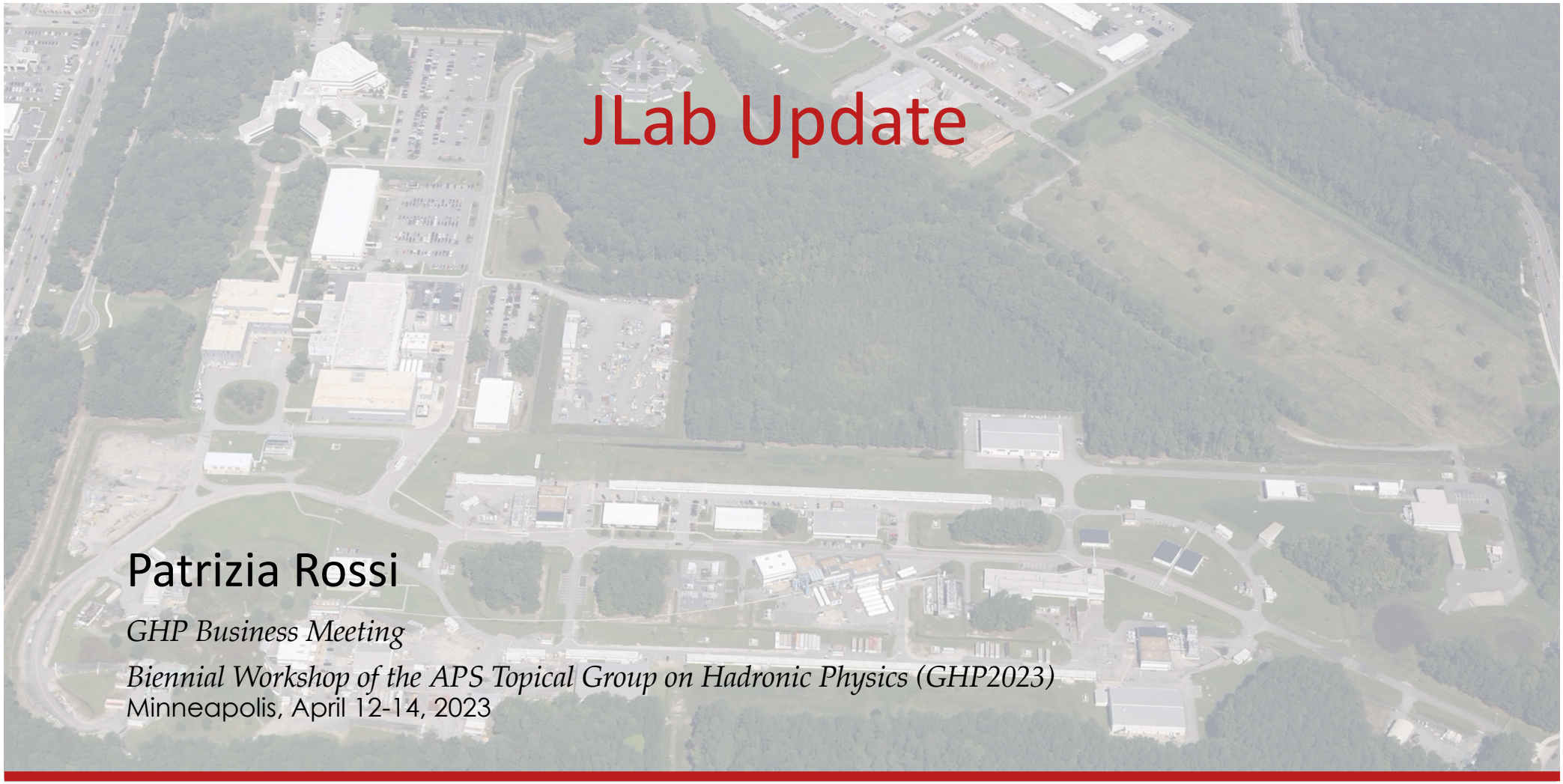


JLab Update

Patrizia Rossi

GHP Business Meeting

Biennial Workshop of the APS Topical Group on Hadronic Physics (GHP2023)

