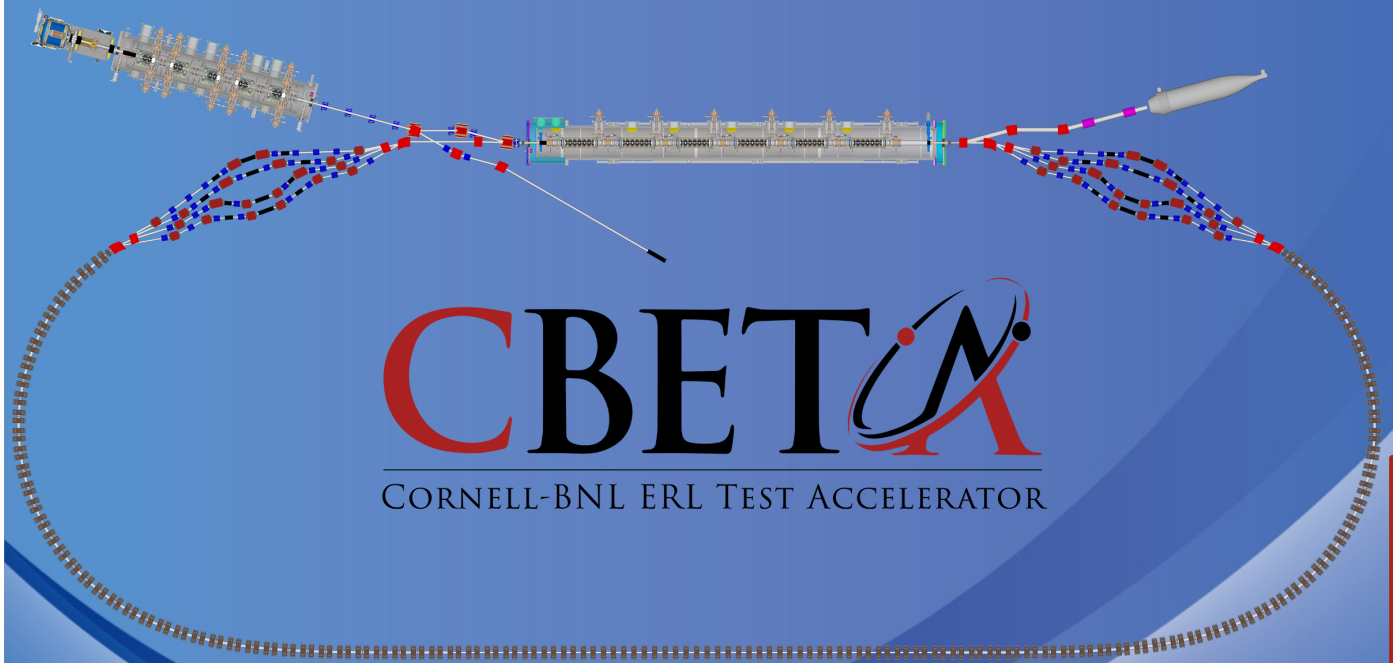
The Cornell/BNL FFAG-ERL Test Accelerator: CBETA
KPP and UPP strategy
Goals for the first 42 months

Georg Hoffstaetter (Cornell)



