EG2: $(e, e'pp)/(e, e'p)$ and new SRC event generator

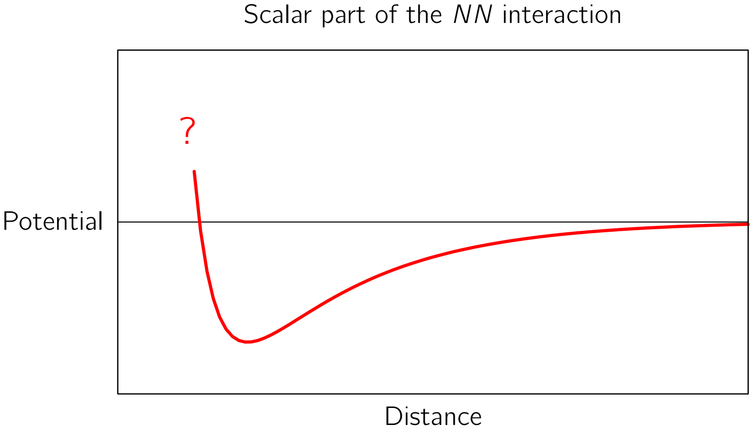
CLAS Nuclear Physics Working Group Meeting

Axel Schmidt

MIT

November 15, 2018

The short-distance *NN* interaction is poorly known.



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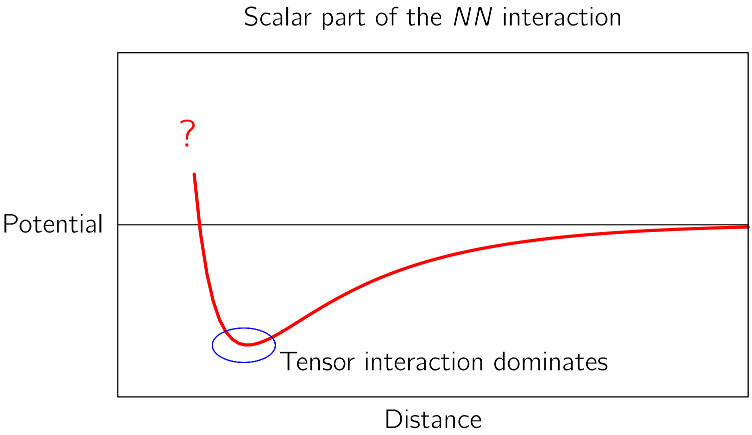
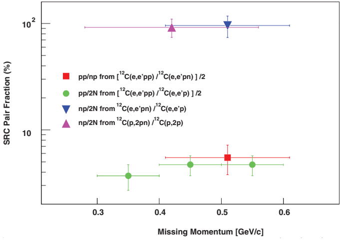
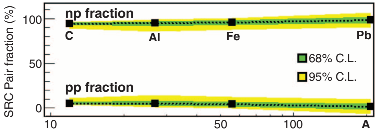
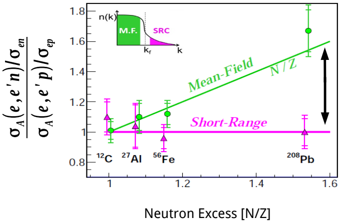
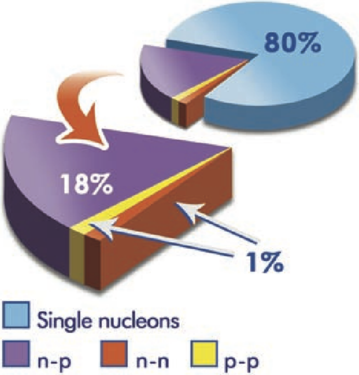


Short-range correlated pairs prefer to be *np* because of the tensor force.

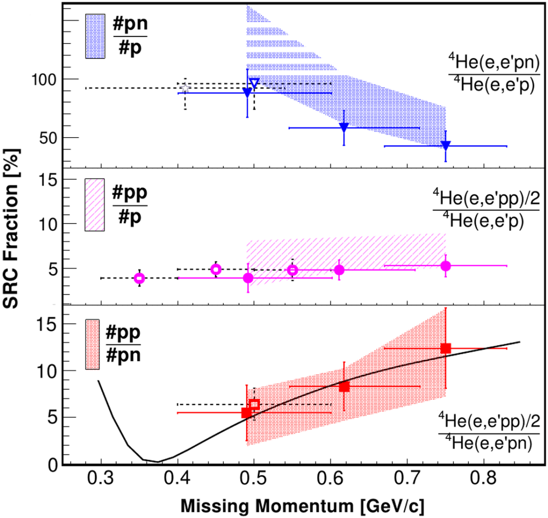








How does *np*-dominance evolve with momentum?



