

# University of California at Los Angeles

Chicane Compressor  
Development and Status

for

*Brookhaven National Lab*  
*Accelerator Test Facility*

•R. Agustsson, J.B. Rosenzweig

# UCLA BNL-ATF Chicane

- **Motivation**

- **Bunch Compression**

- Higher peak current

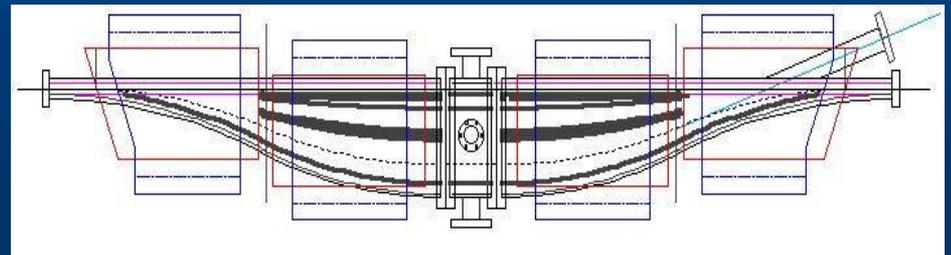
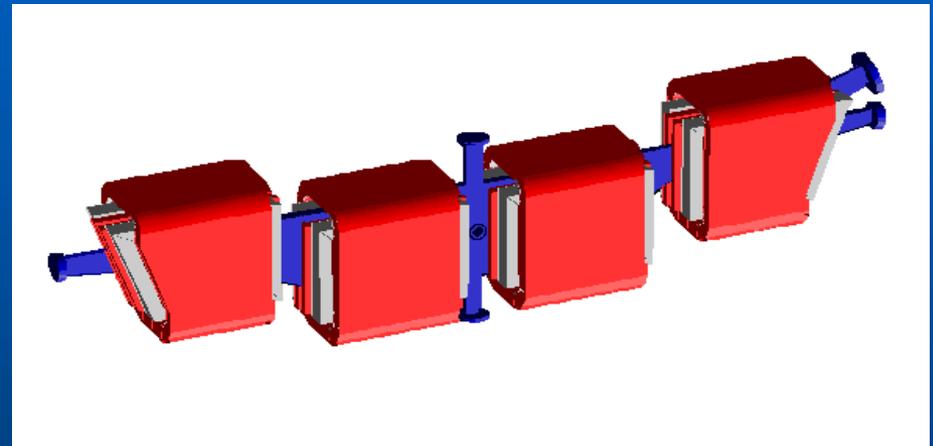
- **CSR effects in bending systems**

- Emittance growth
- Nondestructive bunch length measurement

# UCLA BNL-ATF Chicane

## *Main Components to Compressor Realization*

- Simulation
- design
- manufacture
- testing
- implementation
- experiment



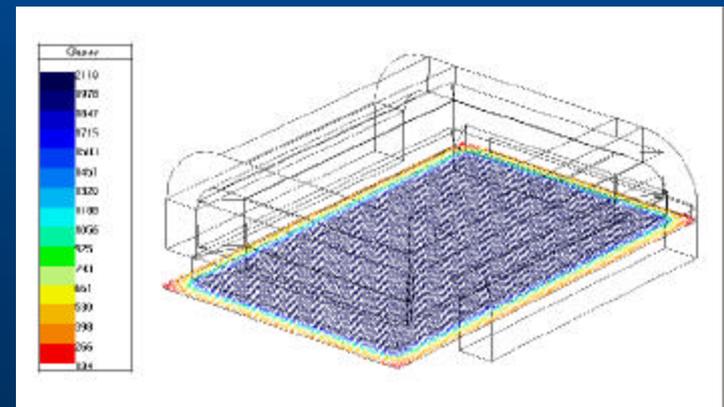
# UCLA BNL-ATF Chicane

## *Simulations*

- **Beamline**
  - Trace 3-D
    - Rough Characterizations
    - No CSR
    - Waterbag Space Charge Description
  - Parmela
    - No CSR
  - *Elegant\**
    - Utilizes 1-D line charge induced CSR
    - Measured field map to be included

\*Primary code to be discussed further

- **Magnet Simulations**
  - Poisson
    - 2-D
  - *Amperes*
    - 3-D Magnetostatic

