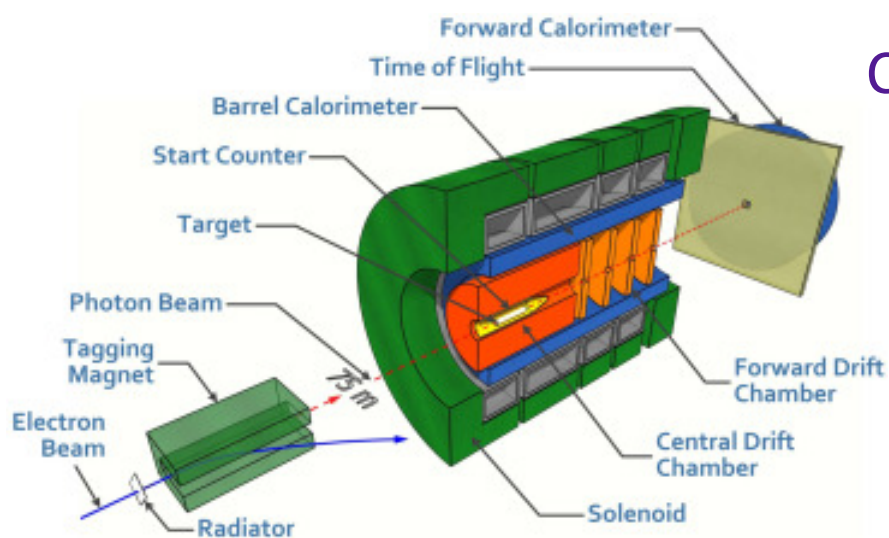


The GlueX Experiment part 1 A Short History of GlueX

Curtis A. Meyer
Carnegie Mellon University
February 2021



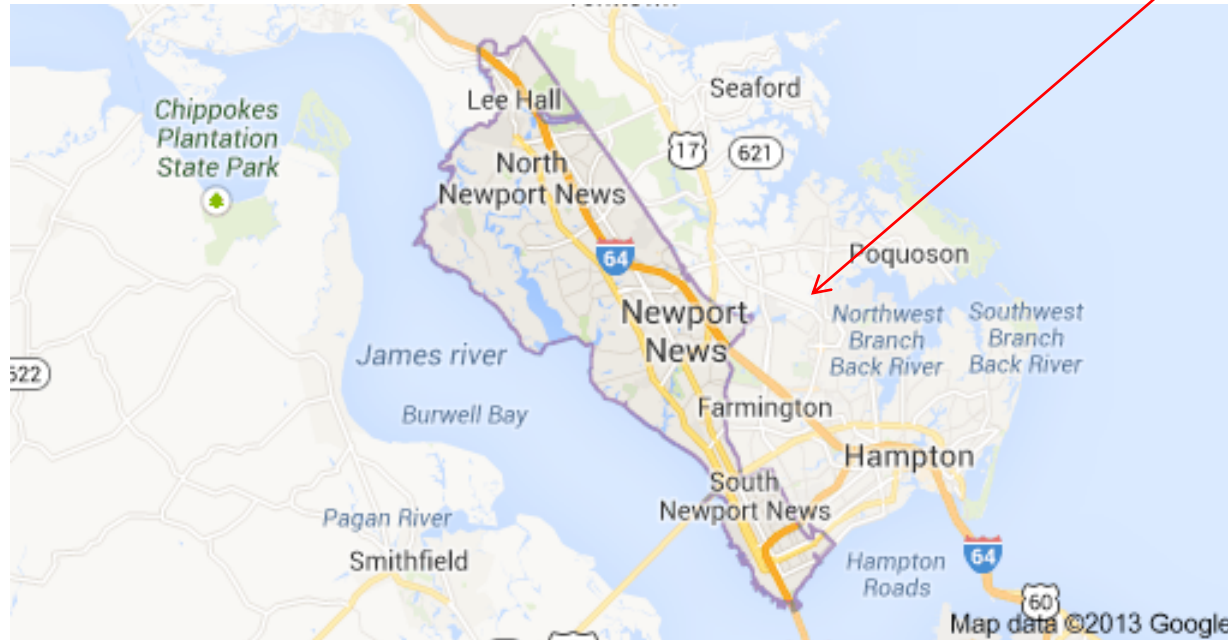
This presentation provides a brief history of GlueX from the first workshop at Indiana University in the summer of 1997 to the present at the beginning of 2021. It is by no means complete, but rather tries to provide some historical perspective to the development of the experiment.

