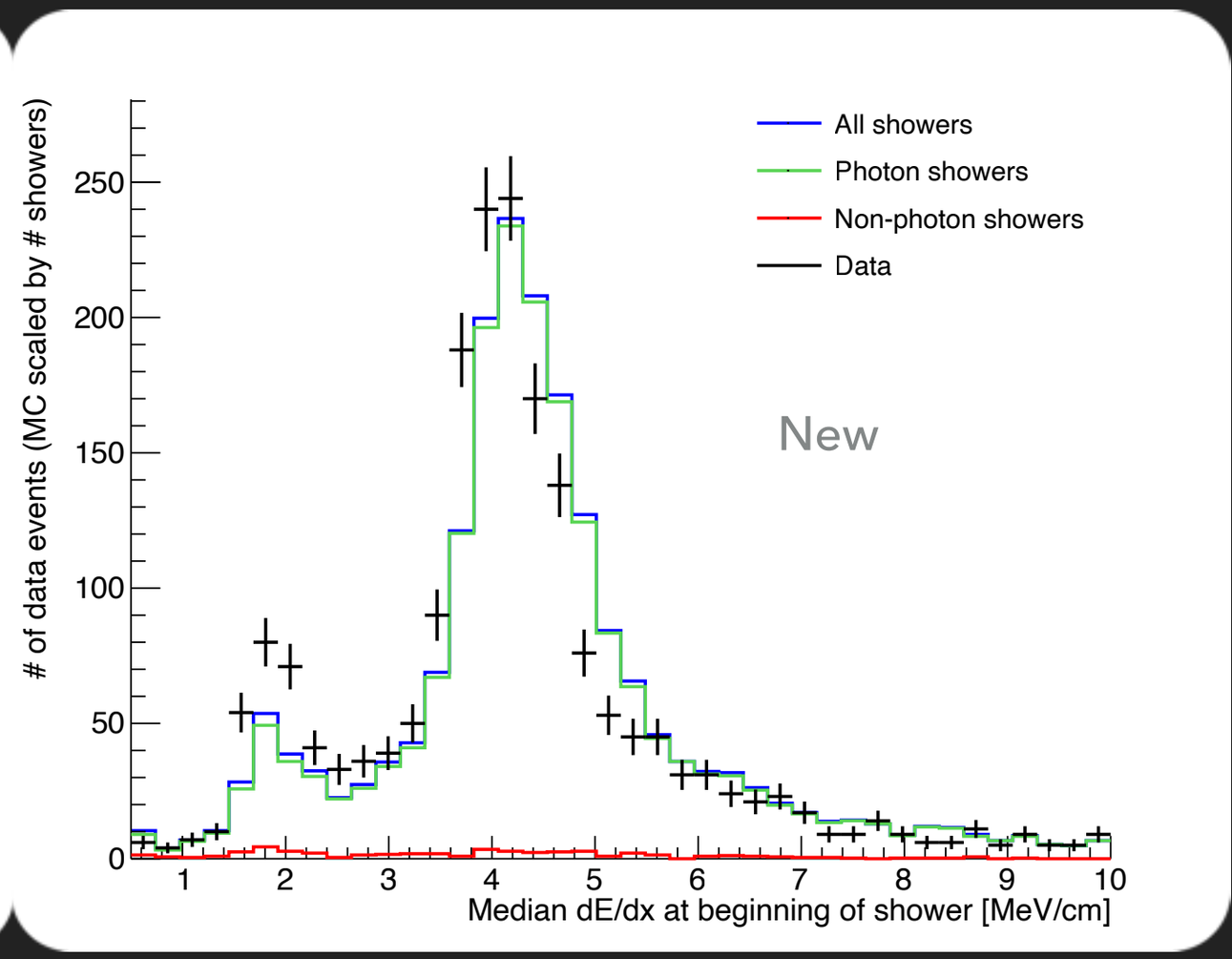
+ YZ and X space charge effect correction maps

SINCE THEN

- More events, new correction factors, slightly different cuts
- Data is now lower in dE/dx than MC??

