

The Jefferson Lab 12 GeV Upgrade Project

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& the Institute for SRF Science &
Technology

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TESLA Collaboration Meeting
DESY, January 14 – 17, 2008

Outline

- Current configuration and upgrade physics discovery potential
- Upgrade additions and modifications
- Project approval status, cost, schedule
- Accelerator and cavity requirements, performance and issues
- Summary
 - With thanks to Allison Lung, Larry Cardman, Leigh Harwood, Charlie Reece and many others!

Jefferson Lab Today

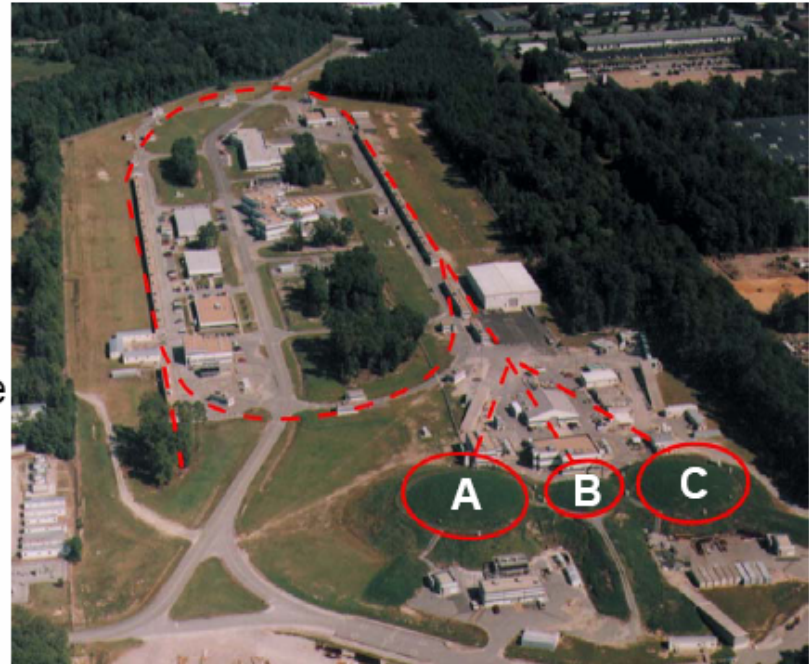
2000 member International User Community exploring the quark-gluon structure of matter



