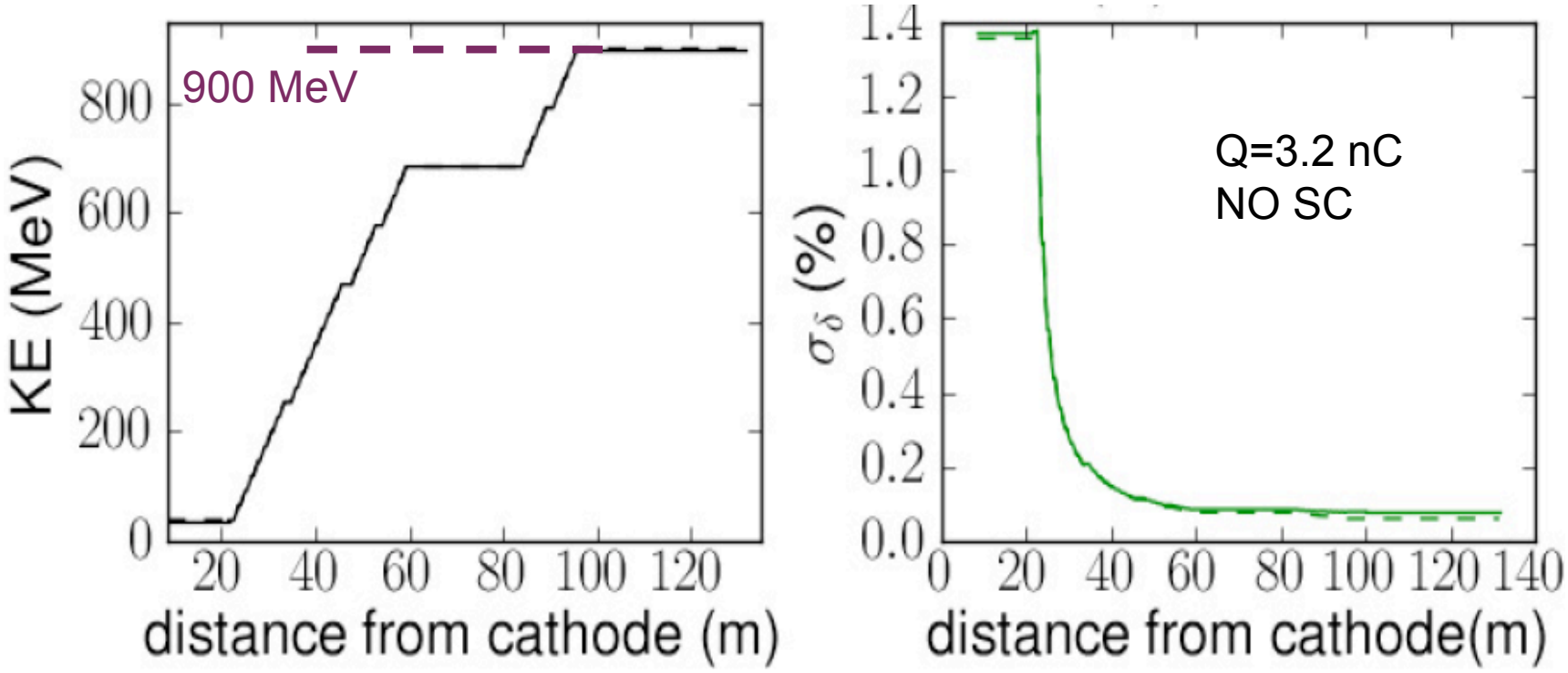
