

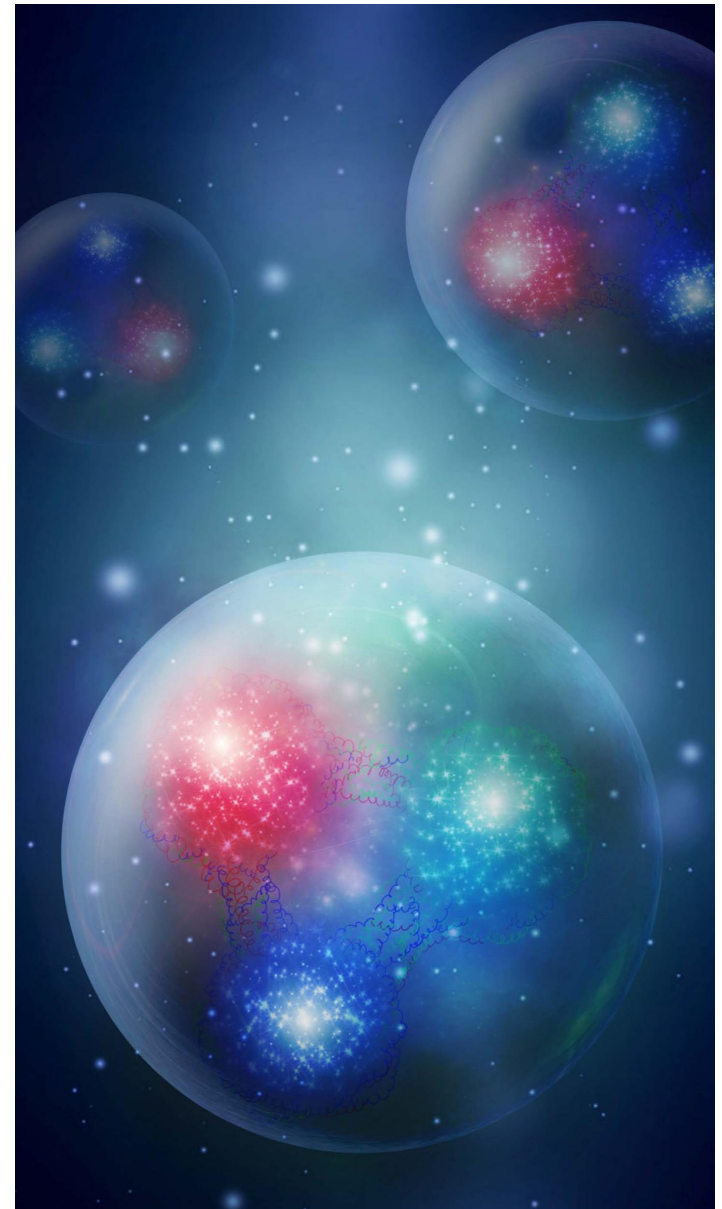
Jefferson Lab User Group Board of Directors Visit

May 30, 2017

Larry Weinstein, Krishna Kumar,
Nadia Fomin and Charles Hyde

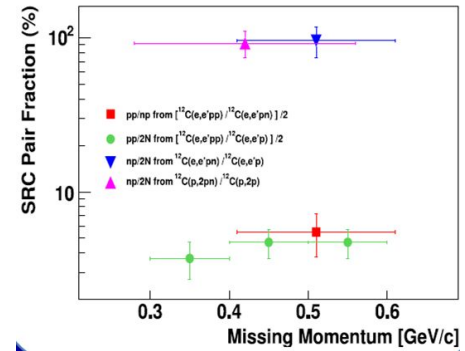
Exciting 12 GeV Physics Questions

- What is the role of glue in the spectroscopy of light mesons?
How is this related to quark confinement?
- Where is the nucleon missing spin?
Is there significant quark and/or gluon orbital angular momentum?
- What surprises will we find from 3D femtometer-scale imaging of the nucleon?
- What is the relationship between short range NN correlations and the QCD structure of nuclei?
- Can we discover evidence for physics beyond the standard model?

