

CTR spectroscopy below 25 um

Stephan Wesch², C. Behrens², H. Delsim-Hashemi², B. Schmidt¹

DESY¹ Universität Hamburg²

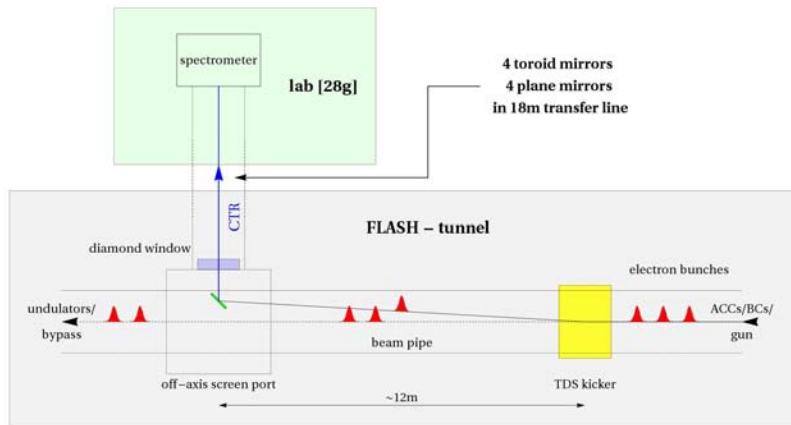
FLASH seminar
8th April 2008



Overview

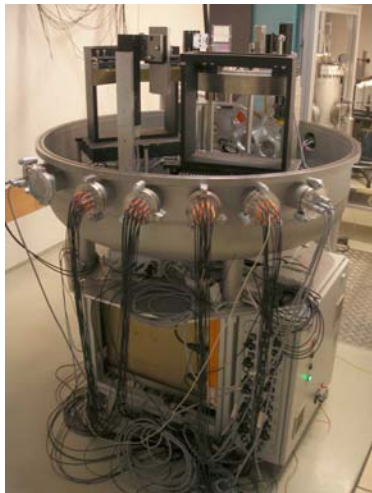
- 1 Experiment
 - CTR generation and transport
 - Spectrometer
- 2 Measurements
 - Signal corrections
 - Phase scans
 - On crest observations
 - Charge dependence
 - Influence of BC2 collimator
 - Intense short μm -radiation
- 3 Conclusion

Radiation generation and transport



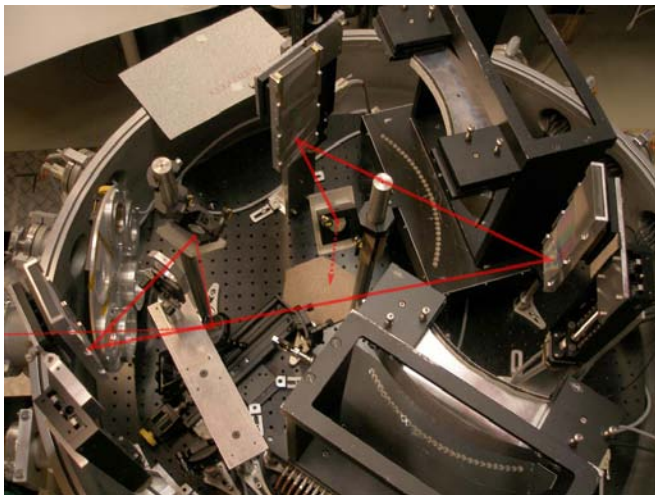
Schematic overview of CDR port at 140m

Experimental setup I



Vacuum chamber in 28g

Experimental setup II



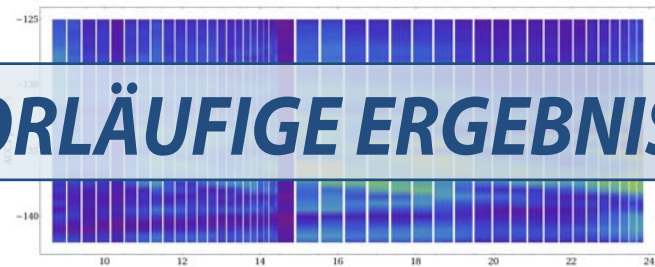
Spectrometer (designed by Hossein)