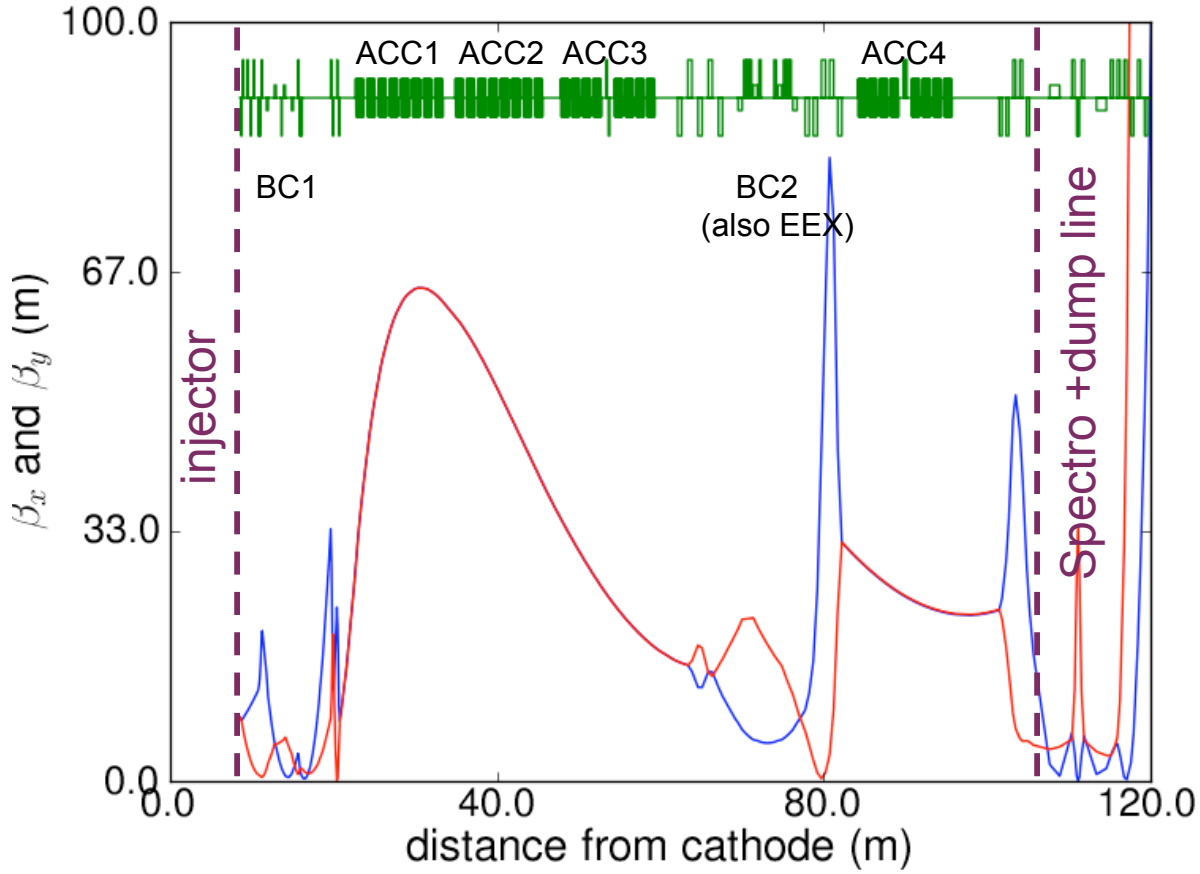
Design status

