

Coherent Diffraction Radiation experiment

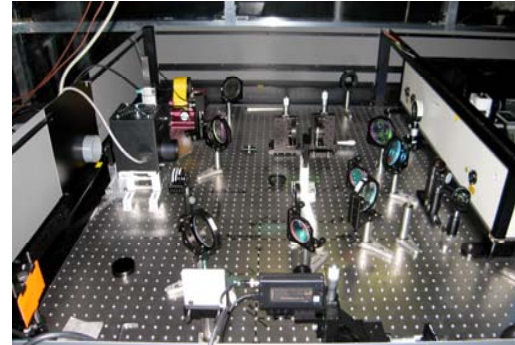
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John Adams Institute at Royal Holloway

Nicolas Chritin, Roberto Corsini, Thibaut Lefevre, Patrick Lelong
CERN

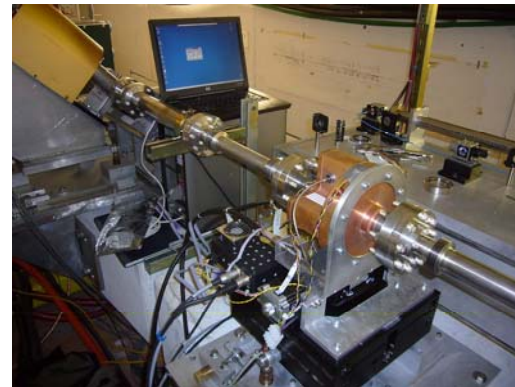
We also would like to acknowledge help of Dr. V. Antonov for target manufacturing, J. Taylor for the workshop efforts, and Dr David Howell for his useful advises on hardware development

January 27 – 29, 2009

- Laserwire (transverse beam profile monitor) with integrated OTR and ODR techniques:



- Cavity beam position monitors:



- Coherent Diffraction radiation (longitudinal beam profile monitor):

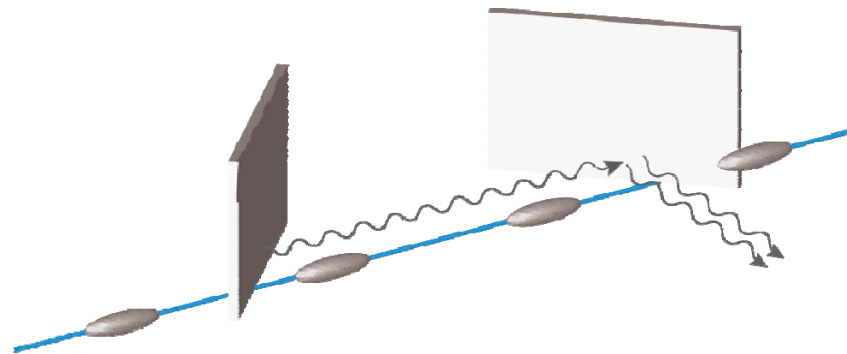


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- Diffraction radiation appears when a charged particle moves in the vicinity of a medium
- Impact parameter, h , is the shortest distance between the target and the particle trajectory
- The criterium for diffraction radiation to be emitted is

$$h \leq \gamma\lambda$$

where γ is the Lorentz factor and λ is the observation wavelength



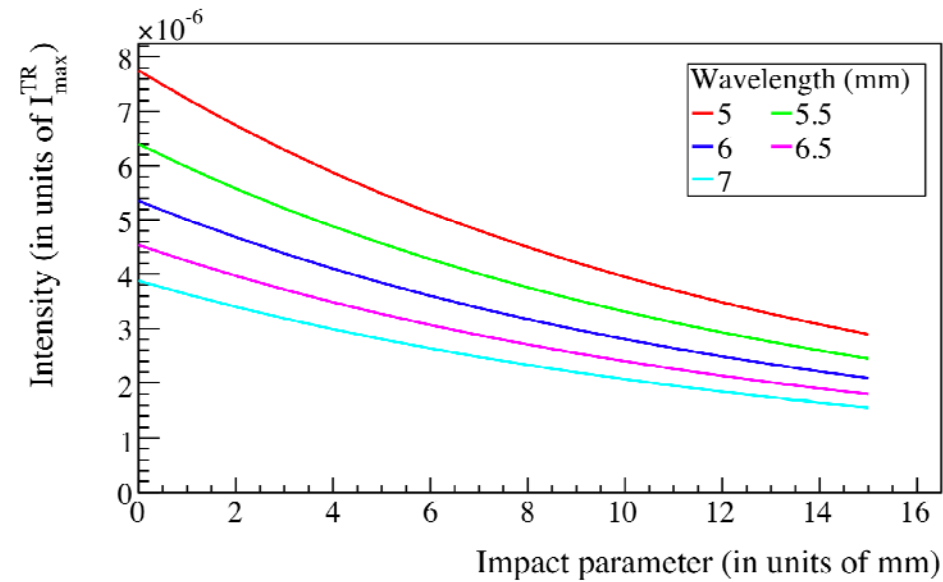
- For our setup at CTF3, $h \approx 15 \text{ mm} \ll \gamma\lambda = 1175$ for $\gamma = 235$ and $\lambda = 5 \text{ mm}$.

