

SHORT DISTANCE STRUCTURE OF
NUCLEI:
MINING THE WEALTH OF EXISTING
JLAB DATA

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And a cast of thousands

Collaboration:

Spokespeople:

L.B. Weinstein, S.E. Kuhn, M. Strikman, M. Sargsian

Data Mining Scientist: G. Gavalian (now at JLab)

Institutions:

ODU, Penn State, Florida International, Tel Aviv, MIT, Glasgow,
Canisius, UTFSM (Valparaiso), William and Mary, Edinburgh,
Ohio State, New Hampshire, Richmond, George Washington,
Mississippi State, [Your Name Here](#)

Support:

DOE Grant for the Data Mining Scientist plus travel 2011-2014
ODU computer support

Why Data Mining?

- Build on the progress made at JLab on Short Range Correlations (SRC) and dynamics of interactions with nuclei at medium Q^2
- Take advantage of the huge CLAS data set
 - Mostly taken with $A(e,e')$ inclusive trigger
- Take advantage of the otherwise “wasted” time while we upgrade JLab to 12 GeV

Project Outline

- Collect **all** CLAS nuclear target data in one place with **one** interface
- Provide **easy** access to this data set to participating universities.
- Provide **universal** analysis tools for all data sets (data selection, momentum corrections, fiducial cuts) as developed and approved by the CLAS Collaboration.
- Provide easy framework for combining data from different data sets.
- Provide SOA based multi-process analysis.

Data Sets with inclusive triggers

Run Period	Beam	Energy (GeV)	Targets
E2a	e	2.2, 4.4	^3He , ^4He , C, Fe
E2b*	e	1.1, 4.5, 4.7	^3He , Fe
EG2*	e	4.0, 4.7, 5.0	^2H and (C, Al, Fe, ^{120}Sn , or Pb)
G8	gamma	<3.1, <4.0	^2H , C, Ti, Fe, Pb
E6*	e	5.77	^2H
EG1a,b	e	1.6 to 5.7	Polarized NH_3 , ND_3 , C
E5	e	2.56, 4.23	^1H and ^2H
E1e	e	2.04	^2H
EG3	gamma	<5.76	^2H
E8 (BoNuS)	e	1.1, 2.2, 4.3, 5.4	^1H , ^2H , ^4He

* Fully or partially implemented

2013-2014 Progress

- “Momentum sharing in imbalanced Fermi systems”, O. Hen *et al.*, submitted to Science, May 29, 2014
- Related papers:
 - “The Nuclear Contact Exists”, O. Hen *et al.*, submitted to PRL, August 2014
 - “Kinetic symmetry energy of nucleonic matter with tensor correlations”, O. Hen *et al.*, arXiv:1408.0772, submitted to PRL, August 2014
- Lots of talks
- New Data Mining grant proposal submitted to DOE, May 1, 2014
- Gagik Gavalian hired by JLab for reconstruction software
 - Aligning CLAS12 and data mining software
- Mississippi State U (Lamiaa El Fasi and Krishna Adhikari) join collaboration

Software Progress

- Gagik Gavalian hired by JLab to (initially) lead the CLAS software reconstruction
 - Gagik still responsible for data mining software, but has no time to work on it himself
- CLARA is now V4.0
- Data mining software converging with CLAS12
 - Will make code maintenance much easier
 - Data temporarily unavailable
 - Need to reskim data mining data for new format
 - Need to update the data mining software
 - Need to implement more cuts and corrections
- Volunteers?

Data Mining Analyses, August 2014

- ◆ SRC Proton Transparency: Or Hen (Tel Aviv), PL B 772 (2013) 63
- ◆ “Momentum sharing in imbalanced Fermi systems”, Or Hen, submitted to Science
- ◆ Deltas in deuterium, Andrew MacClintock (ODU senior thesis, 2013)
- ◆ Mean Field Proton Transparency: Or Hen (Tel Aviv), under CLAS review
- ◆ pp pair momentum distributions, Or Hen (Tel Aviv), under CLAS review
- ◆ Double Spin asymmetry in $d(e,e'p)n$, Mike Mayer (ODU), under CLAS review
- ◆ EMC and SRC, Barak Schmookler (MIT)
- ◆ $d(e,e'p)$ and $(e,e'n)$, M Braverman (Tel Aviv)
- ◆ Many proton knockout from nuclei to explore the potential to reach r -process path below 208Pb, Dan Watts (Edinburgh)
- ◆ ${}^3\text{He}(e,e'n)/(e,e'p)$, Mariana Kachatryan (ODU)
- ◆ p - and n - momentum distributions in asymmetric nuclei, Tel Aviv
- ◆ Hadronization in semi-inclusive DIS, H. Hakobyan (UTFSM)
- ◆ Omega hadronization in nuclei, M. Wood (Canisius)

Data mining summary

- ◆ Data mining software works well
 - ◆ Allows easy access to data, especially for non-experts
 - ◆ Allows archiving of data and analysis tools for future use
 - ◆ Still needs work
- ◆ Lots of fascinating analyses in progress
- ◆ Lots more physics topics and data available
- ◆ New papers
- ◆ New grant proposal under review (decision mid-Fall?)
- ◆ New data miners (welcome Mississippi State!)
- ◆ New topics (neutrino-related reactions)