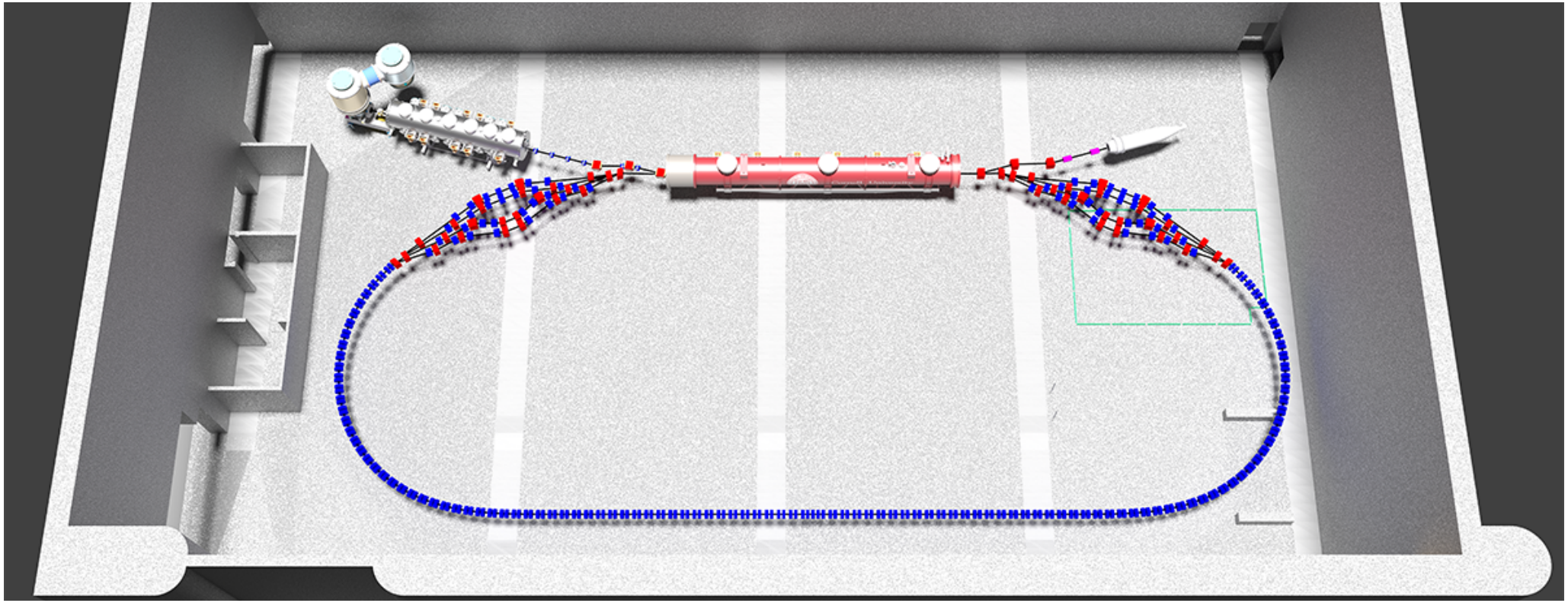
Cornell Perspectives

Ritchie Patterson

CBETA

CORNELL-BNL ERL TEST ACCELERATOR

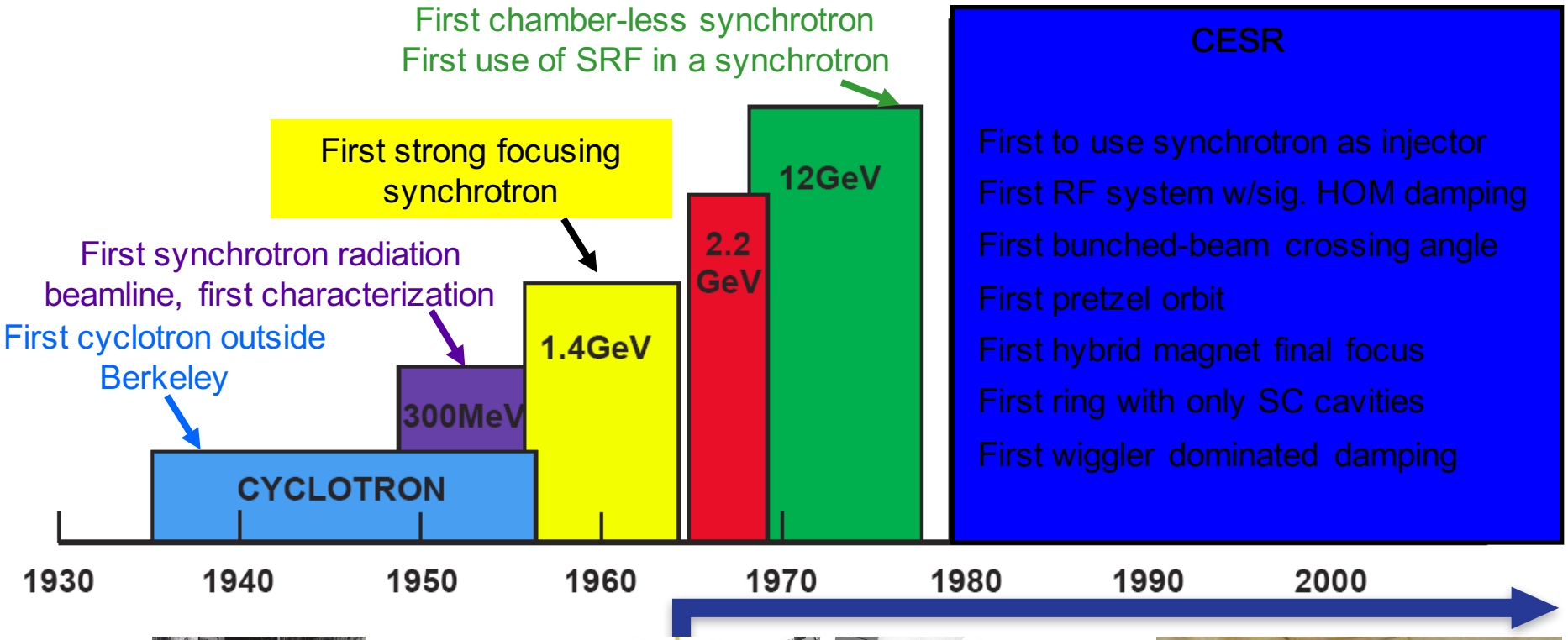


Cornell rings

Cornell synchrotrons and the Cornell Electron Storage Ring (CESR) serving

- Accelerator research
- Particle physics (through 2008)
- X-ray science (CHESS)

