

CSR Studies at FLASH

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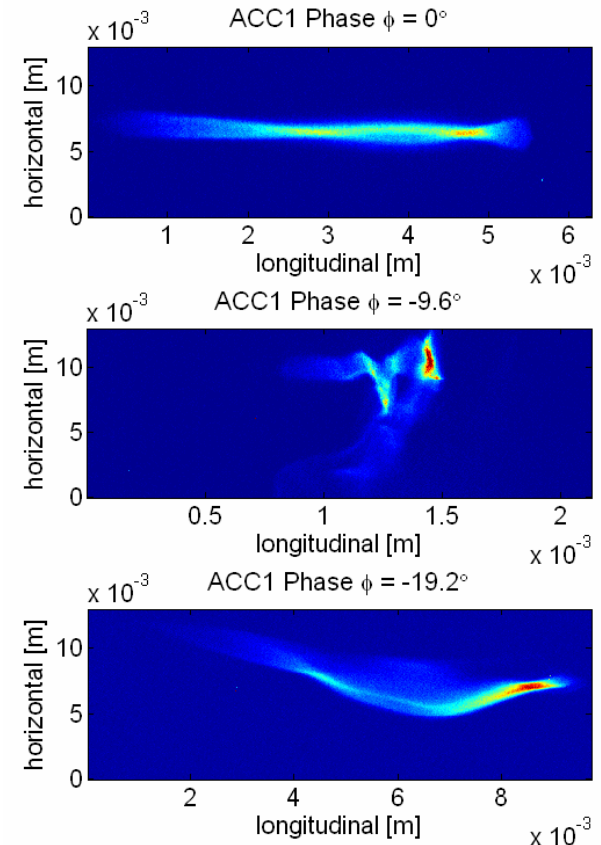
FLASH Seminar 21.11.2006

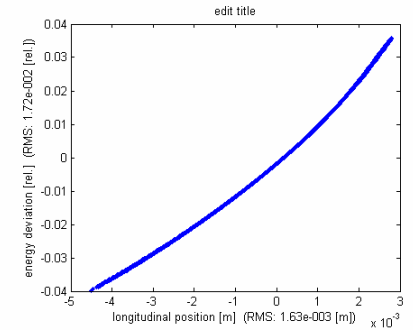
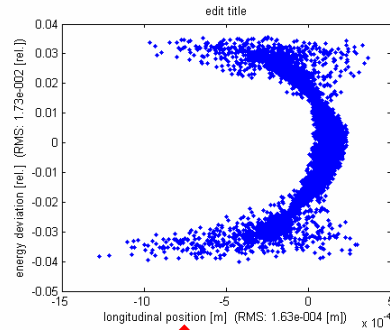
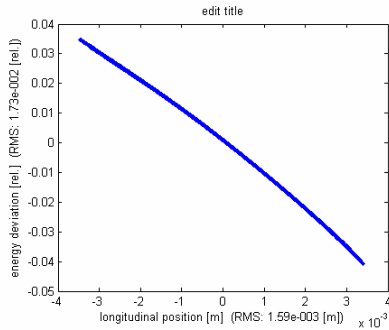
- Introduction
- Experimental Outline
- Analysis and Results
- Simulations
- Summary and Outlook

Self forces on the beam distorts the beam. These distortions are observable at LOLA.

In SASE compression scenarios beam profiles are complicated due to space charge and CSR interactions in both chicanes.

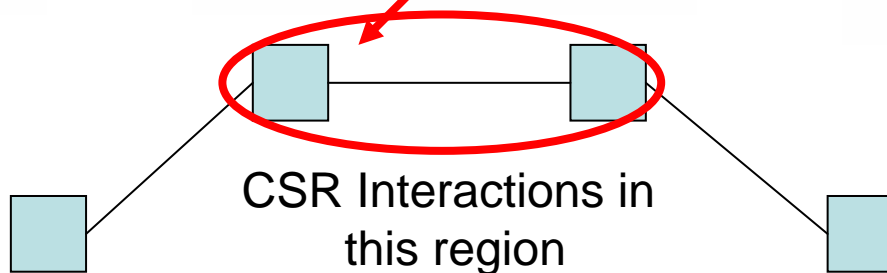
Far off crest compression scenarios lead to low peak currents after BC2. Therefore only small contributions from space charge fields are expected.





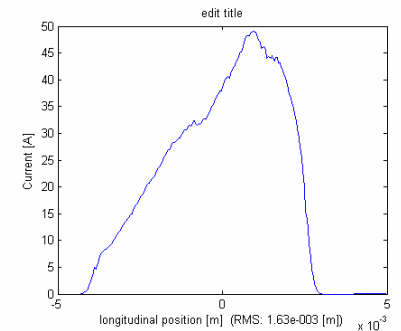
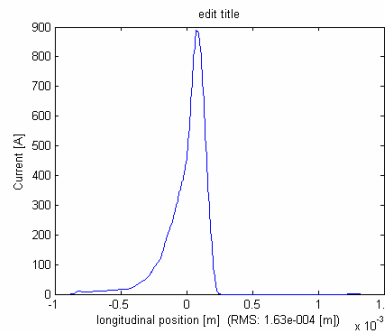
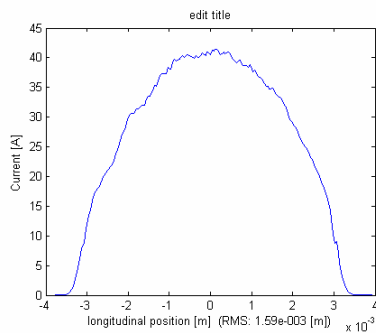
1.

3.



CSR Interactions in this region

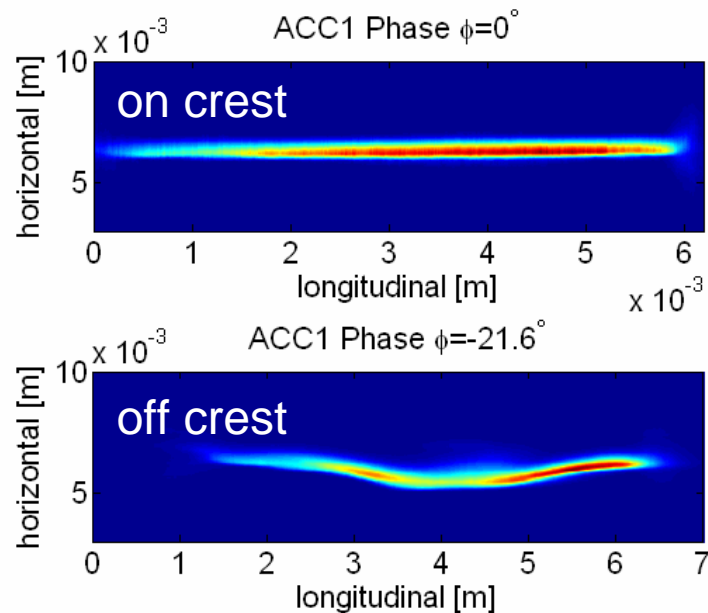
2.