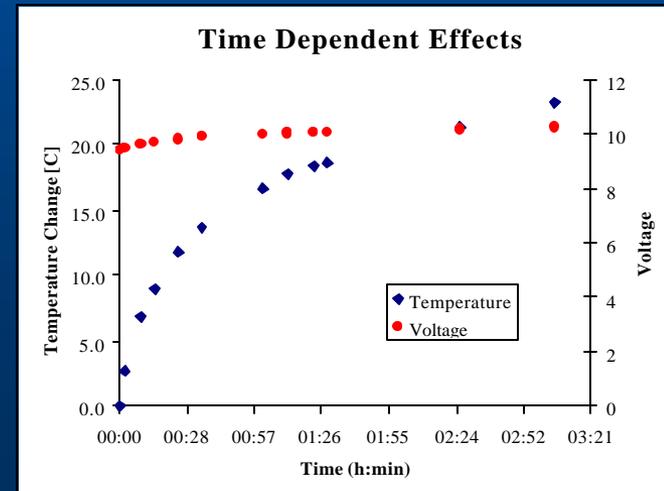
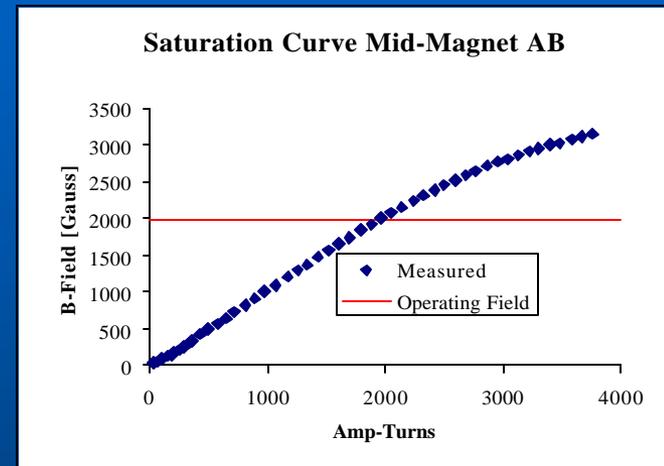


AMPERES Field Map of Central Magnet

# UCLA BNL-ATF Chicane

## *Magnet Testing*

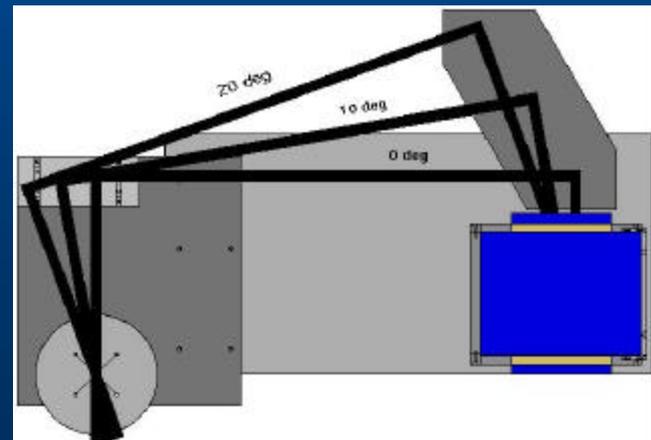
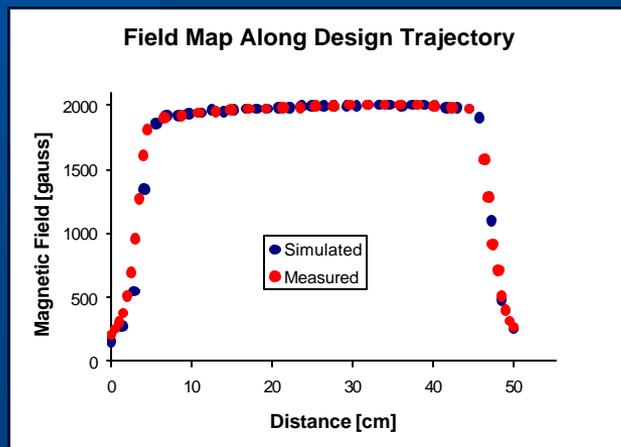
- Initial testing has confirmed magnet design goal achievement
  - operating in linear region
  - no excessive heating of coils
  - ~1.5A/mm @ operating point
  - <10% voltage increase



# UCLA BNL-ATF Chicane

## *Magnet Testing*

- Field mapping
  - Fields along radii
  - allows construction of field for use in simulations
  - in good agreement with Amperes simulation



