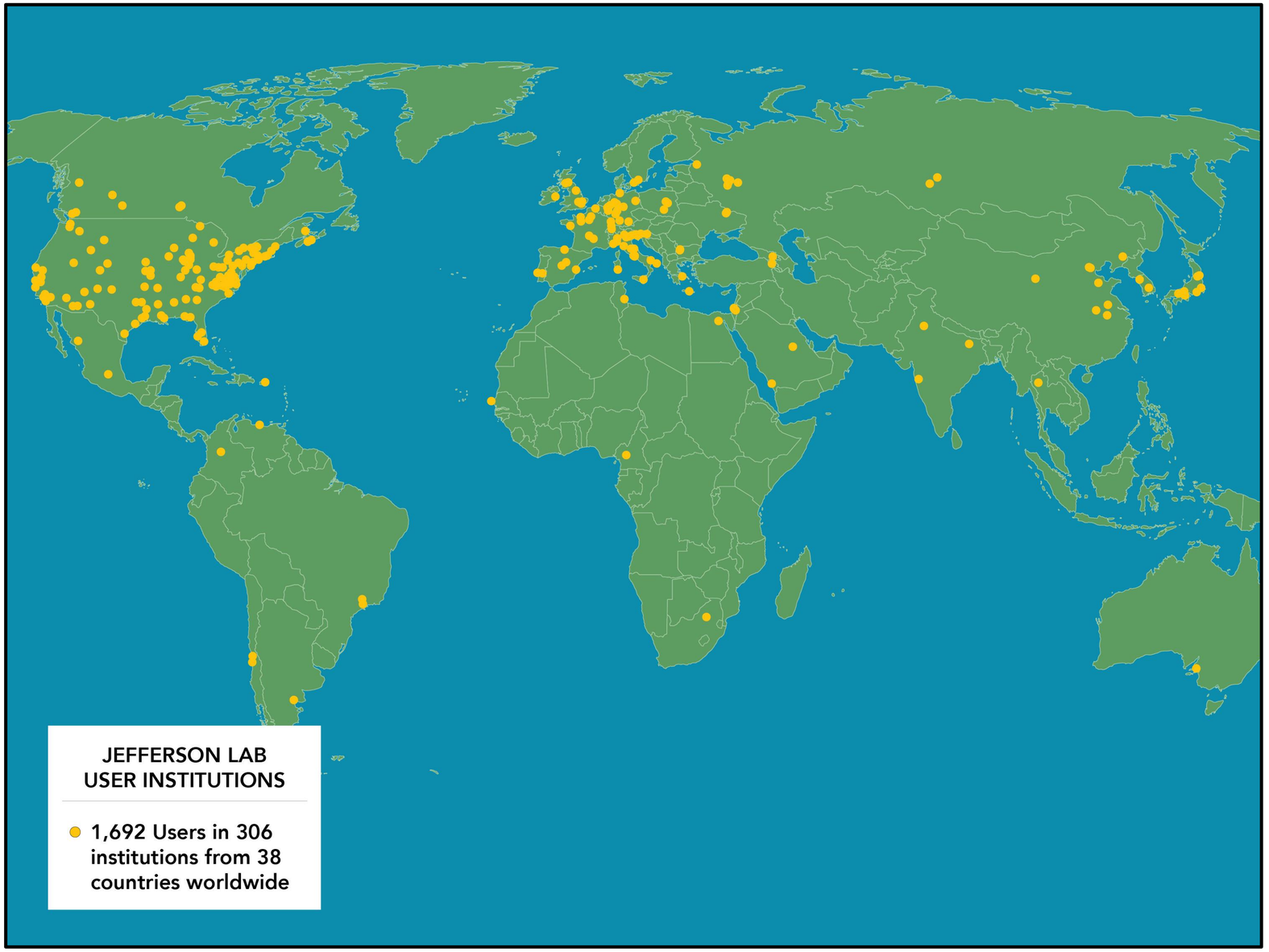
Input from Jefferson Lab Users Organization (JLUO) to the LRP process

Carlos Muñoz Camacho
IJCLab, Orsay (CNRS/IN2P3)

Chair,
JLab User Organization
Board of Directors

Hot and Cold QCD
Town Hall Meeting
(MIT, 9/23/22)



JLUO
JEFFERSON LAB USERS ORGANIZATION

JLab User Organization goals

- Encourage and assist scientists and engineers in the use of the Continuous Electron Beam Accelerator Facility