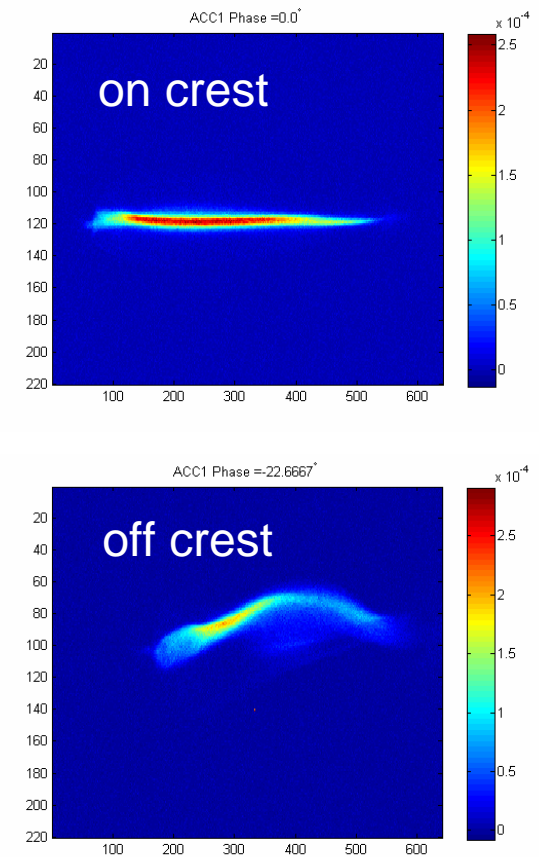
CSR induced centroid sag is predicted by simulations and observed at FLASH.

Experiments on this centroid shifts are discussed here.