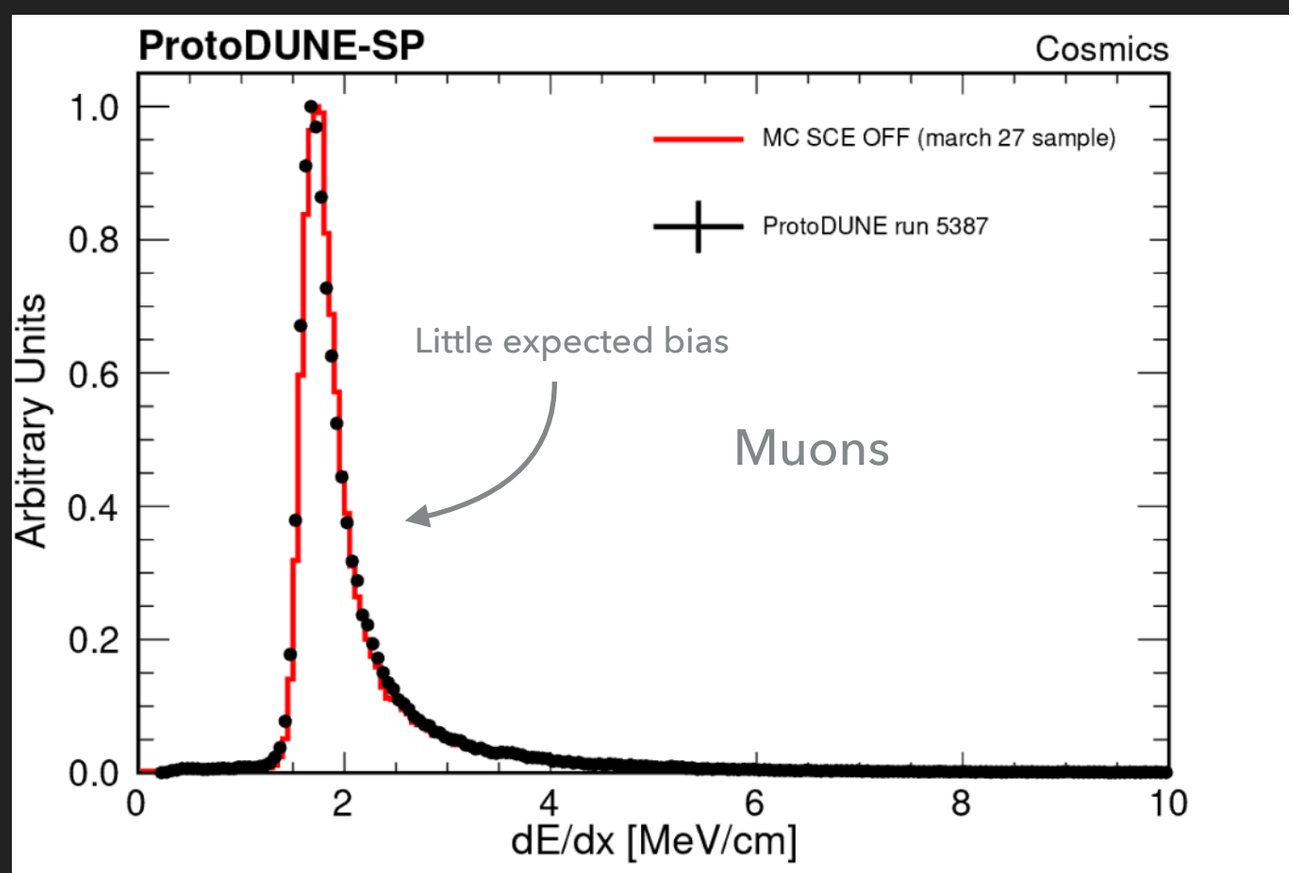
6 GeV/c beam

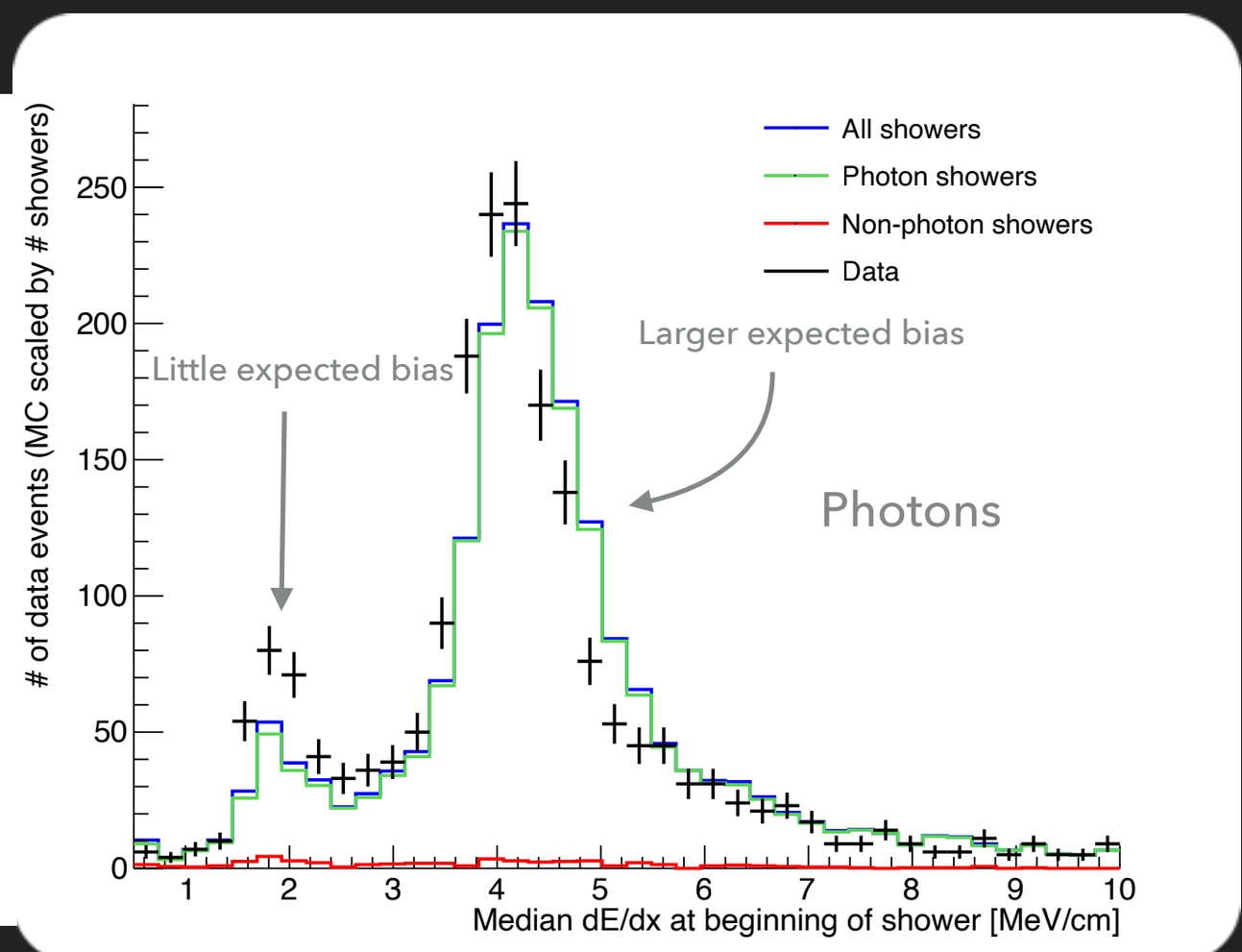