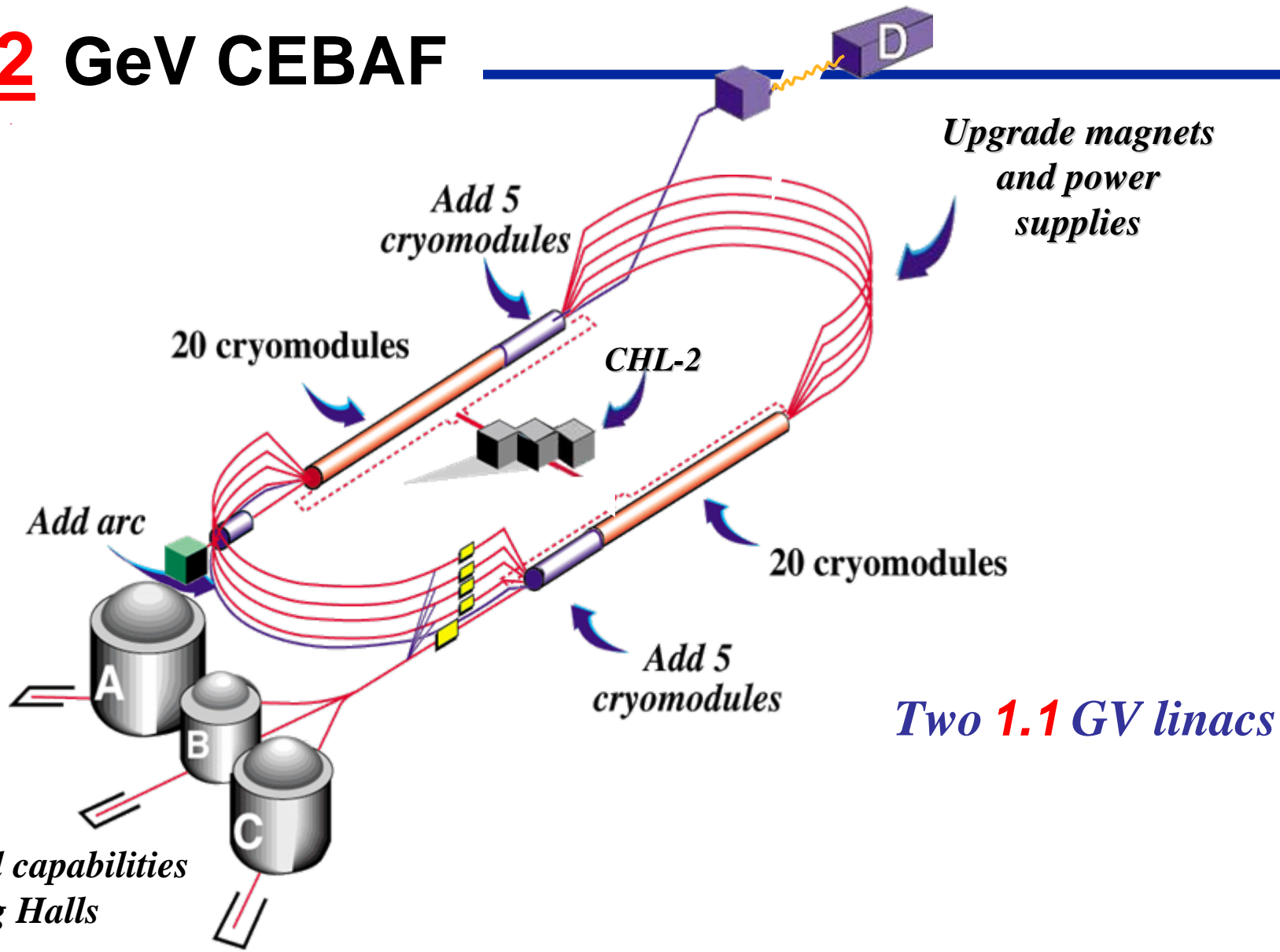
A recirculating superconducting linac provides 100% duty factor polarized beams of remarkable quality with energies up to 6 GeV

CEBAF's innovative design allows delivery of beam with independent currents and independent (but correlated) energies