K. Berkelman,

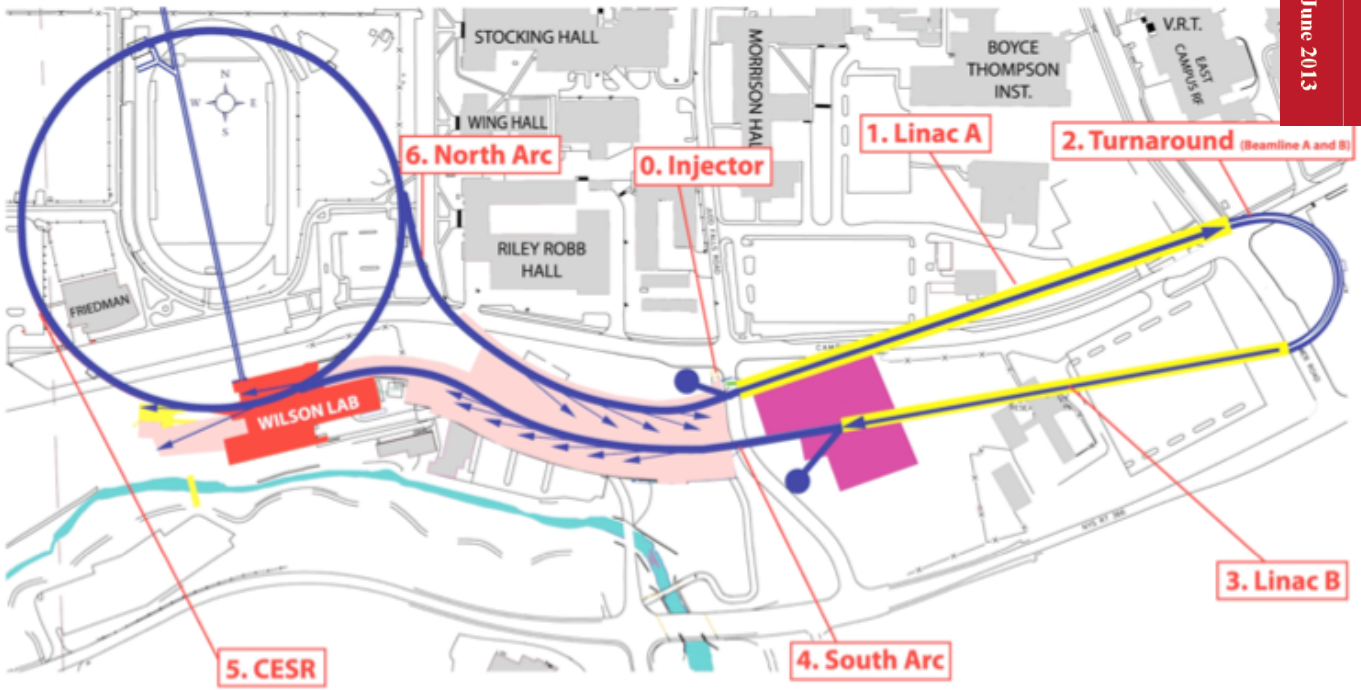


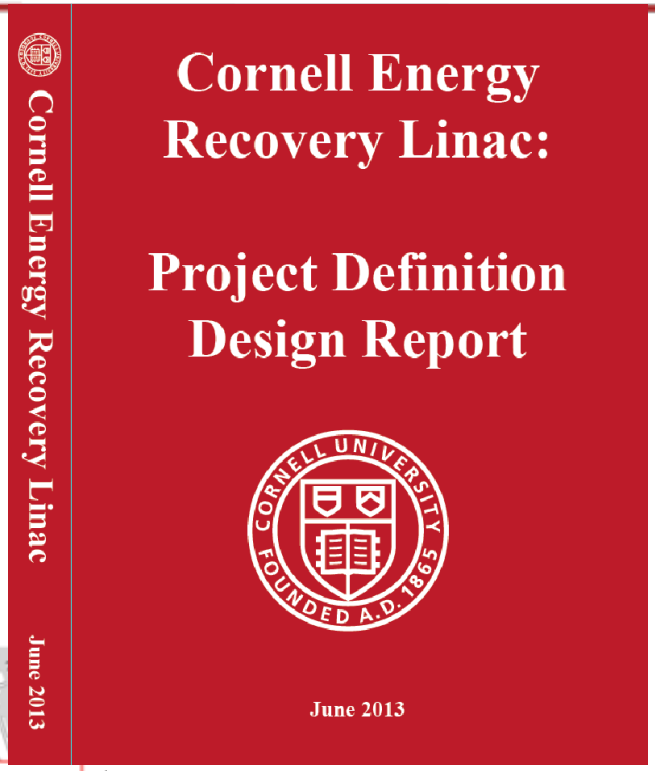
Cornell Energy Recovery Backstory

A decade of work on Energy Recovery Linac technology aimed at an ERL x-ray source

