Towards improved hadron femtography with hard exclusive reactions 2023

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Jefferson Laboratory Hall A

U.S. DEPARTMENT OF ENERGY | Office of Science

Jefferson Lab
Thomas Jefferson National Accelerator Facility

JSA

Modern hadronic structure

- Hadronic structure through Deep Inelastic Scattering (1950s) : nucleons made of quarks and gluons
- Spin crisis : spin of nucleon not simply spin of valence quarks
- Nucleon is a dynamic system, raises many questions
  - Mass repartition
  - Motion of quarks and gluons inside nucleons : quark orbital momentum

New formalism and measurements

- GPDs : exclusive reactions (DVCS, DVMP)
  - Generalization of concept of parton distributions and form factor
- TMDs : semi-inclusive reactions
  - Transvere Momentum Distributions in Nucleon
- J/ψ at threshold gives access to gluons

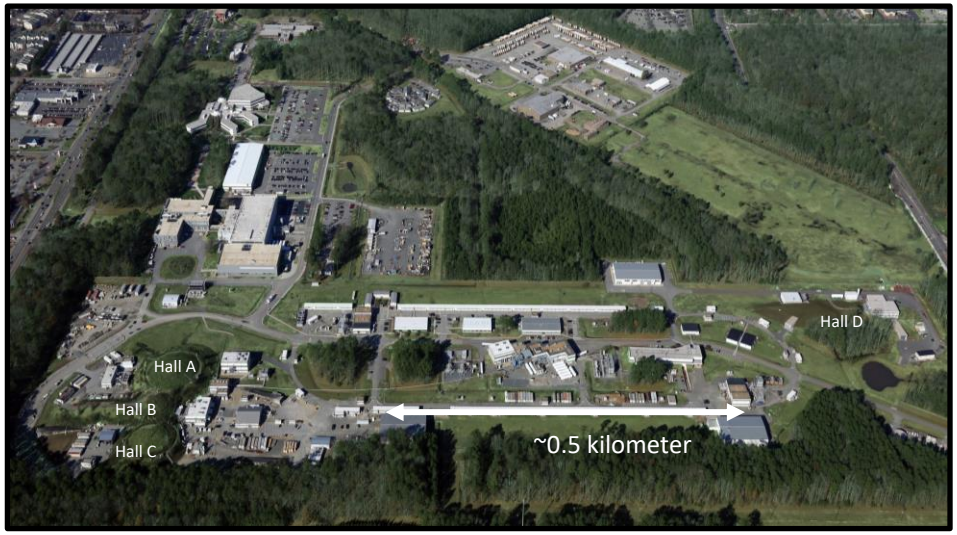
- Form factors and DIS measurements also contributes to GPDs (limit cases)

Workshop goal

- Discussion about how to access GPDs
- Which processes in addition to DVCS can contribute the most to the GPDs extraction
- Future measurements and upgrade
  - EIC, positron, 22 GeV

Overview of Jefferson Lab

Created to build and operate the Continuous Electron Beam Accelerator Facility (CEBAF), world-unique user facility for Nuclear Physics



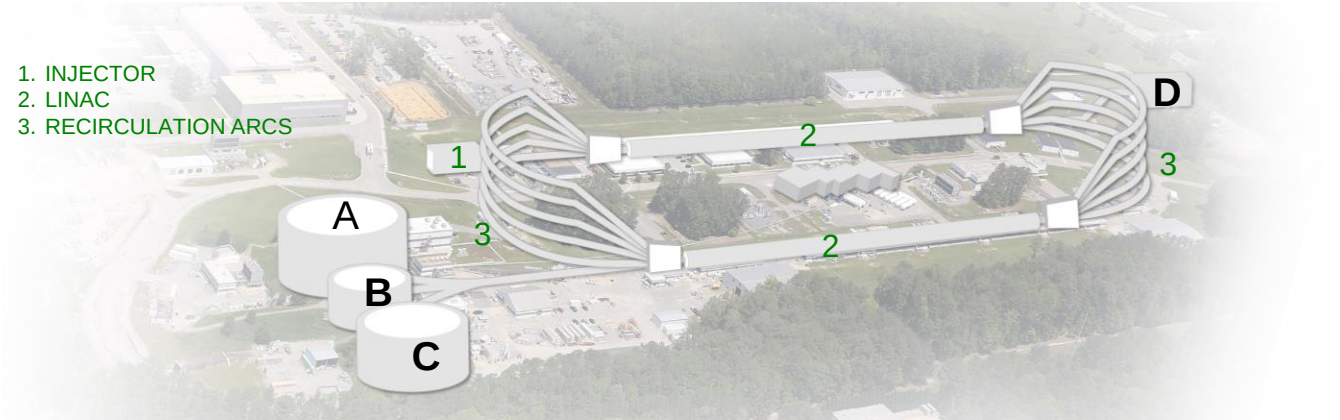
Jefferson Lab Stats:

- Located in Newport News, Virginia
- 169 acre site
- In operation since 1995
- ~700 employees
- 1,694 Active Users (FY21)
- 1/3 of Users are from non-US Institutions, from 37 countries
- >650 PhDs granted to-date
- On average 30% of US PhDs in nuclear physics
- FY2016 Costs: $184.1M (~2/3 operations, ~1/3 new construction)

- What is the role of gluonic excitations in the spectroscopy of light mesons? Can these excitations elucidate the origin of confinement?
- **Can we reveal a novel landscape of nucleon and nuclear substructure through measurements of new multidimensional distribution functions?**
- Can we discover evidence for new physics beyond the Standard Model?

Jefferson Lab

CEBAF at Jefferson Lab



- CEBAF Upgrade completed in September 2017
  - CW electron beam
  - E_{max} = 12 GeV
  - I_{max} = 90 μA
  - Pol_{max} = 90%
- Commissioning:
  - April 2014: hall A
  - October 2014: hall D
  - February/March 2017: halls C & B

CEBAF World-leading Capabilities

- Nuclear experiments at ultra-high luminosities, up to 10^{39} electrons-nucleons /cm^2/ s
- World-record polarized electron beams
- Highest intensity tagged photon beam at 9 GeV
- Ability to deliver a range of beam energies and currents to multiple experimental halls simultaneously
- Unprecedented stability and control of beam properties under helicity reversal

Jefferson Lab

Jefferson Lab's Science and Technology Vision

Experimental Nuclear Physics at CEBAF

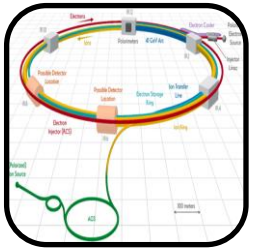
CEBAF operation at > 30 weeks/yr supporting 1,700 annual users

Nuclear Physics research

MOLLER Project

SoLID Proposal

Future upgrade opportunities



Electron-Ion Collider

EIC Project Partnership with BNL

Engagement/leadership in EIC scientific program

Technology Development

Accelerator component production for DOE/SC projects

R&D in superconducting accelerators, detectors, isotopes

Advanced Computing

Vision for world-leading computational program

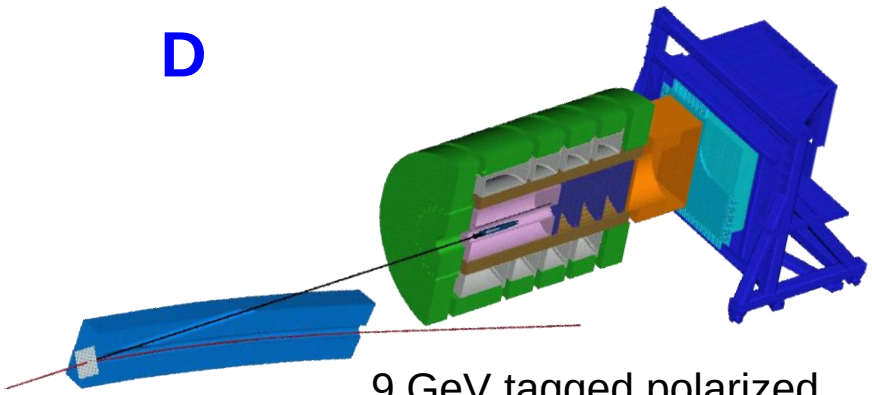
Growth in data science, artificial intelligence, quantum computing research