to three experimental halls simultaneously

Each of the three halls offers complementary experimental capabilities and allows for large equipment installations to extend scientific reach



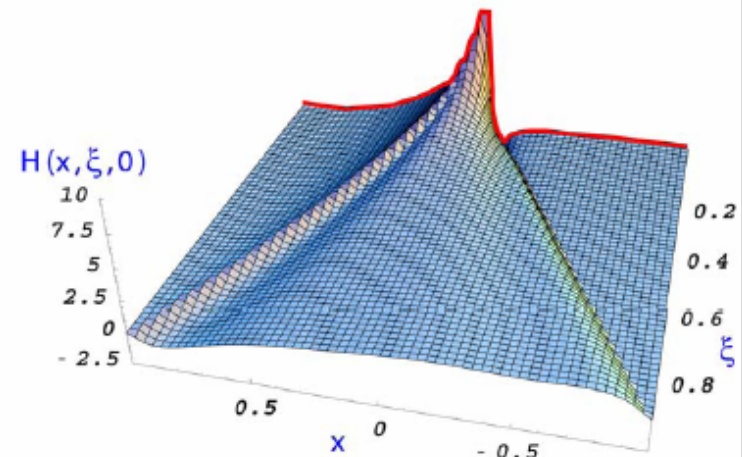
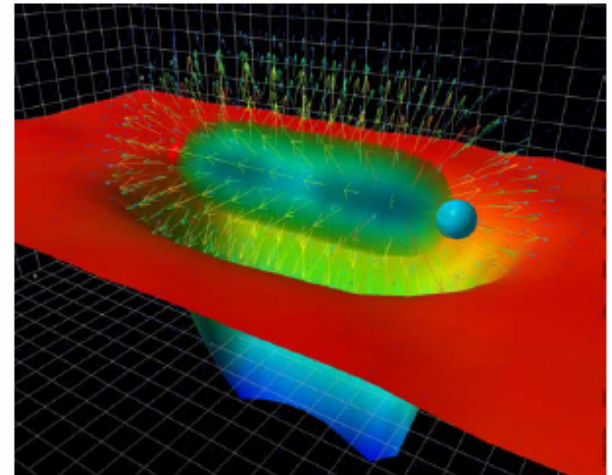
12 GeV CEBAF



