Measurements of Compression and Emittance Preservation after the First *LCLS* Bunch Compressor Chicane

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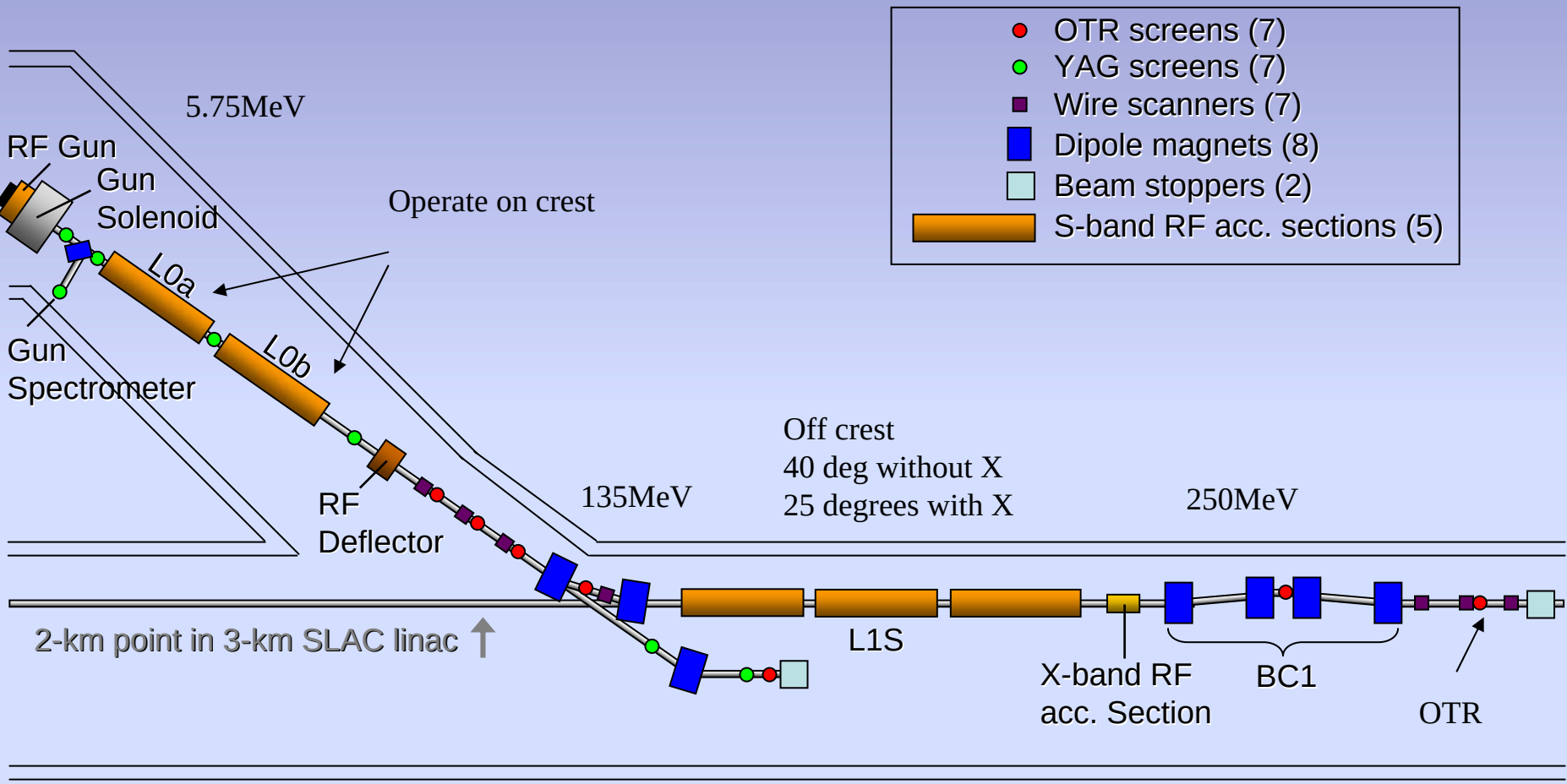
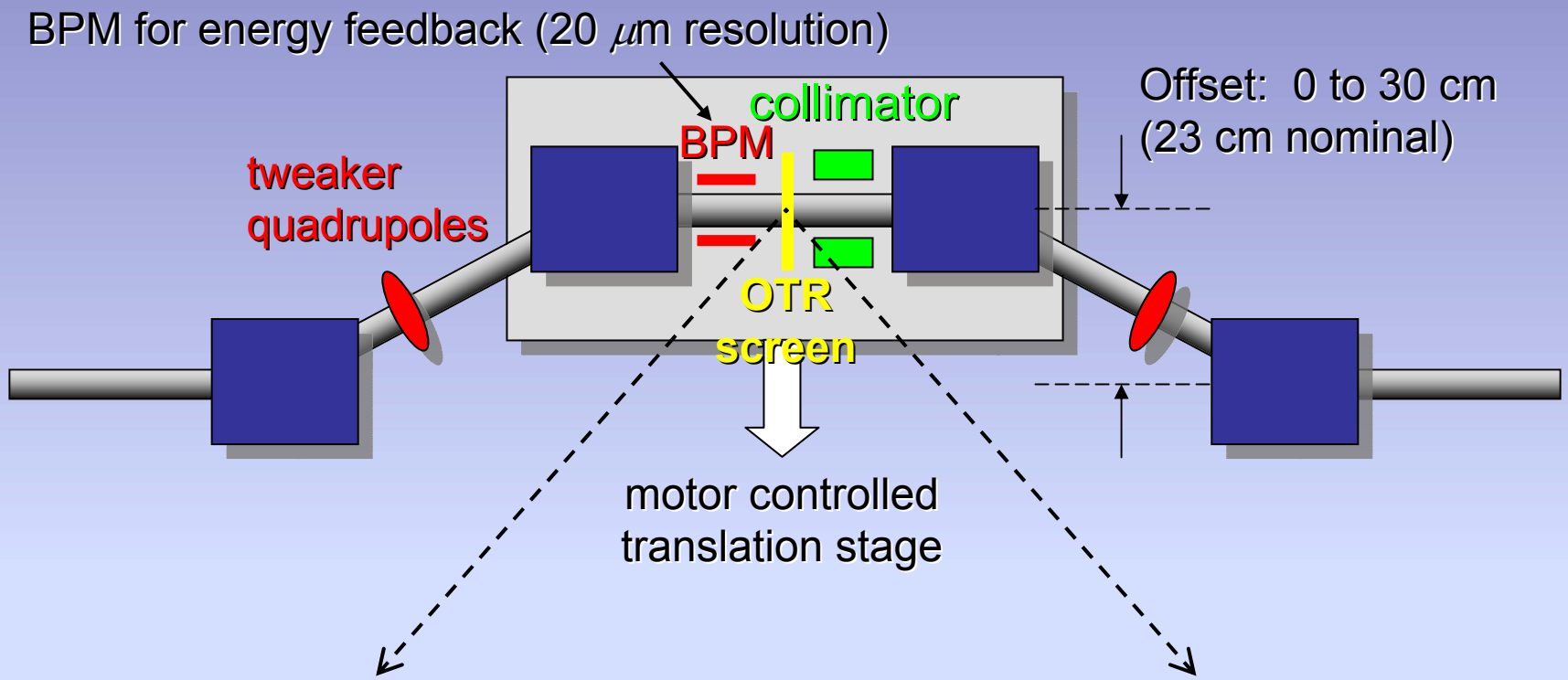
LCLS Injector Layout