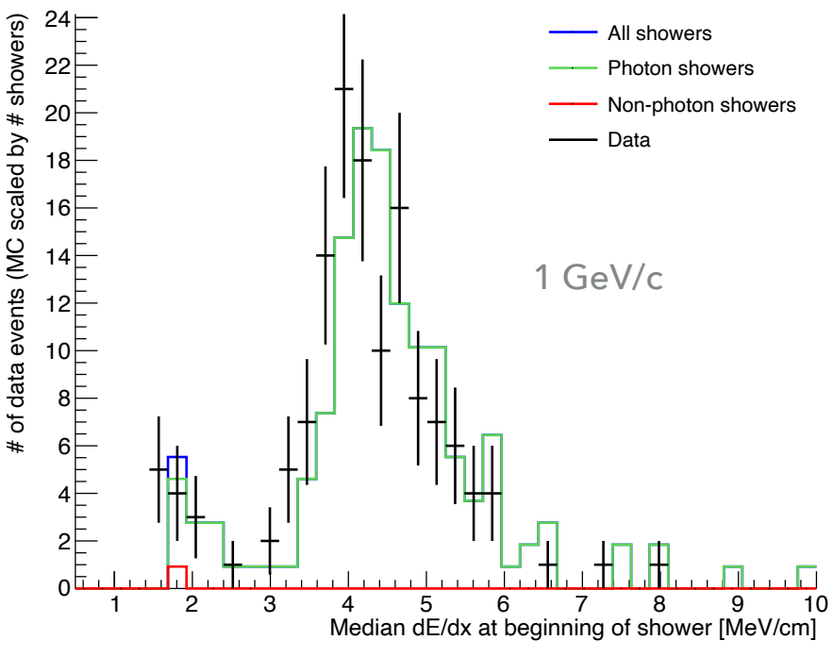
SINCE THEN

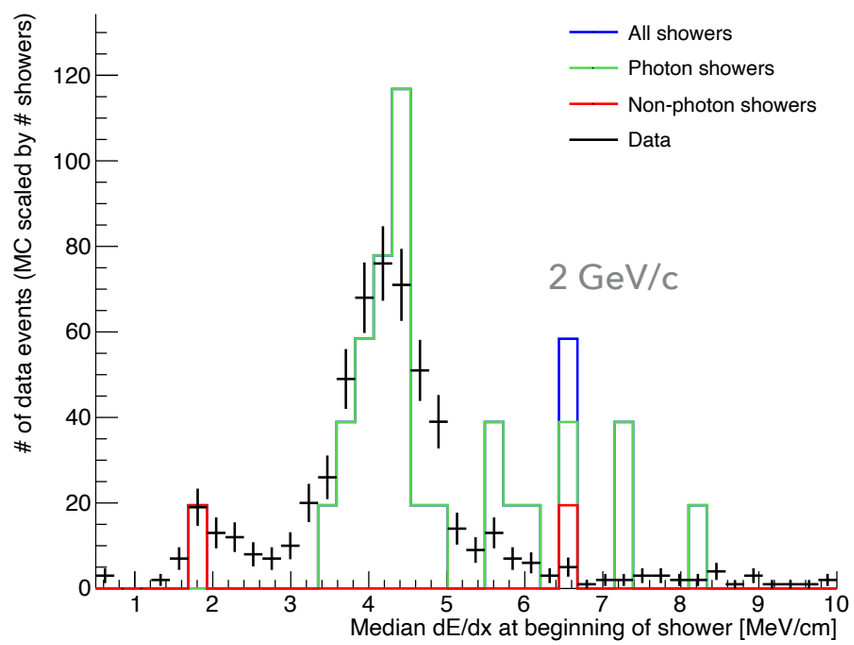
- In talks with dE/dx expert
- Data biased to low dE/dx is seen in muon sample as well
- Bias increases with dE/dx