Signal corrections

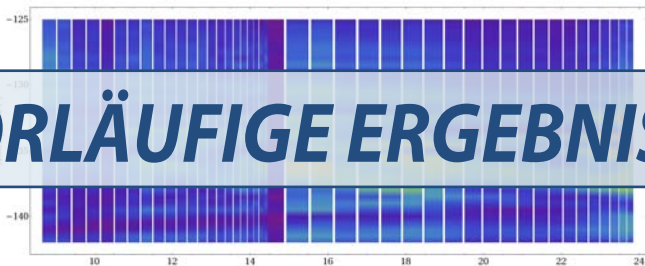
Transform ADC signal into spectral energy density:

1. Diamond window + beamline losses
2. Polarizer efficiency
3. Grating efficiencies
4. Detector efficiency
(no λ dependence yet!)

Spectra example

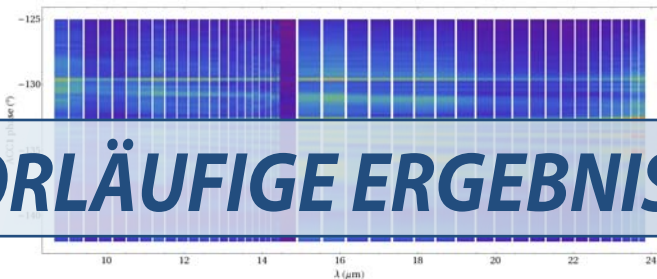


Spectra example



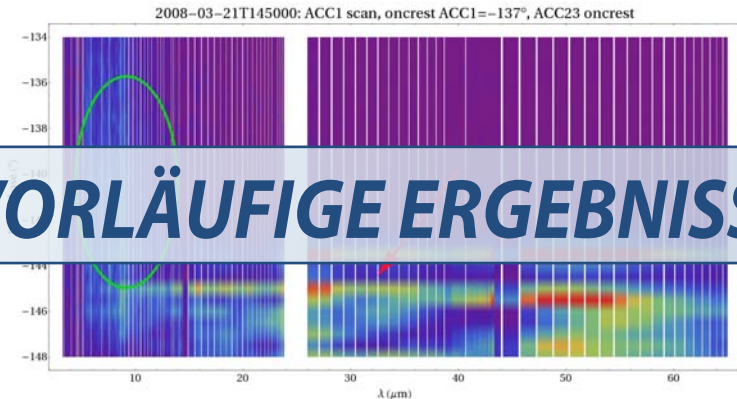
VORLÄUFIGE ERGEBNISSE

reproduce structures with higher resolution (after 45min.)



VORLÄUFIGE ERGEBNISSE

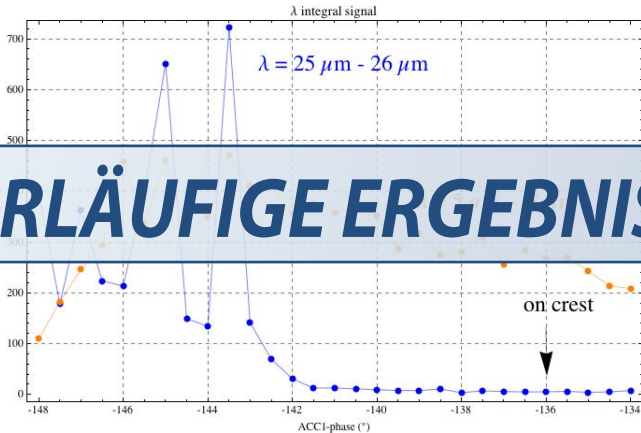
ACC1 phase scan



Known narrow structure above $10 \mu\text{m}$ (Hossein: 080304 FLASH Talk)

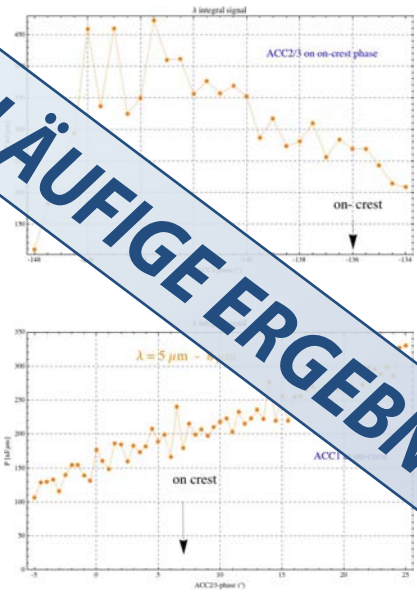
Radiation $< 10 \mu\text{m}$!

