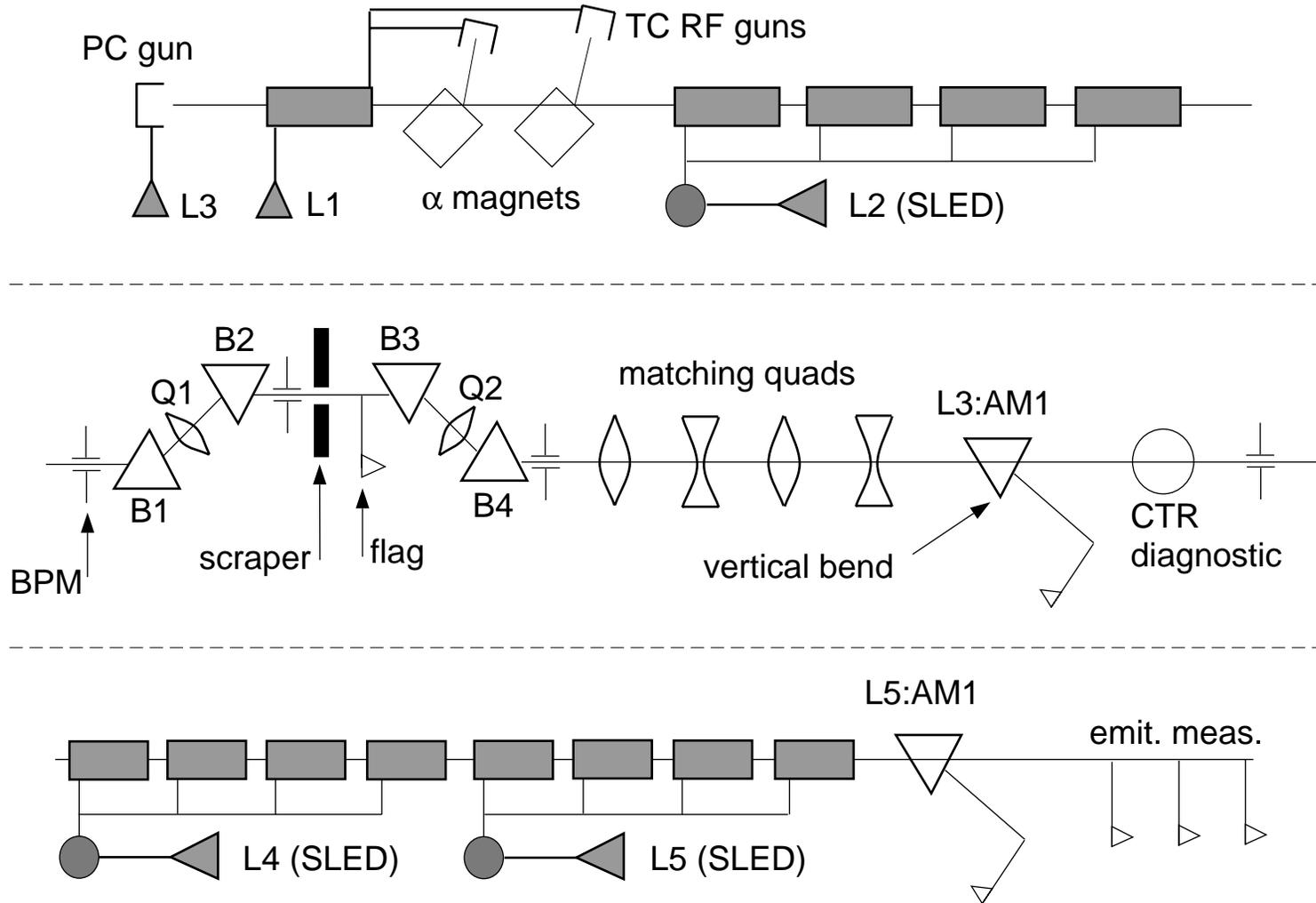


Initial Bunch Compressor Observations

- commissioning started on 7/28
- commissioning team: M. Borland, P. Emma, J. Lewellen, S. Milton
- review of layout
- optics
- bunch compression
 - zero-phase measurements
 - CTR measurements
- observation of apparent CSR effects
 - energy spectrum
 - comparison to simulations
 - emittance

Layout of the Present System



Optics

- Response matrices
 - measured from the RG1 and RG2 guns to the end of the linac
 - found several BPM sign errors in compressor region
 - with cleaner RG2 beam, get decent agreement with predictions
- R56
 - expected value is -65 mm
 - measured value is 64.9 ± 6.6 mm
- Residual dispersion
 - appears to be small, but need to measure

Bunch Compression

- Compression has been performed with all three guns.
- Adjust L2 phase to vary the energy chirp of the beam coming into the chicane.
- Adjust L4 and L5 phase to remove energy chirp after the chicane.
- Measure the bunch length using “L5 zero-phase” method and/or tune it with the CTR diagnostic.

Bunch Length Measurement

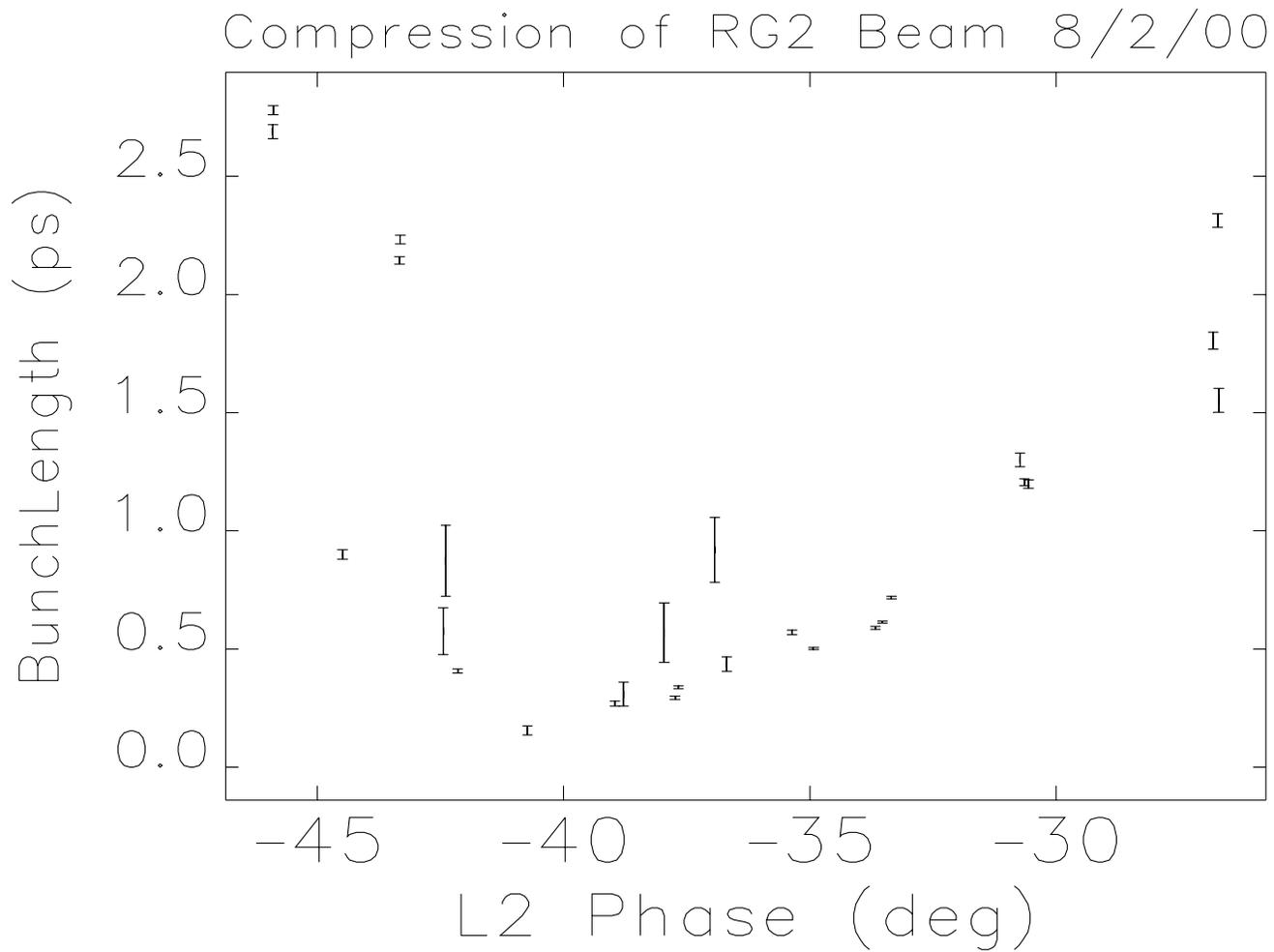
- If the energy spread is measured with L5 off, and at the two zero-crossings, then the rms bunch length in ps is