Community building

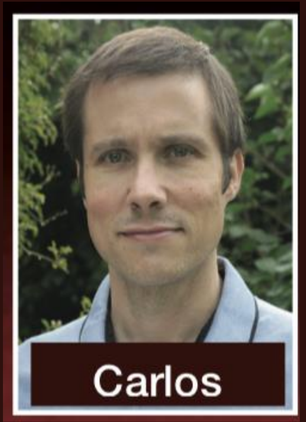
- Create and maintain effective channels for the exchange of information between the staff of JLab and other scientists and engineers interested in using CEBAF
- Create and maintain effective methods of offering advice and counsel to the JLab management on matters of policy affecting the development and utilization of the facility

Representation of users within JLab

- Support, encourage, and assist in the advancement of basic scientific knowledge, and to promote the most effective utilization of CEBAF for the common good and welfare of society

Advocacy, Outreach

2022-2023 JLUO Board of Directors


Carlos

Chair


Marco

Chair-Elect


Yordanka

Vice-Chair


Ed

Past Chair


Lorelei

Secretary-Treasurer


Nathaly

Postdoctoral Rep


Zeke

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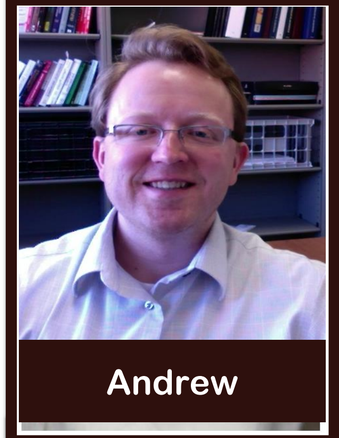
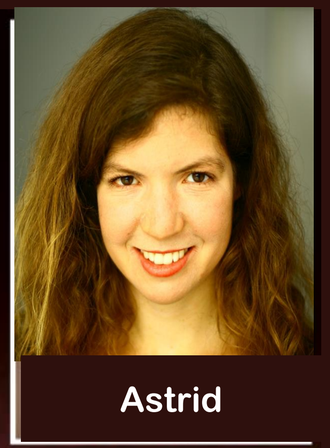

Andrew


Rachel


Holly


Sean


Xiaochao


Astrid

Theory-Experiment Liason

At-Large

Contact information can be found at JLUO wiki

Community process to reach our recommendations

Series of recent White Papers on future opportunities at JLab:

- Physics with CEBAF at 12 GeV and Future Opportunities (2021)
- Jefferson Lab Hall C: Precision measurements at the luminosity frontier (2022)
- An Experimental Program with Positron Beams at Jefferson Lab (EPJA special issue, 2021)
- The Solenoid Large Intensity Device (SoLID) for JLab 12 GeV (submitted to arXiv; to appear next week)

Series of workshops in 2022

- J-Future (March)
- High energy worshop series (5 workshops over the summer) – *WP in preparation*
- Meeting on NSAC long range plan (Sep 8)

- ➢ Summary of recommendations drafted by the JLUO board and submitted to the user community with 1-week comment period
- ➢ Final list of recommendations/initiatives presented today including the additional input received

Draft input from JLUO to the LRP process

The JLab Users Organization, in preparation for the DNP QCD Town Meeting and the NSAC Long Range Plan exercise,

- Embraces with the highest priority the scientific capitalization of investments made at CEBAF, the nation's premier QCD facility, and strongly supports optimal running of the 12 GeV program, including the construction of the SOLID detector, the development of a positron beam, the luminosity upgrade of the CLAS12 detector and the implementation of a secondary K_L beam;
- Considers that the highest priority for new construction should be the Electron-Ion Collider (EIC);
- Recommends to continue refining the science potential and technological opportunities of an energy upgrade of the CEBAF facility that shall open precision science, complementary to the EIC, in a variety of areas;
- Recommends to continue exploring the science potential of a second detector and interaction region at the EIC that shall extend the science portfolio of the facility;
- Considers advanced computing, especially the application of AI/ML/DL algorithms to analysis, simulation, and data acquisition efforts, to be a key element for the successful progress in nuclear physics;
- Recommends investments in nuclear theory, which are an integral part of the scientific program at JLab and the future EIC;
- Supports pursuing diversity and inclusion policies that lead to outstanding contributions to research, education, and innovation.

