Desired Injector Diagnostics

Cathode drive laser (measurement methods OK)

- ✓ Time profile
- ✓ Timing jitter relative to RF
- ✓ Amplitude jitter
- ✓ Transverse profile on cathode

Electron beam (measurement methods OK at low current)

- ✓ Cathode quantum efficiency
- ✓ Current profile and RMS bunch length
- ✓ Energy profile and RMS dE/E
- ✓ Transverse profiles
- ✓ Slice and projected transverse emittance
- o Beam-based alignment of gun, booster, magnets

Methods Discussed for All Areas

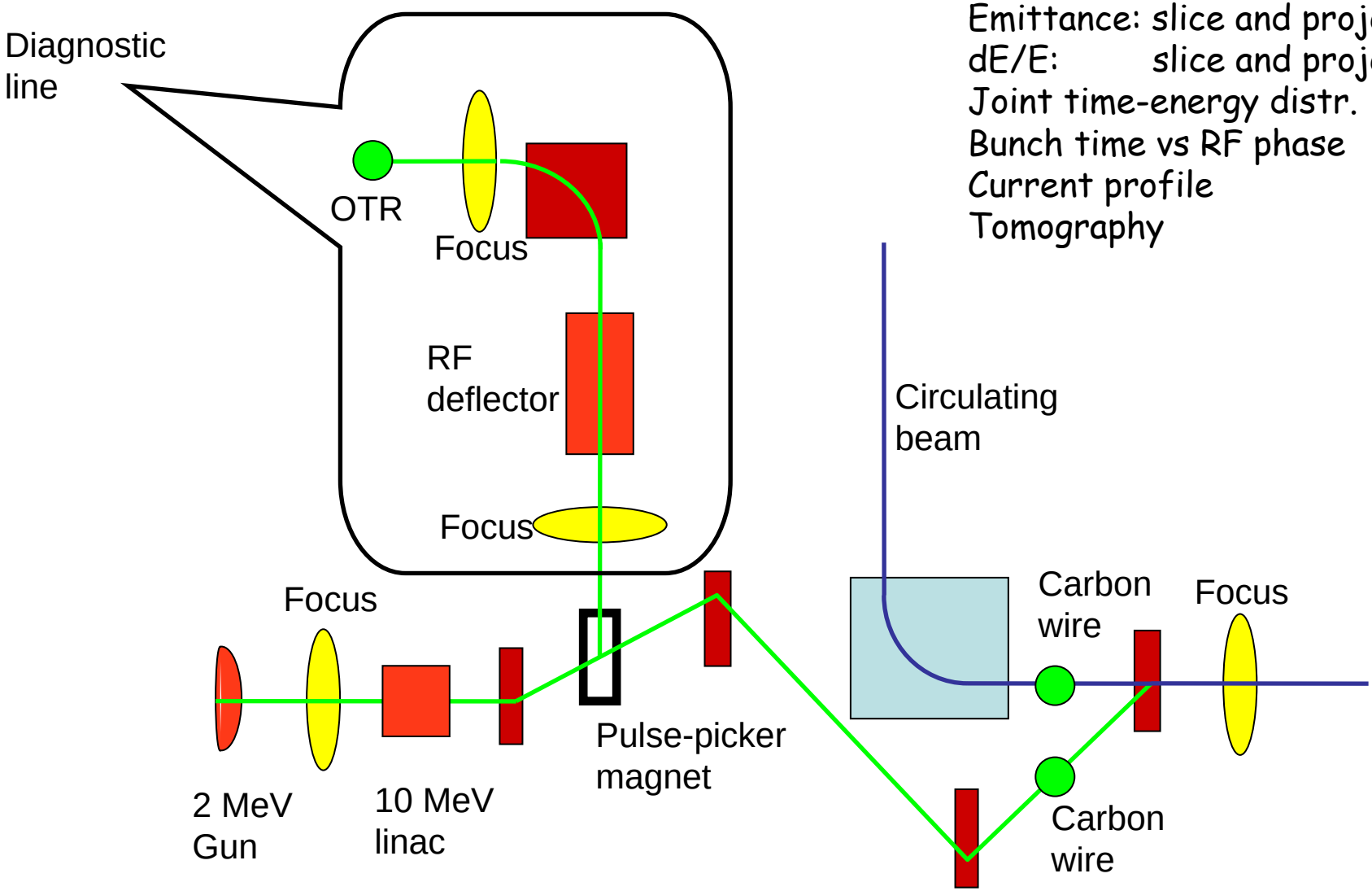
Most non-invasive methods do NOT apply to injector energy