Exploring potential in close coordination with Office of Science

Nuclear Physics spans the whole program at Jefferson Lab

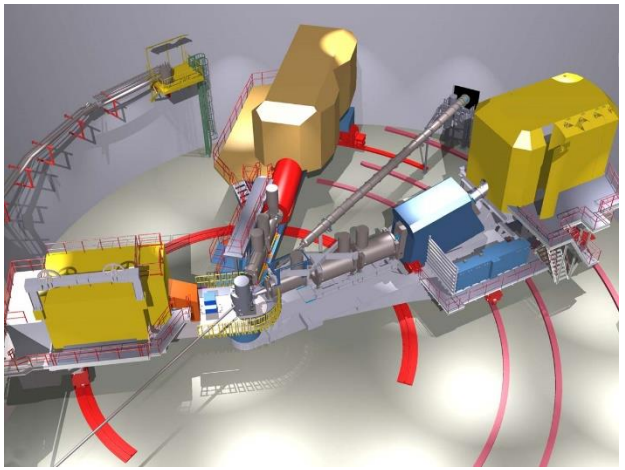
JLab 12GeV experimental halls

D



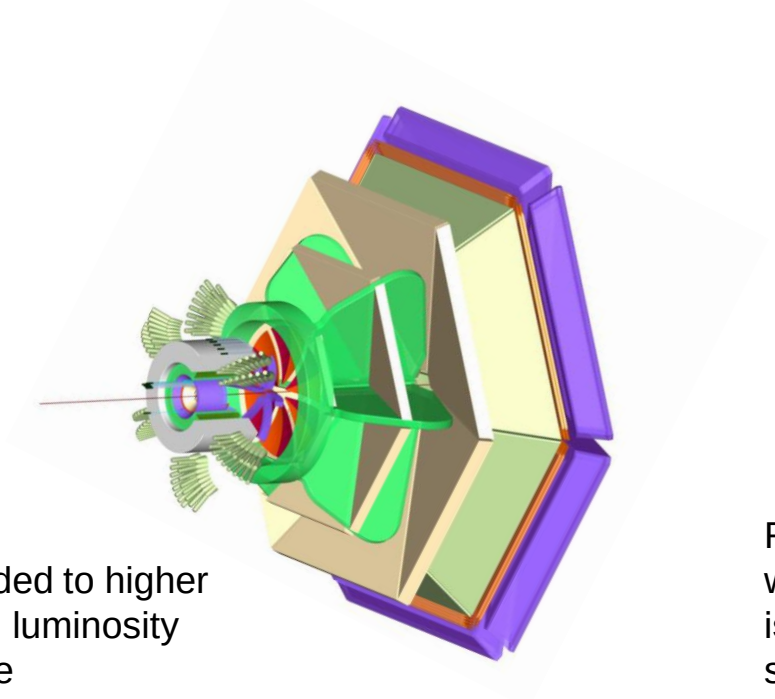
9 GeV tagged polarized photons and a 4π hermetic detector

C



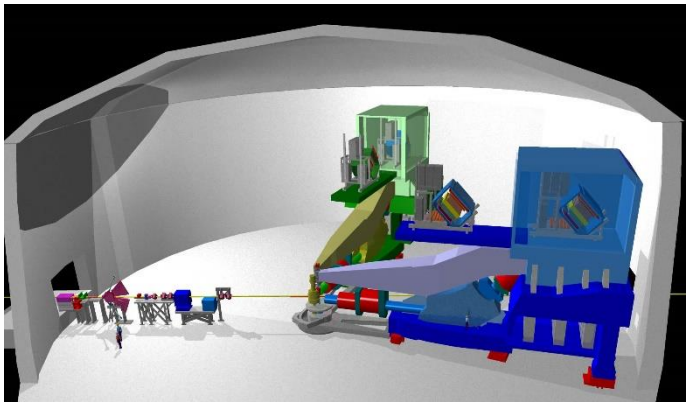
Super High Momentum Spectrometer (SHMS) at high luminosity and forward angles

B



CLAS upgraded to higher (10^{35} $cm^{-2}s^{-1}$) luminosity and coverage

A



Retain HRS Pair for continuation of research in which resolution comparable to nuclear level spacing is essential. Use Hall to stage “one-of-a-kind” specialized experiments requiring unique apparatus.