Motivation:
Bright, coherent, hard x-rays

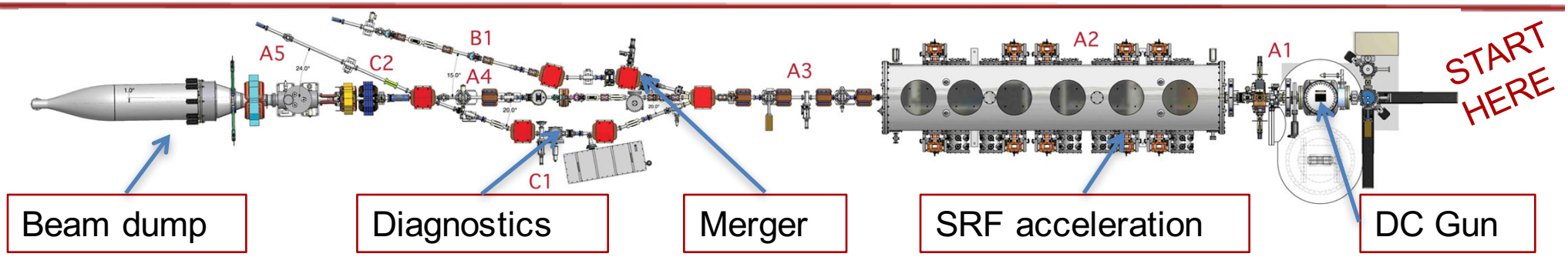
R&D was supported for a decade by NSF Division of Materials Science, New York State and Cornell, and then by NSF Physics Division and industry.

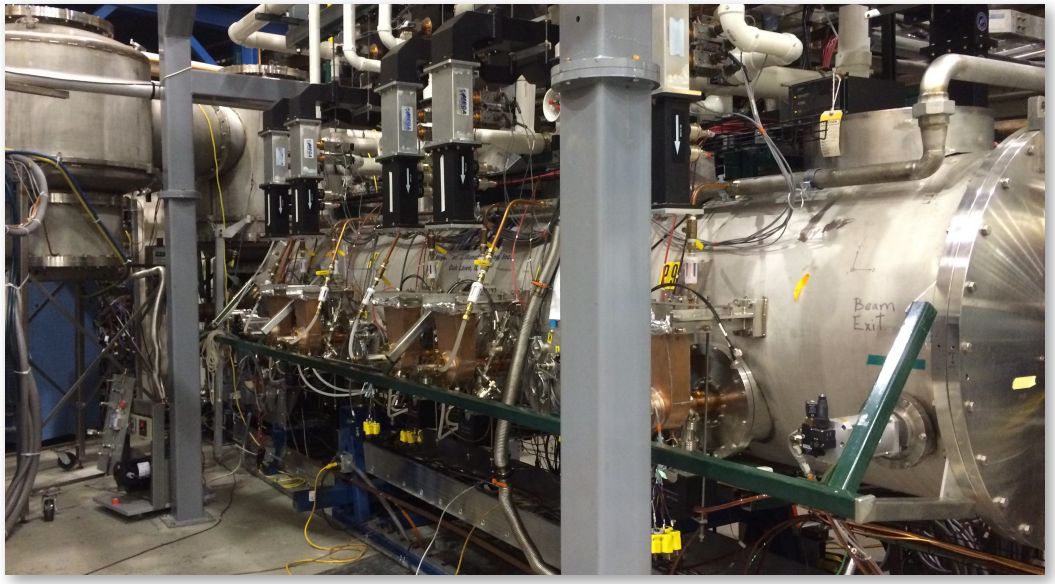


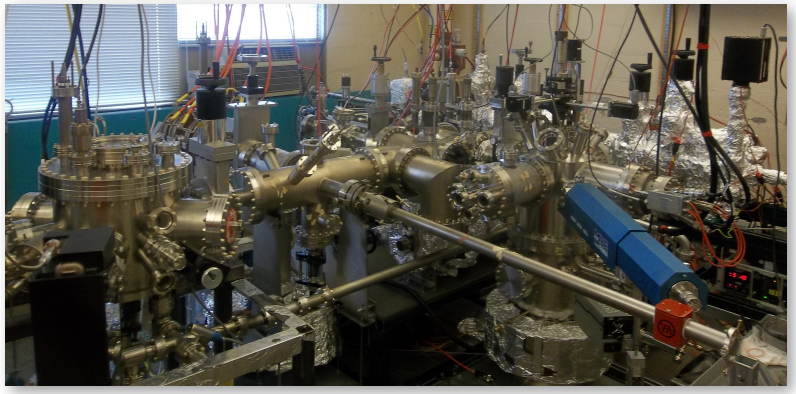


Design report
530 pages of conceptual and engineering design
www.classe.cornell.edu/ERL/PDDR