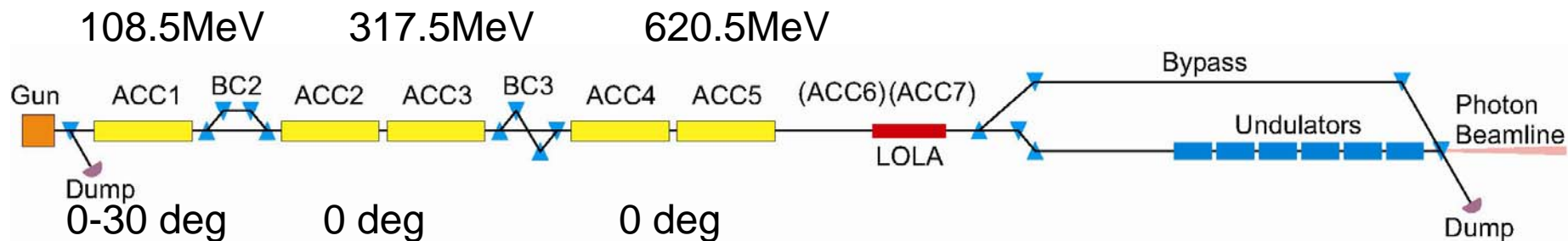
Simulations

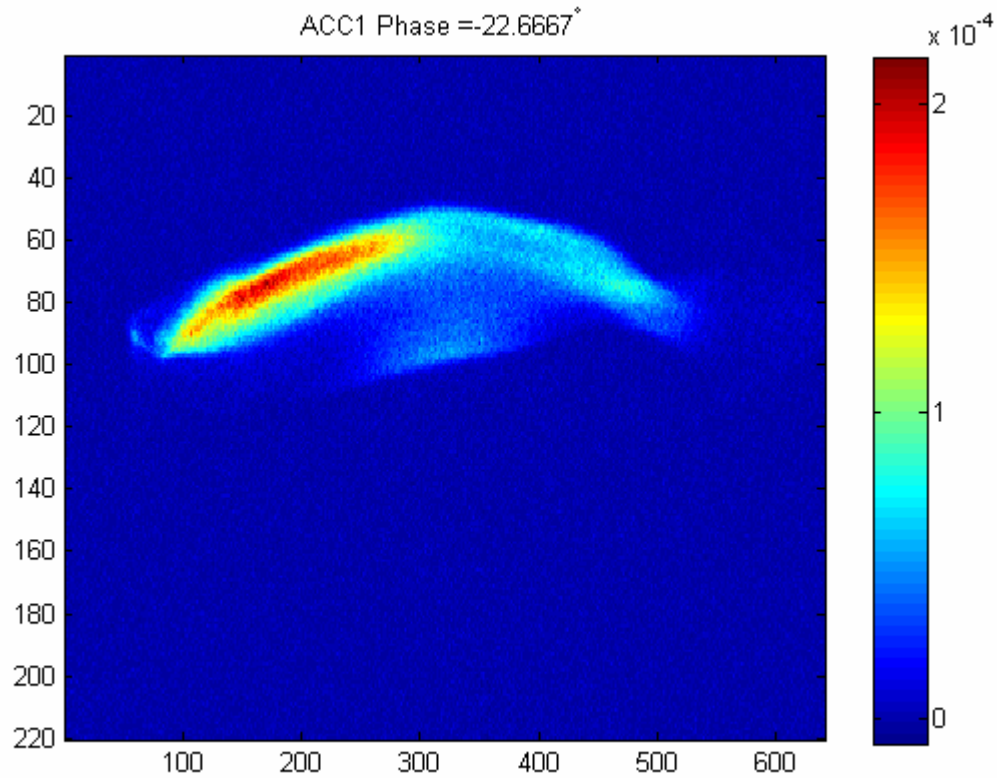


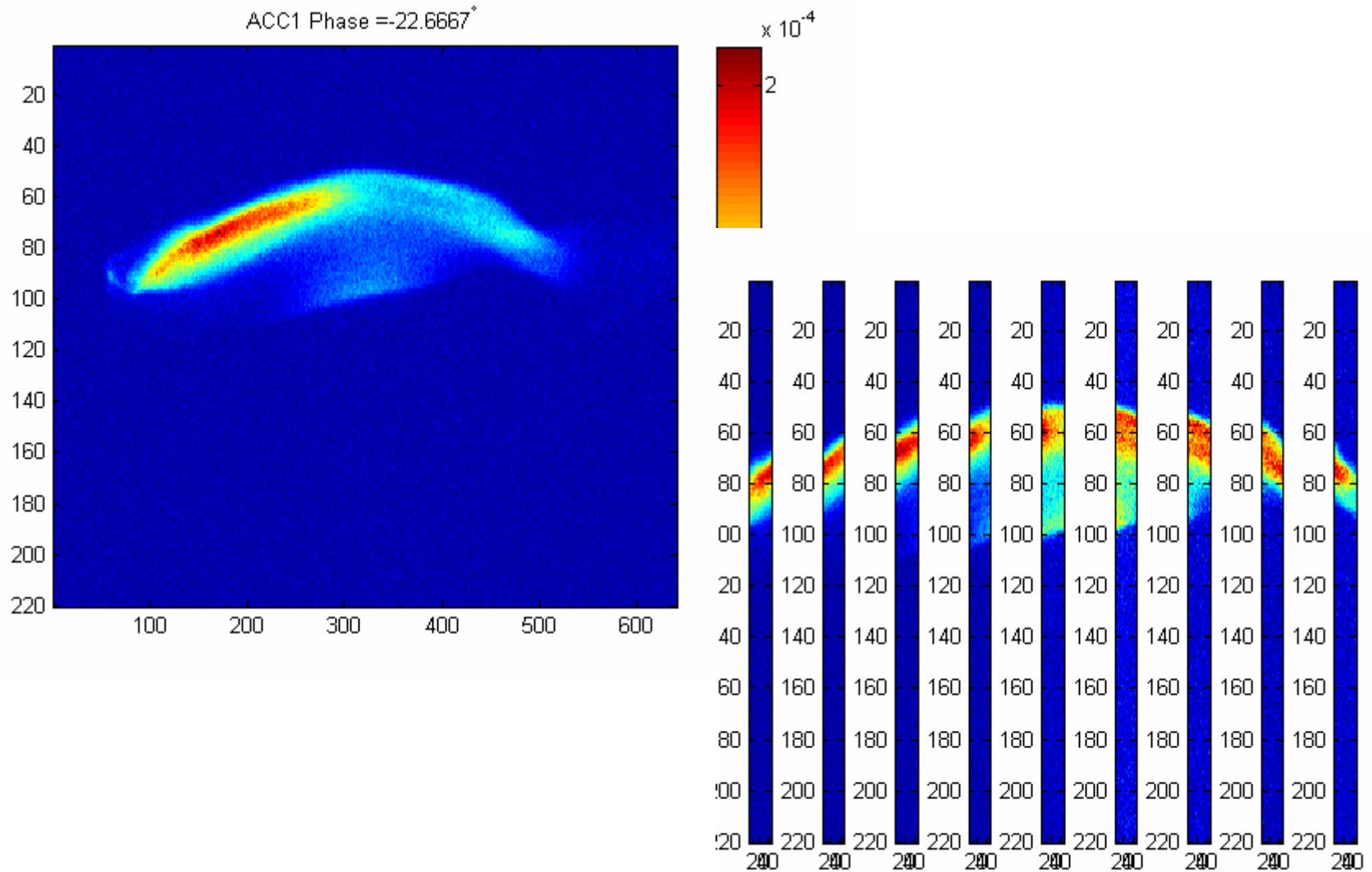
Measurements

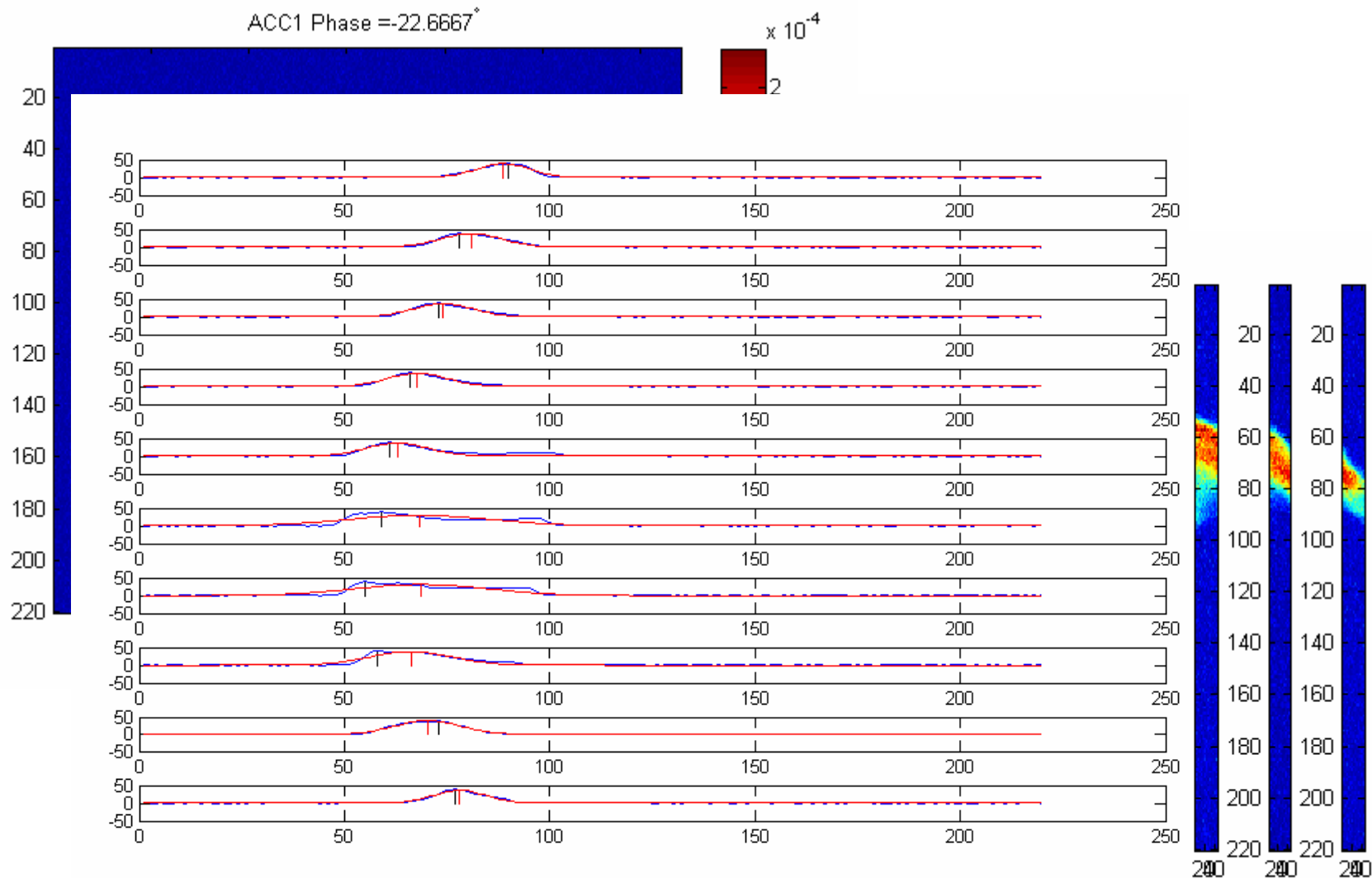


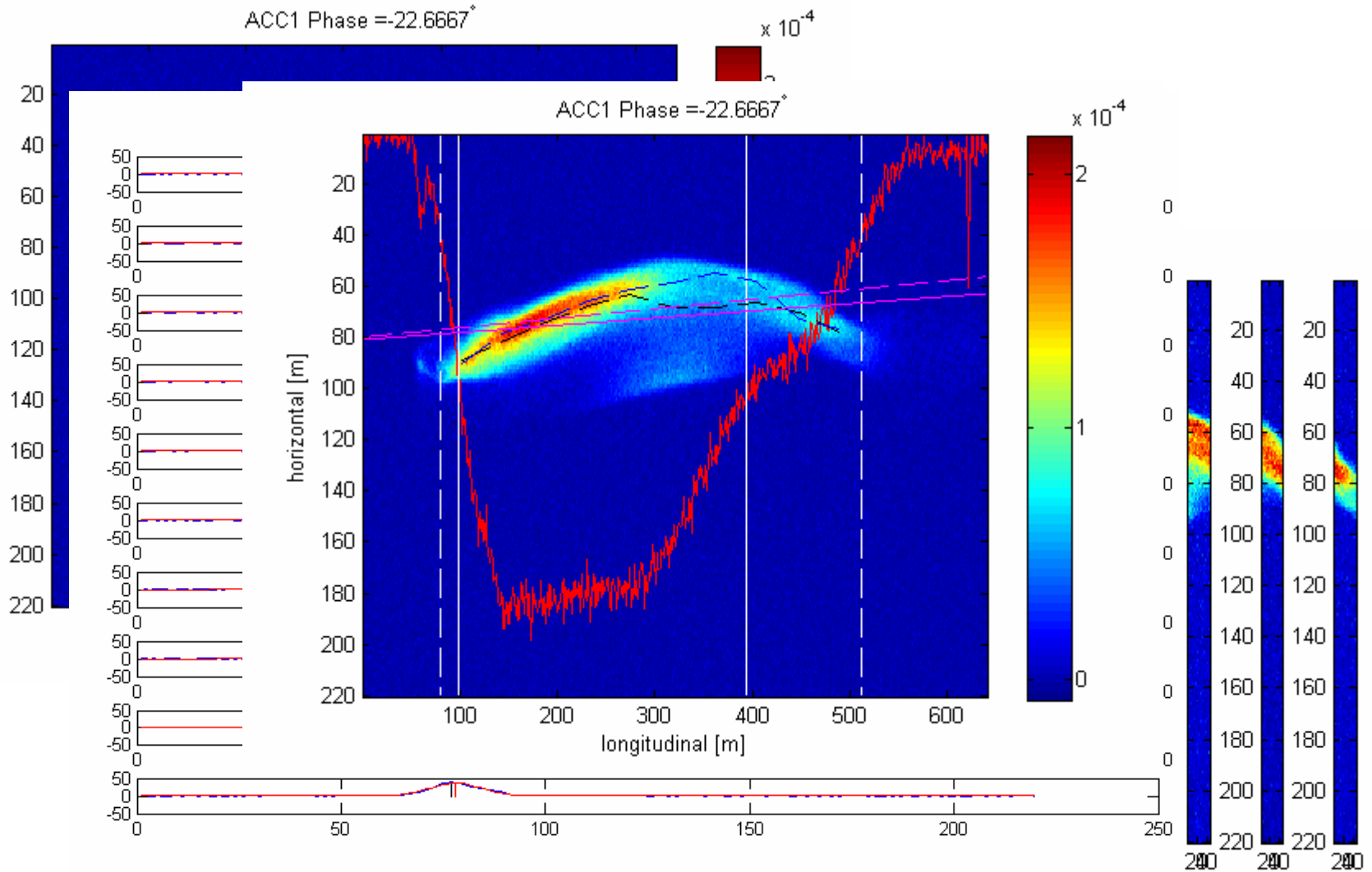
- Beam transport up to LOLA through ACC1, ACC23 and ACC45.