- See C. Prokop et al. PAC 11
- Elegant model for lattice design/optimization
- Astra (or Impact-T) + Impact-Z model for tracking with space charge effects included.



Design status

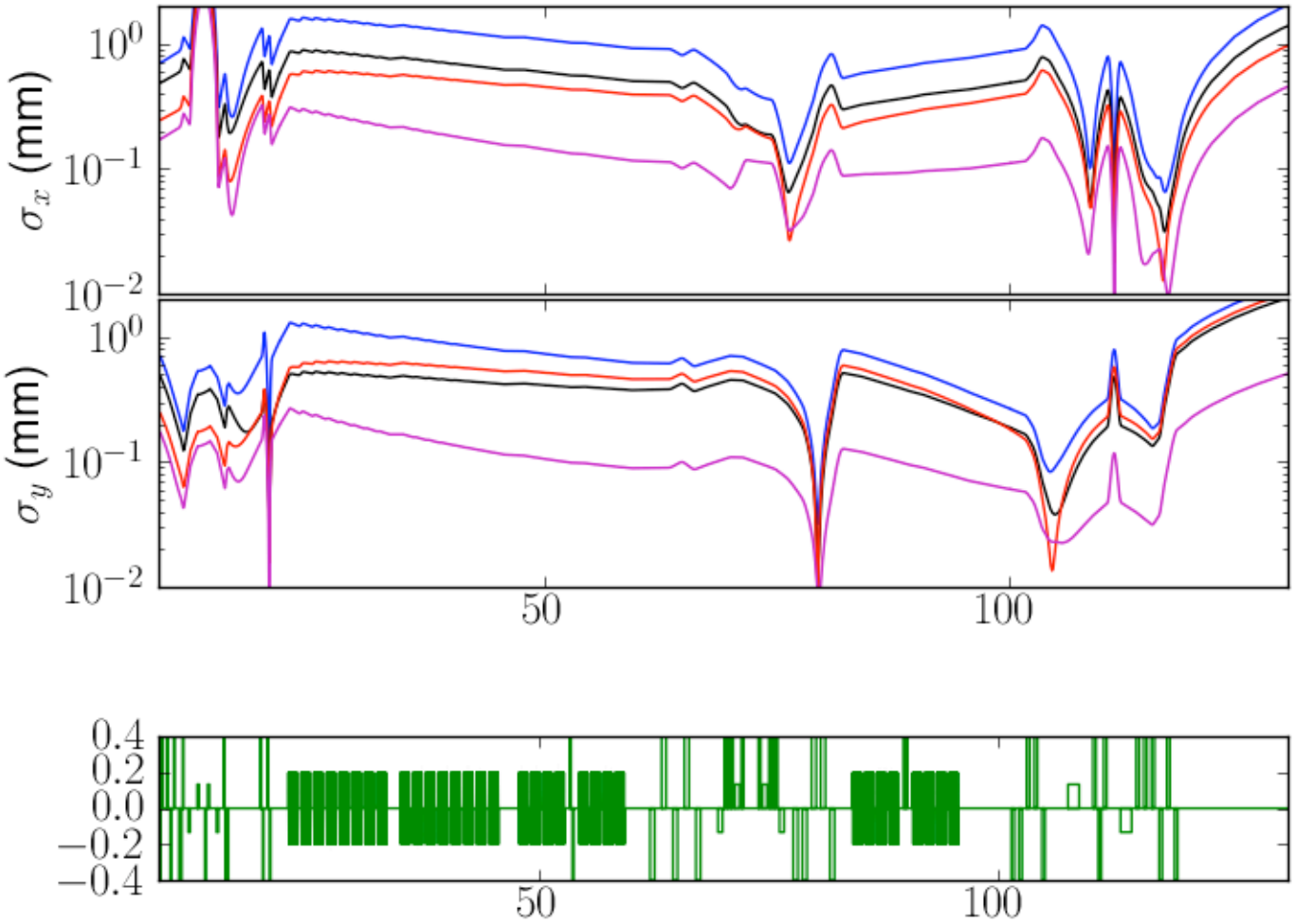
- Nominal lattice "PAC11" lattice



- Minor update on-going (real fringe fields, new cryomodules)

Design status

- Beam envelope versus charge (1st beam: laser is a 3-ps Gaussian pulse)



