12 GeV UPGRADE
Project Status

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Hall C Collaboration Meeting
Jefferson Lab
January 7, 2005

Outline

- 12 GeV Science Review
- Refresher: What is a DOE project?
- 12 GeV Project Overview
  - Scope
  - Management
- Key Activities (CD-0 to CD-1)
  - Reviews
  - CD-1 Requirements
- 12 GeV R&D program
- Summary

The 12 GeV Science Review

12 GeV Science Review

DOE conducted a 12 GeV science review, April 2005

12 GeV experimental physics talks presented:

- **Fundamental Structure of Hadrons**
- **Generalized Parton Distribution Functions**
- **QCD in the Confinement Regime**
- **Physics of Nuclei**
- **Symmetry Tests in Nuclear Physics**

12 GeV Science Review Report

Review report released August 2005

"The proposed science program includes three major elements: the fundamental structure of hadrons, the physics of nuclei and fundamental symmetry tests in nuclear physics."

"This review found that the proposed research in all three areas to have high scientific merit, that all these programs require the high intensity, polarized electron beams that are unique to TJNAF and will not be possible at any other known facility in the foreseeable future, and that significant results of high scientific impact were expected to emerge from the program in both in the near and long term."

12 GeV Science

- **The goal of the Upgrade Project is to build a facility that fully enables the science discussed in the review**

- **The good news: *we are on track for doing exactly that***

Refresher: What is a DOE Project?

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- **DOE "Directives" are official communications of policies, requirements and procedures.**
  - **— http://www.directives.doe.gov/**
- **Directives include Policies, Orders, Notices, Manuals, and Guides**
- **DOE projects of $5M or more are addressed by**
  - **— Order 413.3 (39 pages, 2000)**
  - **— Manual 413.3-1 (174 pages, 2003)**
- **Project Management for the Acquisition of Capital Assets "To provide Department of Energy (DOE), including the National Nuclear Security Administration (NNSA), project management direction for the acquisition of capital assets that are delivered on schedule, within budget, and fully capable of meeting mission performance and environmental, safety and health standards."**

DOE Generic Project Timeline

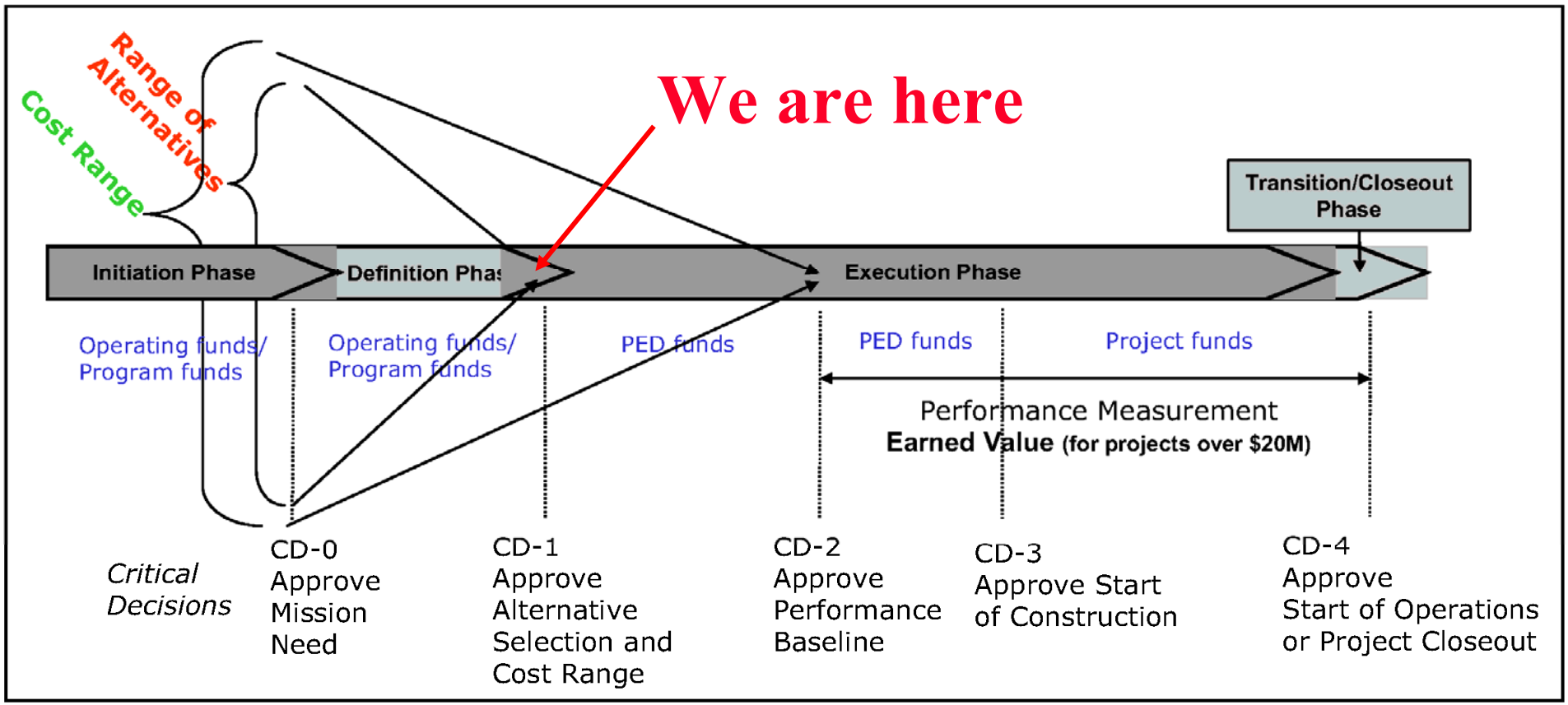


Figure 1-1. DOE Acquisition Management System.