- ACC1 phase varies while ACC23 and ACC45 are on crest.
- Energy profiles along the machine is kept constant by adjusting the gradient in ACC1 with the phase
- Bunch charge were changed while the beam was kept matched in DBC2



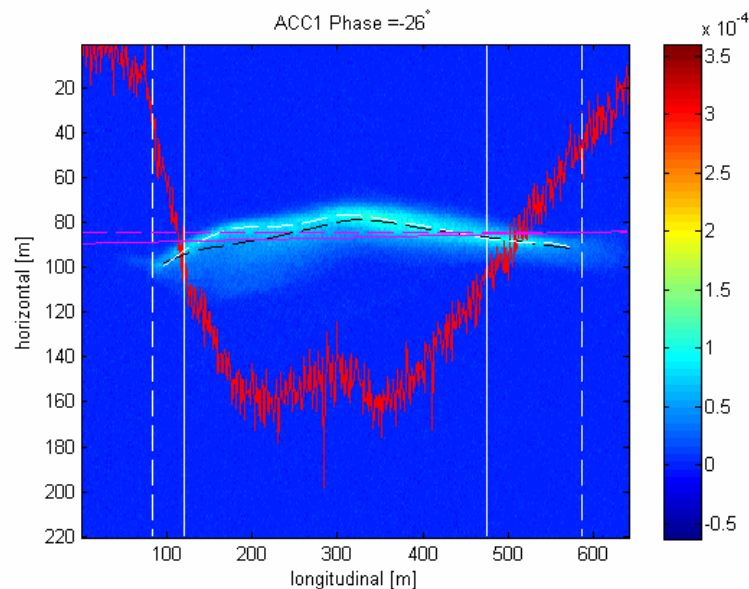
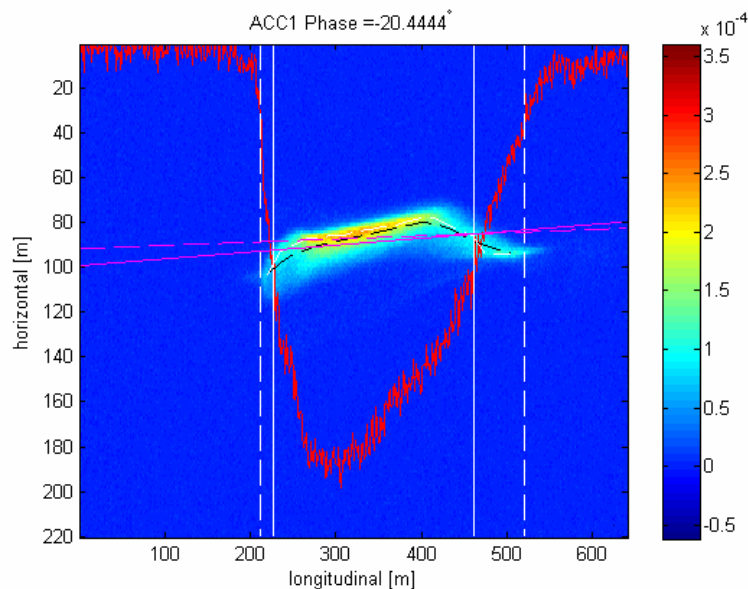