From the Indiana meeting until groundbreaking for construction in 2009 was over 22 years. From that point to the first beam in Hall D in 2014 was 5 more years. Another 4 years was needed to complete data collection for Phase I of the program at the end of 2018. At present time, GlueX is nearly 24 years old.

Many thanks are due to some of the early proponents of the experiment. Without the efforts of Alex Dzierba, Nathan Isgur, George Lolos and Larry Cardman, we would not be where we are today.

Jefferson Lab

Built as a “4 GeV” electron accelerator.
 Can deliver extracted electron beams to three
 experimental halls simultaneously.
 Energy can be in 1/5 steps of beam energy.



Electron beams can be
 used to produce photon
 beams.

Original cost was about
 600 million dollars.

Ultimately delivered nearly 6 GeV electron beams

Developing the Physics Case

July 1997 - Workshop at Indiana University Community Interest

November 1997 – Workshop at NCSU on Physics Interest & Feasibility

March 1998 - Workshop at Carnegie Mellon on Detector Designs

June 1998 - Presentation to the JLab User's Group

September 1998 – Workshop at Florida State on Physics and Detectors

January 1999 Hall D Preliminary Design Report 170 pages

January 1999 Jefferson Lab Program Advisory Committee

March 1999 – Workshop at RPI, Collaboration formed.

August 1999 – Design Report Version 2

December 1999 – External Review of the project – very positive.

March 2000 – Meet with DOE and NSF in DC

September 2000 – Article in American Scientist

October 2000 – APS DNP Meeting.

December 2000 – NSAC Town meeting

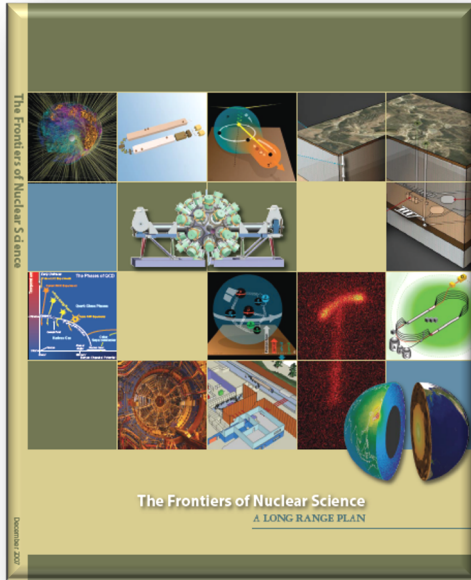
April 2001 – NSAC Long-range Planning Meeting.