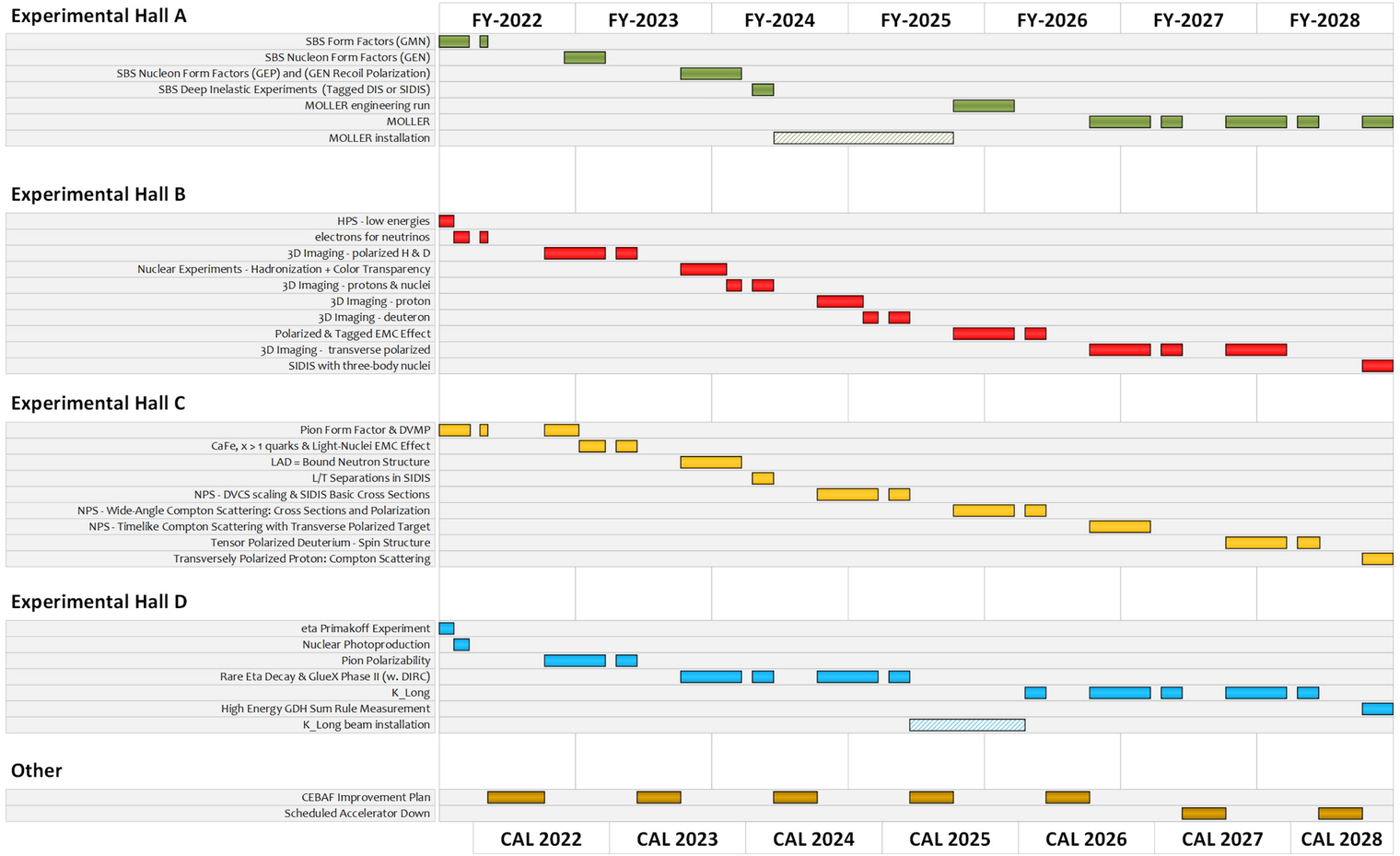
JLUO recommendations and initiatives (1/3)

Recommendation: We recommend as the highest priority the scientific capitalization on investments made at CEBAF. We strongly support the running of the full 12 GeV program, including the construction and deployment of the SOLID detector.

Since the successful completion of the 12-GeV upgrade, Jefferson Lab has been carrying out rich and diverse high-impact nuclear science. The ultra-high luminosity of up to 10^{39} $cm^{-2}s^{-1}$ and the complementarity of the four experimental halls allow one to address key questions in QCD, such as the dynamical nature of hadron mass, the origin of quark confinement, the structure of hadrons and nuclei, as well as to perform tests of fundamental symmetries and the Standard Model.