System Status

- Most results without X-band, and without CSR bunch length monitor.
- Operation at 200pC – low charge design point.
- X band system commissioned ~1 week ago, only have preliminary results
- CSR bunch length monitor saw first signals Saturday – no results yet.
  - Use mm-wave gap monitor
- Note: this is the injector bunch compressor, second bunch compressor to be installed downstream later this year

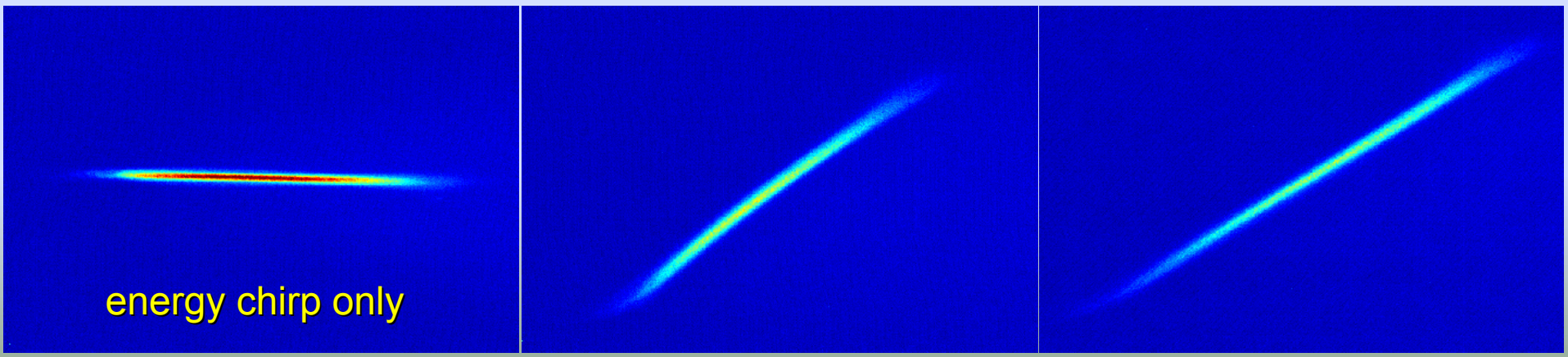
Chicane is Motor Controlled with BPM, OTR Screen, & Collimator