CBETA

CORNELL-BNL ERL TEST ACCELERATOR

BROOKHAVEN NATIONAL LABORATORY

a passion for discovery

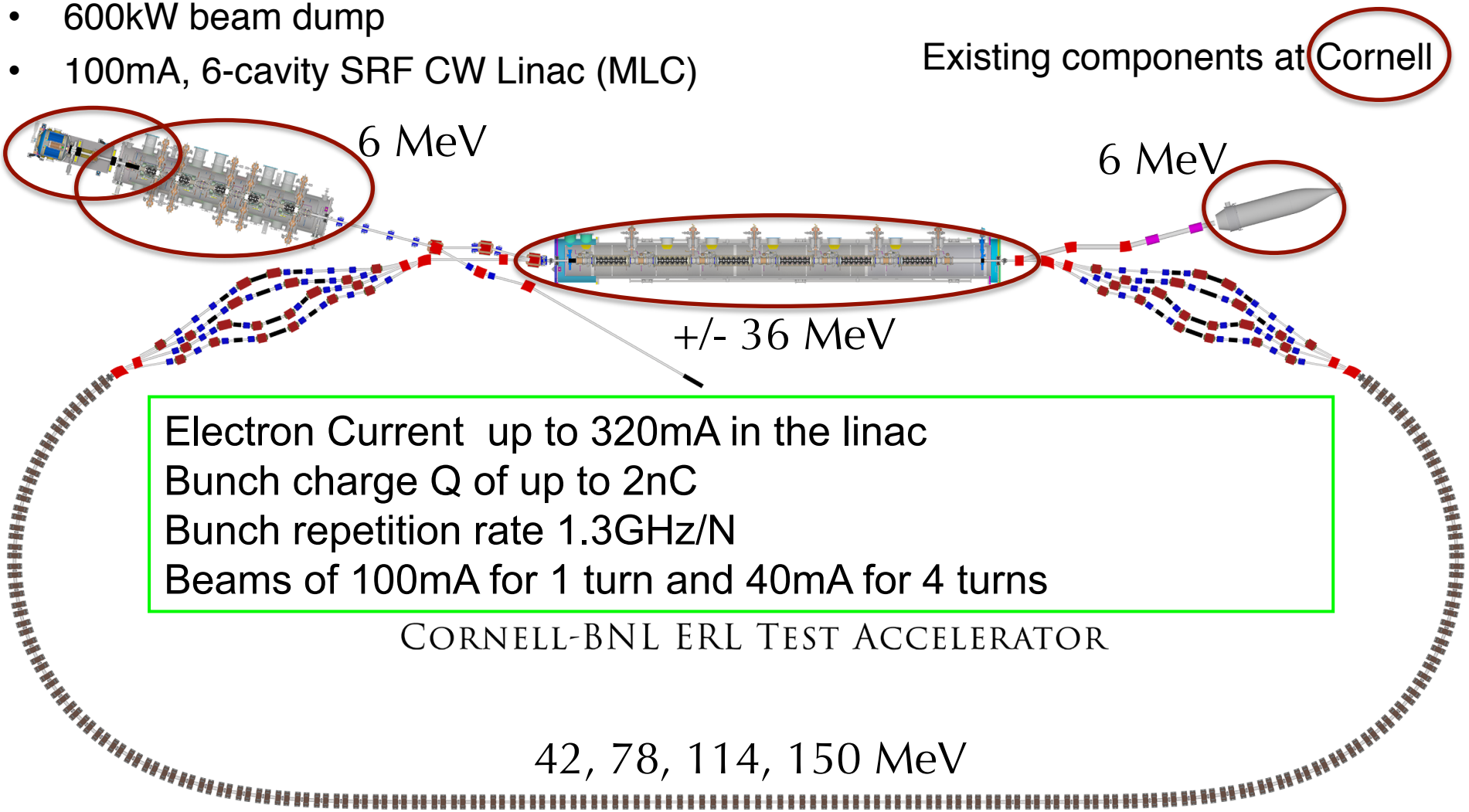
Office of Science
U.S. DEPARTMENT OF ENERGY

Cornell Laboratory for Accelerator-based Sciences and Education (CLASSE)

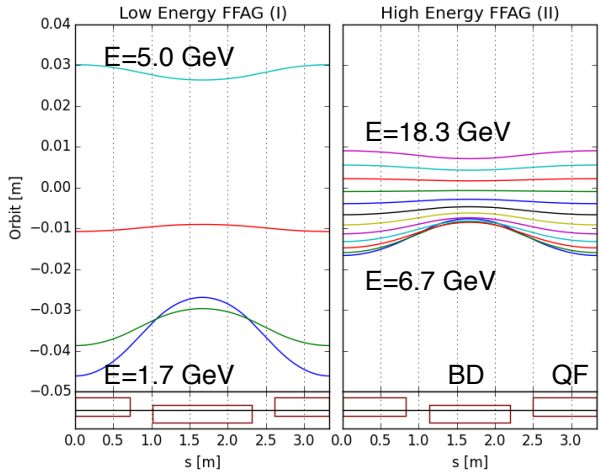
The test ERL in Cornell's hall LOE

- Cornell DC gun
- 100mA, 6MeV SRF injector (ICM)
- 600kW beam dump
- 100mA, 6-cavity SRF CW Linac (MLC)