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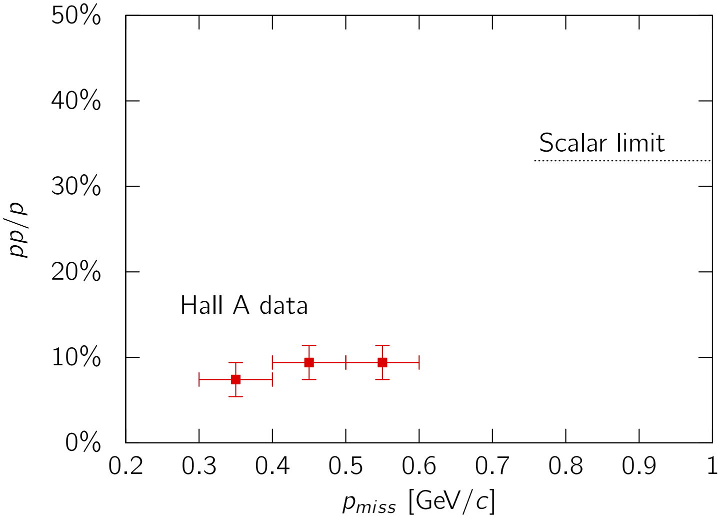
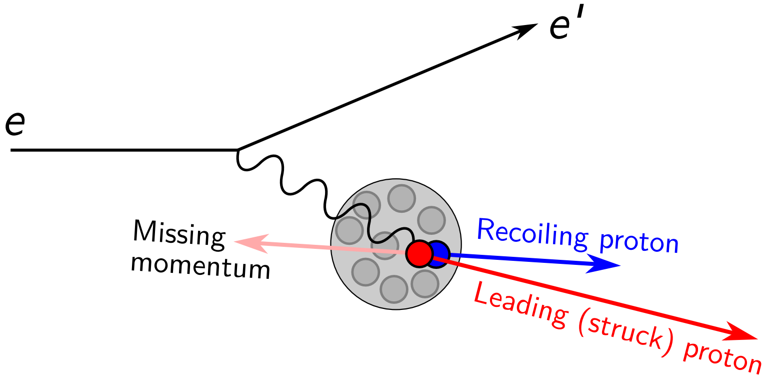


Missing Momentum is a proxy for the pre-collision momentum.



$$\vec{p}_{\text{miss}} = \vec{p}_{\text{lead}} - \vec{q}$$

$$\vec{p}_{\text{miss}} + \vec{p}_{\text{rec}} = \vec{p}_{\text{CM}}$$

pp/p analysis using EG2 data

1. Select $A(e,e'p)$ events in which the p comes from an SRC pair.
   - Exact same procedure (exact same EVENTS!) as in:
     - O. Hen et al., "Probing pp-SRC in ^{12}C, ^{27}Al, ^{56}Fe, and ^{208}Pb using the $A(e,e'p)$ and $A(e,e'pp)$ Reactions" (2014)
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2. See how often there is an additional proton in coincidence.

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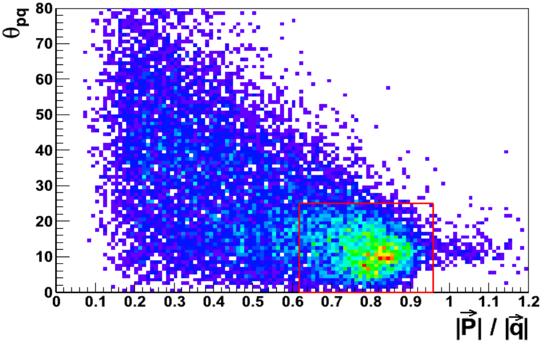
- $\theta_{pq} < 25°$



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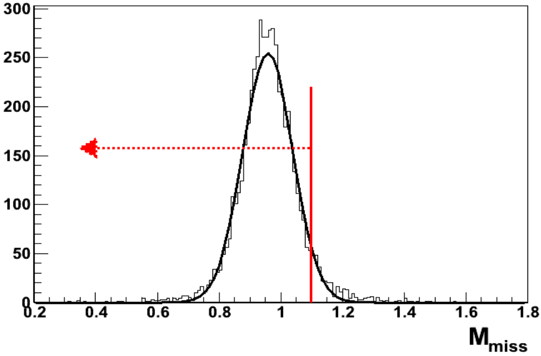
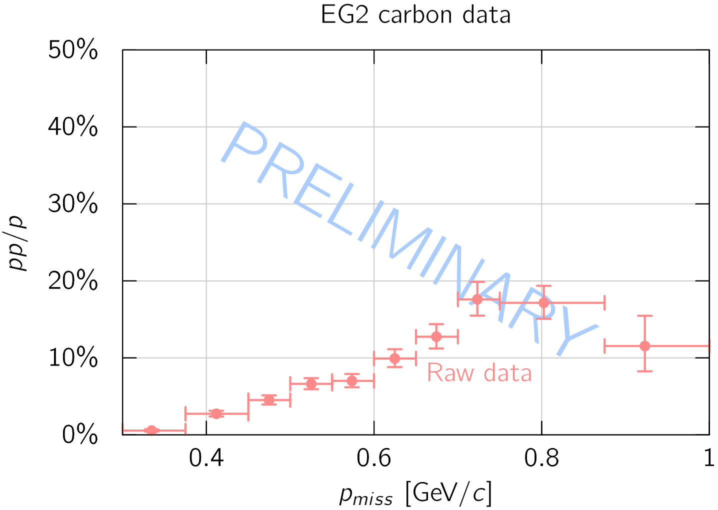


How many recoil protons go undetected?



