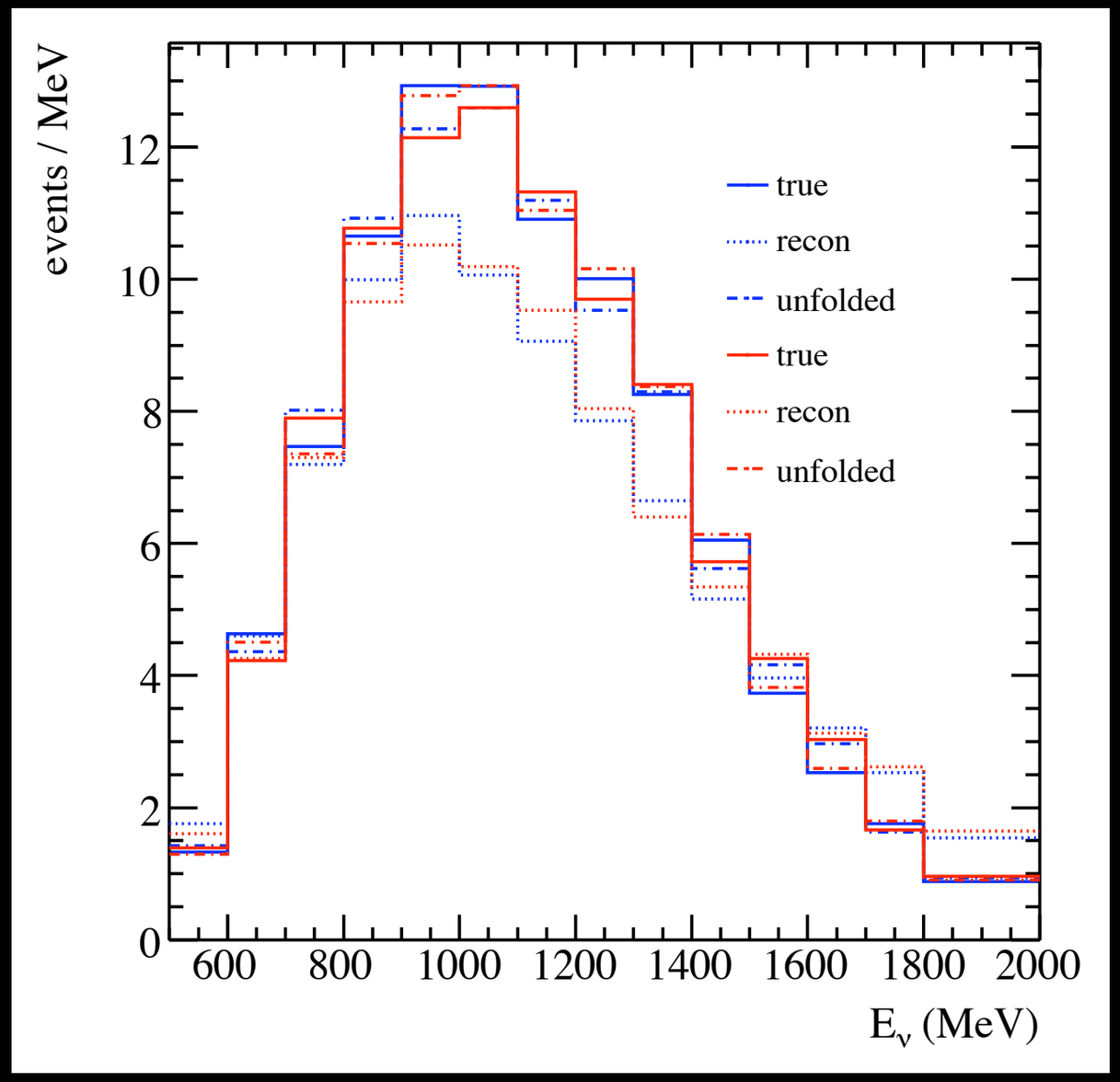
$CC\pi^0$ update

Robert Nelson
2009.9.15

Unfolding tests



- I split the CV MC after cuts into two samples.
- This plot has a lot going on so listen and stop reading.

Test 2

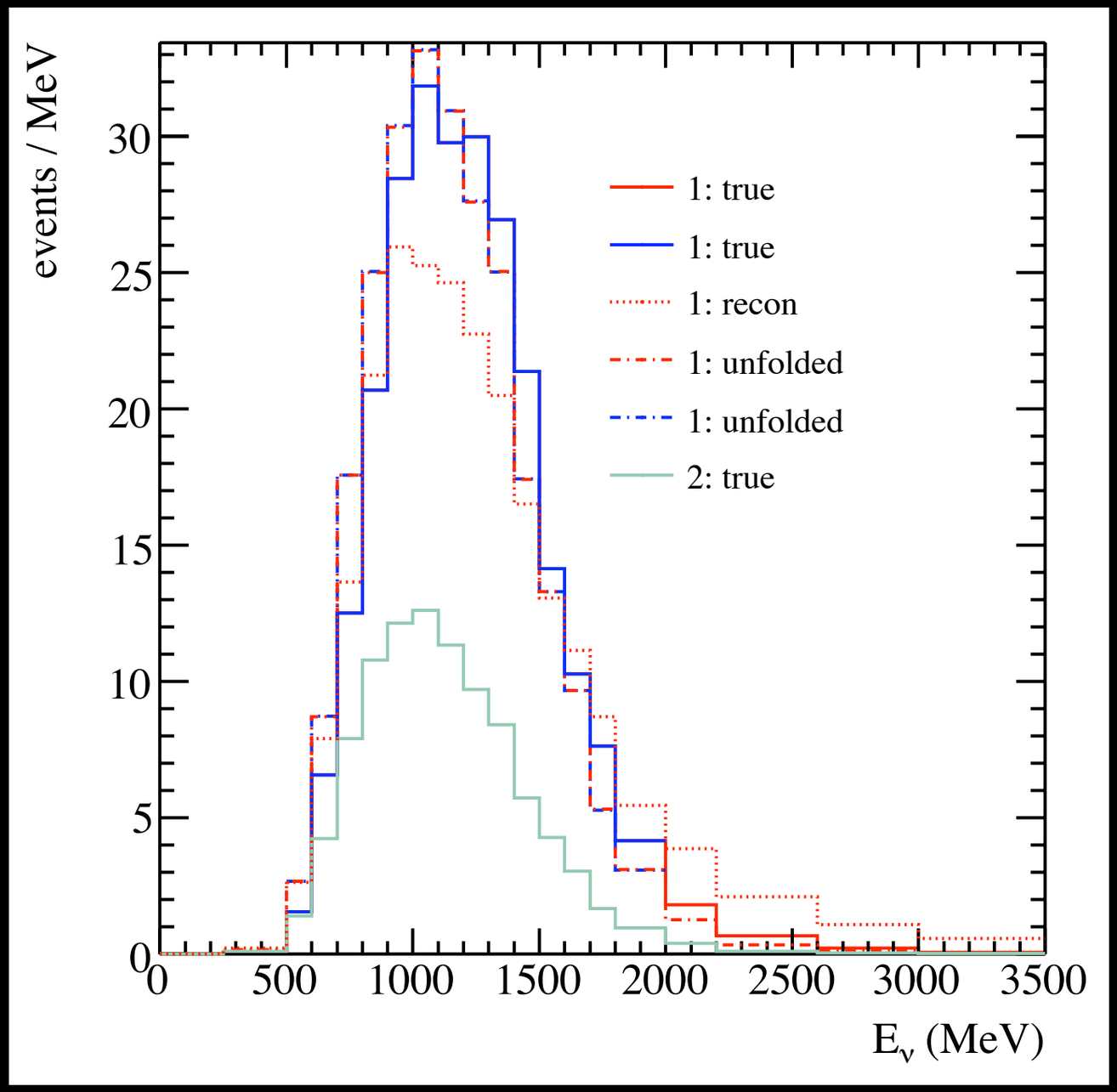
- Sample one has been linearly weighted by true neutrino energy:

  1 at 500 MeV,
  5 at 2000 MeV.