Photoinjector performances

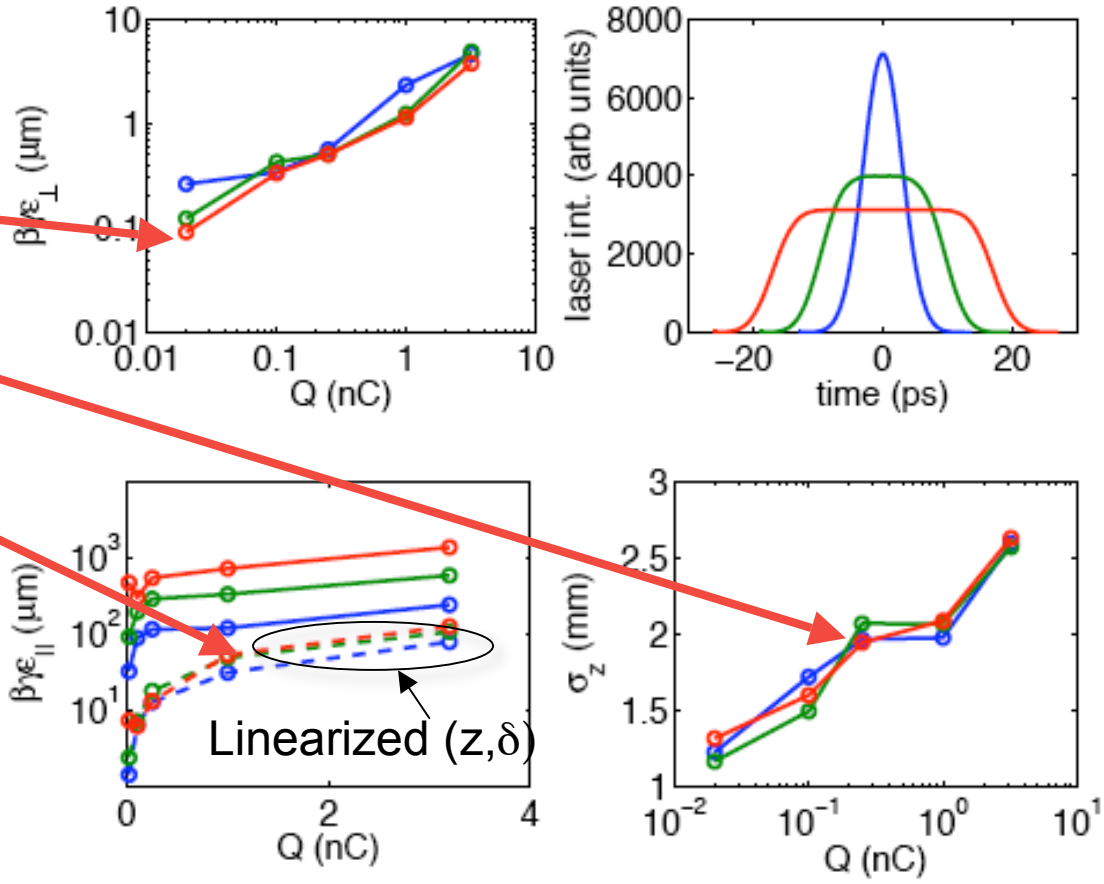
- Optimization of NML Injector supports the production of bright electron beams
- Scaling for Gaussian laser distribution is

$$\varepsilon_{\perp} \approx 2.11 Q^{0.69}$$

$$\sigma_z \approx 2.18 Q^{0.13}$$

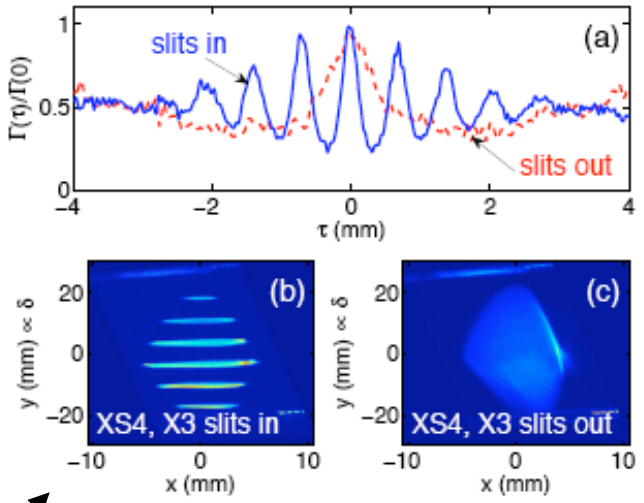
$$\varepsilon_z \approx 30.05 Q^{0.84}$$

- Flat beams will also be possible: at 1 nC
  $\varepsilon_x/\varepsilon_y$=31/0.06 ~ 500
  σ_δ=1.7x10^{-4} (40 MeV)