We built a simple model for the pair center-of-mass motion.

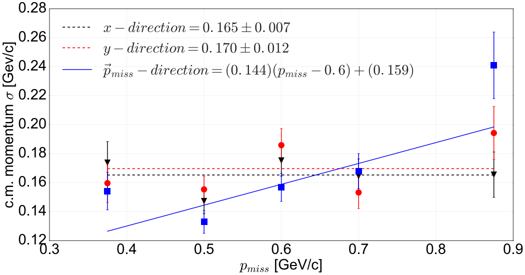
$\vec{p}_{CM}$ is described by a three-dimensional Gaussian.

Longitudinal to p_{miss}:

- Width: $\sigma_{\|} = \mathbf{a}_1(p_{\text{miss}} - 0.6 \text{ GeV}) + \mathbf{a}_2$
- Mean: $\mu_{\|} = \mathbf{b}_1(p_{\text{miss}} - 0.6 \text{ GeV}) + \mathbf{b}_2$

Transverse to p_{miss}:

- Width: $\boldsymbol{\sigma}_{\perp}$
- Mean: $\mu_{\perp} = 0$



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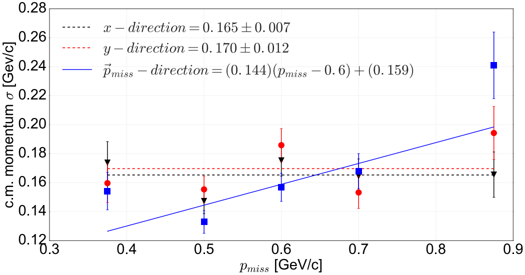
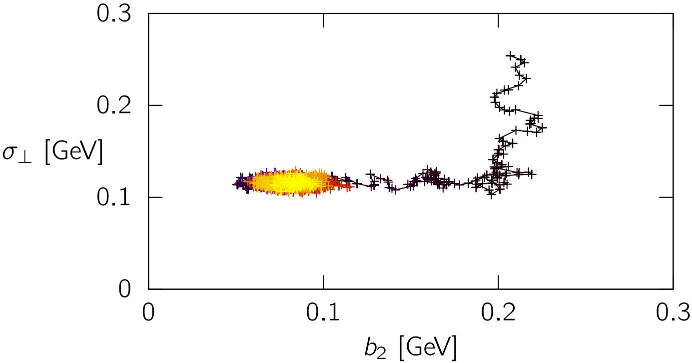
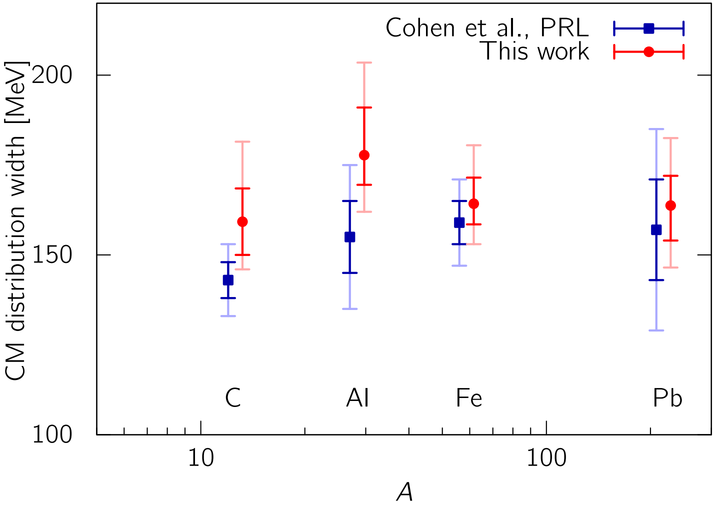


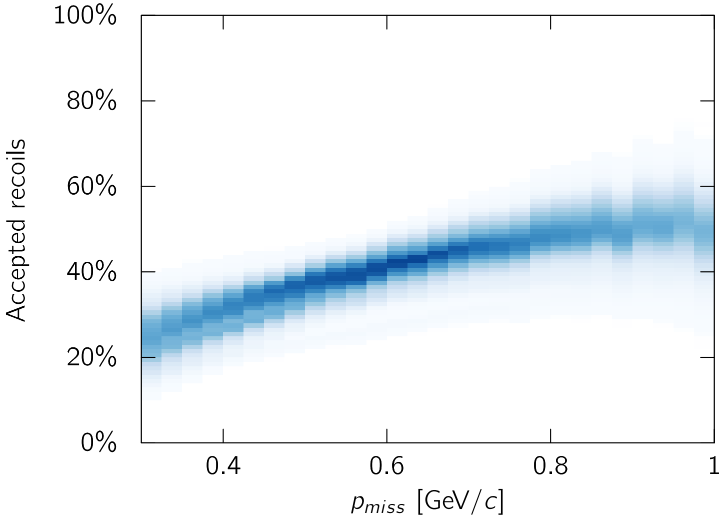
I used a Markov Chain MC to estimate the parameters, and the recoil acceptance.