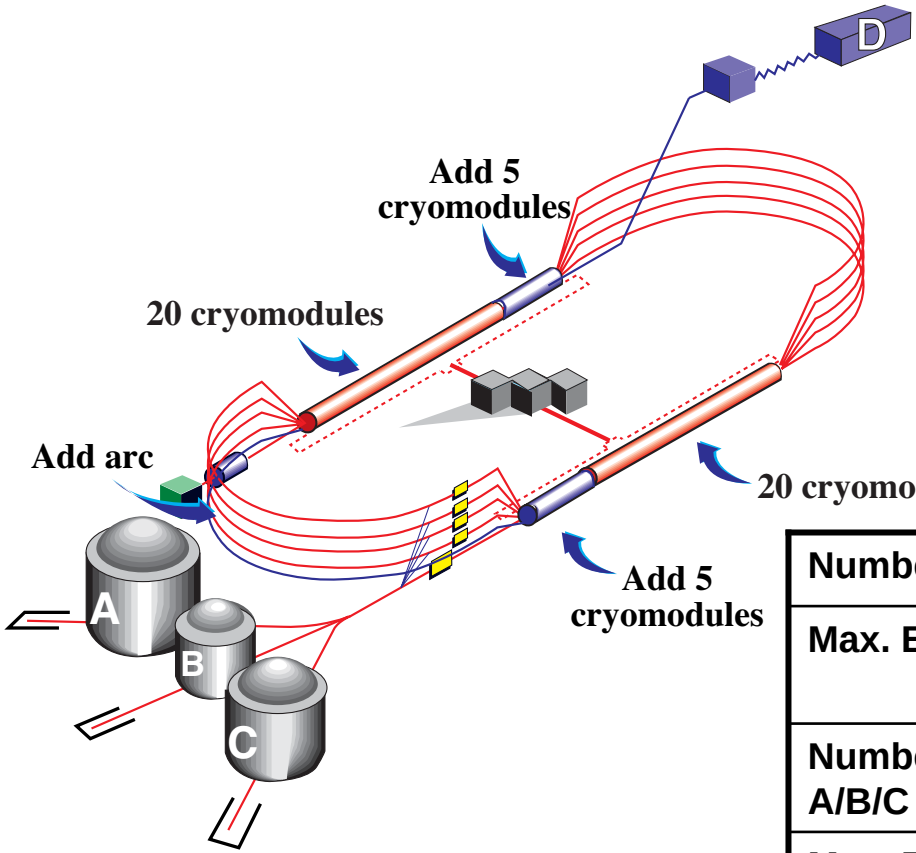
Examples of DOE Project Elements

- Integrated project team
- Project reviews
- Change control system
- Earned value management system
- Required documentation

►Highly structured system to control scope, cost, and schedule

12 GeV Project Overview

Project Overview – Accelerator and Civil Scope

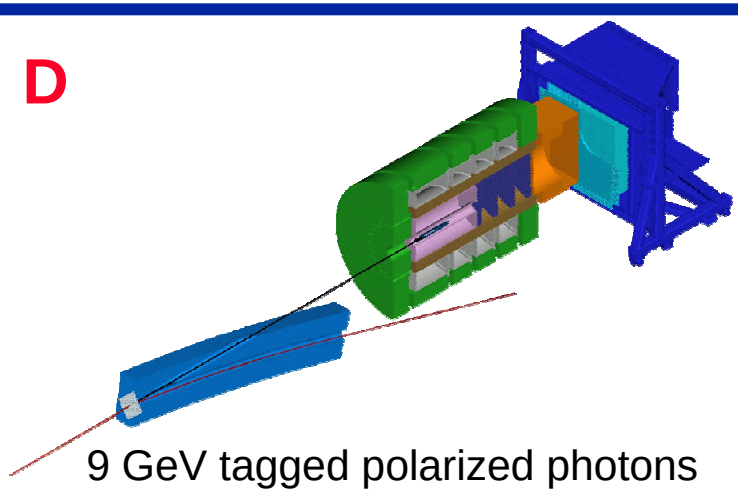


Scope of the proposed project includes doubling the accelerator beam energy, a new experimental Hall and associated beamline, and upgrades to the existing three experimental Halls.

Number of passes for Hall D	5.5 (add a tenth arc)
Max. Energy to Hall D	12 GeV (for 9 GeV photons)
Number of passes for Halls A/B/C	5
Max. Energy to Halls A/B/C	11 GeV
New Cryomodules	10 (5 per linac)
Central Helium Liquefier upgrade	9 kW (~2x present capacity)

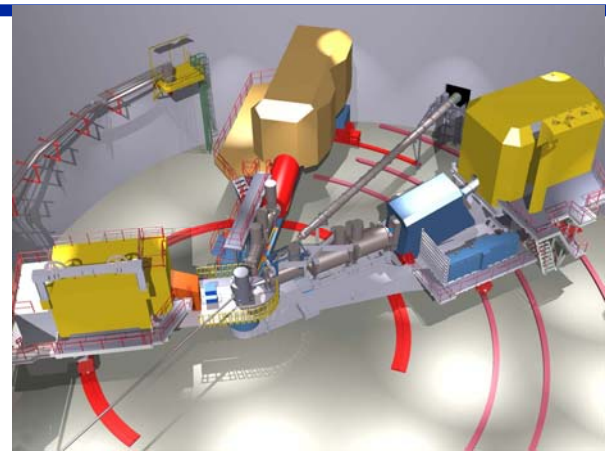
Project Overview – Experimental Equipment Scope