Existing components at Cornell

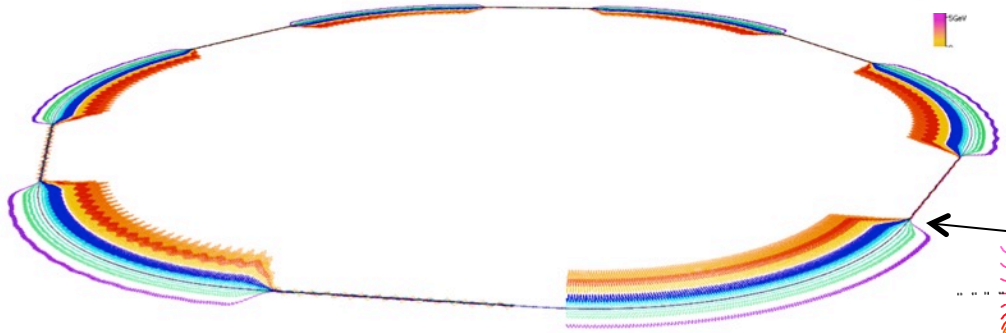


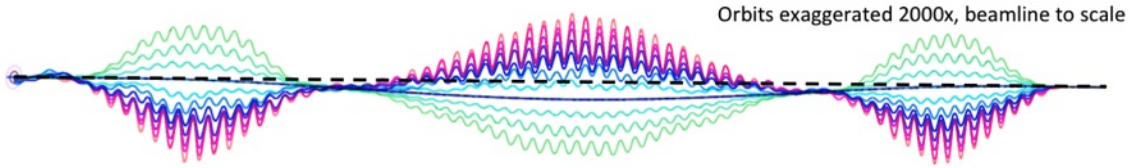
Topics of eRHIC to be studied in CBETA



- eRHIC uses two FFAG beamlines to do multiple recirculations.
  (FFAG-I: 1.7-5.0 GeV, FFAG-II: 6.7-18.3 GeV, 20 GeV)
- All sections of a FFAG beamline is formed using a same FODO cell. Required bending in different sections is arranged by proper selection of the offsets between cell magnets (or, alternatively, with dipole field correctors).
- Permanent magnets can be used for the FFAG beamline magnets (no need for power supplies/cables and cooling)

@S.Brooks, D.Trbojevic

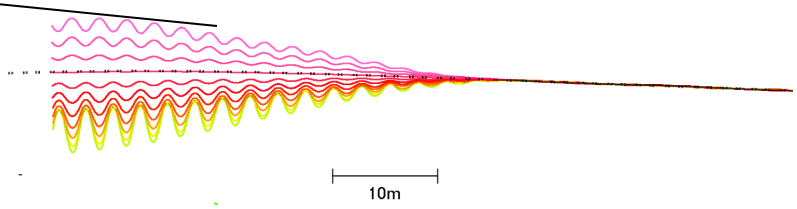




Orbits in Detector bypass section

Quad offsets evolve adiabatically

Orbits in Transition section



Each of two eRHIC FFAGs contain 1066 FFAG cells

CBETA topics to support eRHIC

CBETA study topics important for eRHIC:

1) **FFAG** loops with a factor of 4 in momentum **aperture**.
   a) Precision, reproducibility, alignment during magnet and girder production.
   b) Stability of magnetic fields in a radiation environment.
   c) **Matching** and correction of multiple simultaneous **orbits**.
   d) **Matching** and correction of multiple simultaneous **optics**.
   e) **Path length control** for all orbits.

2) Multi-turn ERL operation with a large number of turns.
   a) **HOM damping.**
   b) **BBU limits.**
   c) **LLRF control and microphonics.**
   d) **ERL startup from low-power beam.**

Key Performance Parameters and Ultimate Performance Parameters

Parameter	Unit	KPP	UPP (Stretch)
Electron beam energy	MeV		150
Electron bunch charge	pC		123
Gun current	mA	1	40
Bunch repetition rate (gun)	MHz		325
RF frequency	MHz	1300	1300
Injector energy	MeV		6
RF operation mode			CW
Number of ERL turns		1	4
Energy aperture of arc		2	4