# UCLA BNL-ATF Chicane

## *Hardware Status*

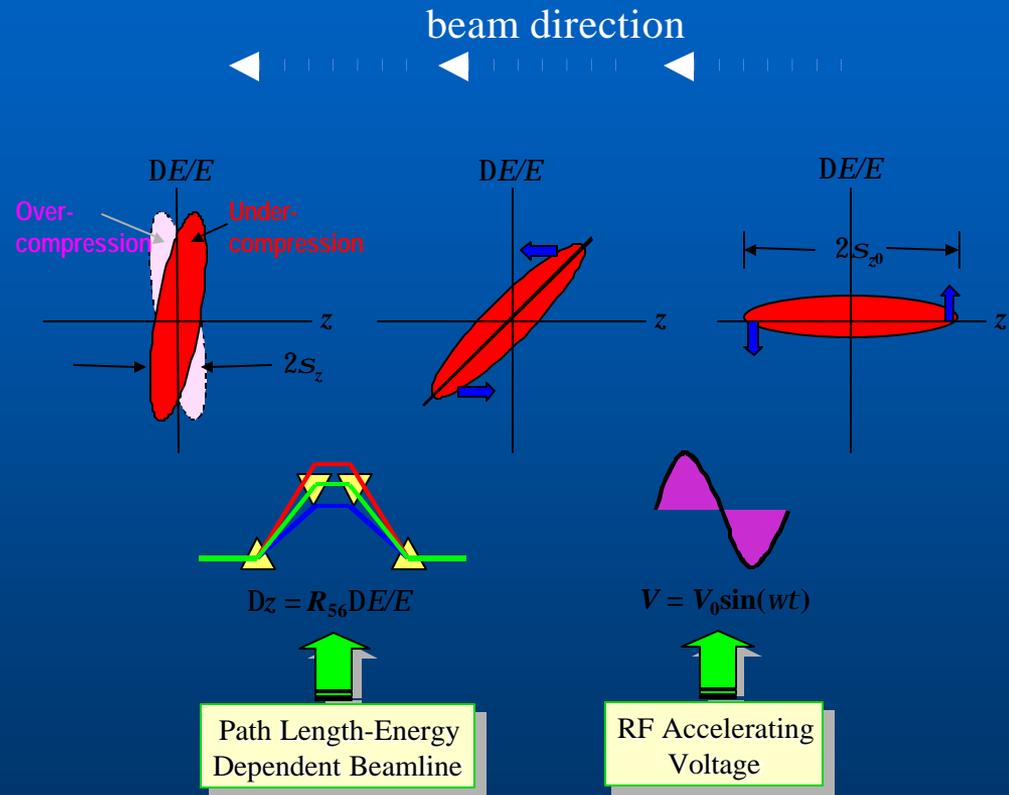
- **Magnets**
  - **Conducting field tests**
    - **Saturation**
    - **Field Quality (shimming underway)**
- **Vacuum Chamber**
  - **Machining completed**
  - **At SLAC being welded**
  - **Note CSR port aimed between magnets 3 & 4**
- **Stands**
  - **near design completion**
  - **kinematic adjustments**
  - **alignment via optical targets**



# UCLA BNL-ATF Chicane

## Stand alone studies

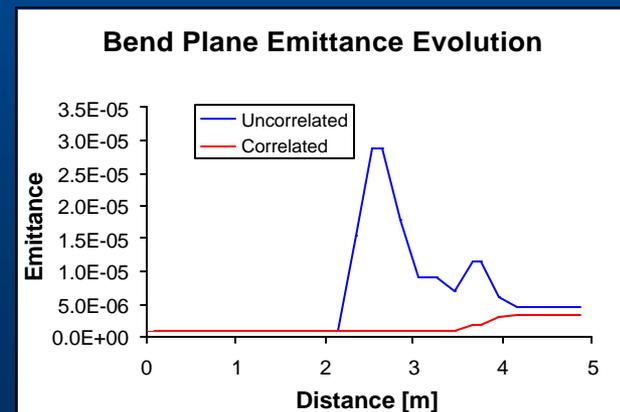
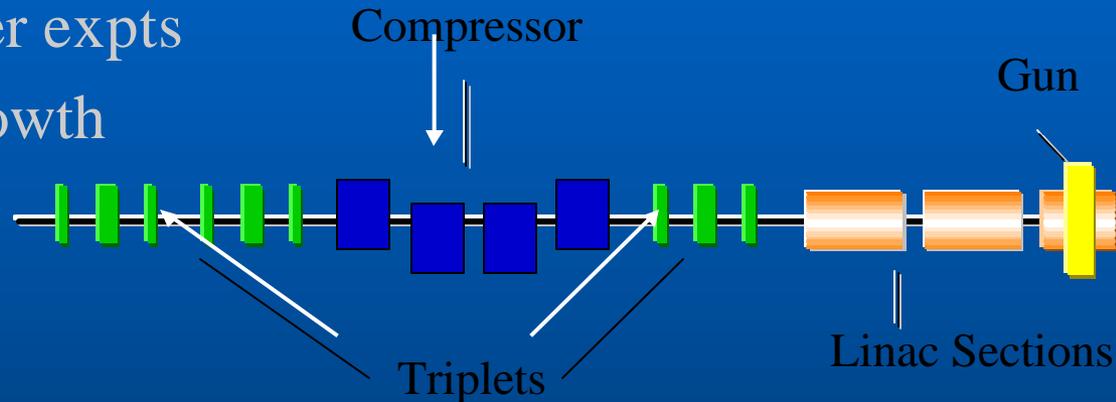
Beam Energy	70.7 MeV
Beam Charge	200 pC
Energy Spread	0.395%
Bend Angle	20 degrees
Magnetic Length	44.6 cm
Magnetic Field	1965 gauss
Initial Pulse Length	.345 mm rms
Final Pulse Length	.045 mm rms
Final Peak Current	1.67 kA
Norm. Emitt. Growth	3.9 mm-mrad