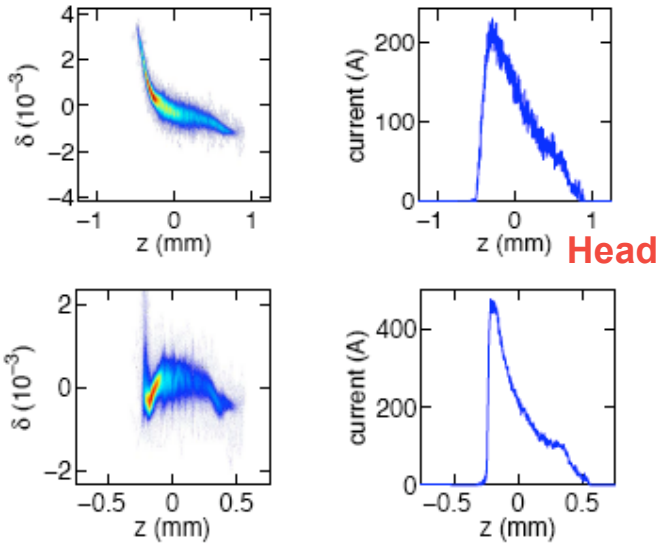


Phase space manipulations

- Collaboration with Los Alamos (with B. Carlsten)
  - Arbitrary repartition of beam emittance within the 3 degrees of freedom,
  - Currently revisiting flat beam generation and optimization using the concept of eigen-emittances
- Tailoring of electron bunch current (FNAL-NIU)
  - Many applications
  - Demonstrated at A0 (EEX)
  - Demonstrated at FLASH/DESY (control of LPS nonlinearities)
  - These two techniques have complementarities/synergie



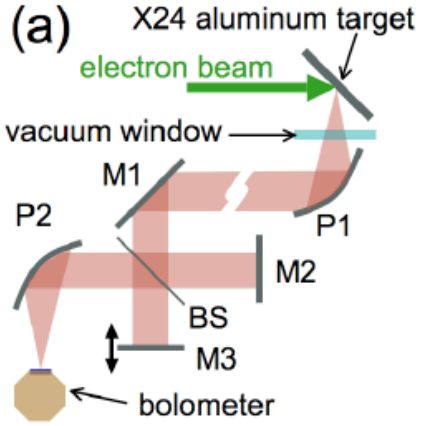
[Sun et al. 2010]

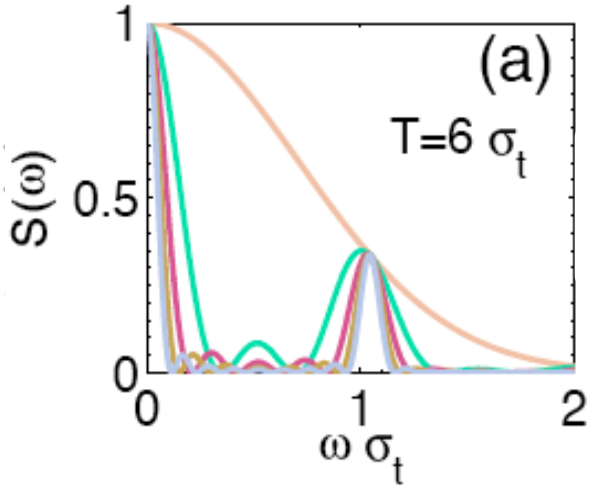


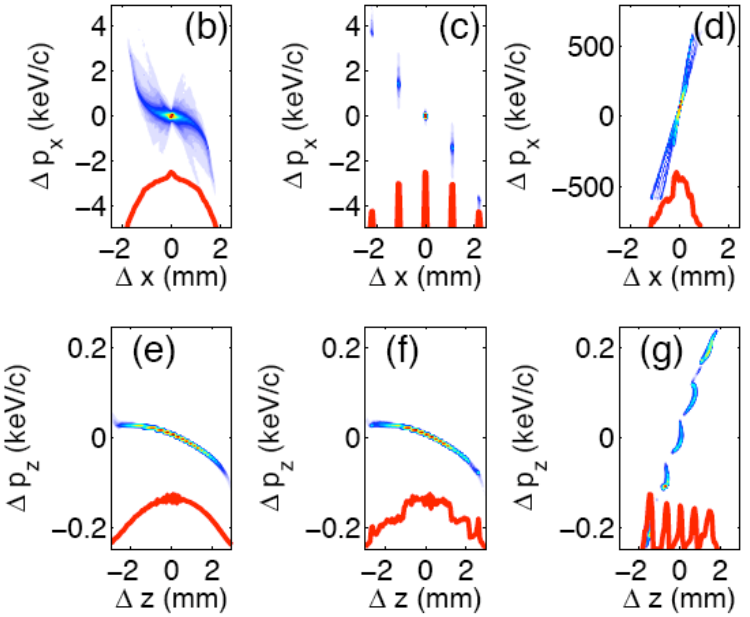
[Piot et al. 2011]