Bright source of electrons





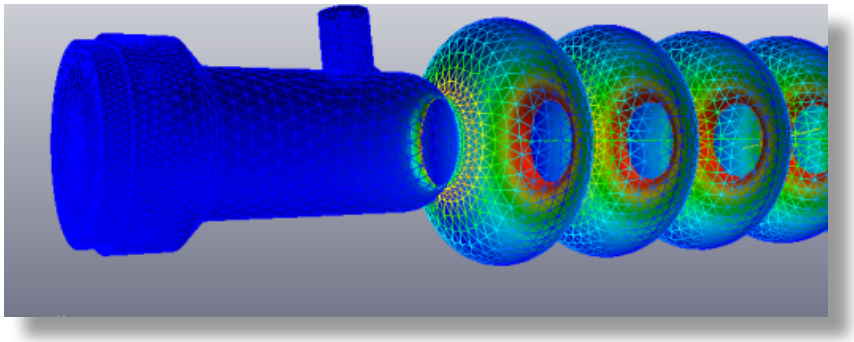


Bazarov Photocathode Lab

Alkali-antimonide growth and characterization

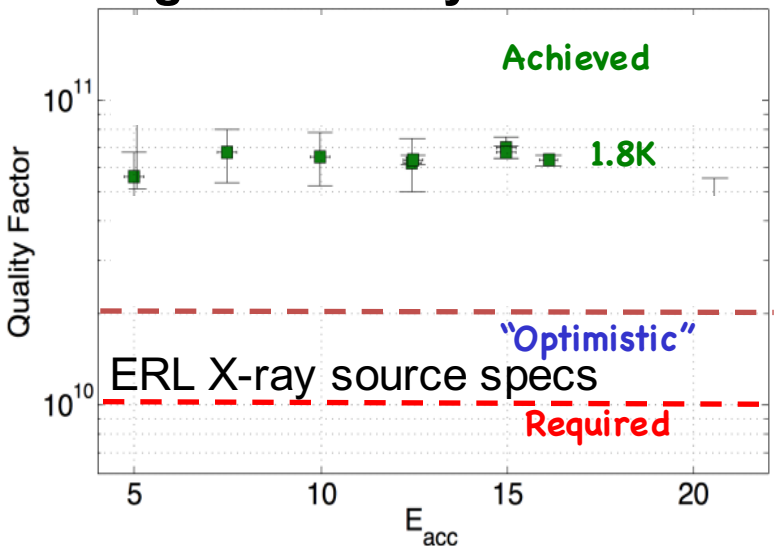
- Record current for a low emittance source (>65 mA)
- Record low emittance
- Good cathode lifetime