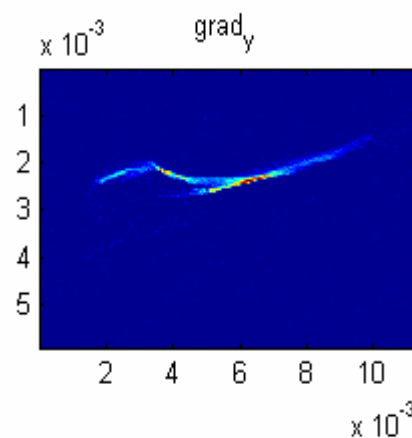
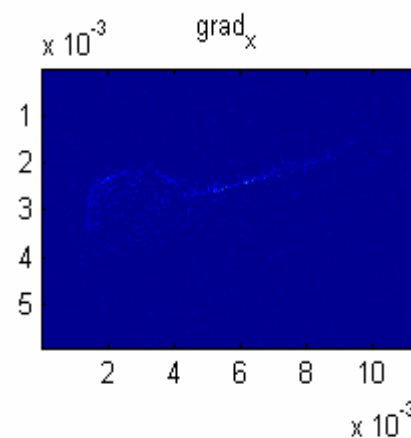
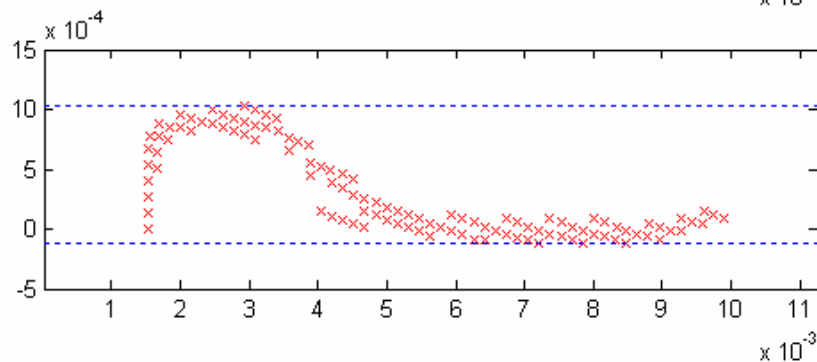
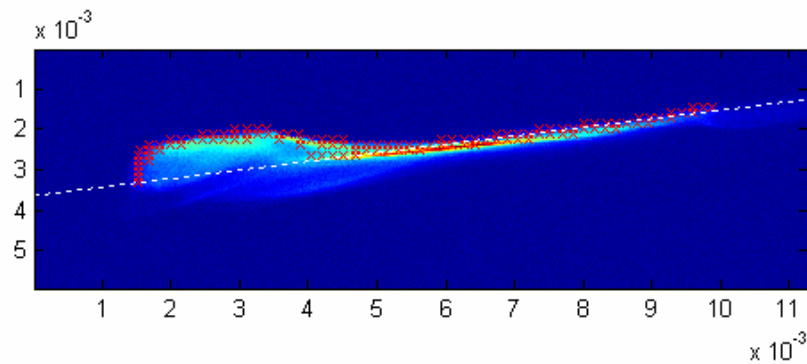
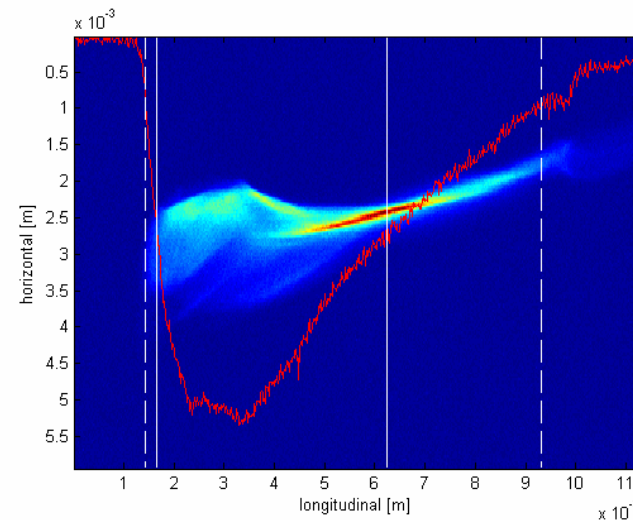




