FIU group's activities within the Data Mining Initiative

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FIU will work on several subjects within the data mining initiative.

- Large Q^2 electrodisintegration of the deuteron at large missing momenta

The CLAS collaboration has collected a substantial amount of data related to the electrodisintegration of the deuteron. Part of these data were used to study $d(e,e'p)n$ reactions in which the azimuthal angle of produced proton was integrated over. In addition, the data were integrated over a rather large kinematic region in Q^2 and in missing momenta. These integrations were justified in order to obtain enough statistics to study largest possible Q^2 kinematics[1].

We plan to re-analyze these and additional data available on deuteron electroproduction in order to survey possibilities of probing (a) very large missing momenta in this reaction, (b) to determine the azimuthal asymmetry of the electroproduction cross section and (c) to identify kinematic regions where contributions from final state interactions are minimal. Even though some of the expected results will suffer from low statistics we expect that they still will allow us to develop strategies to probe the core of the NN interaction in strongly correlated pn systems. This will also motivate the further research among the groups that presently work on theoretical models of high Q^2 electrodisintegration of the deuteron at large missing momenta[2, 3, 4, 5, 6, 7]. These results will be invaluable for designing new, high Q^2 experiments for the 11 GeV program.

- Exclusive electroproduction of resonances in $d(e,e'R)N$ reactions

We will use the existing data set to perform a first investigation of resonance electroproduction reactions in a kinematic regime where the eikonal approximation has been shown to be applicable. In this case the main idea is that isolating and amplifying the effect of the rescattering of the produced resonance off the spectator nucleon will create a new experimental situation in which the hadronic properties of this resonances are studied via the final state interaction. The analysis of [8] indicates that photo/electroproduction of the $N^*(1535)$ resonance in a kinematic setting that is dominated by the $N^*N \to N^*N$ re-interaction in the final state allows to discriminate between the constituent quark model and effective chiral Lagrangian calculations of the S_{11}. Hence we will first focus on the channel $\gamma^* + d \to N^*(1535) + N$. This will be followed by analysis of other channels like production of Δ isobar which are sensitive to the chiral dynamics at large Q^2.

- Photoproduction of two-baryons in large angle center of mass kinematics

These studies are will allow to extend JLab's program on hard photodisintegration reactions. JLab performed two main series of experiments on 90^0 photodisintegration of the deuteron[9, 10, 11, 12, 13, 14] and of proton pairs in ^3He[15].

For both systems energy scaling consistent to quark counting rule[16] has been observed for high energy photons ($>$ 1GeV for pn and $>$ 2Gev for pp pairs) consistent with quark-counting rules. Thus one expects that these reactions probe the hadron-quark transition in the nuclear medium (see e.g. [17, 18]).

The assumption that quark degrees of freedom are involved in these reactions allows one to also make specific predictions for the production of two baryons with different compositions (such as ΔN, $\Delta\Delta$, ΛKN etc.). We plan to perforce the first such study using available photodisintegration data obtained at CLAS.

-Physics event generators and universal Monte Carlo programs for studies of triple coincidence experiments

In the reactions in which resonances are probed one has to work with situations in which at least three particles have to be detected in the final state. We plan to develop event generators and Monte Carlo (MC) programs to simulate these triple (and higher order) coincidence experiments. The MC will be based on the generalized eikonal approximation[2] to propagate the particles through the nucleus, use our previous MC codes for break up of two nucleon correlations which successfully describes the current JLab and BNL data, and available theoretical models of baryon resonance electroproduction.

Comparing the result of MC calculations with available experimental data will allow us to make first steps in understanding of the dynamics of baryon resonance interactions at intermediate energies, probe non nucleonic degrees of freedom in light nuclei as well as to improved the MC codes that will be used extensively in future 11 GeV experiments.

References

[1] K. S. Egiyan *et al.* [the CLAS Collaboration], Phys. Rev. Lett. **98**, 262502 (2007).
[2] L. L. Frankfurt, M. M. Sargsian and M. I. Strikman, Phys. Rev. C **56**, 1124 (1997)
[3] J. M. Laget, Phys. Lett. B **609**, 49 (2005) [arXiv:nucl-th/0407072].
[4] S. Jeschonnek and J. W. Van Orden, Phys. Rev. C **78**, 014007 (2008)
[5] S. Jeschonnek and J. W. Van Orden, arXiv:0907.3712 [nucl-th].
[6] M. Alvioli, C. Ciofi degli Atti and L. P. Kaptari, arXiv:0904.4045 [nucl-th].
[7] M.M. Sargsian, Int. J. Mod. Phys. E **10**, 405 (2001) [arXiv:nucl-th/0110053].
[8] L. Frankfurt, M. Johnson, M. Sargsian, W. Weise and M. Strikman, Phys. Rev. C **60**, 055202 (1999)
[9] J. Napolitano *et al.*, Phys. Rev. Lett. **61**, 2530 (1988); S.J. Freedman *et al.*, Phys. Rev. **C48**, 1864 (1993).
[10] J.E. Belz *et al.*, Phys. Rev. Lett. **74**, 646 (1995).
[11] C. Bochna *et al.*, Phys. Rev. Lett. **81**, 4576 (1998).
[12] E.C. Schulte *et al.*, Phys. Rev. Lett. **87**, 102302 (2001).
[13] E. C. Schulte *et al.*, Phys. Rev. C **66**, 042201 (2002).
[14] M. Mirazita *et al.*[CLAS Collaboration], Phys. Rev. C **70**, 014005 (2004)
[15] I. Pomerantz *et al.*,"Hard Photodisintegration of a Proton Pair," arXiv:0908.2968 [nucl-ex].
[16] S.J. Brodsky and B.T. Chertok, Phys. Rev. Lett. **37**, 269 (1976).
[17] L.L. Frankfurt, J.A. Miller, M.M. Sargsian, M.I. Strikman, Phys. Rev. Lett. **84**, 3045 (2000).
[18] R. Gilman and F. Gross, J. Phys. G **28**, R37 (2002).