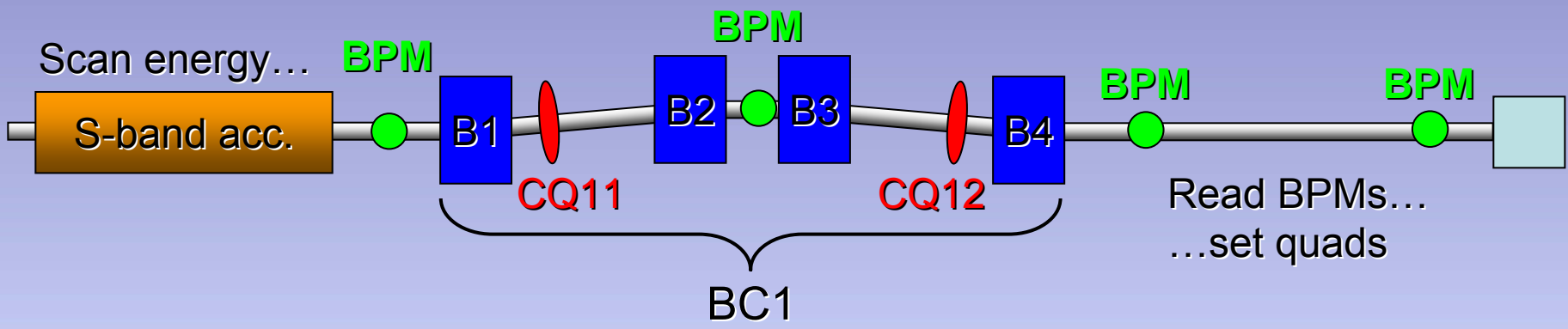
RF deflector **OFF**

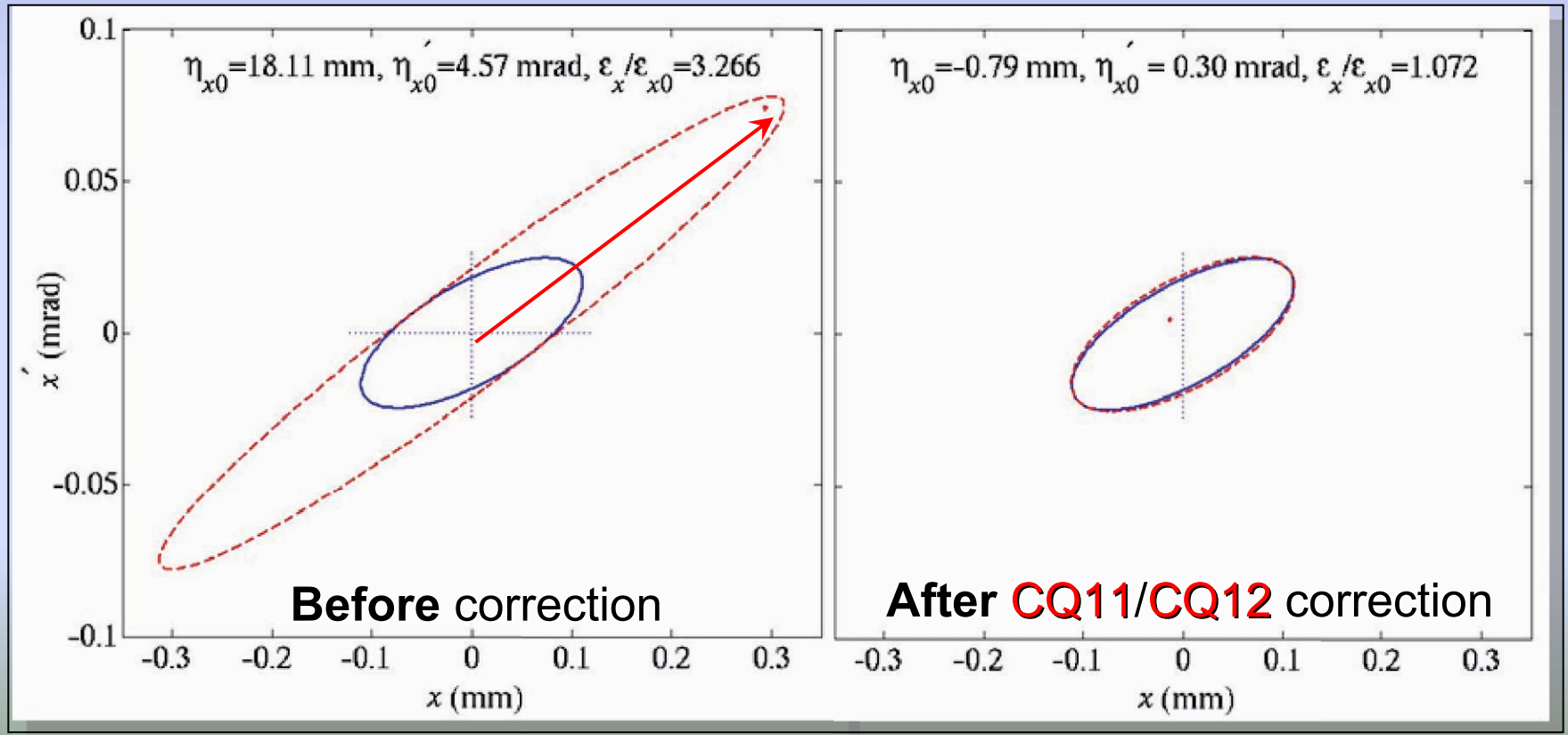
RF deflector **ON**

RF deflector **ON** & X-band **ON**

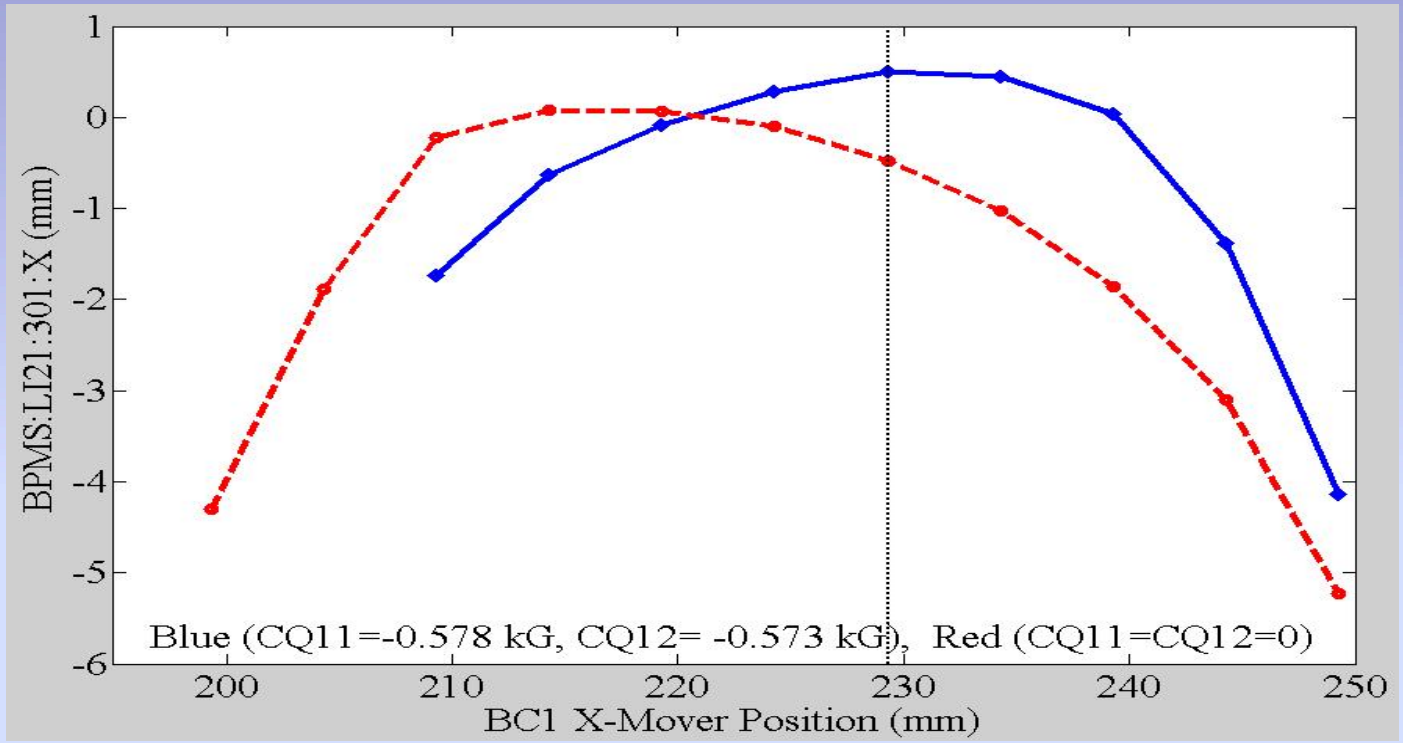


Residual Dispersion Measurements & Correction