Minneapolis, April 12-14, 2023

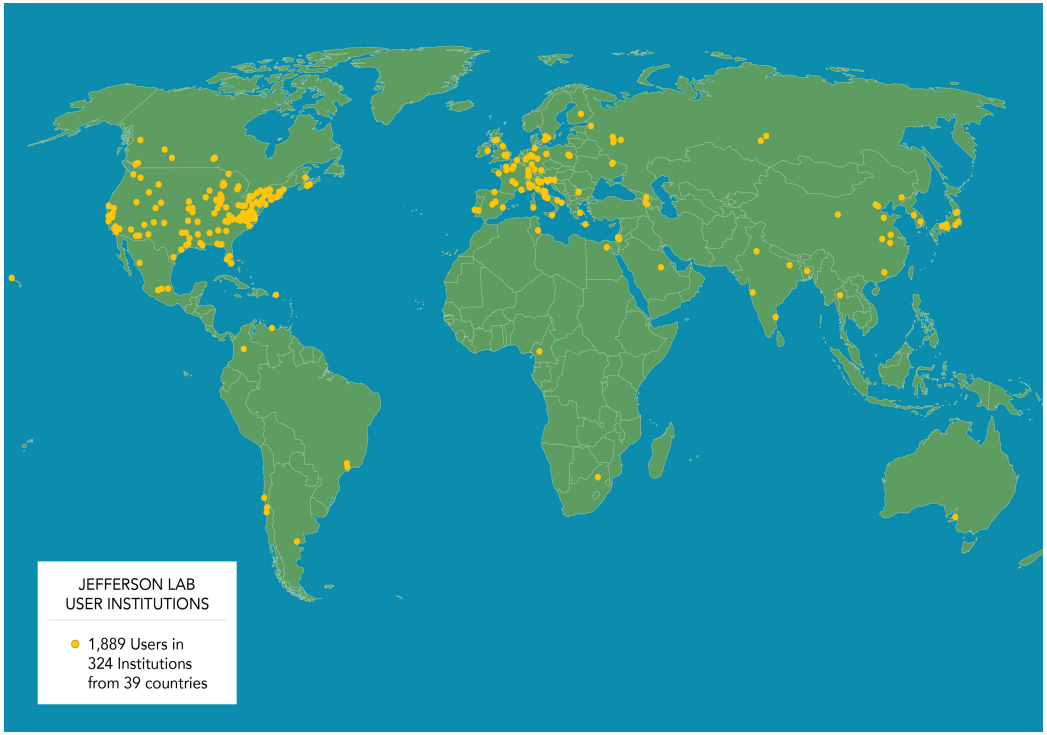
TJNAF is managed by Jefferson Science Associates for the US Department of Energy

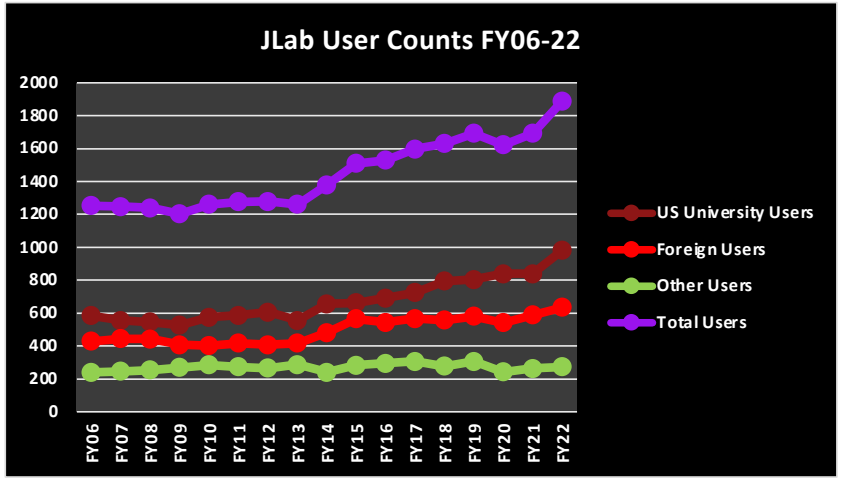
Jefferson Lab
Thomas Jefferson National Accelerator Facility