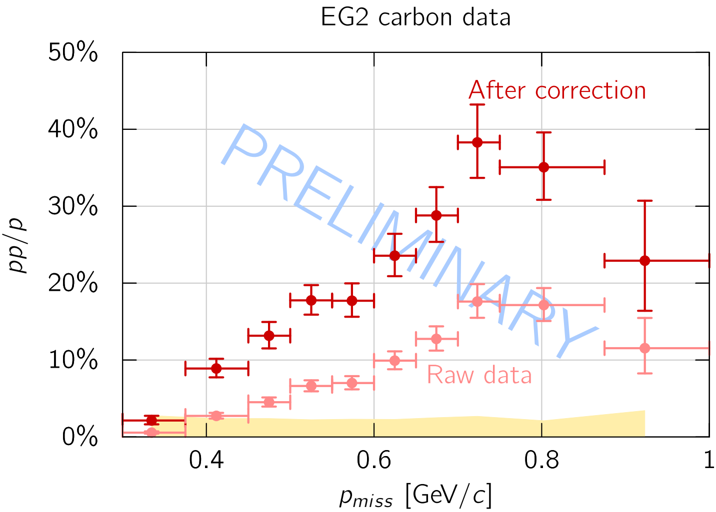
This method yields a similar estimate for σ_{CM}.



Each MC step predicts an acceptance factor.



I can apply a correction to the data.



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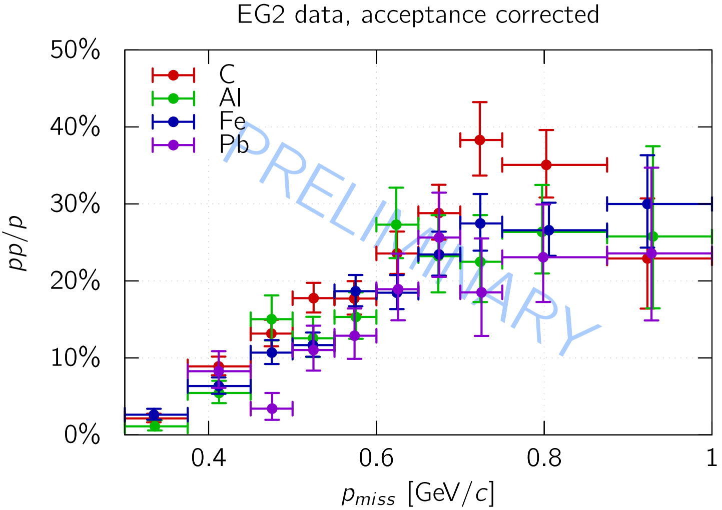

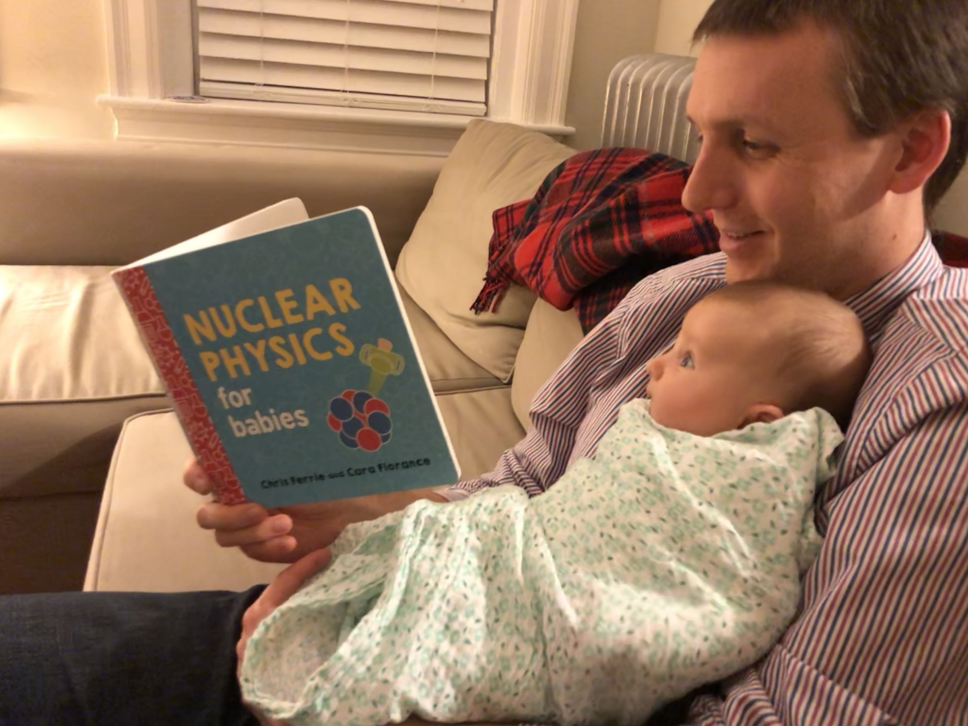
NUCLEAR PHYSICS for babies
Chris Ferrie and Cara Florance

What does the generator say?