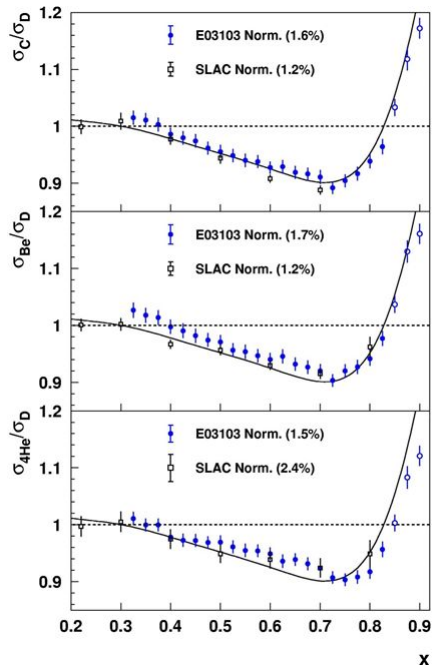


Short Range Correlations and EMC effect

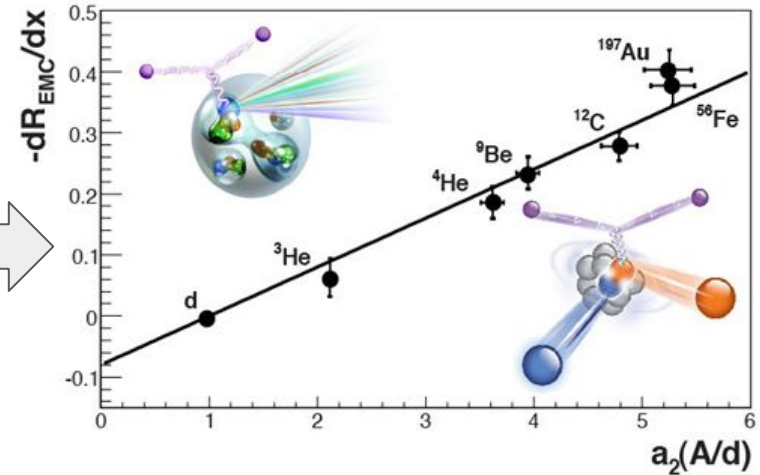
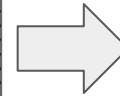
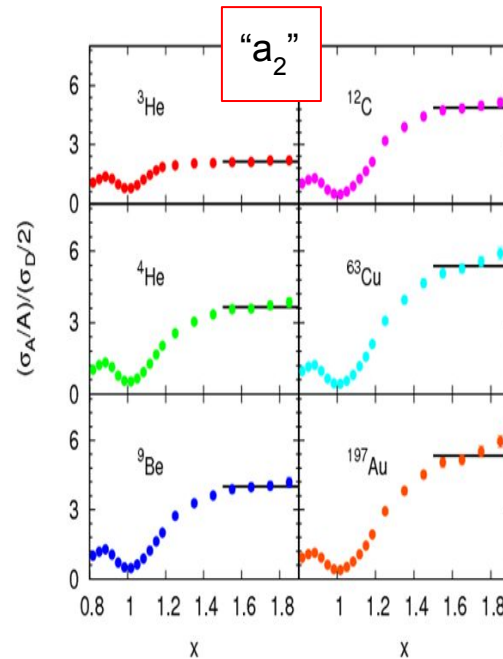
- How does the nucleus arise from QCD?
- How do short range correlated pairs form?
- How are nucleons modified in the nucleus?
 - How is this related to SRC pairing?
- Are 3N correlations measurable?



Many 12 GeV (e,e'), (e,e'N), (e,e'N_S), (e,e'pN) experiments!

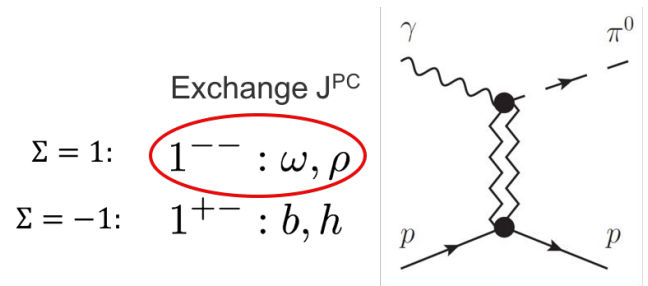
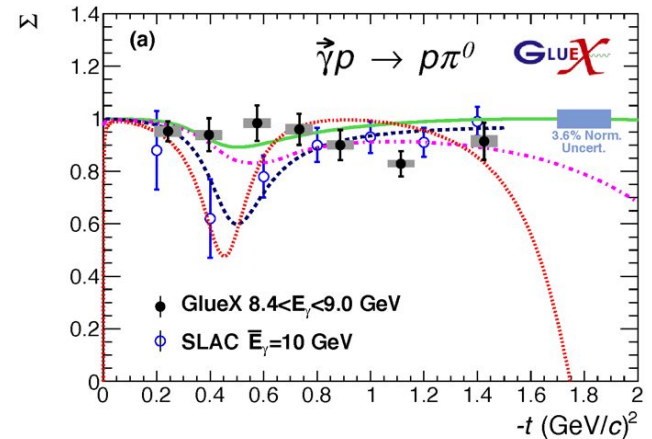