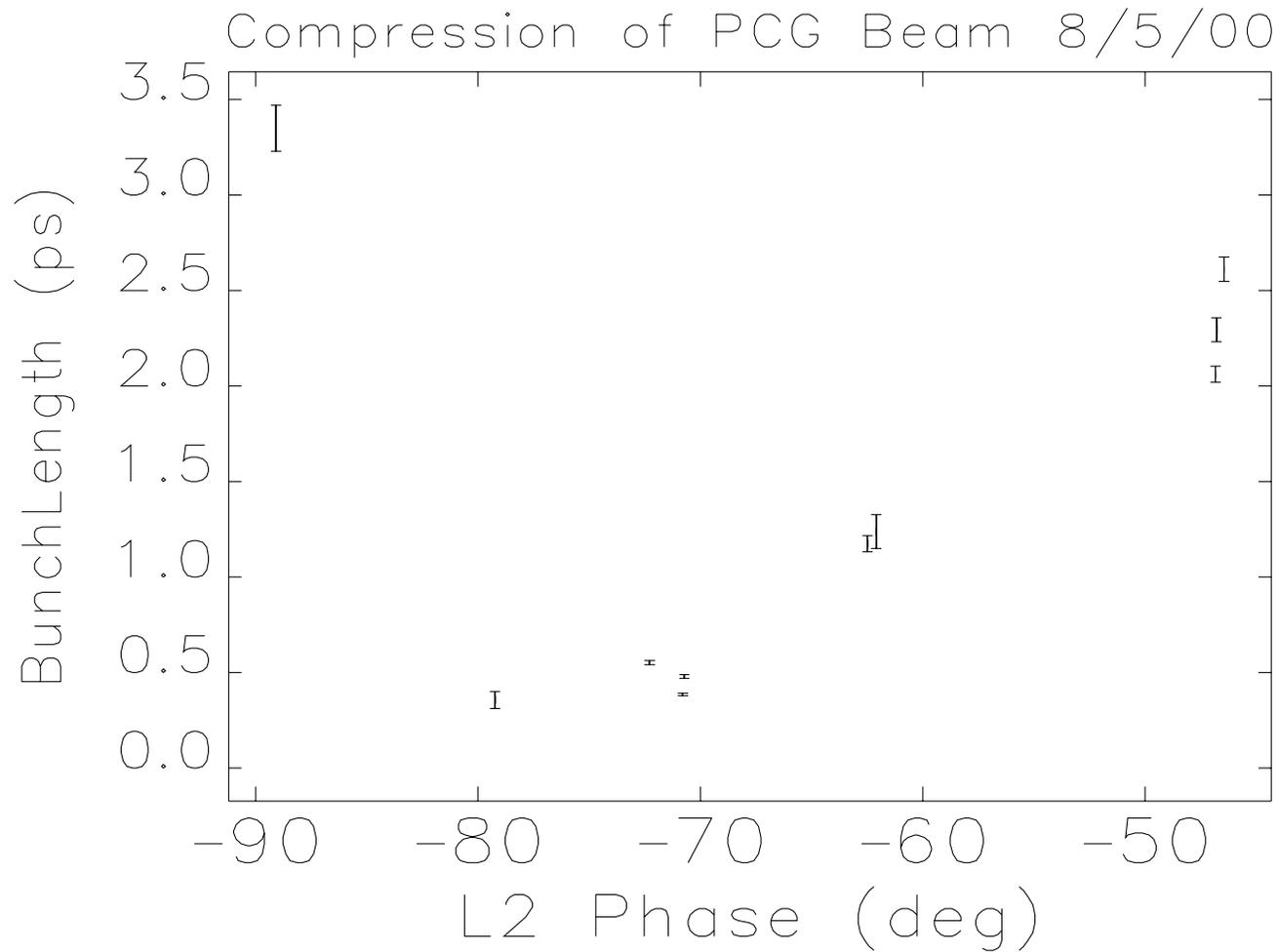
$$\sigma_t = \frac{350}{2\pi V} \sqrt{\frac{(\sigma_{E,1}^2 + \sigma_{E,2}^2)}{2} - \sigma_{E,0}^2}$$

where $\sigma_{E,i}$ is the energy spread in MeV and V is in MV.

- V is typically 150MV. We can resolve about 0.05% energy spread at 210MeV. Hence, we expect to be able to measure *at best* to ~70 fs rms.
- We measure the rms energy spread for the three situations using the L5:AM1 magnet and a flag.

- 20 measurements are taken for each situation. The top and bottom 10% are thrown out to reduce noise.
- About 10 feedback loops are employed to keep the system quasi-stable
 - rf phases and power levels
 - beam energy at chicane center
 - beam position on BPM in spectrometer line
 - x and y trajectories along linac
- A bunch length measurement takes ~3 minutes.



