PR12-25-003

The proposed experiment aims to investigate high-momentum (p~800 MeV/c) components of nucleons in the deuteron by measuring the d(e,e'p)n cross section at $Q^2=(4.5\ \mathrm{GeV/c})^2$. In order to study non-nucleonic components in deuteron, of which hint was found in the previous experiment in the same kinematics, this experiment measures the neutron angular (theta_nq) distribution to investigate the effect of FSI.

Comments and questions from the first reader:

(1) Please describe the difference between your previous Hall C experiment [14] and the proposed experiment. I understand that you will repeat the experiment with the same kinematics but with a wider angular coverage of theta_nq $=30^0$-80^0 to investigate the effect of FSI. What else are different? How much statistical improvement do you expect in the theta_nq $=30^0$-50^0 region? Please plot, in Fig.14, the data points of the previous experiment [14] at 35^0 and 45^0 for various p_m.

(2) Since this experiment is an extension of the previous one with the same setup, there seems to be no major problem in the feasibility and the systematic errors. Are there any concerns in using a higher beam current (80 μA) than before (45-60 μA), as mentioned in the TAC report? Are the target and DAQ systems the same as before? Please show us your possible concerns and/or expected improvement, if any, in the performance of the apparatus, DAQ, or the analysis, compared to the previous experiment.

(3) It is not very clear how well you will be able to understand and/or control the FSI by using the new data from this experiment.

In the proposal, you wrote "If it is due to the wave function then this experiment for the first time will establish the existence of non-nucleonic components in the deuteron.", but how and in which case can you establish the non-nucleonic components?

Based on Ref. [15], you hope to observe "angular anisotropy" as evidence for non-nucleonic components. FIG. 1 of Ref. [15] shows an anisotropic distribution falling down at forward and backward angles above 800 MeV/c. Although the definition of "angle" is different, I am afraid that it could be difficult to distinguish between the angular distribution from the FSI and the angular anisotropy due to exotics. Could you roughly draw in Fig.14 an expected angular distribution (in theta_nq) for the anisotropy due to exotics? (Although, of course, it will be done after the relativistic PWIA calculation by Sargsian is finished.) Will you need a wider coverage of theta_q and/or better statistics to confirm the angular anisotropy in future?

(If possible, please send me Ref.[1] because I cannot access it from my university. In addition, if possible, could you give an intuitive explanation on why angular anisotropy appears from non-nucleonic components at a relativistic regime? --It was hard for me to understand it from Ref.[15].)

(4) Similar comments to (3), but please show the positioning of this experiment and further experimental (and theoretical) plans or prospect toward your ultimate goal of unveiling exotic components.

Additional questions from the second reader:

(5) The TAC indicates that extra SHMS optics may be needed for the high momentum settings. Is there an effect on the team's simulations?

(6) The TAC report also comments that 80 microAmps of beam current might be challenging depending on the beam current going to Hall A. What percentage of beam intensity could be lost and still give results that the team considers impactful?

(7) In response to the PAC52 LOI on the same topic, the team was advised to revisit the kinematics simulations prior to a full proposal once the team's theoretical framework fully contains relativistic effects. We noticed that the data presented in Figures 13, 14, and 15 of the proposal are identical to the PAC52 LOI. We appreciate that the experimental team engaged in a new collaboration with S. Jeschonnek, who works on such models, and that long-time collaborator M. Sargsian continues to incorporate a relativistic deuteron wavefunction within the GEA using both the CD-Bonn and the AV18 potentials. We would be interested in a brief update on the progress towards obtaining such a theoretical framework and resulting kinematics simulations for high momenta.