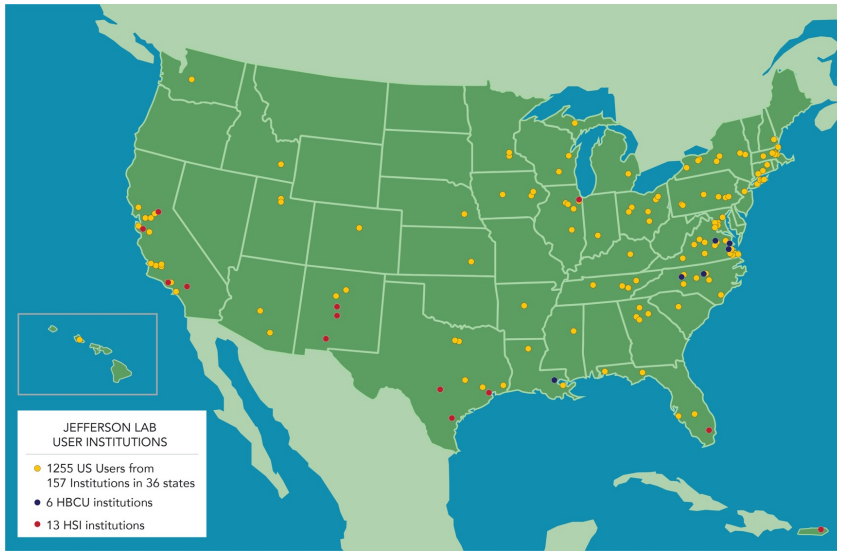
Extensive, engaged user community

CEBAF: a world-unique user facility for Nuclear Physics

Delivers a vibrant research program
- operating more than 30 weeks per year
- supporting ~1,900 users annually







Highlights from the Lab

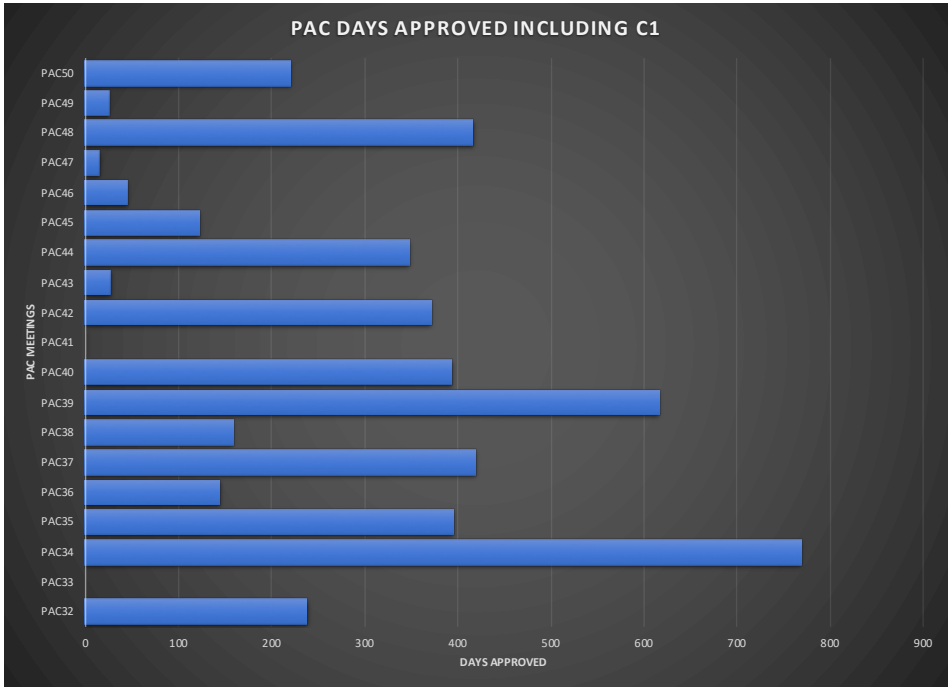
- 12 GeV scientific era is going strong
  - More than 30 weeks operation in FY22 and FY23 (planned), enabled by supportive Operations budget
  - High-profile results emerging from 12 GeV program (and still from 6 GeV program)
  - Progressing on CPP with CM refurbishments, C75 CM construction and spares purchases
- Successful partnership with BNL in management, design, construction of EIC Project
  - Developed and defended cost/schedule basis for JLab scope integrated into EIC project plan
- MOLLER Project achieved CD-3A (approve Long Lead Procurements) in March 2023 ; SoLID ready to move ahead
- Exploring exciting scientific opportunities enabled by cost-effective and technically innovative CEBAF upgrade concept
- Initial steps toward diversifying Jefferson Lab's scientific mission

12 GeV Approved Experiments (status Feb 15, 2023)

Topic	Hall A	Hall B	Hall C	Hall D	Other	Total
Hadron spectra as probes of QCD	0	3	1	4	0	**8**
Transverse structure of the hadrons	7	4	1	1	0	**13**
Longitudinal structure of the hadrons	1	3	12	1	0	**17**
3D structure of the hadrons	7	9	8	0	0	**24**
Hadrons and cold nuclear matter	9	6	8	1	1	**25**
Low-energy tests of the Standard Model and Fundamental Symmetries	3	2	0	1	2	**8**
Total	**27**	**27**	**30**	**8**	**3**	**95**
Total Completed	**11**	**11**	**8**	**3**	**0**	**33**
Experiments Removed by Jeopardy	**4**	**4**	**3**	**0**	**0**	**11**
Total Experiments Remaining	**12**	**12**	**19**	**5**	**3**	**51**