D



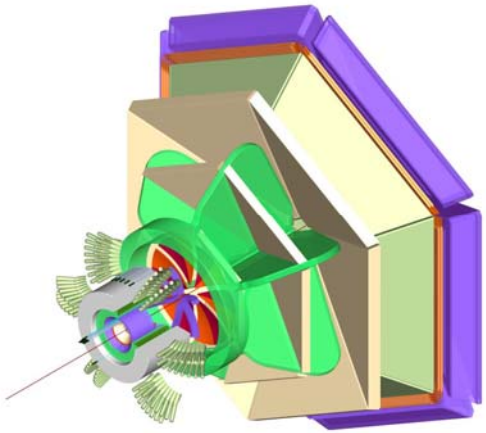
9 GeV tagged polarized photons and a 4π hermetic detector

C



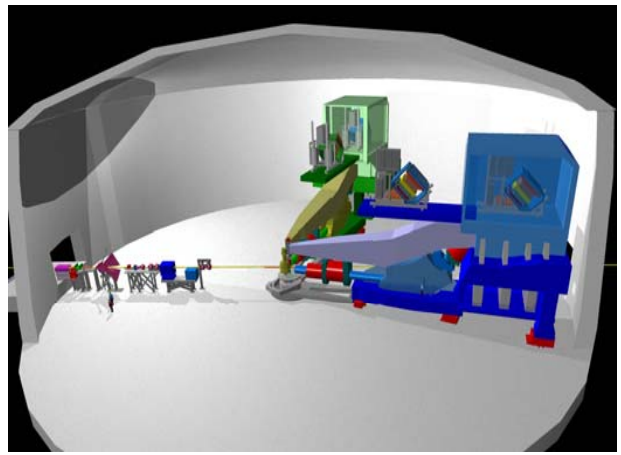
Super High Momentum Spectrometer (SHMS) at high luminosity and forward angles

B



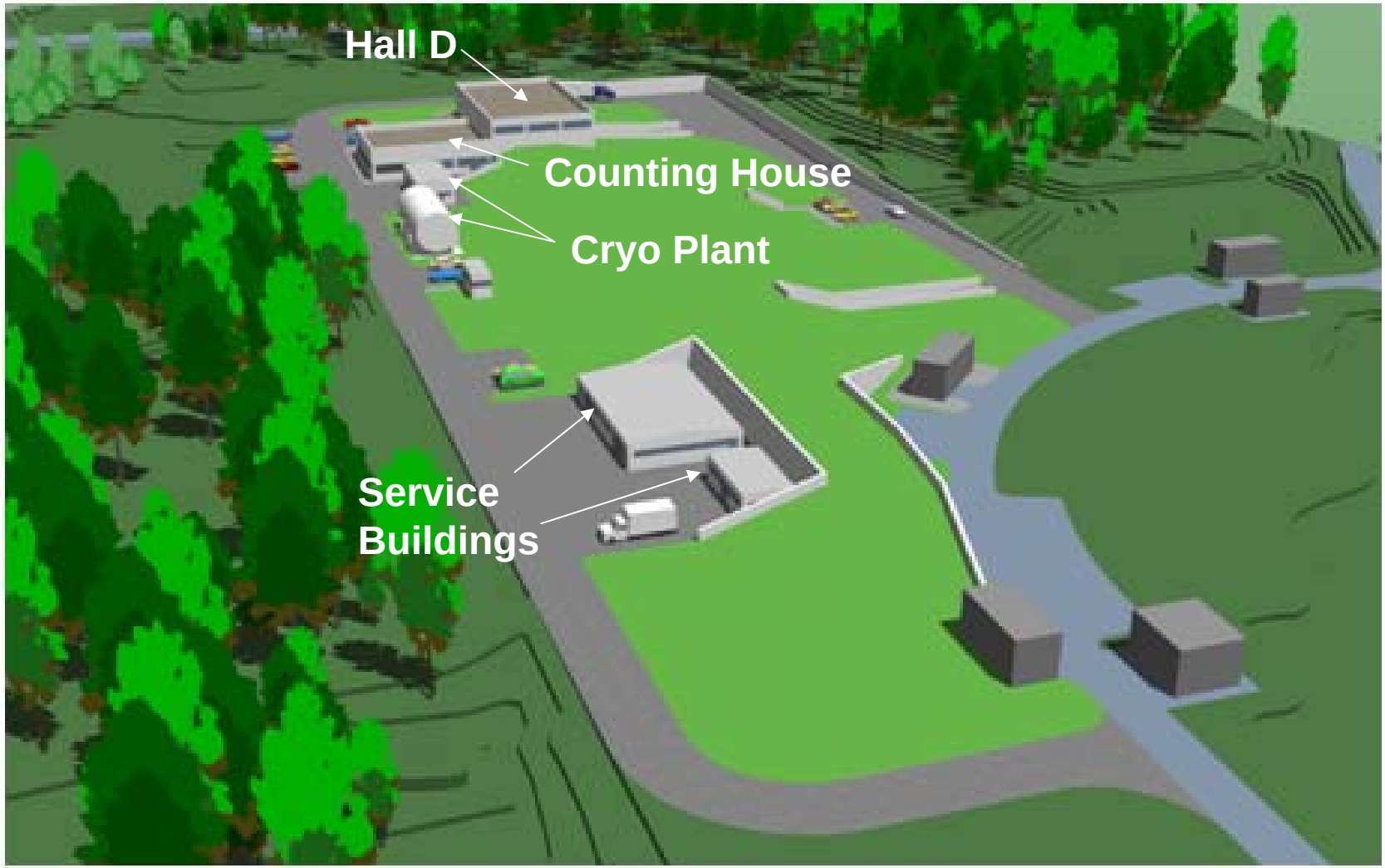
CLAS upgraded to higher (10^{35}) luminosity and PID to higher energy