- Phase 1 (October – December 2008):
 - Observation of CSR signal
 - Check hardware performance and the signal level
 - Observe CDR and CSR signal as a function of target position and orientation angle
 - Measurement of charge dependence
- Phase 2 (March – December 2009):
 - Interferometric measurements of CDR and CSR spectra
 - Extraction of information on longitudinal beam profile
 - Array of detectors on motorized stage
- Phase 3 (March 2010):
 - Inserting 2nd target
 - Single shot spectral measurements using grating type spectrometer

What has been done in 2008:

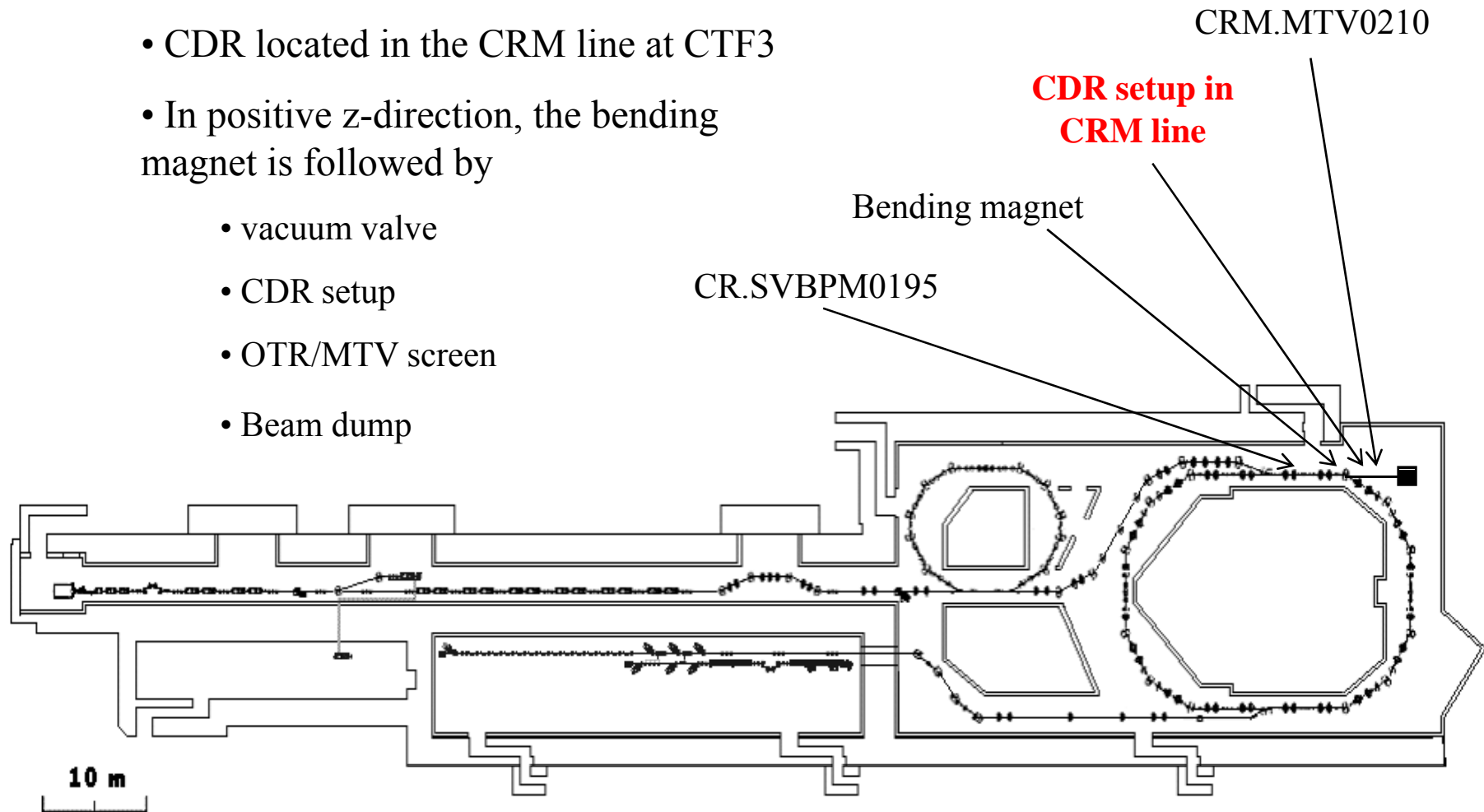
- Preparation of the setup
- Simulation studies