Enhanced capabilities in existing Halls

The 12 GeV Upgrade Will Support Breakthrough Programs in Four Areas:

- The experimental study of the confinement of quarks – one of the outstanding questions of the 21st century physics (**Hybrid Meson Program**)
- Dramatic improvements in our knowledge of the fundamental quark-gluon structure of the nuclear building blocks (**GPDs and Valence PDFs**)
- Further exploration of the **limits of our understanding of nuclei** in terms of nucleons and the *N-N* force
- Precision experiments with sensitivity to TeV scale **physics beyond the Standard Model**
- **And other science we can't foresee**



DOE Generic Project Timeline

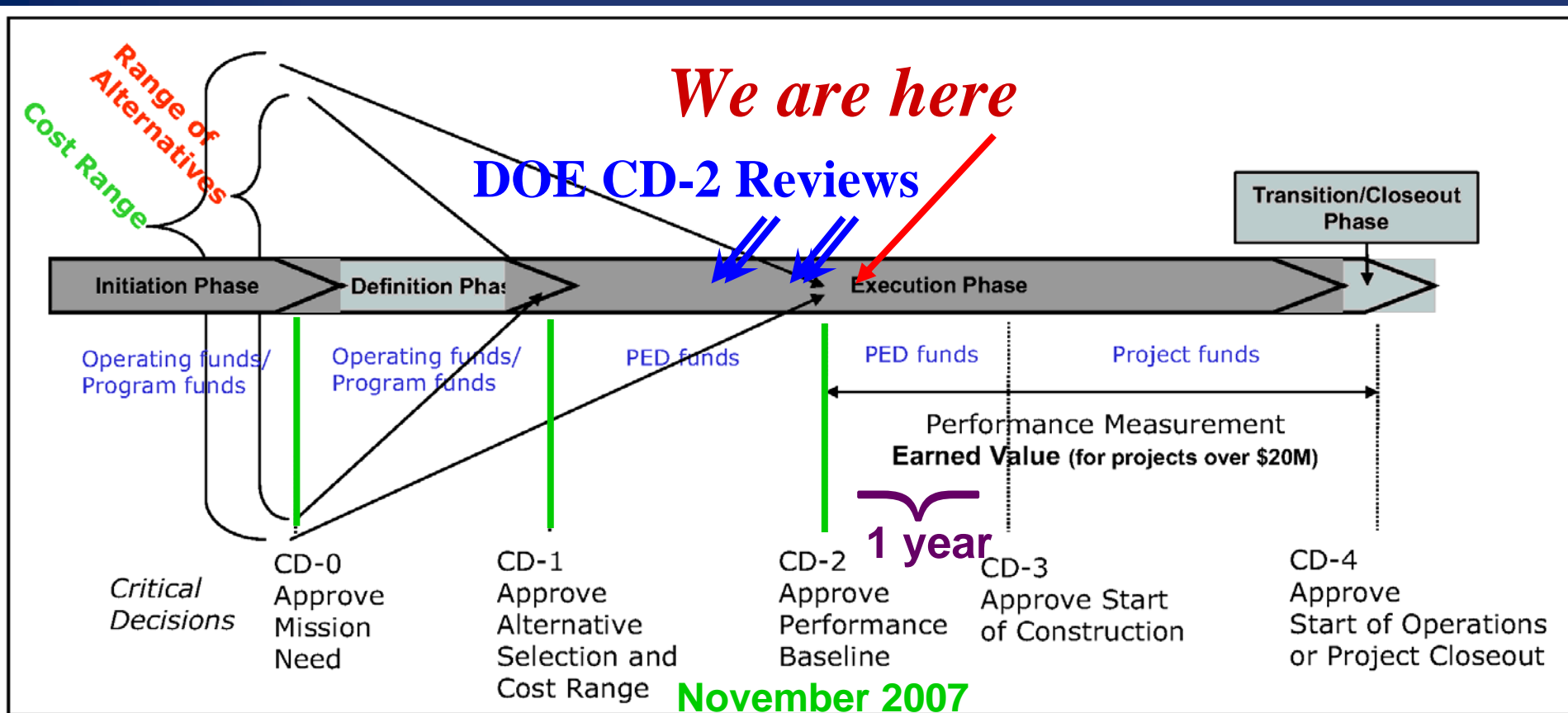
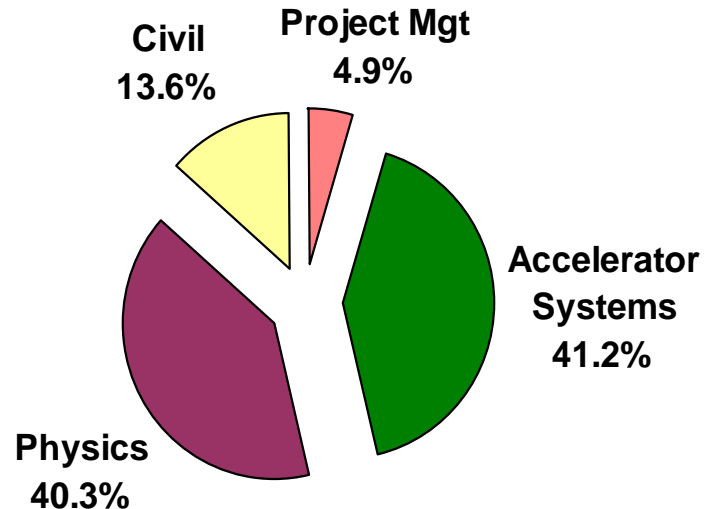


