APS Bunch Compressor Initial Experimental Results

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LCLS TAC Meeting January 12-13, 2001

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APS Bunch Compressor

- APS linac has a four-dipole chicane compressor at 100-200 MeV.
- Ran at 140 MeV for experiments.
- Most experiments involve precompressor linac (“L2”) phase scans. Energy held constant in compressor using feedback.
- Present configuration lacks the flexible chambers that will eventually allow variation of R_{56} and asymmetry.

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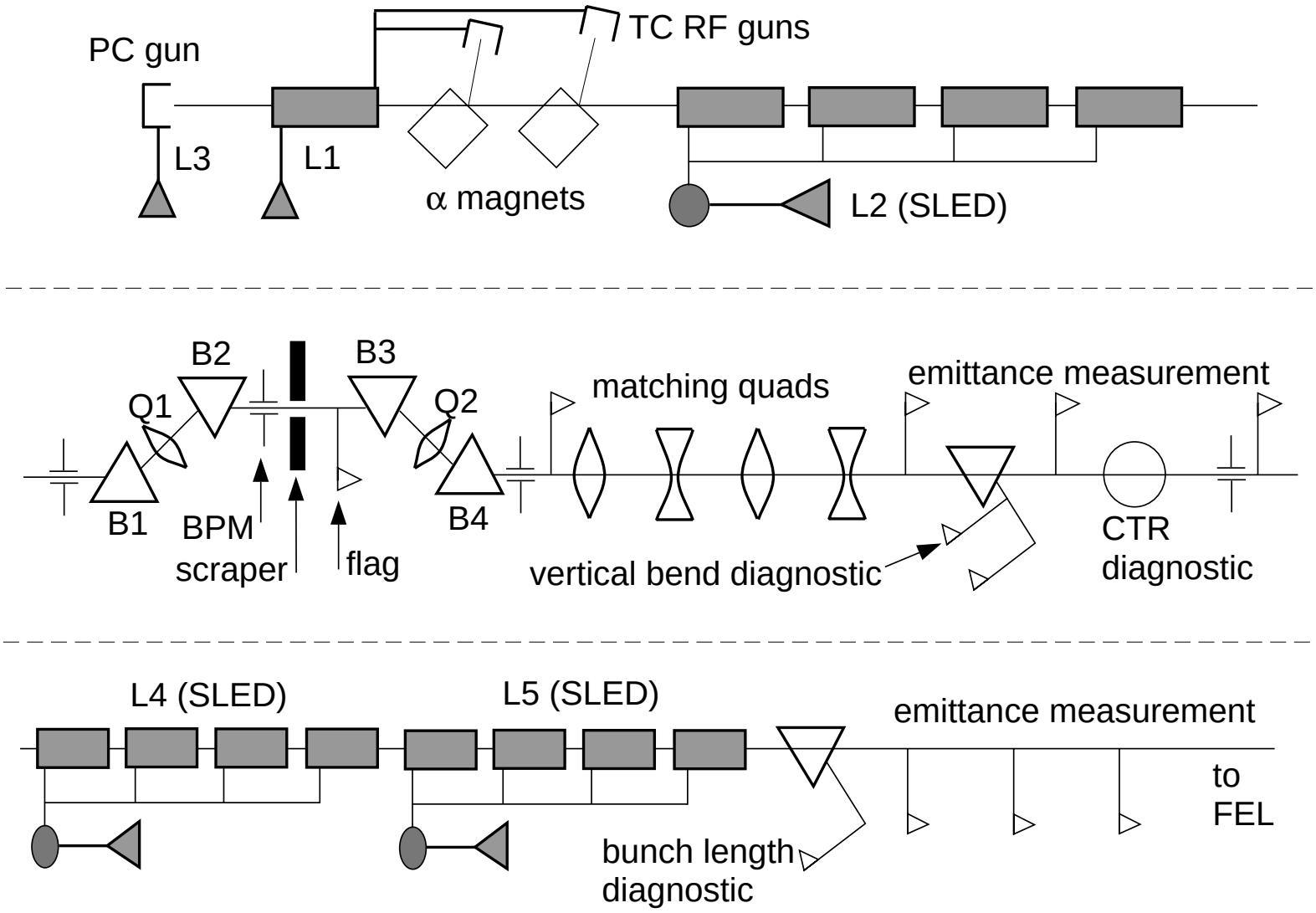
APS Linac and Bunch Compressor



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Measurement Capabilities and Limits

- Bunch length measured using rf zero-crossing method. Works well for ~0.2 to ~4 ps rms.
- Emittance measured directly following bunch compressor using three-screen method.
- Energy spectra can be measured at the chicane center and after the chicane using a vertical bend spectrometer.
- Ideally, would measure emittance, bunch length, spectra, etc., together as a function of L2 phase.
- Need for rapid data taking makes this unworkable.

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Summary of 12/17/00 Shift

- 180 pC/bunch from PC gun.
- Principle data taken:

1. scanned L2 phase, measured emittance, bunch length
2. scanned L2 phase, measured energy spectra at center of chicane and after chicane. [Phase jumped.]
3. scanned L2 phase, collected images on Dowell Diagnostic flag.

- Also looked for emittance growth when decompressing the bunch.

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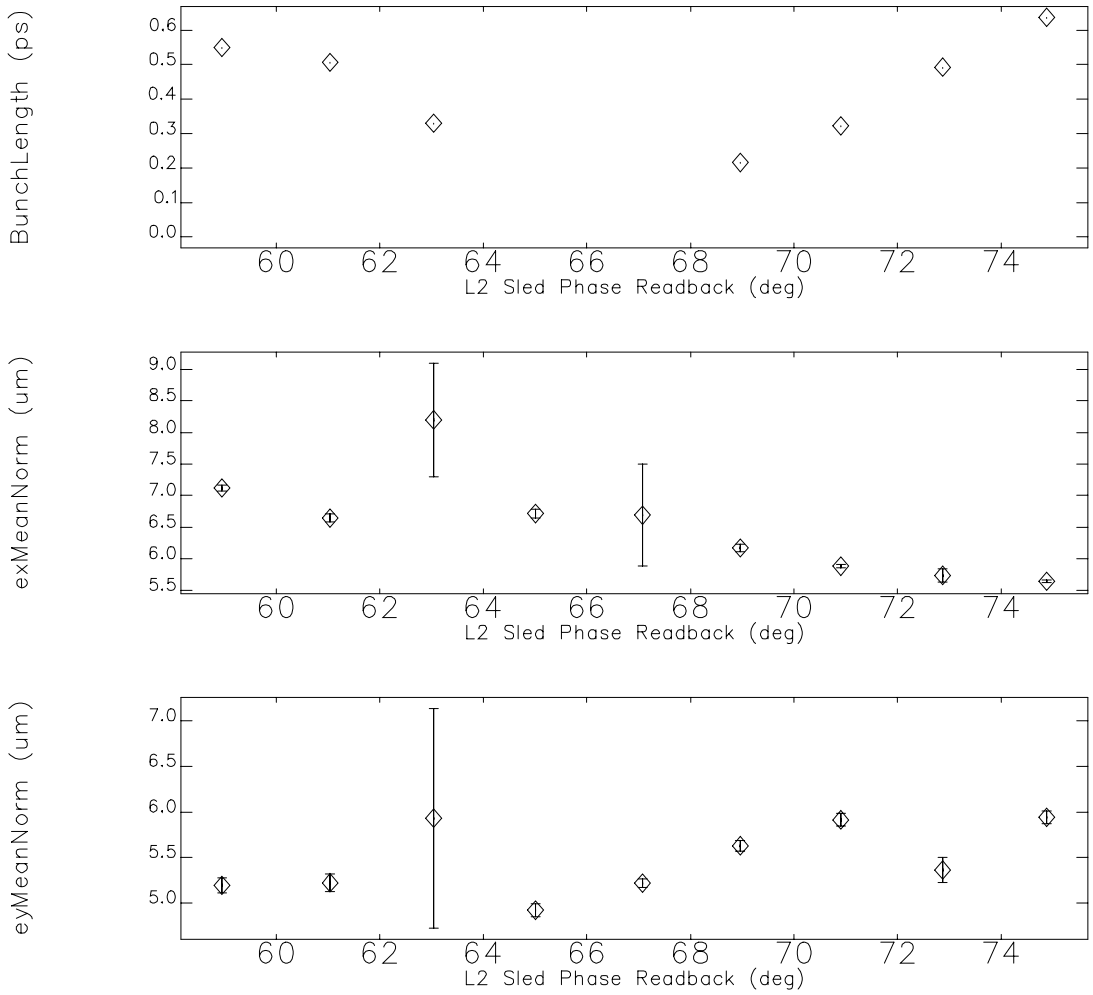
Scan #1, 12/17/00 (Set17)