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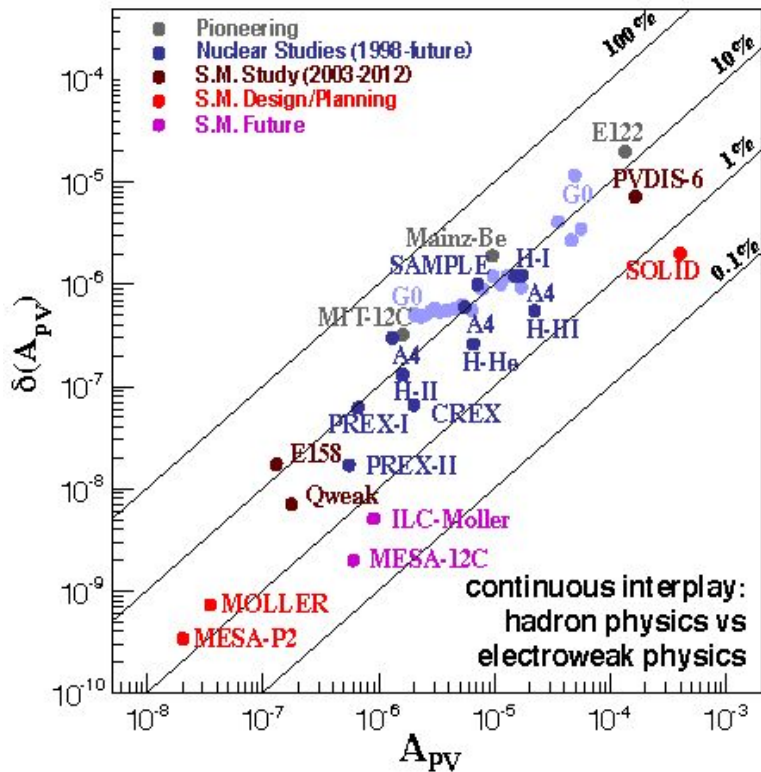
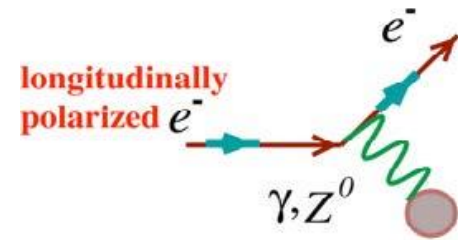
GLUEX in Hall D

- First 12 GeV results from JLab use polarized photon beam to shed light on meson photoproduction mechanisms.
- Azimuthal production asymmetry from two orthogonal beam polarizations
 - Important constraint for low energy baryon production
 - Results for other pseudoscalar mesons to follow
- GlueX physics program is underway
 - Systematic strategy to enhance analysis complexity as understanding of the detector improves
 - On the path to doing core hadron spectroscopy program
- Successful Spring 2017 run
 - 46 billion triggers: 900 TB of data
 - Flux: $2.5 \cdot 10^7$ γ /s in 8.2 - 8.8 GeV polarization peak
 - Max trigger rate: 55 kHz (about 900 MB/s)
 - 7x engineering run that produced first publication
 - 20% of initial physics run allocated by PAC



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Parity-Violating Electron Scattering



Steady Improvements in JLab polarized source, accelerator, and detector technology

State of the Art

$\leq 1:10^9$

Statistical reach and systematics control.

