

Recent results from the UITF and a look forward

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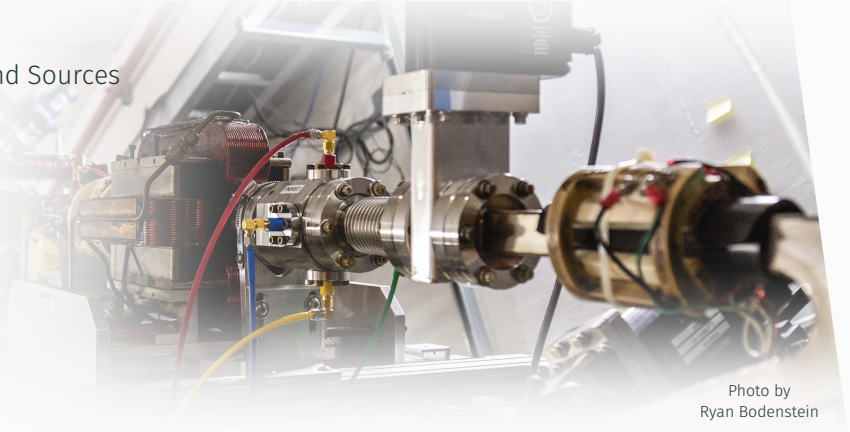
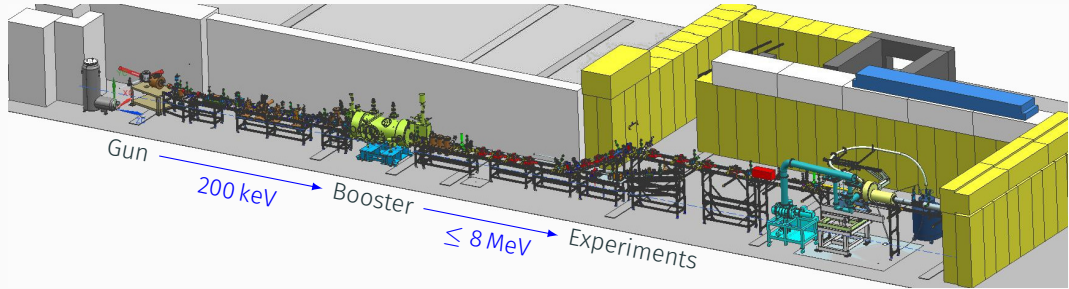


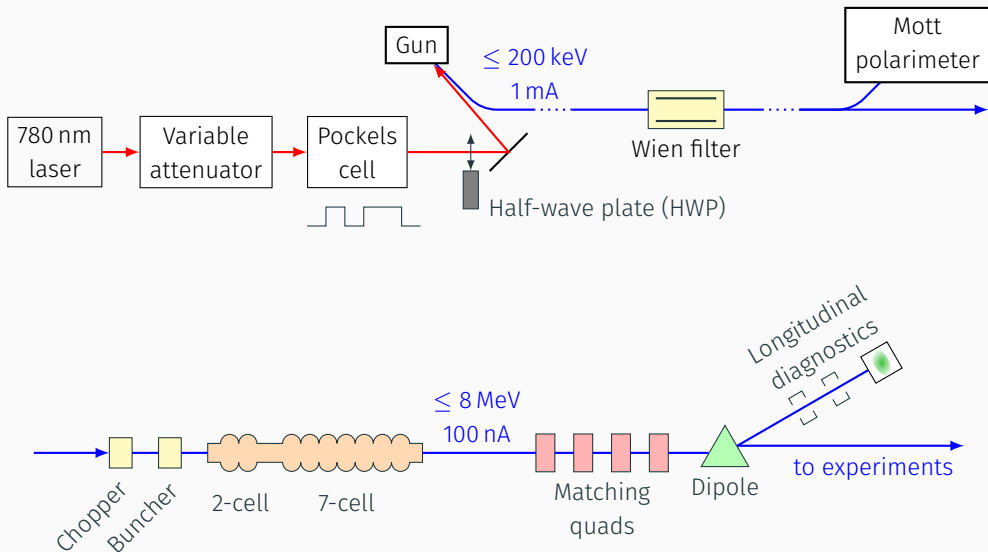
Photo by
Ryan Bodenstein

The Upgraded Injector Test Facility (UITF)