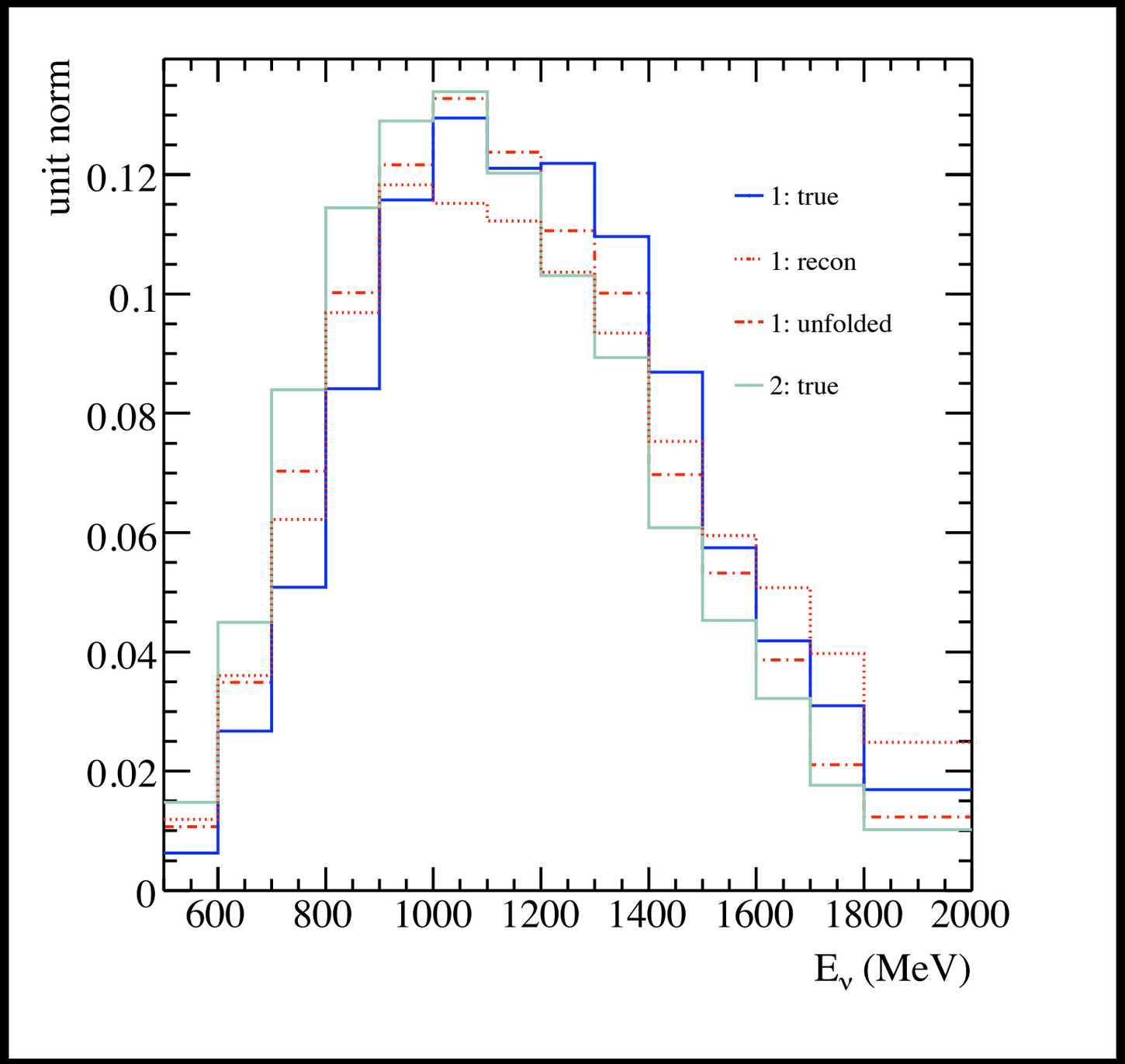
- The Unfolding matrix is formed from the statistically different, unweighted sample.

- The red vs. blue is what happens when you change the unfolding matrix to have a larger range.

  - Proving that a large matrix acts identical to the overflows of the smaller matrix across the region of interest.