- Simulating Carbon
- Contact values from Weiss et al. PLB (2018)
- Need to require $p_{rel} > 250$ MeV for numerical stability

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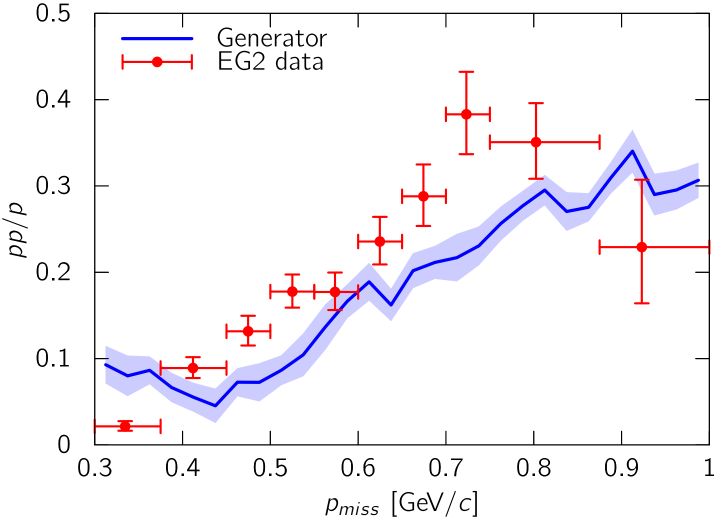

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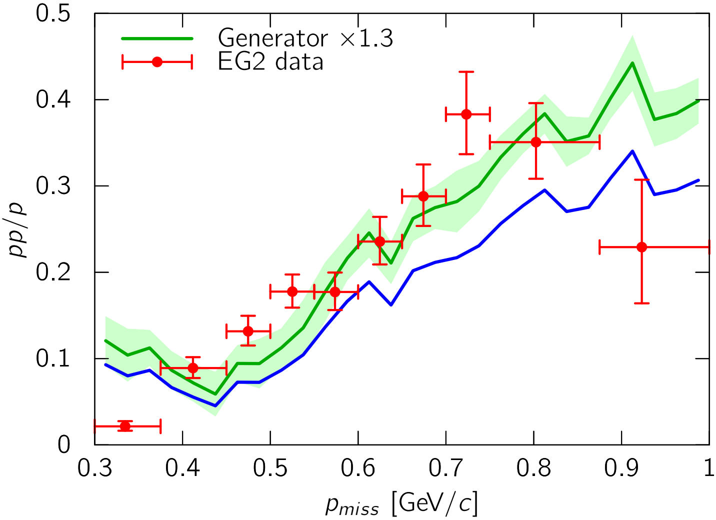

We can ask the question the other way around.

- Physics $\longleftarrow$ Data

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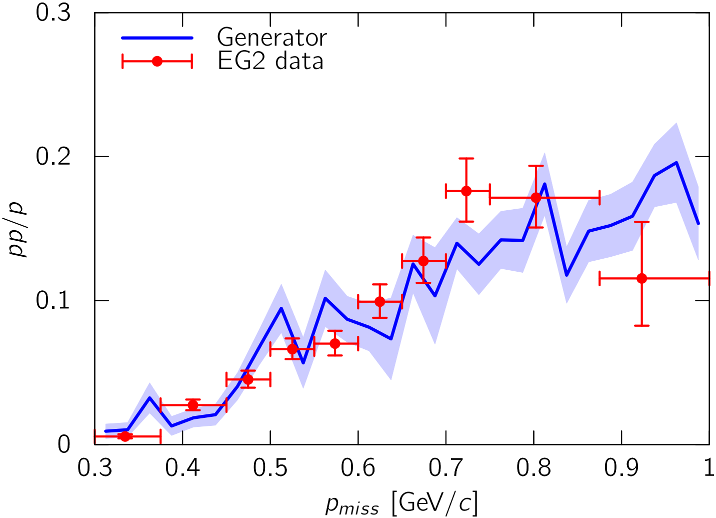
- Physics $\longrightarrow$ Data

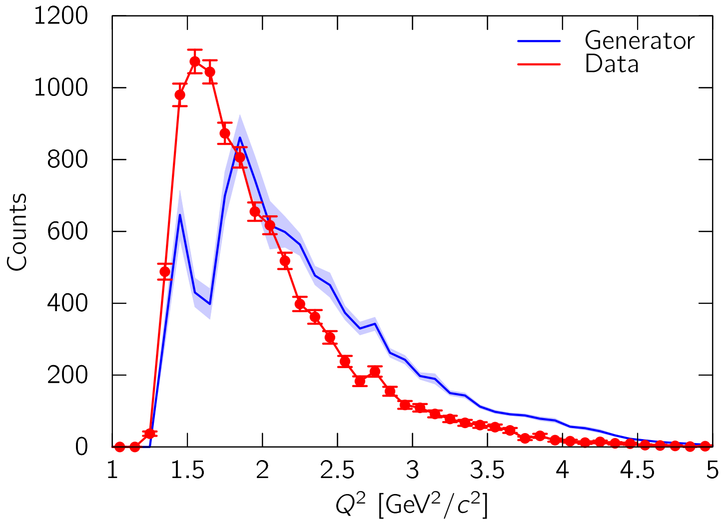
Does the generator explain the data we see?