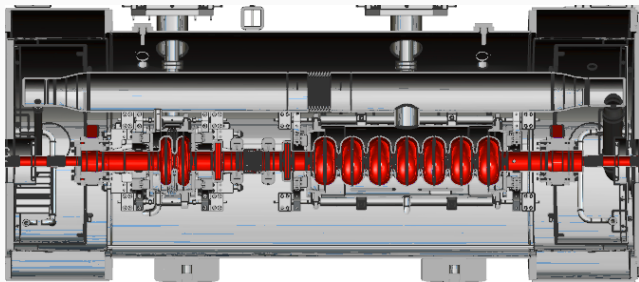


- Polarized photoinjector, wide variety of applications
 1. Similar to CEBAF injector: risk mitigation, injector R&D
 2. R&D of non-injector components
 3. Target/detector experiments
- Easy reconfiguration (both hardware and beam parameters)

Spin polarization and flexible beam dynamics



Commissioning the booster cryomodule



- Booster is central to CEBAF injector upgrade
 - Parity-quality beam (MOLLER)
 - Matched to 200 keV gun energy
 - Resolves coupling & deflection
 - Mitigates emittance growth

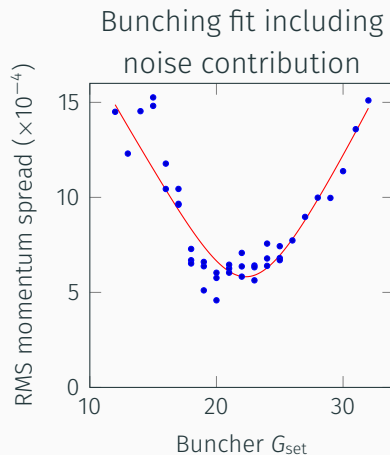
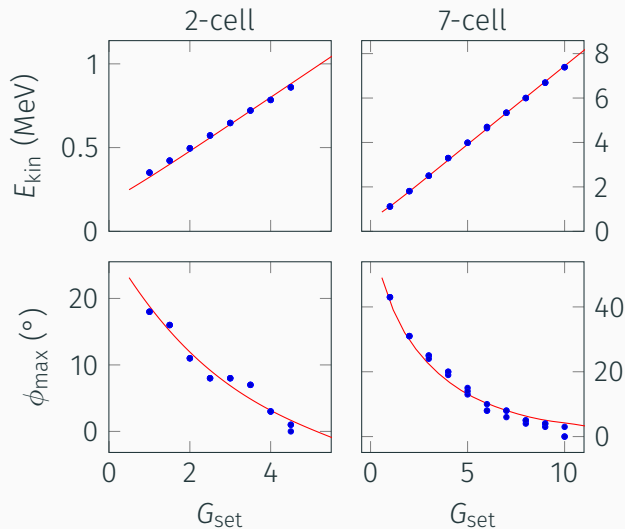
Measured results

E_{kin} (stable)	$\leq 8 \text{ MeV}$
$\epsilon_{n,x}$	$0.3 \mu\text{m rad}$
$\epsilon_{n,y}$	$0.2 \mu\text{m rad}$
x/y coupling angle	$\leq 0.6^\circ$
x/y deflection	$\leq 12 \text{ mrad}$

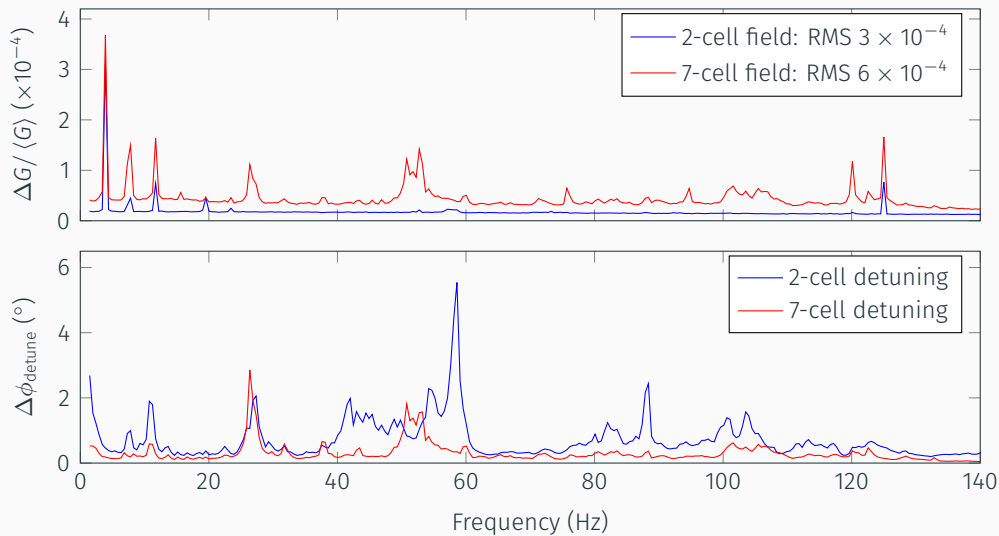
For more data, see:

- JLAB-TN-23-005
- <https://doi.org/10.18429/JACoW-NAPAC2022-WEPA12>

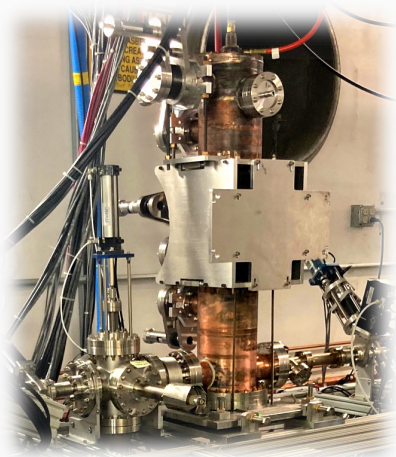
Model-based field calibration



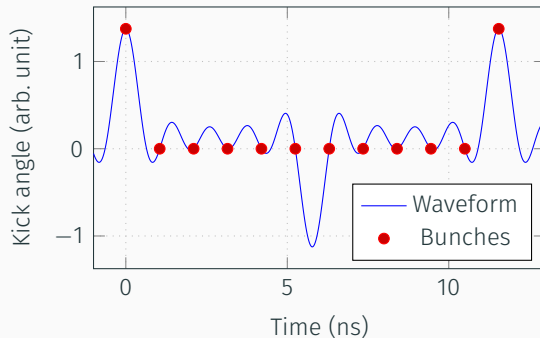
Microphonic field modulation



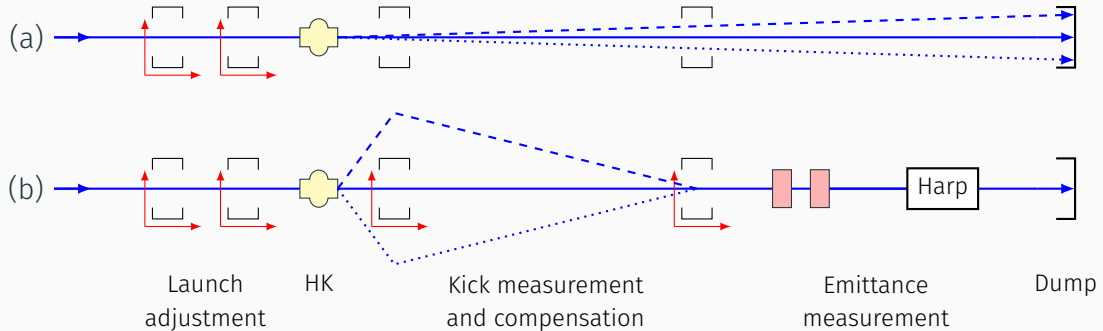
Proof-of-principle test of the harmonic kicker



- Multi-mode RF deflector cavity
DOI: 10.1103/PhysRevAccelBeams.24.061002
- Single-output drive circuit “HAWG”
(DOE SBIR DE-SC0020566)

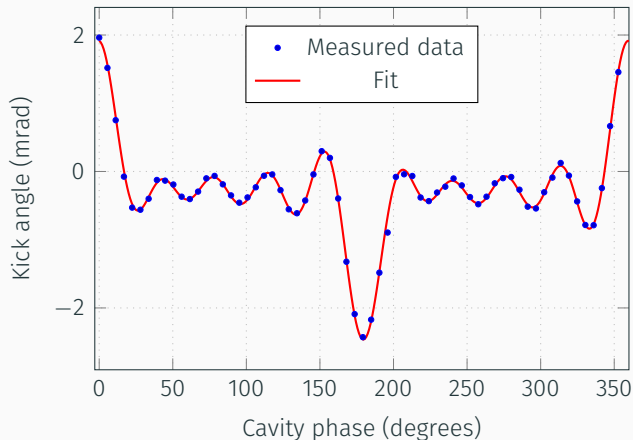


Harmonic kicker: principle of test



- all bunches arrive at same phase \Rightarrow only one beam in the machine
- can measure deflection waveform and optics

Harmonic kicker: results (3-week beam run, Oct/Nov 2022)



