NEUTRINO-ELECTRON ELASTIC SCATTERING
RECO VS TRUE VARIABLES REVISITED AND FURTHER CUTS

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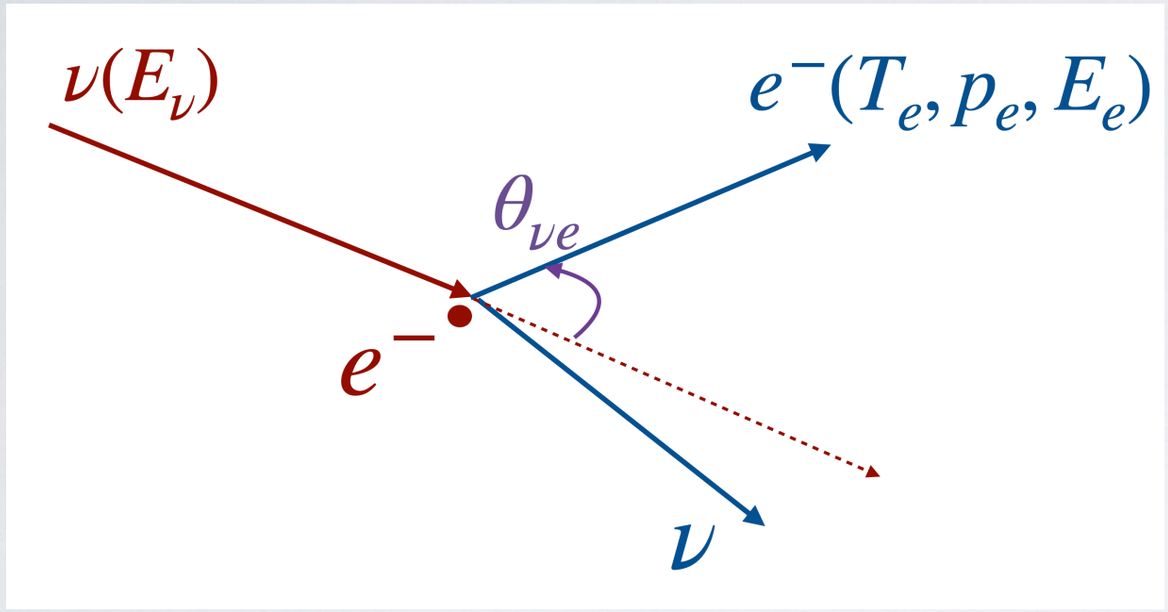
21 October 2022

Introduction

- Main update since last meeting: found bug in MC energy, now things look a lot more sensible
- Showing how the selection would benefit from a better reconstruction
- Estimated resolution needs for a good energy reconstruction

INTRODUCTION



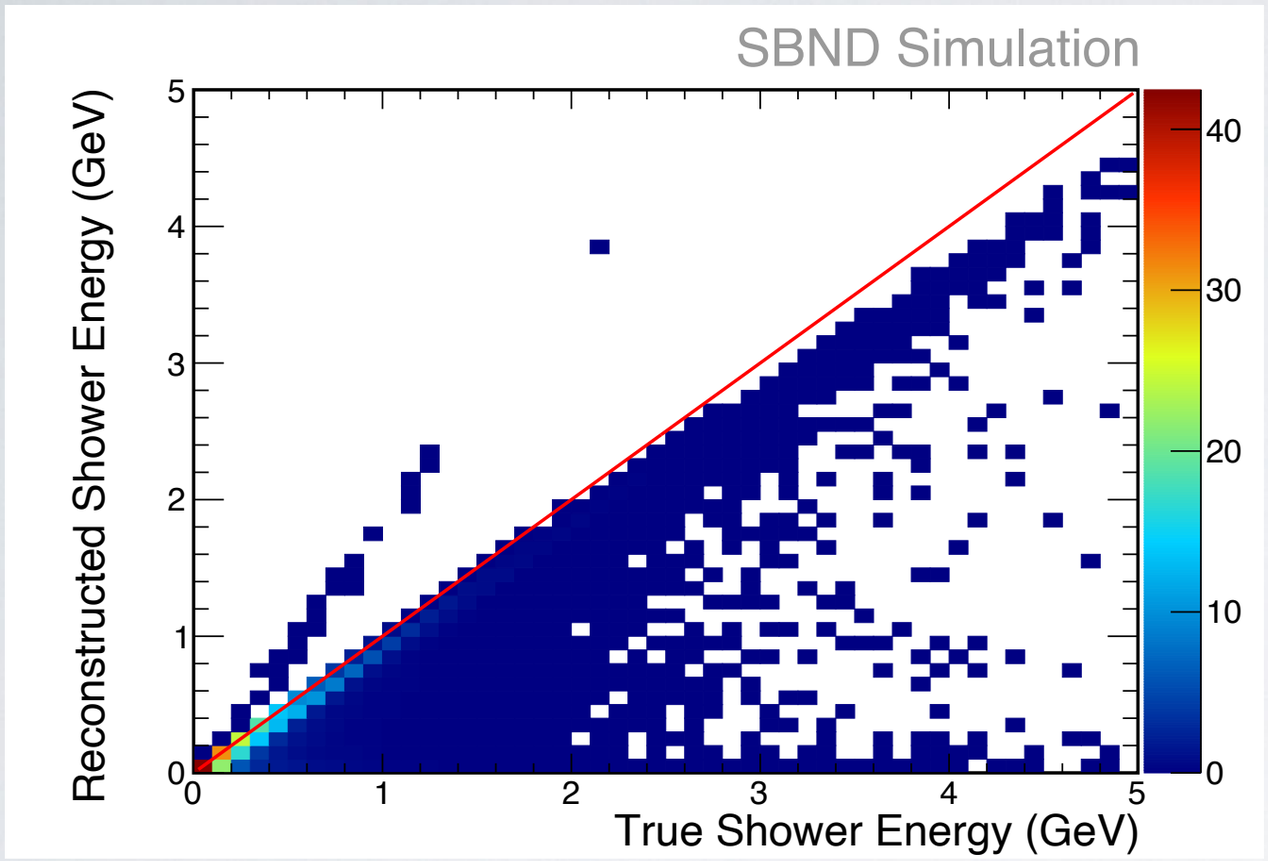
$$E_\nu = \frac{m_e T_e}{p_e \cos\theta_{\nu e} - T_e}$$

O(10-4) O(1) O(1) ~1

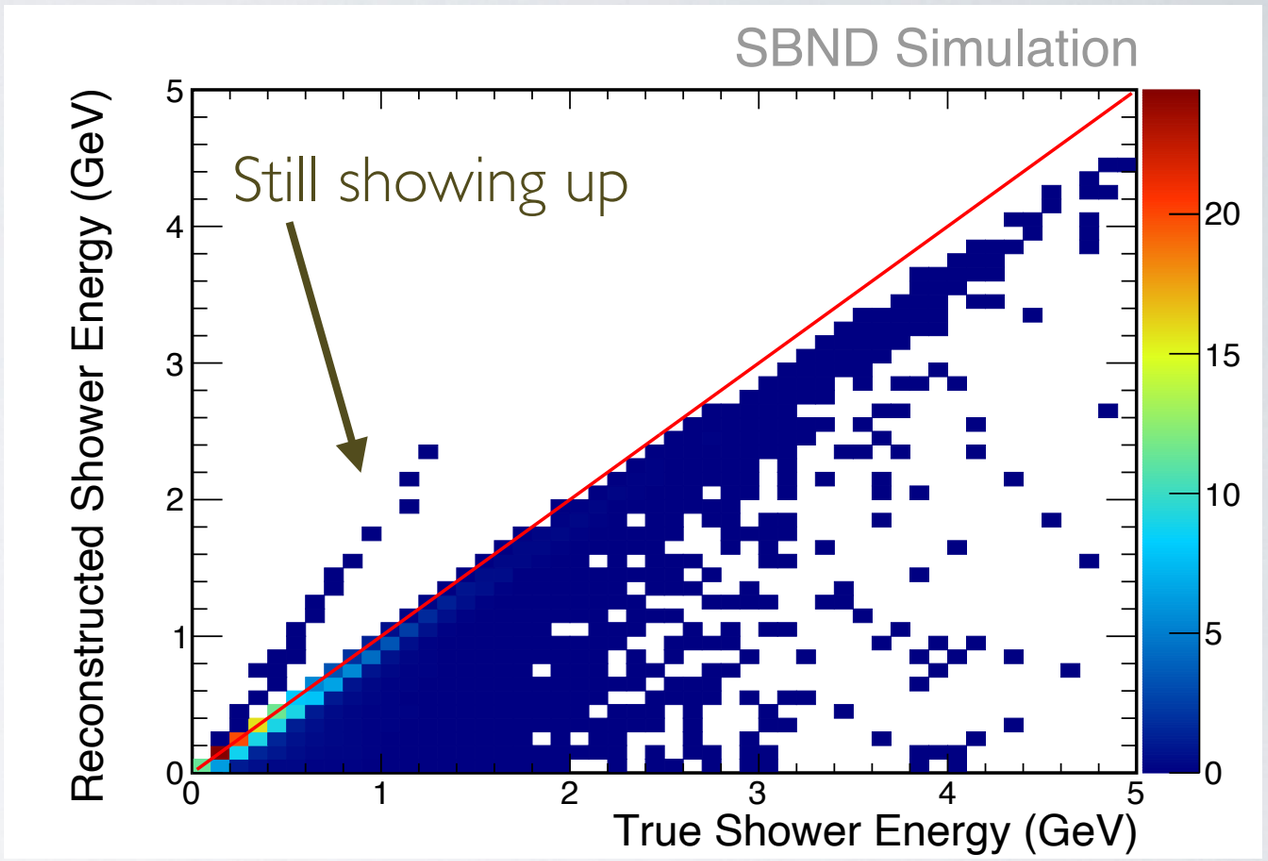
Caveat:

Measuring the incoming neutrino energy requires an **excellent** precision measuring both the energy and direction of the electron shower

SHOWER ENERGY (SIGNAL)