- Single-charge exchange and transparency
- Detector acceptance (using map)
- Event selection cuts

The generator can explain the pp/p ratio we measure.



Kinematic distributions are well-reproduced.



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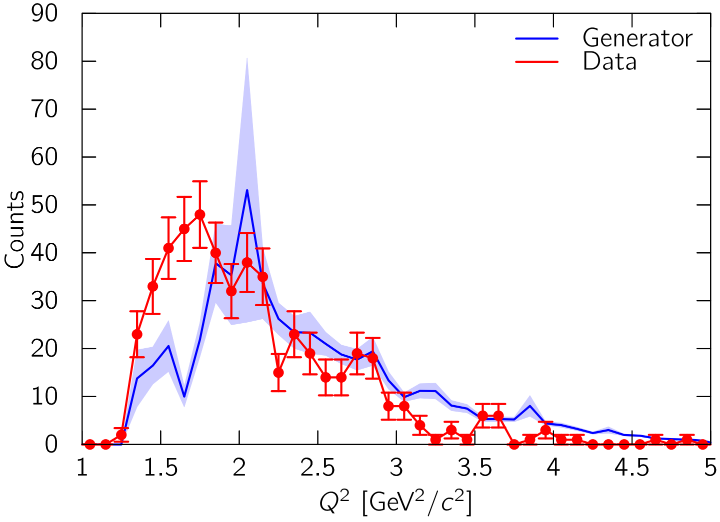

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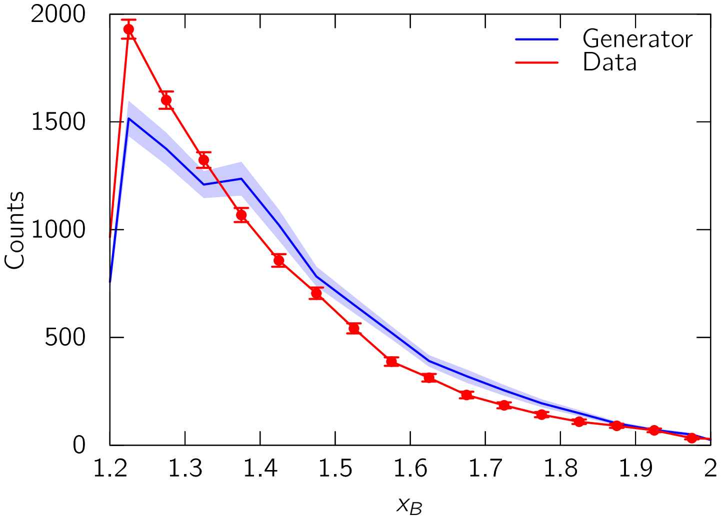

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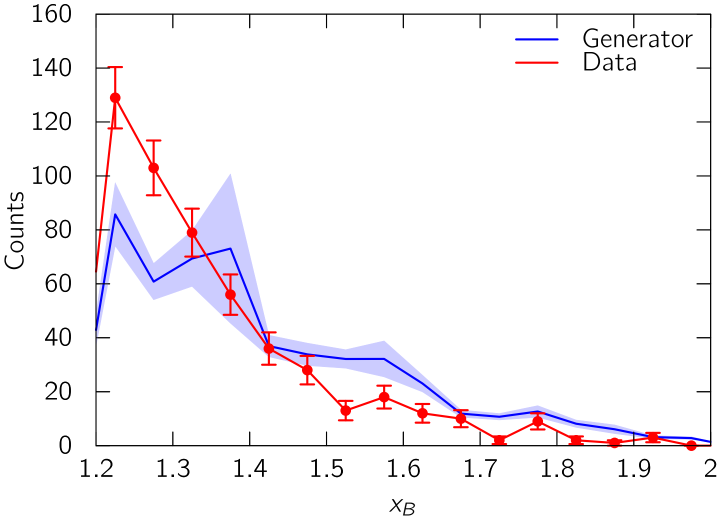