A



High Resolution Spectrometer (HRS) Pair, and specialized large installation experiments

Architect's Rendering of Hall D Complex



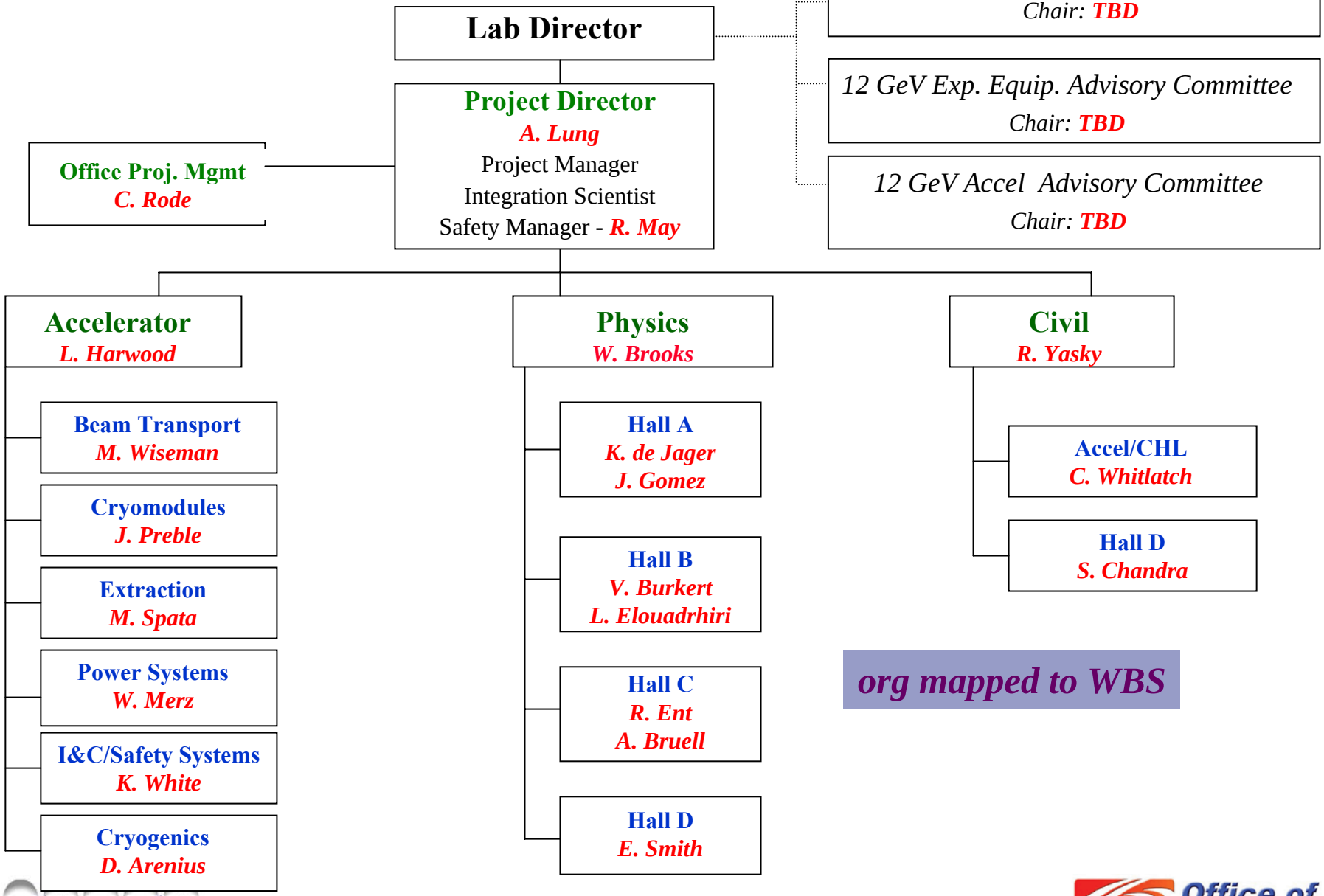
Project Leadership

Integrated Project Team (IPT) Members –

NAME	ROLE	ORGANIZATION
J. Simon-Gillo	DOE Program Manager *	DOE-NP
J. A. Turi S. Mallette	DOE Federal Project Director * Deputy Federal Project Director	DOE-TJNAF Site Office
R. Korynta	DOE Federal Project Engineer	DOE-TJNAF Site Office
B. Tippens	DOE Physics Lead	DOE-NP
W. Skinner	DOE Contracting Officer	DOE-TJNAF Site Office
S. Neilson	DOE ES&H Lead	DOE-TJNAF Site Office
A. Lung	JLab Project Manager *	SURA-TJNAF
C. H. Rode	JLab Project Management Support	SURA-TJNAF
L. Harwood	JLab Assoc. PM: Accelerator	SURA-TJNAF
W. Brooks	JLab Assoc. PM: Physics	SURA-TJNAF
R. Yasky	JLab Assoc. PM: Civil	SURA-TJNAF
R. May	JLab ES&H	SURA-TJNAF
M. J. Waite	JLab Procurements & Contracts	SURA-TJNAF

* Core IPT members

JLab 12 GeV Project Organization



org mapped to WBS

Work Breakdown Structure (WBS)

12 GeV WBS structure

3/10/2005

WBS Level	
1	Project
2	Sub-project
3	System
4	Sub-system
5	Major component
6	Component
7	Detailed part

