COMMISSIONING EXPERIENCE AND FIRST RESULTS FROM THE NEW SLS BEAM SIZE MONITOR

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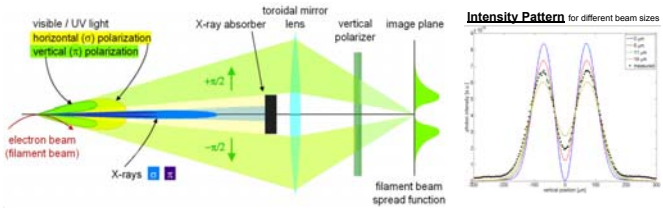
Motivation

TIARA WP6 "SLS vertical emittance tuning" (SVET): Ultra-low vertical emittance tuning and control in the regime of strong IBS for damping rings of future linear colliders & for next generation light sources.

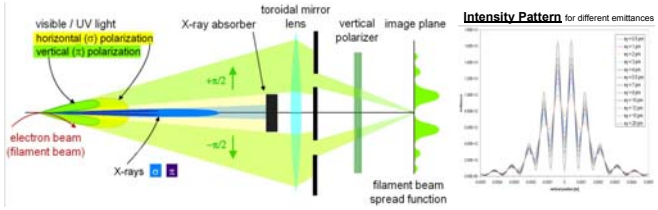
At SLS, an extremely small vertical beam size of **3.6 ± 0.6 µm**, corresponding to a vertical emittance of **0.9 ± 0.4 pm**, has been achieved through systematic coupling correction. It was verified using an optical monitor based on imaging of π-polarized synchrotron radiation. Since the existing beam size monitor reached its limit of resolution, a new monitor beam line was designed and installed at the 08BD bending magnet of the SLS storage ring. Larger magnification and operation at shorter wavelengths provide improved spatial resolution. Reflective optics enables convenient switching between different wavelengths. Movable obstacles in the beam path create interference patterns and thus provide redundancy of model based analysis of the images.

π-Polarized Imaging Method



- imaging of vertically polarized SR lobes with 180° phase shift in the visible/UV
  - → destructive interference in the mid plane
  - → full modulation (zero intensity) for point-like SR source
  - → modulation depth proportional to vertical SR source size / vertical emittance
- SRW simulations of SR through beam line is used to fit measured SR source size

π-Polarized Interference Method

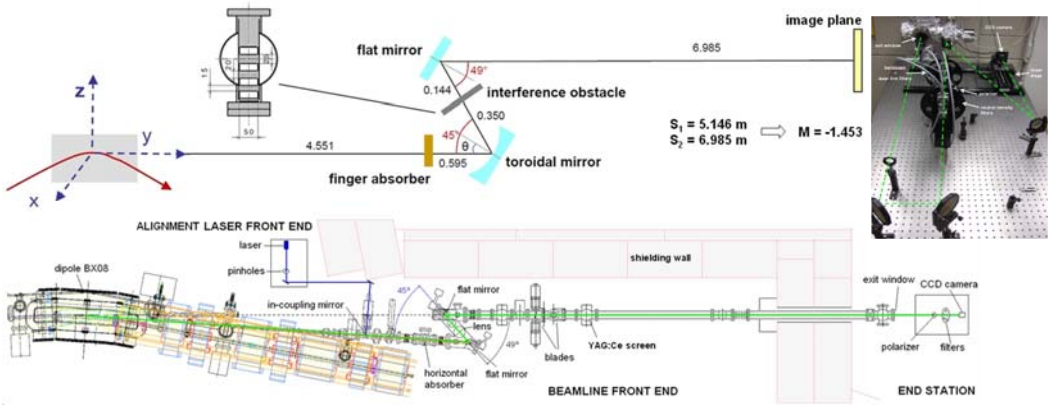


- interfering of vertically polarized SR lobes in the visible/UV through horizontal slits
  - → interference pattern depends on slit width (15, 20 and 25 mm for SLS BX08 monitor)
  - → full modulation (zero intensity) for point-like SR source
  - → modulation depth proportional to vertical SR source size / vertical emittance
- SRW simulations of SR through beam line is used to fit measured SR source size

BX08 Beamline Design

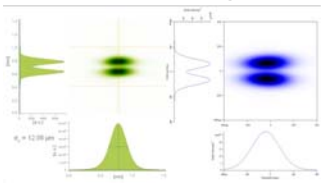
Main Improvements

- Higher optical magnification ratio
  - → increase of measurement precision
- π-polarization & interferometric method
  - → complementary measurement methods
  - → cross-checking of results
- Longer beamline (X08DA)
  - → optics table outside of accelerator tunnel
  - → accessibility at any time
- Alignment laser front end and YAG-screen
  - → alignment check of focusing element to minimize optical aberrations
  - → online monitoring optical component quality with lasers at 405 nm and 532 nm (266 nm)
  - → possibility to detect UV induced degradation of optical components and obstructions in beam line

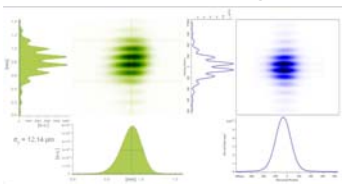


Commissioning Results and First Beam Size Measurements

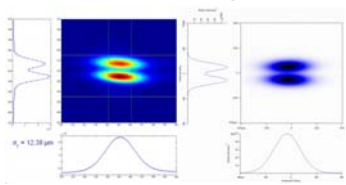
π-Polarization Imaging @ 325 nm



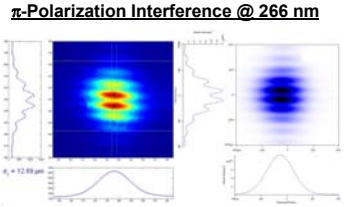
π-Polarization Interference @ 325 nm



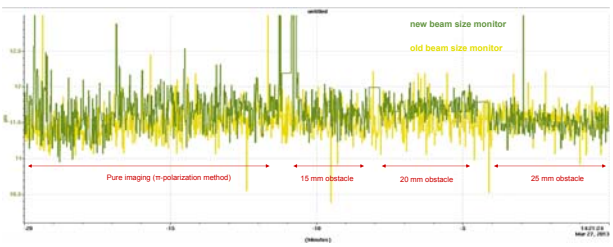
π-Polarization Imaging @ 266 nm



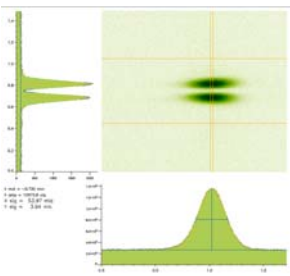
π-Polarization Interference @ 266 nm



Comparison between "old" BX09 and "new" BX08" Beam Size Monitors



…smallest beam size measured so far



Upgrades in Fall 2013

- exchange of the lens for a **toroidal mirror** as the focusing element
  - → free selection of SR wavelength without shift of image plane
  - → allows broader spectral bandwidth (increases intensity on camera)
  - → shorter wavelength measurements with increase resolution
- laser front end will be equipped with a **266 nm laser**
  - → image quality check at relevant wavelength

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