JLab Program Advisory Committee

- PAC51 will be held during the week of July 24, 2023
- The deadline for submission of proposals and updates is 8:00 a.m. EDT (Eastern Daylight Time) on Monday, **May 22nd, 2023**.
- Hall A & C approved experiments that are not yet scheduled and more than five years since approval, will be reviewed under jeopardy. The PAC will review the updated proposals and reconsider their approval status, grade and number of approved PAC days. The spokespersons of these experiments have already been notified.
- New PAC members: Alexandra Gade, Curtis Meyer, Marco Radici



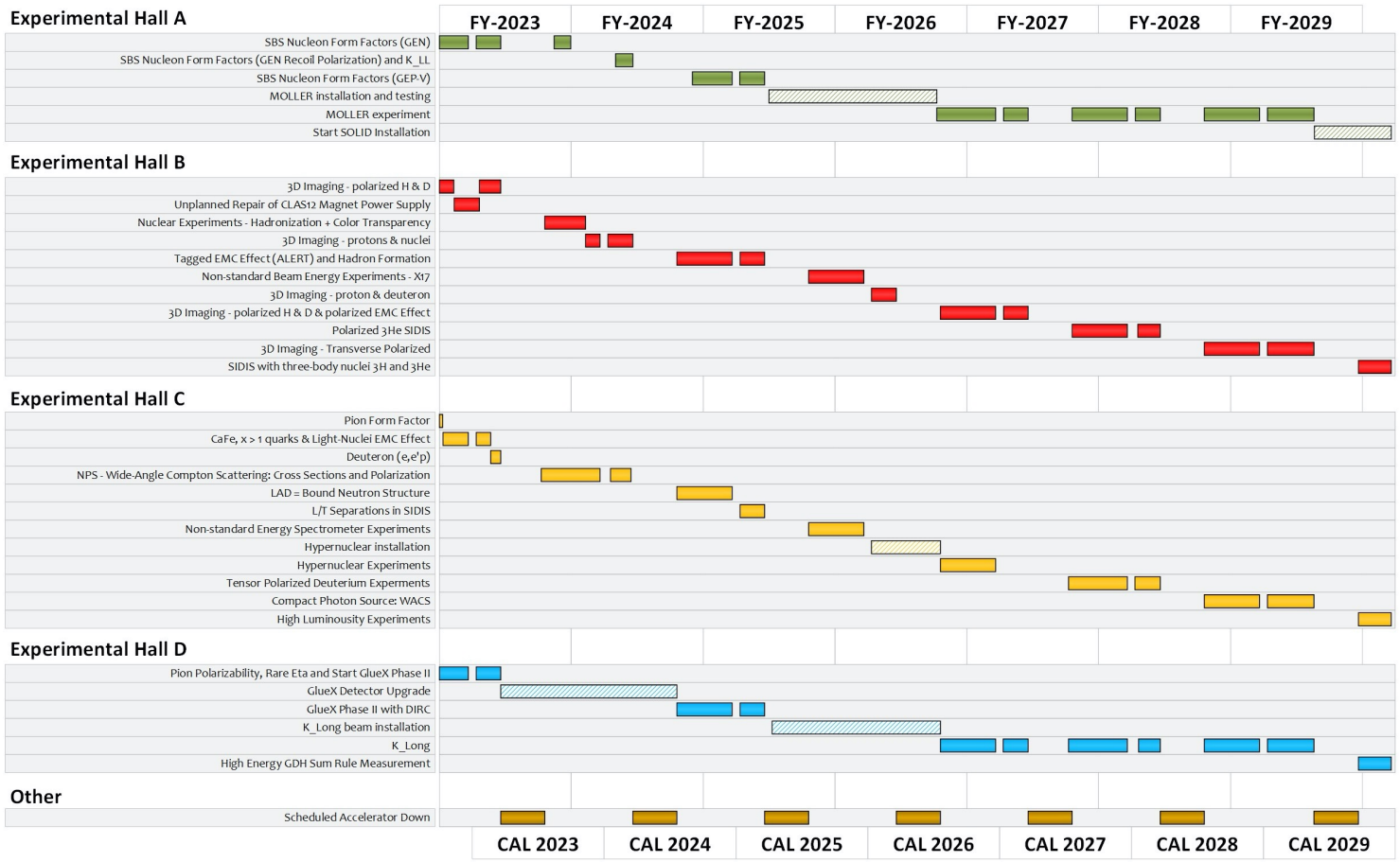
- PAC history since start of 12 GeV approvals
- Many more days *proposed!*
- More experiments (run groups increasing)
- Creative community - new ideas still coming up