$\leq 1\%$

Normalization precision

6 GeV Era (previous decade):

- PREX-I result: first electroweak measurement of neutron skin of a heavy nucleus: 200+ citations
- PVDIS result on axial-quark couplings published in Nature
- Successful Qweak:
 - result unblinded,
 - publication and high profile conference talks in preparation

12 GeV Era (next decade):

- Nuclear physics community eagerly awaits results from PREX-II and CREX
- MOLLER CD-0: broad interest within Fundamental Symmetries and related fields for this unique search for physics beyond the Standard Model
- SoLID: unique next generation PVDIS measurement also enabling broad SIDIS program

Enthusiastic and Growing User Group

- 1530 Users, 543 International Users [FY16]
 - Up from 1270 Users at the peak of the 6 GeV era
 - Domestic and foreign growth
 - Shows strong interest in the 12 GeV program!
 - Largest user group among U.S. nuclear physics labs



12 GeV Science Era is ramping up

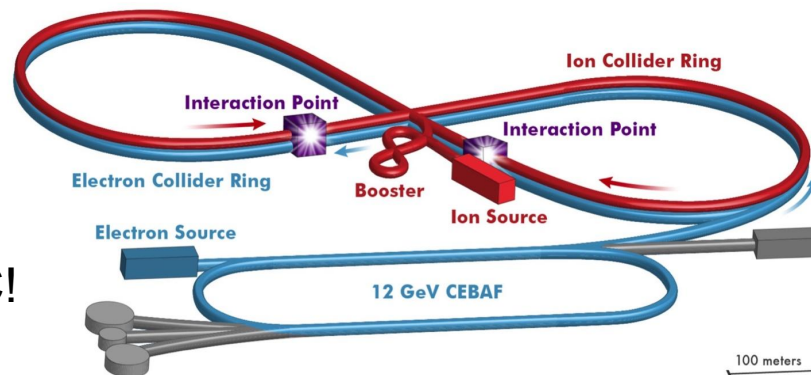
- Hall Status
 - Halls A and D are running physics
 - Halls B and C have completed KPP and will start commissioning and physics in Fall 2017
- 12 GeV will probe a variety of physics topics (not just more beam hours)
 - DISCOVERY POTENTIAL
- Breadth of Physics output far greater at 35 weeks/year as opposed to the current 16 weeks/year
 - More topics, not just more statistics
- Backlog of students, postdocs, and faculty ready to run
 - Years of detector and analysis prep work

Jefferson Lab User Group - Concerns

- **Operations Funding - ability to do physics**
 - Continuing resolution adversely affected transition from construction to operations
 - FY18 budget is the first *real* budget for 12 GeV running - sets precedent
 - 34.5 weeks of running during 2001-2012 at 6 GeV
 - Average cost/week goes down with longer running
- **Decline of Lab resources**
 - Harder to mount and support experiments
- **Impact on morale and lack of confidence in the future**
 - Training students
 - Shuffling to available experiments rather than those university groups are dedicated to
 - Significant delays - costs to keep students waiting
 - University faculty
 - Reduced operations impact productivity and ability to obtain tenure
 - Low productivity impacts ability to renew research grants
 - Difficult to retain Jlab-oriented faculty lines after retirements

Electron Ion Collider

- Jlab community is enthusiastic for the EIC!
 - >45 Experimental groups in EIC Users Group
 - Workshops, Users collaborating on JLab LDRD projects
- Strong support for the specific features of the JLEIC concept
 - Polarized Deuterons; Maximal luminosity; Full acceptance from positive to negative beam rapidity; Paths to energy upgrades
 - Strong interest in expanded participation in Detector and Accelerator R&D
 - >8 user groups active in detailed design of JLEIC Full Acceptance Detector.
- Perception in international community that there's unequal treatment of labs
 - More detector & accelerator R&D funding goes to RHIC
 - RHIC/BNL administers R&D funds for EIC - already "in charge" of EIC



User Group Board Request:

- JLab funding to restore operations to 35 weeks/year of running
 - Maximize breadth of physics output and discovery potential of a new facility
 - Support careers of graduate students, postdocs, young faculty
 - FY18 sets the precedent for subsequent years
 - Difficult to improve if we start with 16 weeks/yr
- Strengthen research budget to support user groups at JLab

Time to reap the benefits of the 12 GeV upgrade, the large DoE and user investments, and the user group enthusiasm!