We anticipate, that as part of running the 12-GeV program, the luminosity upgrade of the CLAS12 detector, and the implementation of a secondary KL beam will be realized. We also note that full utilization of CEBAF during EIC construction is essential to maintain the productivity and health of the entire nuclear physics community, including the EIC user community, and provides the opportunity for a future complementary program during EIC operations.

Jefferson Lab at 12 GeV



199 completed experiments to-date (22 full; 22 partial in 12 GeV era)

57.3 experiments remaining

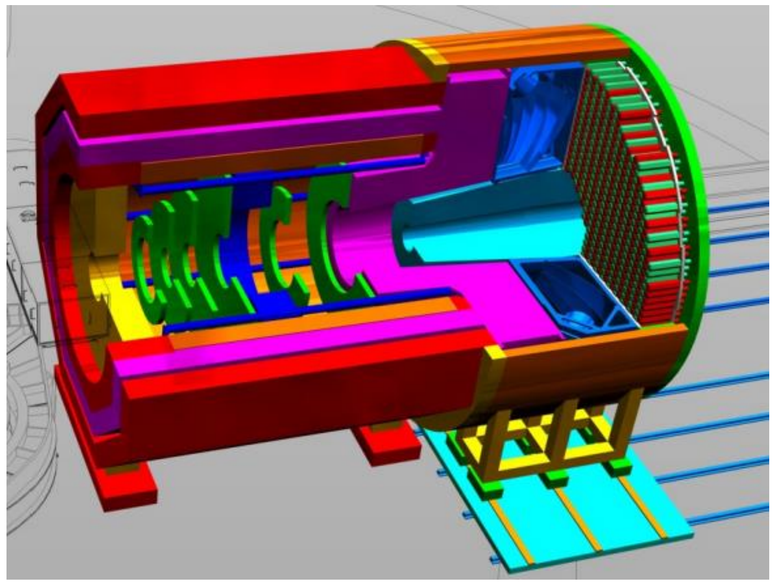
~8 years at ~30 weeks/year

…not including SoLID

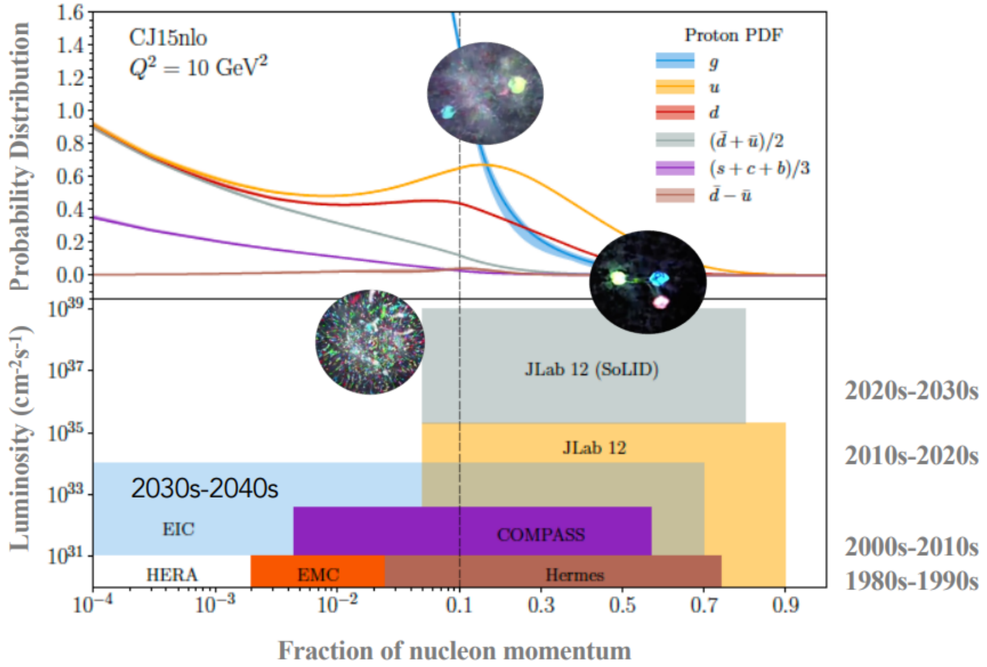
…not including new proposals

- CEBAF's approved program extends into 2030s
- CEBAF will remain a critical facility for fixed target electron scattering at high luminosity
- Full utilization of CEBAF during EIC construction is essential to maintain the productivity and health of the entire nuclear physics community, including the EIC user community, and provides the opportunity for a future complementary program during EIC operations.