Additional Magnet Errors

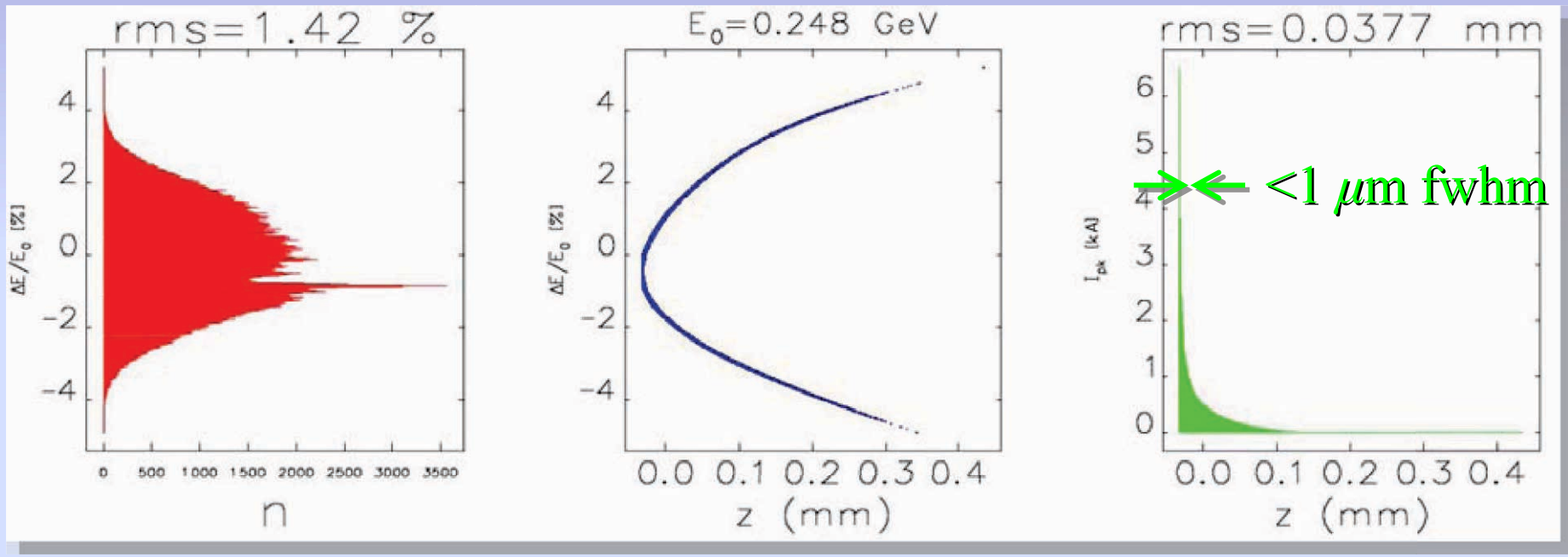


- With constant magnet currents, move chicane magnets, look for orbit change downstream of compressor.
- Have found assembly problem with dipole – will be corrected.