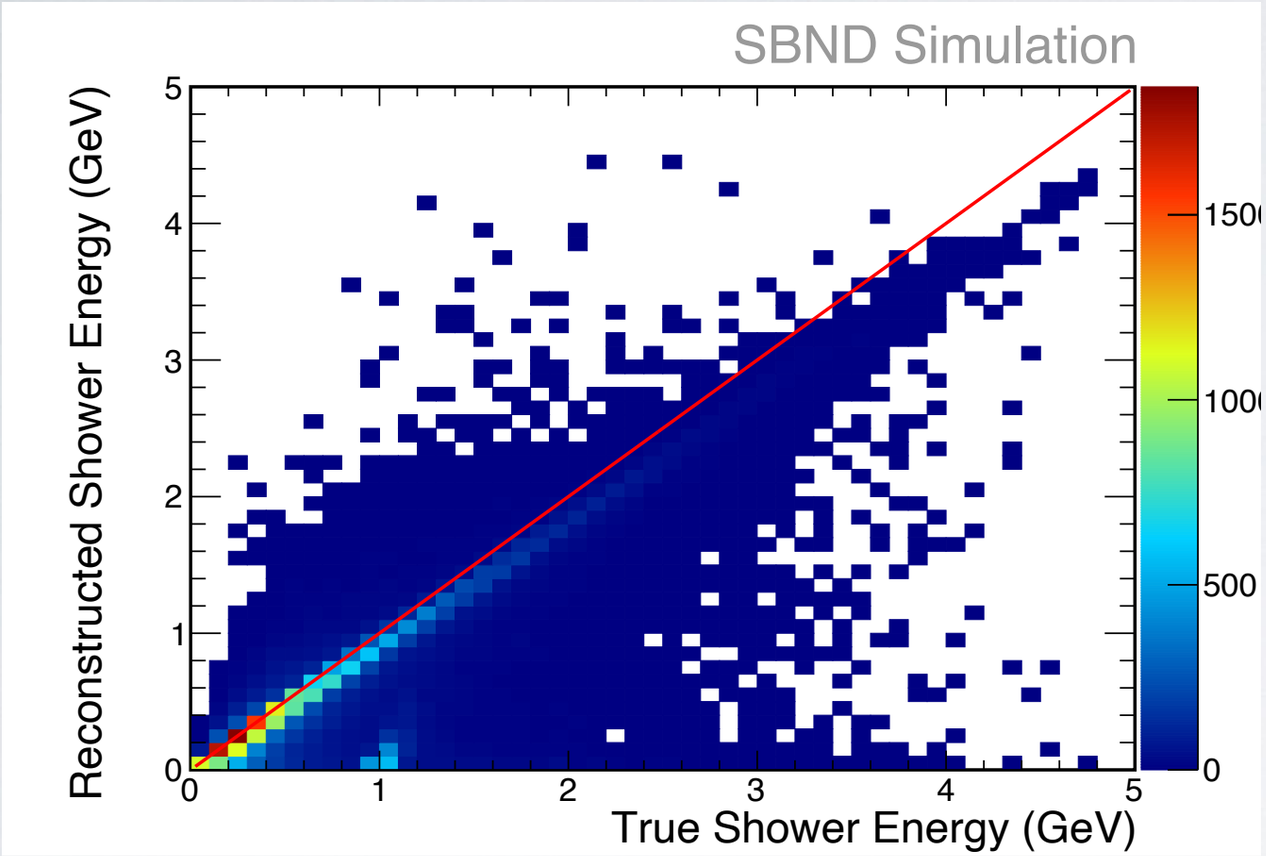


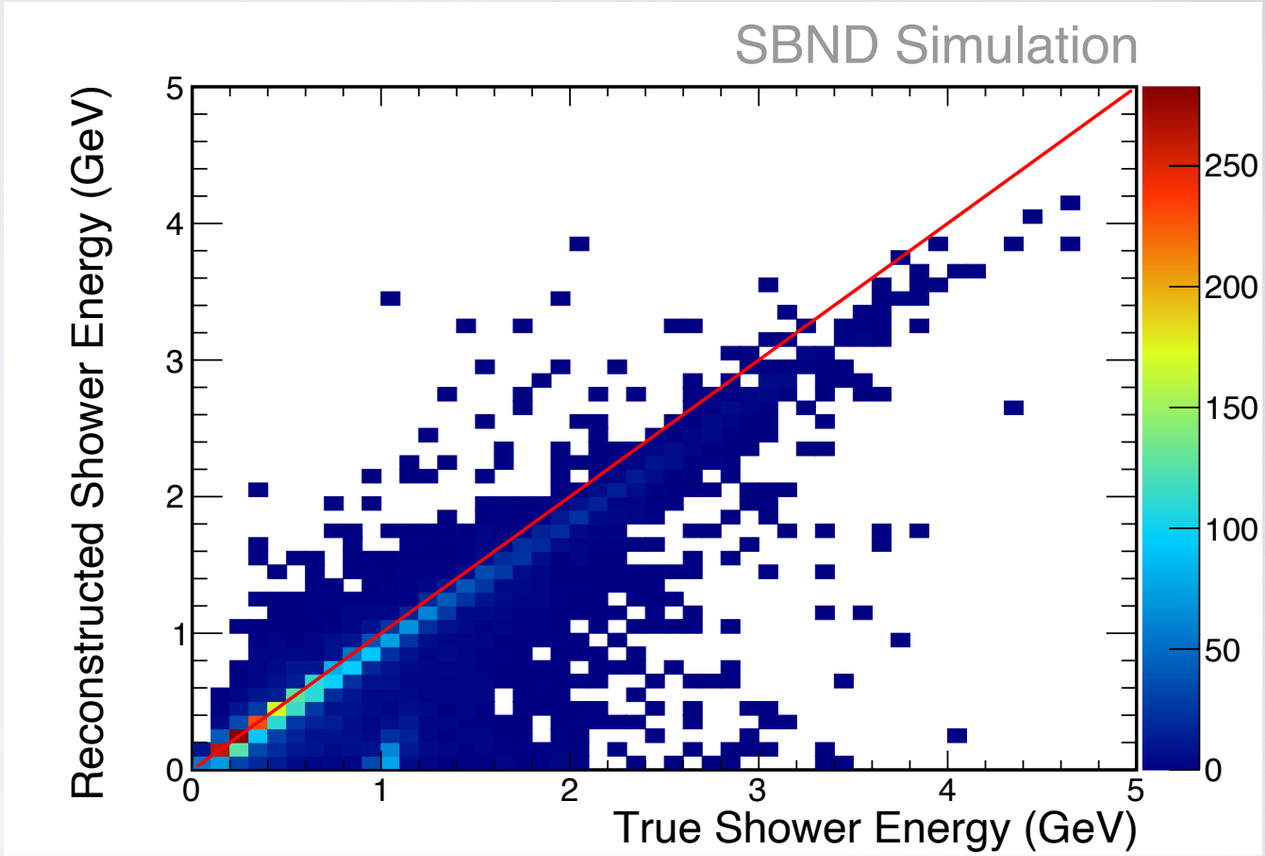
No cuts



One shower, no tracks

SHOWER ENERGY (BACKGROUND)

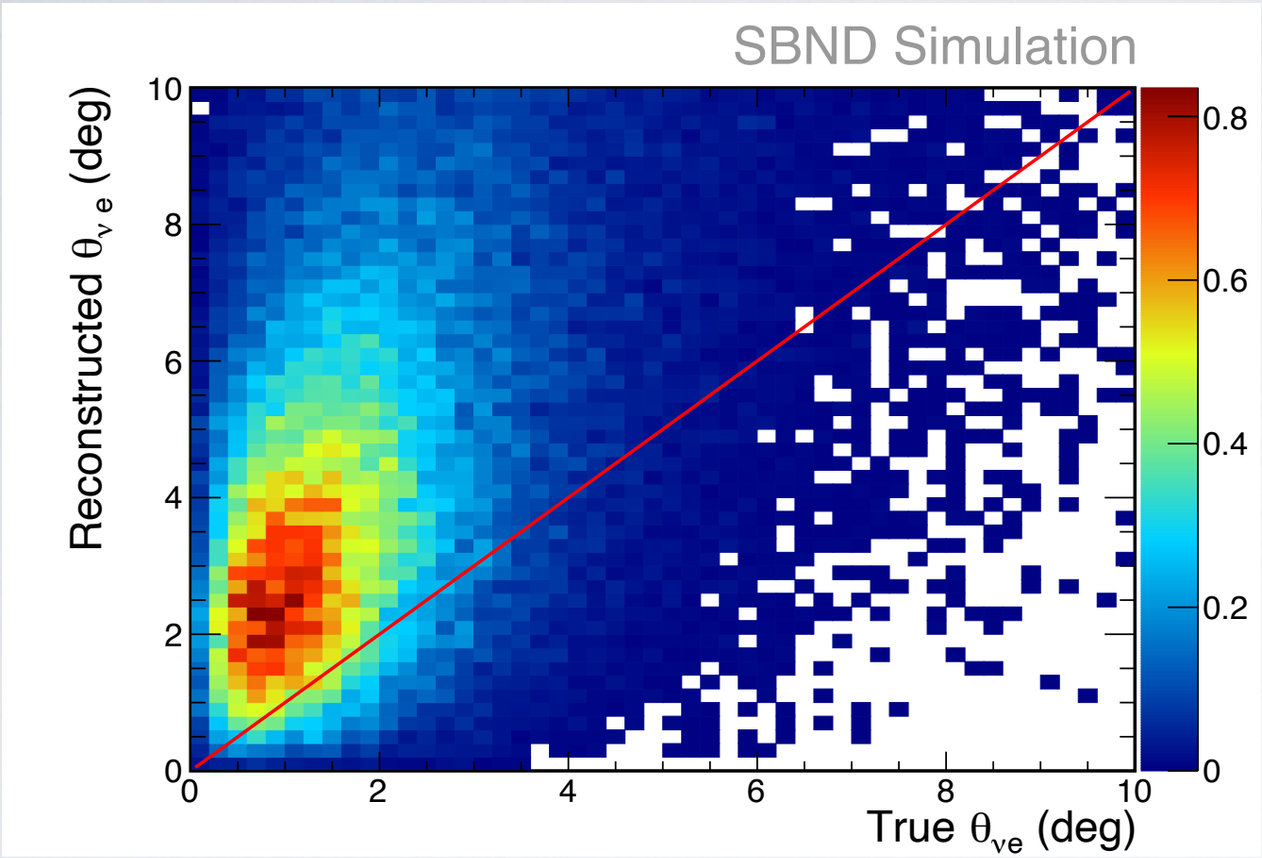


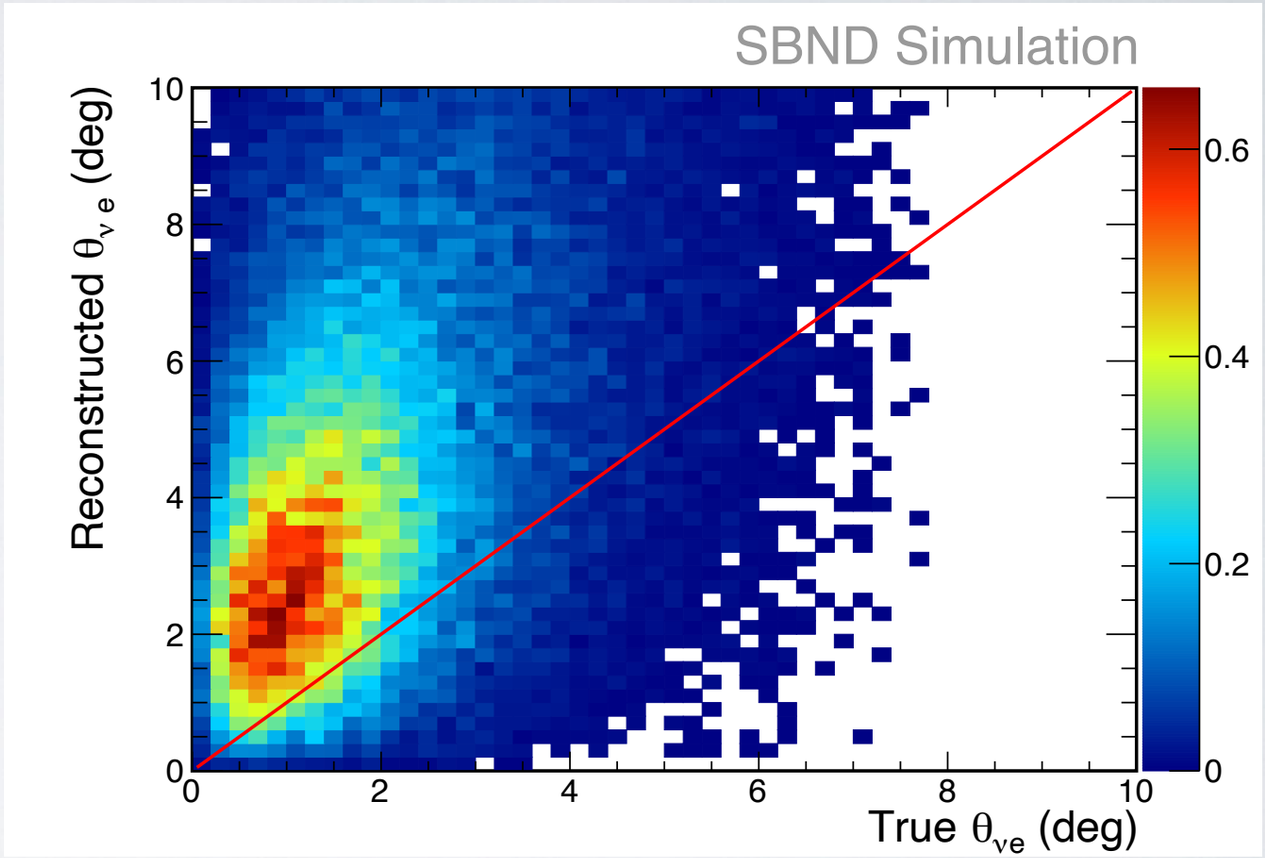


No cuts

One shower, no tracks

SHOWER DIRECTION (SIGNAL, ZOOM)