Level

1 2 3 4 5 6 7

Summary Level L1-4 Folder

1. 12 GeV Upgrade to CEBAF
   - 1.0. CDR
     - 1.0.1. Accelerator systems
     - 1.0.2. Hall A
     - 1.0.3. Hall B
     - 1.0.4. Hall C
     - 1.0.5. Hall D
     - 1.0.6. Civil
     - 1.0.7. Document Preparation
     - 1.0.8. EA & NEPA
   - 1.1. R&D
     - 1.1.1. Accelerator systems
       - 1.1.1.1. Cryomodules
       - 1.1.1.2. Power Systems
       - 1.1.1.3. Cryogenics
       - 1.1.1.4. Beam Transport
       - 1.1.1.5. Extraction
       - 1.1.1.6. Instrumentation, Controls, and Safety Systems

WBS exists down to Level 5 or lower as appropriate for all major subsystems

12 GeV Upgrade: Reviews (CD-0 to CD-1)

Supporting CD-1:

- **JLab: GlueX detector review (10/04) -** *complete*
- **JLab: GlueX solenoid assessment (11/04) –** *complete*
- **JLab: review of baseline design (12/04) –** *complete*
- **JLab: review of Hall spectrometer options (1/05) –** *complete*
- **JLab: PAC27 review of "new" science motivations (1/05) –** *complete*
- **DOE: Science Review of the 12 GeV Upgrade (4/05) -** *complete*
- **JLab: Cryomodule Review (4/05) -** *complete*
- **JLab: Director's Project Review (5/05) -** *complete*

CD-1 Requirements:

- **DOE: Independent Project ("Lehman") Review (7/05) -** *complete*
- **DOE: Office of Science "ESAAB review" for CD-1 approval**

Independent Project (Lehman) Review

- **Pre-requisite for submission of 12 GeV Upgrade to Ray Orbach for CD-1 approval**
- **Review convened by Dennis Kovar (DOE-NP Program Manager) ; chaired by Dan Lehman (Director, Office of Project Assessment)**
- **Comprehensive charge covering cost/schedule/technical readiness for CD-1**
- **Held at JLab July 12 –14, 2005**
- **26 reviewers plus 5 DOE observers**
- **8 subcommittees for break-out sessions**
  - **4 Accelerator, 1 Civil, 1 Physics, 2 Cost/Schedule/Management**

Project Costs as Presented at Lehman Review

WBS	SCOPE	COST
1.2	PED	15
1.3	Accelerator Systems	68
1.4	Upgrade Halls A, B, C	44
1.5	Hall D	27
1.6	Civil	20
1.7	Project Management	6
1.10	Non-DOE Scope	(20)
	DOE TEC *	160
1.0	CDR	1
1.1	R&D	5
1.8	Pre-Ops	5
1.9	ACD	3
	DOE OPC+TEC*	174
	Contingency @ 29%	51
	Escalation	25
	TOTAL DOE TPC (w/C&E) *	250

- Accelerator and Hall equipment are roughly equal
  - Hall A equipment ~$1M
  - Hall B/C/D equipment cost averages ~$24M
- Civil split ~equally between Accelerator systems and Hall D

* Assumes anticipated non-DOE funding secured

Lehman Review Outcome

- **No action items identified**

"All requirements required for CD-1 approval have been completed and are appropriate and adequate for CD-1 approval"

- **~45 Recommendations**
  - **additional text in documents**
  - **technical issues to be investigated through simulation or measurements**
  - **additional staff in Project Director's office**
  - **increased contingency for some items**
  - **increased schedule float**
- **Overall positive feedback and valuable advice**
- **Costbook from Lehman Review is the current operative budget**
  - **Change control process now in force**

CD-1 Documentation Requirements

- JLab Environmental Assessment Determination (EAD)
- Acquisition Strategy
- Preliminary Hazard Analysis Report
- Project Conceptual Design Report
- Project Execution Plan
- Risk Management Plan

Current Status of CD1

- **Project team has submitted all required CD1 documents to DOE**
- **We have responded to comments from JLab Site Office and DOE-NP; completed first round response to comments on this documentation from OECM at DOE**
- **Subsequent steps are all internal to DOE (NP approval, OECM approval, ESAAB review, CD1 signing)**
  - **project team provides additional information as requested**
  - **possible that all CD1 requirements met within a few weeks**
  - **planning assumes PED funding begins in April**

Upcoming Reviews in FY06

Internal project reviews

- Hall D tagger and beamline conceptual design review this month
- Upgrade Cryomodule Design Review before end of July
- Superconducting magnet conceptual design review before the end of August

External project reviews

- CD2A review of long lead procurements hoped for in spring/summer time frame

12 GeV R&D Program

12 GeV Upgrade R&D

- **Motivation - increase technical contingency by reducing risk**
- **Active and successful R&D program in FY04/05; larger program planned for FY06-FY08**
- **R&D Plan for FY06 to FY08 in place**
  - **Accelerator R&D**
    - cavity processing
    - 13 kW klystron testing
    - prototype LLRF system
    - spreader/recombiner magnet prototype
  - **Physics R&D**
    - magnet studies
    - detector prototyping
    - electronics studies/prototyping

12 GeV Upgrade: R&D (CD-0 to CD-1)

Experimental Equipment (FY04/05)

