

# Status and Upgrades of the NLCTA for Studies of Advanced Beam Acceleration, Dynamics, and Manipulation

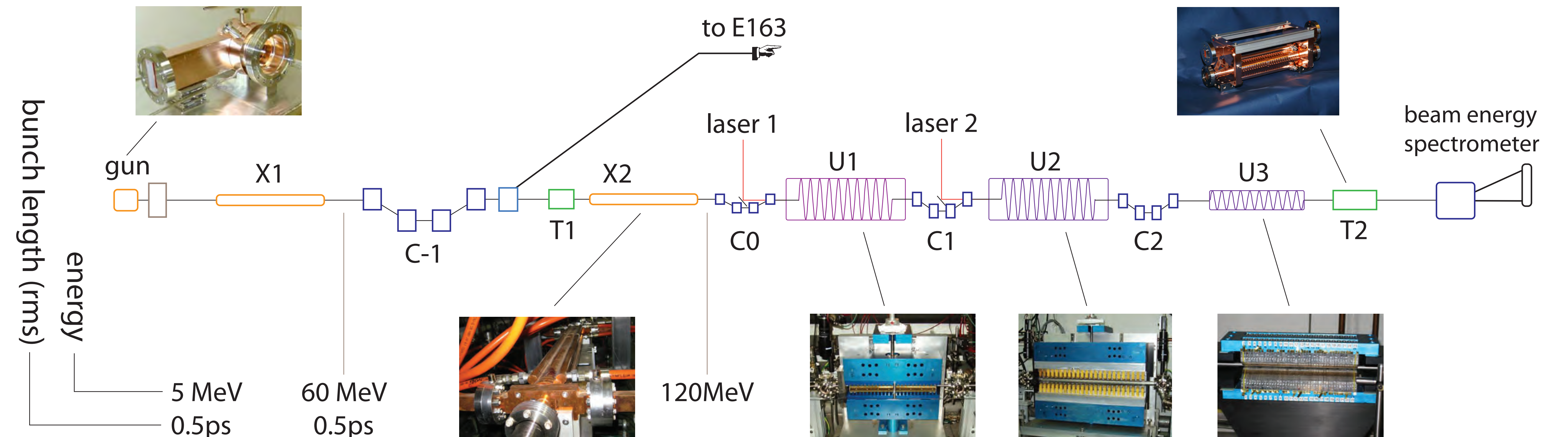


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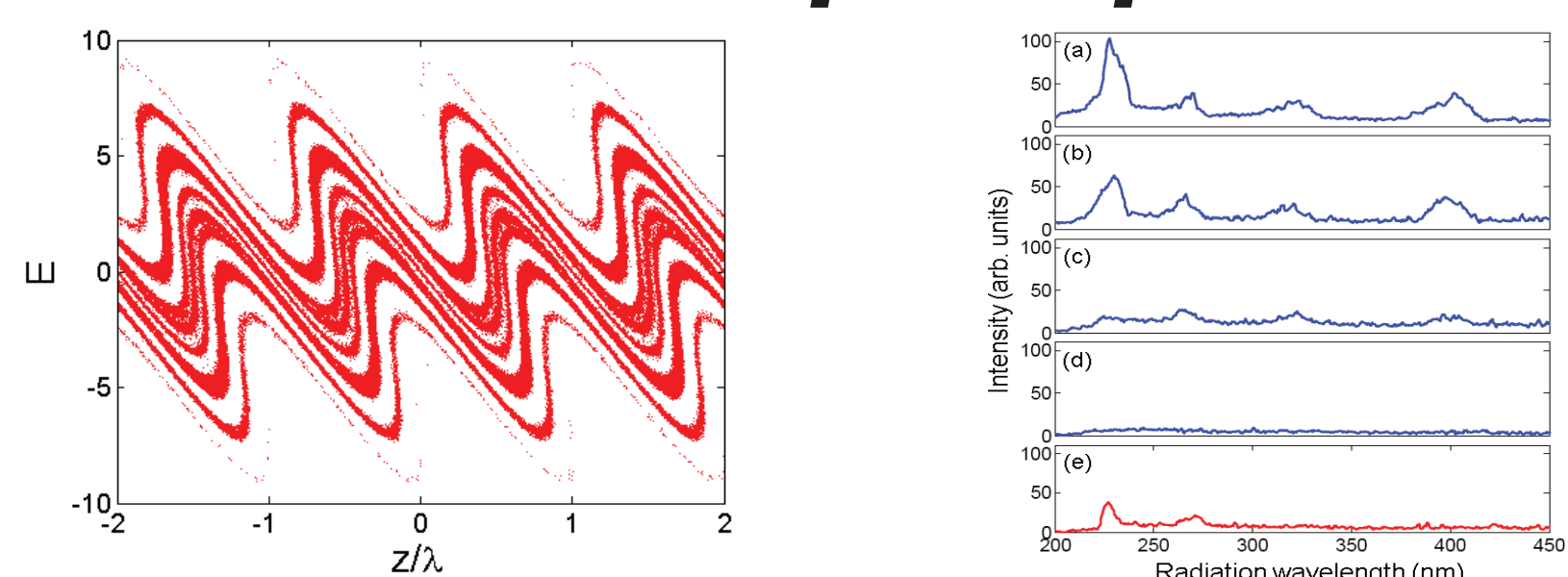
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The Next Linear Collider Test Accelerator (NLCTA) is a low-energy electron accelerator (120 MeV) at SLAC that is used for ultra-high gradient X-band RF structure testing and advanced accelerator research. Here we give an overview of the current program at the facility, including the E-163 direct laser acceleration experiment, the echo-enabled harmonic generation (EEHG) FEL experiment, narrow-band THz generation, coherent optical transition radiation (COTR) studies, microbunching instability studies, and X-band structure testing. We also present the upgrades that are currently underway and some future programs utilizing these upgrades, including extension of the EEHG experiments to higher harmonics, and an emittance exchange experiment.