CSR Simulation* Through BC1

Bunch charge = 0.2 nC

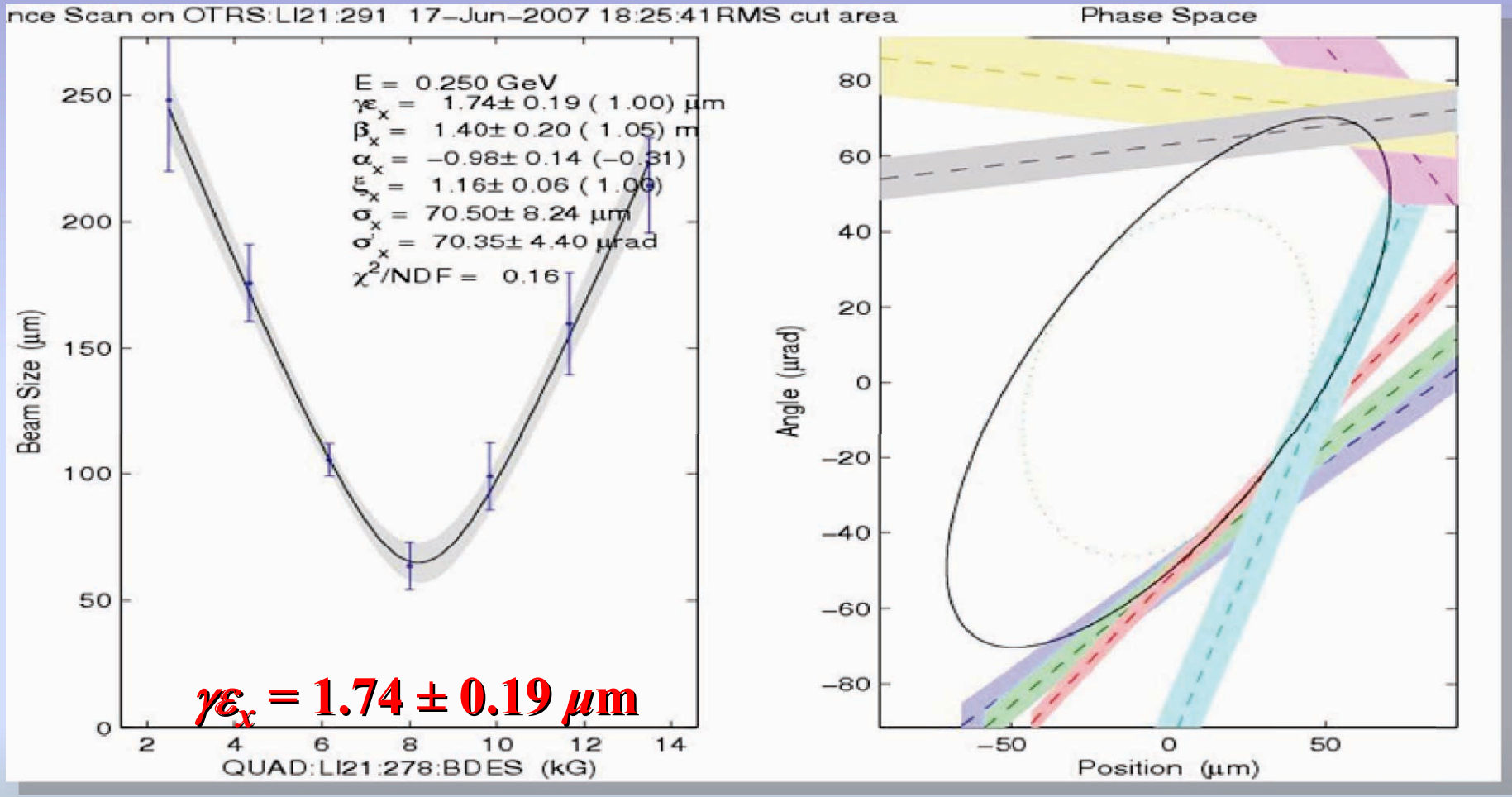
$\gamma\varepsilon_x$: 1.8 → 2.7 μm



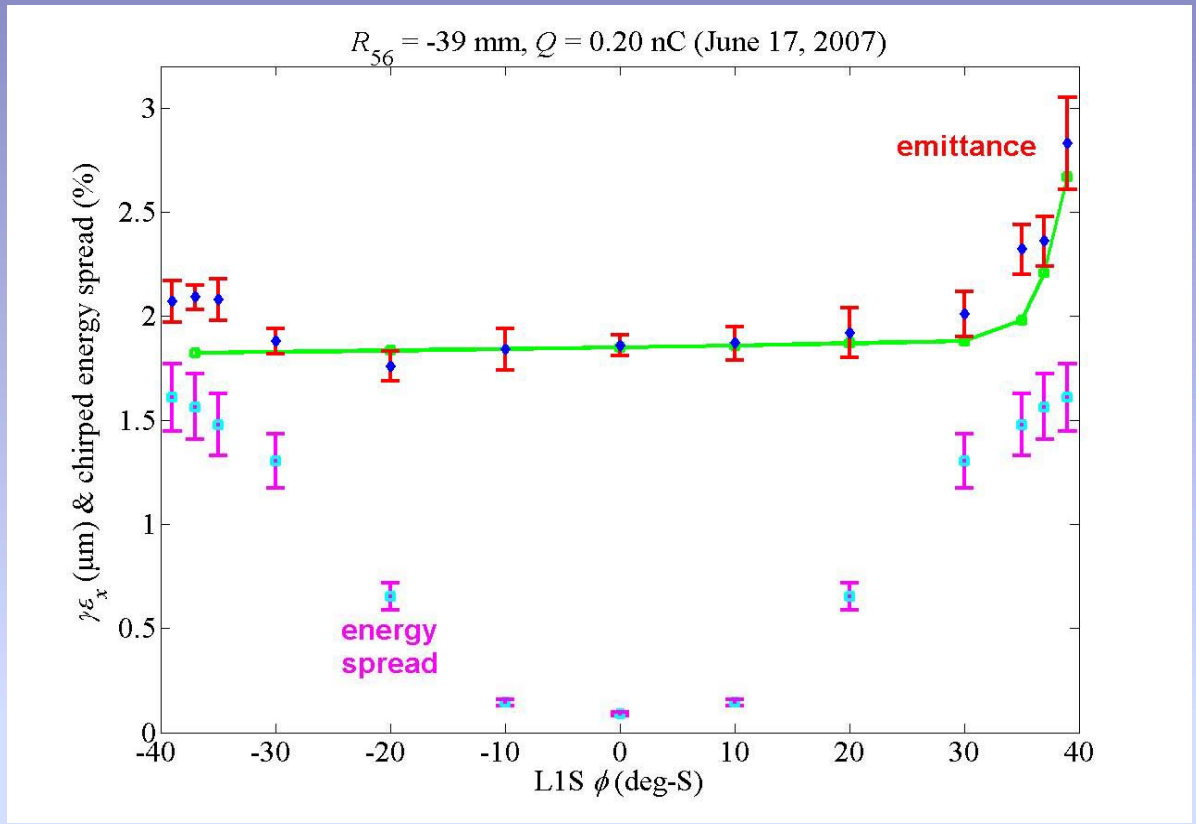
Assuming 1 keV initial rms energy spread, calculated in tracking.

* Using *Impact-T* and *Elegant*

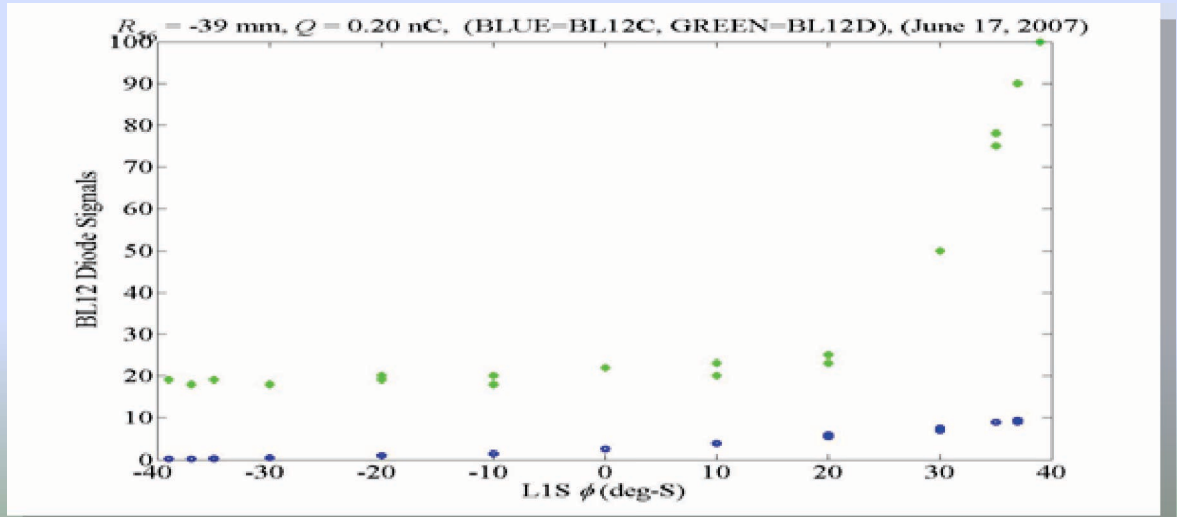
Example Emittance Measurement with Quad-scan on OTR Screen after BC1 Chicane