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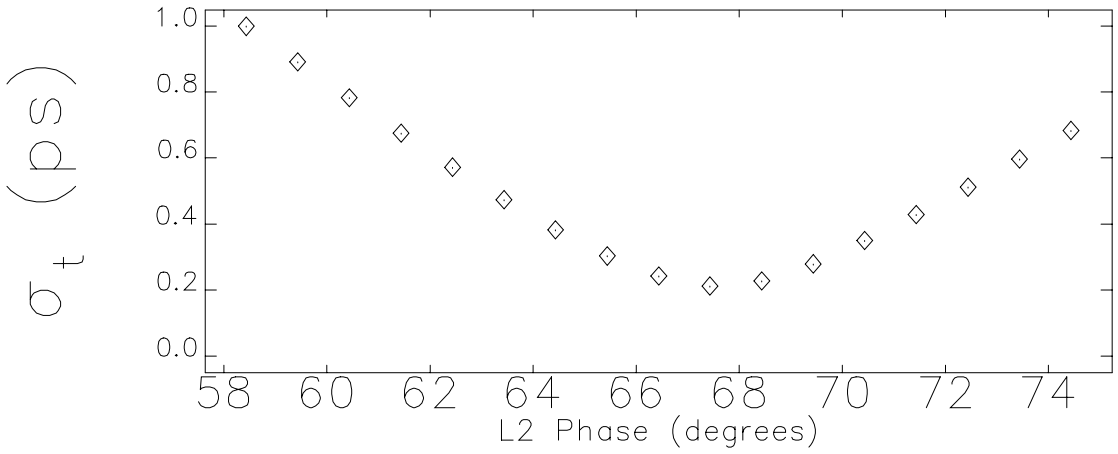
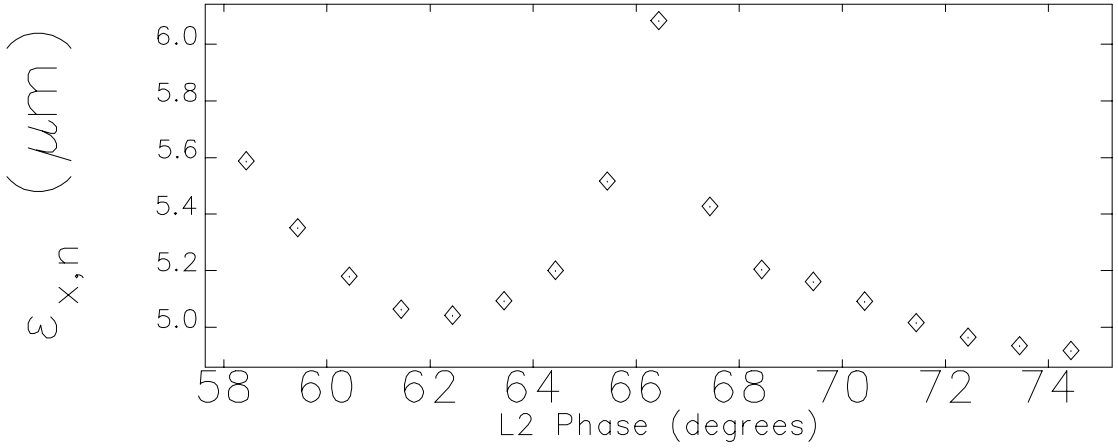
Simulation of Scan #1 with elegant





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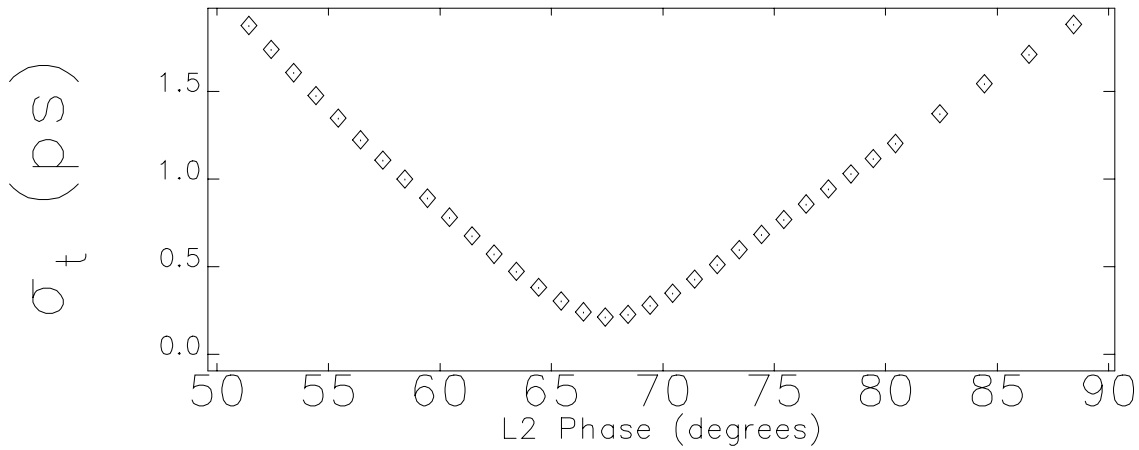
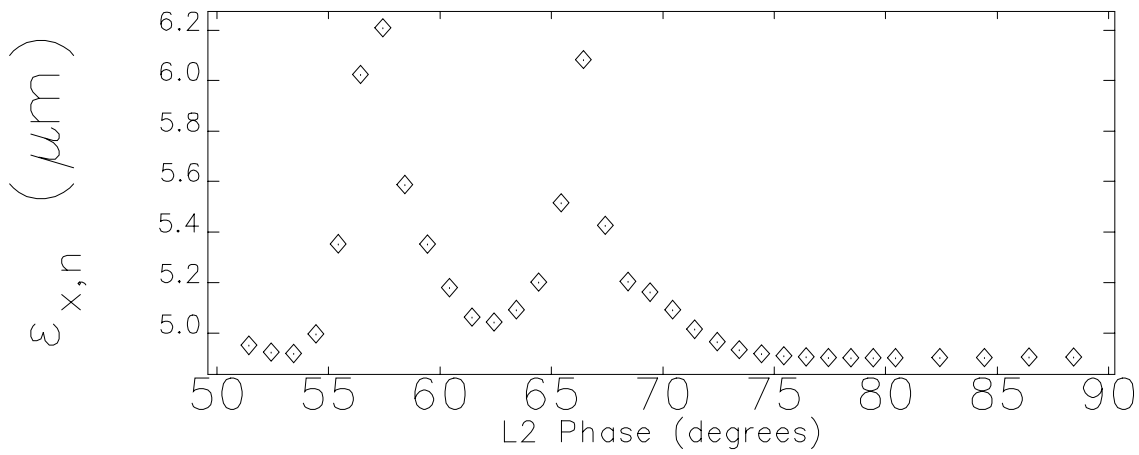
Simulation of Scan #1, Expanded Scale





