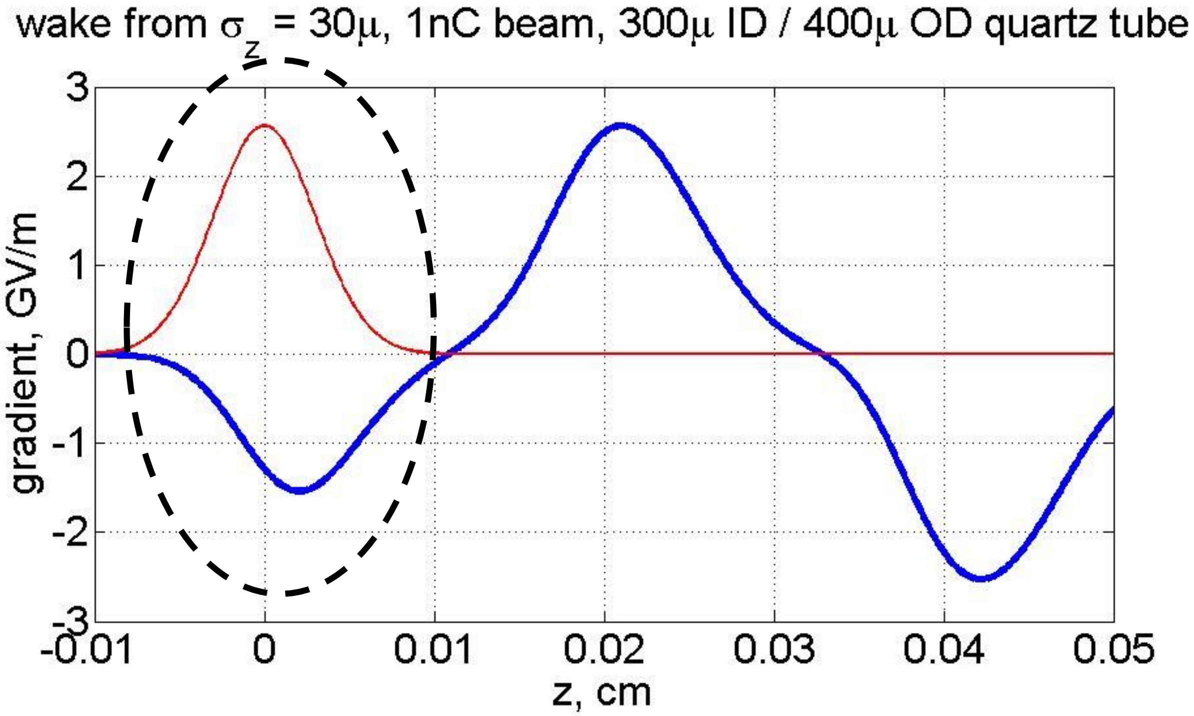
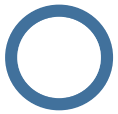
Dielectric chirp corrector

Chirp correction

- Wavelength <-> bunch length
  - $\sigma_z << \lambda$
- Amplitude <-> aperture, A, m^2
  - G ~ F x Q/A, F – form factor
- Wavelength <-> aperture
  - $\lambda \sim \varepsilon\sqrt{A}$
- Single mode <-> multimode
  - $\sigma_z << \lambda_i$ for most i
- Transverse kick <-> optimization
  - $G \sim F_{dechirp}$ x Q/A
  - $K \sim F_{kick}$ x Q/A^2