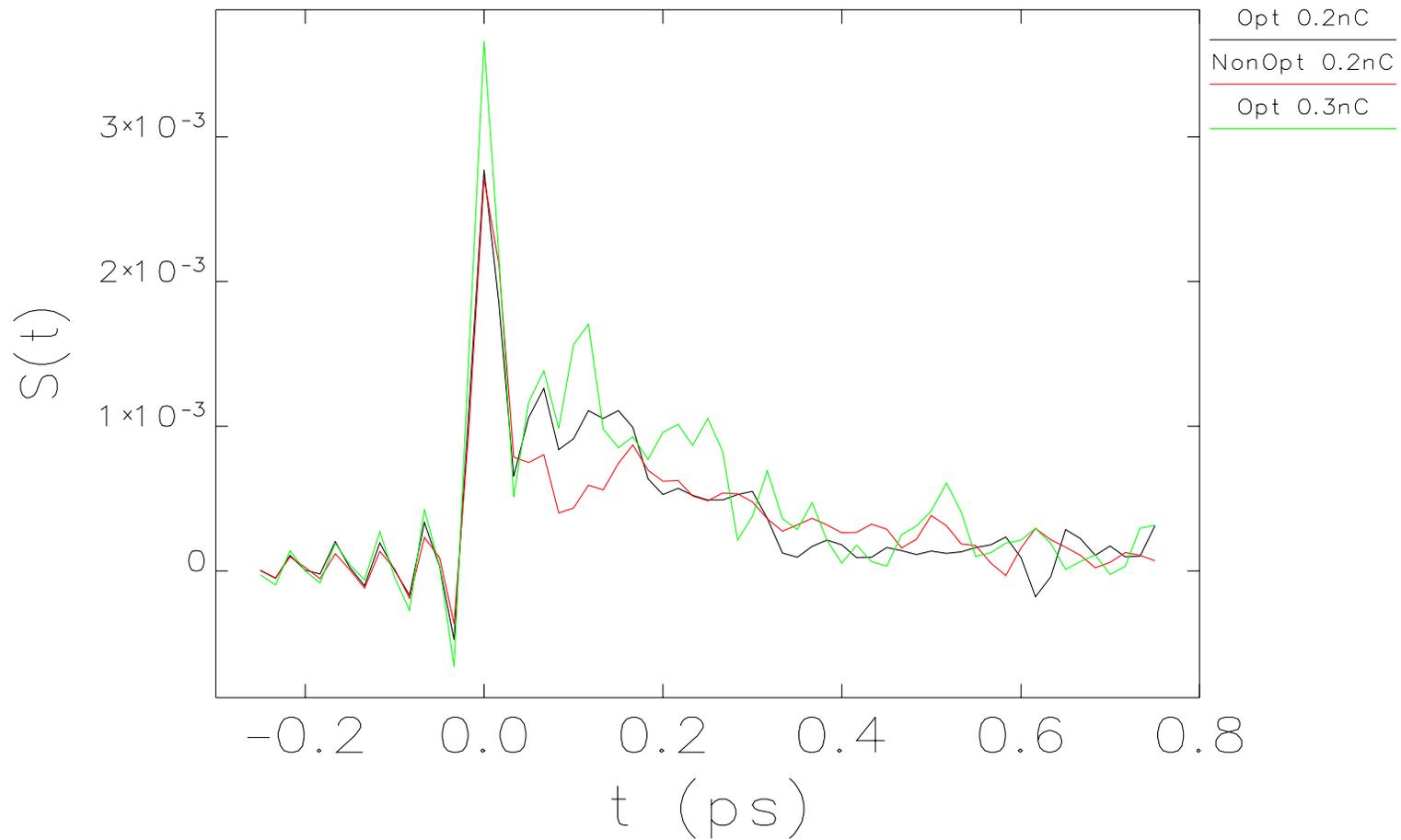


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CTR Measurements

- A coherent transition radiation diagnostic is just downstream of the chicane.
- We easily found a tunable signal on this diagnostic with RG2 and PCG beams.
- Inversion of the CTR inteferometer scan indicates very short bunches.
- We are suspicious of details at this point.

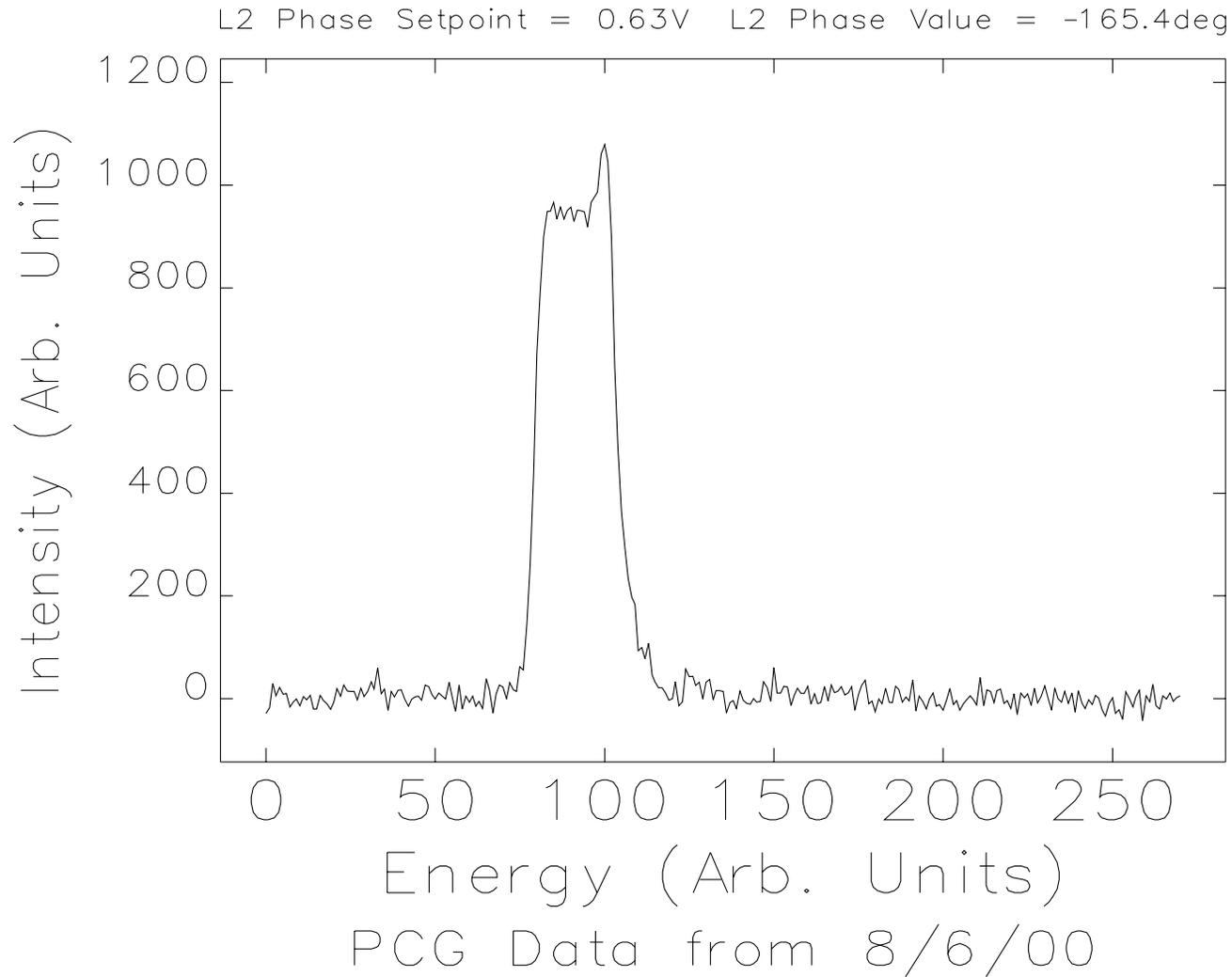
CTR Data with PCG Beam 08/03/00



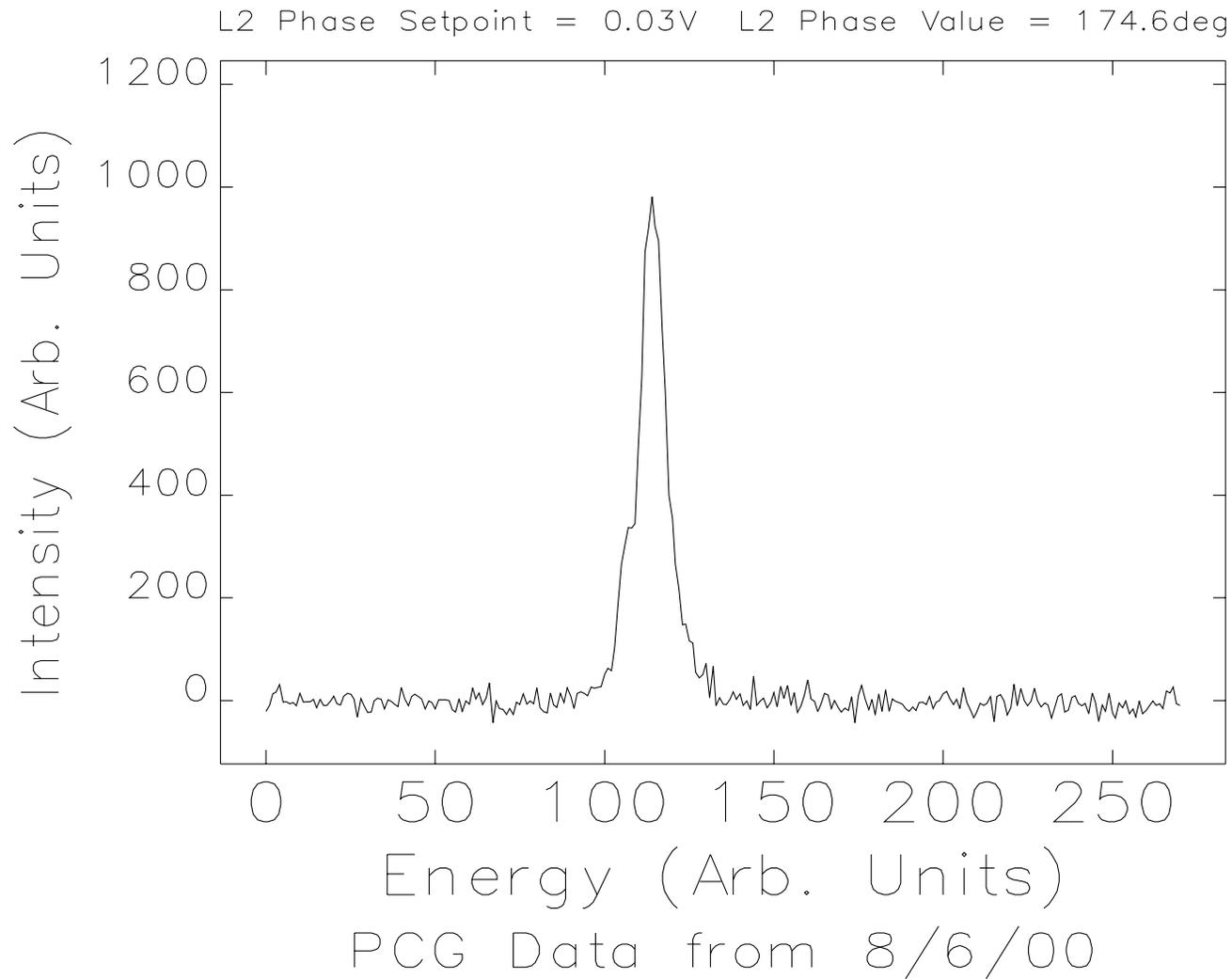
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Observations of CSR Effects