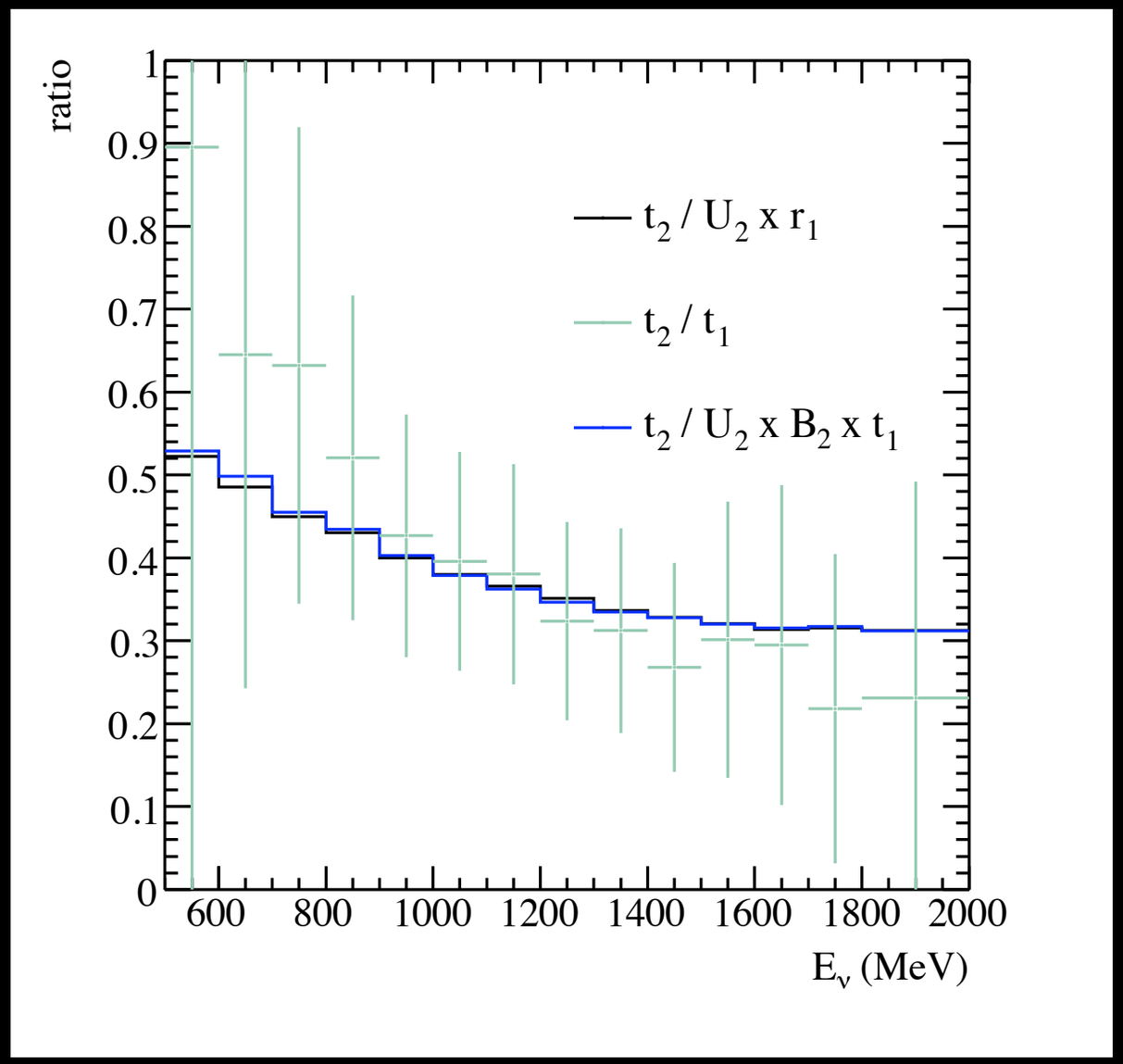
Test 2: unit normalized

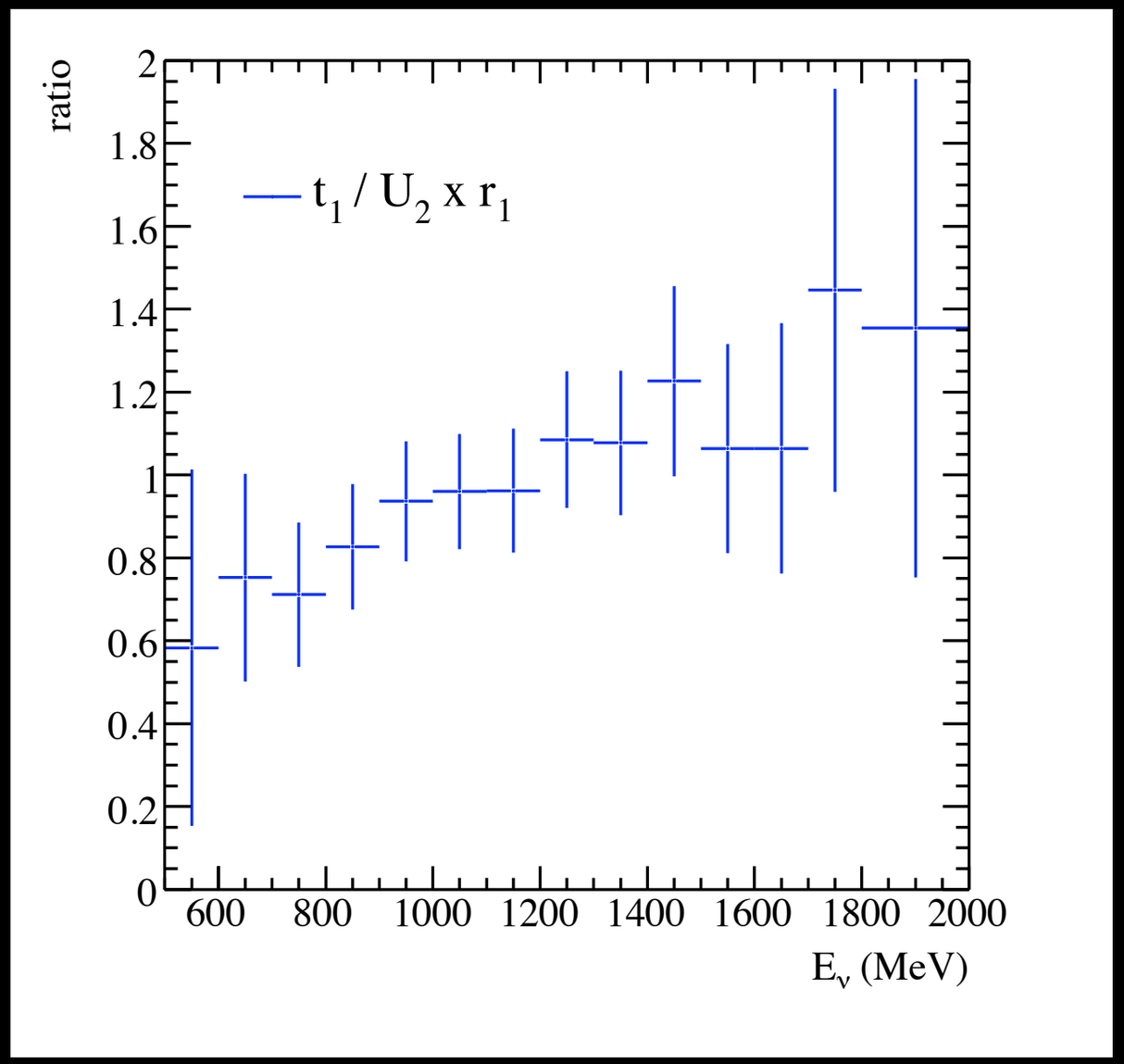


- The unfolding appears to put the distribution between both true distributions.
- So we do have to account for some bias.