SOLID



- 7 experiments (+6 run group experiments) approved by JLab PAC so far (most of them A-rated): ~5 years of physics running
- Rich physics program:
  - 3D imaging
  - PVDIS
  - Threshold J/y
- Mature pre-conceptual design
- DoE science review successfully completed in 2021
- Physics running could start in 2029-2030
- Total escalated equipment cost: $82M



Physics program at the Town Hall meeting

- Plenary: Sat@ 4:10PM
- Parallel: Fri @ 5:10PM, Sat @ 11:40AM
- Open mic: Fri @ 7:19PM

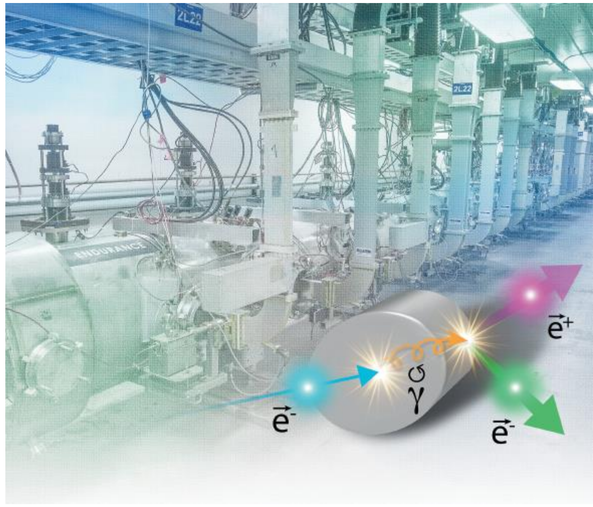
JLUO recommendations and initiatives (2/3)

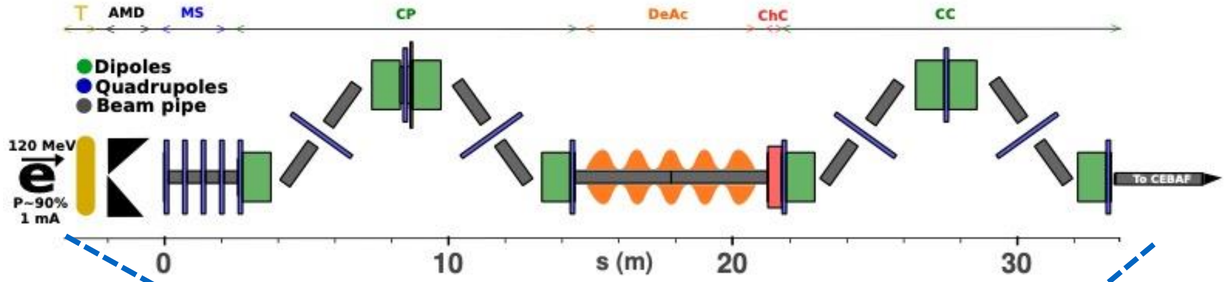
Initiative: We recommend the allocation of necessary resources to implement high duty-cycle polarized positron beams at CEBAF.