Sessions

- Experimental facilities and new experiments
- Theory / phenomenology
- Compton-like reactions
- Meson structure
- Hard exclusive meson production
- Transition GPDs
- Theoretical activities and centers / new theory idea and future facilities
- Polarized targets and new observables

Please fill the google form for dinner at Crab Shack Wednesday

https://docs.google.com/forms/d/e/1FAIpQLScMcw9JPBPerLEXYXx-MvyjFvHvUoBCpXLrKnizQN

(if you did, you are fine)

Contact us if you have extra guests

Fill the form also for Wednesday social (4 PM - evening)

https://docs.google.com/forms/d/e/1FAIpQLScpdBoLnpiomIs69f1S_UAlCQK9wu0fyzsyRQqYaK

- museum (4-5 PM)

- trail along the beach
or trail in the park
(time TBD)

- beach (anytime)

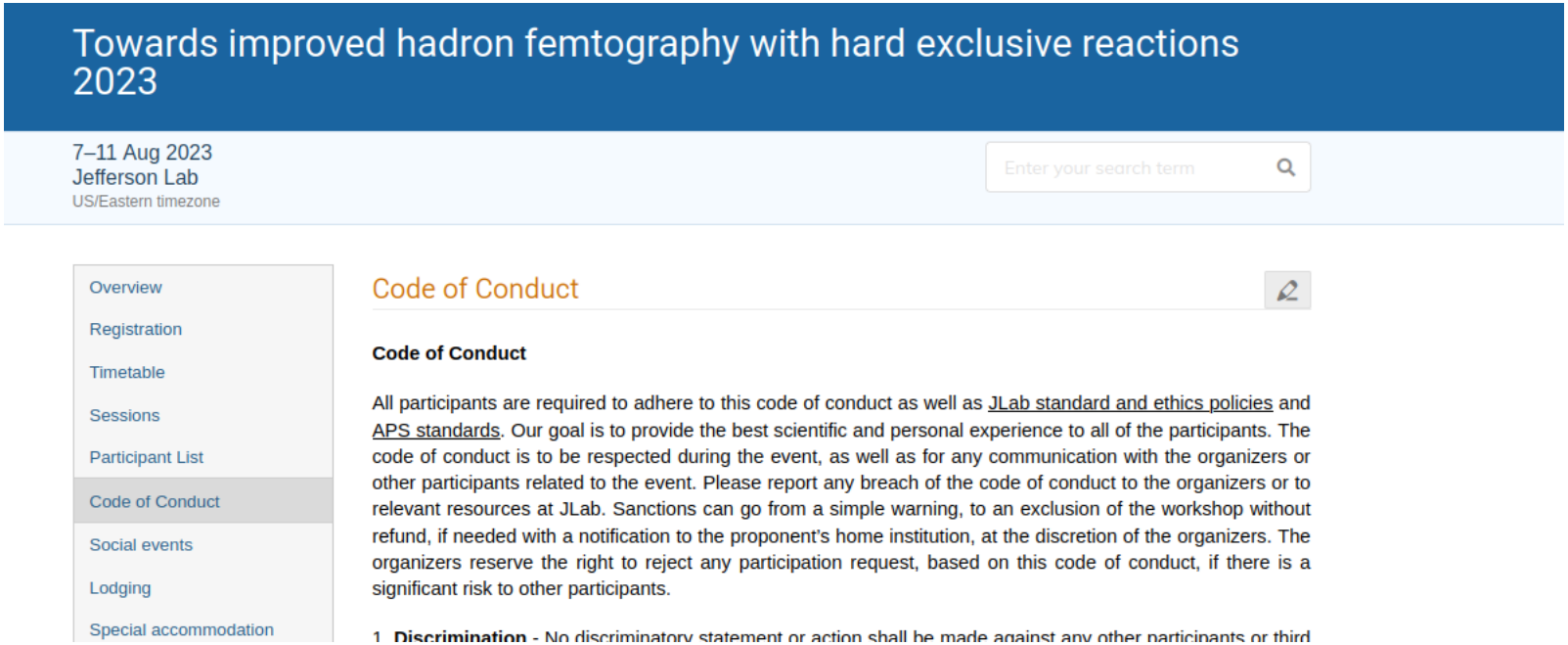
- picnic (after 7 PM)

- other: let us know

Code of conduct

https://indico.phys.vt.edu/event/58/page/46-code-of-conduct

- Not to annoy anyone, but to protect us and ensure that we all get a good experience out of this event
- If you are here: you read and all agreed to follow it



Please register if you aren't yet!

https://indico.phys.vt.edu/event/58/registrations/28/

Networking session tonight at Residence facility