Phase dependence



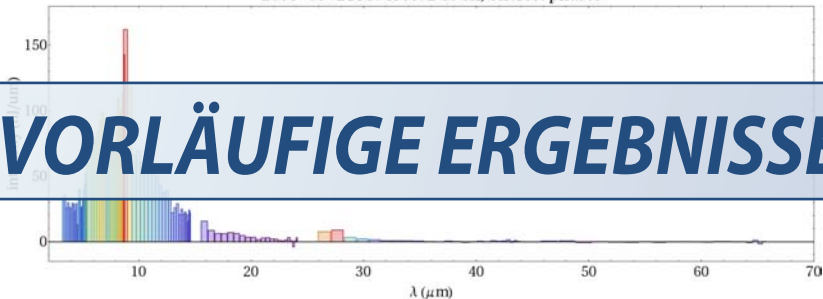
Phase dependence

VORLÄUFIGE ERGEBNISSE



Double oncrest spectrum

2008-03-21T074500: BCs on, oncrest phases



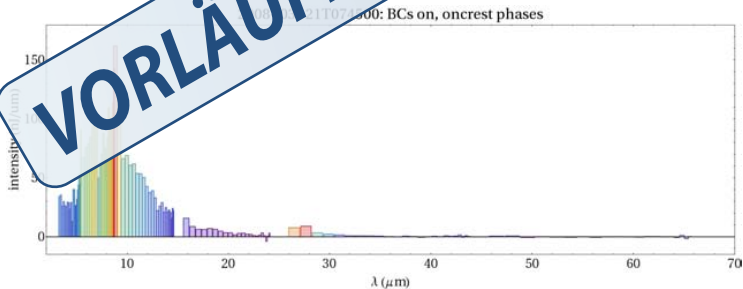
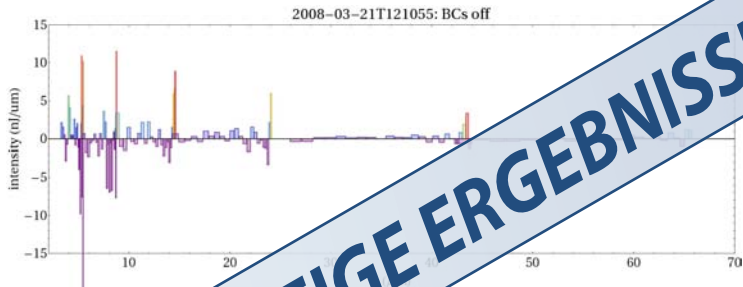
VORLÄUFIGE ERGEBNISSE

Crosschecks

Measures taken to verify that this radiation is real not an artifact:

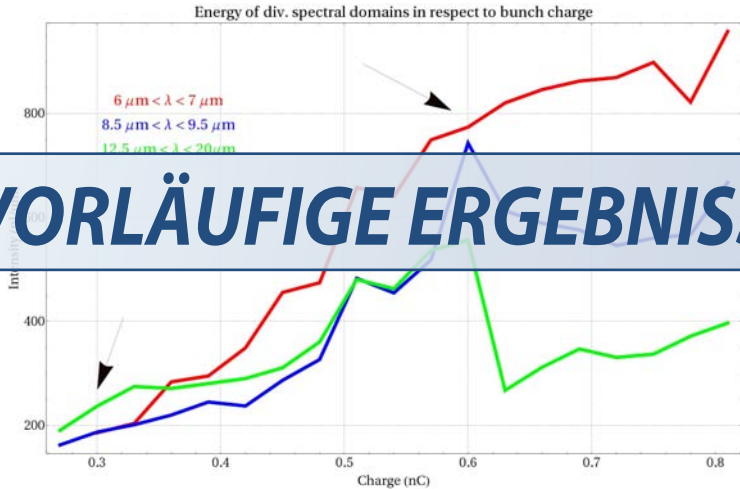
1. **Various filters** → **blocking longer wavelengths (e.g. NaCl: >20 um)**
2. **Turn off gun laser** → **no visible signal**
(no intensity due to dark current)
3. **Turn off LOLA kicker** → **no visible signal**
(no intensity from halo electrons or synchrotron radiation from BCs)
4. **Turn off LOLA kicker + on axis screen** → **same intensity than with off axis screen**
(no signal related to edge radiation from LOLA kicker)
5. **Turn off BCs** →