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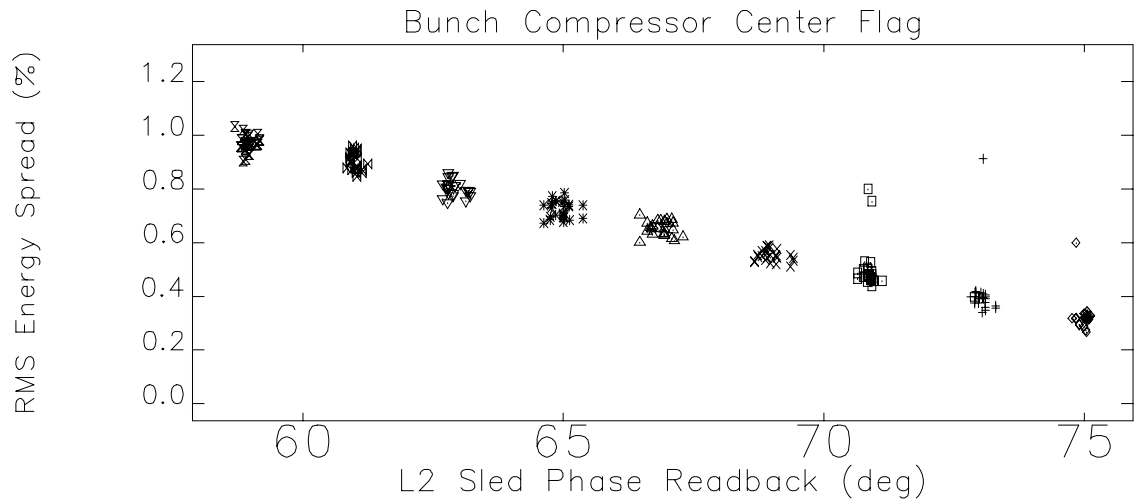
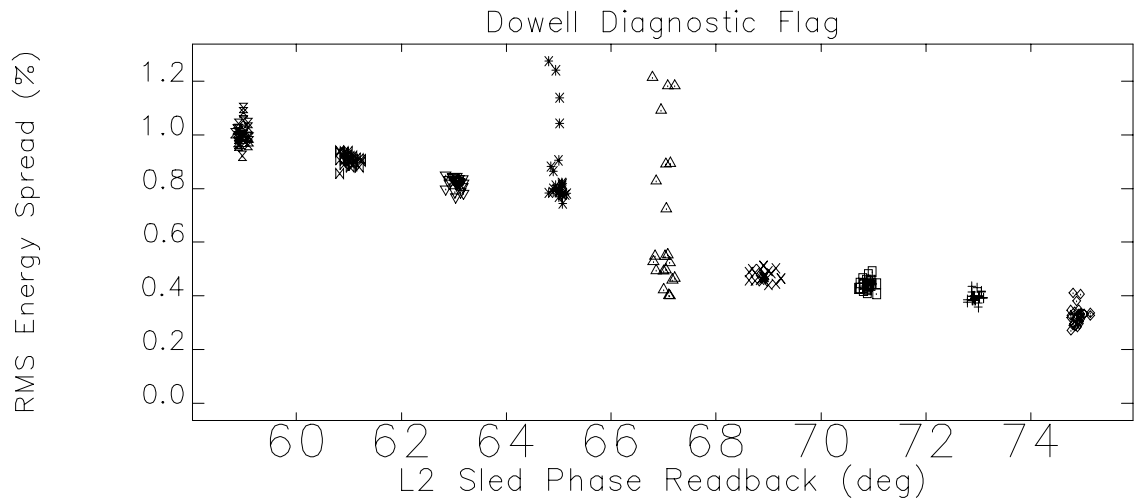
Energy Spread (Computed from σ_y), Scan #2, 12/17/00





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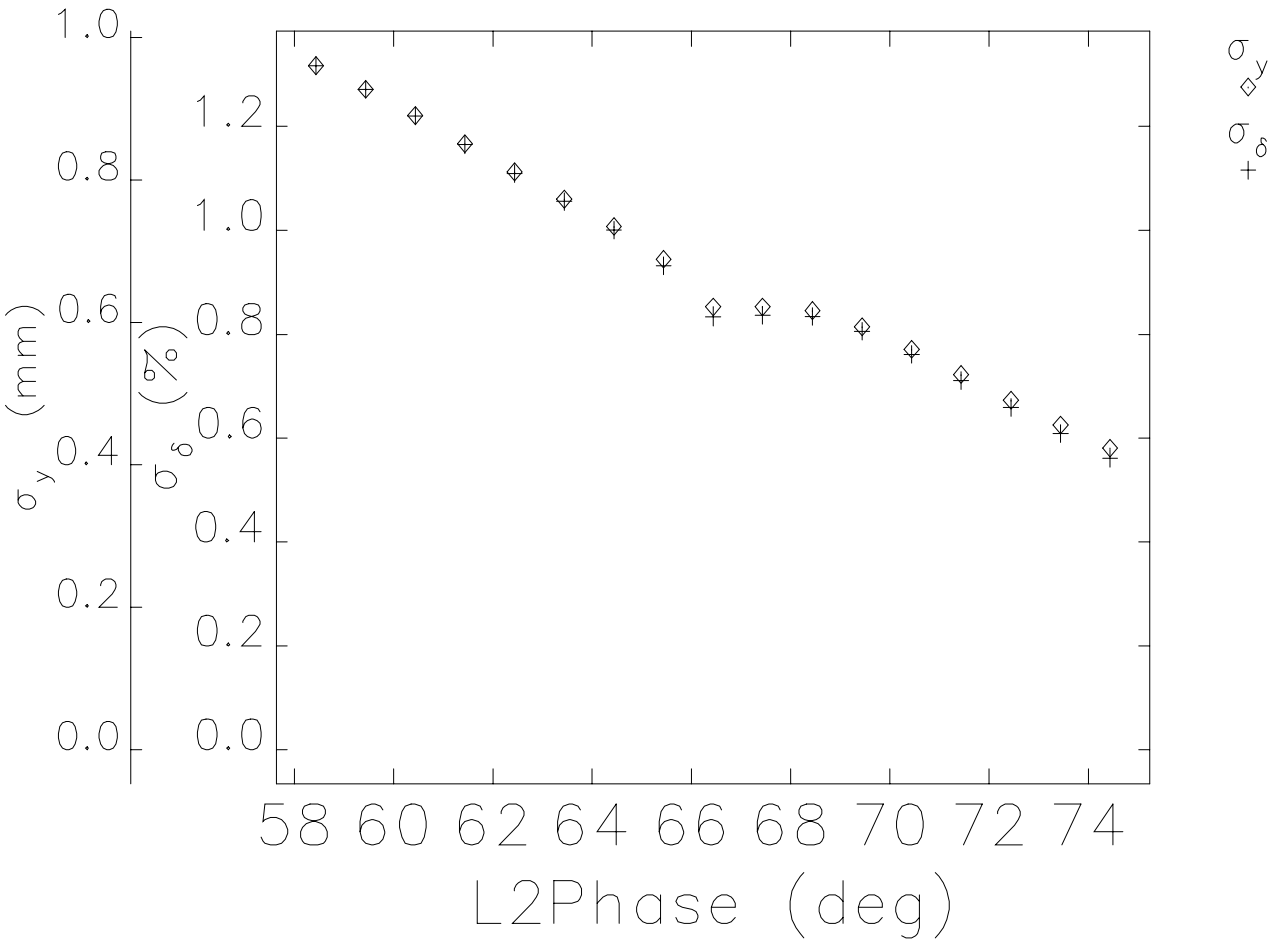
Simulation of RMS Energy Spread for Scan #2