NSAC Long-Range Plans



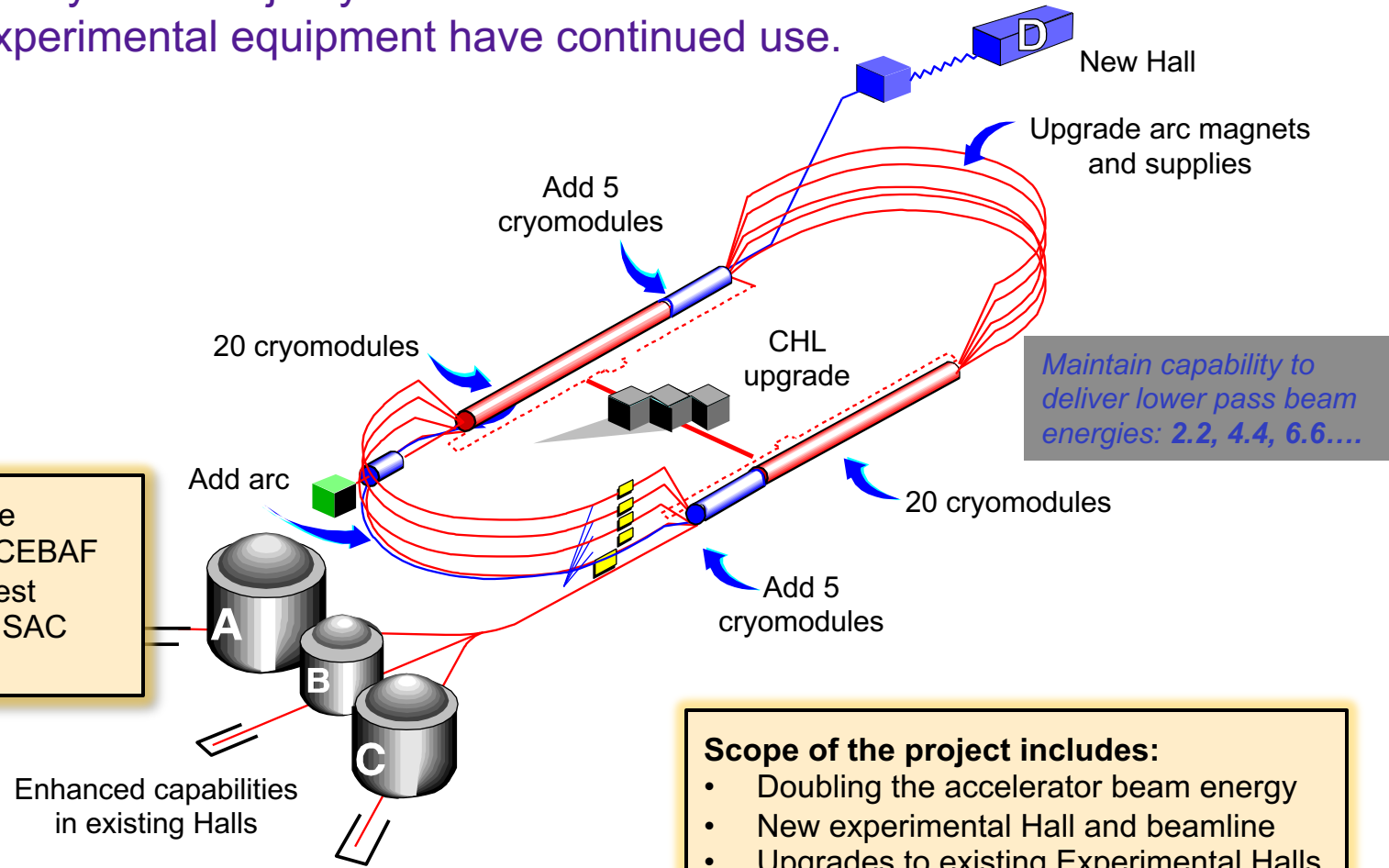
- **1976: Long Range Plan**
 - Identified the construction of Jefferson Lab (CEBAF) as top priority for new construction. Science started in 1994.
- **1983: A Long Range Plan for Nuclear Science**
 - Identified RHIC at BNL as top priority for new construction. Science started in 2000.
- **1989: Nuclei, Nucleons and Quarks” Long Range Plan**
 - Complete CEBAF, Build RHIC
- **1996: Nuclear Science: A Long Range Plan**
 - Run the program and finish RHIC are top priorities.
- **2002 NSAC Long Range Plan: Opportunities in Nuclear Science, A Long-Range Plan for the Next Decade**
 - Rare isotope facility is top priority. Upgrade JLab is #4.
- **2007 Long Range Plan: The Frontiers of Nuclear Science**
 - Upgrade Jefferson Lab is top priority. FRIB is number 2.
- **2015 Long Range Plan: Reaching for the Horizon**
 - Capitalize on investments made in facilities. Electron-ion Collider is number 3.

Jefferson 12 GeV Upgrade Project



Upgrade is designed to build on existing facility: vast majority of accelerator and experimental equipment have continued use.

The completion of the 12 GeV Upgrade of CEBAF was ranked the highest priority in the 2007 NSAC Long Range Plan.



360 million dollar project

The Critical Decision Process

February 2002 – NSAC Long Range Plan is Approved.

A project management system put in place to define the project and schedule of a large project and to make sure that it completes on time and on budget. ``CDi'' means Critical Decision ``i''

Apr. 2004 CD0 -Develop the conceptual design.

Feb. 2006 CD1 - Perform needed R&D to establish costs.

Nov. 2007 CD2 - Project engineering and baseline cost and schedule.

Sep. 2009 CD3 - Allows for start of construction.

Oct. 2015 CD4a - Start of operations.

Sep. 2017 CD4b – Official project completion.