Ratio to truth

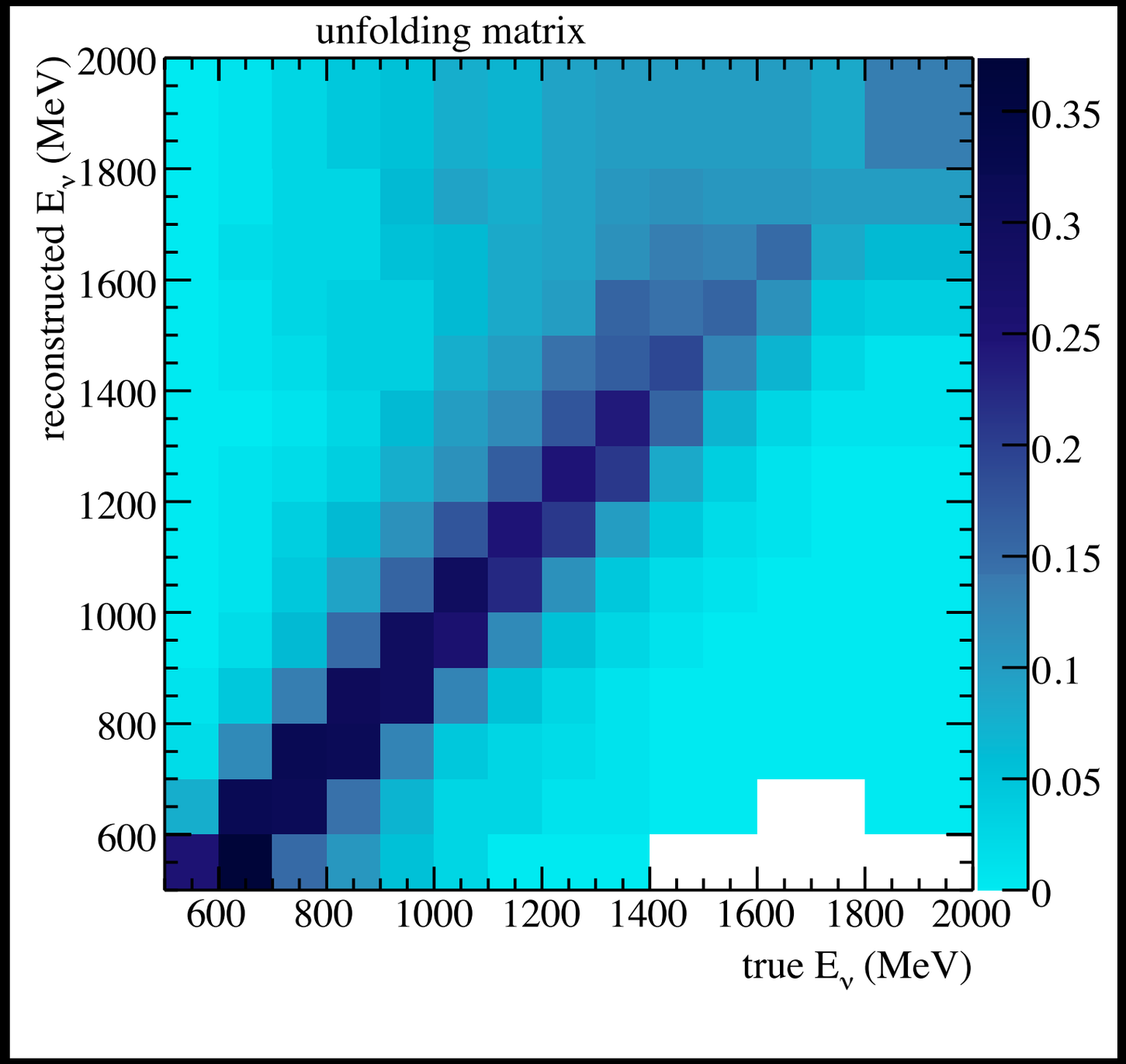
- Unfolding appears to smooth out statistical variations.
- The bias pulls the result toward true 2.
- Maybe iteration is the way to go? Haven't had a chance to look at it yet.