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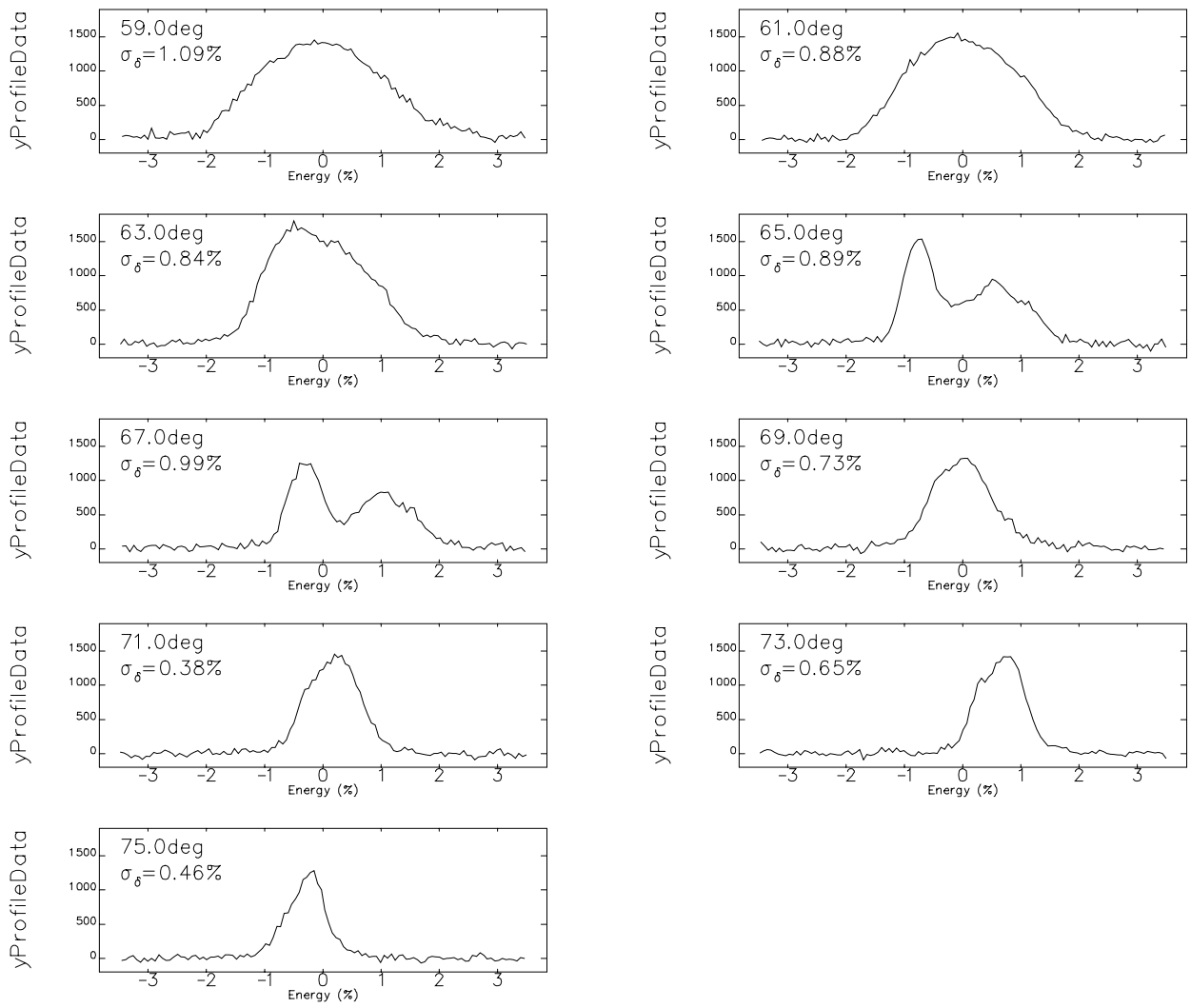
Measured Bunch DD Profiles for Scan #2



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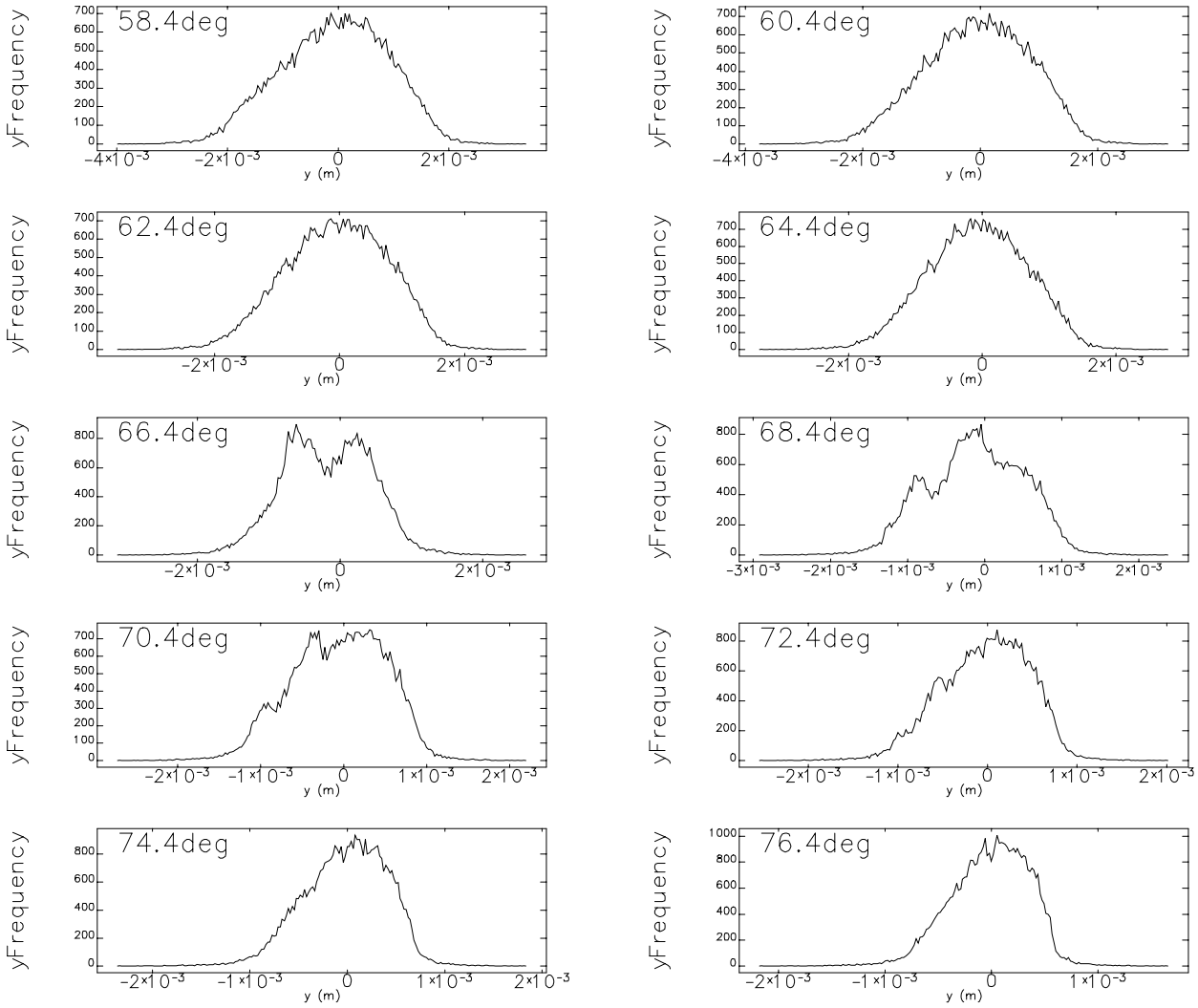
Simulation of Bunch DD Profiles for Scan #2