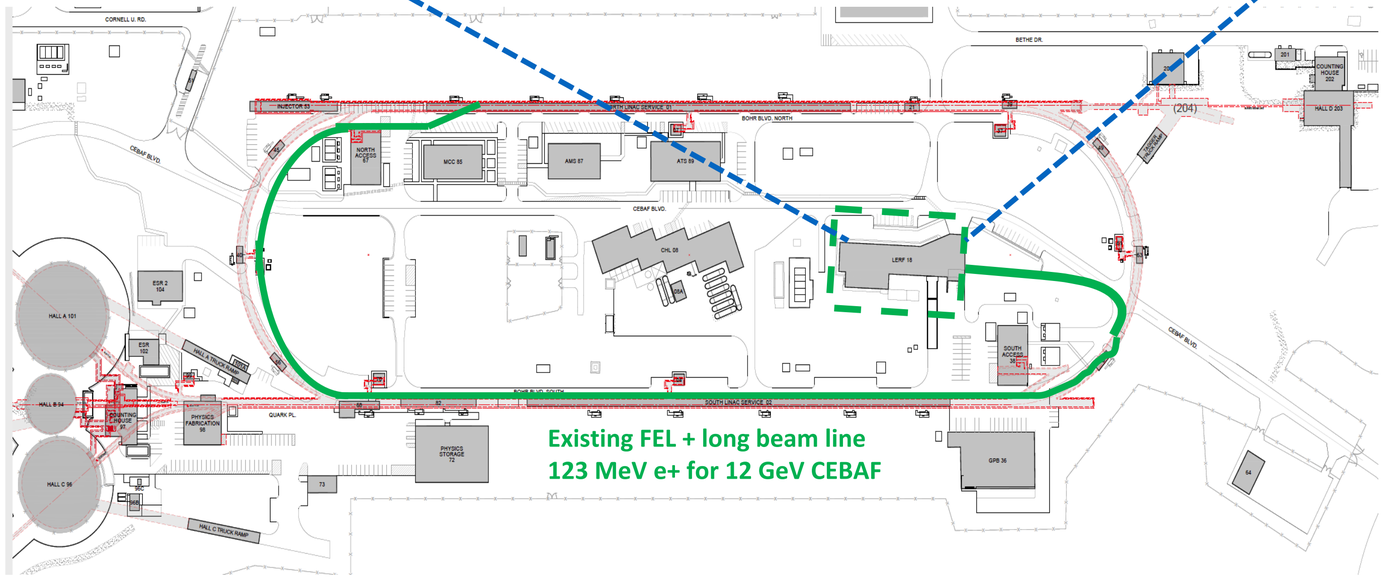
Using the 12 GeV CEBAF and capitalizing on positron source innovations at Jefferson Lab, high duty cycle polarized electron and positron beams, together with the outstanding capabilities of Jefferson Lab detectors, will enable a unique science program at the luminosity and precision frontier. It will comprise the mapping of two-photon exchange effects as well as essential measurements of the 3D structure of hadrons. It will also offer new opportunities to investigate electroweak physics and physics beyond the standard model.

Positron beams

- Beam charge dependance critical to complete the 3D imaging of nucleon and nuclei (real part of Compton Form Factors: D-term, energy-momentum tensor…)
- Studies of two-photon exchange and BSM physics
- 20 peer-reviewed paper published as a special issue of EPJA
- Unique capability in the world
- Stepping stone for a potential upgrade at EIC
- Multi-Hall, high intensity beam will enable a 5+ years program with JLab12







Physics program at the Town Hall meeting

- Parallel: Fri @ 3:20PM,
  Sat @ 11:00AM

JLUO recommendations and initiatives (3/3)