- ✓Electro-optic crystals (reduced time resolution)
- •Diffraction radiation
- •Synchrotron radiation
- ✓BPMs, feedback, digital systems
- •Subtle phase and amplitude modulation of RF
- •Diagnostic undulators (SC wiggler?)
- •Synchrotron light interferometer
- •Photon BPMs
- ✓THz radiation (bunches are relatively long, impedance issue)
- •Ionization profile monitor (vacuum?)

Mildly invasive methods DO apply (they work directly on ebeam)

- ✓Flying carbon wire
- ✓Pulse picking with fast deflector

Possible Injector Diagnostic Layout

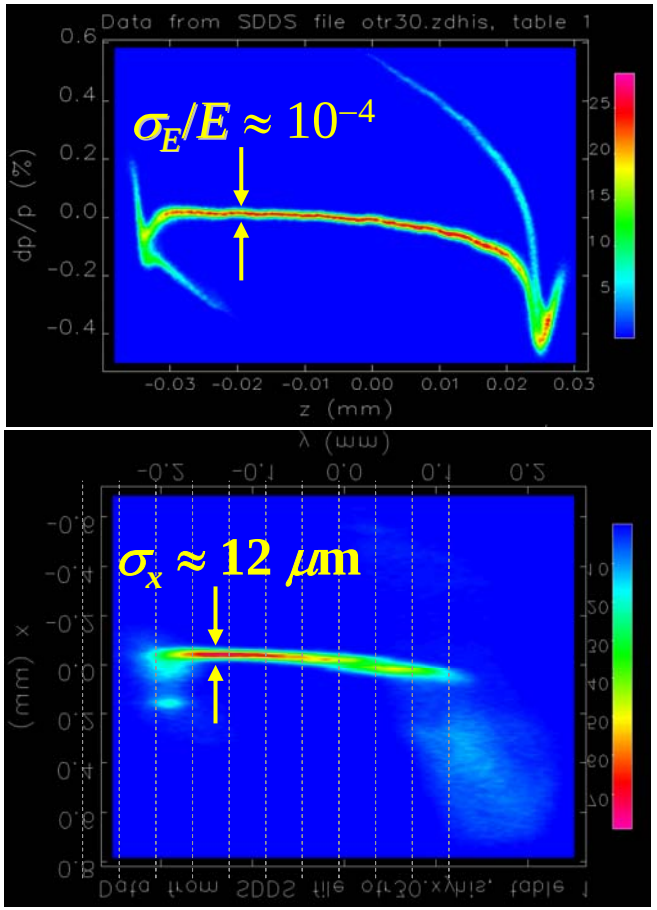


Emittance: slice and projected
dE/E: slice and projected
Joint time-energy distr.
Bunch time vs RF phase
Current profile
Tomography