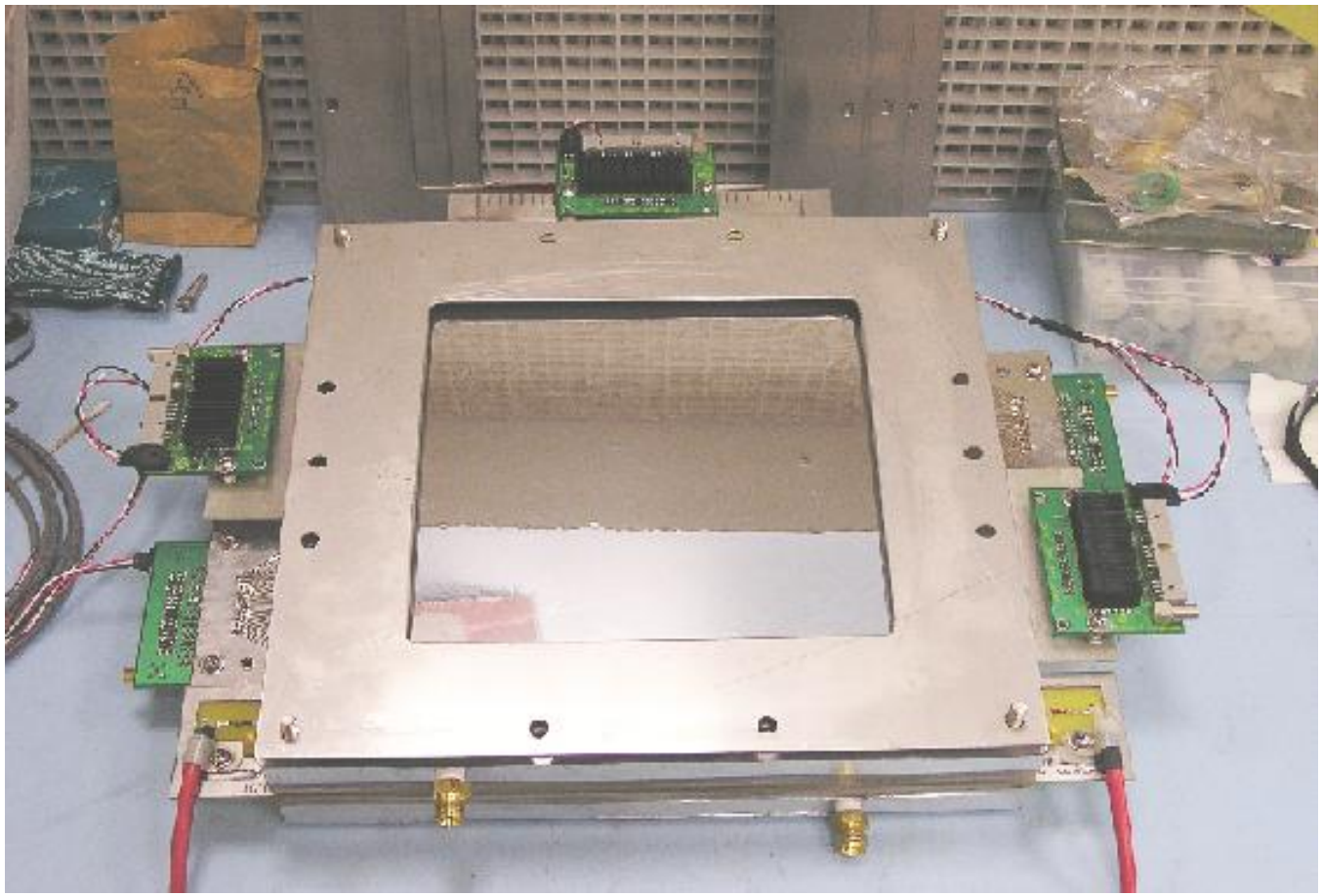
Detector Prototyping:

1. **Silicon Vertex Tracker Parasitic Beam Test (Hall B)**
   - Evaluated operation of silicon strip detector in close proximity to electron beamline
2. **Silicon Vertex Tracker Interface Board, Phase I (Hall B)**
   - Make a technical plan for development of the final design to interface SVT to JLab DAQ
3. **Central and Forward Drift Chambers (Hall D)**
   - Design cathode strip readout geometry to achieve required resolution at optimized cost
4. **Cosmic Ray Test Setup for Large-Scale Drift Chamber Prototype (Hall D)**
   - Fabricate, validate performance of large-area cosmic ray telescope

Superconducting Magnets: *(complete)*

1. **Test of superconducting magnet cable (Hall C)**
   - All can handle ~factor of two over spec in current
2. **Design and prototype of 5 kA current lead (Hall C)**
   - Design met requirements, no issues
3. **Feasibility study: SC spectrometer magnets (Hall C)**
   - Conclusions in agreement with project cost/schedule estimate