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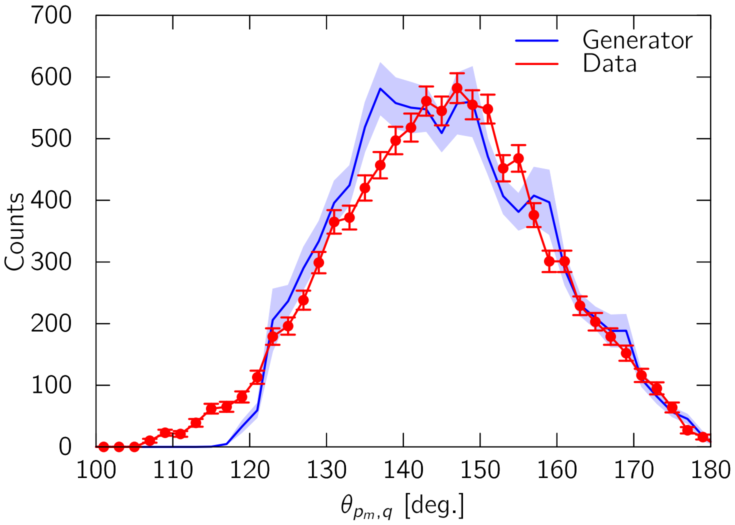

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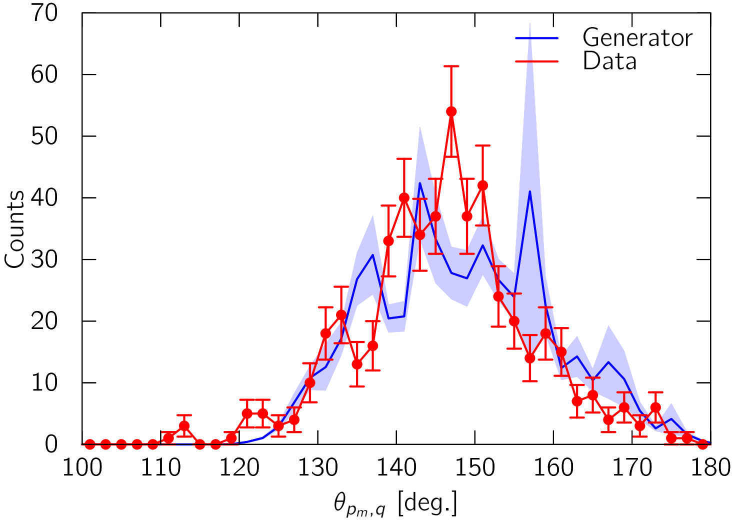

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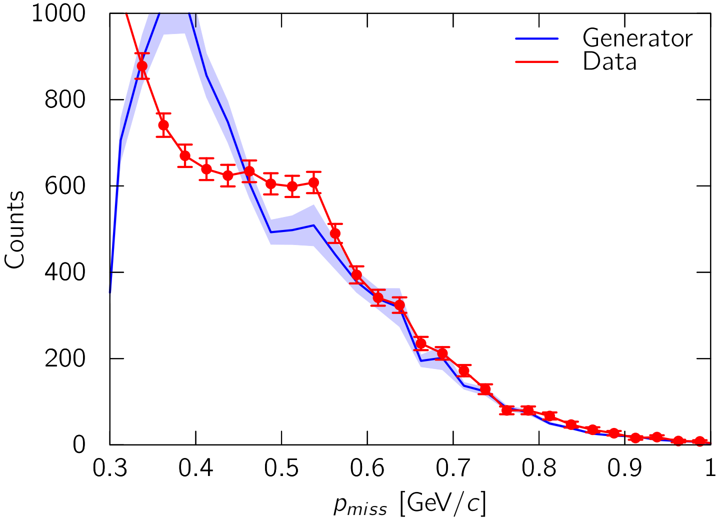

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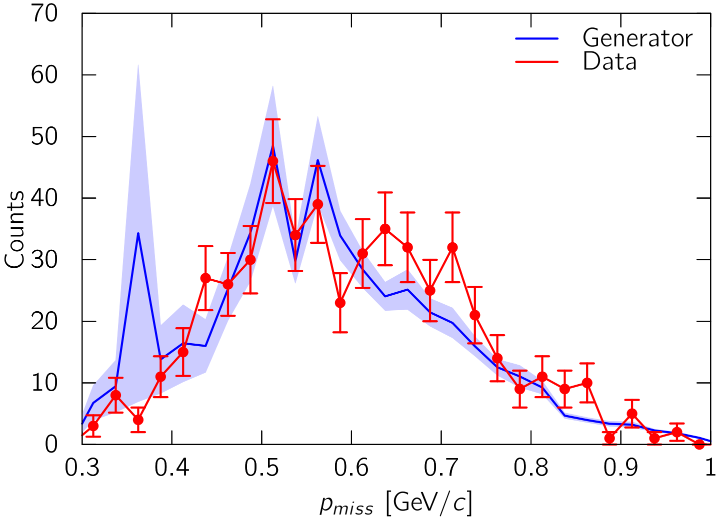
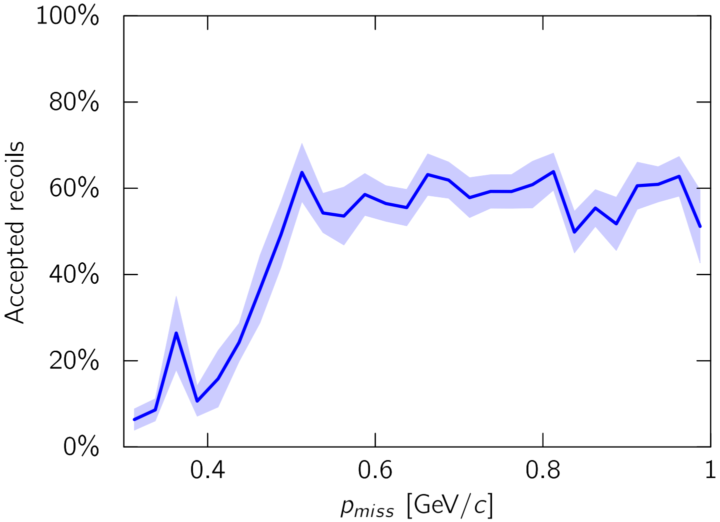