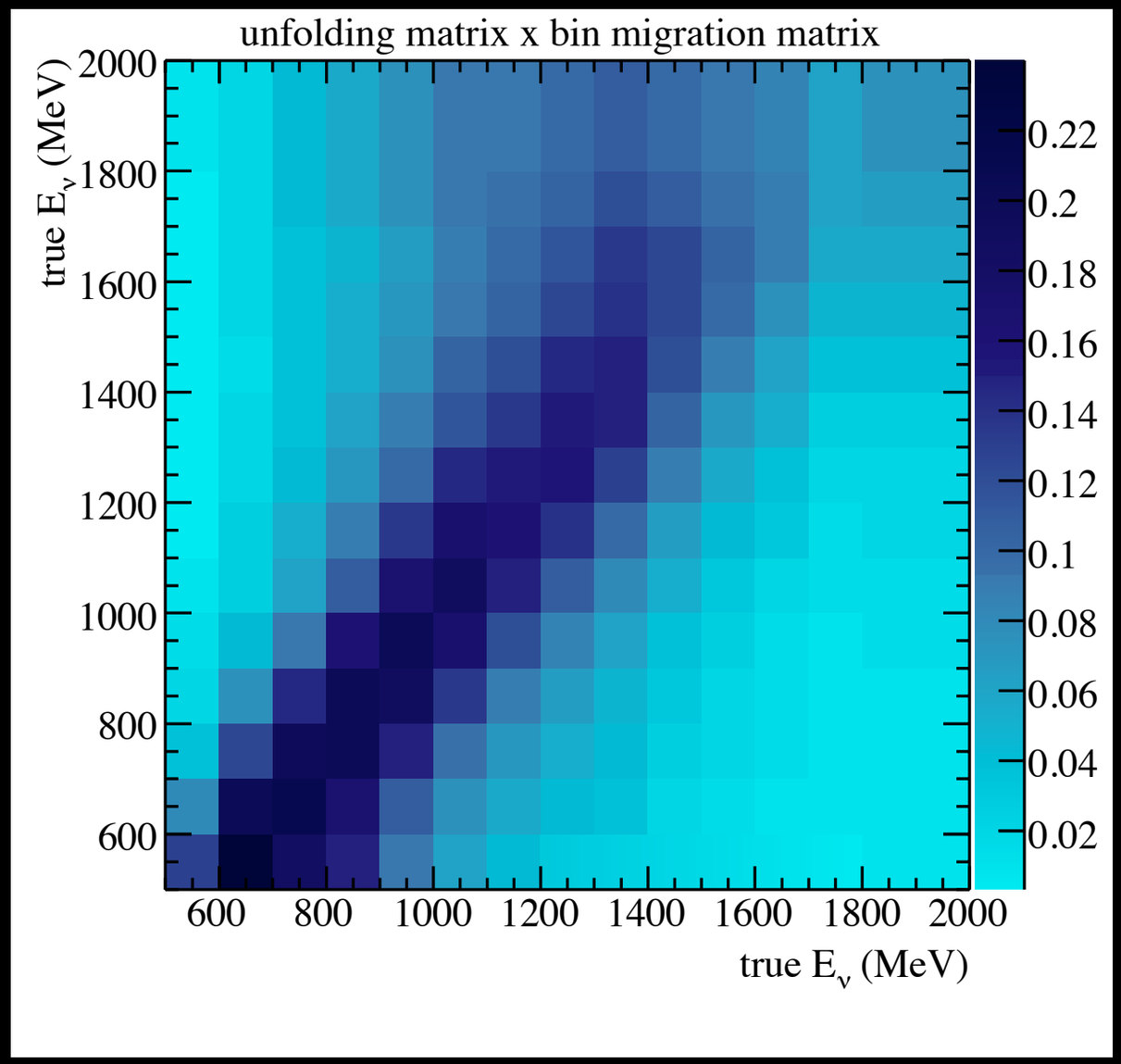
Unfolding from the full CV MC with cuts

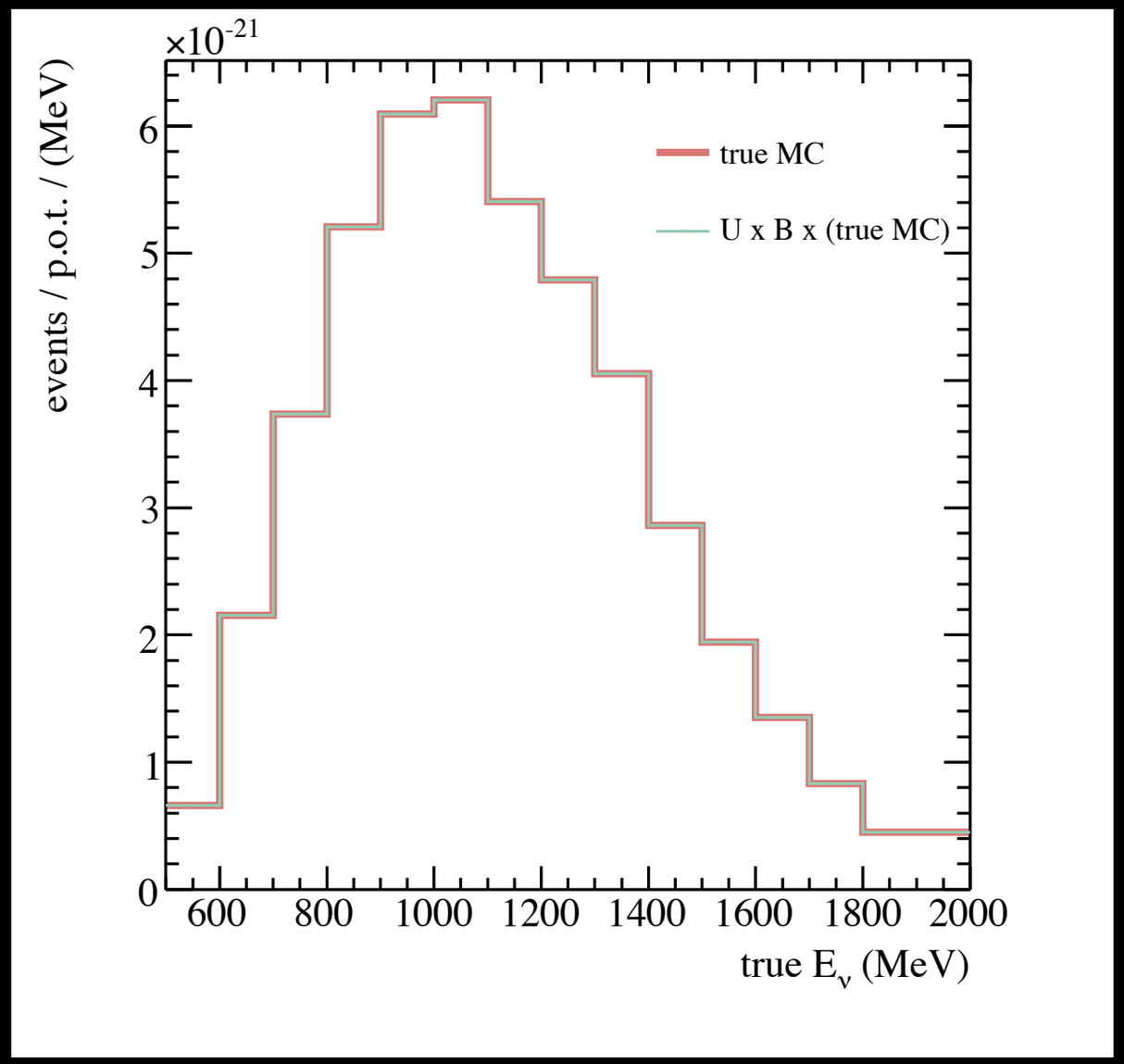
- Nice and diagonal over this range.
- Same range as the CCπ^+ analysis; different binning.



Eigenvector test

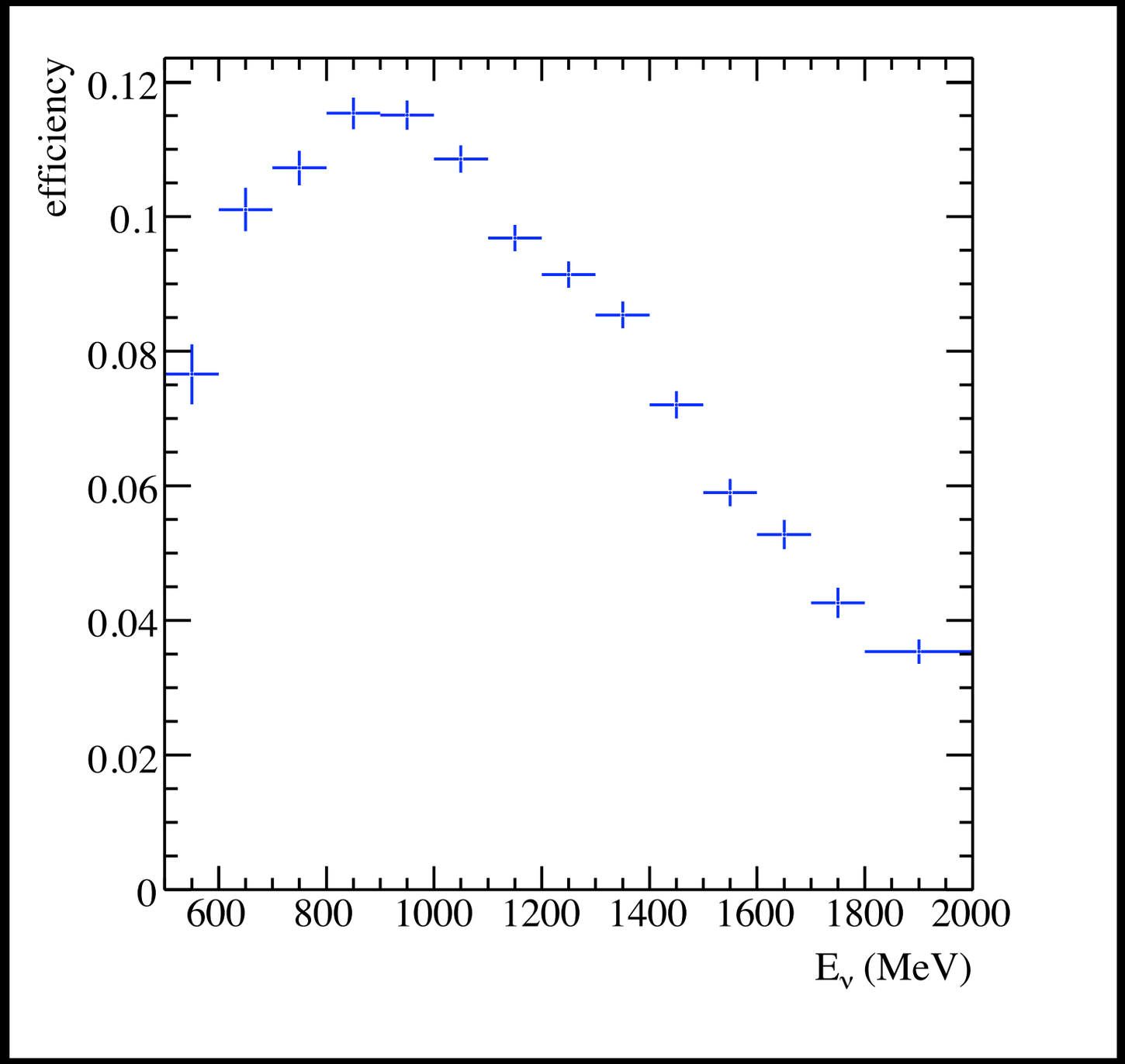
- This still satisfies the test.