## Current Program

### • *Echo-7: a proof-of-principle EEHG experiment*

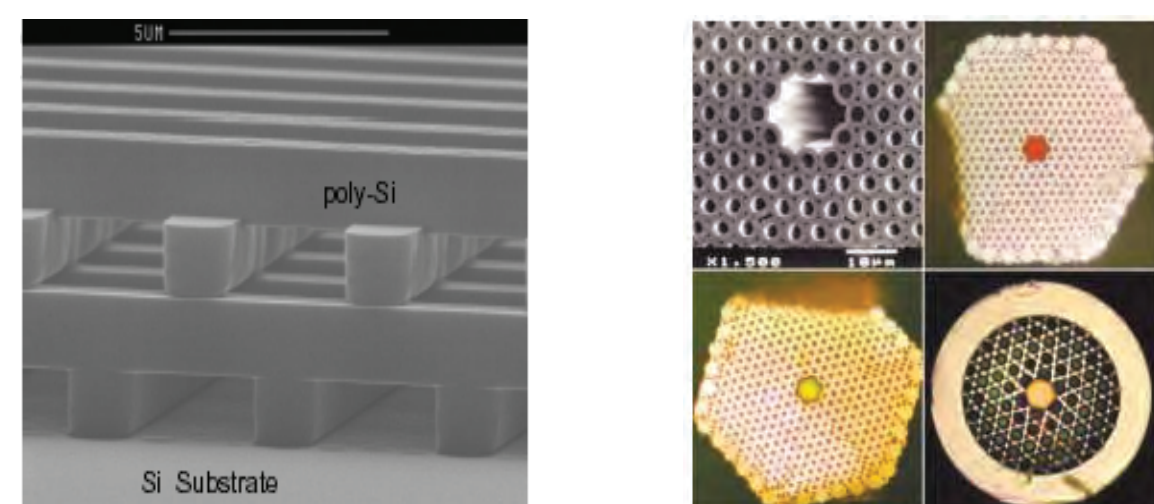


Simulated longitudinal phase space (left) and recent results (right).