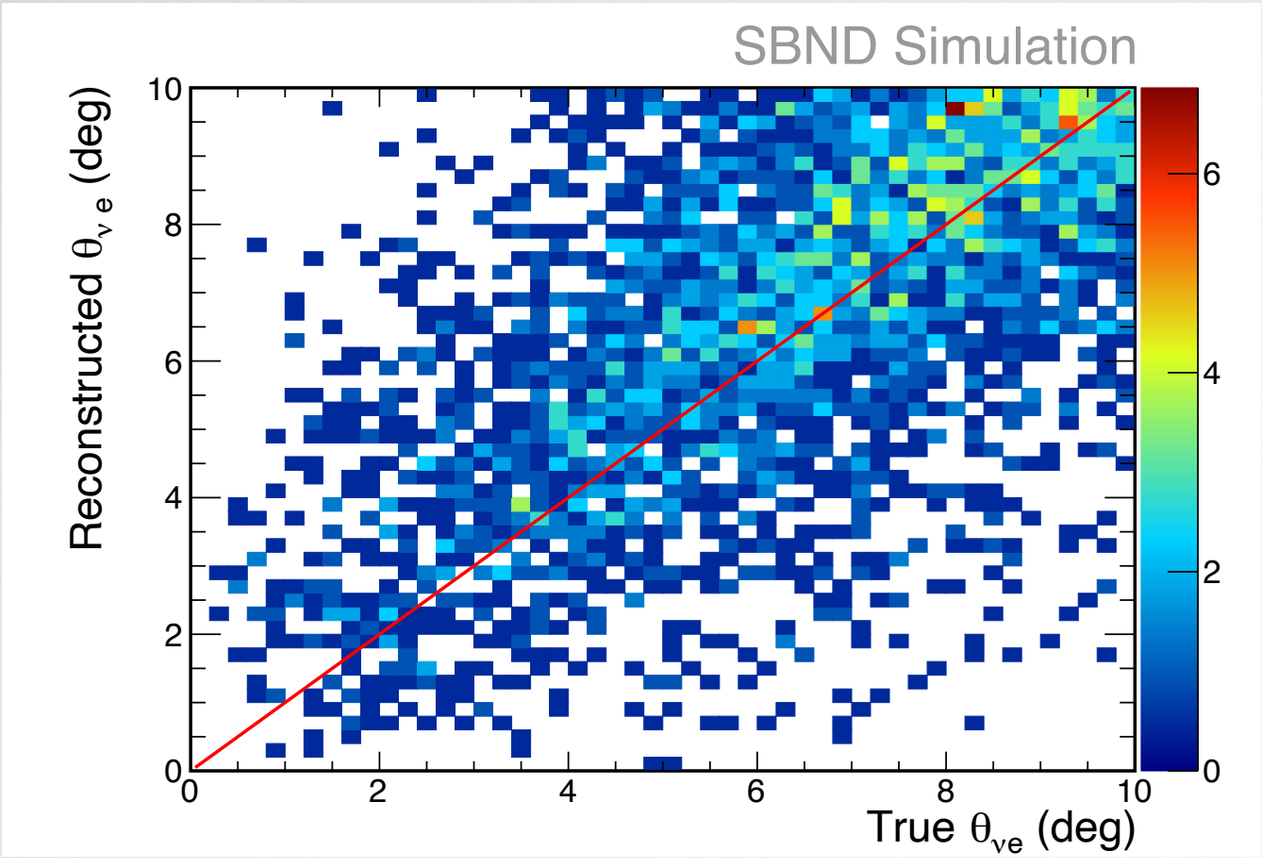


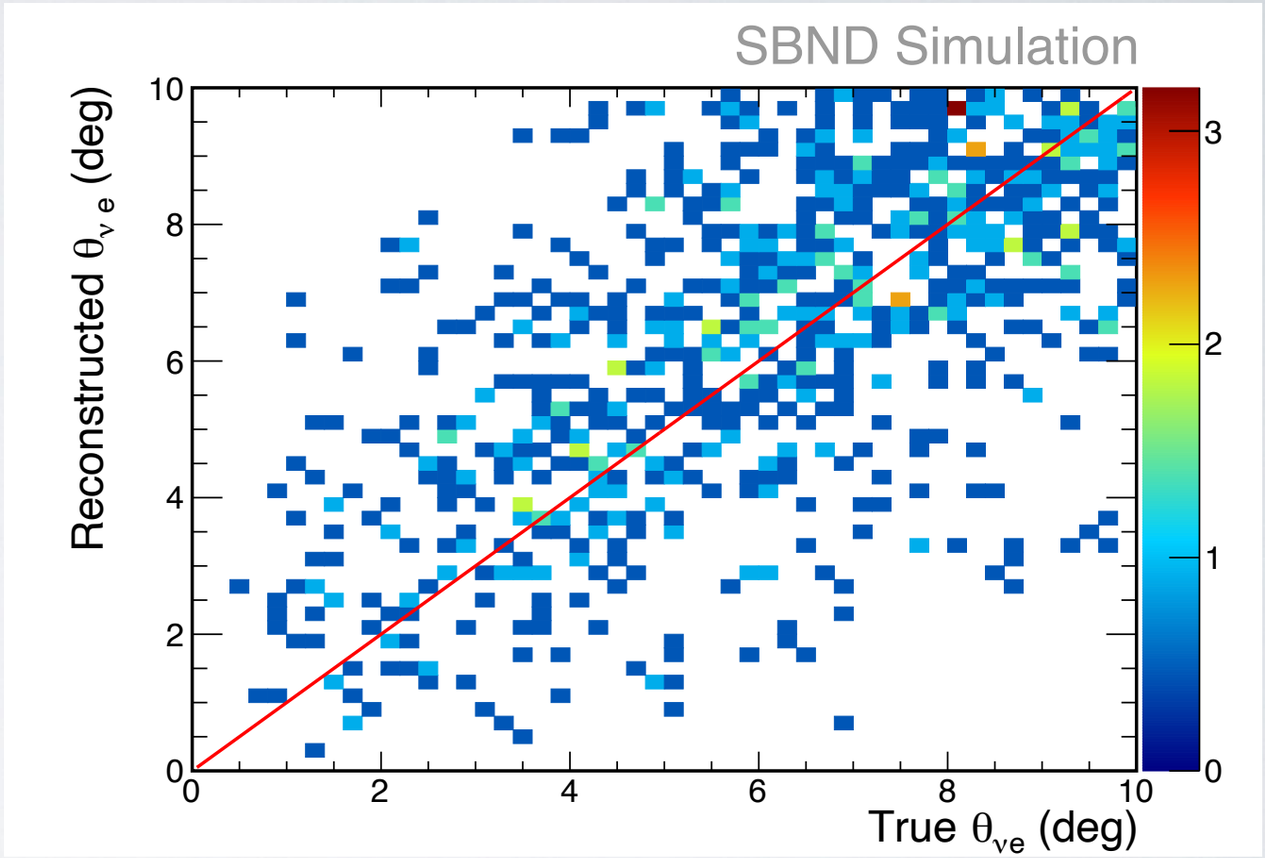


No cuts

One shower, no tracks

SHOWER DIRECTION (BACKGROUND)