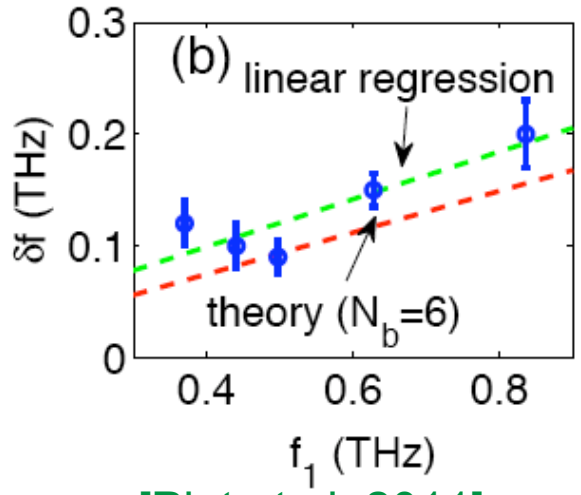
Radiation sources

- Use of prebunched-beam to produce intense narrow-band THz (or shorter λ) radiation
- did this with TR at A0 would do this with DR at 40 MeV at NML









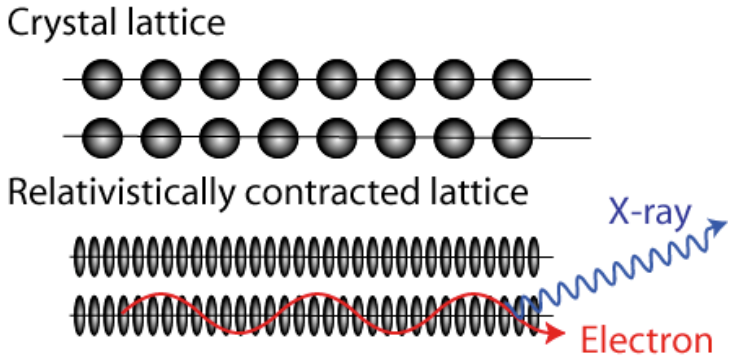
- Scale to shorter wavelength?

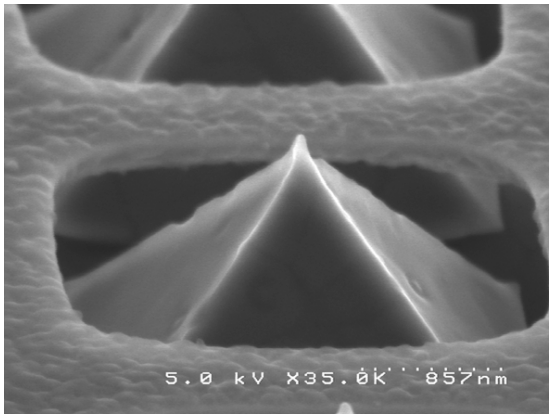
[Piot et al. 2011]

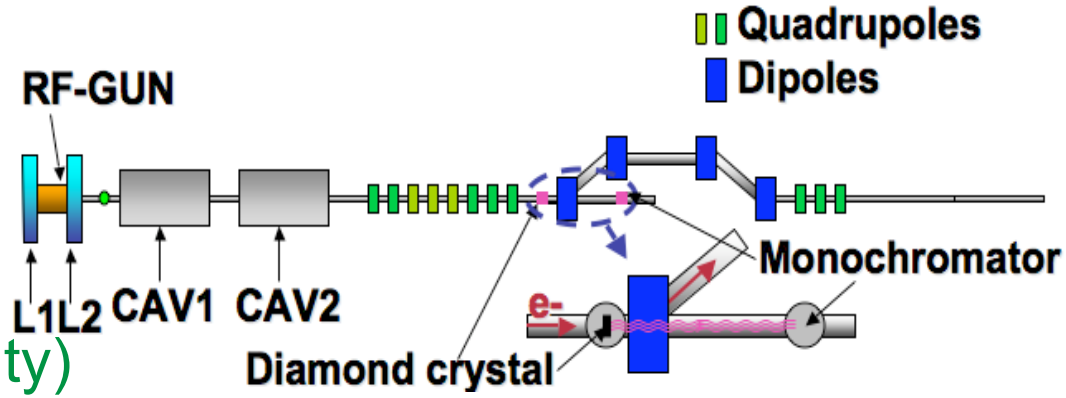
Channeling radiation (Vanderbilt/NIU)