- Coherent x-rays possible directly from a UV seed laser
- 7th harmonic measured so far; higher harmonics soon

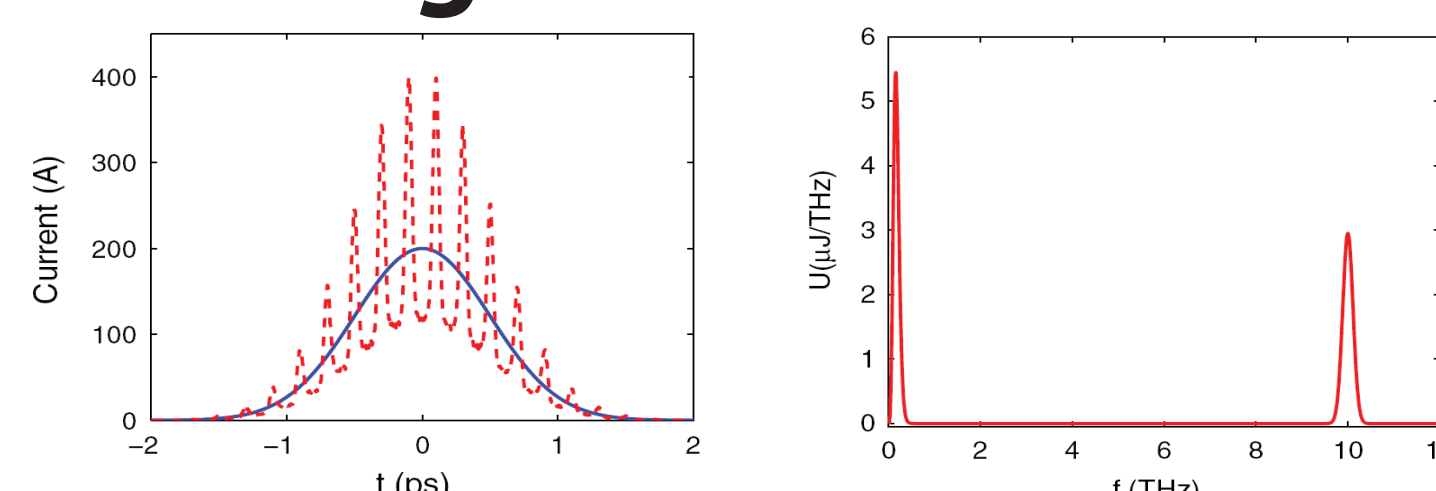
### • *E163 laser acceleration*

- Beam after chicane C-1 (60 MeV) is transported to a separate experimental hall for laser acceleration studies



Photonic band gap structures made by lithography (left) and fiber-drawing (right).

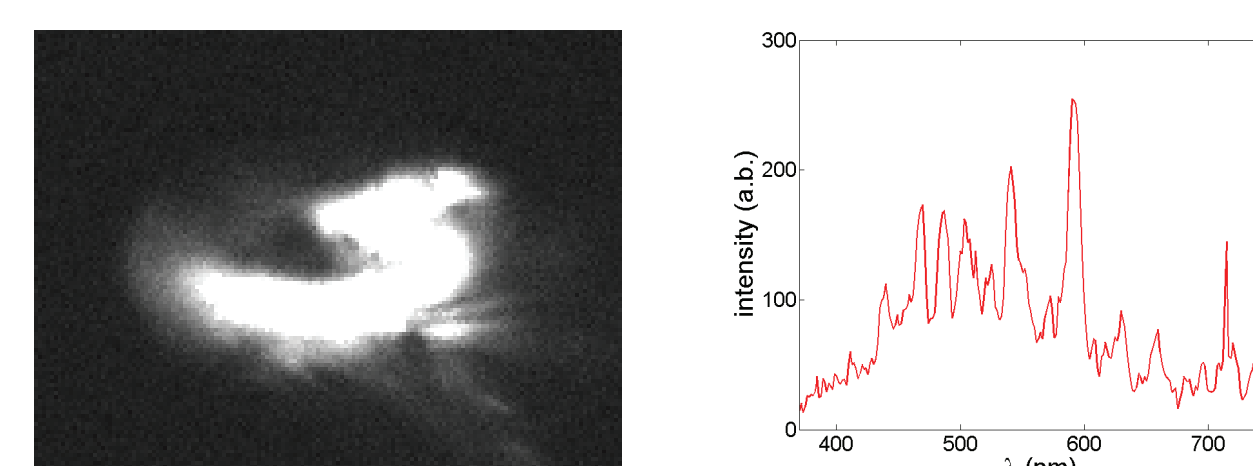
### • *Narrow-band THz generation*



- Difference frequency generation of two lasers, with relativistic electron beam being the nonlinear medium
- Uses existing echo-7 beamline (frequency down-conversion instead of up-conversion)