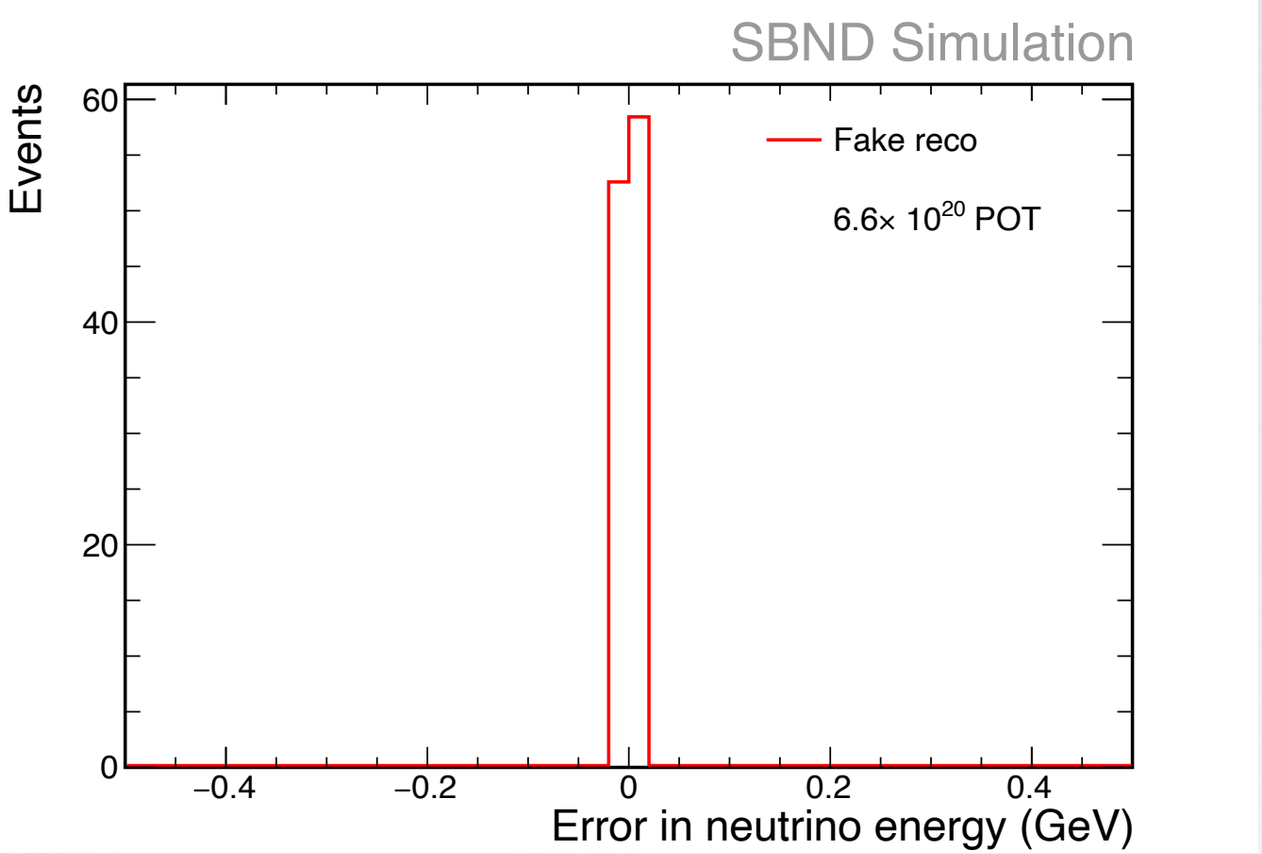


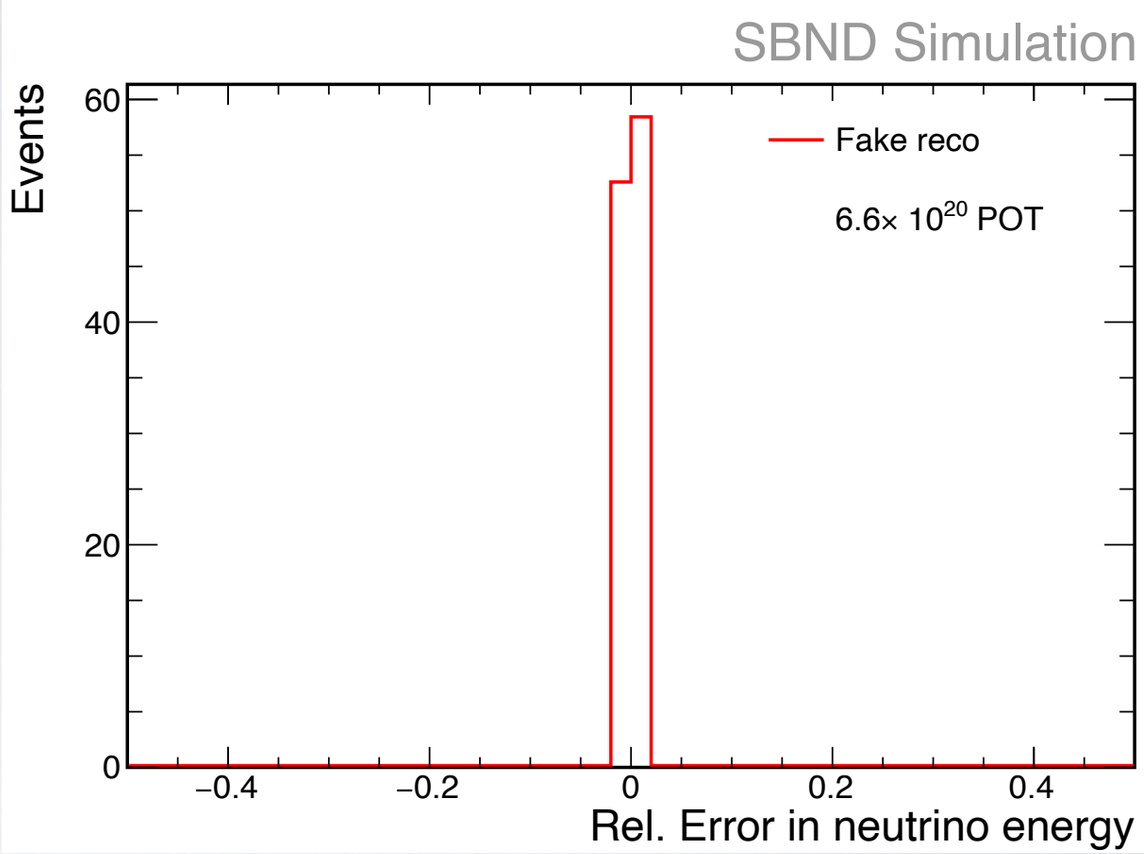


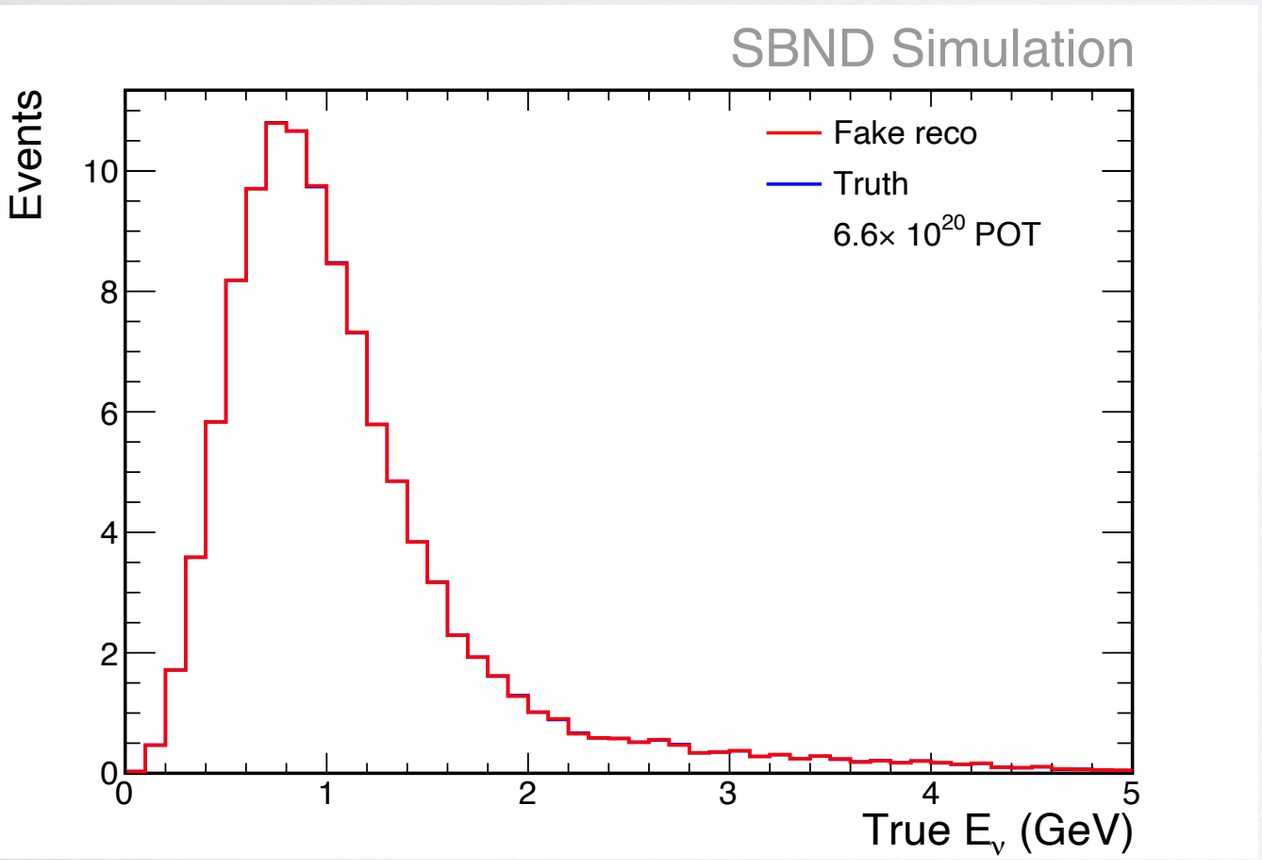
No cuts

One shower, no tracks

HOW GOOD DO WE *NEED* THE RECONSTRUCTION TO BE?