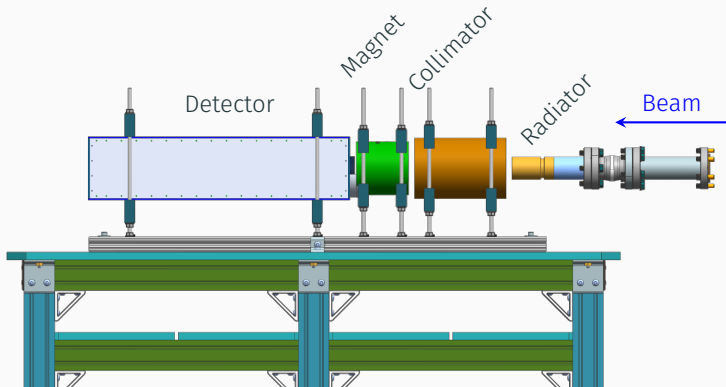
Fit results:

	ampl.	phase
$1f_0$	0.47	1°
$3f_0$	0.46	2°
$5f_0$	0.46	4°
$7f_0$	0.43	4°
$9f_0$	0.38	-16°

- $9f_0$ settability issue
- note: open-loop drive

Compton Transmission Polarimeter test (COMTRA)

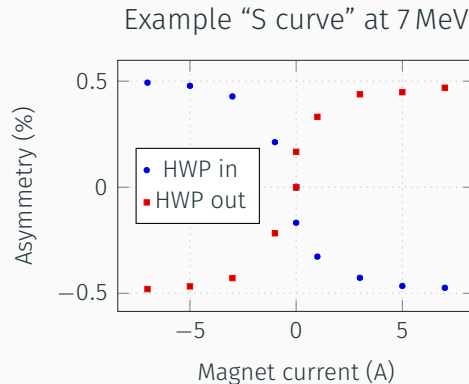
- Collaboration with ODU, IJCLab, BNL, FNAL, Stony Brook
- For test of polarized SRF gun at BNL



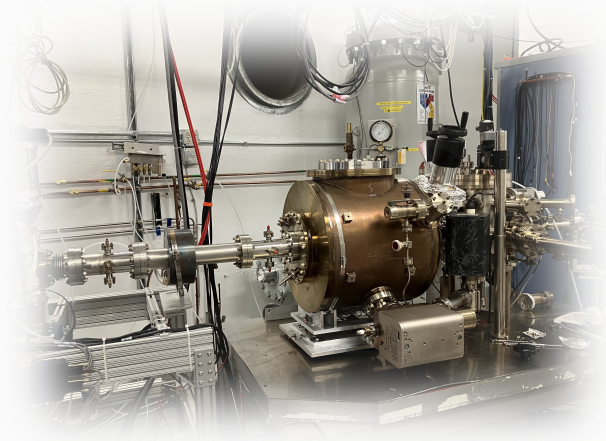
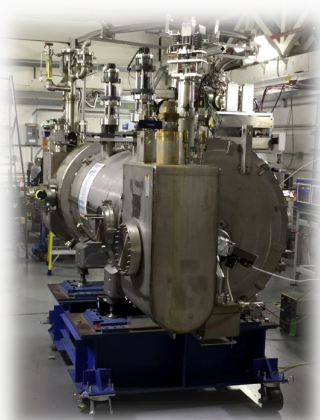
- Cu radiator converts \vec{e} to $\vec{\gamma}$
- Polarized absorber analyzes $\vec{\gamma}$
- Helicity-integrating calorimeter measures asymmetry

COMTRA results (16-day beam run, Oct 2022)

- UITF test: 5–7 MeV, 1–10 nA
- Polarization well known (Mott)
- Commissioned DAQ
- Parametric studies:
 - Beam energy and current
 - Spot position and shape
 - Analyzing-magnet current
- FOA deliverable completed, plan to deliver to BNL this year



MeV runs have ended ...for now



Future options

Limited to gun energy:

- Gun tests
- Polarimetry
- Wien filter optics
- Photocathode R & D
- eEDM storage ring?

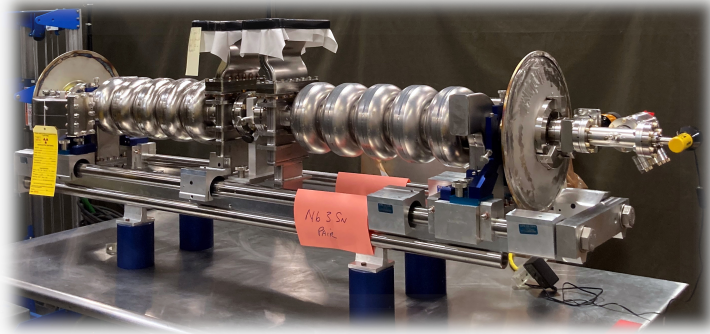


Photo by Sarah Overstreet

- Nb₃Sn cryomodule in production
- Supports SRF S&T
- Provides MeV beam for experiments

Beam time impressions