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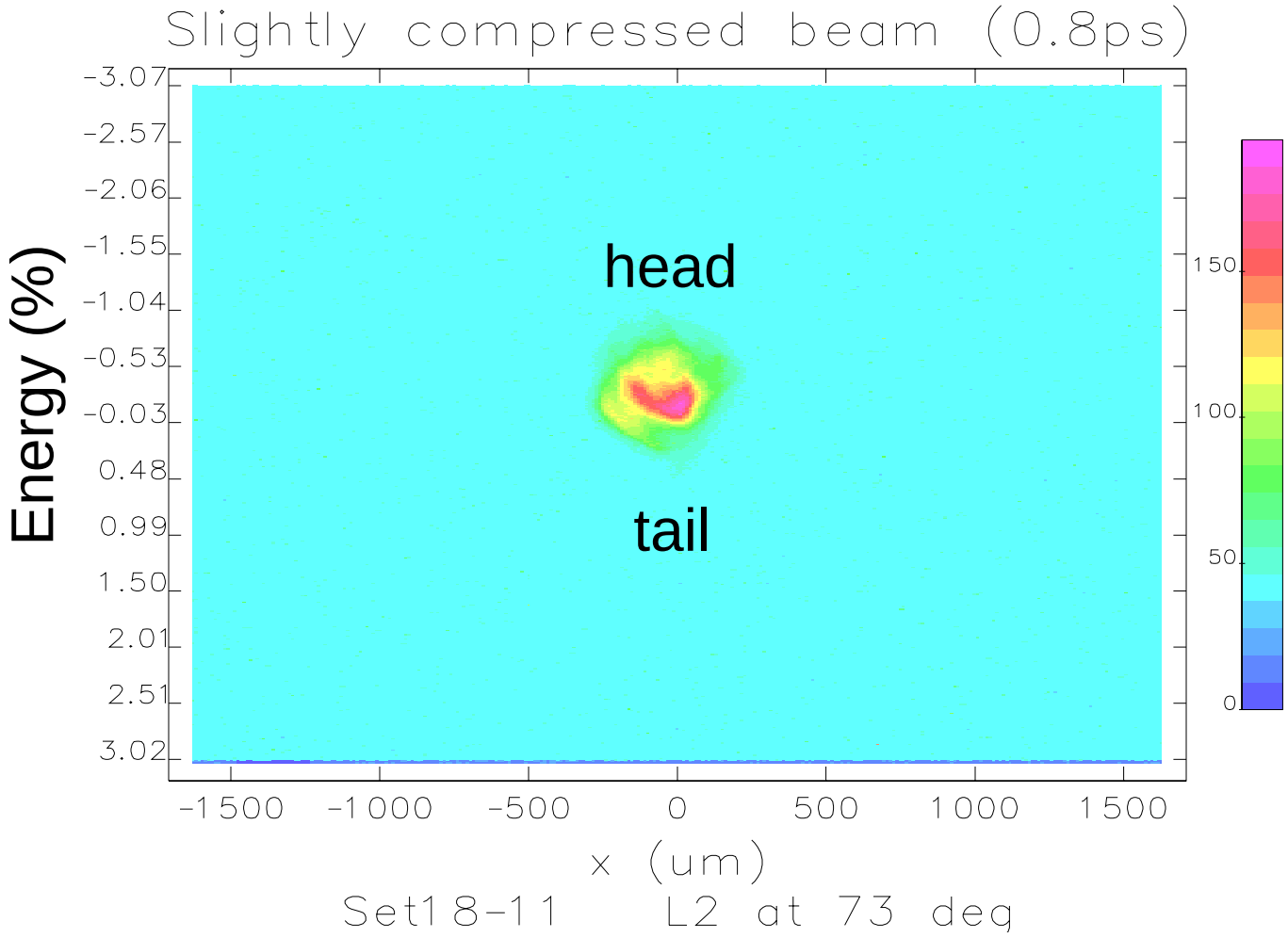
Dowell Diagnostic Images, Scan #3, 12/17/00