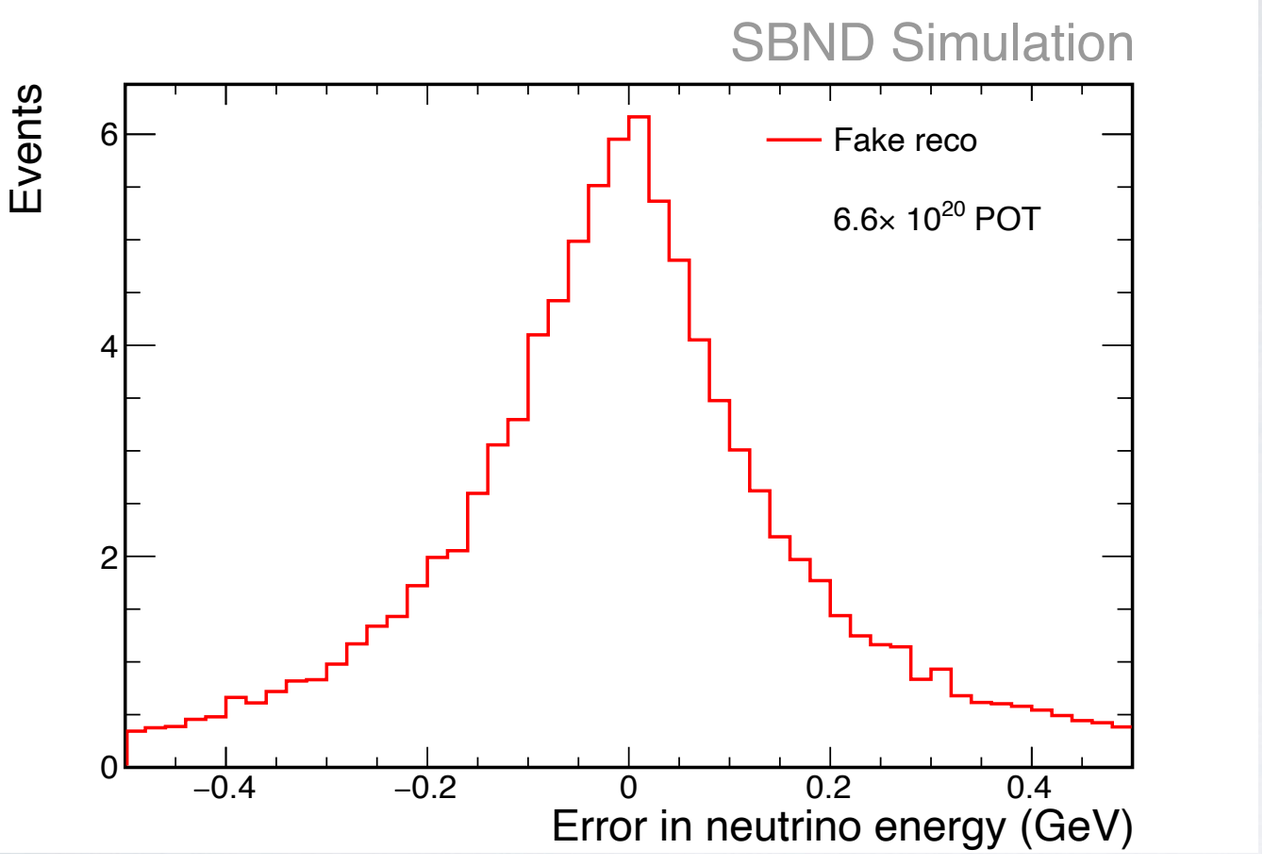


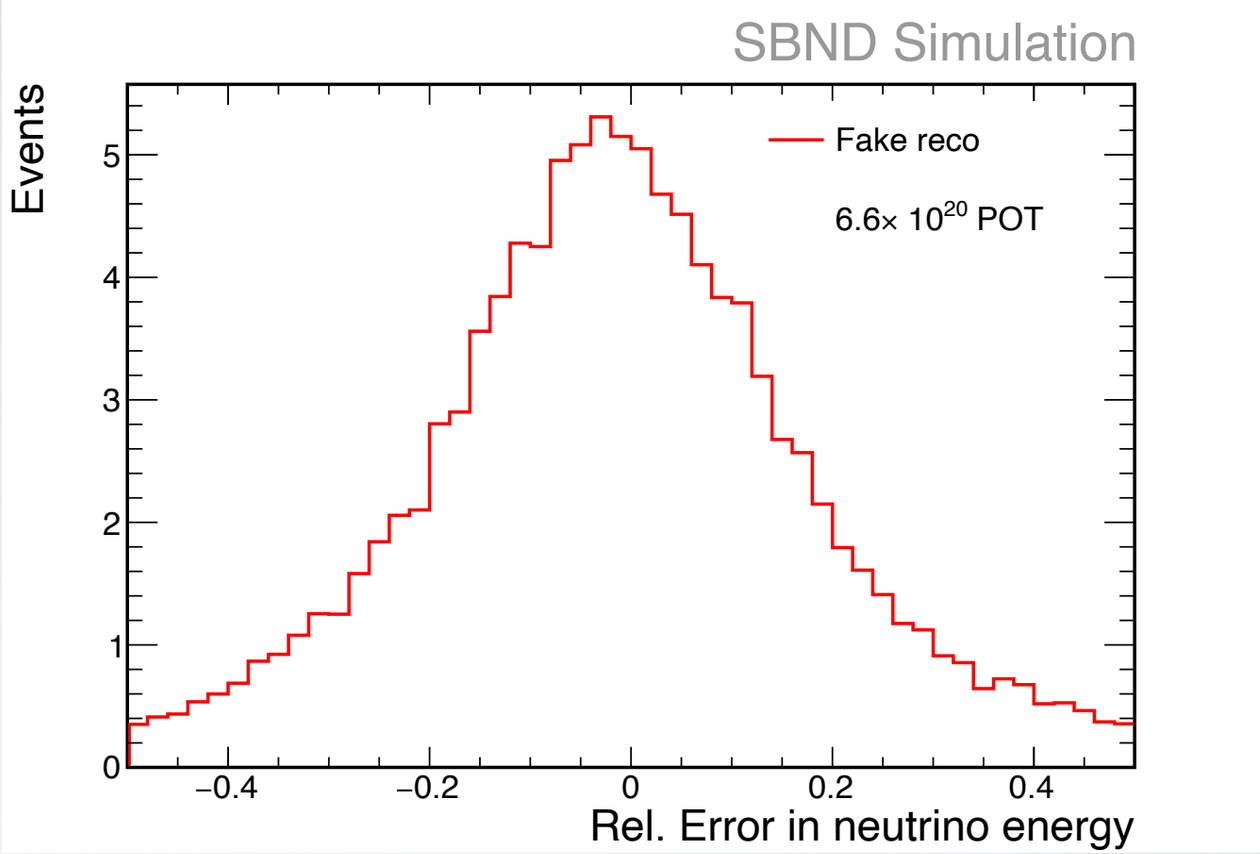


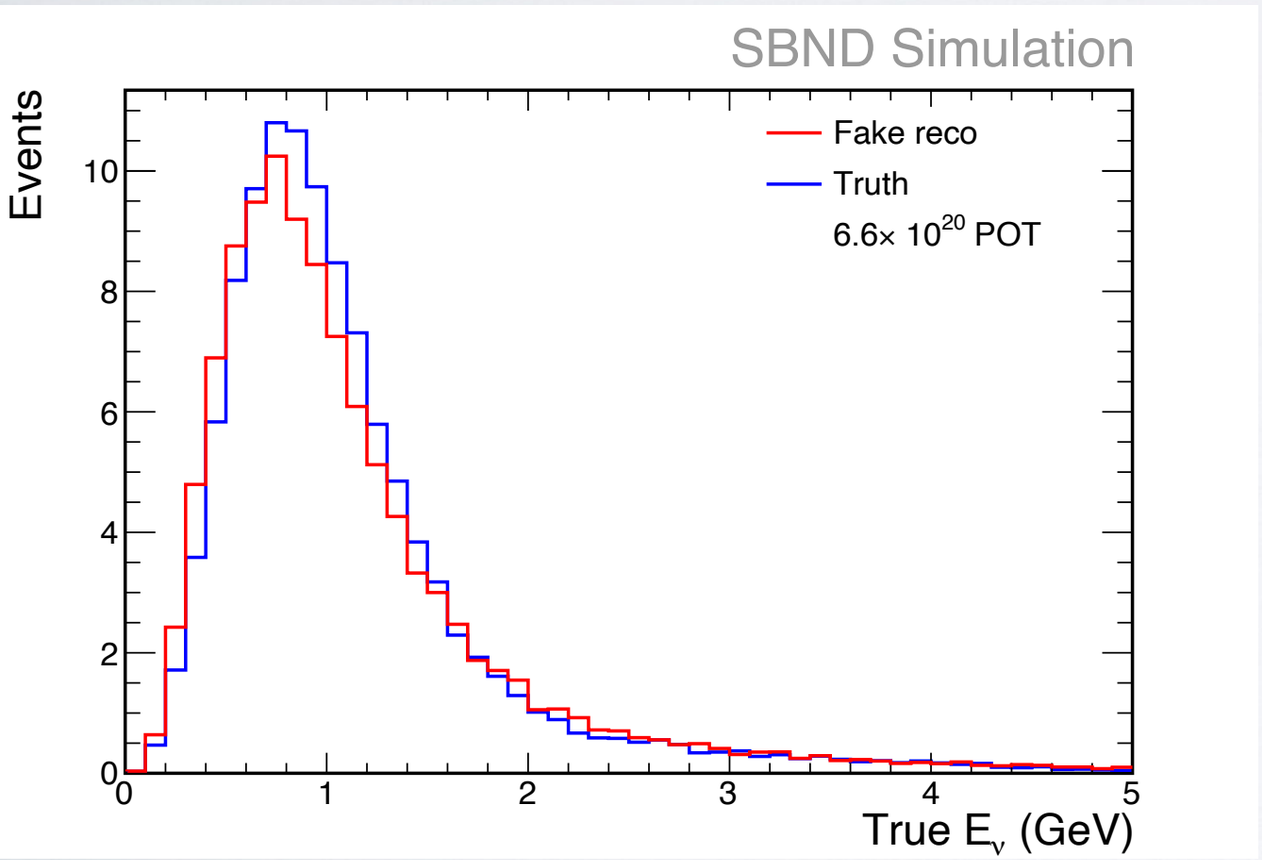


Using all the true information in

$$E_\nu = \frac{m_e T_e}{p_e \cos\theta_{\nu e} - T_e}$$

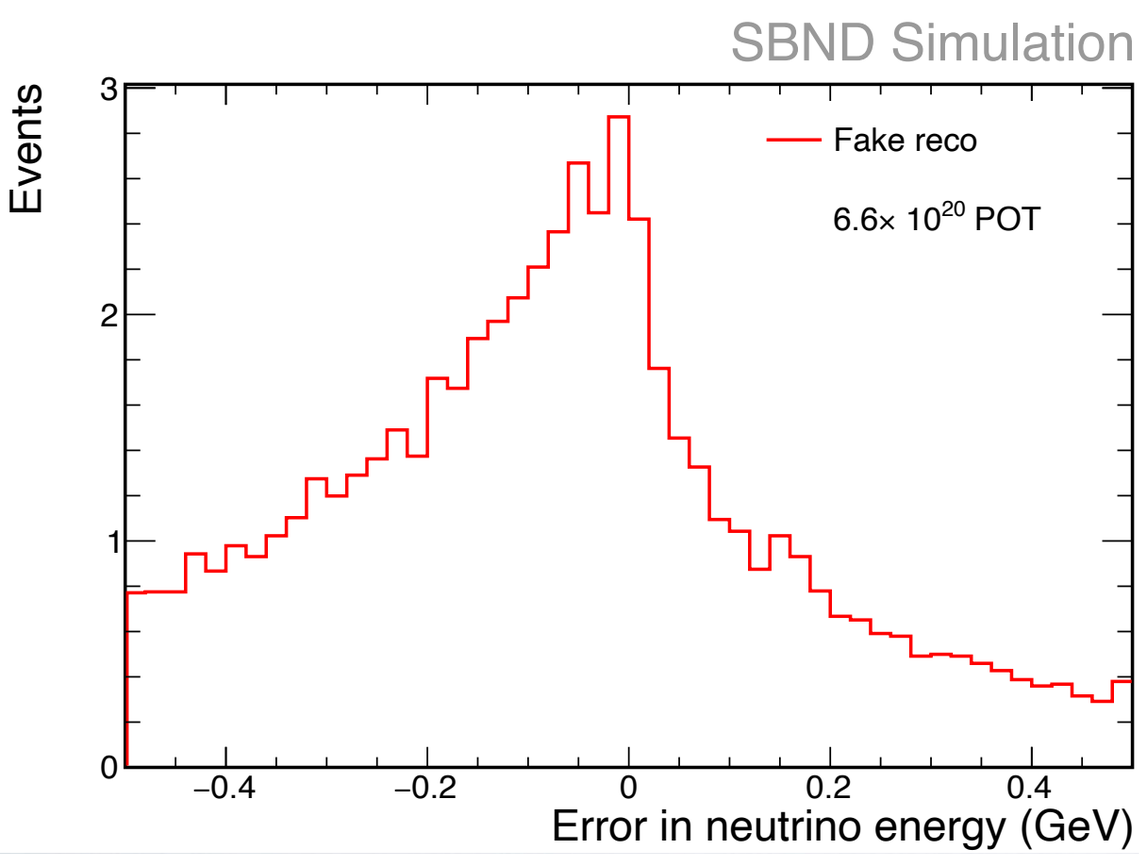


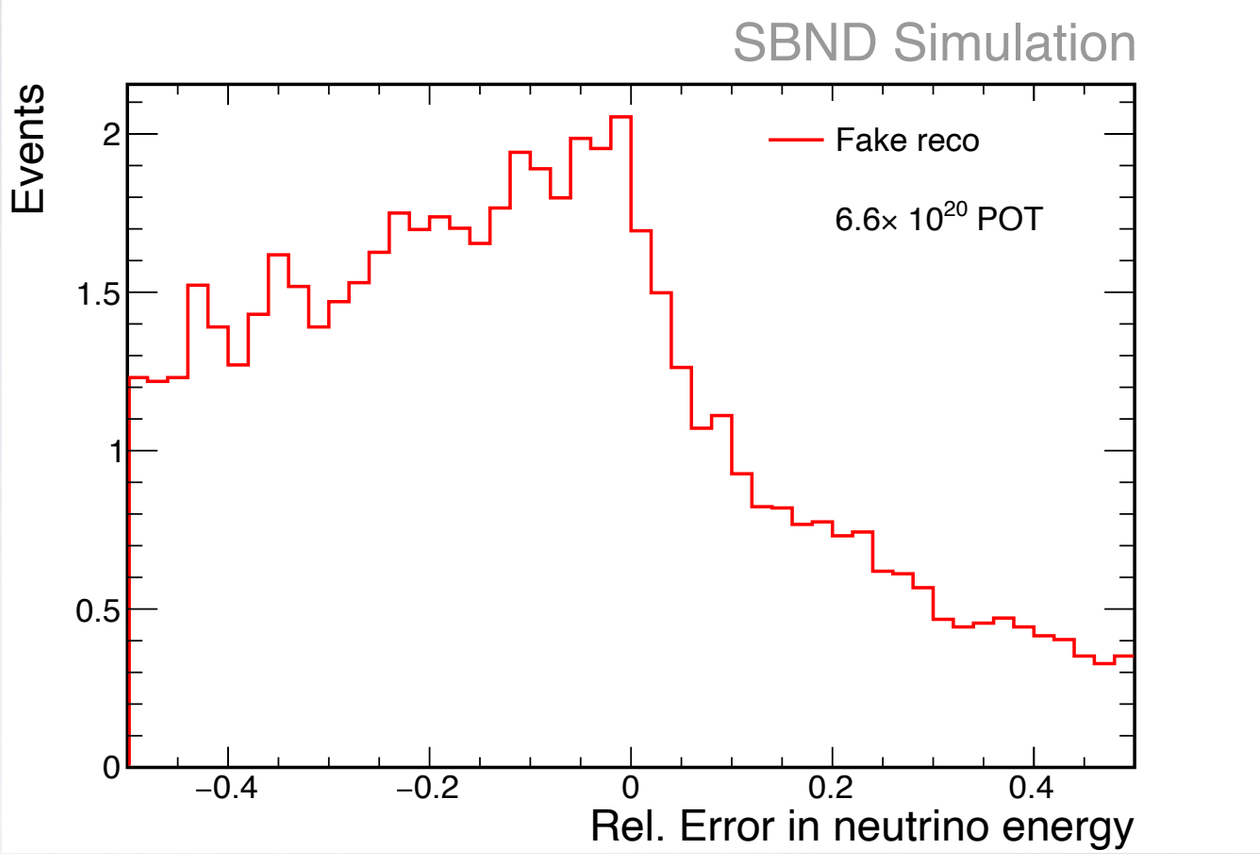


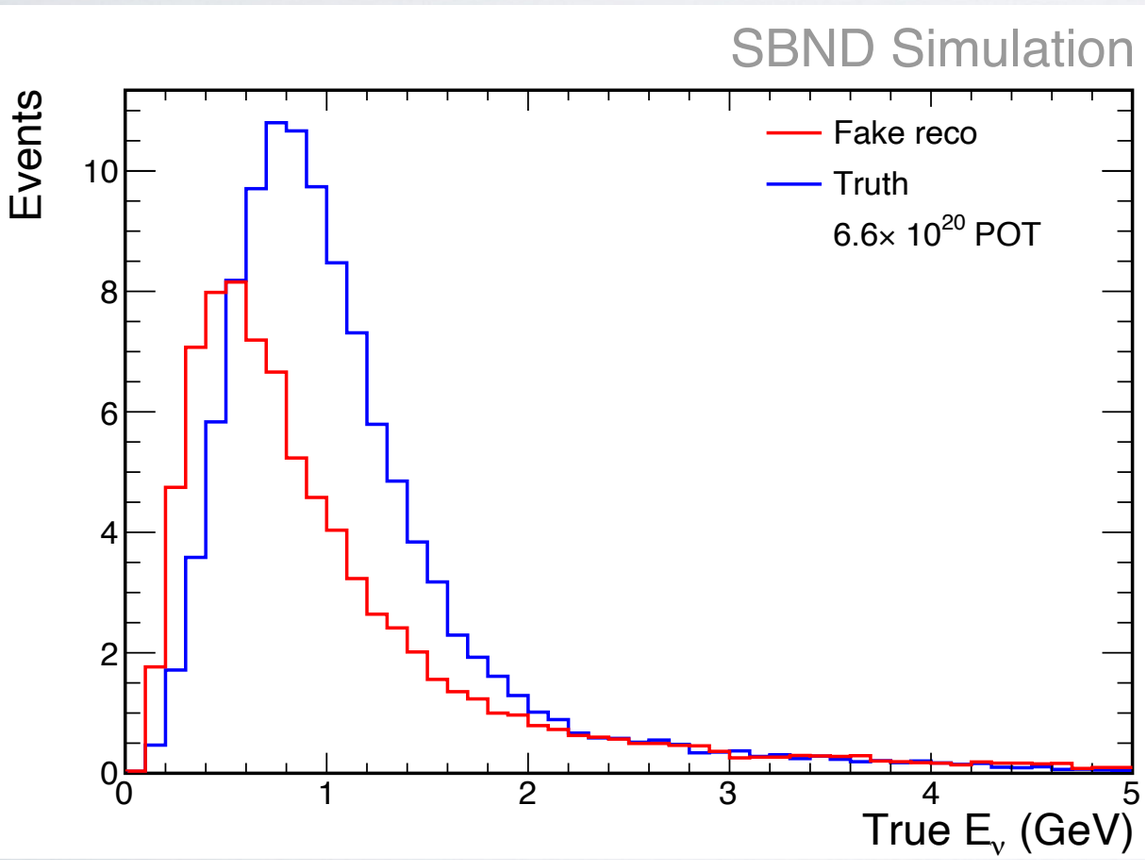


Smearing energy reconstruction by a gaussian 10% (unbiased)