Publications: Healthy growth over the years

Publication	Calendar Year					
	18	19	20	21	22	23
Phys. Rev. Lett. Phys. Lett.	7	15	9	11	11	3 (+6)
Other Refereed Journals	39	21	38	35	38	5 (+10)
Instrumentation Papers	6	7	27	4	4	2 (+4)
Invited Talks	87	94	81	55	44	N/A yet

In parenthesis, papers submitted but not yet published

Extended Experimental Schedule/Draft



- **SoLID installation could start ~mid-FY29**
- **86% complete in FY29 without SoLID, 70% complete with SoLID** (assuming optimal running operation)

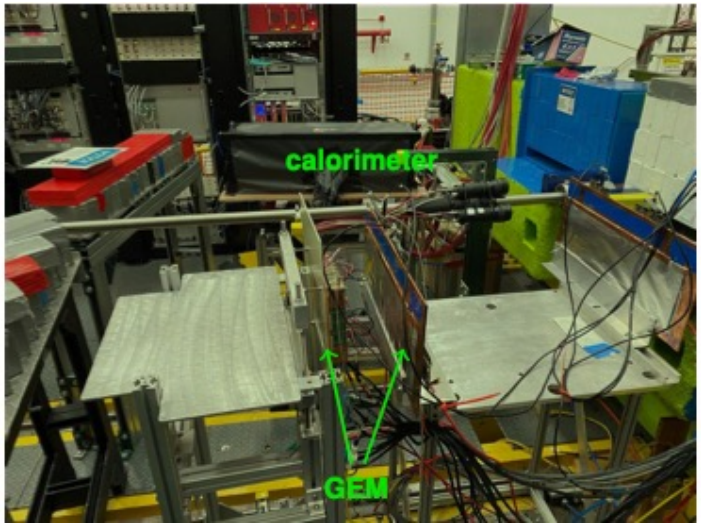
…not including new proposals

- **A new NPES schedule is about to be released**
  - **Schedule to March 2025**
  - **Assumes 33 weeks of physics running annually**

Jefferson Lab

EIC R&D – Project & Generic

- Generic EIC Detector R&D ($2M) funded and R&D starting
- MPGD-based R&D:
  - Development of cylindrical μRWELL prototypes with capacitive-sharing readout and small drift space
    - Synergy with Hall B luminosity upgrade & medical imaging
- Test stand ready for DIRC bars from SLAC



- 3 calorimeter blocks for EIC
- GEM for tracking and for TRD

- Streaming Readout (SRO)
  - Synergy with Hall D and Hall B
- ML/AI applications to analysis/monitoring/controls
  - Synergy with all four halls + accelerator

- Proceeding with prototypes of ESR 591 MHz single cell and 197 MHz crab cavity
- Successful test of 5-mode harmonic kicker in UITF
- SHC ERL studies underway

Accelerator Highlights – CEBAF now and near Future

Injector upgrade

- CEBAF beamline upgraded
- New SRF Booster commissioned at UITF and being installed in CEBAF
- The upgrade reduces helicity correlated asymmetries for the Parity Quality Beam program

Plasma processing (improve the field emission properties of the niobium surface)

- Procedure established
- Application to C100-05R in June '22 showed an overall 12 MV gain
- Developing the process for C20/C50/C75

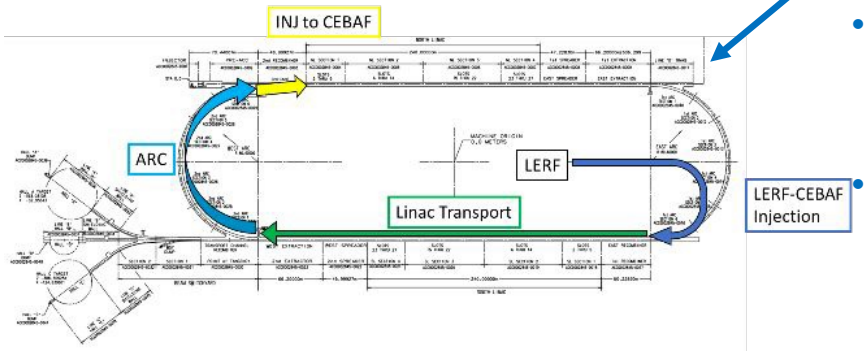
Development of AI/ML for use in CEBAF Control Room