Figure 1-1. DOE Acquisition Management System.

12 GeV Cost Breakdown – Total \$310M

Accelerator and Hall equipment
are roughly equal ~\$75M each

Design & Construction



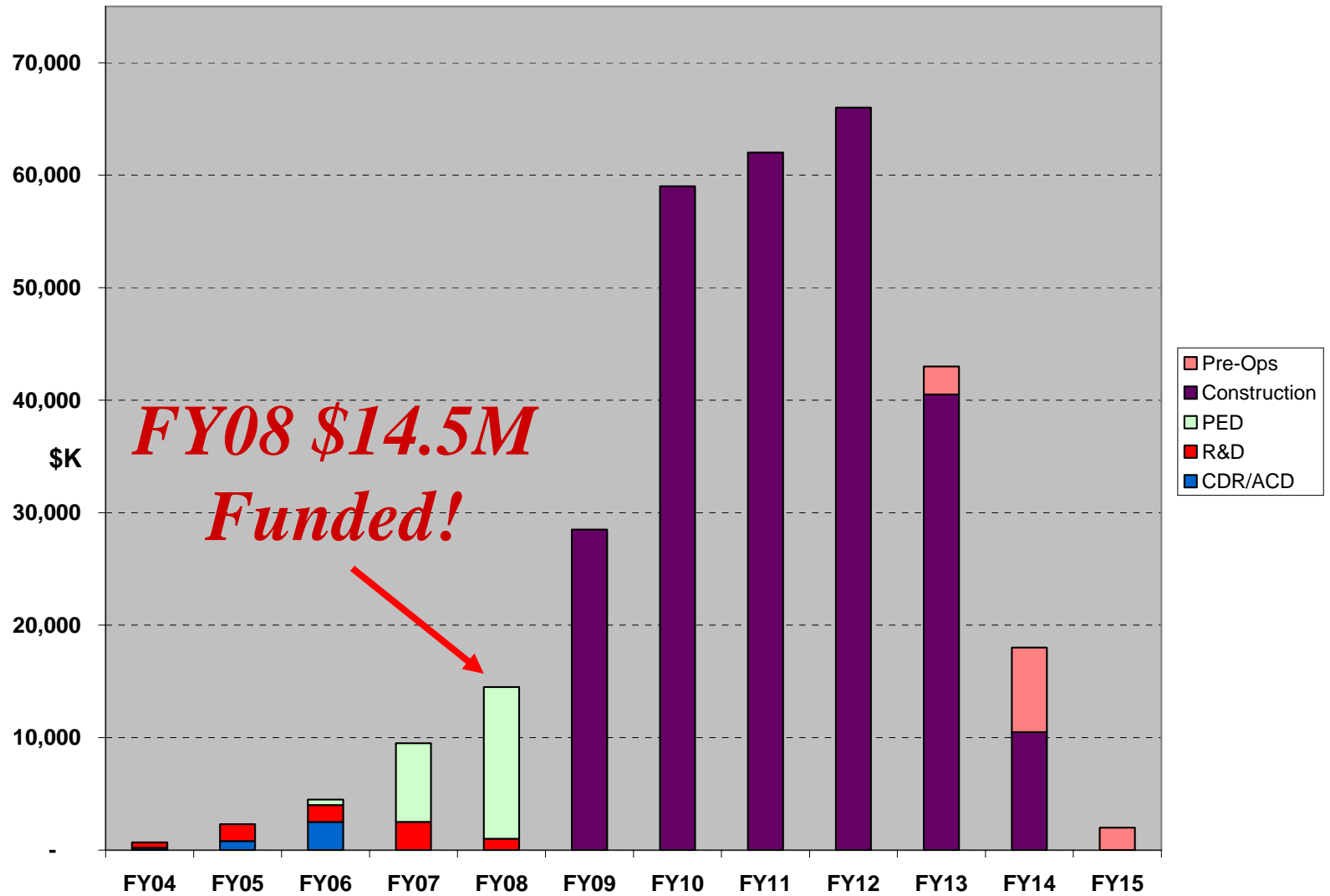
Hall B/C/D equipment cost
averages ~\$25M