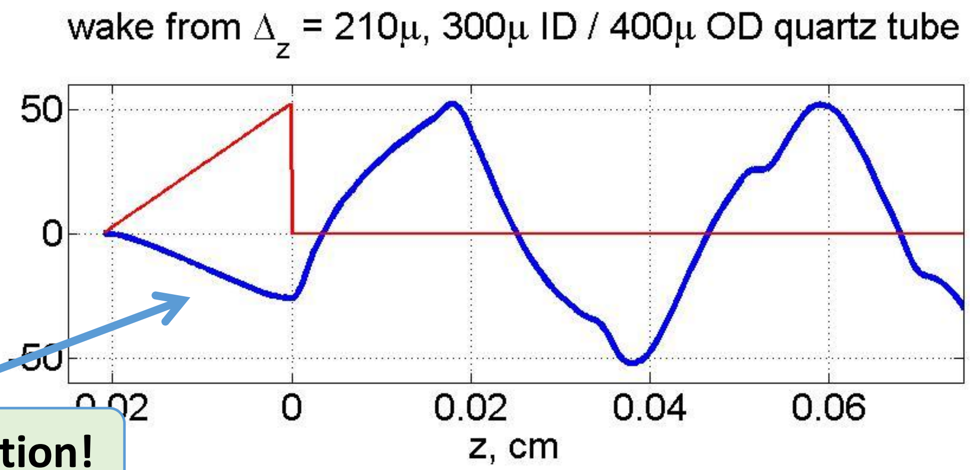


vs



Energy Chirp Correction Experiment at ATF

Triangular-shaped (current) beam with energy chirp

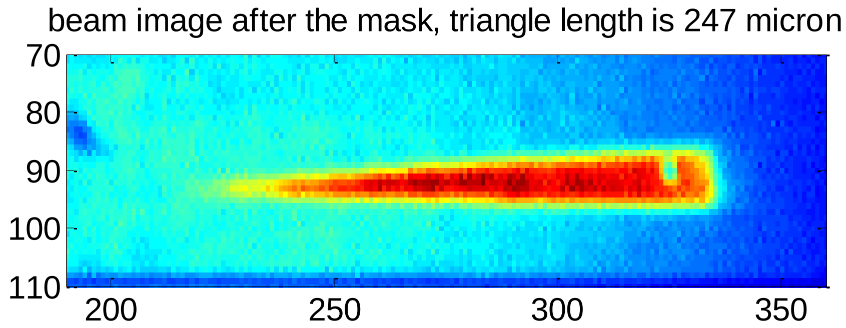


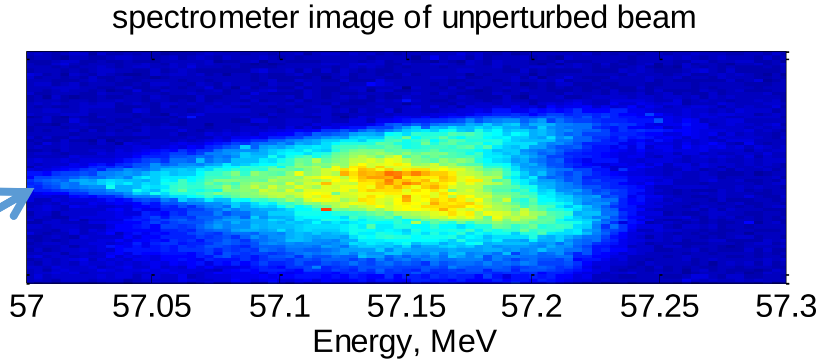
Self-deceleration!

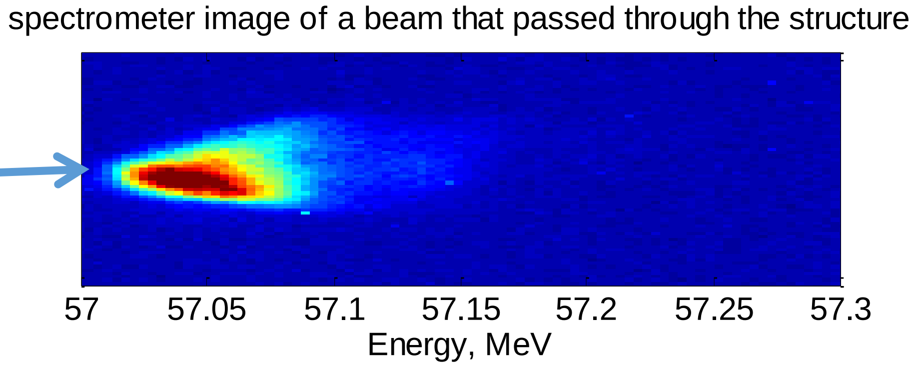
Chirp corrector – passive wakefield tube: dielectric loaded waveguide