Superconducting accelerating cavities

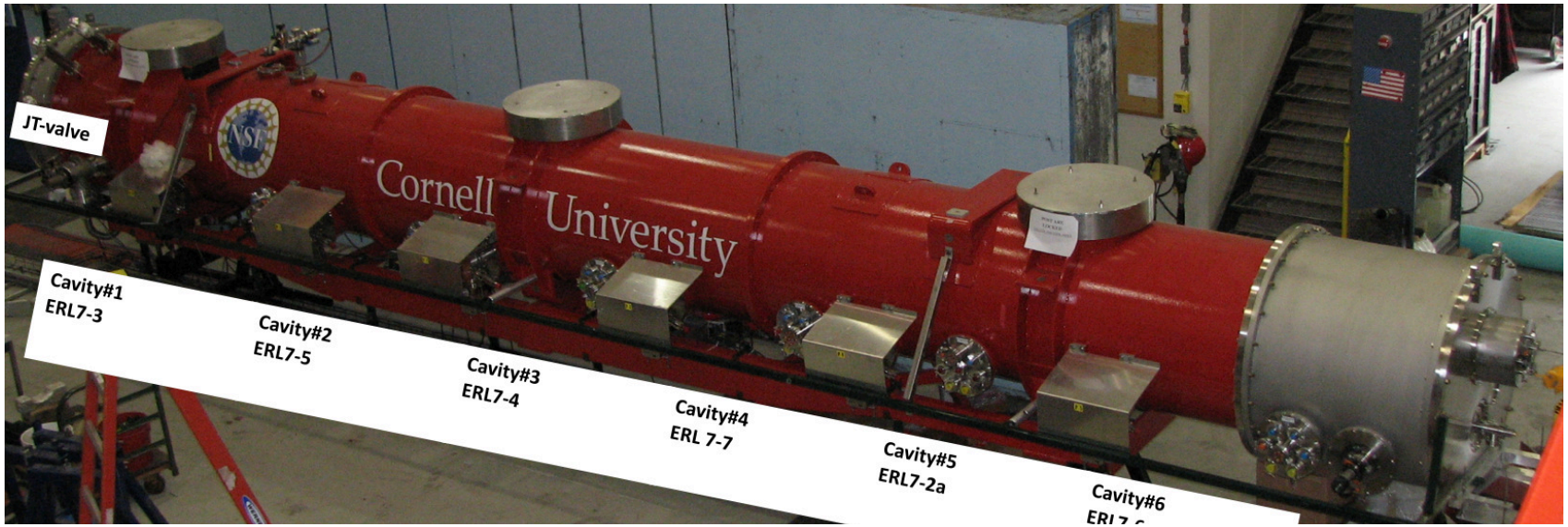


An earlier Cornell cavity design is now in use in NSLS II

High Efficiency Cavities



Highest Q_0 in a cryomodule

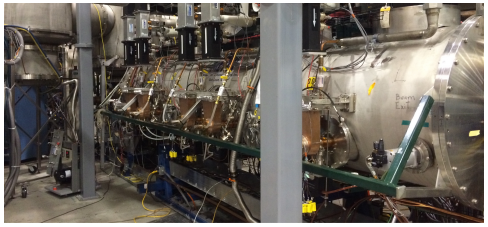


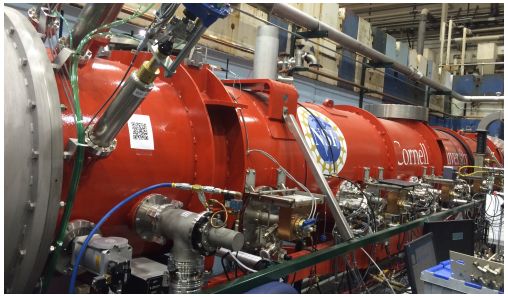
Initial tests in 2015; further tests planned for Fall 2016
Gradient and efficiency surpass CBETA needs

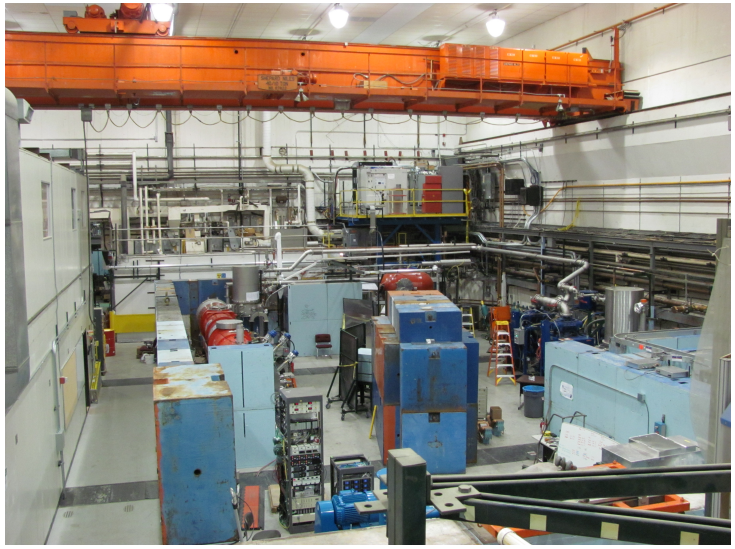
Cornell contributions to CBETA

Cornell provides:

- High performance photoinjector with DC gun and SRF accelerating section
- High Q superconducting RF linac
- Beam dump







Estimated value: $32M

All

- Have met or surpassed CBETA performance specs
- Are complete and operational
- Are installed in the experimental hall

CBETA team at Cornell is experienced, with an outstanding track record.

Cultural note

Cornell is funded primarily by NSF.

Typical process (with apologies to experts)

- Identify an interesting research program.
- Prepare a budget and timeline. NSF forbids contingency (except MREFC).
- Submit a proposal.
- Hope for approval, following peer review. Average NSF success rate is 20-25%.
- Do the research and submit annual reports.
- If you don't complete the project by the end of the award (usually 3 years), you may submit a follow-on proposal, but with reduced odds of success if you didn't deliver (Results of Prior Support)

- Differences from DOE: No contingency; less mid-project review; potentially dire consequences for failure. (Stewardship is not part of the NSF mission; rather, peer review rewards good performance.)

Why does Cornell want CBETA?

- Accelerator research is a focus of our Physics Department, and CBETA is a research accelerator
  Thesis topics for our students
- CBETA advances an ERL X-ray source.
- The CBETA beam has interesting applications:

- Very hard X-rays (>150 keV) for materials science using Inverse Compton Backscattering
  Could extend CHESS, a national X-ray user facility adjacent to CBETA
- Search for dark photons
- Probe Standard Model with a measurement of low energy parity violation