## Current Program

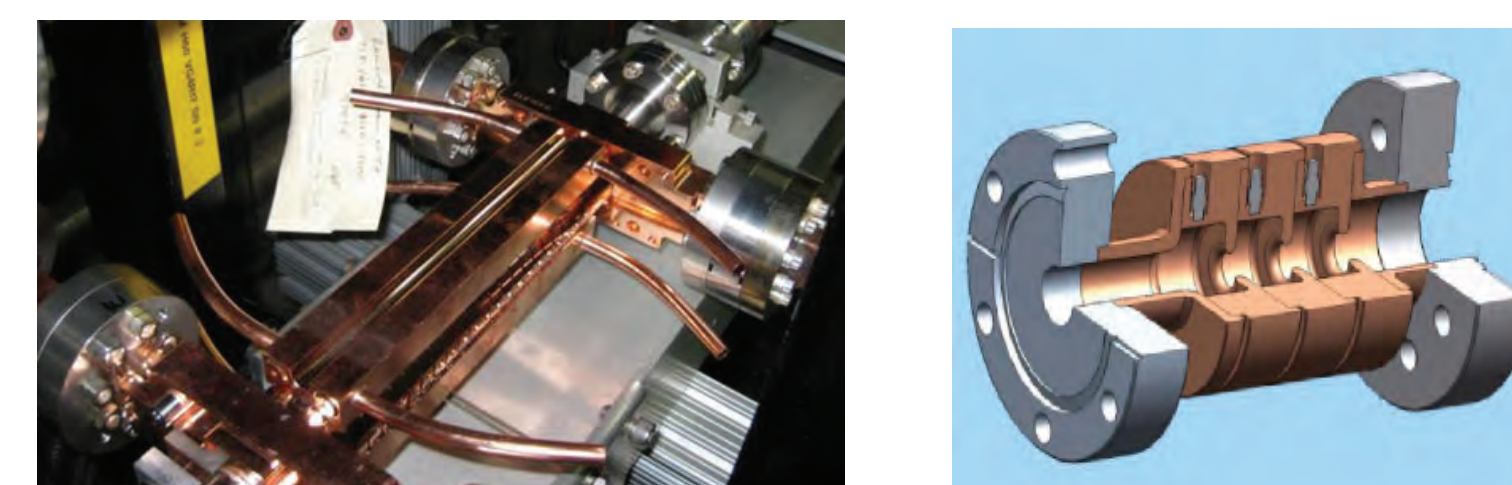
### • *COTR/Microbunching instability studies*



COTR image (left) and spectrum (right)

- With 4 chicanes, the microbunching gain is very high

### • *High-gradient X-band RF structure testing*



SLAC/CERN/KEK high-gradient structures.

- Structures have been reliably operated at 100 MV/m

## Upgrades

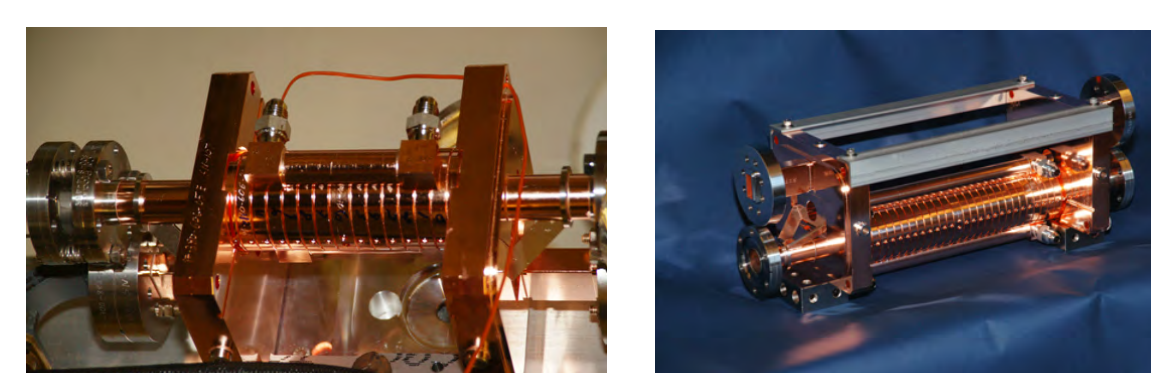
### • *Beam spectrometer redesigned for higher resolution (dispersion increased 3x)*