Bunch compressors off



VORLÄUFIGE ERGEBNISSE

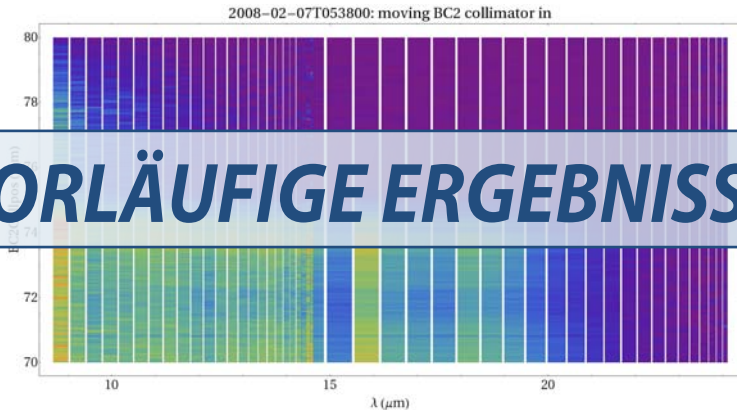
Charge dependence



SASE conditions

BC2 collimator

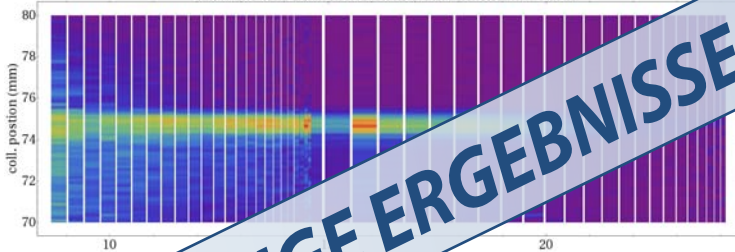
Collimator limits the beam in dispersive section.



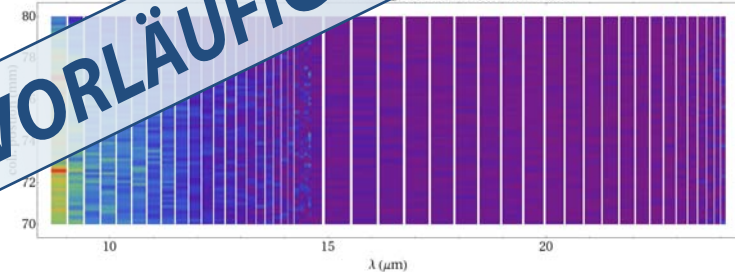
Compression phases at normal SASE conditons (NaCl filter \rightarrow λ blocked above 20 μm)