Comparison of recoil acceptance



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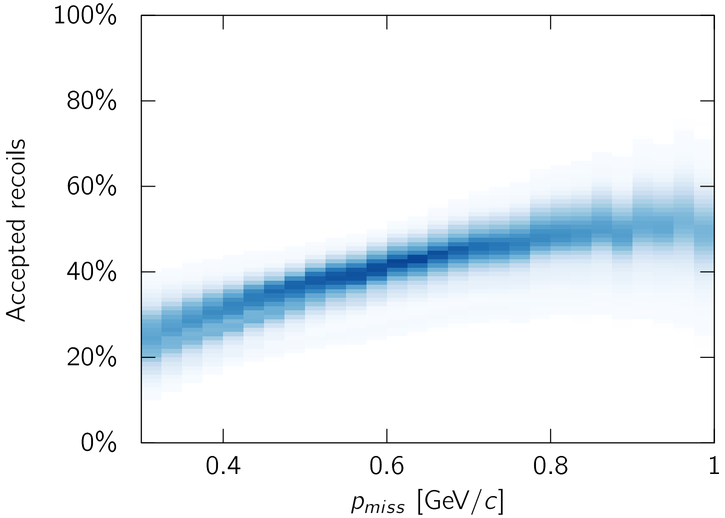

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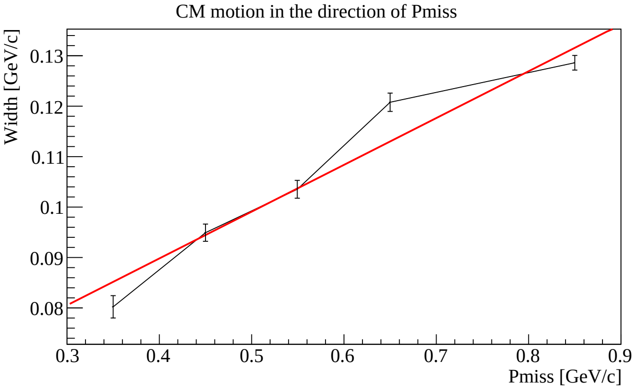

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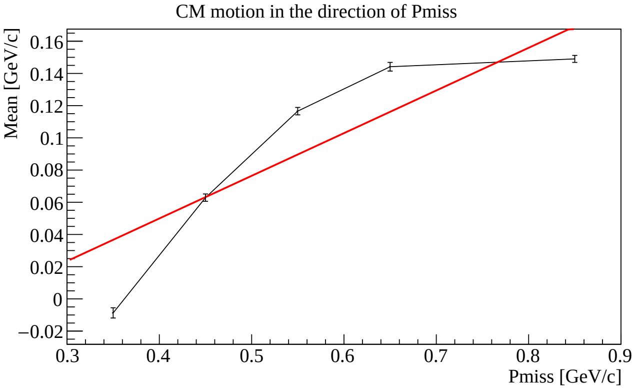

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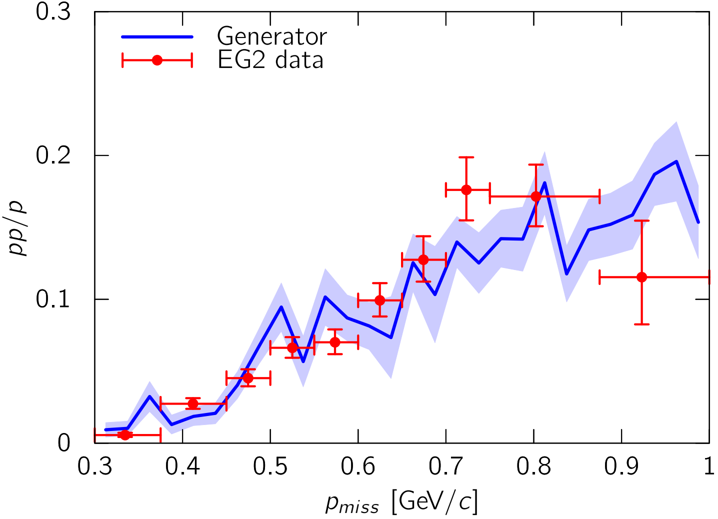

Summary

1. The p_{miss} evolution of pp/p probes the limits of tensor dominance.
2. Markov-Chain MC can infer how many protons were missed.
3. Alternately: the new SRC Generator can make contact with the data directly.