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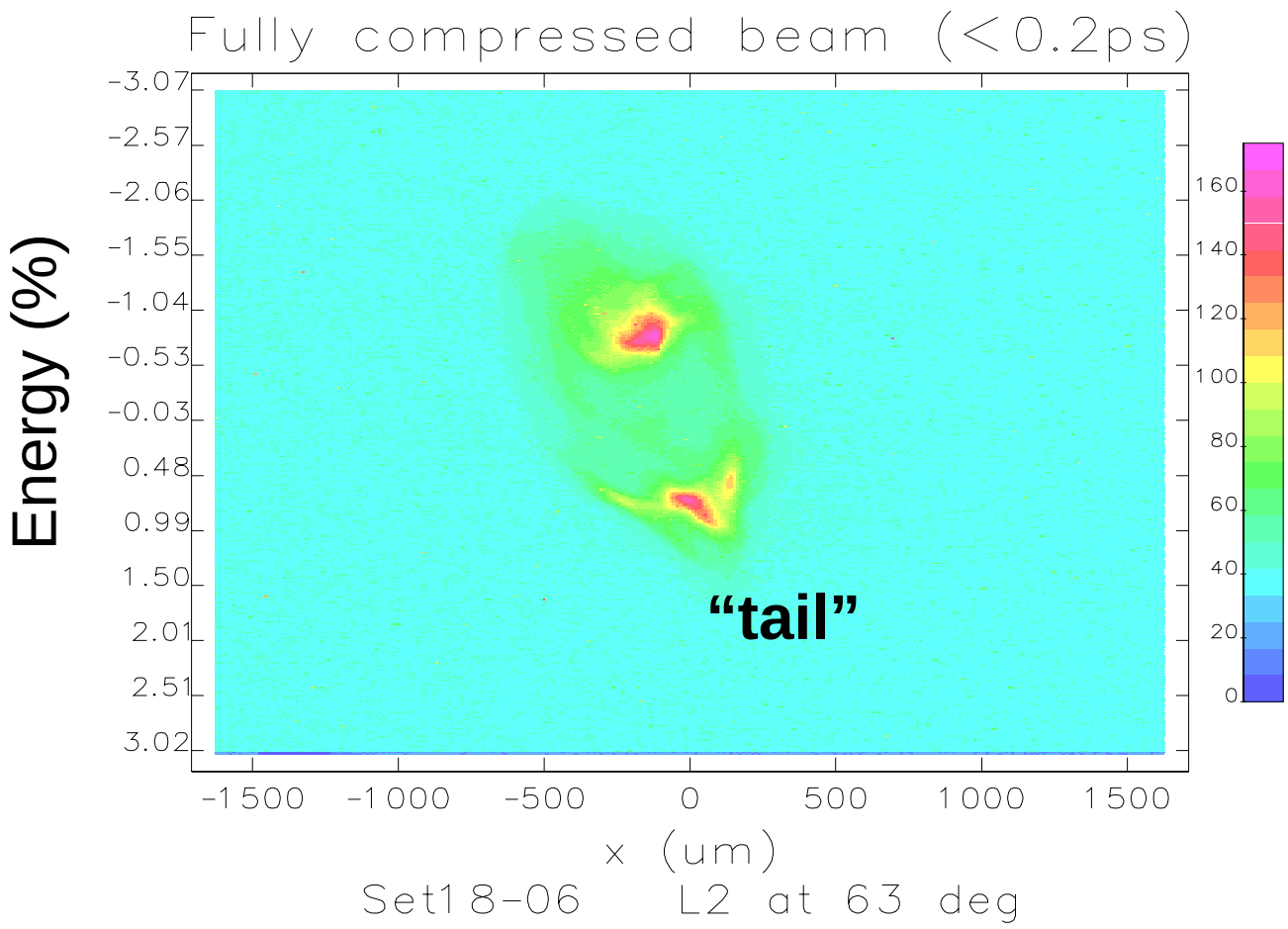
Dowell Diagnostic Images, Scan #3, 12/17/00



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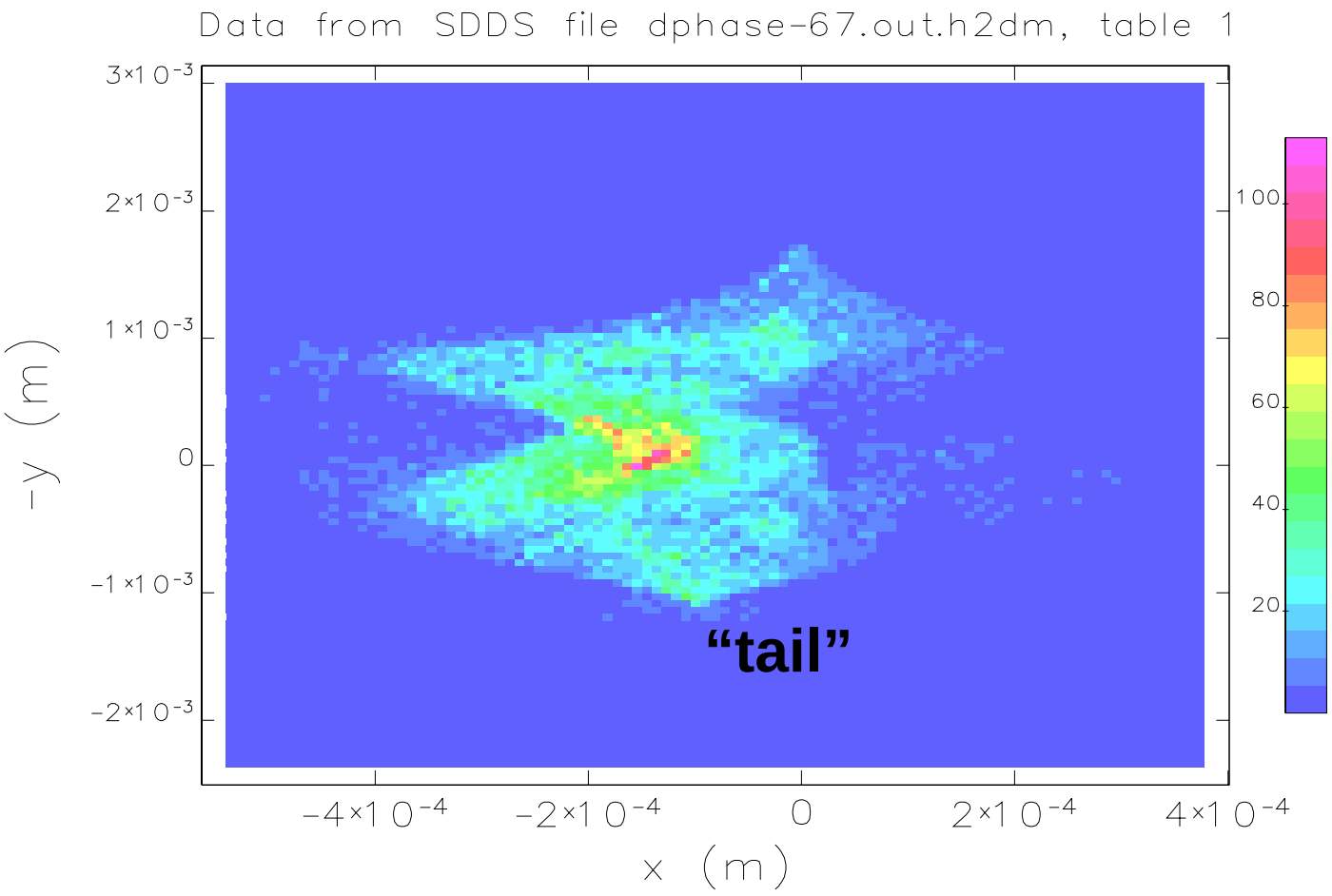
Simulated DD Image for Full Compression