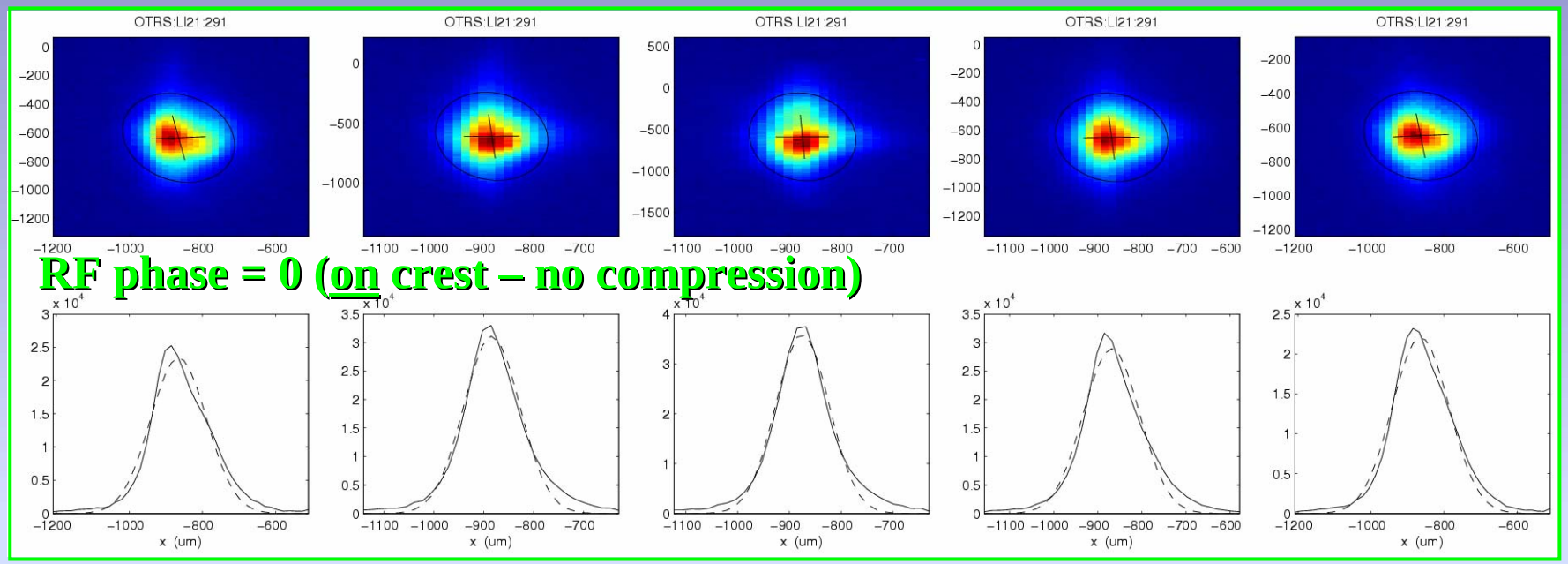
Measured and Simulated Emittance after BC1 vs. RF Phase Before BC1