Civil ~\$25M is split ~equally
between Accelerator/CHL
systems & Hall D Complex

- Data - EIR Sept 2007
- FY07\$, no cont./escalation

12 GeV FUNDING PROFILE

12 GeV - \$310M Total TPC - Jul-2007



12 GeV Upgrade: Phases and Schedule

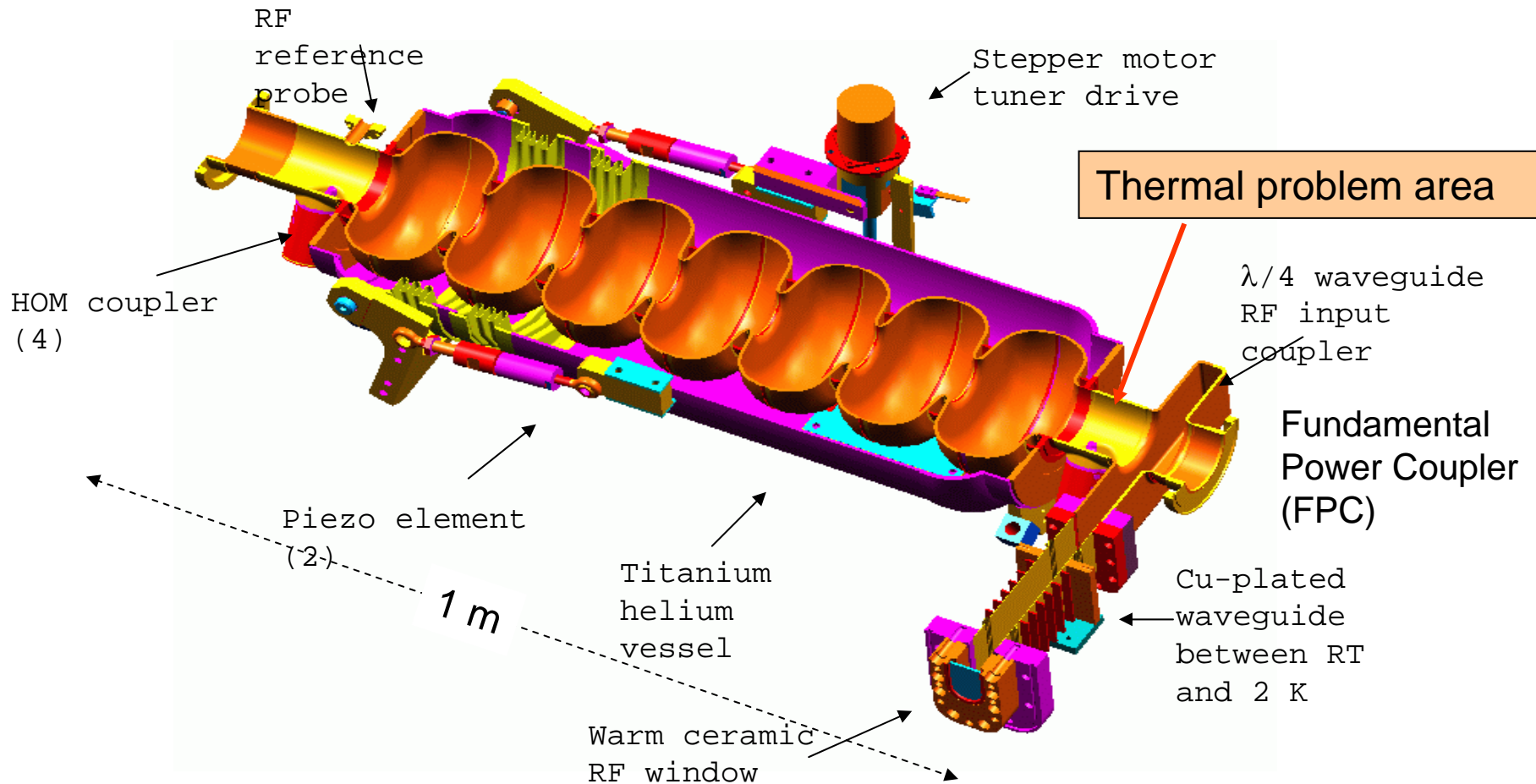
- ❑ 2009-2013 Construction – *starts in ~12 months!*
 - *Parasitic machine shutdown – May 2011 through Oct 2011 (6 months)*
 - *Accelerator shutdown start mid-May 2012*
 - *Accelerator commissioning mid-May 2013*
- ❑ Now-2012 Challenging balance act!
 - *Expectation is to complete ~80% of approved 6 GeV program*
 - *Skill mix – lean (but improving) engineering and design manpower*
- ❑ 2013-2015 Pre-Ops (beam commissioning)
 - *Hall A commissioning start ~October 2013*
 - *Hall D commissioning start ~April 2014*
 - *Halls B and C commissioning start ~October 2014*

Accelerator Upgrade

- CRYOMODULES:
 - Eight cavities packaged into each cryomodule
 - 42 cryomodules are installed in CEBAF today
 - 10 new ones will be added
- POWER SYSTEMS:
 - Each cavity has a dedicated microwave source
 - 338 of these are installed in CEBAF today
 - 80 new ones will be added
- CRYOGENICS:
 - New cryomodules result in a ~100% increase in the cryogenics load
 - Will replicate the existing cryogenics plant's capacity with a new, second CHL