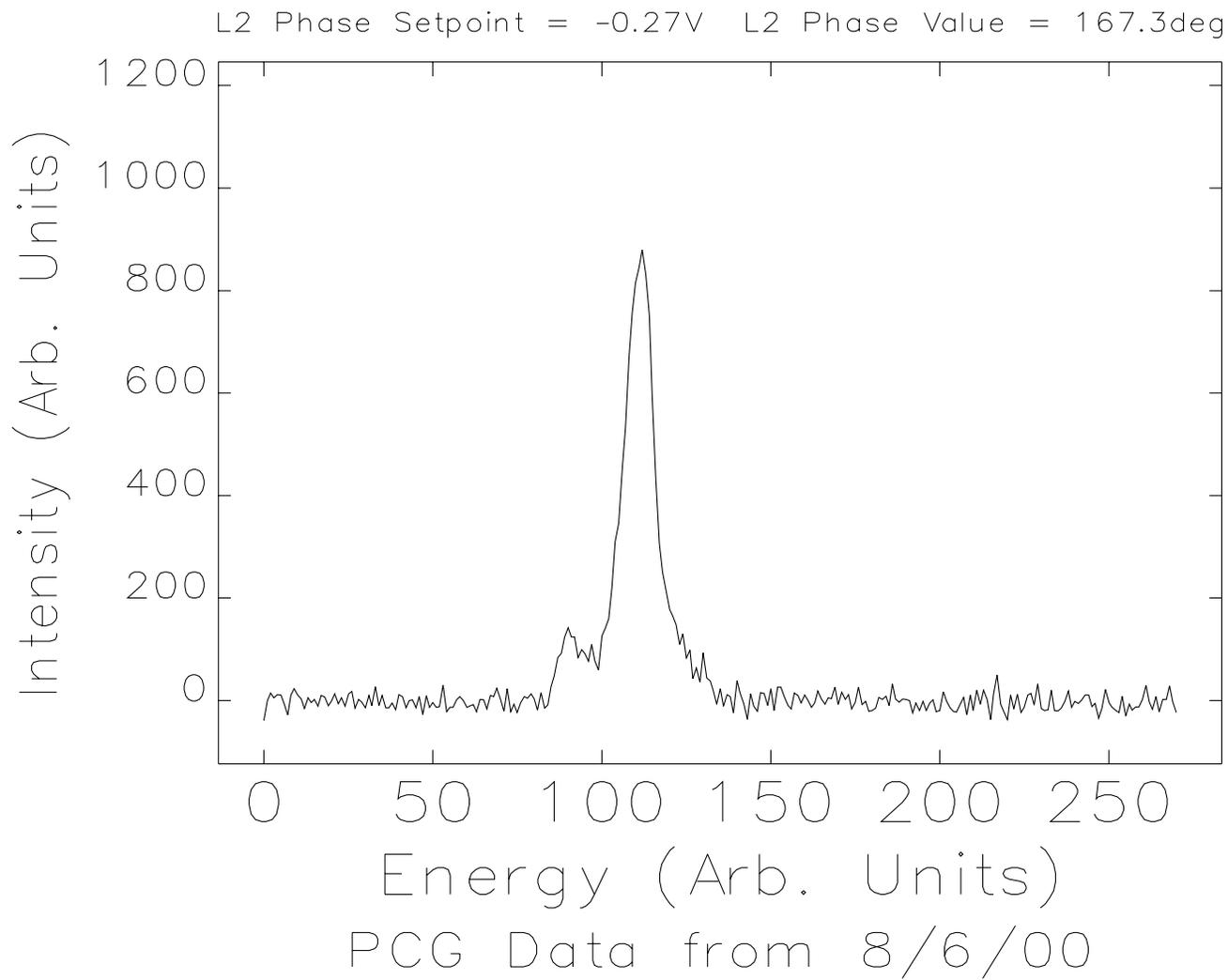
- Measured energy spectrum using L3:AM1 (just after chicane) as L2 phase was varied.
- See spikes in energy spectrum for overcompressed case, qualitatively similar to simulation results with **elegant**.
- Energy spread seems to *decrease* after chicane was we compress, although it clearly *increases* at chicane center.
- Incoming distribution is clearly not what we use in simulations, e.g., double-humped temporal distribution seen in incoming beam.