We can absorb this with unfolding (reco-to-true matrix)







Smearing the angle by 1° (unbiased)

Improving the direction reconstruction is the priority

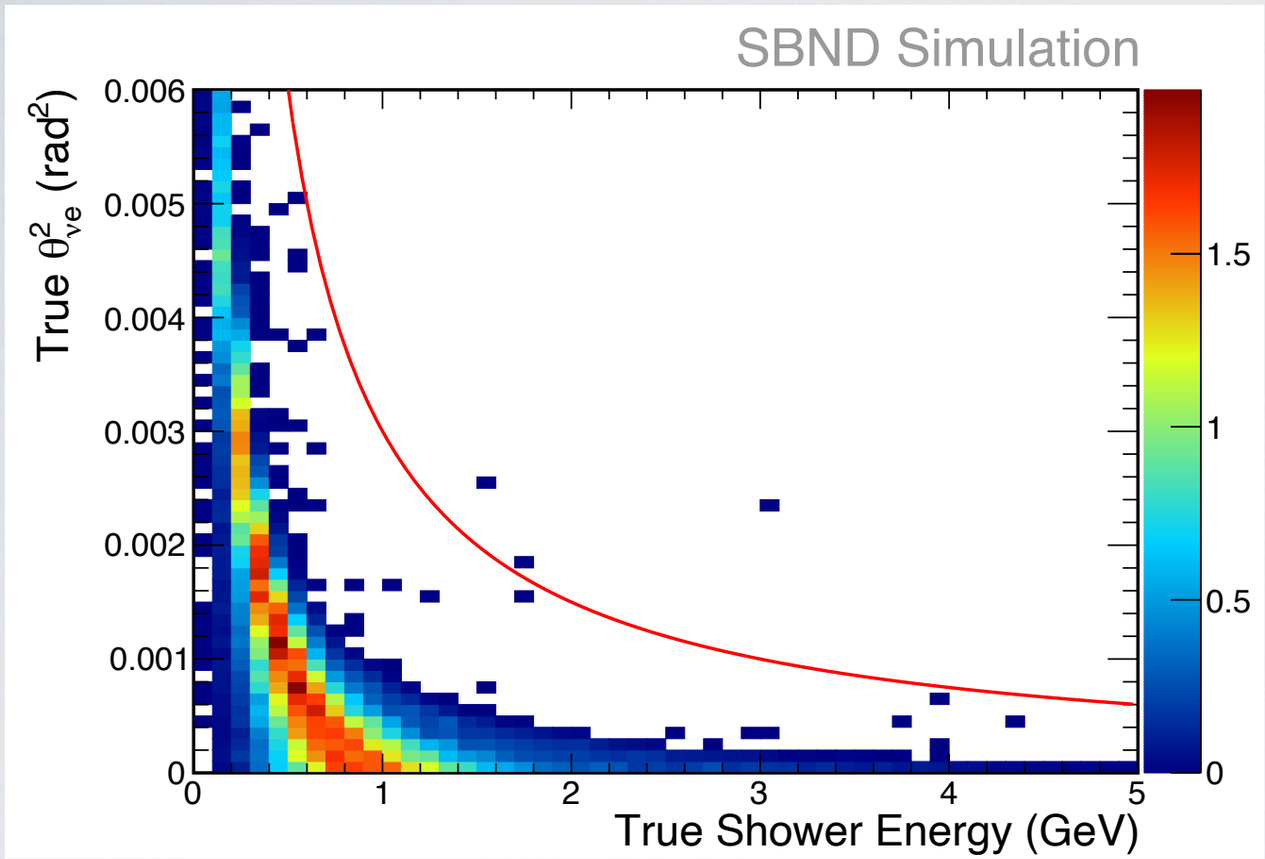
About the kinematic cut

In the relativistic limit:

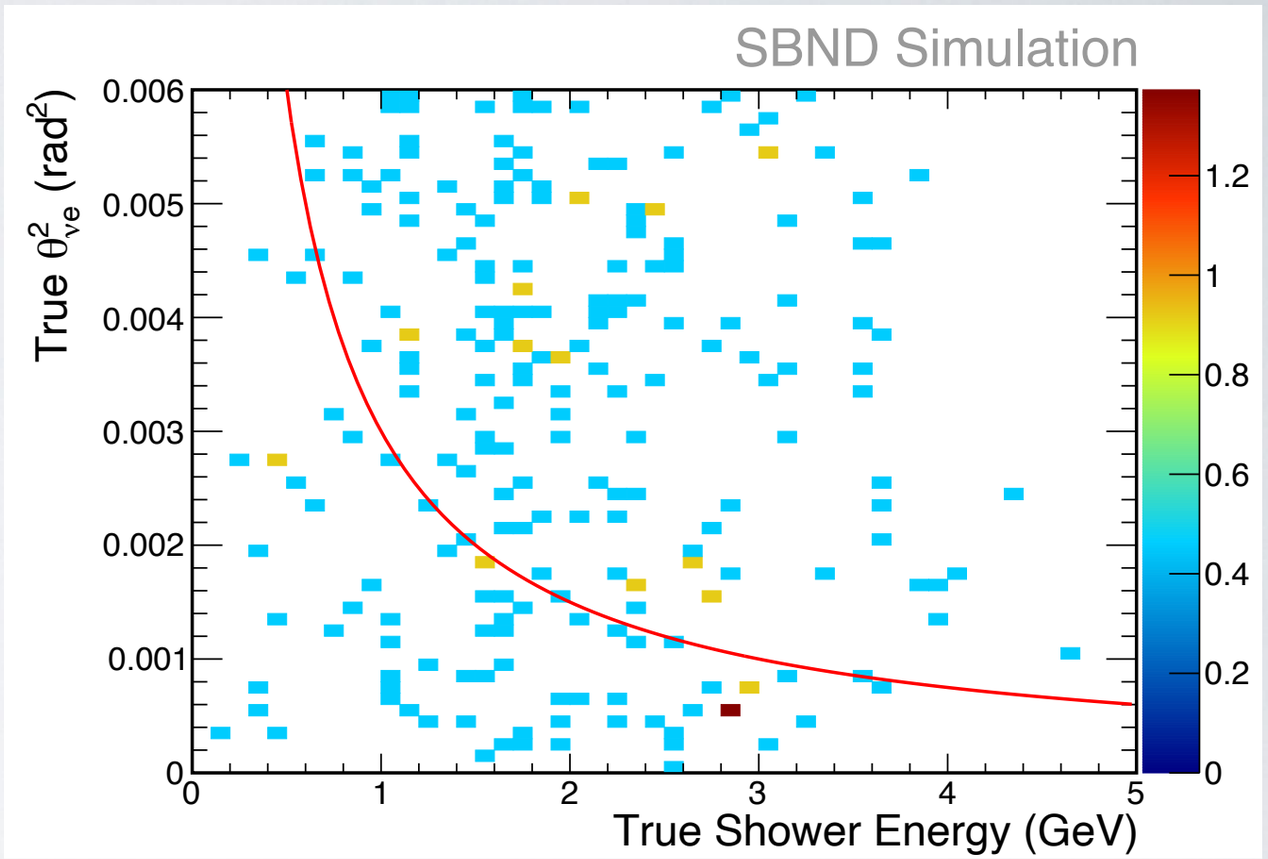
$$1-\cos\theta=\frac{m_e\left(1-y\right)}{E_e}\text{, where y}=\frac{T_e}{E_\nu}$$

$$E_e\theta^2\simeq 2m_e\left(1-y\right)\leq 2m_e=0.001\text{ GeV}$$

SELECTION (TRUE VARIABLES)