- Completed in March 2011

### • *Two deflecting cavities to be installed, one for heating, one as longitudinal diagnostic*

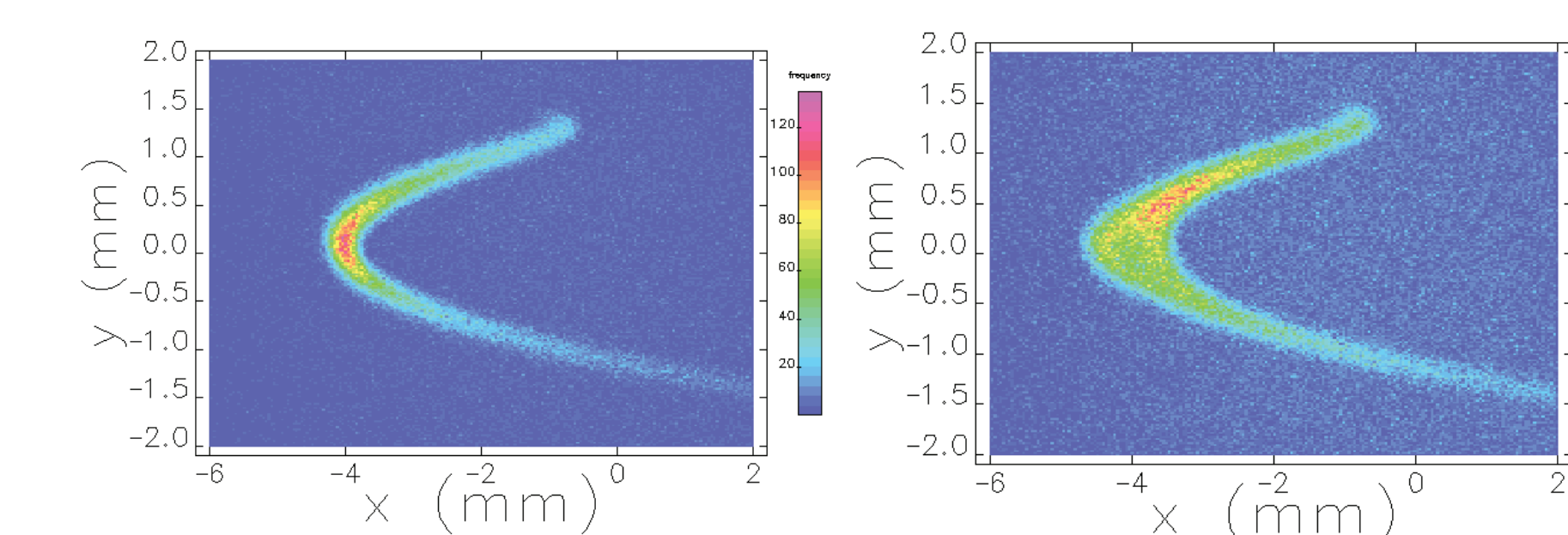
- Installed March 2011

### • *Other laser, controls upgrades*



## Future Program

### • *Fully benchmark EEHG theory and scale to higher harmonics (Echo-15)*



Beam image after energy spectrometer with laser off (left) and on (right), from simulation. Peak energy modulation is 30

### • *Continue studies on COTR/microbunching instability*

- Use T1 to Landau damp microbunching instability by increasing the beam slice energy spread

### • *Emittance and phase space exchange*

- Exchange transverse/longitudinal emittance
- Exact exchange can be done with C-1 chicane quads

### • *X-band gun test area*

- New beamline being installed to test high-gradient (200MV/m) X-band photoinjectors
- Several guns to be tested: modified 5.6 cell Compton scattering gun, new SLAC/LLNL MEGa-ray gun, UCLA Hybrid gun
- Will feature X-band accelerating structure (100MeV) and diagnostic area with T-cav and beam spectrometer