# UCLA BNL-ATF Chicane

## *Stand alone studies*

- Follow on to Neptune, other expts
- CSR induced emittance growth
  - better compression
    - radiation scaling
    - more emittance growth
  - Phase space tomography
- CSR instability
  - Signature in radiation, energy spectra
  - Dedicated CSR port is unique in the field
  - Goly cell with band-pass filters for CSR measurement



# UCLA BNL-ATF Chicane

## *Stand alone studies*

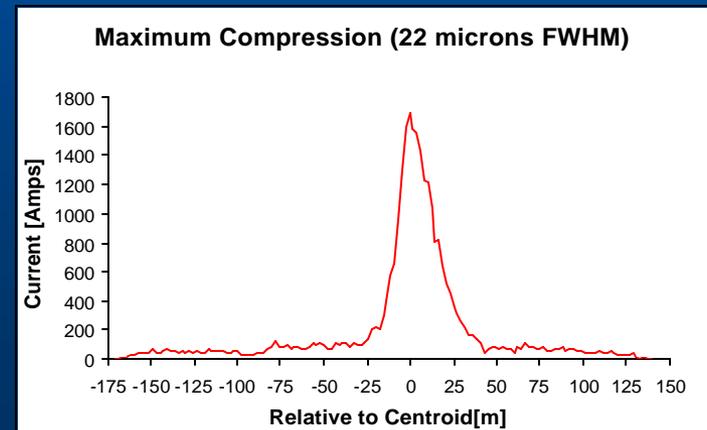
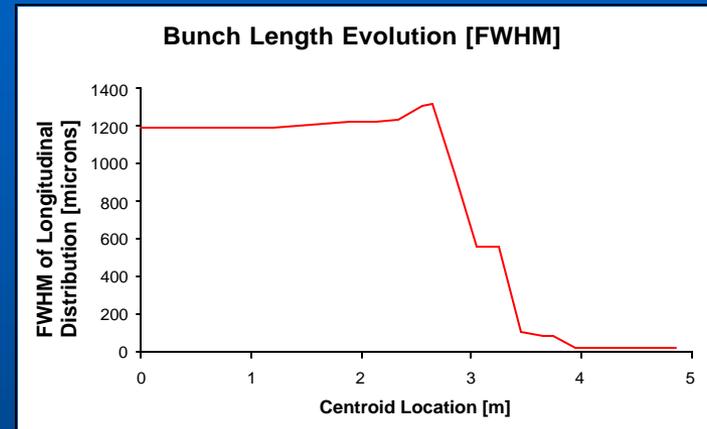
- Modeling with PARMELA/ELEGANT; benchmarked during VISA!
- 1200 microns FWHM or 345 microns RMS initial bunch length after the linac

$$I_{initial} = 55 \text{ amps}$$

- 22 micron FWHM after the compressor

$$I_{final} = 1.69 \text{ kA}$$

- Provides a shorter beam w/less initial charge
- 3.9 mm-mrad emittance growth
- Used initial beamline description with matching optics to be coordinated with ATF personal



# UCLA BNL-ATF Chicane

## *Experimental summary*

- **Study stand alone compressor experiments not feasible at Neptune phase space measurements**
  - no post chicane spectrometer
  - Space Charge, not CSR dominated
- **Coherent Synchrotron Radiation measurements**
  - Polychromator?
  - Golay Cell
    - power measurement
    - low budget filtering scheme
- **Emittance Measurements**
  - Quad Scan
  - Phase Space Tomography (follow on to Neptune slit expts.)

# UCLA BNL-ATF Chicane

## *Conclusion*

- Notable increase expected in ATF peak current
- Study has increased scope of PBPL capabilities  
i.e.. PARMELA/Elegant/GENESIS studies for VISA!
- Provides us the opportunity to examine CSR induced emittance growth and instability (hot topic!) in bending systems
- Magnets operating within desired parameters
- Vacuum hardware near completion
- Electrical/control systems in conjunction with ATF
- Ship all hardware within 6 weeks.