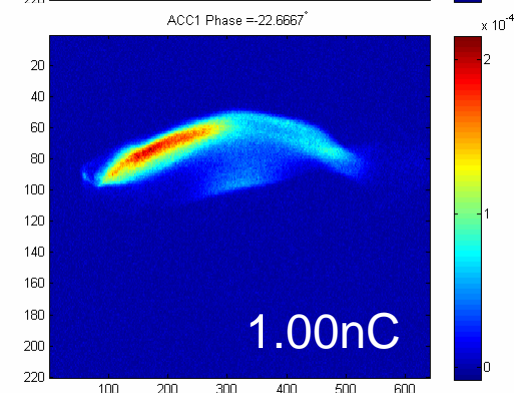
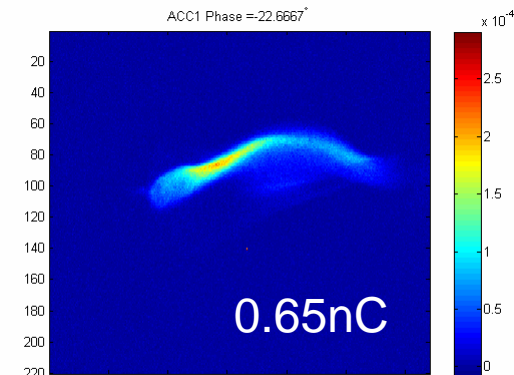
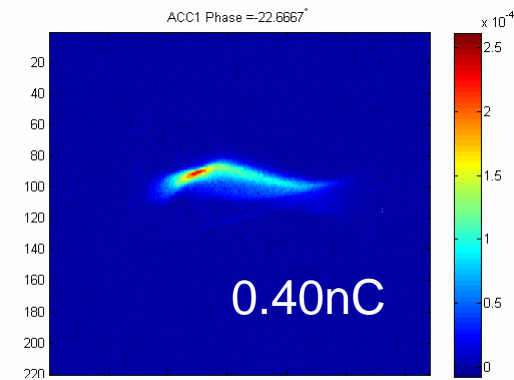
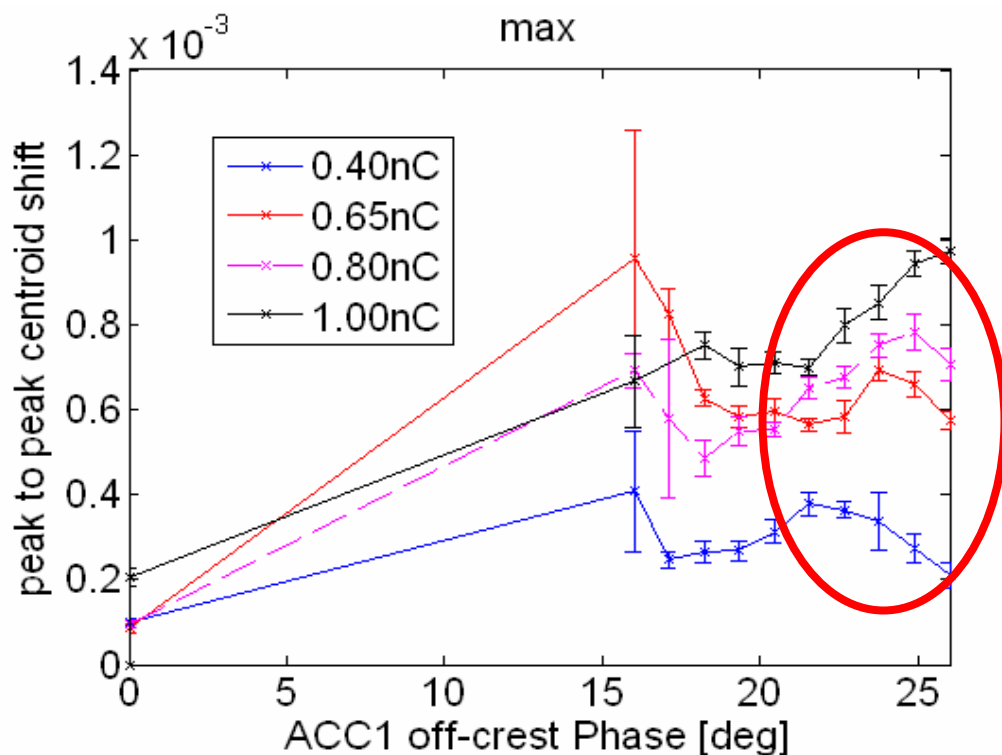
- Centroid curves has been extracted from the pictures.
- The linear correlation is determined from this curve
- Subtraction of linear correlation
- From the corrected centroid curve the peak to peak spread is calculated



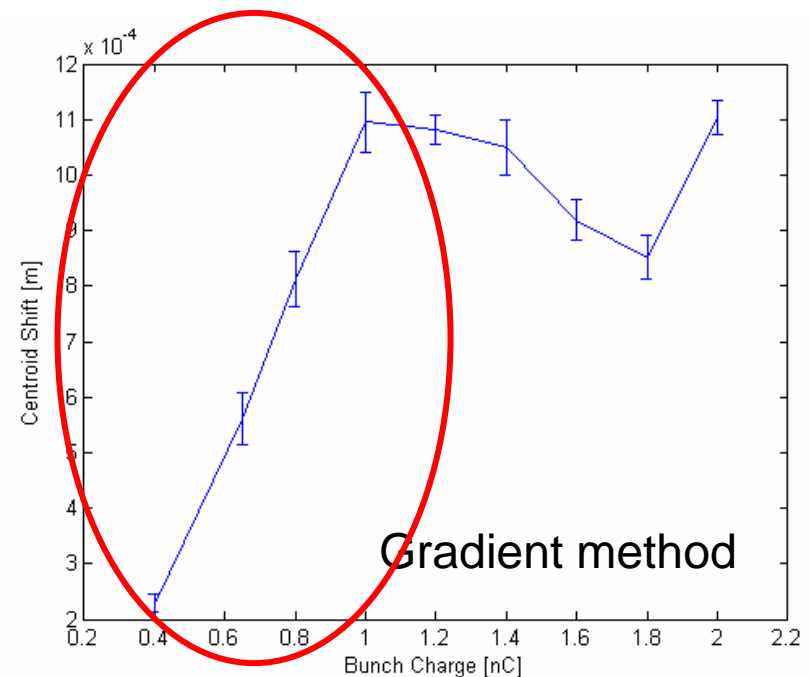
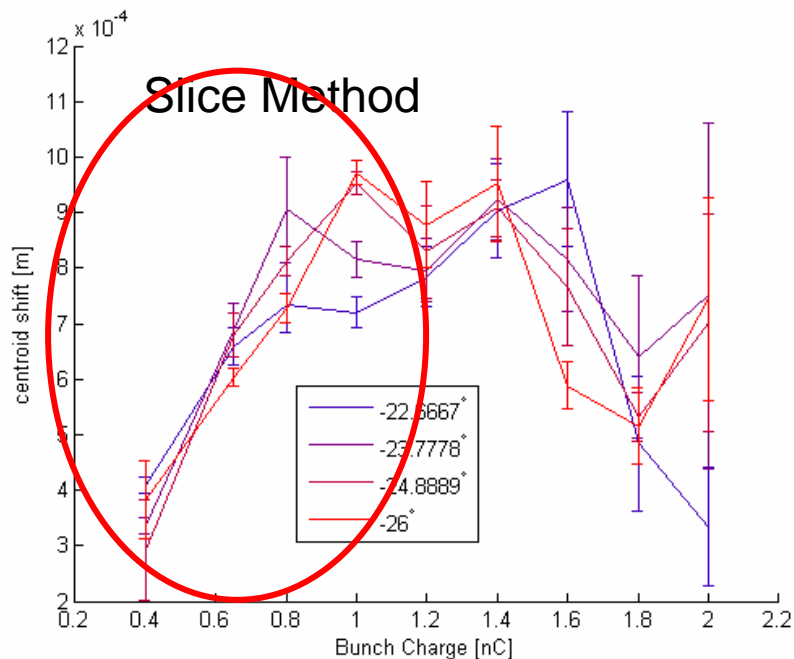
- Beam profiles at high bunch charges are distorted
- Evaluation off the centroid curve is replaced by evaluation of the ridge which is determined by the gradient



- In the strong over compression range a charge dependence is observable for charges between 0.4 and 1.0nC

