SRC Draft Report

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This is excellent work. The authors present a new method to measure single proton momentum distribution and to identify short range correlation pairs, in C12, free of initial or final state interactions. As such the results deserve to be granted the status of preliminary BM@N results.

However, on the technical or format side, the material presented is not really an Analysis Note. It is hard to follow the description of the experimental set-up and the analysis procedure when the material is split between the main text, the extended data material and the Supplemental Material. The text is well written but the split makes the reading not easy. On the content side, I find that many details are missing both on the description of the experiment and on the data analysis. I also find that some steps could be or should be improved in the analysis chain. In the following I present a list of questions and comments for the authors to consider (the line numbes refer to the version that I received on May 11):

L 4, 7, 16 and several other places: when you talk about distributions do you mean momentum distribution? Pls specify.

L 8: need a ref at the end of this sentence.

L 19: what is quasi-free inverse kinematics?

L 23: would 🡪 could?

L 28: factorization needs explanation

L 31: theoretical calculations or simulations?

 L 612: what is the interaction length of the hydrogen target?

L 998: what is the orientation of the X’ U’ and V’ planes?

L 1021: only 4 of the 8 coordinate planes are defined.

L 1083-4: It is more important and significant to know the momentum resolution with the liquid H2 target. In addition to Fig. 2, could you show also the C12 momentum resolution with the liquid H2 target?

L 1102: Can you show the distribution of minimum distance between the two proton tracks?

L 1111: Do I understand it properly that tracks are reconstructed in the two arms with two spatial points only and that all reconstructed tracks are assigned the proton mass in the momentum determination?

What is the momentum resolution of the proton arms?

L 779: How was the total reaction cross section determined? Or give a ref?

L 811-813: The Introduction speaks about ground state distributions. However, it is clear that the selected residual nuclear fragment is not necessarily in its ground state. You should quote the sigma value of the selected events in order to quantify the quasi-elasticity of the events.

L 827-828: What is the phi acceptance of the two proton arms? The distribution shown in Extended data Fig. 2c could just be an artifact of their limited acceptance?

L 880: you should quote the value of R as defined in eq. 4 with its statistical and systematic uncertainty. The latter is not at all discussed in the material presented. It should be estimated by a thorough study based on variations of the cuts that may affect differently the exclusive and inclusive reactions.

L 905: why the fragment attenuation factor was calculated at the center of the hydrogen target instead of performing a proper average over the entire target length?

L 209-216: What are the errors quoted in these numbers?

Where are the statistical errors and where are the systematic errors in these fractions? They should be quoted separately.

L 919-920: you should show the opening angle distributions for the four cases considered to justify the angular cut used.

Fig.4a needs more explanation: the scatter plot shows triangles of two kinds and squares and it is not clear from the figure caption what do they represent.

Extended data Fig.4a: the p\_miss > 350 MeV/c cut seems to miss most of the SRC yield. Can you better justify this cut? Or am I missing something?

Fractions of SRC events quoted at the end of the Extended data section:

-The variation of the opening angle cut by 1 deg seems very small.

-You should quote separately the statistical and systematic uncertainties.

-Some of the cut variations (for example the p\_miss cut) seem to have an asymmetric effect in the SRC yield. This should be reflected in asymmetric uncertainties in the SRC fractions.

- I suggest to make a table with the values of the fractions of SRC events obtained by the variation of each cut.

Some additional comments or missing information:

* Weakness of the analysis: the proton arms do not have real particle identification

capabilities and it is assumed that all reconstructed tracks are proton tracks. The analysis is lacking a full GEANT detector simulation of generated events. Such simulations would allow to determine the proton track reconstruction efficiency, the purity of the proton sample and the amount of background under the quantities measured. The addition of SRC pairs in the simulated events would also allow to determine the acceptance and reconstruction efficiencies of SRC pairs. This type of simulation would greatly enhance the value of the results and could pasve the way to allow the determination of absolute cross sections or probalbilites.

* What is the size of the beam or the beam profile?
* How many events were recorded?
* There is no QA analysis of the data recorded. How many events were analyzed?
* The systematic uncertainties should be analyzed and presented more thoroughly.
* How sensitive are the results to variations of the beta selection cuts on the proton tracks?
* Could you show the distributions of track multiplicities in the RPC and GEM detectors and their correlations i.e # of tracks in RPC vs. # of track in GEM.
* Fig. 1b: could you quote the relative abundances of 11B, 10B and 10Be?
* What would you get in Figs. 2b and 3a if instead of asking for a 11B fragment to be in coincidence with the two arms you ask for a 12C fragment?