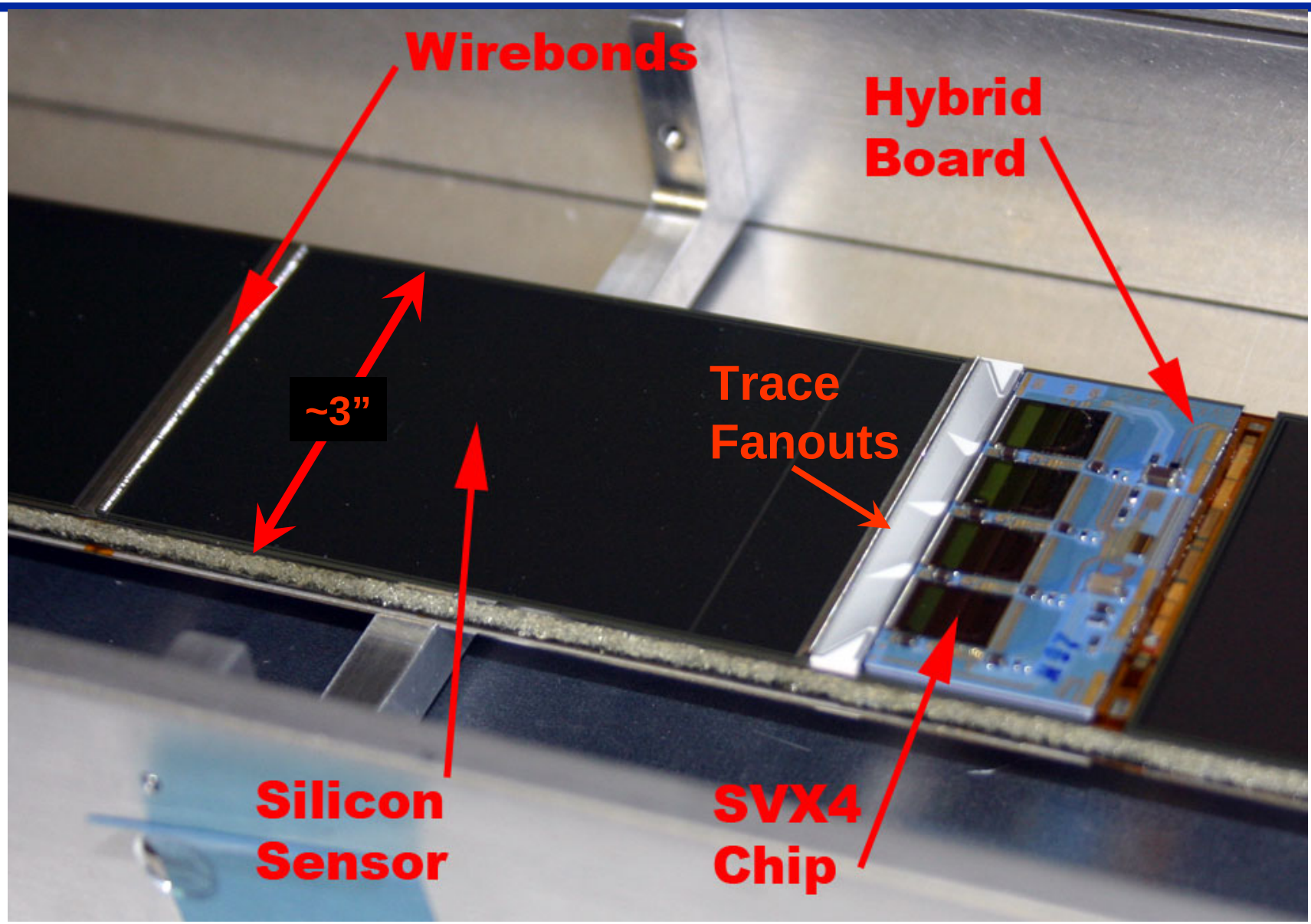
12 GeV Upgrade: Detector R&D

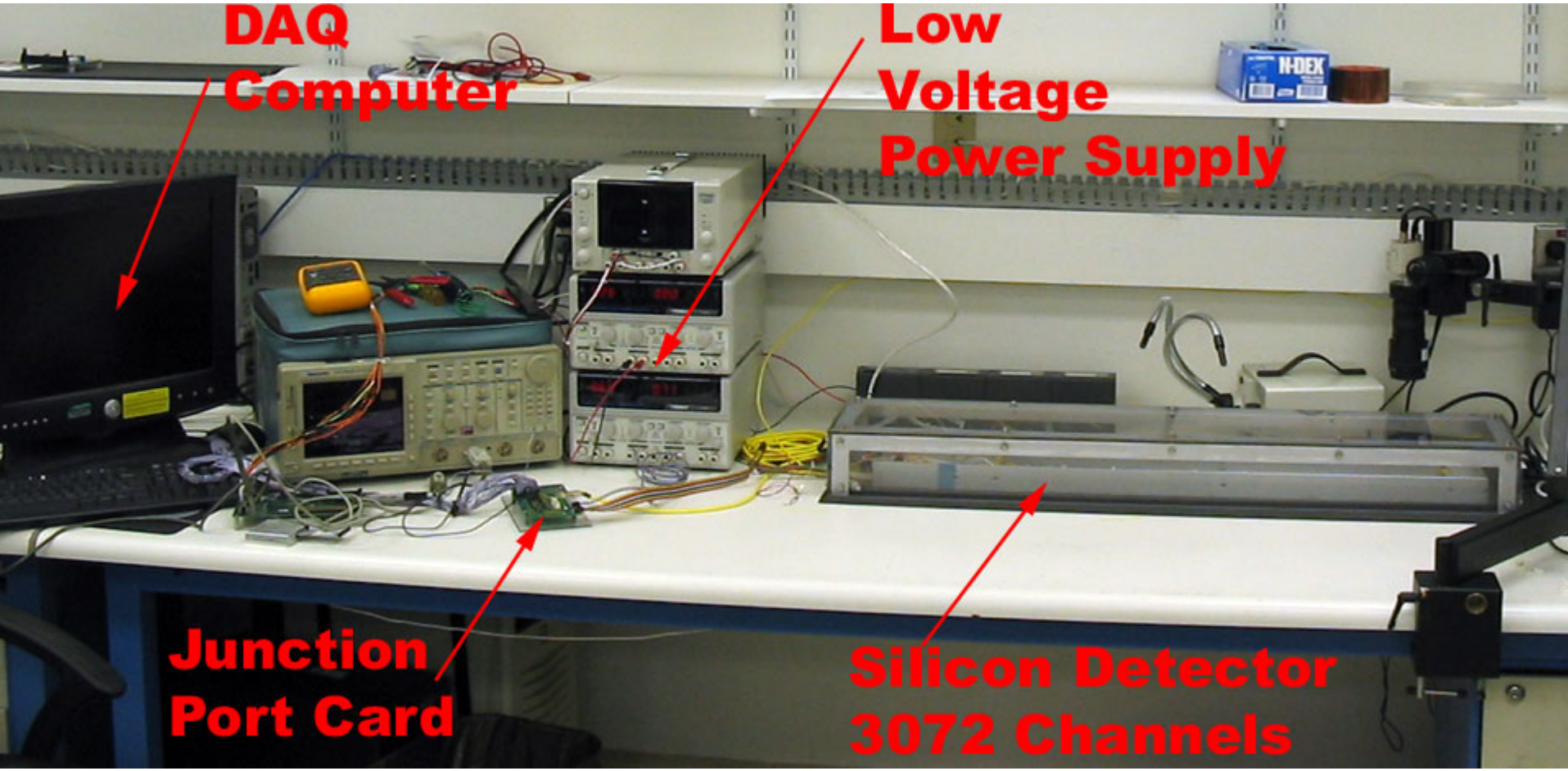


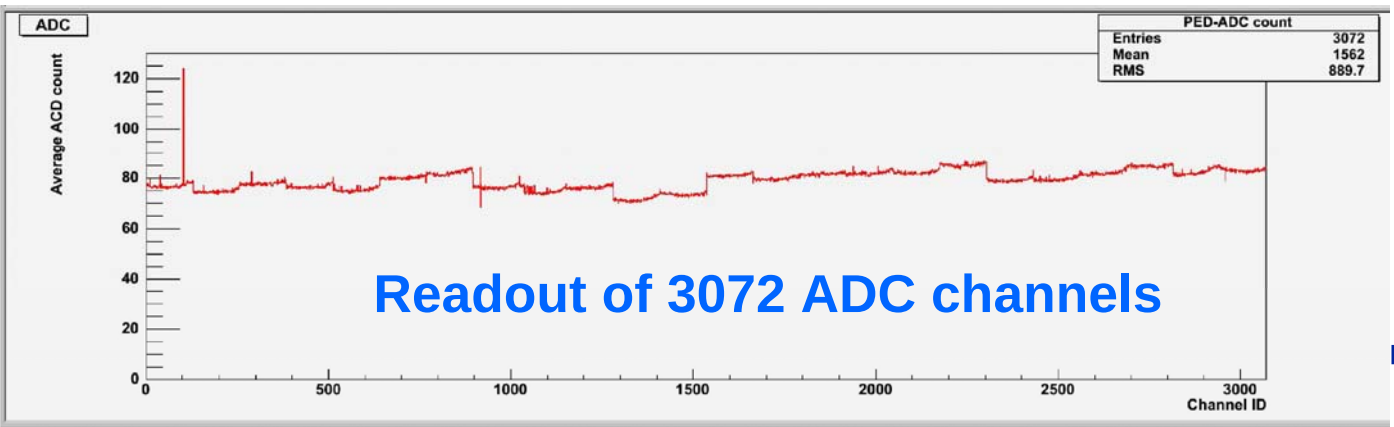
Photograph of assembled Hall D Forward Drift Chamber (FDC) prototype

(Simon Taylor and Daniel Carman, Ohio University)

Silicon Vertex Tracker Prototyping (CLAS12)







Bench tests of SVT prototype at JLab

12 GeV Upgrade: R&D (CD-0 to CD-1)

Accelerator Systems (FY04/05)

Upgrade cryomodule design and RF controls:

1. Testbed: FEL-3 Cryomodule and Low Level RF control system

- successful collaboration with Cornell
- digital LLRF can meet the phase and amplitude specs for 12 GeV

2. Testbed: Second generation high gradient cryomodule (Renascence)

- June '05 first 12 GeV-specific design bench tests in Test Lab

FY06 R&D Projects

Physics R&D projects for FY06

Hall B
SVT interface board and laser test stand
Prototyping mirror for high threshold Cerenkov
Prototyping of the pre-shower calorimeter
Prototyping of beam line

Hall C
SHMS quadrupole cold mass stress analysis
Prototype of quartz hodoscope
Development of alternative calorimeter configurations
Study combining both quadrupole magnets into a single cryostat*

Hall D
Full-scale prototypes of FDCs and CDCs
Barrel calorimeter fiber tests
Cerenkov readout and optics
UPV prototypes
FADC prototyping
Trigger development
Auxiliary electronic prototypes
Tagger prototypes

Accelerator R&D projects for FY06

Cryomodules
Renascence in-tunnel performance testing
RF window design
Cavity processing studies
Cavity tuner testing
Magnetic shielding validation

Power Systems
13 kW klystron testing
Phase 1 vertically integrated LLRF system test