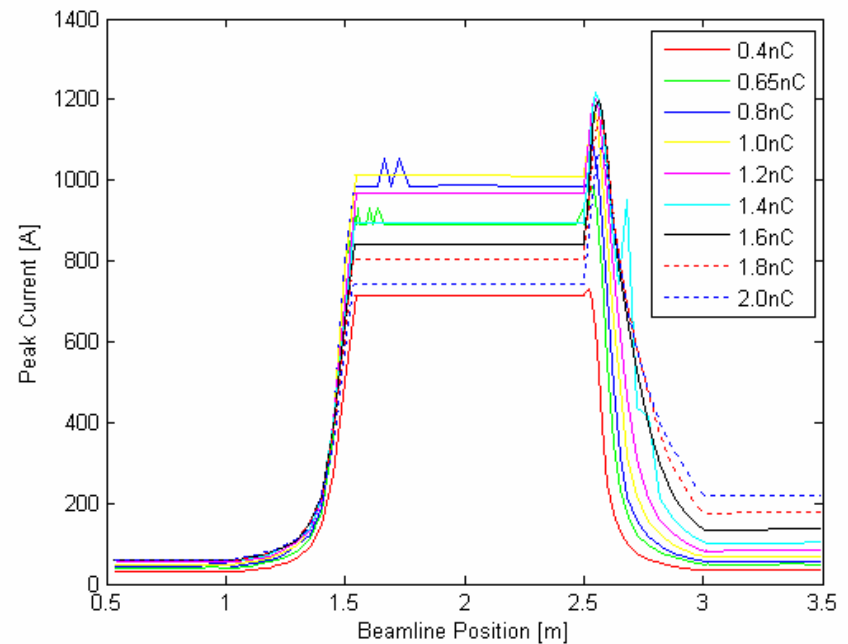
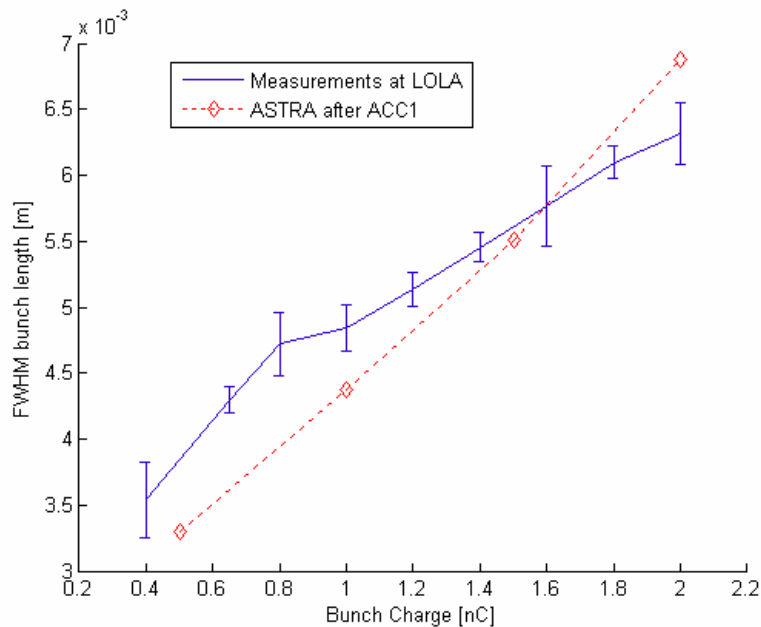


- Centroid shifts increase roughly linear with charge between 0.4nC and ~1.0nC
- “Saturation” and even a decrease at higher bunch charges is not completely understood



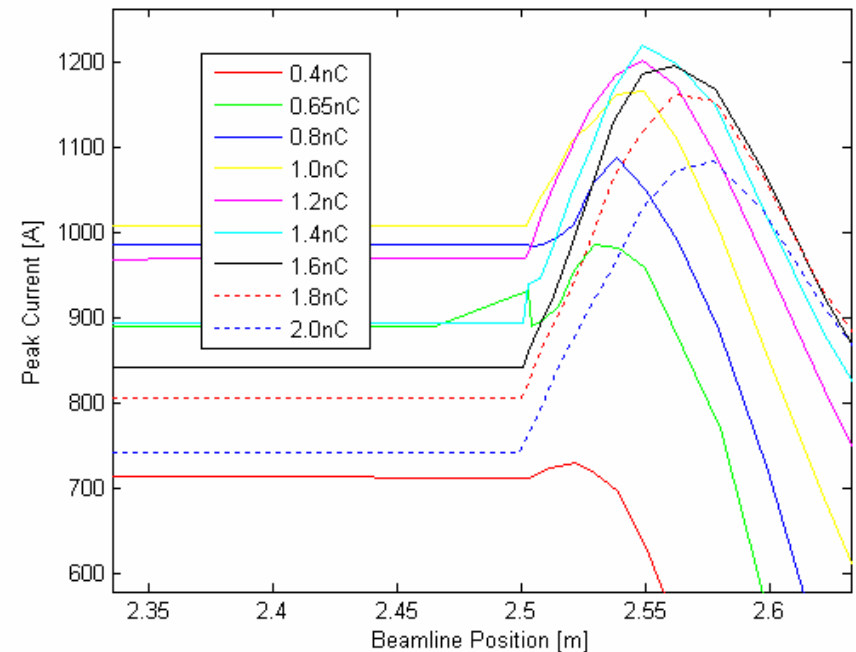
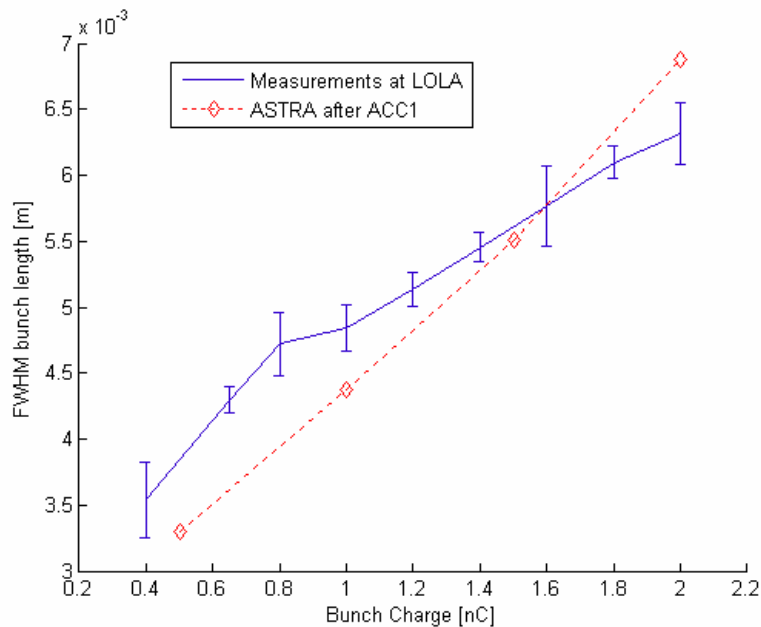
Space charge forces in the Injector are important

- Bunch length increases with charge => peak current drops
- Higher uncorrelated energy spread reduces peak current at high bunch charges