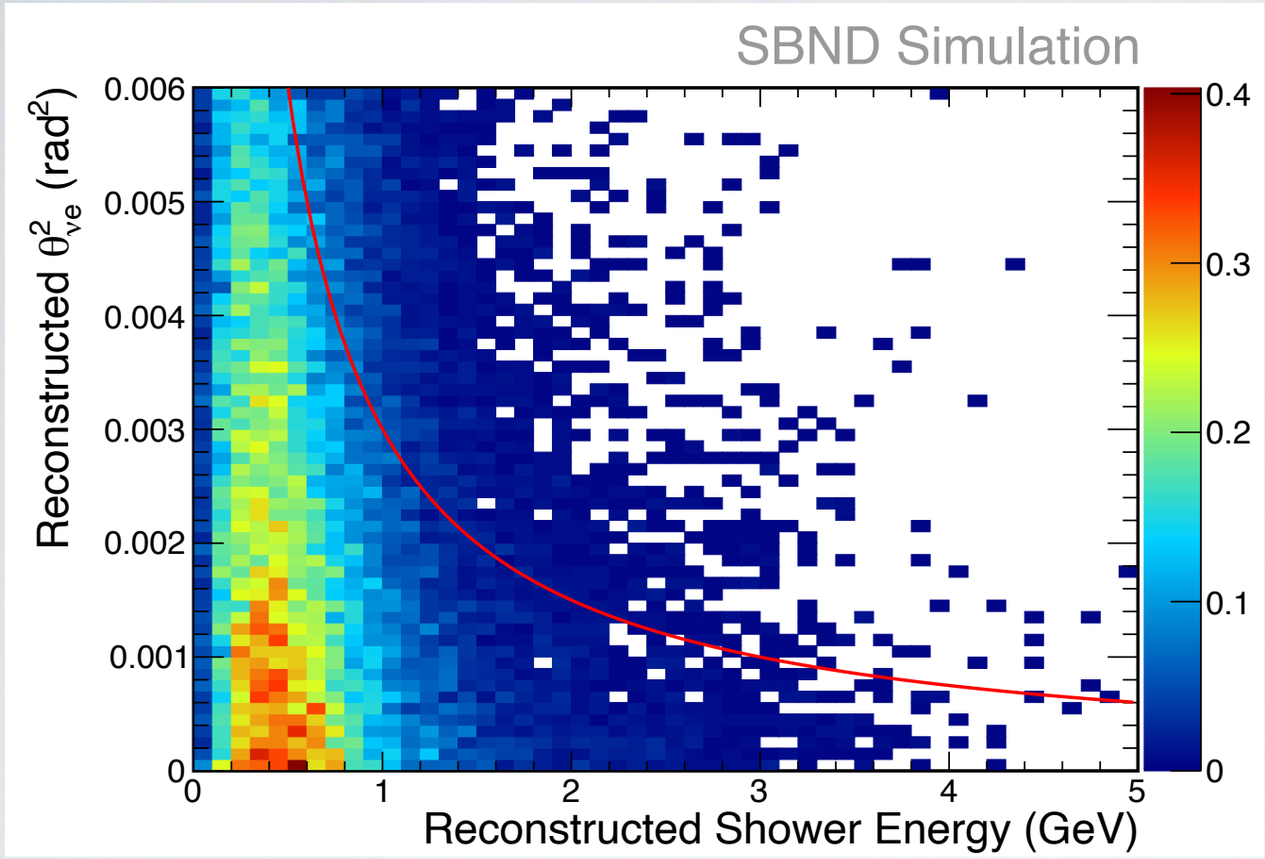
Signal



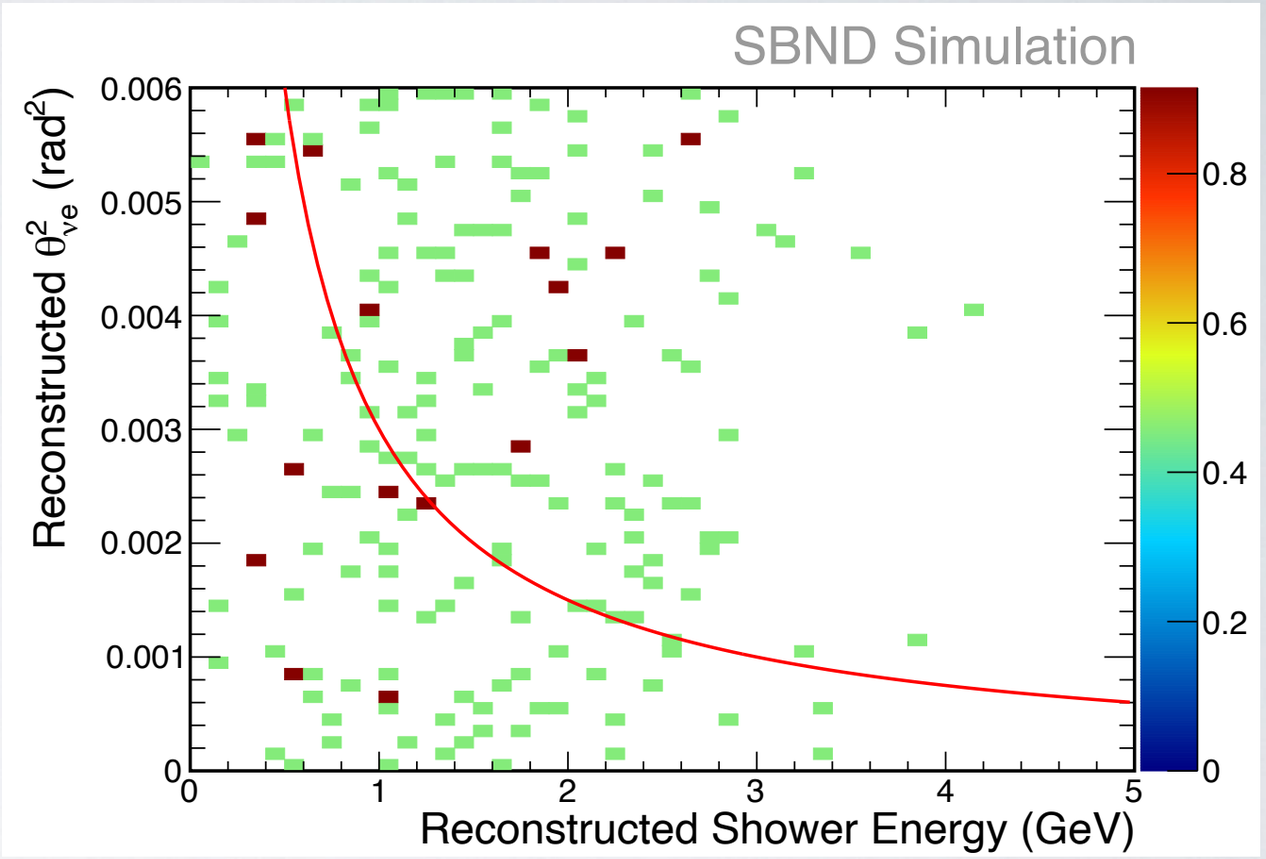
Background

Optimum is at $E\theta^2<0.0011$ GeV·rad^2, very close to the theoretical boundary

Selection (Reco variables)



Signal

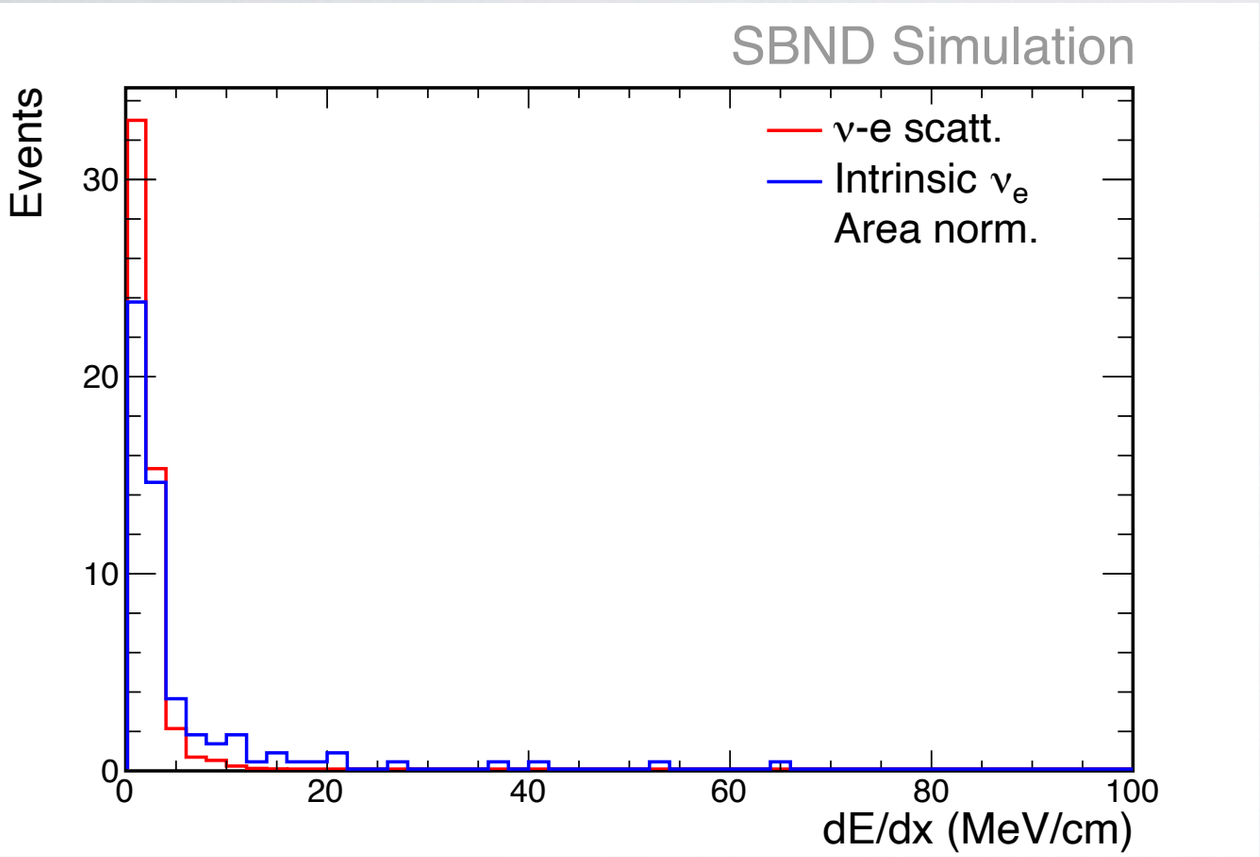


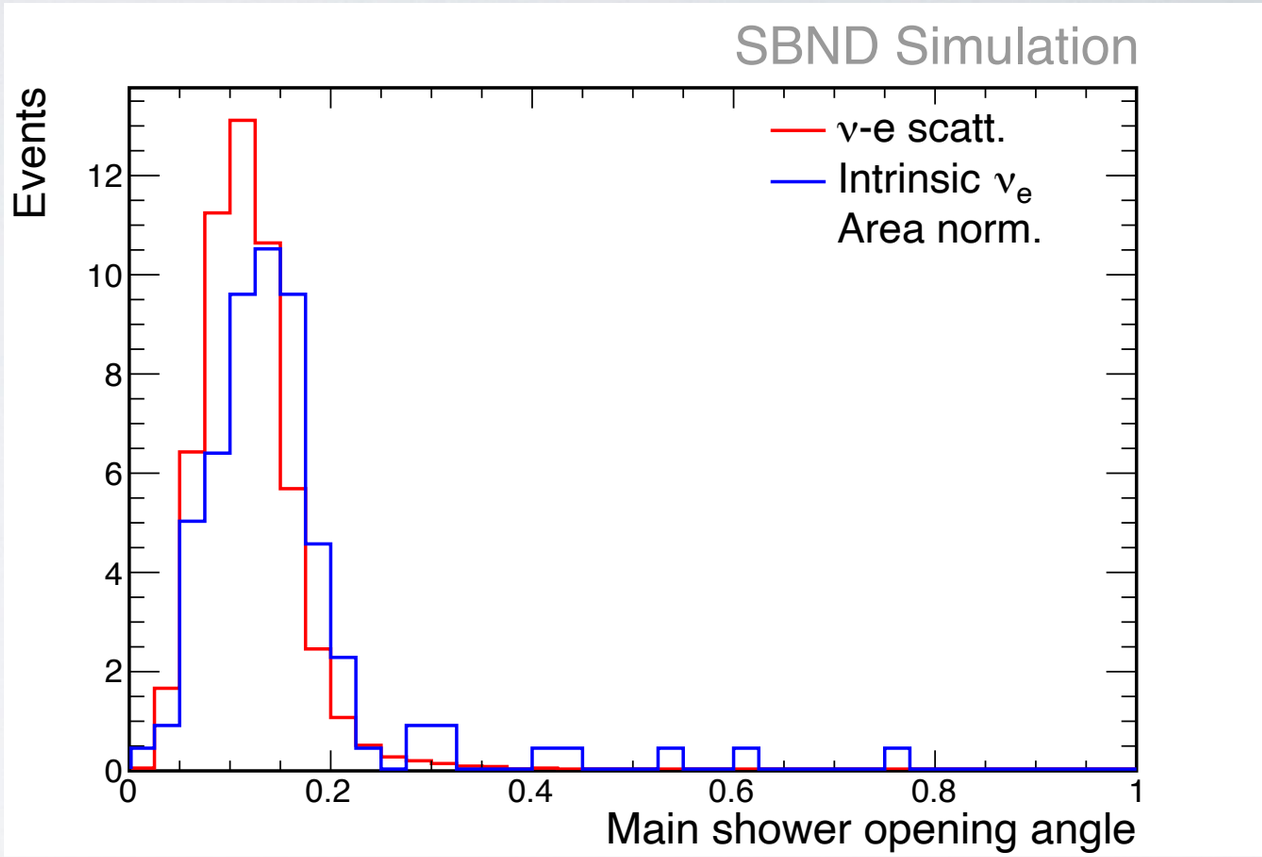
Background

Optimum is at $E\theta^2<0.0029$ GeV·rad^2

Checked linear cut and we gain nothing (~same efficiency and purity)

ADDITIONAL VARIABLES?