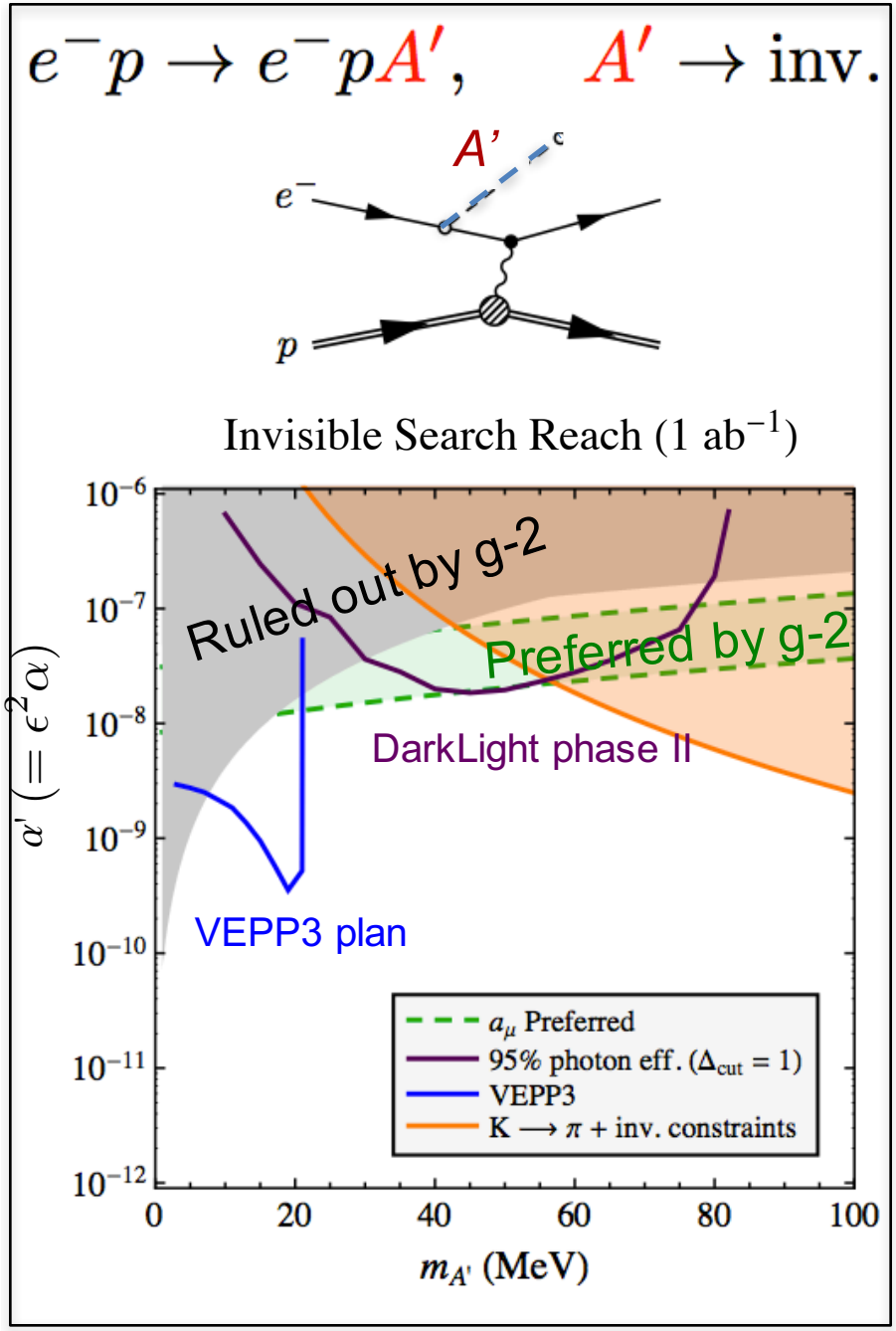
CBETA physics workshop

June 17-19, 2015 at Cornell

Workshop to study physics opportunities
with intense low energy electron beams

Parity Violation -- co-conveners: Kent Paschke (U. Virginia), Maxim Perelstein (Cornell)
Dark Matter, Dark Photons, Axions -- co-conveners: Andrei Afanasev (George Washington University), Gordan Krnjaic (Perimeter Inst.), Bogdan Wojtsekhowski (JLAB), Philip Schuster (Perimeter Inst.)
Electromagnetic nuclear physics -- co-conveners: Jan Bernauer (MIT), Ronald Gilman (Rutgers)
Technology -- co-conveners: Vadim Ptitsyn (BNL), Joe Grames (JLAB), Alexander Nass (Fz. Jülich)

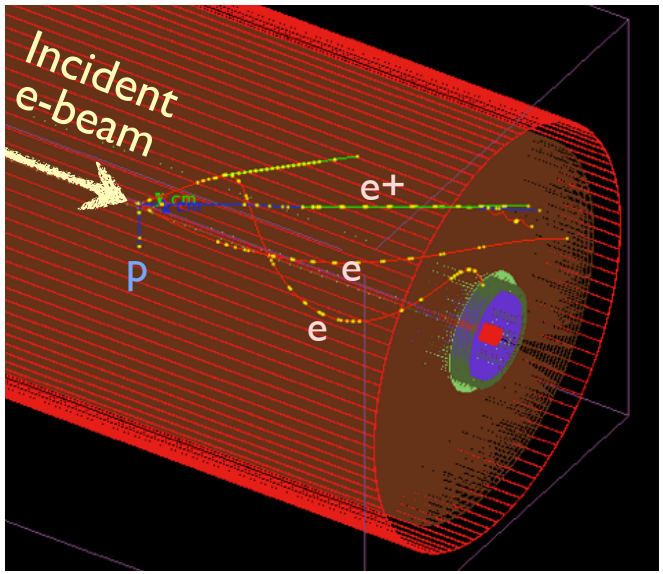
Dark photons



Search for *invisible* Dark Photon decays

- Not currently addressed by beam dump experiments
- High ERL flux → short target →vertex constraint

Full reconstruction of recoiling proton and electron



Cornell and Milner group at MIT proposed a feasibility study to NSF.

Focus: target, detector and machine optics designs

End