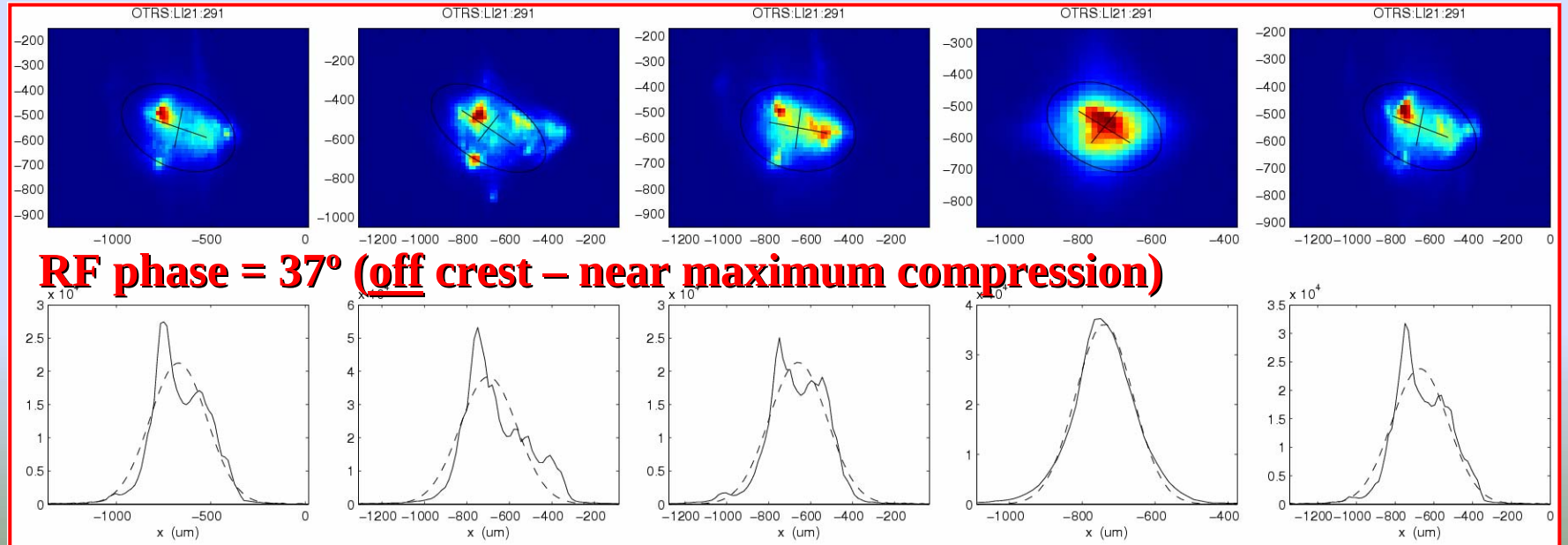


Bunch length Monitor Diodes 100 and 300GHz

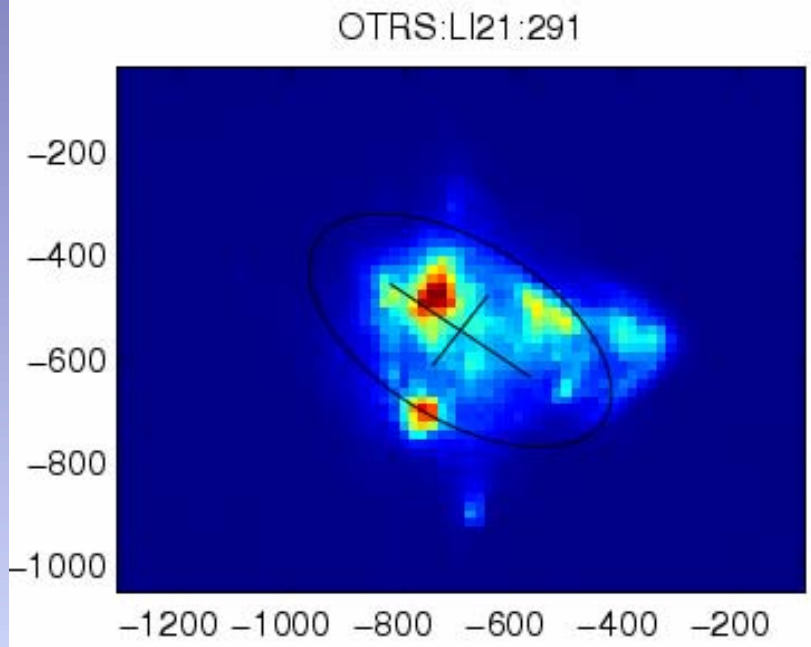


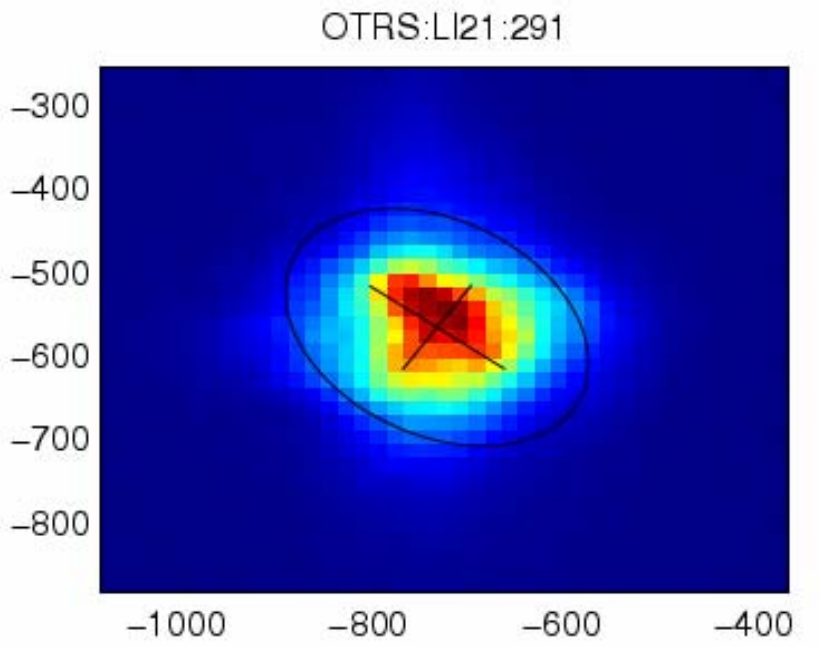

135 MeV
250 MeV
OTR screen


OTRS:LI21:291
OTRS:LI21:291
OTRS:LI21:291
OTRS:LI21:291
OTRS:LI21:291
RF phase = 0 (on crest – no compression)
x (um)
x (um)
x (um)
x (um)
x (um)

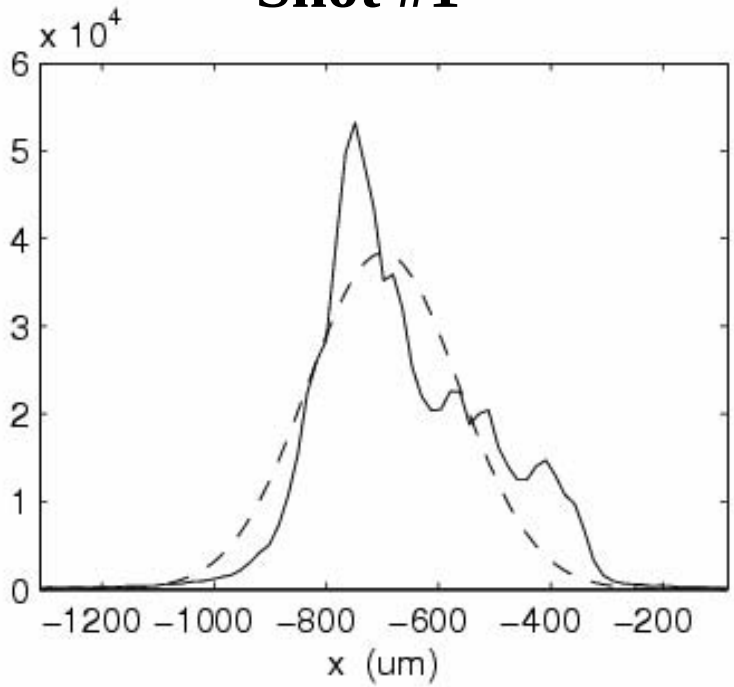

OTRS:LI21:291
OTRS:LI21:291
OTRS:LI21:291
OTRS:LI21:291
OTRS:LI21:291
RF phase = 37° (off crest – near maximum compression)
x (um)
x (um)
x (um)
x (um)
x (um)

RF phase = 37° (off crest – near maximum compression)