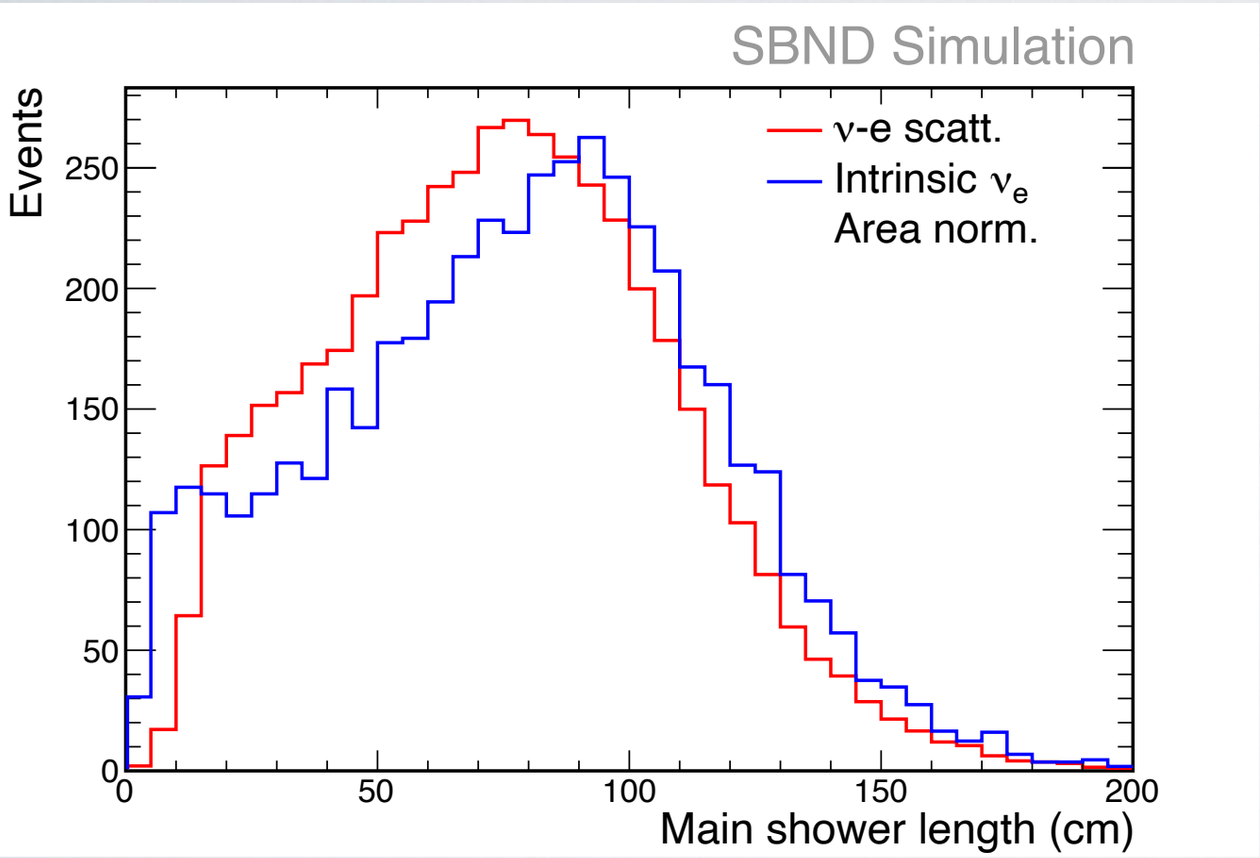


Cut < 30 MeV/cm

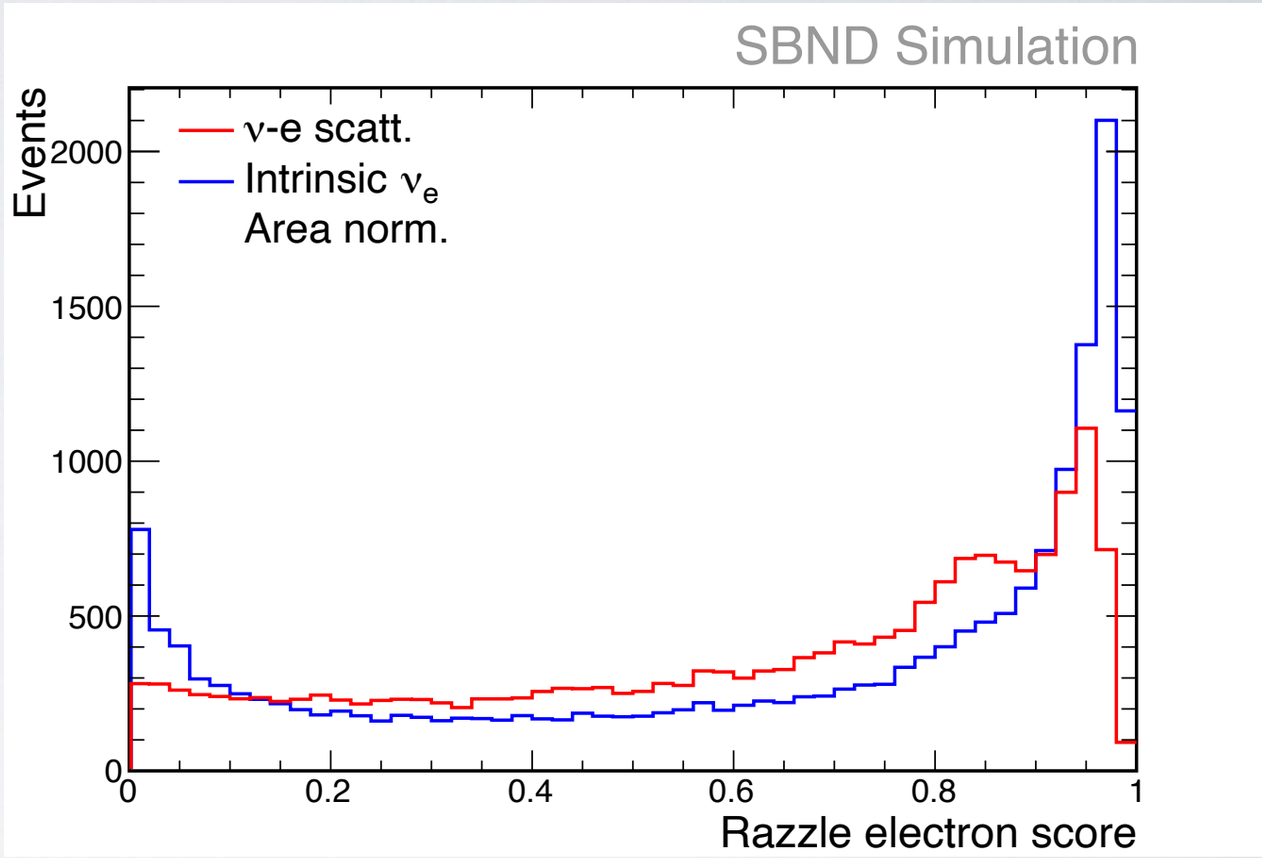
Cut < 0.5

Preliminary cuts (i.e., eyeballed), on top of previous cuts
Underlying idea: what's left is events where a hadronic shower is collinear

Additional variables?



Cut > 10 cm

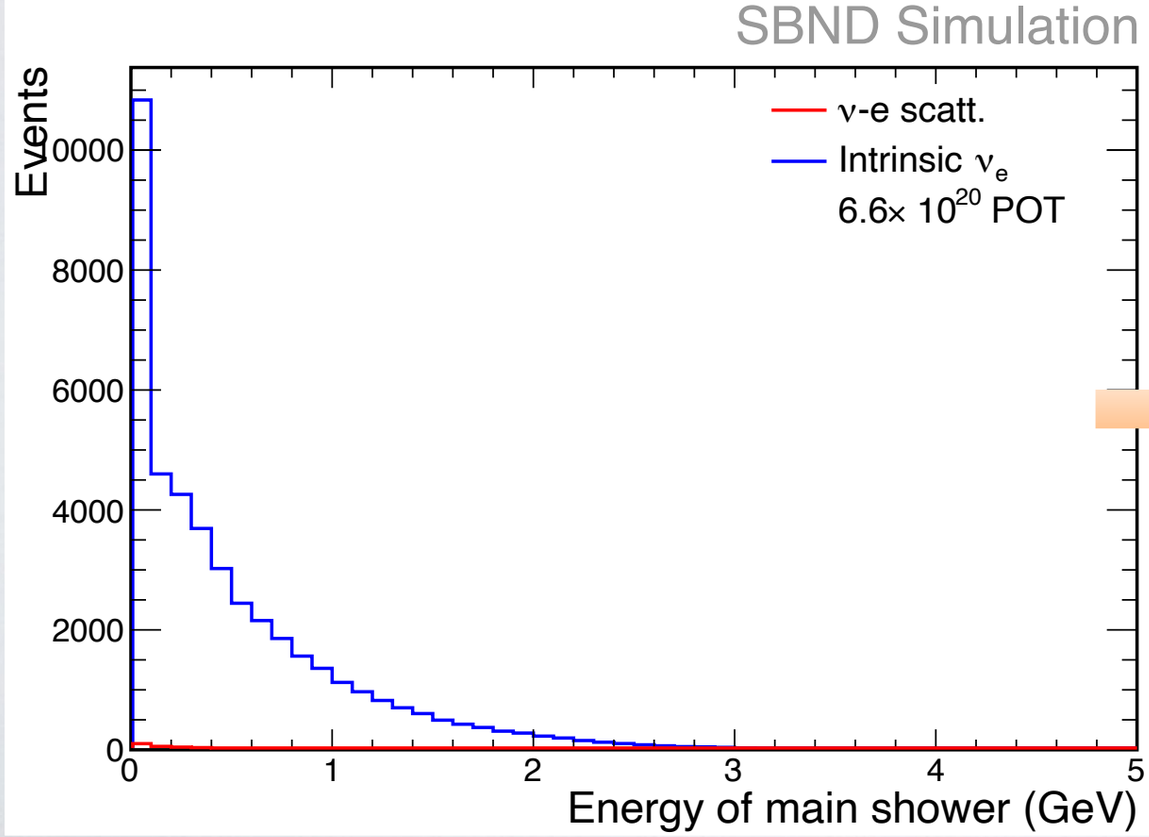


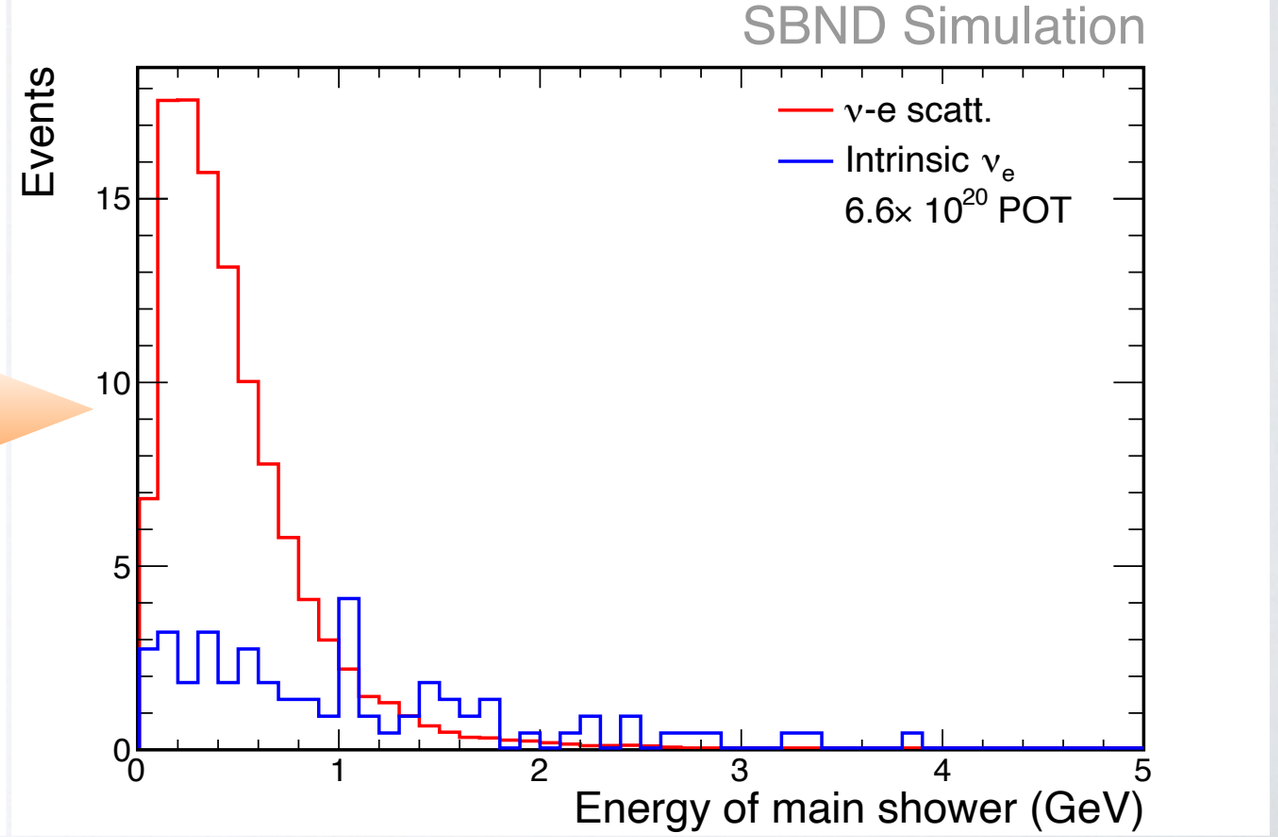
Cut > 0.2

Preliminary cuts (i.e., eyeballed), on top of previous cuts

Cutflow

Cut	Efficiency	Purity
No cut	100%	0.8%
One shower	68.5%	1.4%
No tracks	59.0%	4.3%
$E\theta^2 < 0.003$	32.7%	68.9%
All remaining	30.4%	74.3%





Conclusions

- In order to reconstruct the energy of the incoming neutrino with good precision, the main goal lies in improving the reconstruction (particularly direction)
- Event selection would also greatly benefit from such improvement
    - Next step, test out using Marina's direction reconstruction algorithm
- There seems to be some room form improvement in the selection but most of the low-hanging fruit has already been picked