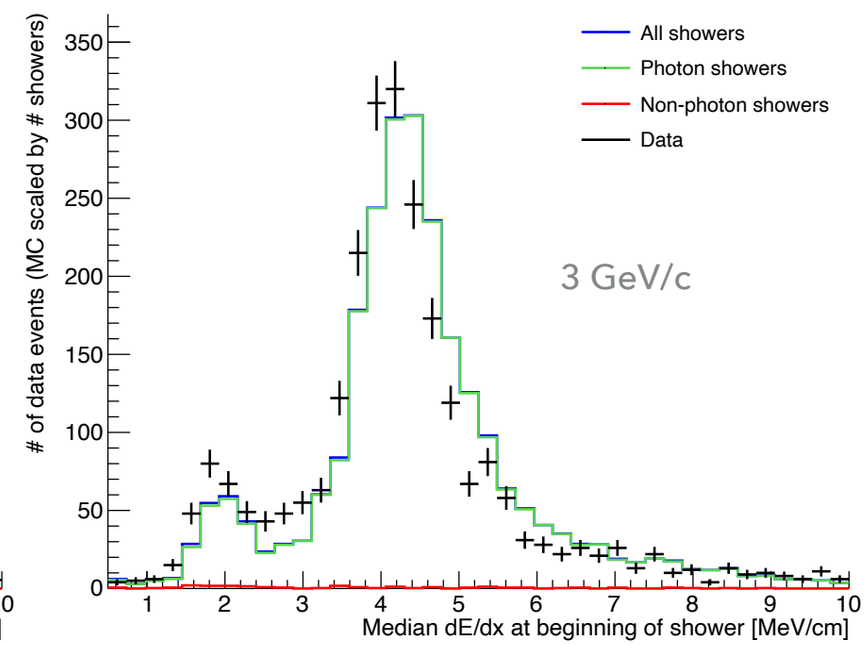


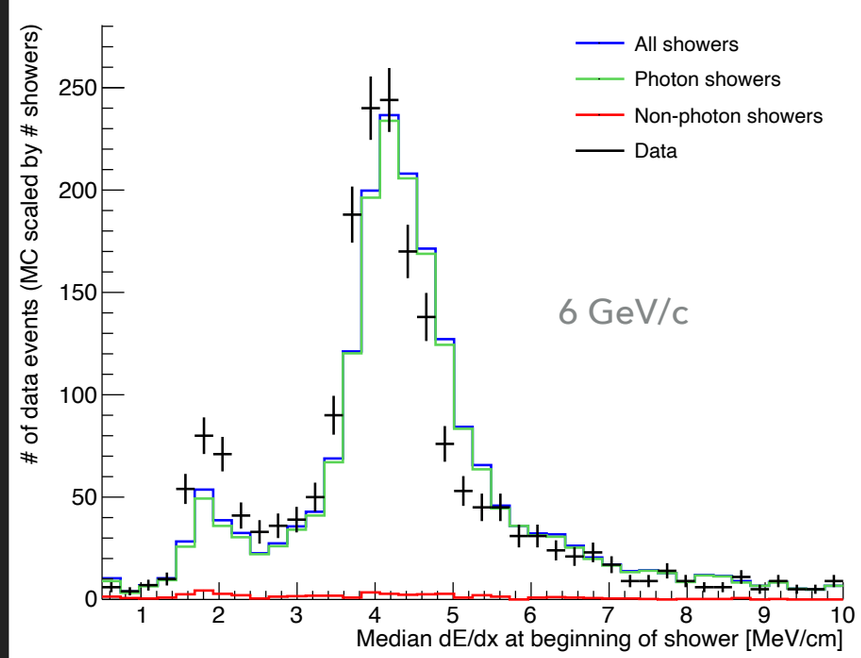


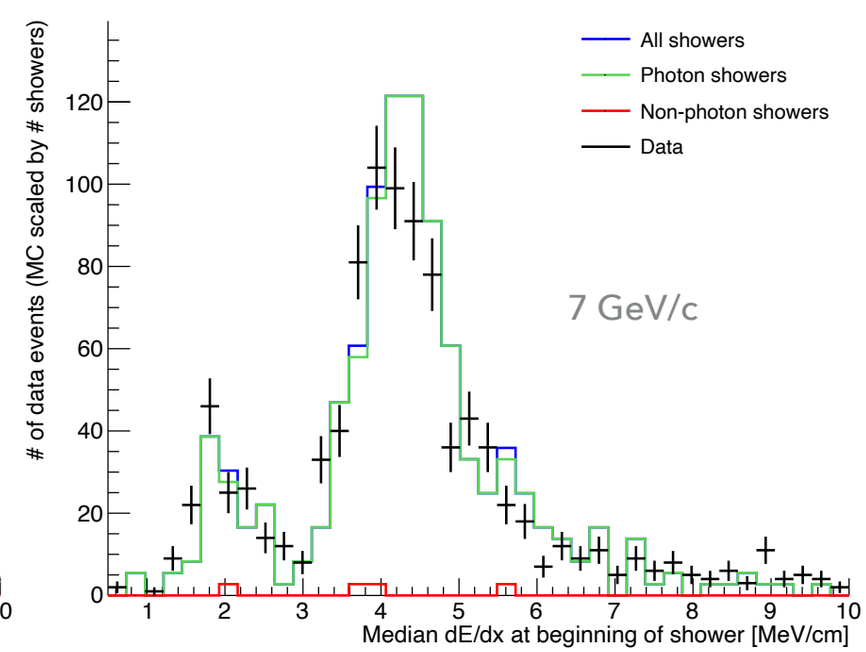
SINCE THEN


All showers
Photon showers
Non-photon showers
Data
1 GeV/c
# of data events (MC scaled by # showers)
Median dE/dx at beginning of shower [MeV/cm]


All showers
Photon showers
Non-photon showers
Data
2 GeV/c
# of data events (MC scaled by # showers)
Median dE/dx at beginning of shower [MeV/cm]