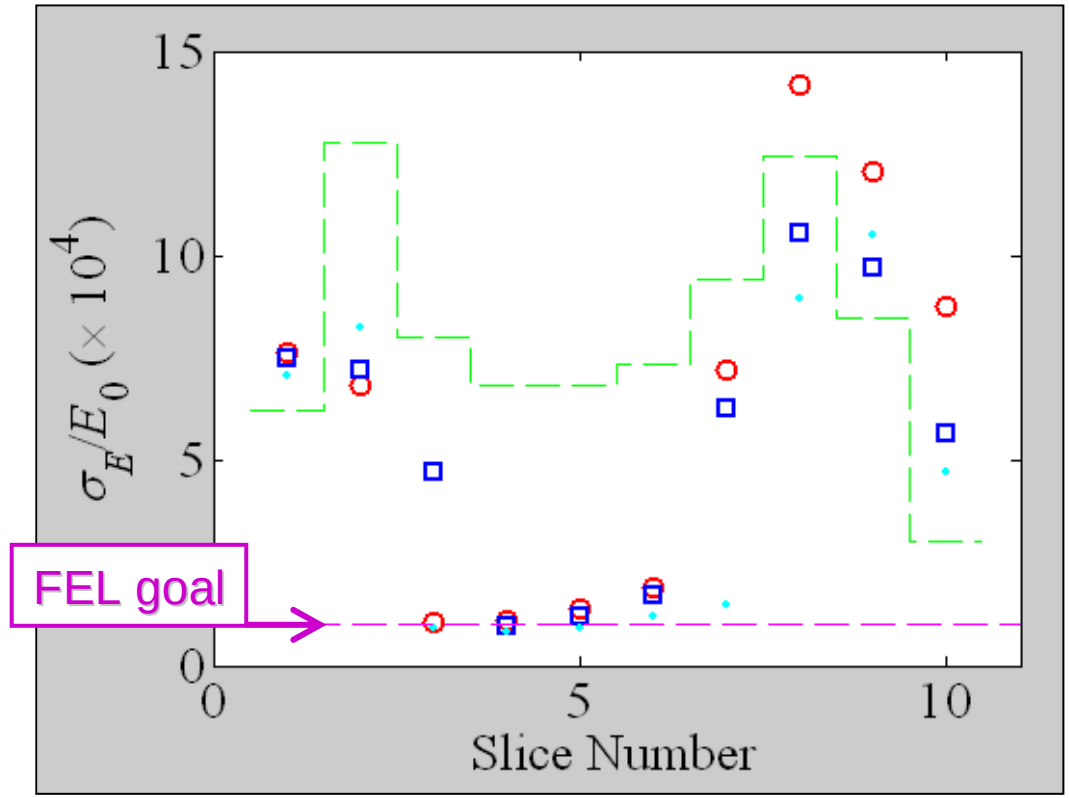
Slice Energy Spread Measurements in the LCLS