Feasible, Cost effective, Innovative Path from e^+ to 22 GeV

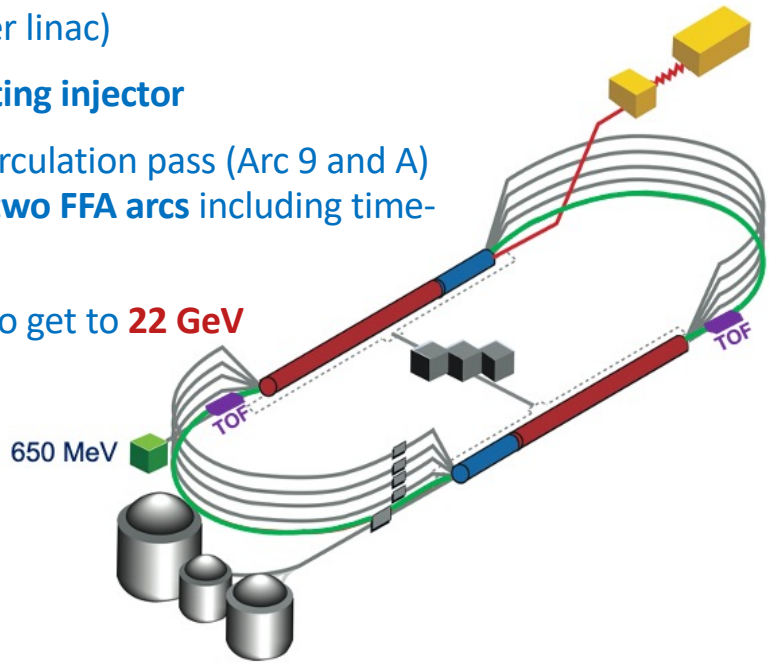
- CEBAF's approved program extends into 2030s
- CEBAF will remain the prime facility for fixed target electron scattering at very high luminosity

Capitalize on recent science insights and US-led accelerator science and technology innovations to develop a **staged program at the luminosity frontier**

- CEBAF @ 22 GeV
- Positron beam



- Starting with 12 GeV CEBAF
- NO new SRF (1.1 GeV per linac)
- **New 650 MeV recirculating injector**
- Remove the highest recirculation pass (Arc 9 and A) and **replace them with two FFA arcs** including time-of-flight chicane
- Recirculate 4.5+6times to get to **22 GeV**



- **Positrons (e+) in the LERF with transport to CEBAF**
- Injection energy upgrade for 650 MeV Electron (e-) in LERF

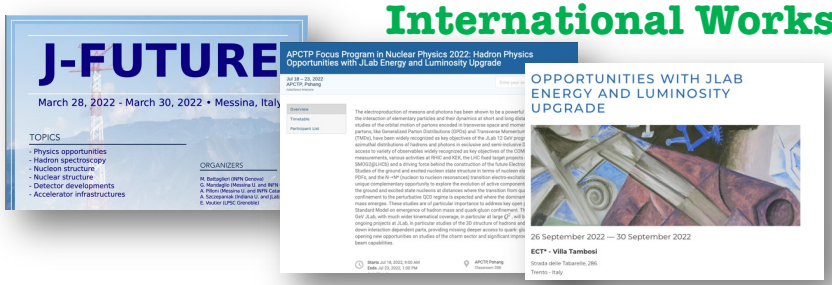
FFA@CEBAF RETREAT

FFA@CEBAF RETREAT – APRIL 6-7

Last week, April 6-7, the FFA@CEBAF Retreat took place on campus. Retreat participants from Jefferson Lab, Brookhaven National Lab and Oak Ridge National Lab all contributed to the future 22 GeV CEBAF Energy Upgrade as the core architects of the project. For questions, contact Alex Bogacz.