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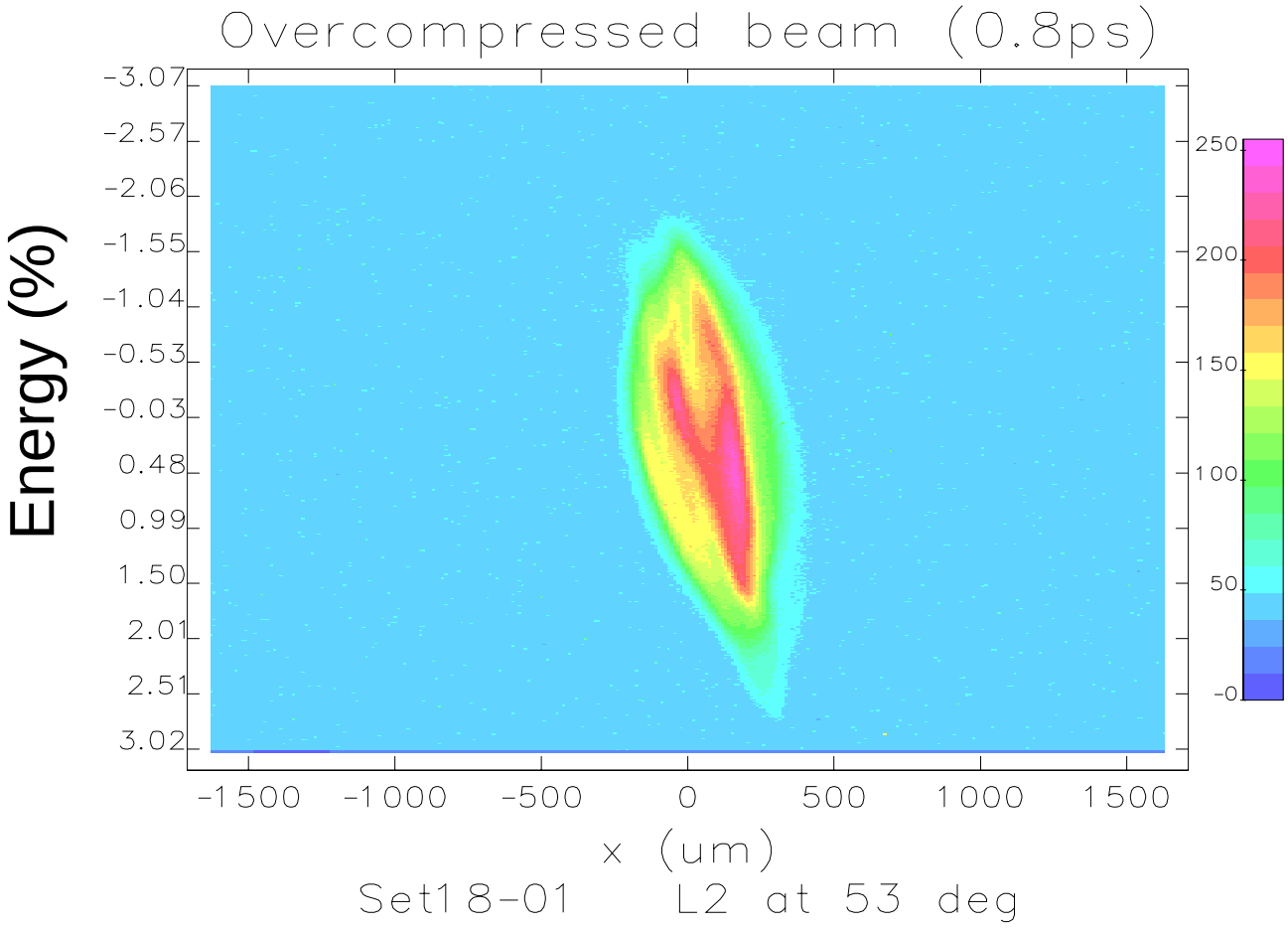
Dowell Diagnostic Images, Scan #3, 12/17/00



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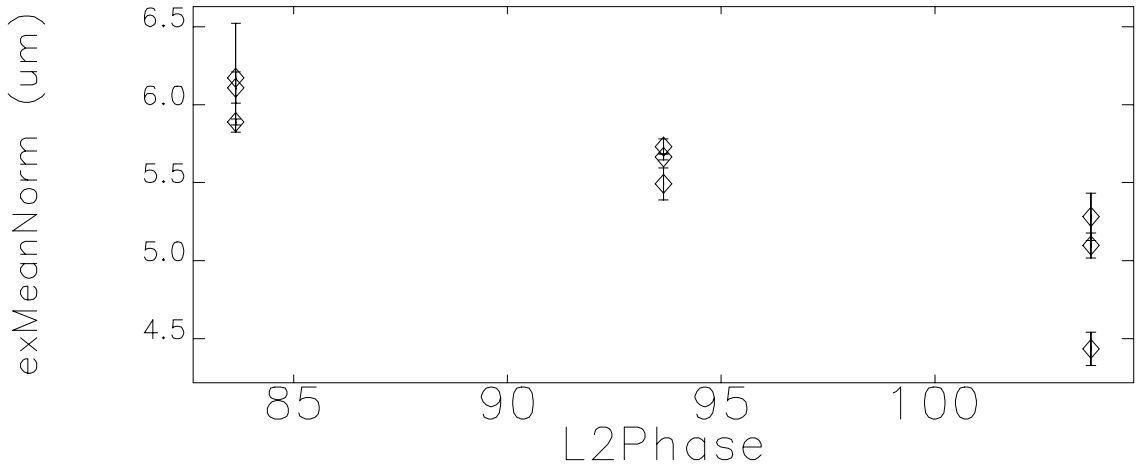
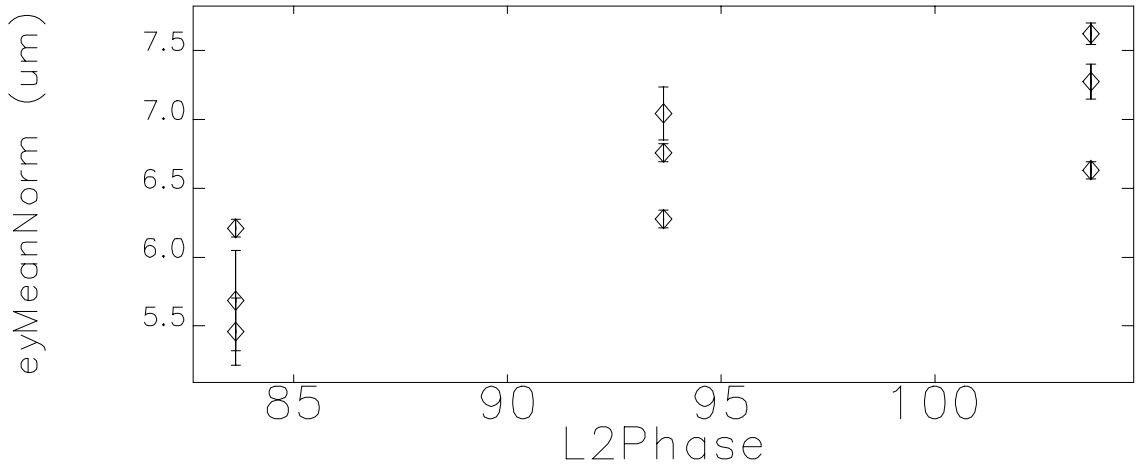
Emittance Growth for Decompression, 12/17/00





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Summary of 12/21/00 Shift

- 100 pC/bunch from the gun.
- Looked for evidence of residual dispersion downstream of chicane.
- Verified and optimized beam size at exit of B4.
- Matched beam into three screen system.
- Scanned L2 phase, measured emittance and bunch length.