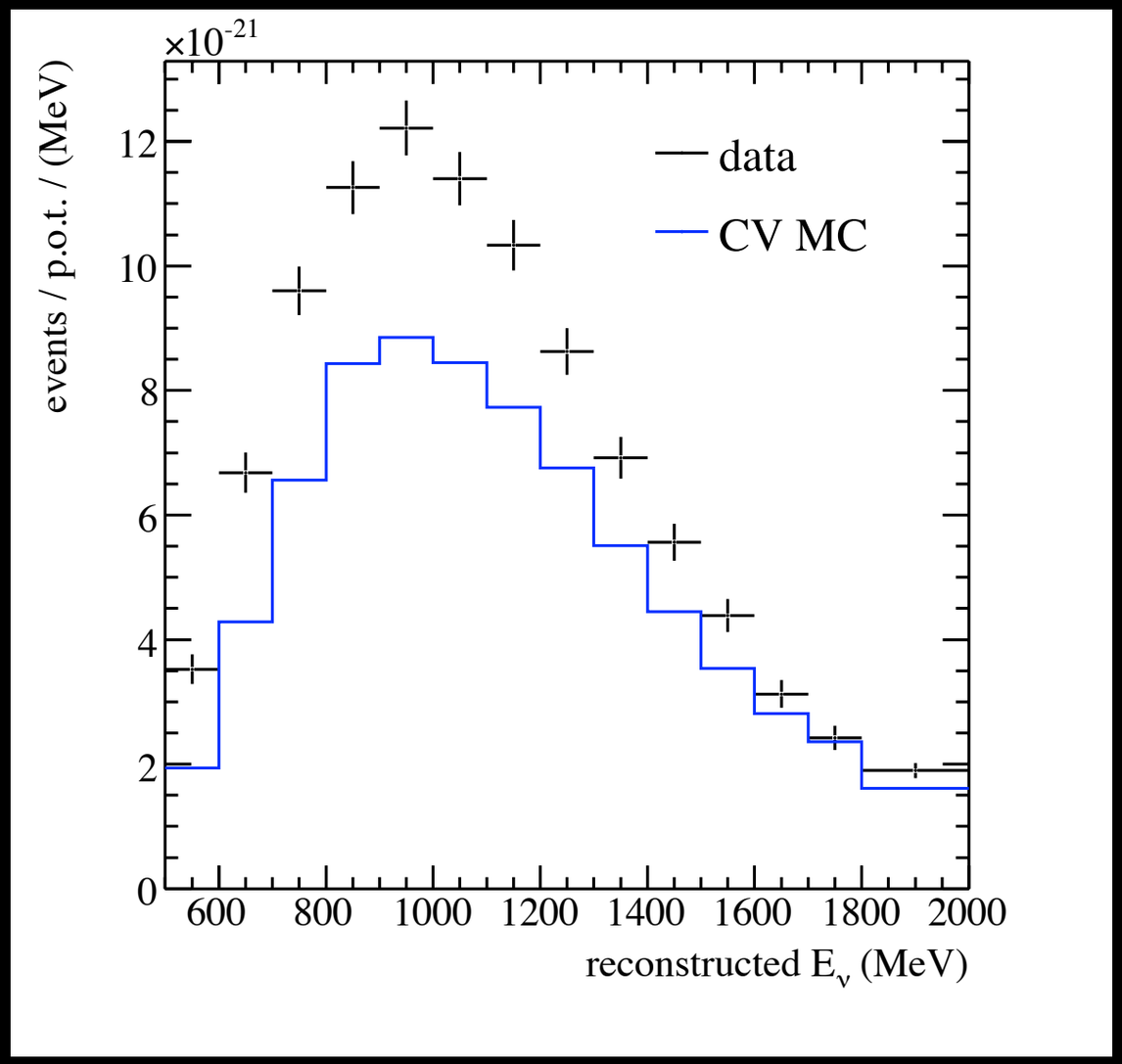
Efficiency vs E_ν

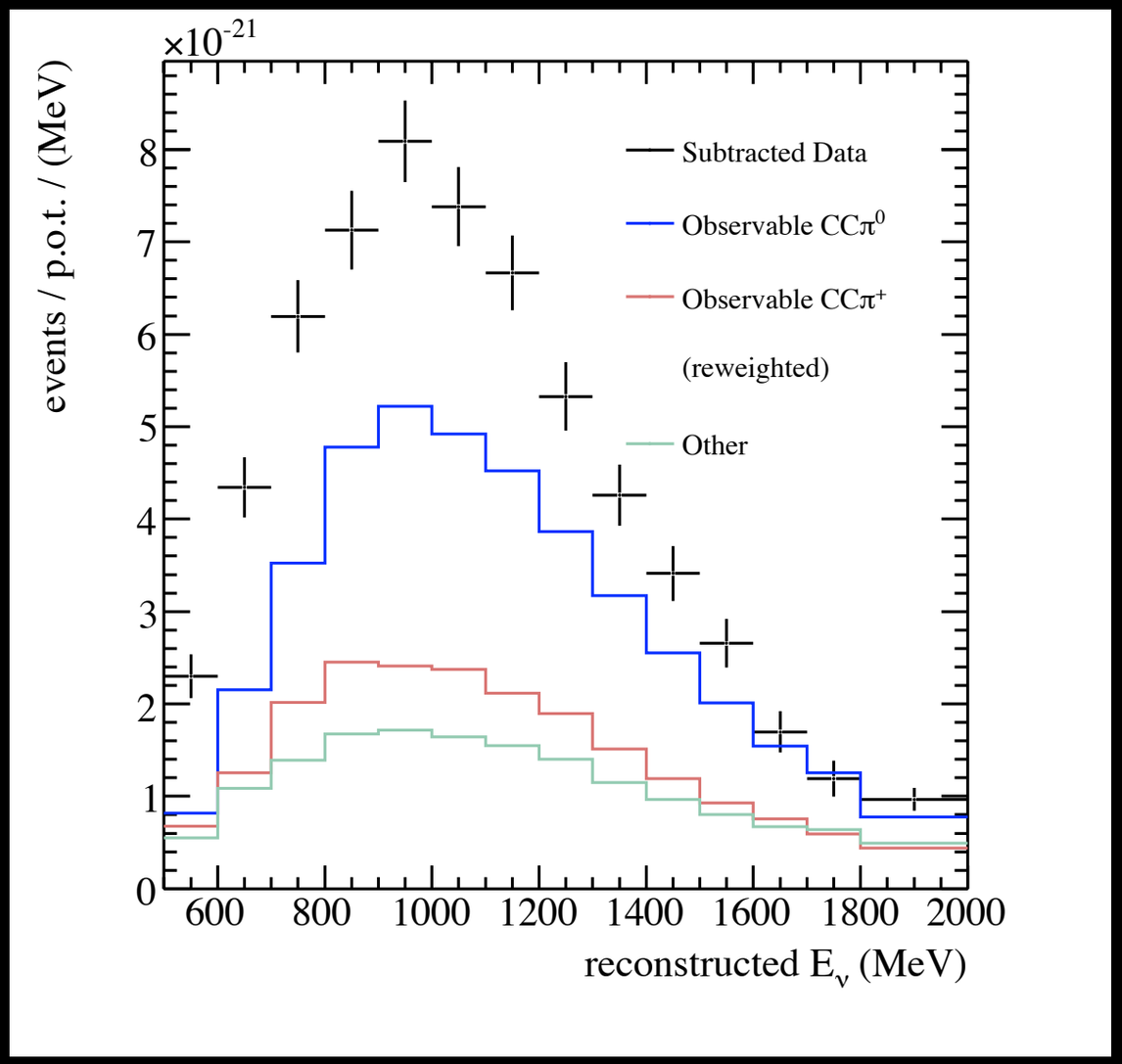
- The efficiency is relatively smooth.
- I added a π^0 mass cut that lowered the overall efficiency and reduced some backgrounds.
  $75\ \text{MeV} < m_\pi < 200\ \text{MeV}$