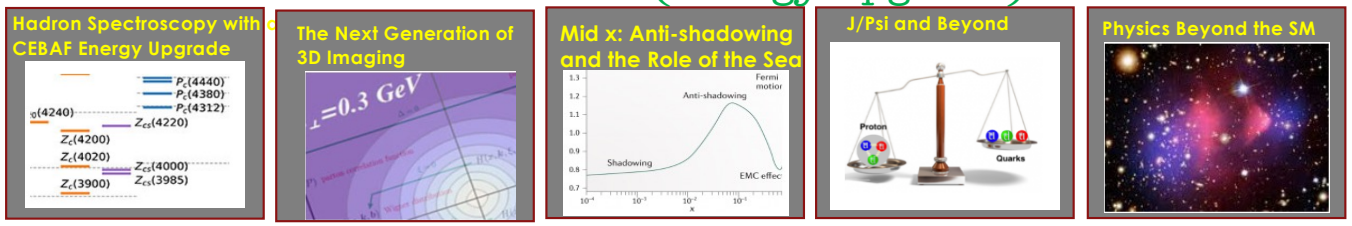
Science Case for CEBAF Upgrades

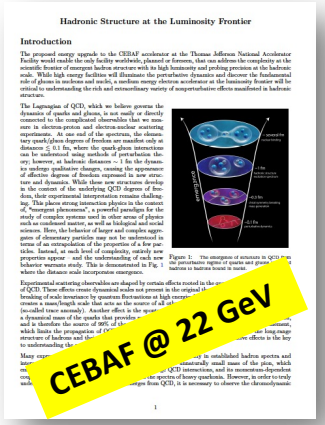
International Workshops March-Sep 2022

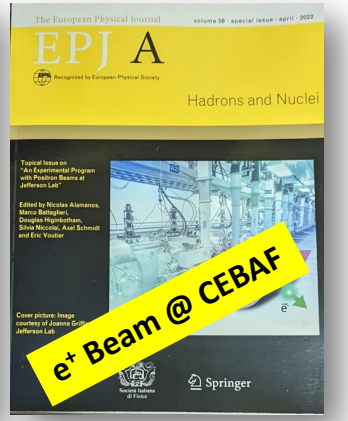


- **Physics case for the energy upgrade summarized in a short document sent to the LRP writing committee (Longer document in preparation)**
- **Physics case for a positron beam published in EPJA**

Summer Series @ Jlab (Energy Upgrade) Jun-Aug 2022







Science at the Luminosity Frontier: JLab at 22 Gev January 23-25, 2023

- Spectra and structure of heavy and light hadrons asprobes of QCD
- Sea and valence partonic structure and spin
- Form Factors, Generalized Parton Distributions and Energy-Momentum Tensor
- Fragmentation, Transverse Momentum and Parton correlations
- Hadron-quark transition and nuclear dynamics at extreme conditions
- Low-energy tests of the Standard Model and Fundamental Symmetries

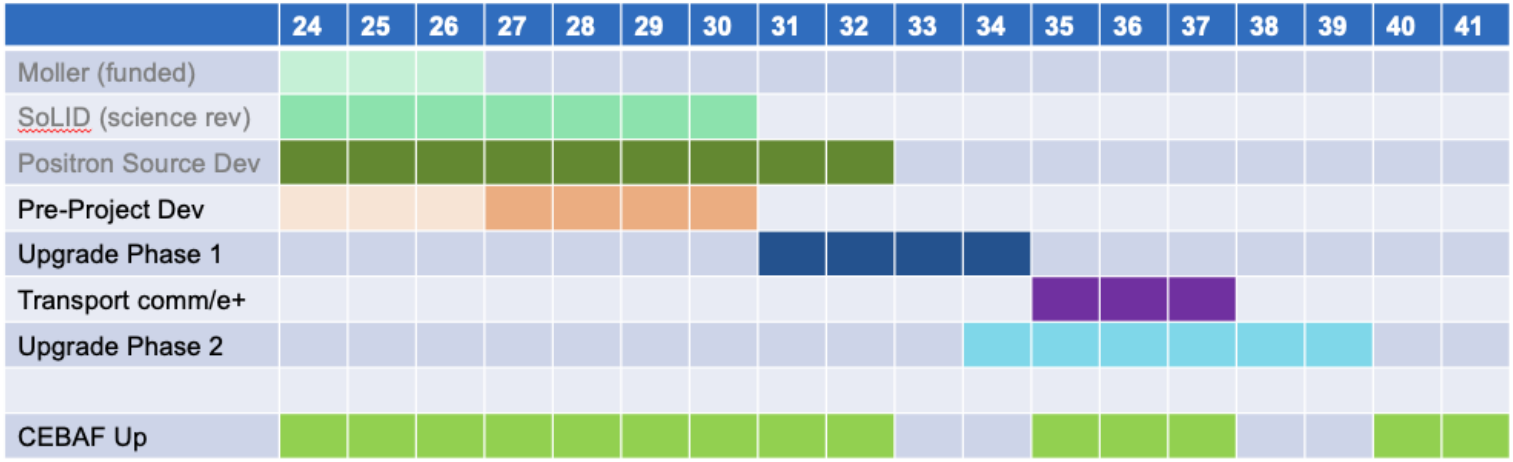
https://www.jlab.org/conference/luminosity22gev

APS April Meeting 2023
Apr 15 & 16, 2023

B15/K16 Mini-Symposium:
Opportunities with Jlab Upgrades in Energy, Luminosity and a Positron Beam

Potential Timescale and Cost

- Accelerator and Engineer teams have worked up an early schedule and cost estimate
  - Schedule assumptions based on a notional timing of when funds might be available (near EIC ramp down based on EIC V3 profile)



- FY23 $$
- Phase 1: tie LERF to CEBAF & injector for e+ — $101M ($78M – $152M)
- Phase 2: High Energy Upgrade (includes FFAs) — $244M ($188M – $366M)
- Total cost (Class 4 estimate) — $345M ($265M – $517M)