BC2 collimator

2008-02-07T060904: moving BC2 collimator in -1° acc1

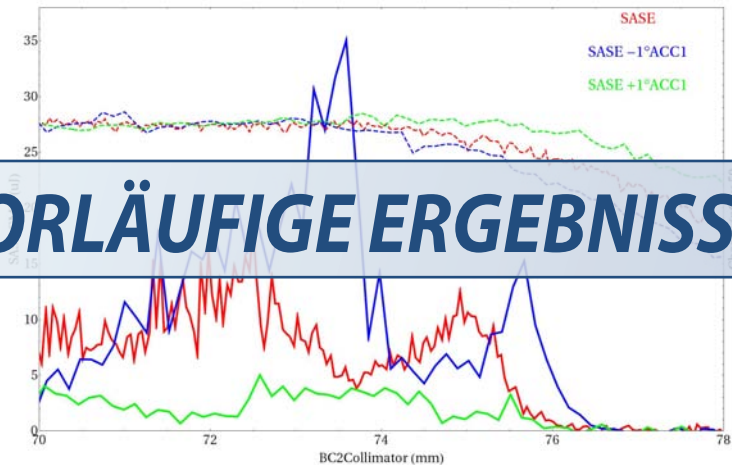


2008-02-07T060904: moving BC2 collimator in $+1^\circ$ acc1



VORLÄUFIGE ERGEBNISSE

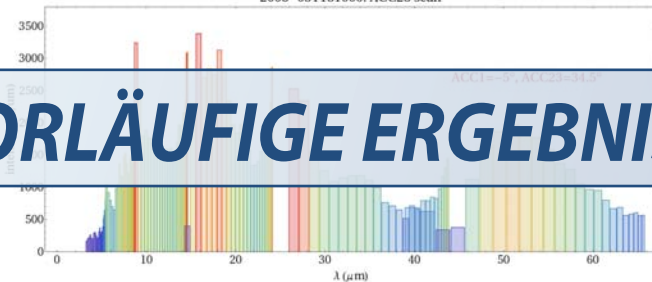
BC2 collimator



VORLÄUFIGE ERGEBNISSE

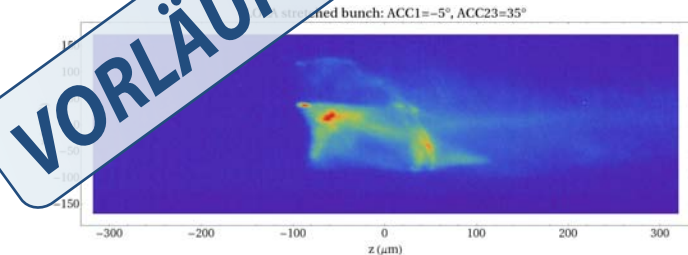
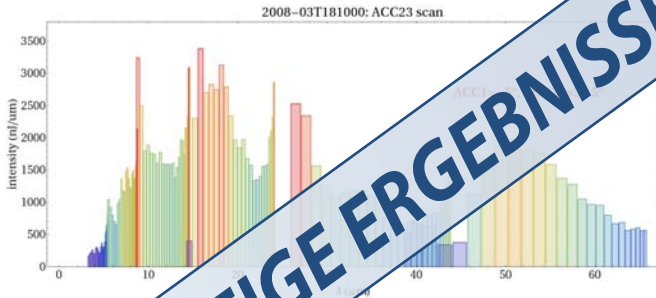
Maximize μm -radiation

2008-03T181000: ACC23 scan



VORLÄUFIGE ERGEBNISSE

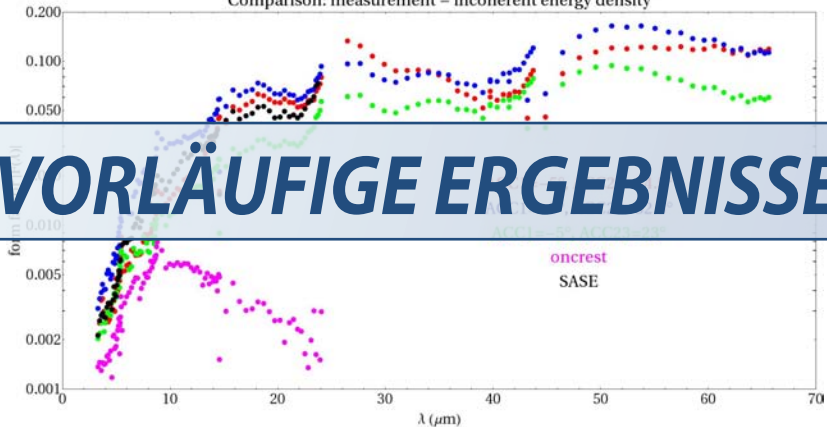
Maximize μm -radiation



VORLÄUFIGE ERGEBNISSE

Form factor

Comparison: measurement – incoherent energy density



Conclusions

FLASH electron bunch generates coherent radiation observed below $10\ \mu\text{m}$:

- i. intensity level around $100\ \text{nJ}/\mu\text{m}$
- ii. weak dependence of compression phases
- iii. smooth (quadratic) charge dependence
- iv. no radiation without magnetic chicanes
- v. form factor indicates modulation and not single spike