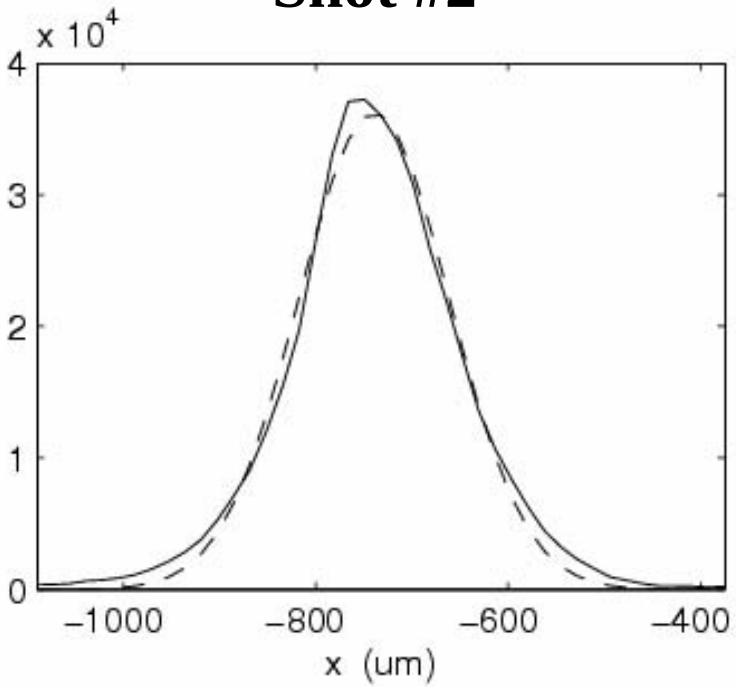




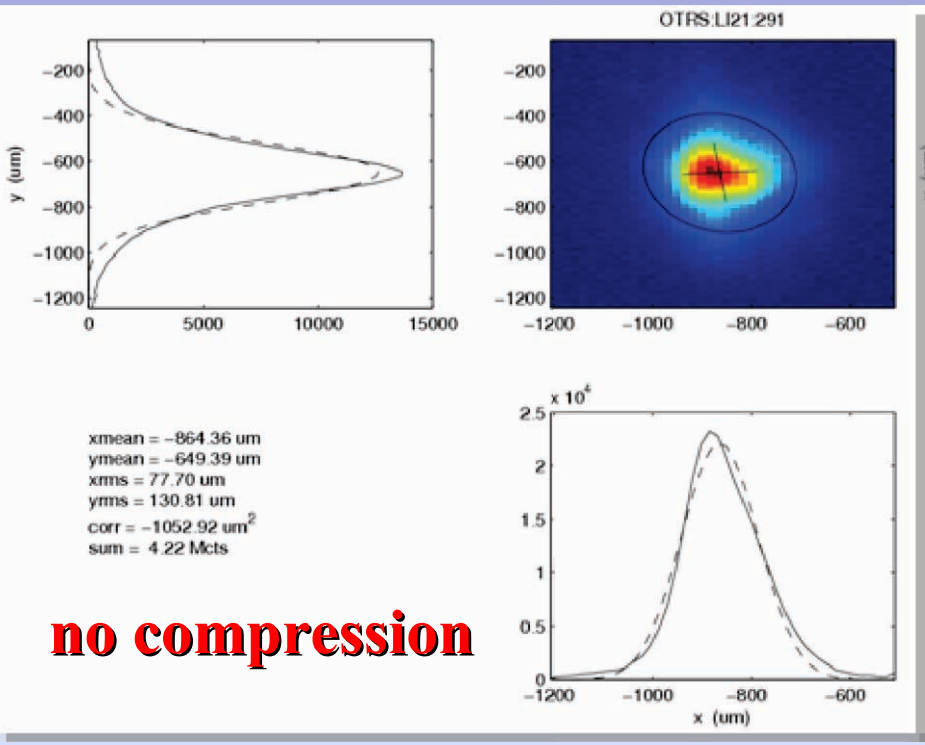
Shot #1

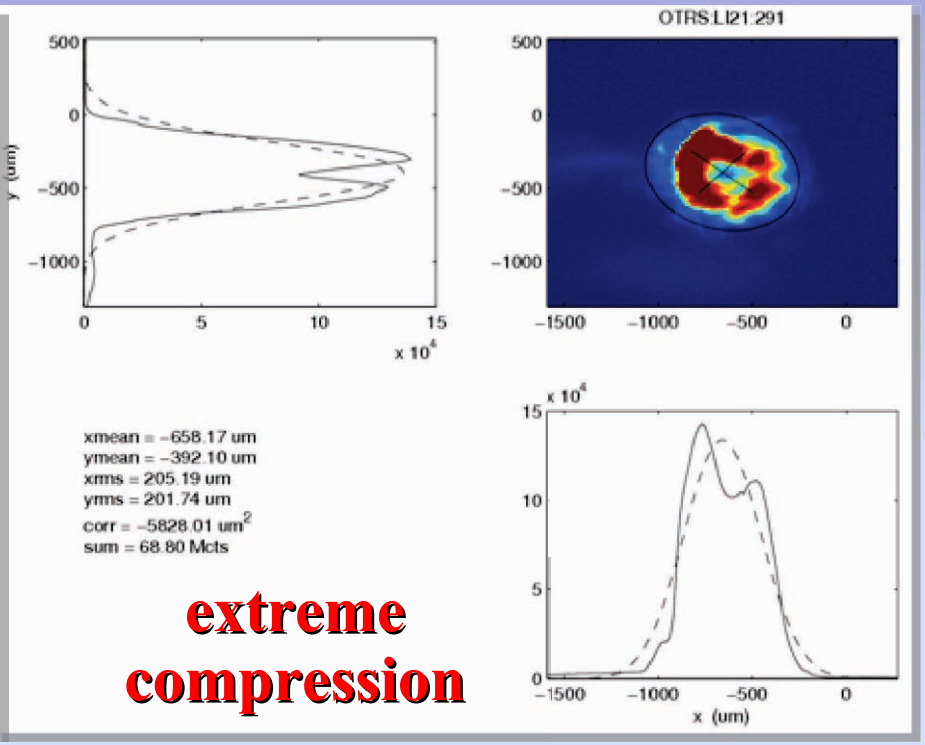


Shot #2



Post-BC1 OTR Screen Images with and without Compression
X-band adjusted for maximum compression





The total optical camera signal increases by up to 100-times for the case at right (COTR?) Could corrupt measurements at high compressions

Overall Status

- Measured emittance growth from compression matches model
- 1.7mm-mr (integrated) at 200pC, need 0.8 slice.
  - System not optimized yet
- Commissioning X-band compression linearization now – should eliminate narrow “spike” on bunch, reduce CSR growth at strong compression
- Interesting evidence for Coherent Optical Transition Radiation (not directly useful for FEL)