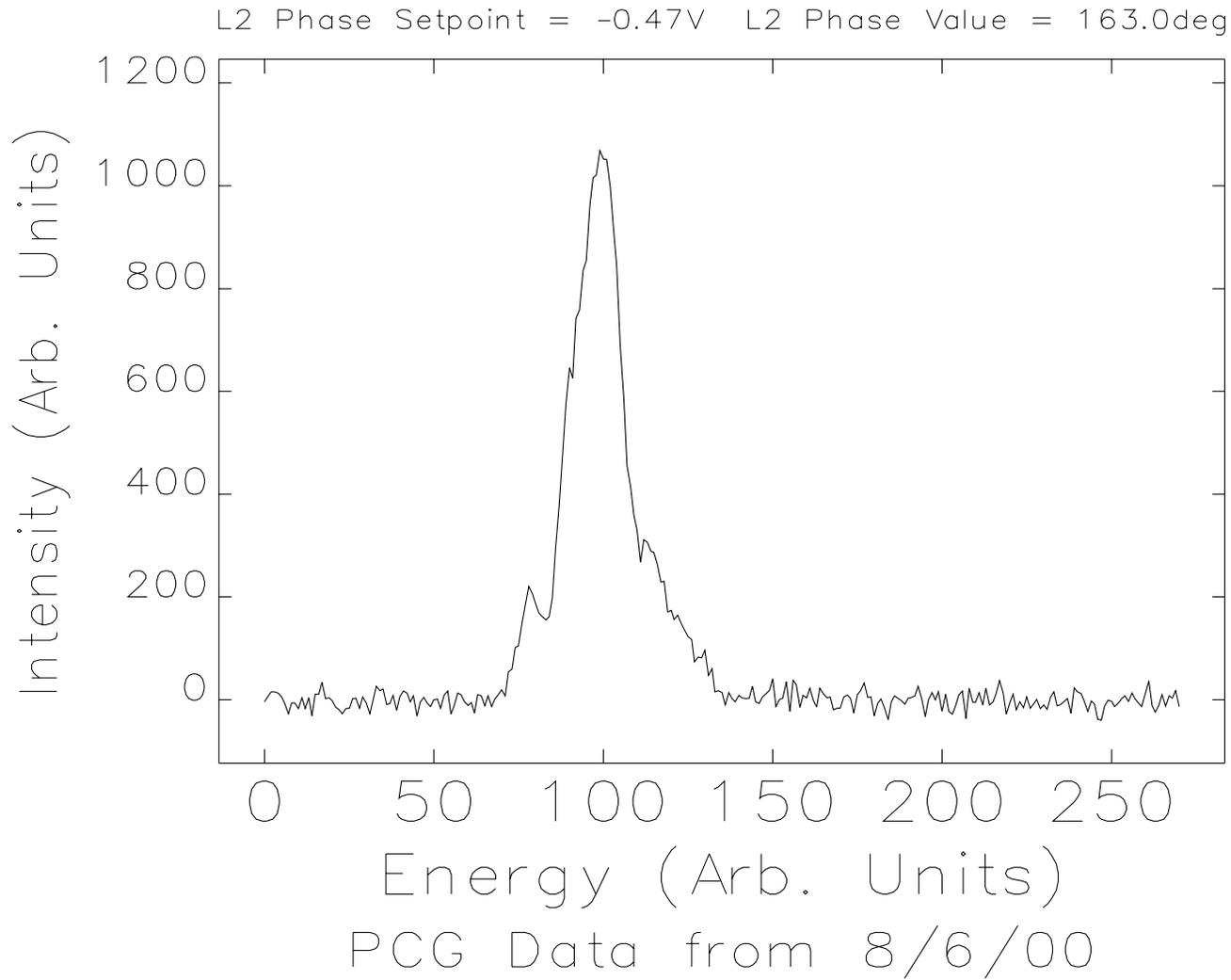


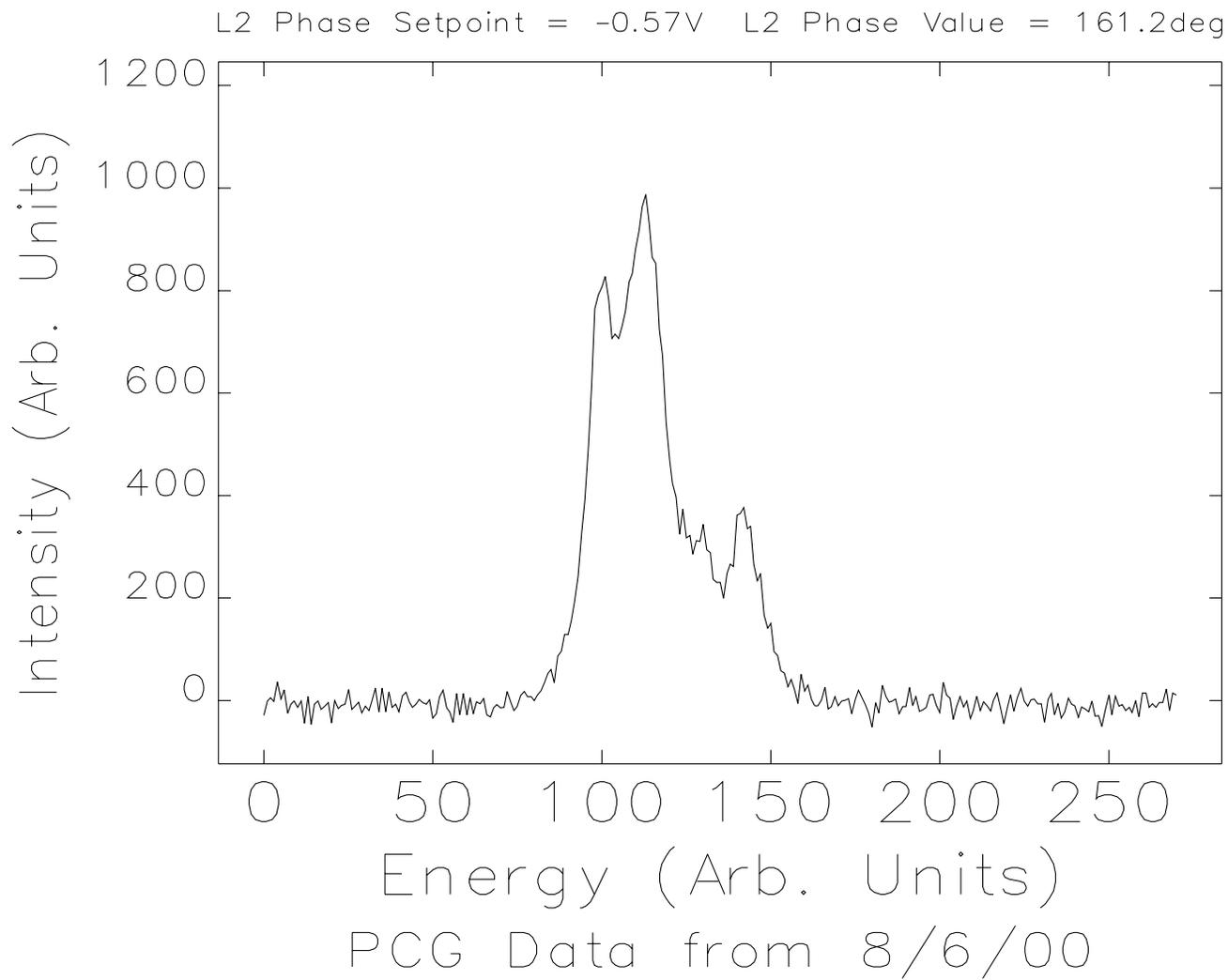
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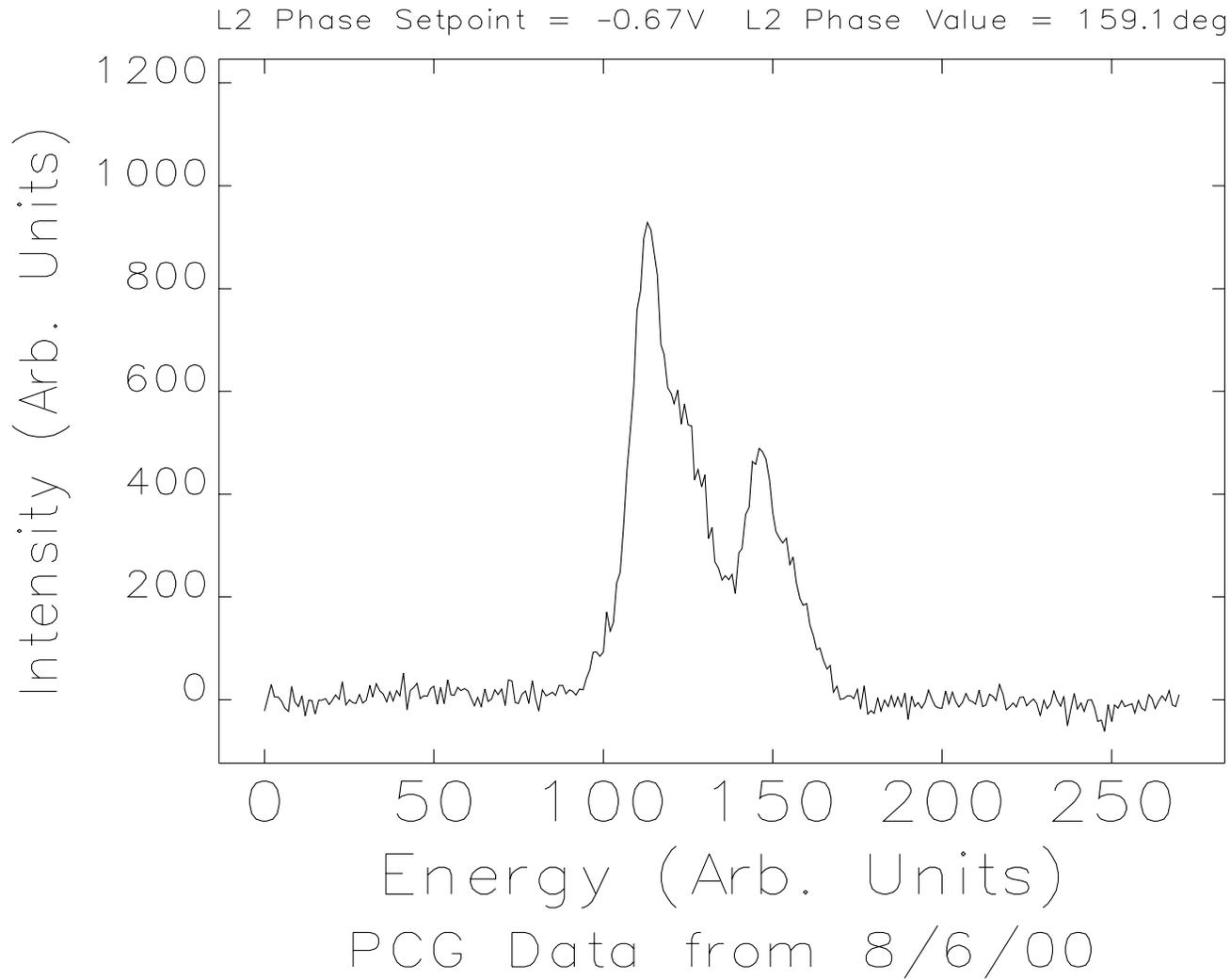