Rates, before and after background subtraction

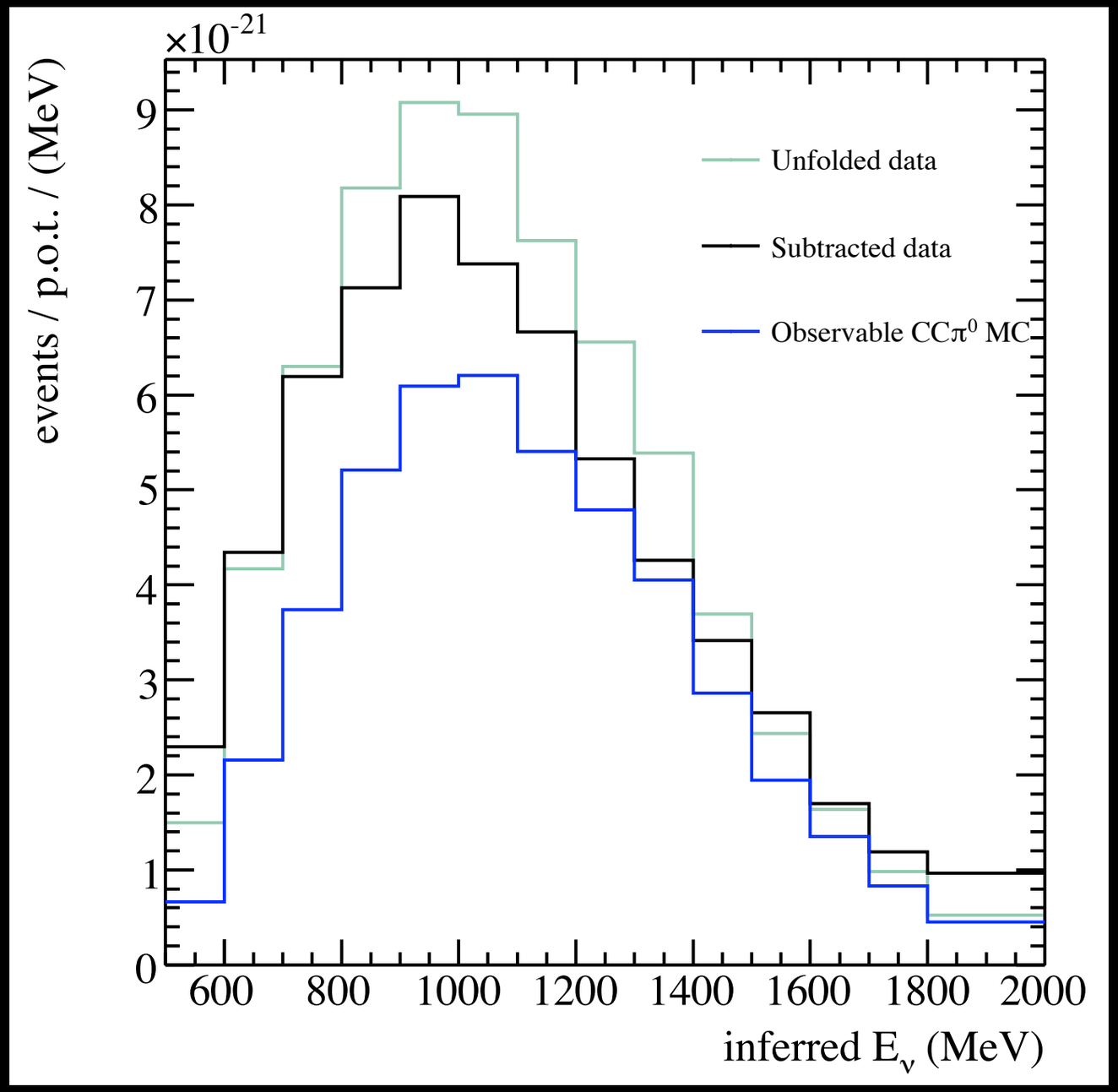
- Reconstructed energy, pre-unfolding.
- CCπ^+ events are re-weighted.
- No other backgrounds are (I should probably do something about that....)