- DOD challenge
  10^{12} photons /s/mm^2/mrad^2/0.1%BW in 0.01 m^3
- Channeling radiation makes this possible
  - Requires electron beam of exquisite brightness
- New cathode technology
  - a single gated diamond field emitter
- Accelerator challenge
  - Can the emittance be preserved in an rf accelerator?

(C. Brau, Vanderbilt University)



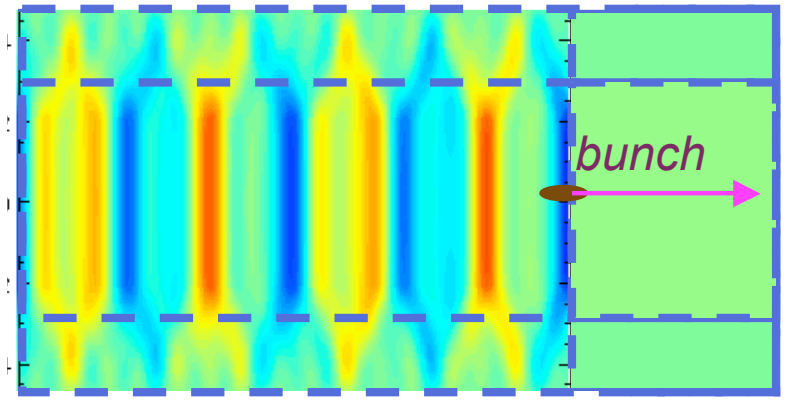




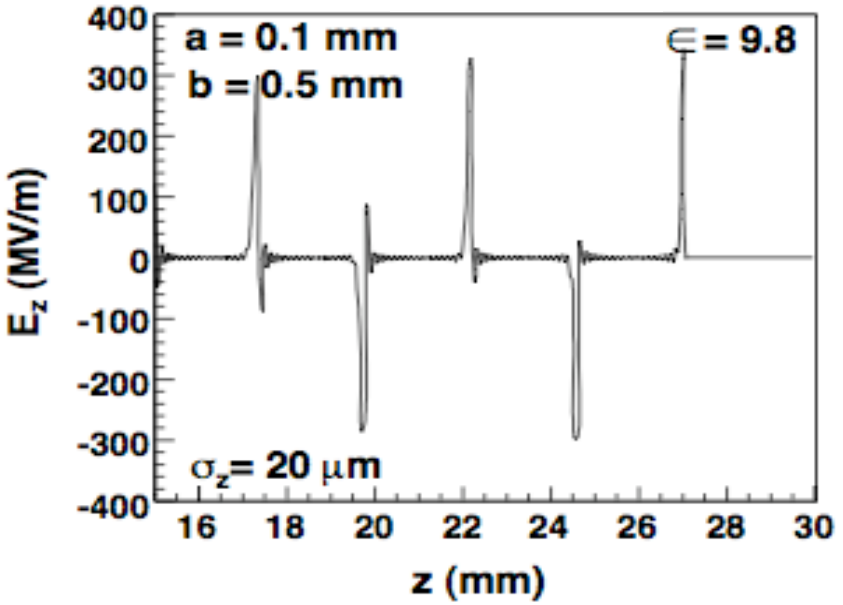
Proposal for DWFA experiment

- Simple experiment use all the “bell and whistle” capabilities of NML (flat beams, emittance exchange, current pulse shaping)
- The emphasis is on
  - transplanting and commissioning the manipulations developed at A0
  - Developing a generic setup that could be used by other interested parties
- **As a first experiment we chose dielectric wakefield acceleration in slab structure**
  - Simple,
  - Novel and well matched to NML capabilities,
  - Promise is great E_z>*0.3* GV/m,
  - **Leverage on AWA-ANL expertise**,
  - NIU and Tech-X obtained funding from DTRA to model, design and perform such an experiment.