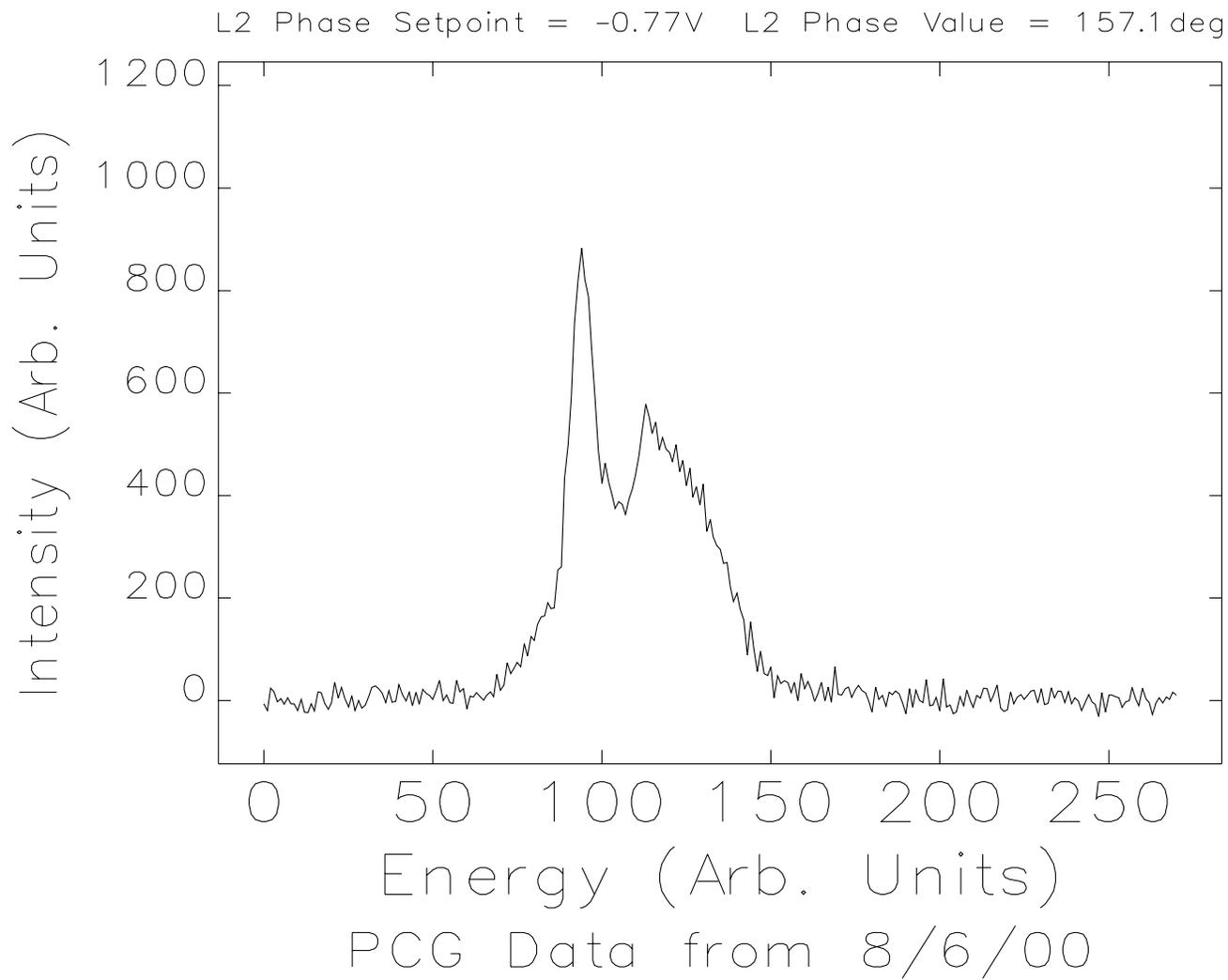
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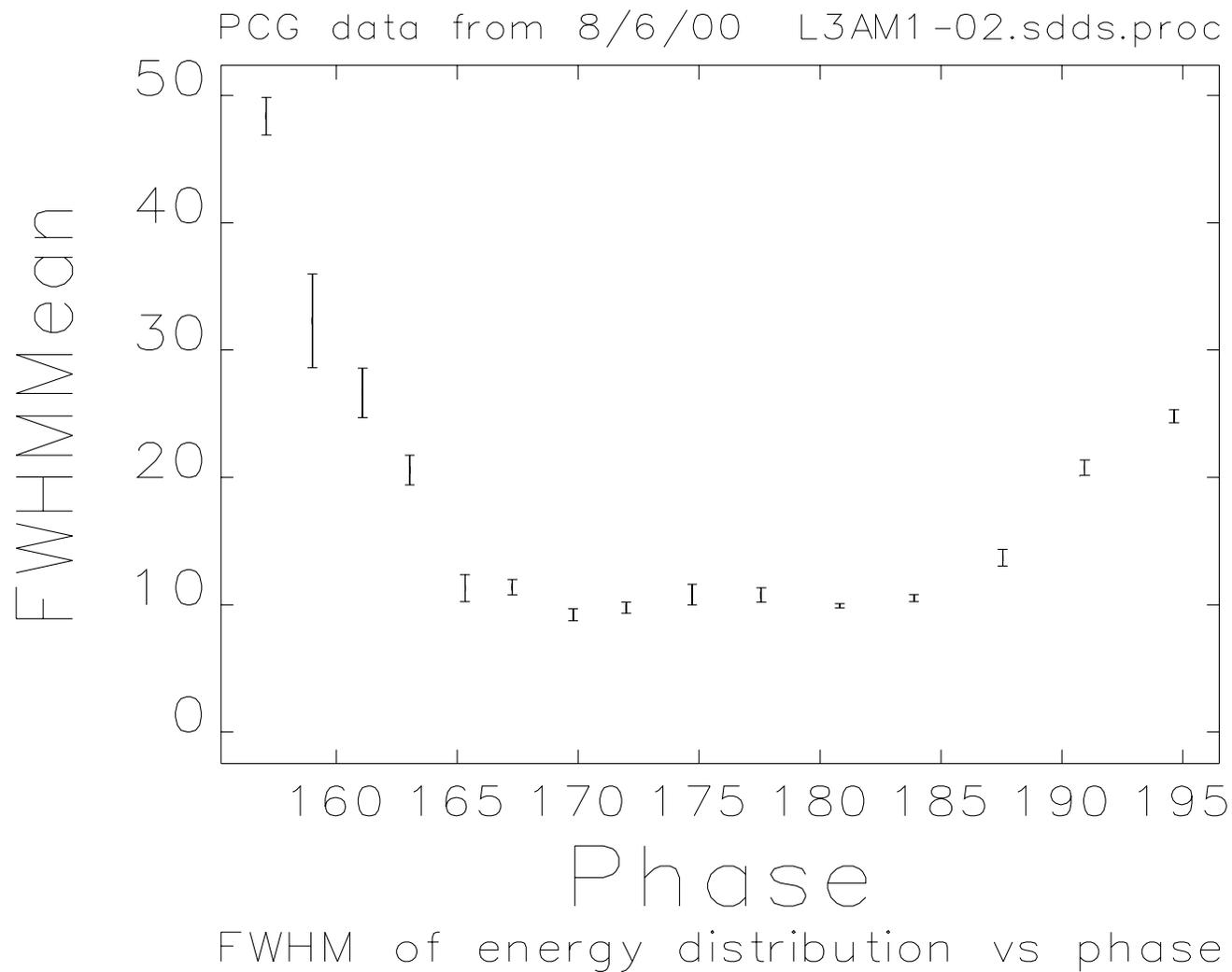