elegant simulation (M. Borland) courtesy P. Emma

Screen located at dispersive location, η_x=10 cm



LTU at 14 GeV with S-band RF-deflector at 24 MV

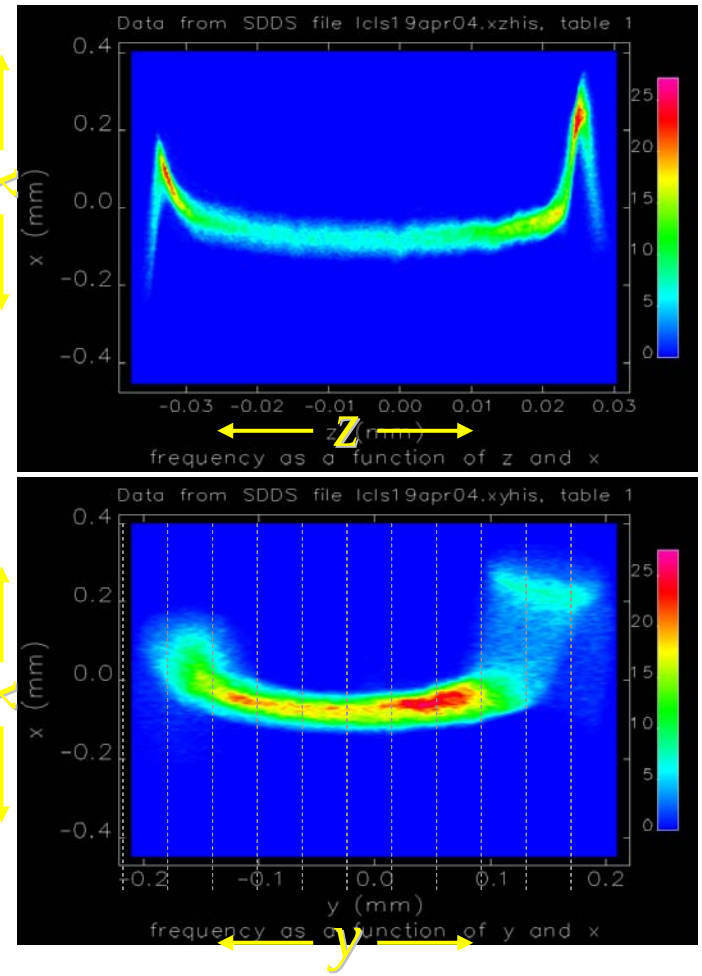


Courtesy of Patrick Krejcik (SLAC)

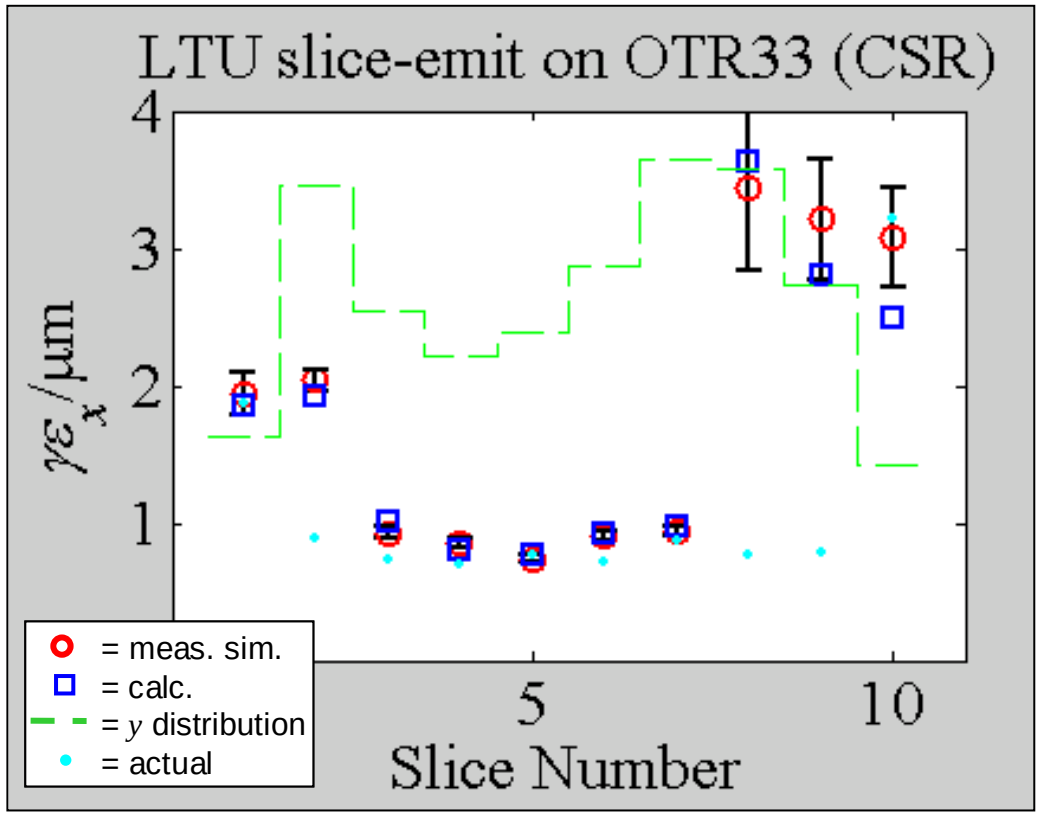
Slice-Emittance Measurements in LCLS

elegant simulation (M. Borland) courtesy P. Emma

3-screen method



LTU at 14 GeV with S-band RF-deflector at 24 MV



Courtesy of Patrick Krejcik (SLAC)

Questions for Pulse-picking Method

Pulsed magnet rise/fall time?

Beam losses and machine protection?

Low energy beam optics (effect of bends, space charge)?

Applicable for all rep rates: 10 MHz – 1.5 GHz?