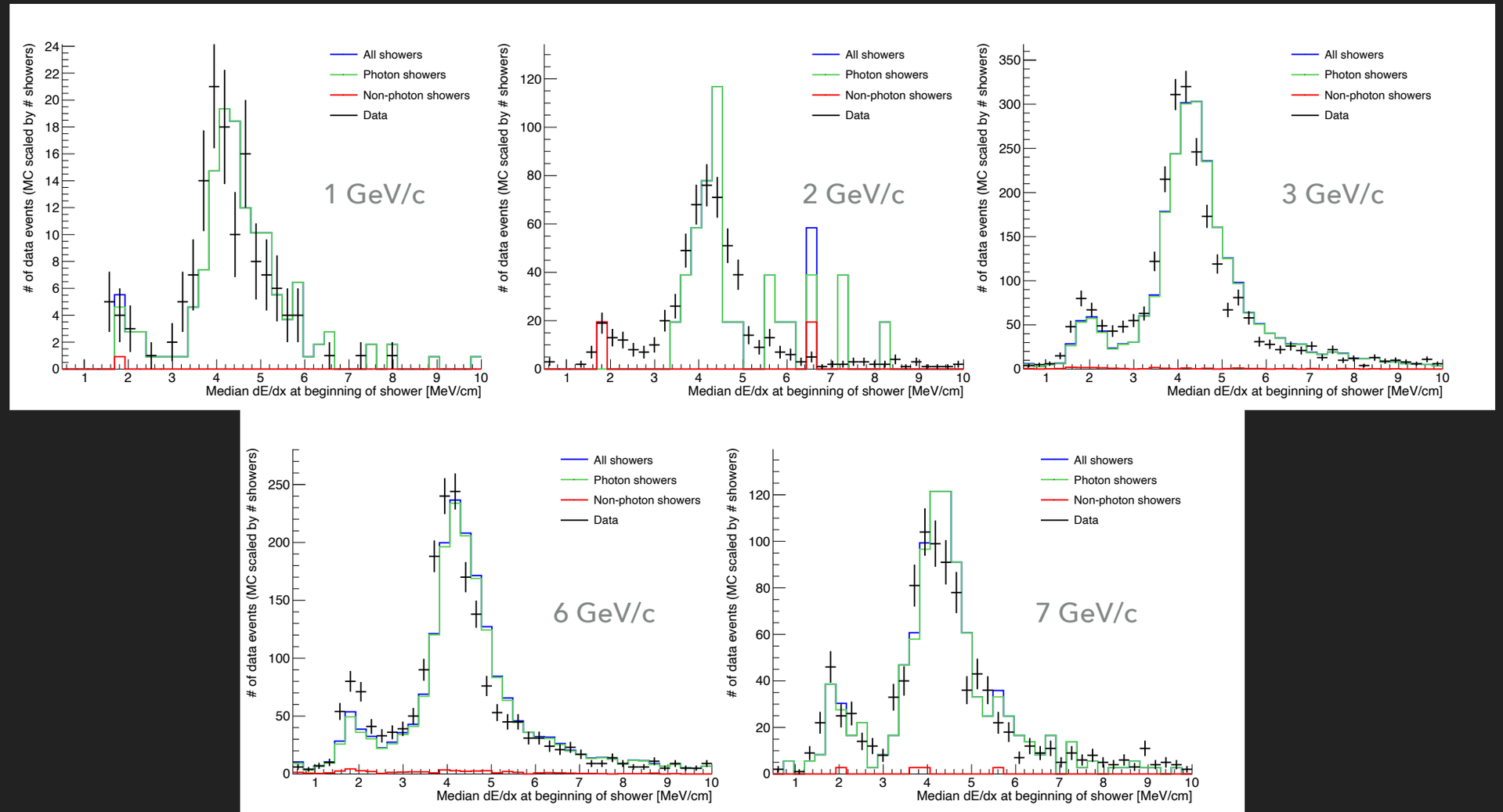

All showers
Photon showers
Non-photon showers
Data
3 GeV/c
# of data events (MC scaled by # showers)
Median dE/dx at beginning of shower [MeV/cm]


All showers
Photon showers
Non-photon showers
Data
6 GeV/c
# of data events (MC scaled by # showers)
Median dE/dx at beginning of shower [MeV/cm]


All showers
Photon showers
Non-photon showers
Data
7 GeV/c
# of data events (MC scaled by # showers)
Median dE/dx at beginning of shower [MeV/cm]

SINCE THEN

- Results look consistent across beam runs – need quantitative validation
- Low statistics, particularly MC



SUMMARY AND OUTLOOK

- Moving on from this really soon
- Results look consistent between beam runs – need quantitative validation
- MC statistics are very low in some cases

BACKUP

WHAT IS DE/DX?

- dQ/dx → dE/dx:
  - According to modified box model
  - $\frac{dQ}{dx} = \frac{Q_{hit}}{\text{pitch}/\cos\theta}$ norm $\sigma(\vec{x})$ / calib
  - $\frac{dE}{dx} = \left(\exp\left[\frac{dQ}{dx}\frac{\beta_P}{\rho E_f(\vec{x})}W_{ion}\right] - \alpha\right)\frac{\rho E_f(\vec{x})}{\beta_P}$