[Mihalcea et al. 2011]

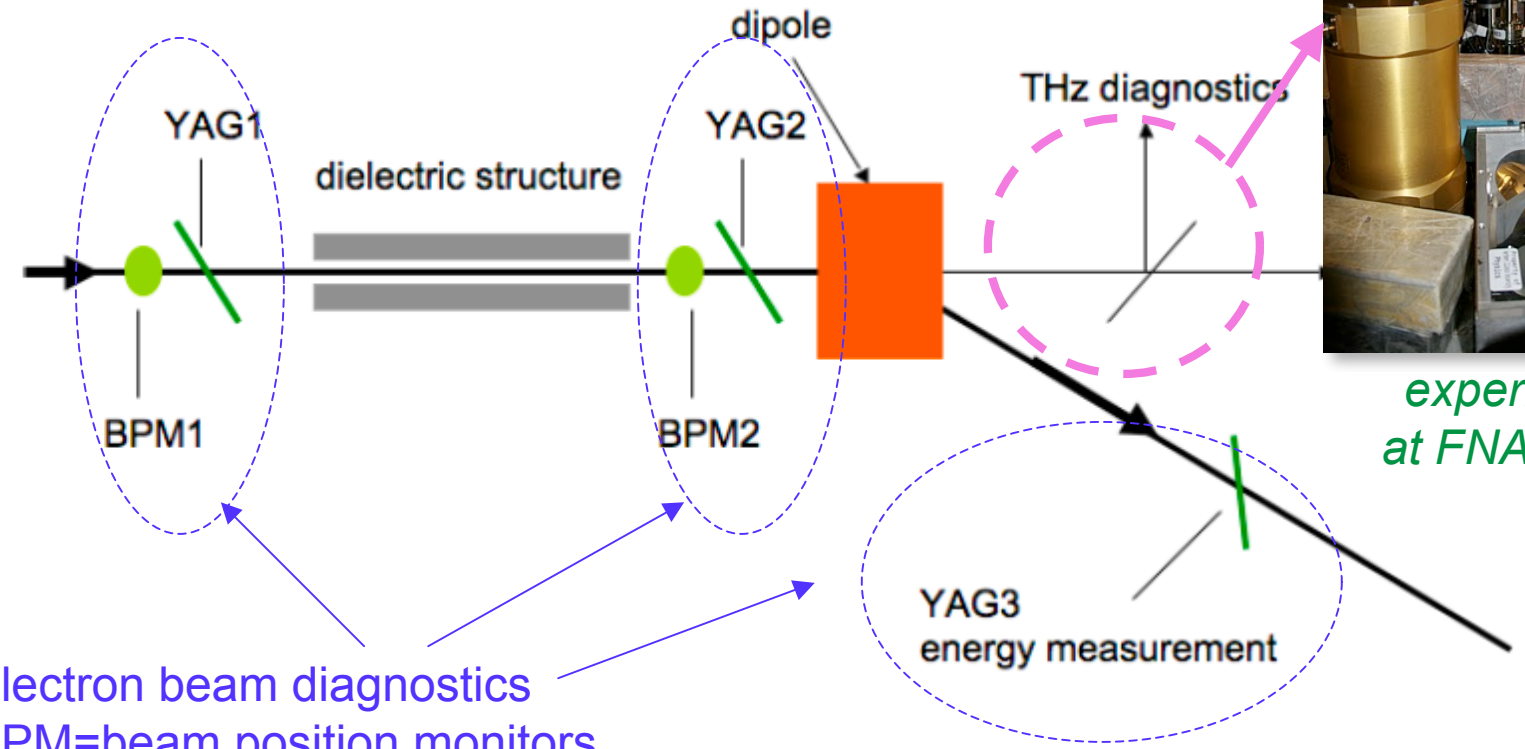


VORPAL



Generic acceleration test

- Diagnostics
  - energy gain and loss
  - Cherenkov radiation



experiment at FNAL's A0

Electron beam diagnostics
BPM=beam position monitors
YAG= Ce-doped Yttrium Aluminum Garnet or Optical transition radiation screens