- Presented at the DOE LMBB in February
- Sent to the LRP Budget sub-committee

High Performance Data Facility (HPDF)

- **Scientific community recognizes the need for a data-centered high performance computing facility**
- Focused on unique opportunities for data-intensive applications and real-time computing to support significant growth in DOE-SC user facility data
- Designed to meet the data management, long term storage, and data mining needs of researchers

HPDF
High Performance Data Facility

- High Performance Data Facility proposal being developed ($300-$500M)
- Growing a data sciences program
  - Ex: Partnership with ODU and health care providers on public health analyses
  - Hires and joint faculty positions in process, including state funded positions
- Growing partnerships, programs and attracting funding

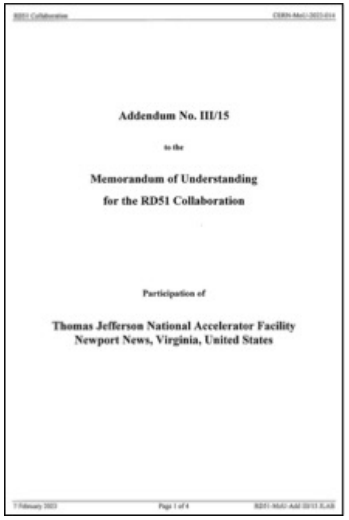
US-based MicroPattern Gaseous Detector Center - A Community User Facility

Need for US-MPGD center for NP, HEP, Medical application and beyond

- Large number of US institutions engaged in MPGD activities
  - limited inter-disciplinary interaction between the institutions
- The community needs a dedicated US-based MPGD User Facility with a:
  - **Production workshop** l(ike to the SiDet Facility for at FNAL) for fabrication of large MPGDs (µRWELLs, GEMs, flexible PCBs…)
  - **Detector R&D Lab** (ike the RD51 / GDD Lab at CERN) with equipment and instrumentation for detector assembly, testing, irradiation, high-rate and aging studies, for internal and external users with local technical and scientific support team
- US-MPGD center will be greatly beneficial for the Jlab's experimental program and EIC detector development
- Jefferson Lab is an excellent place for an MPGD center in the US
  - At the forefront in the deployment of large MPGDs in NP exps
  - In-house MPGD expertise and beam test capabilities for MPGD tests

Discussed during the 2022 Snowmass meeting and also in the meeting's white paper's section *4.4. Need for MPGDs R&D facility in the US for the Nuclear Physics community*

- **Some funding (~$ 2M) included in 2024 DOE NP JLab projections**
- **JLab Detector Group member of RD51 CERN Collaboration !**



Addendum No. III/15

to the

Memorandum of Understanding
for the RD51 Collaboration

Participation of

Thomas Jefferson National Accelerator Facility
Newport News, Virginia, United States

JLAB: BIOMEDICAL RESEARCH & INNOVATION CENTER

BRIC Biomedical Research & Innovation Center

Jefferson Lab is establishing the Biomedical Research & Innovation Center (BRIC) as a central hub for transitioning state-of-the-art research and technology development from nuclear and particle physics to biological and health-related fields, including: novel cancer treatments, medical imaging, environmental monitoring, plant biology, and radiation detection and therapy. Our researchers partner with industry, academia and healthcare organizations to identify instrumentation needs that can enhance research and patient care, or fill technology gaps.

BRIC collaborates with private and public sector partners to develop new devices and systems based on our expert knowledge of particle accelerators and detectors. We engage with community organizations on data-driven research and advanced predictive analytics to facilitate better health outcomes. Several innovations from Jefferson Lab researchers are in use today for cancer treatment and diagnosis, among other applications. The BRIC also facilitates special events, colloquia, and workshops on various topics, including serving as host for the joint NIH/DOE series "Advancing Medical Care Through Discovery in the Physical Sciences.

LEADERSHIP

Thia Keppel, Co-Director
Associate Director for Experimental Nuclear Physics

Drew Weisenberger, Co-Director
Radiation Detector and Imaging Group Leader

Keynote given by: Dr. Asmeret Asefaw Berhe,
Director, Department of Energy Office of Science

Jefferson Lab, March 24, 2023

Conclusions

- The Lab is in a strong position moving forward
- Supportive funding for CEBAF Operations
- Our priorities are clear:
  - Ensuring that the 12 GeV program is successful in all facets
  - Moving EIC forward
  - Laying the groundwork for an exciting role for CEBAF in the EIC era – positrons and 22 GeV
  - Diversifying Jefferson Lab's scientific mission
  - Increasing our impact in accelerator S&T