Spectrometer image of the original beam

Spectrometer image after chirp corrector

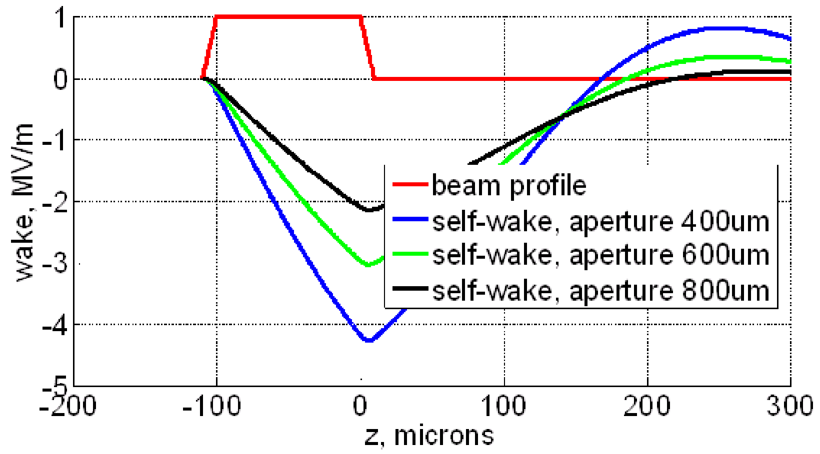


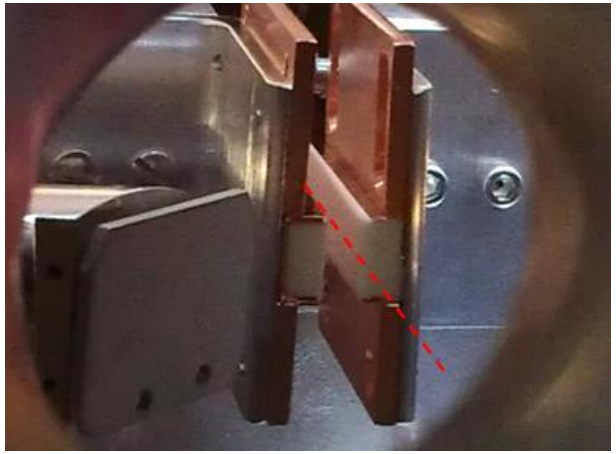


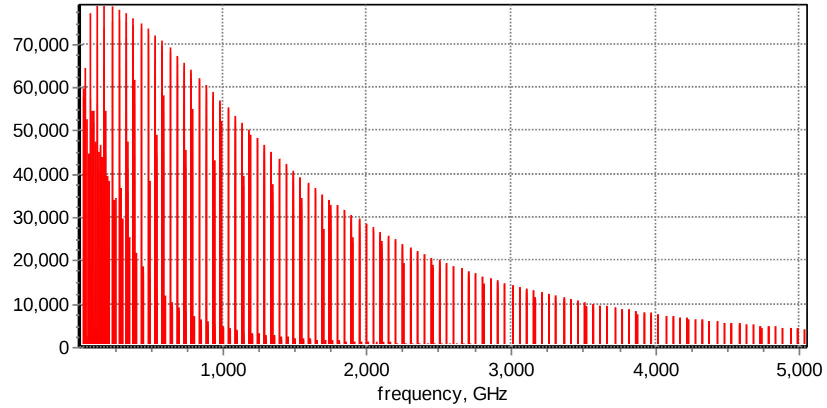


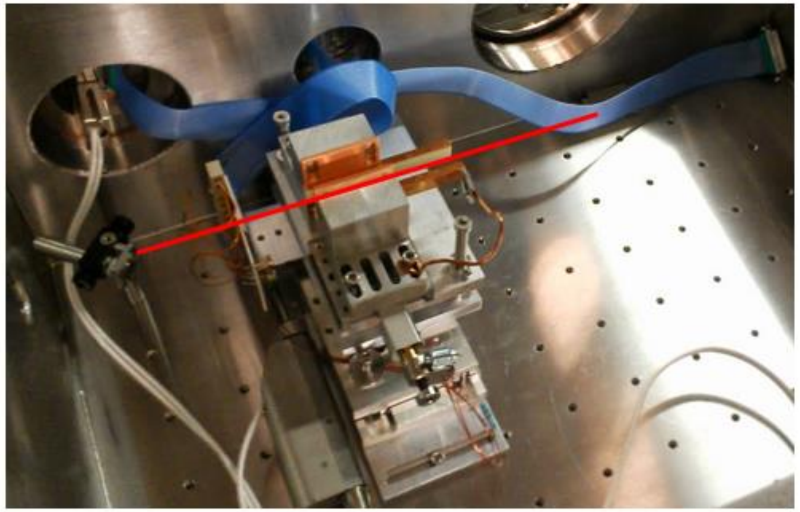
S. Antipov, et al, Phys. Rev. Lett. 108, 144801 (2012)