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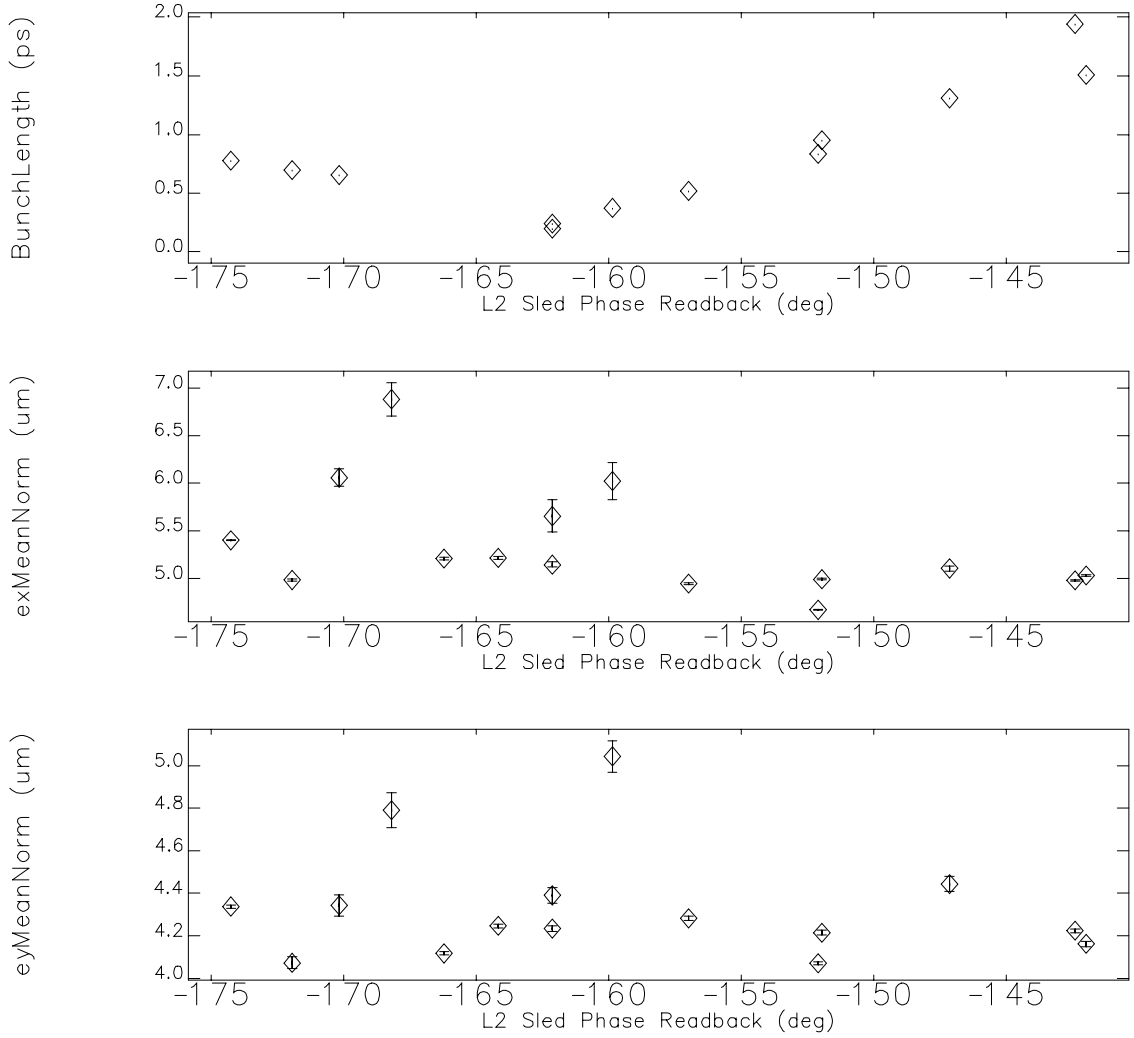
Scan #1, 12/21/00



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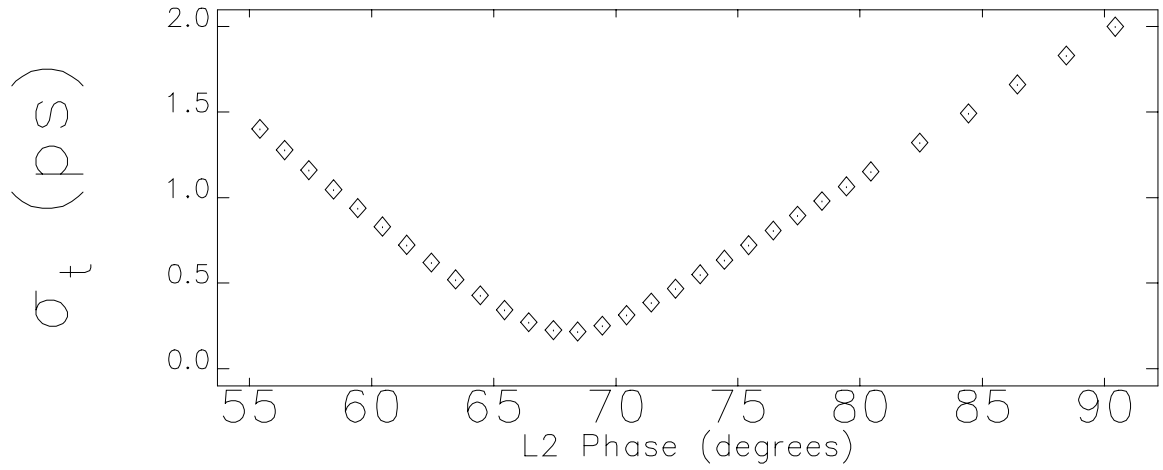
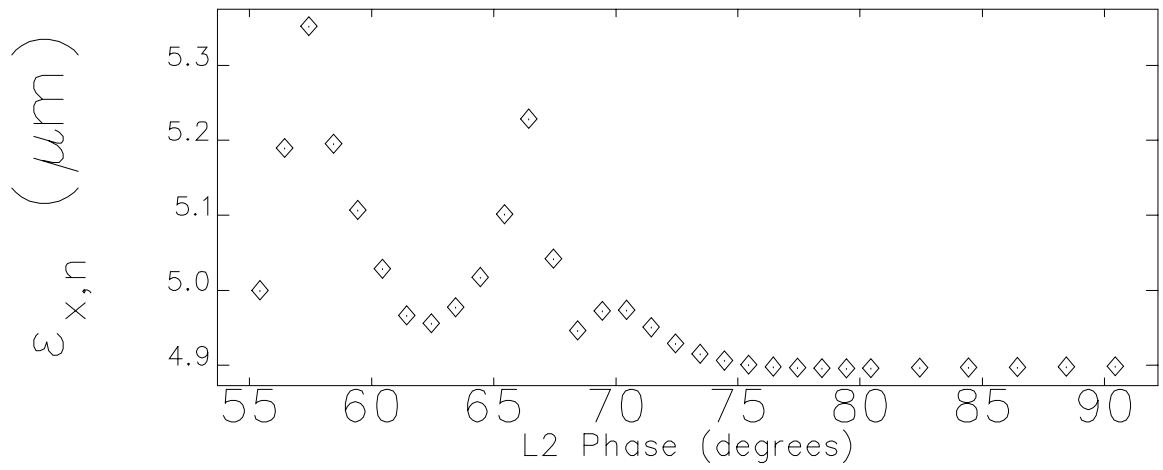
Simulation of Scan #1, 12/21/00





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Plans for Future Experiments

- Repeat all of the above, especially more data for decompression.
- Higher-resolution bunch length measurement.
- Explore effects of CSR in drift space using the two flags in the vertical bend line.
- Try tuning out emittance increase with “tweaker” quads inside chicane (look at decompression phase).
- Measurements at higher charge.
- Measurements with variable R_{56} and asymmetry.