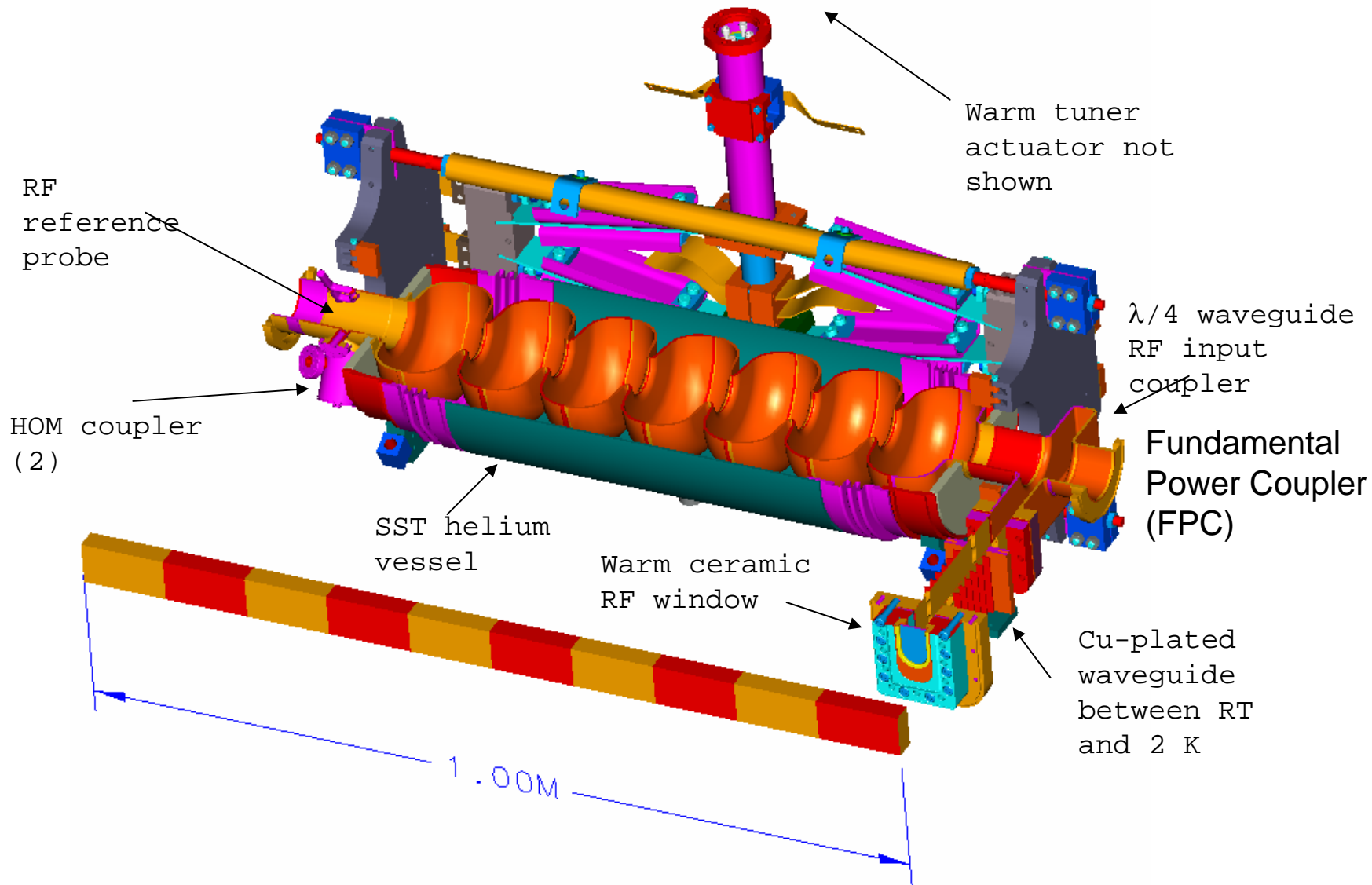
Upgrade Cavity – Initial Configuration



Issues and Solutions

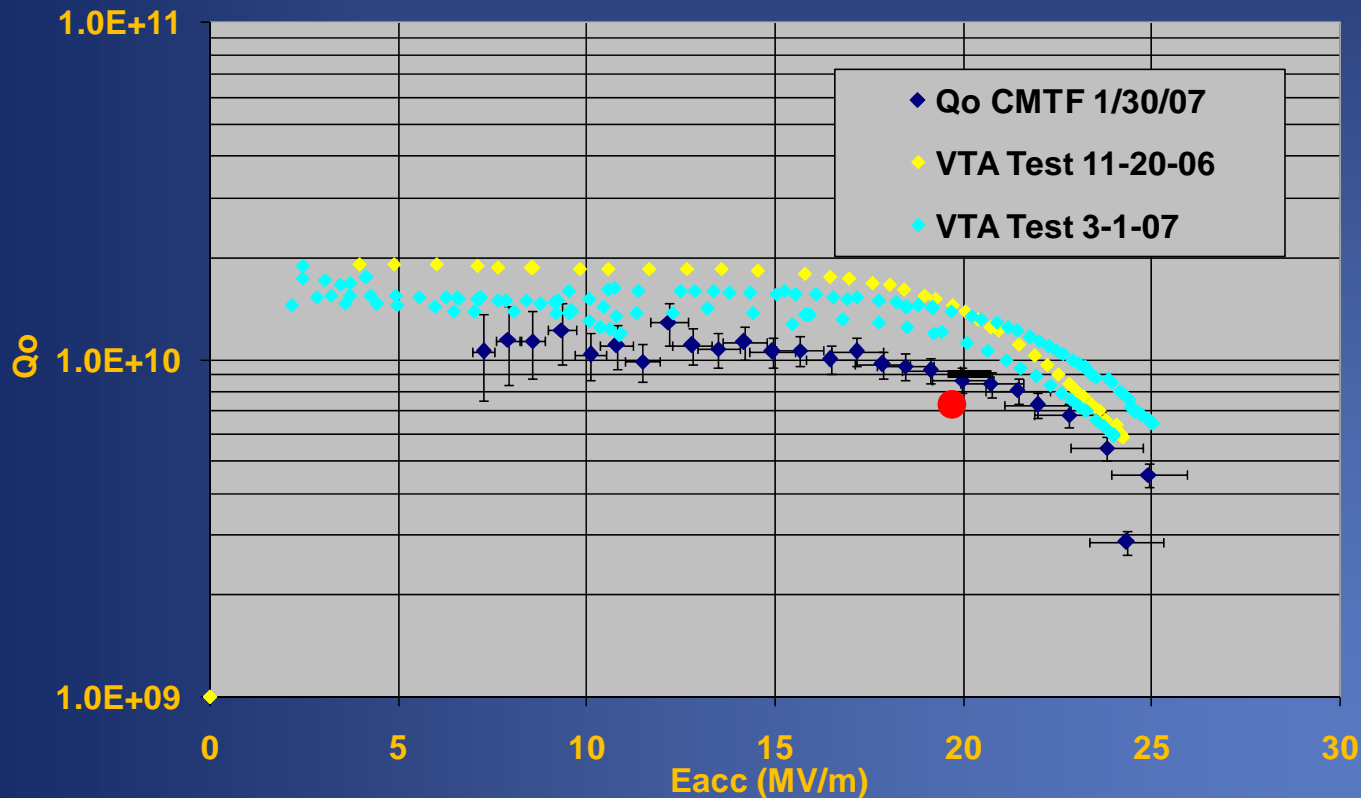
- **The HOM couplers on the FPC end of the cavities were particularly problematic.**
 - Subject to dynamic thermal environment due to conducted waveguide heat.
 - Adequate fundamental rejection was not consistently achieved.
 - **These problems are eliminated if these couplers can be removed.**
- **The HOM feedthroughs were not thermally stabilized.**
 - We cannot depend on conduction cooling through the gasket and flange.
 - **Strap the Cu body to a 2 K supply line.**
- **The HOM coupler rf cables need better thermal intercepts for the inner conductor.**
 - Measure cable conduction properties to enable better system engineering.
 - Avoid continuous 300 K to 2 K conductor.
 - **A thermal shunt has been developed and tested.**
- **The fundamental H fields on HOM hook and probe are ~10% of peak in cells.**
 - Produces RF dissipation of 5-20 mW on Nb probe at 20 MV/m operation
 - **Reduce this further by optimizing the coupler orientation and location.**

Upgrade Cavity – Optimized Configuration



Cavity Performance – 1/4 Cryomodule

Qo vs. Eacc HTB-7
1/30/07



12 GeV Upgrade Summary

- CD-2 Approval
- Construction start in ~12 months
- Opportunities:
 - Highest priority in the 2007 NSAC Long Range Plan
 - Highest priority construction within DOE SC Nuclear Physics
- Challenges:
 - Maintaining/building science case within political arena – Users / JSA / SURA
 - Balancing ongoing operations with major construction project – make smart decisions & communicate them!