→ Intensity dependence on impact parameter ($\gamma = 235$)



Location of CDR:

- CDR located in the CRM line at CTF3
- In positive z-direction, the bending magnet is followed by
 - vacuum valve
 - CDR setup
 - OTR/MTV screen
 - Beam dump



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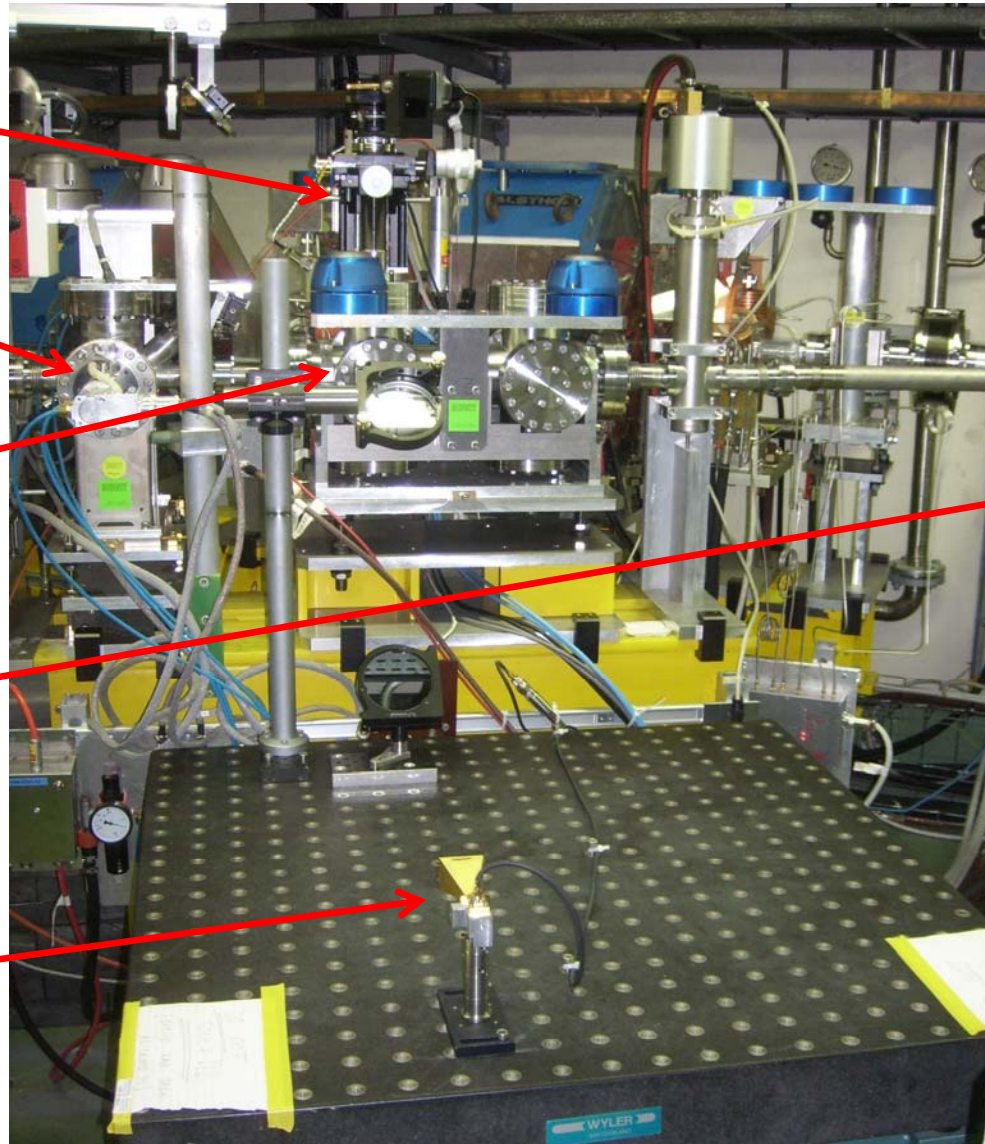
Vacuum manipulator
for target rotation and
translation