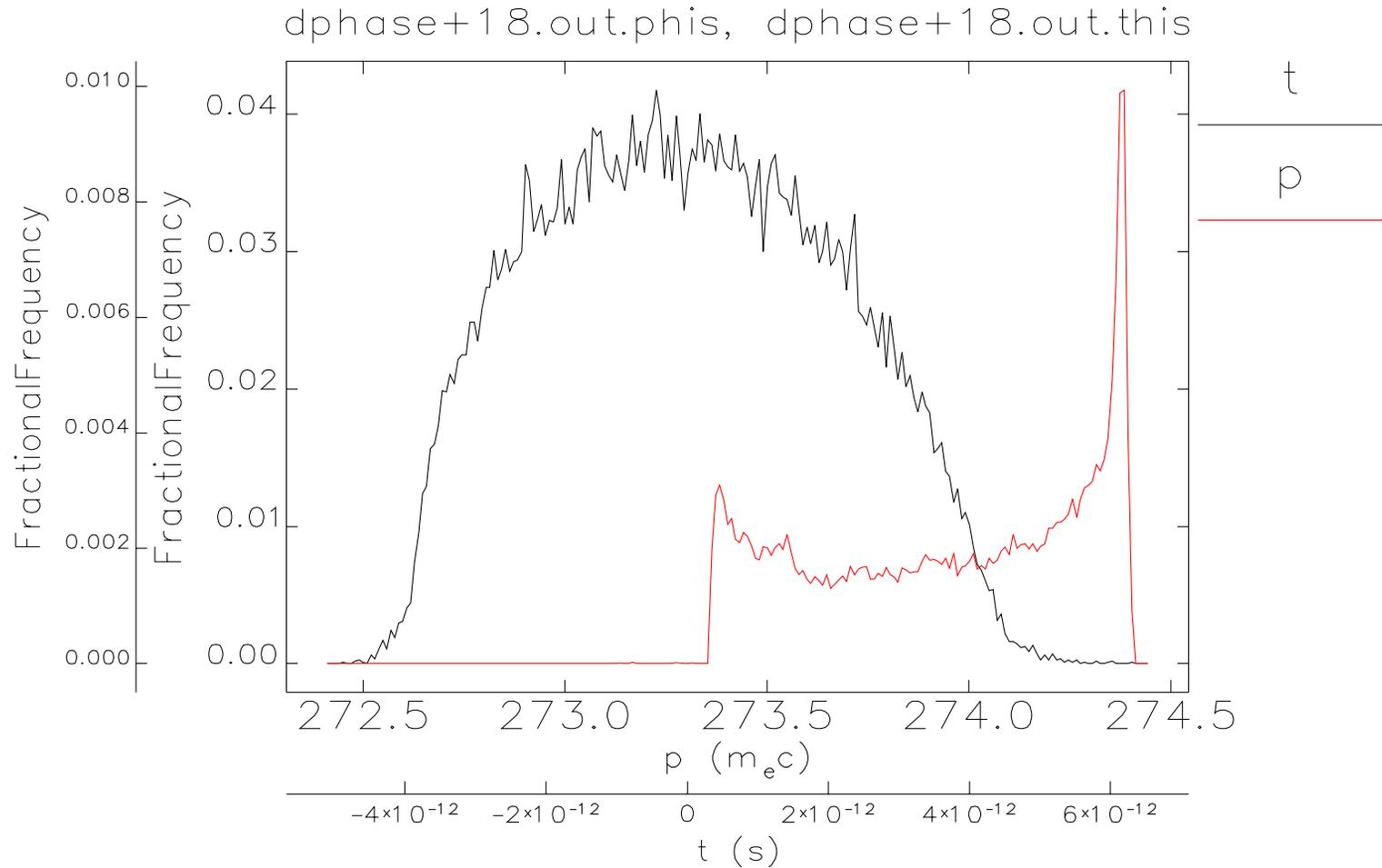




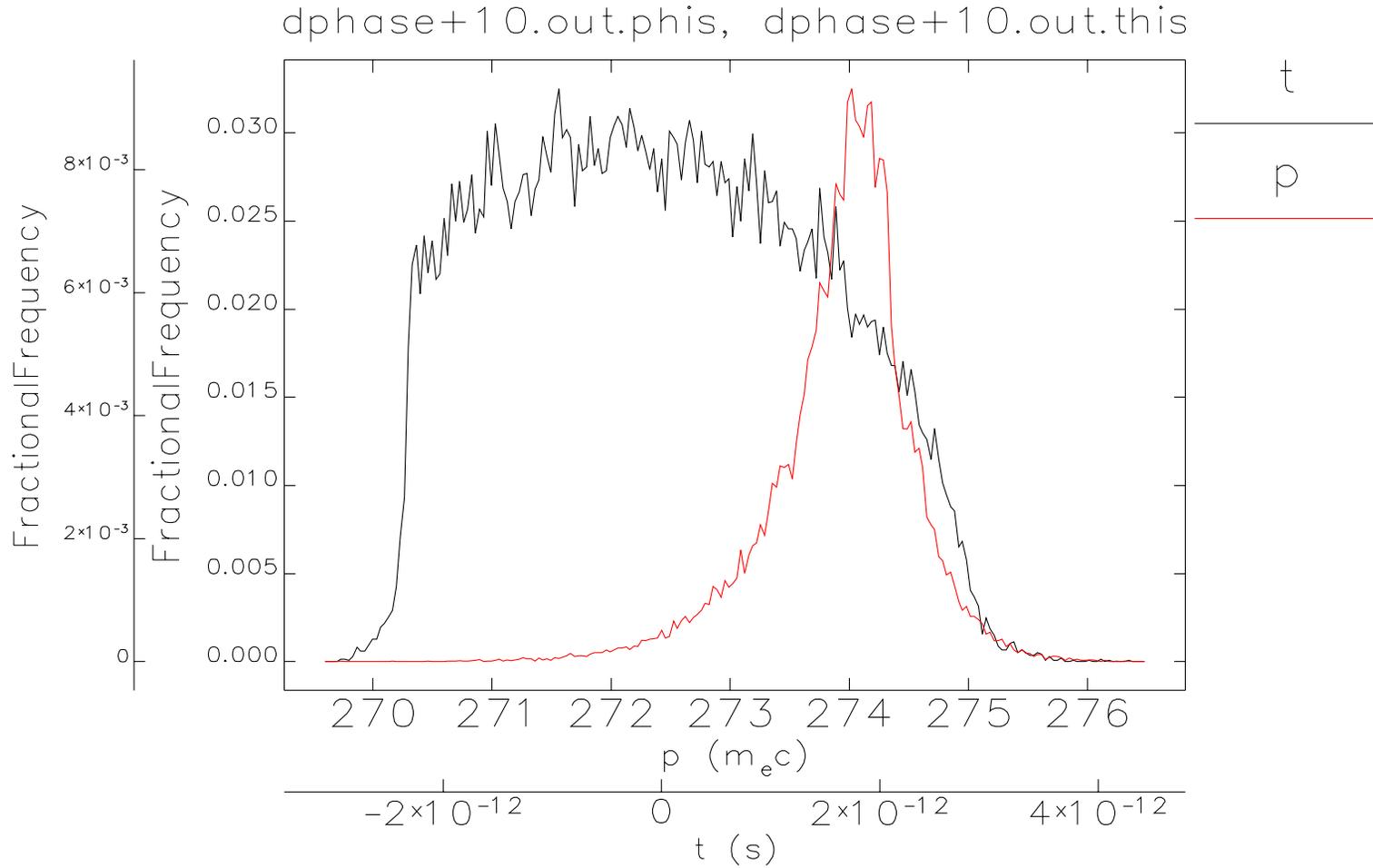




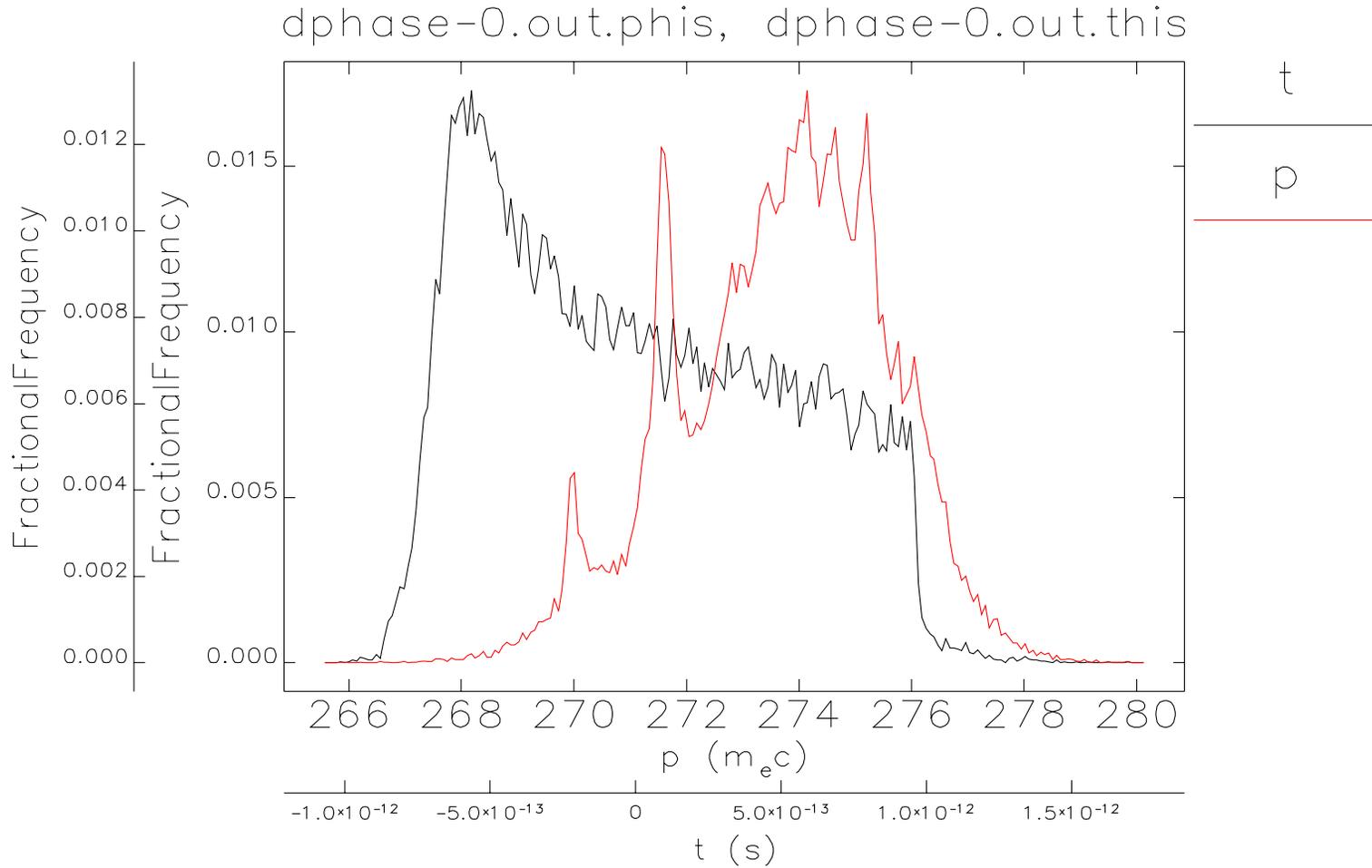




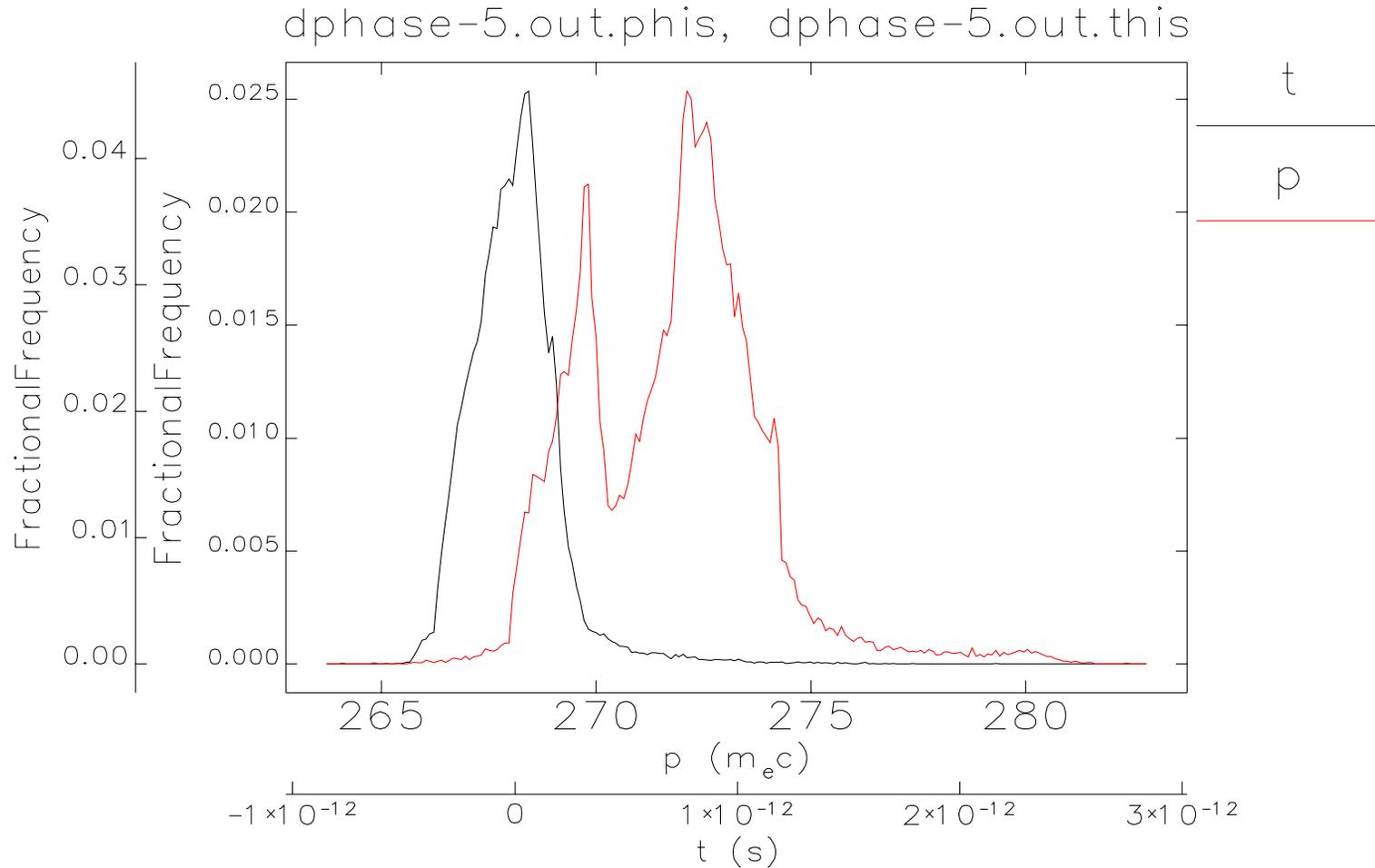
phase = 88.4 deg



phase = 80.4 deg



phase = 70.4 deg



phase = 65.4 deg

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Emittance Changes

- Measured emittance after L5 for compressed and uncompressed conditions.
- 160 pC charge from PCG

Case	RMS Bunch Length (ps)	x emittance (um)	y emittance (um)
uncompressed	1.0	7	7
compressed	0.35	9	8

- The peak current in the compressed case was about 180A.
- Our best peak current was 270A.