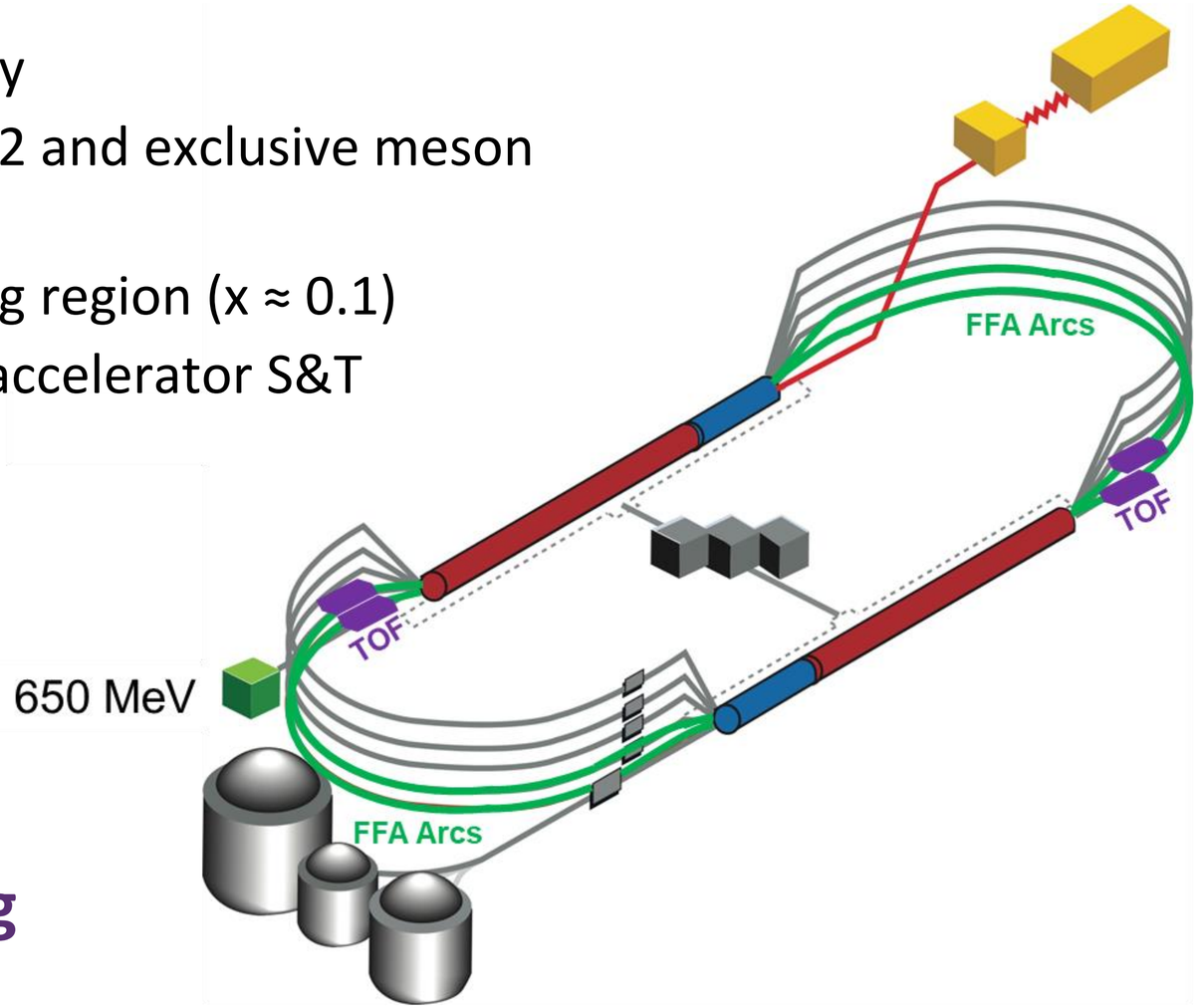
Initiative: Capitalizing on recent science insights and US-led accelerator science and technology innovations, we strongly recommend the allocation of resources to develop a cost-effective energy upgrade of CEBAF, and its construction when EIC construction is complete. This will enable a worldwide unique nuclear science program at the luminosity frontier.

The last decade has provided multiple science surprises such as the discovery of the new charmonium states at CERN, the so-called "XYZ" states, and the first determination of the shear and pressure distributions in the proton at Jefferson Lab. In addition, mysteries of the visible matter around us remain unsolved, such as a small enhancement of partons found in nuclei at the interface of the quark- and gluon-dominated regions, the so-called "anti-shadowing" region, that to date lacks explanation and can only be further studied at the luminosity frontier.

Capitalizing on recent innovations enabled by accelerator science and technology, a cost-effective energy upgrade of the 12-GeV CEBAF at Jefferson Lab to a 20+ GeV facility has become feasible. Such an upgrade would permit a worldwide unique nuclear science program with fixed targets at the luminosity frontier, roughly five decades above that possible with a collider. Beyond its nuclear science opportunities, this will further steward best-in-class accelerator technology within the U.S.

JLab energy upgrade

- Unique new opportunities in hadron spectroscopy
- Extension of the 3D imaging program to higher Q2 and exclusive meson production channels
- High precision data in the puzzling anti-shadowing region (x ≈ 0.1)
- Will capitalize on recent innovations enabled by accelerator S&T



Physics program at the Town Hall meeting

- Plenary: Sat @ 4:35PM
- Parallel: Sat @8:30AM
- Open mic: Sat @12:08PM

Summary

Recommendation: We recommend as the highest priority the scientific capitalization on investments made at CEBAF. We strongly support running of the full 12 GeV program, including the construction and deployment of the SOLID detector.

Initiative: We recommend the allocation of necessary resources to implement high duty-cycle polarized positron beams at CEBAF.

Initiative: Capitalizing on recent science insights and US-led accelerator science and technology innovations, we strongly recommend the allocation of resources to develop a cost-effective energy upgrade of CEBAF, and its construction when EIC construction is complete. This will enable a worldwide unique nuclear science program at the luminosity frontier.