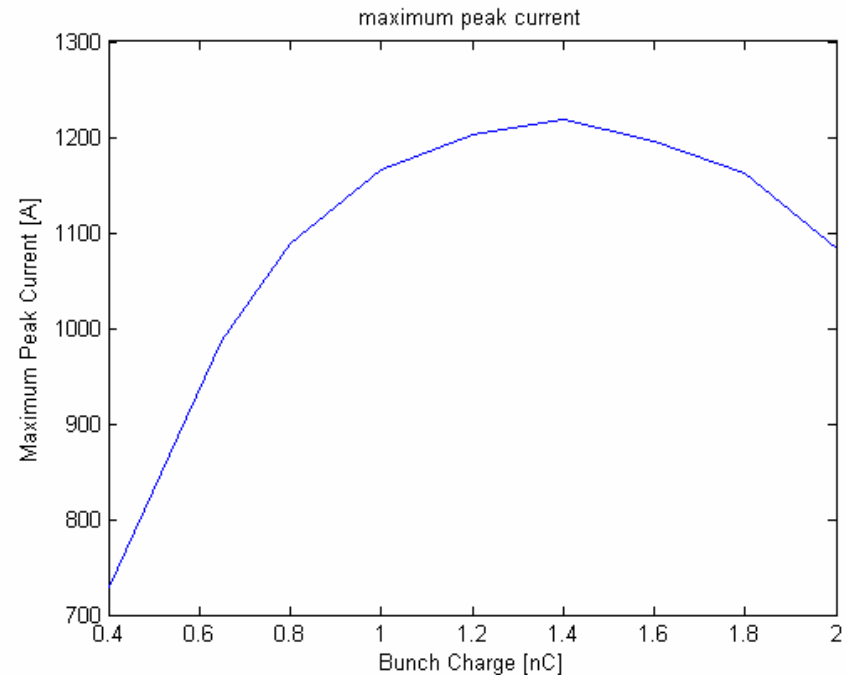
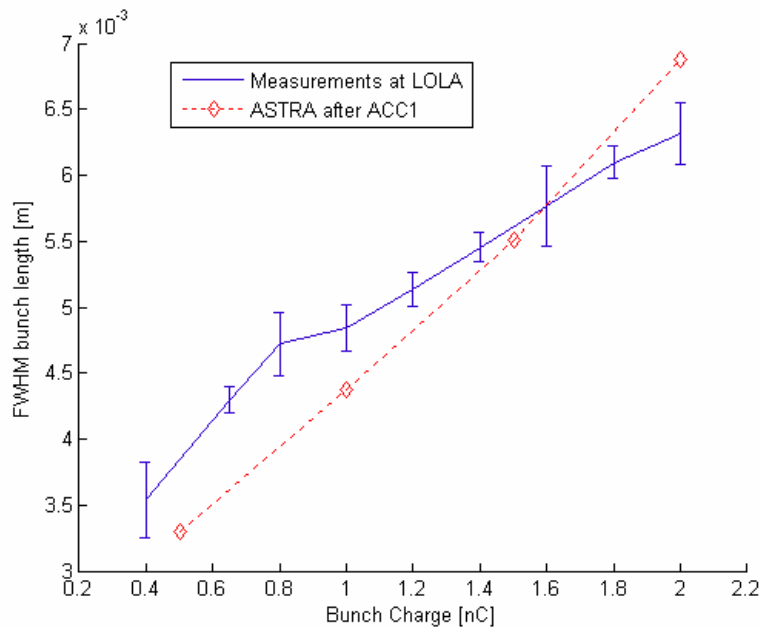
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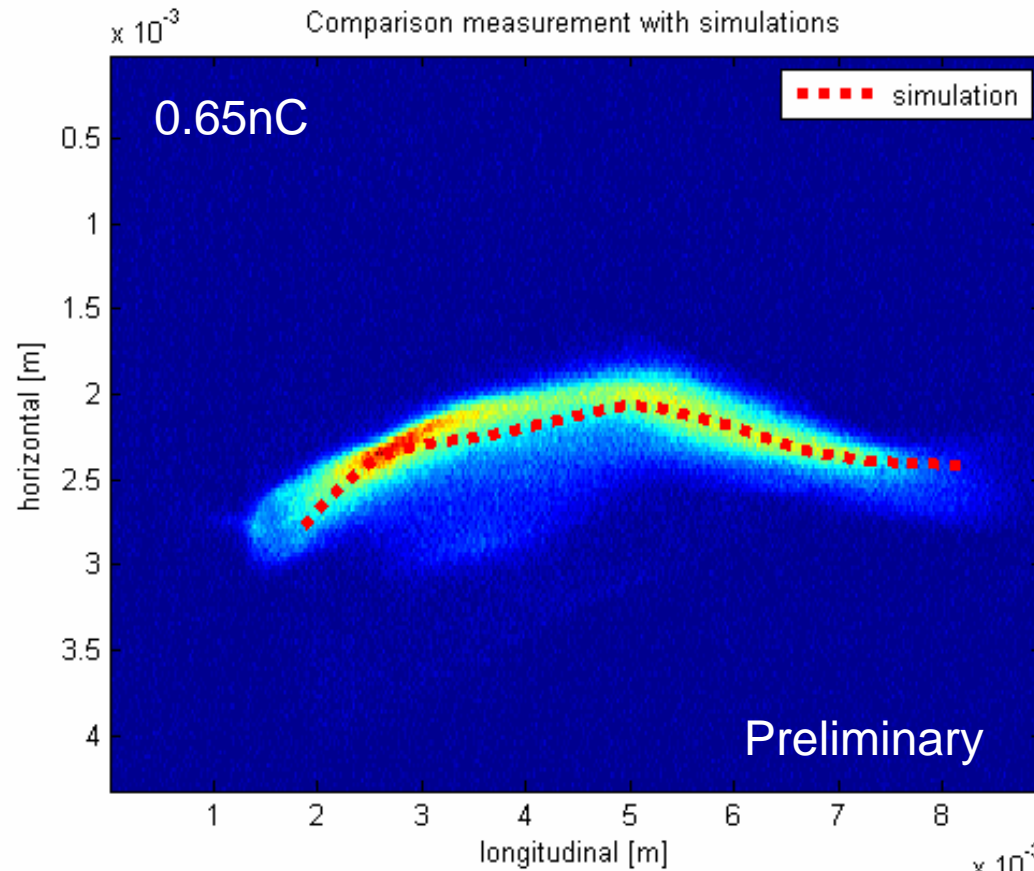
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Comparison of measured centroid shifts with simulations are preliminary

- Transport between BC2 and LOLA are not well known
=> Calibration measurements are required

- Increase of CSR induced centroid shifts with bunch charge were observed between 0.4 and 1.0nC
- Agreement between simulated and measured centroid curves

Next Steps:

- Optics calibration measurements and analysis
- Further comparison with start to end simulations
- Measurements in BC3

Thank You!