Tunable chirp corrector





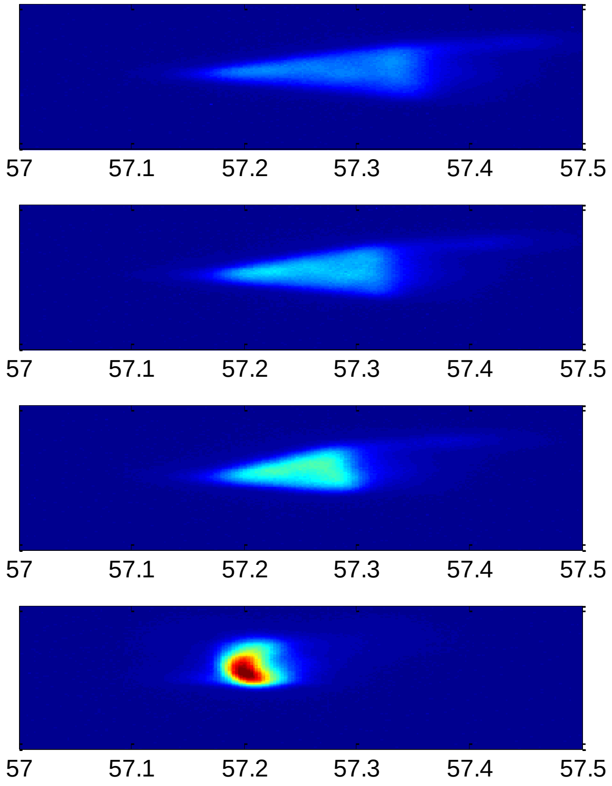




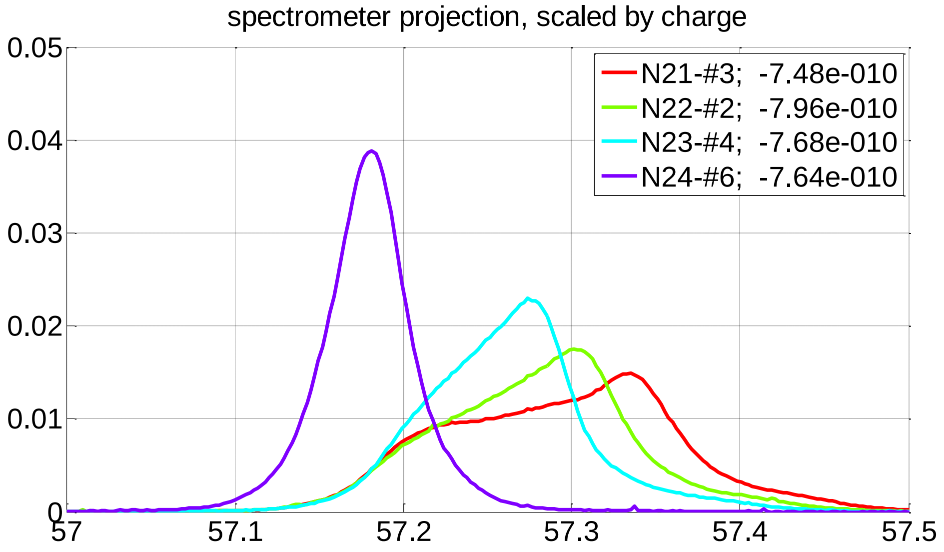
chirp corrector is 10 cm long

Experimental results: triangular current with chirp

Spectrometer

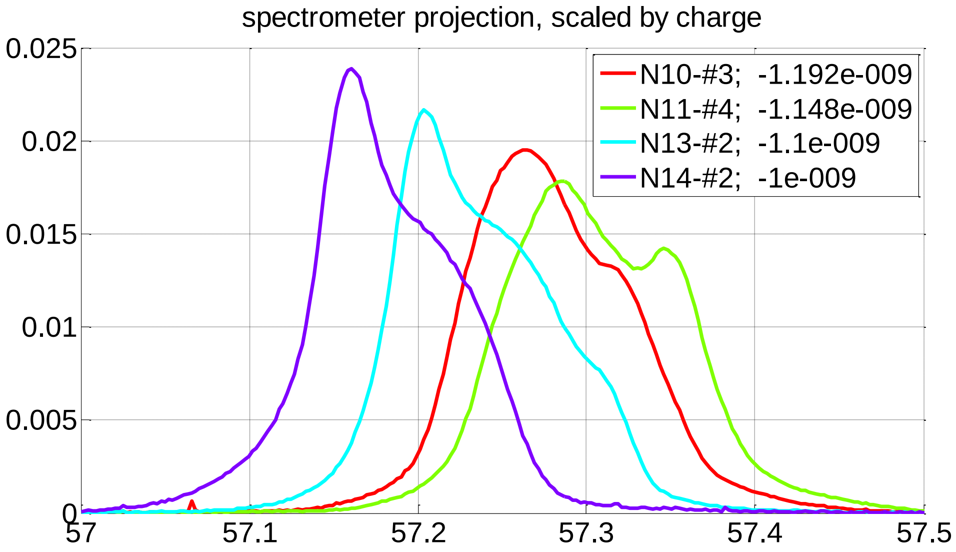


Energy, MeV

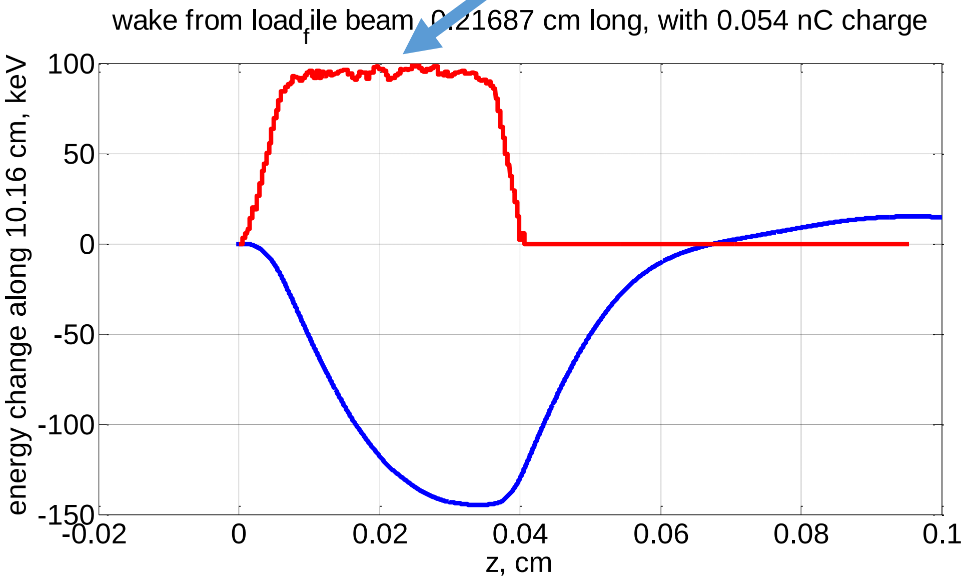


Gap ~ 2.8mm, 2.7mm, 1.9mm, 1mm
100% charge transmission
54pC total charge, ~160keV corrected
~60keV/m/mm/pC – chirp correction number
Say, 300pC beam with σ_z = 100um, goes through 1m of chirp corrector → 1.8 MeV corrected

Rectangular beam experimental results



Actual calibrated current profile



Conclusion / discussion

- PoP experiments demonstrated
  - General principle
  - Amplitude tuning
- Full-scale (~m) experiment is due
  - Requires the FEL-quality low emittance beam ← **ASTA, FNAL facility**
  - Alignment
  - Characterization (spectrometer resolution, kick, etc…)