CRM.MTV0210 for
target reference position

CDR target within six-
way cross

CR.SVBPM0195 (not
shown in picture) for beam
position and charge
readings

SBD detector connected
to DAQ



January 27 – 29, 2009

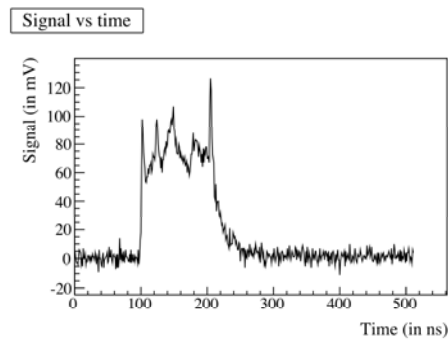
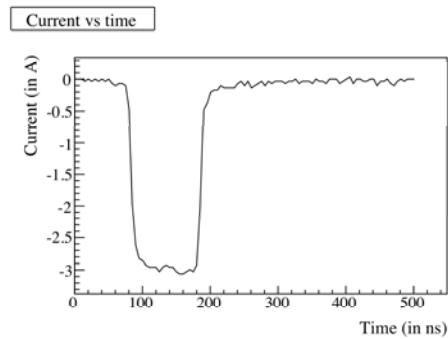
What has been done in 2008 (cont.):

- Identifying and removing errors of the setup
 - Replacing the detector and some cabling
 - Solving some software issues
- Successful **Phase 1 (October 2008)**:
 - ✓ Observation of CSR signal
 - ✓ Check hardware performance
 - ✓ Check the signal level
 - ✓ Observe CDR and CSR signal as a function of target position and orientation angle
 - ✗ Charge dependence of CDR and CSR

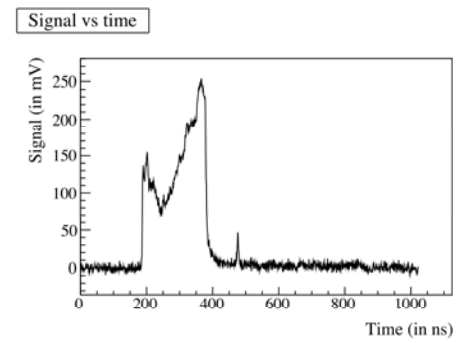
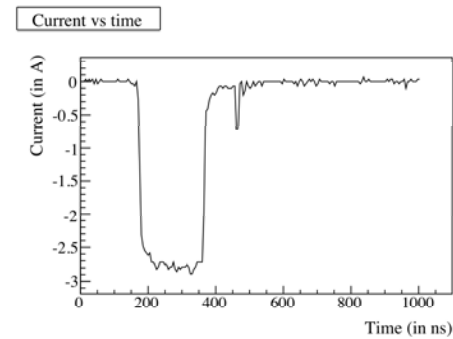
What has been done in 2008 (cont.):

- Signal of CDR and CSR including the BPM current reading

→ CDR signal:



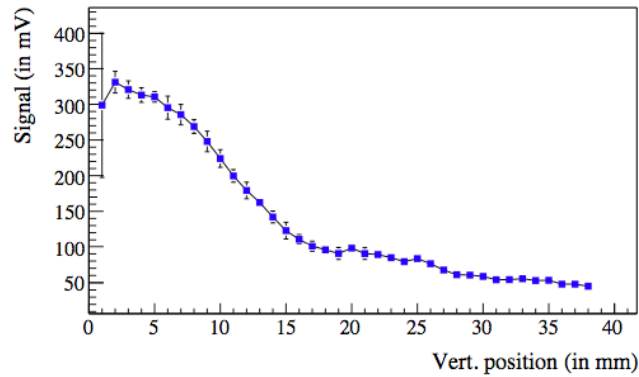
→ CSR signal:



CSR signal dependences:

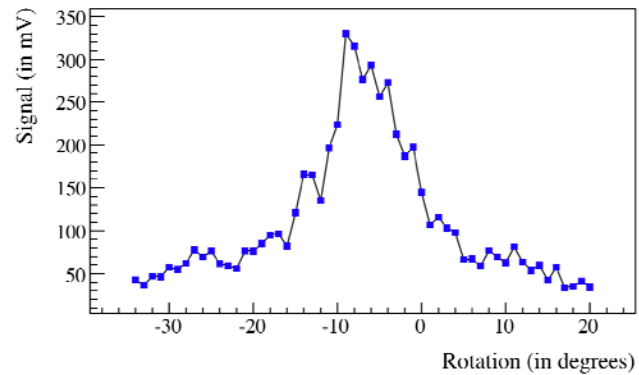
- Checked the signal level depending on the target position and orientation:

CSR position variation (Maximum)



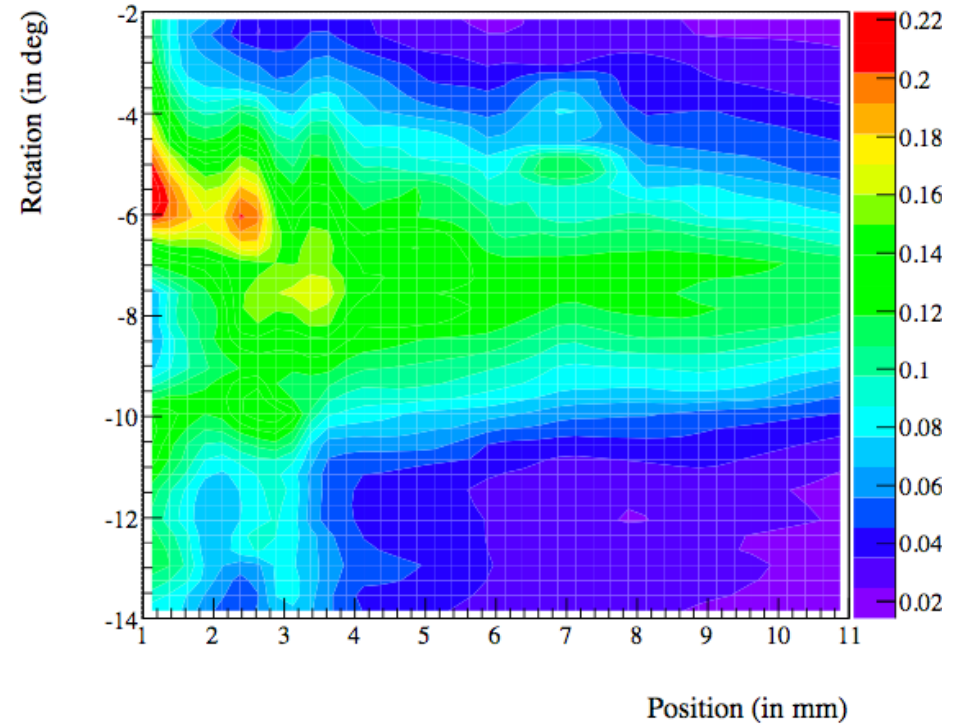
Thu Dec 4 12:51:23 2008

CSR rotation variation (Maximum)



Thu Jan 15 17:13:18 2009

CSR 2D scan

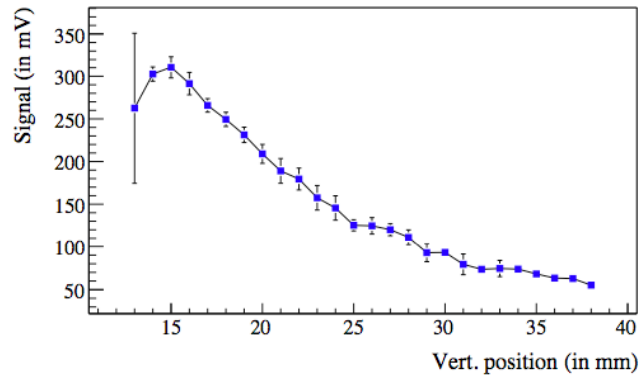


Mon Dec 8 23:03:00 2008

CDR signal dependences:

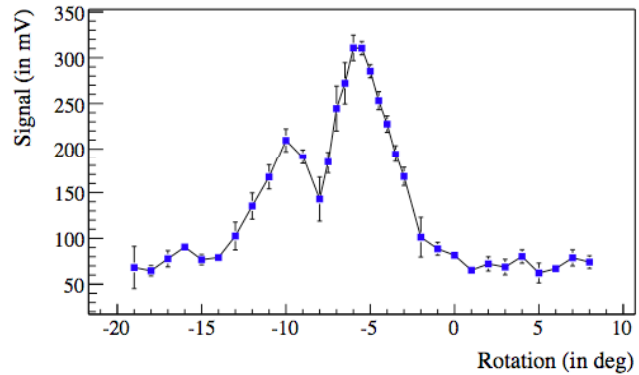
- Checked the signal level depending on the target position and orientation:

CDR position variation (Maximum)



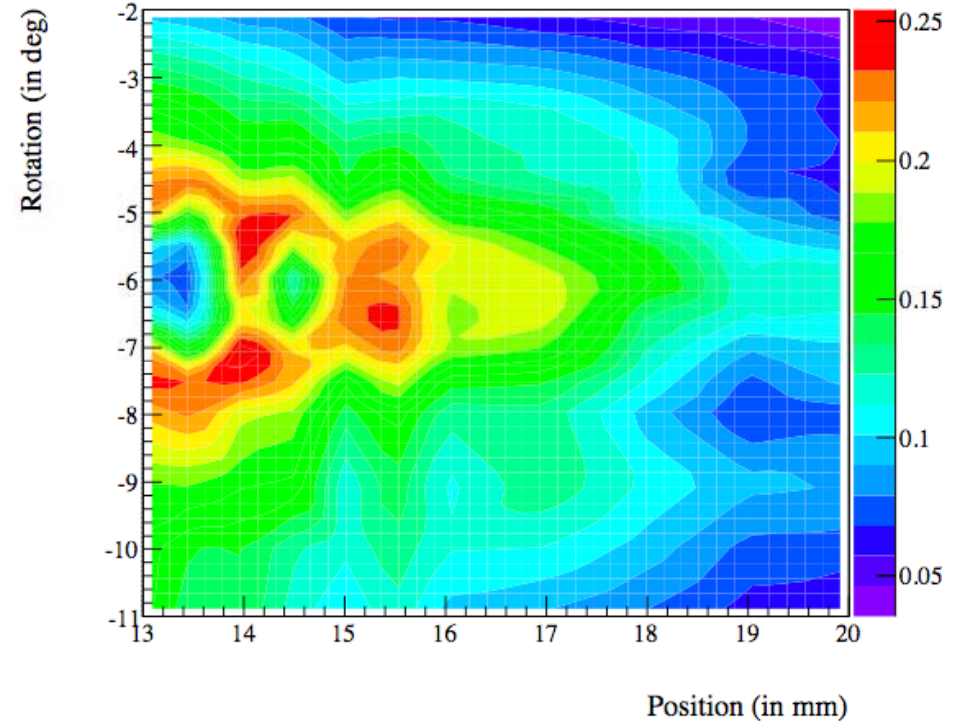
Thu Dec 4 12:53:48 2008

CDR rotation variation (Maximum)



Thu Dec 4 13:01:38 2008

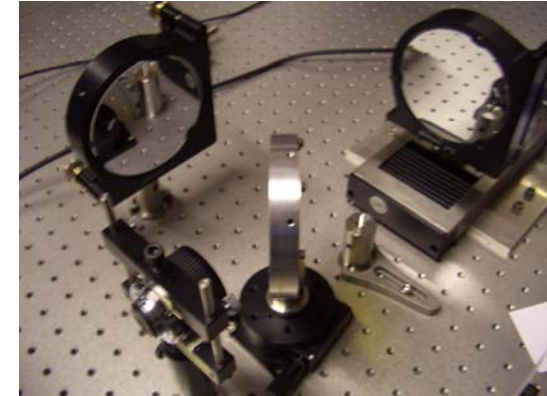
CDR 2D scan



Mon Dec 8 14:32:59 2008

Current activity:

- Developing the interferometer
 - in the accelerator lab at RHUL
 - shipment to CERN at the end of February 2009
- Minor upgrades to the current system needed
 - some additional cabling to be done (power, signal, and control cable)
 - adapter base plates for optical table
 - fast photo diode (4GHz bandwidth) for alternative bunch charge measurements using OTR light from MTV.CRM0000



Activity in the proximate future:

- Installation of the interferometer in the CRM line in February/March 2009
- Commencing interferometric measurements of CSR and CDR spectra ([Phase 2](#))

Summary of 2008:

- Theoretical work has been done on diffraction radiation
- The CDR setup has been installed in CRM line at CTF3
- Observed real signals from CSR and CDR measurements in November 2008
- Performed some measurements on CSR and CDR

Outlook:

- Upgrades to the system during the shut-down
- Ready for Phase 2

Thanks to all the people involved the start-up of the experiment was a (fairly) smooth and successful process