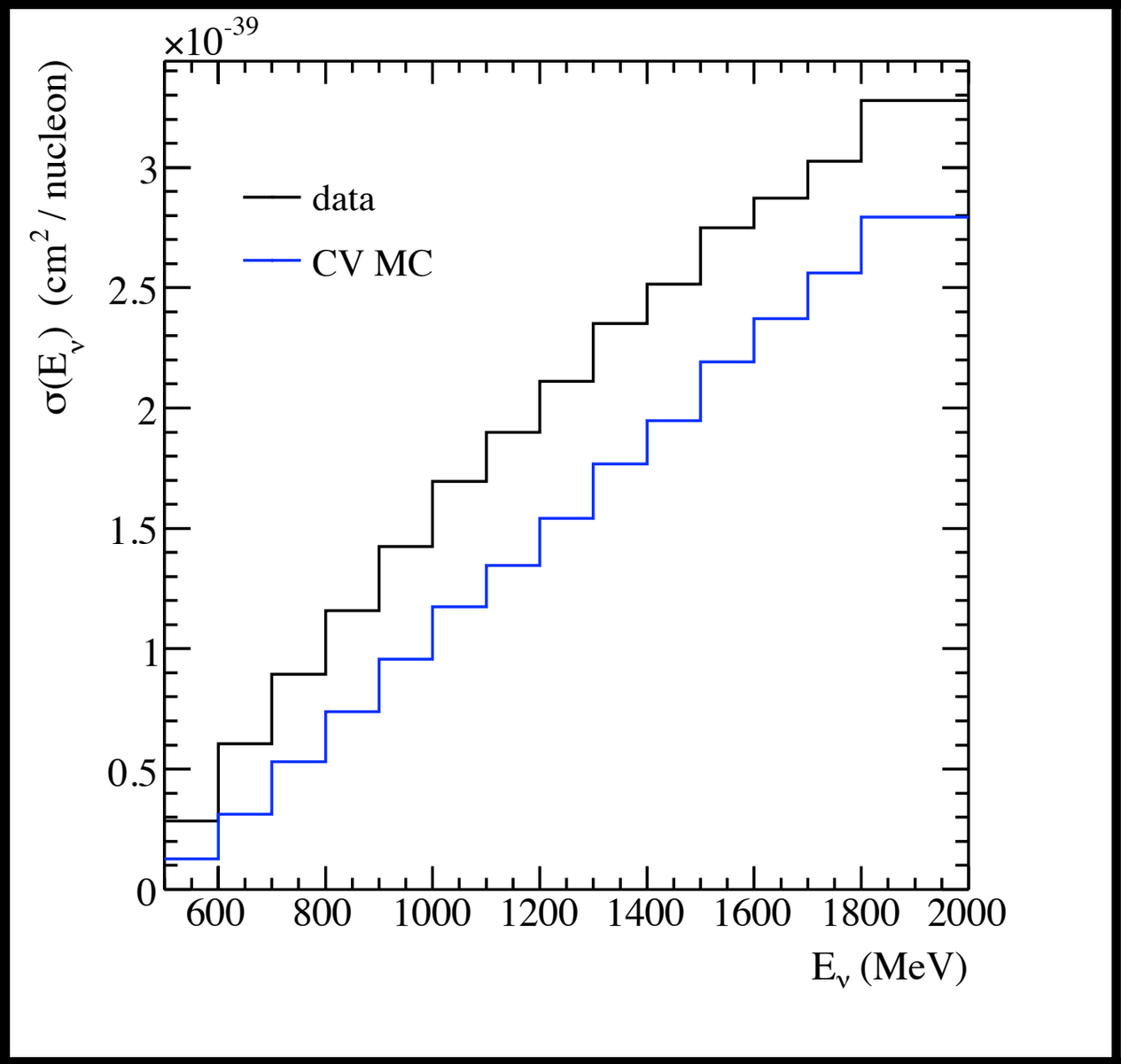
Re-weighted background subtracted data

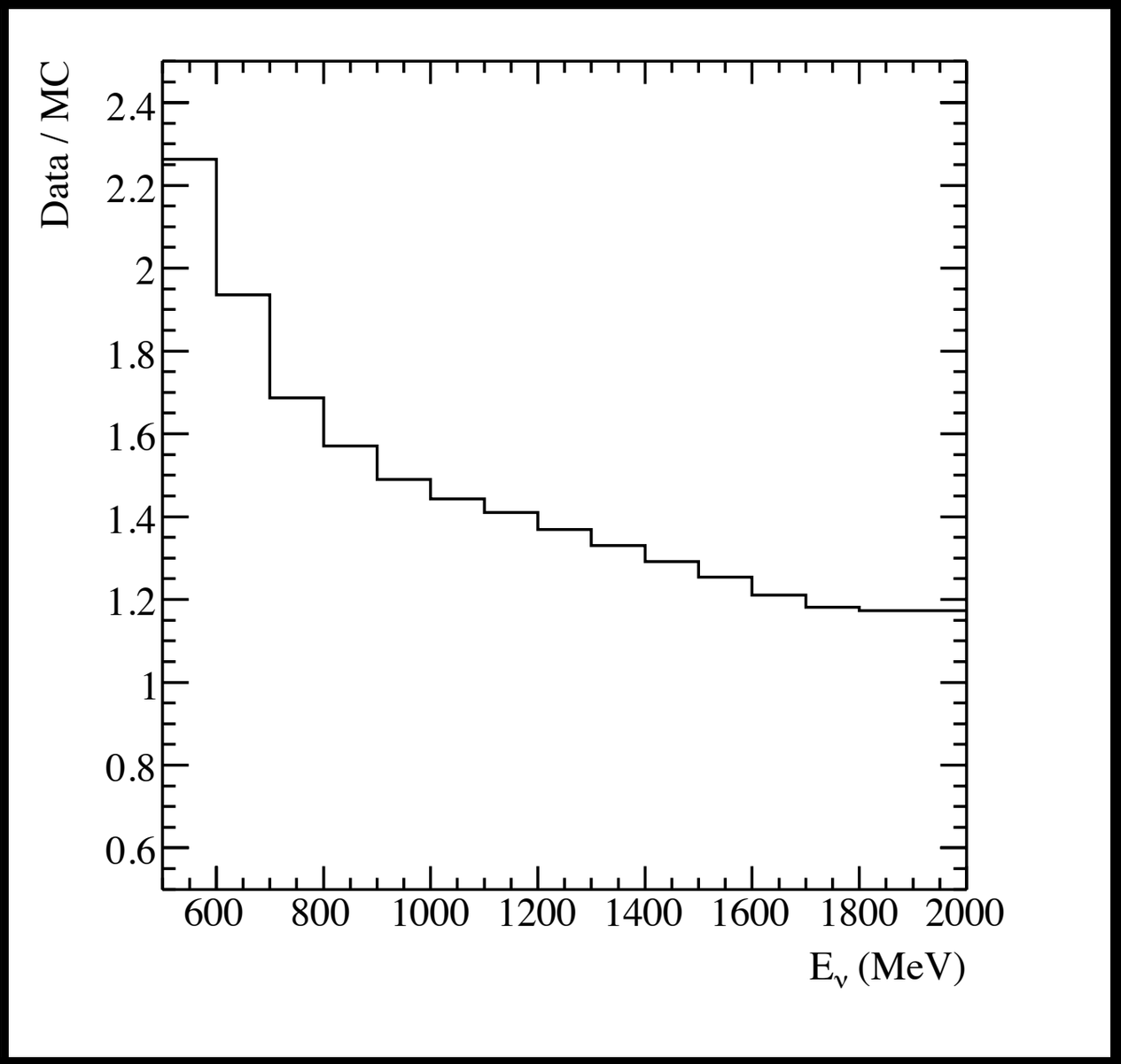
- Well, it is what it is....
- It doesn't look crazy, but we know the unfolding pulls towards the true MC.



$\sigma(E_\nu)$ no errors

- This exercise has proven that we'll be able to make this measurement.





What's left?

- Do some more unfolding studies.
- Optimize cuts.
- Adjust the remaining backgrounds to "match" our data.
  - Re-weighting the CCQE.
  - Scale the normalization of other modes based on our data.
- Evaluate the errors..... Besides the standard Flux, OM, etc. errors, we need to address:
  - Unfolding uncertainty
  - Charge-exchange/absorption model