From CD2 to CD3: Project Reviews

A grueling process filled with 2-3 daylong reviews with external reviewers. We needed to prepare detailed written documentation and presentations on all aspects of the experiment and construction.

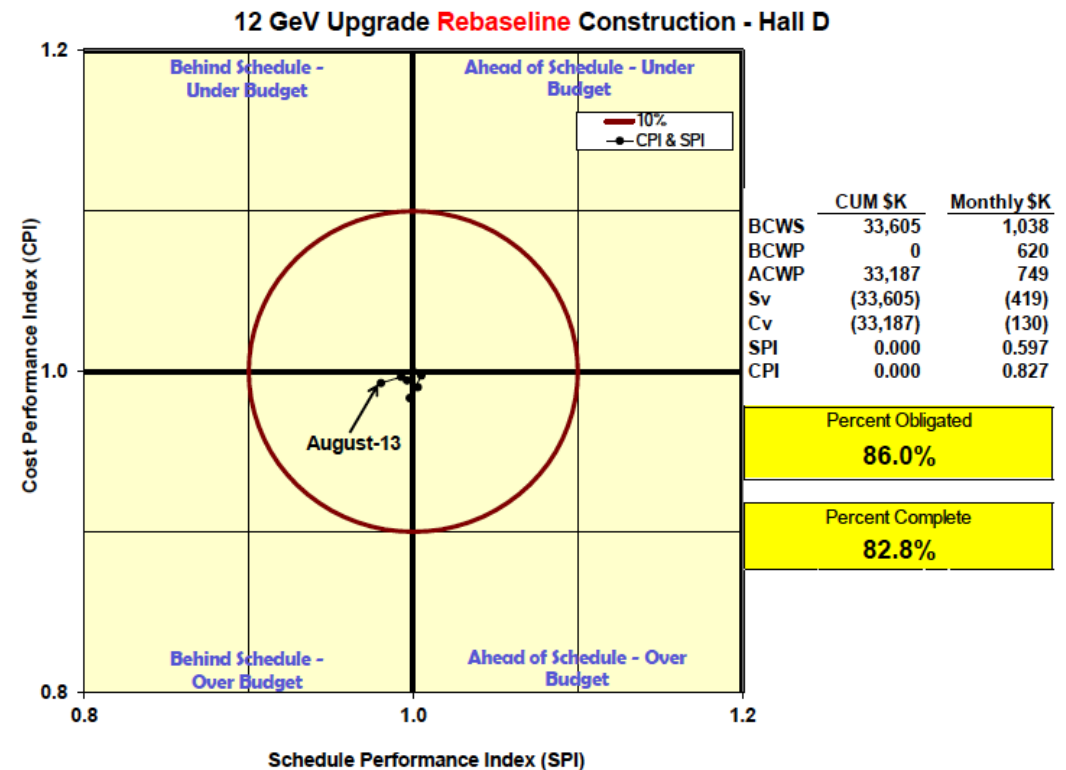
- October 2004 – Detector Review (pre-CD1)
- March 2007 – Initial tracking review (pre-CD2)

- February 2008 - FDC technology Review
- February 2008 -Calorimeter Design Review
- March 2008 - Tracking and PID Final Design Review
- May 2008 - System and Infrastructure Design Review
- **July 2008 - IPR Lehmann Review**
- November - 2008 Beamline and Tagger Review.
- February - 2009 - Installation Review
- July 2009 - Tagger Magnet Design Review
- July 2009 - BCAL Readout Review
- November 2009 - Solenoid Magnet Internal Review

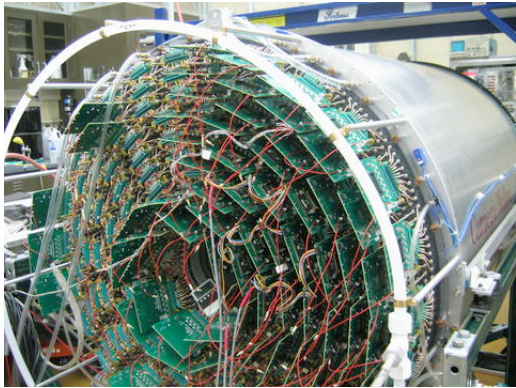
Construction Groundbreaking



The official groundbreaking for the 12-GeV upgrade took place on April 14, 2009.