Phase 2 vertically integrated RF system test
Electronic damping of microphonics

Beam transport
Magnet modeling validation

~$1.5M effort this year in R&D!
~$3.0M effort in ACD!

FY06 Hall C R&D and ACD

- **R&D projects (~$110k):**
  - SHMS quadrupole cold mass stress analysis
  - Prototype of quartz hodoscope
  - Development of alternative calorimeter configurations
  - Study combining both quadrupole magnets into a single cryostat*

- **ACD projects (~$250k):**
  - Validate and extend the existing concept for the combined function (CF) magnet; study performance parameters, such as resolution
  - Explore a CF magnet design (co-linear magnets) that is simpler to build
  - Lay groundwork for PED bid package for combined function magnet

Some FY06 Hall C Project Work and Milestones

- Report on SHMS quadrupole cold mass stress analysis before end of August
- Report on prototype studies of quartz hodoscope before end of June
- Report on development of alternative calorimeter configurations before end of July
- Successful participation in superconducting magnet review before end of August
- Preparation for full baseline design review for CD2B (~spring/summer 2007)
- Preparation and planning for FY07 R&D ($237k) and PED ($769k) work ($1M effort in total)
- Tracking of project cost and schedule

12 GeV Upgrade: Summary

- **Strong science program**
- **Planned project matching this unique science capability**
- **Experienced management team in place and operating**
- **A large effort already underway, much more to come**
- **On-cost and on-schedule completion of Upgrade is JLab's highest priority**

Project is on track for a CD-1 approval!