Cost estimate after value engineering and concentration on KPPs

Staying in the financial frame requires concentration on the KPPs

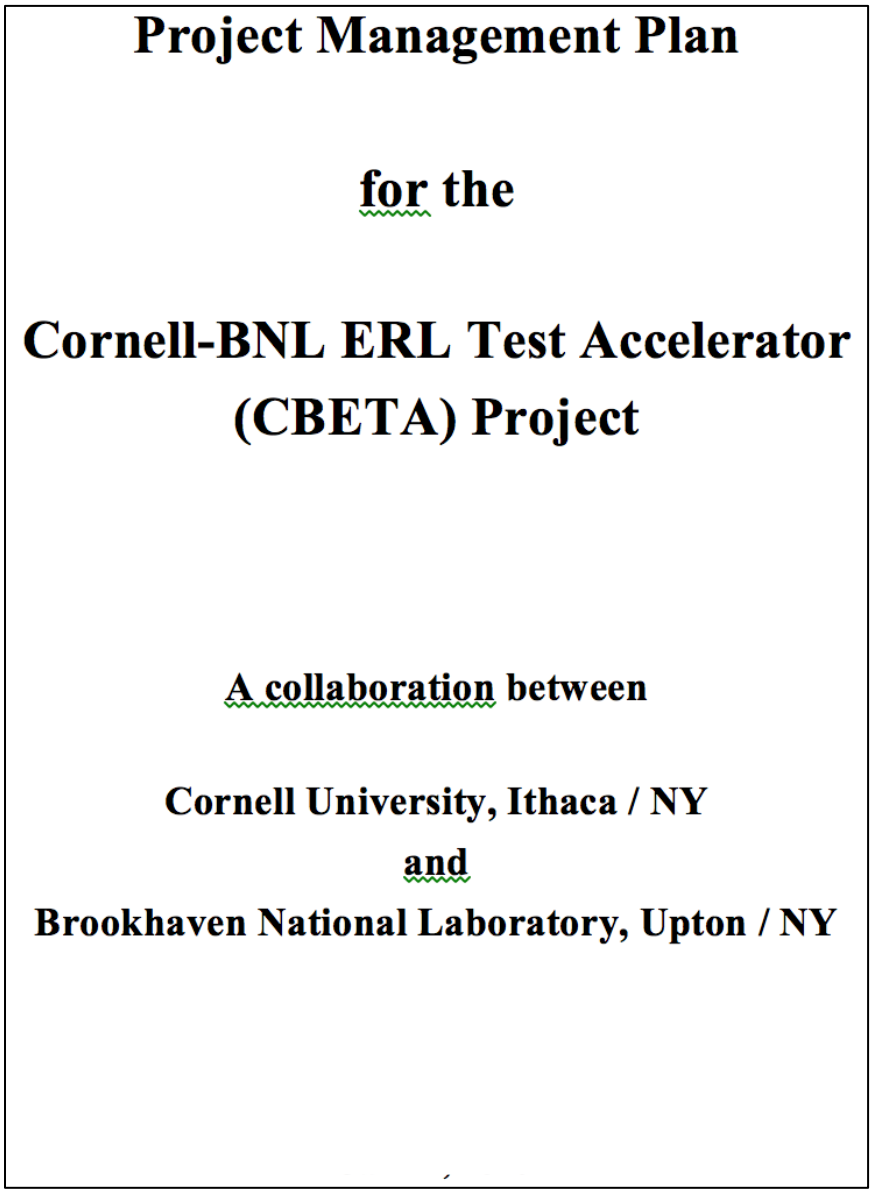
Fund-limited decisions

The commissioning time is 10 months.

The quadrupole correctors for permanent magnets are not equipped with power supplied.

Every other cell is equipped with BPM electronics, as backed up by orbit-correction studies.

Congratulations: Path is free for CBETA



Project Management Plan

for the

Cornell-BNL ERL Test Accelerator (CBETA) Project

A collaboration between

Cornell University, Ithaca / NY

and

Brookhaven National Laboratory, Upton / NY

This plan spells out the KPPs and UPPs as well as the milestones for construction and commissioning of the project.

It includes

1) Commissioning to KPPs
2) Construction so that UPPs are not precluded by design decisions.
3) Pushing beyond KPPs as much as possible.

3a)The first push will be commissioning 4-turns with low current.

Congratulations: Path is free for CBETA

#	**NYSERDA milestone** (at the end of months)	**Baseline**	**Actual**
	NYSERDA funding start date		Oct-16
1	Engineering design documentation complete	Jan-17	
2	Prototype girder assembled	Apr-17	
3	Magnet production approved	Jun-17	
4	**Beam through Main Linac Cryomodule**	**Aug-17**	
5	First production hybrid magnet tested	Dec-17	
6	**Fractional Arc Test: beam through MLC & girder**	**Apr-18**	
7	Girder production run complete	Nov-18	
8	Final assembly & pre-beam commissioning complete	Feb-19	
9	**Single pass beam with factor of 2 energy scan**	Jun-18	
10	**Single pass beam with energy recovery**	Oct-19	
11	**Four pass beam with energy recovery (low current)**	Dec-19	
12	Project complete	Apr-20	

Things to learn with KPP+ approach

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Questions?