Installation of the Equipment



Software and Computing Reviews

Jefferson Lab management realized that while extremely important to the success of the 120GeV Upgrade, Software and Computing were not formally part of the tracked project. Hence, they started a series of software and computing reviews to cover that part of the project.

- June 2012
 - November 2013
 - February 2015
 - November 2016
 - November 2018
- } 12 GeV Software and Computing Reviews

2012: First Large-scale Data Challenge

Will GlueX be able to analyze data when we get it?



Data formats defined for all levels of GlueX/Hall-D analysis.

- EVIO Raw Data 15kbyte/evt.
- REST DST Data ~2kbyte/evt.
- PART Physics Analysis (root tree).

Expected GlueX to generate petabytes per year of raw data.

OSG: 4 billion events, peaking at 7000 cores
 JLab Farm: 1 billion events
 CMU Farm: 0.3 billion events



2 weeks in December 2012
 ~10 TB of data

This data was driven by the physics analysis needs and the PID upgrade working groups that used it to develop the case for the DIRC.

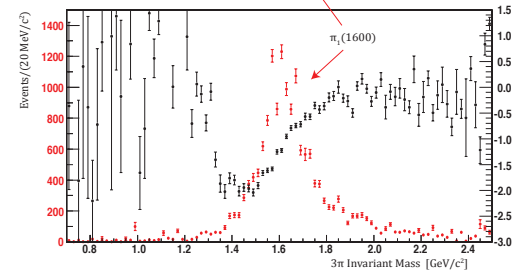
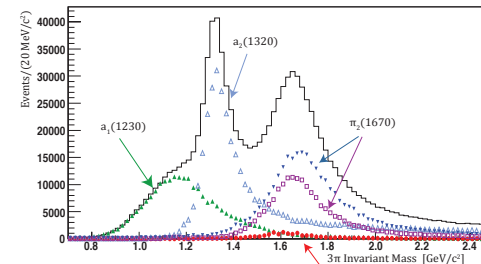
July 2013: First Software Workshop

2-day long workshop held at JLab with a video broadcast. Over 30 participants.



- Event generation
- Background simulation
- Simulation with HDGEANT
- Reconstruction (JANA)
- Event Selection
- Multivariate Analysis
- Amplitude Analysis

Make sure people know how to do analysis.



$$\sigma_{3\pi} = 10\mu b$$
$$\sigma_{tot} = 120\mu b$$

95% purity
>25% efficiency

The Arrival of GlueX Data

Fall 2014: Commissioning run with a solid target and restricted beam energy.

Spring 2015: Engineering run, cut short due to accelerator problems and completed at 6GeV electron energy. A limited amount of physics quality data.

Spring 2016: Engineering run, full shakedown of GlueX with physics quality data collected.

Spring 2017: Start of GlueX Phase I running.

Spring 2018: Continue GlueX Phase I running.

Fall 2018: Complete GlueX Phase I running.

Fall 2019: GlueX Phase II Commissioning of DIRC and high intensity.

Spring 2020: GlueX Phase II running.

Fall 2020: Continue GlueX Phase II running.

GlueX Leadership

Spokesperson:

Alex Dzierba: 2000 to 2007
Curtis Meyer: 2007 to 2020
Matthew Shepherd: 2020 to present

Deputy Spokesperson:

Curtis Meyer: 2000 to 2007
George Lolos: 2007 to 2011
Matthew Shepherd: 2012 to 2019
Justin Stevens: 2020 to present

Hall D Leader:

Elton Smith (acting) 2001 to 2006
Elke Aschenauer: 2006 to 2009
Eugene Chudakov: 2009 to present

Elected Physics Coordinator:

Justin Stevens: 2018 to 2020
Sean Dobbs: 2020 to present

Past and Present Collaboration Board Members

Werner Boeglin	Christina Kourkoumeli
Will Brooks	George Lolos
Daniel Carman	David Lawrence
Volker Crede	Ryan Mitchell
Larry Dennis	Zisis Papandreou
Sean Dobbs	Reinhard Schumacher
Jo Dudek	Matthew Shepherd
Paul Eugenio	Elton Smith
Liping Gan	Justin Stevens
Mark Ito	Alex Somov
Richard Jones	Adam Szczepaniac
Jim Kellie	Mike Williams
Andi Klein	John Zarling