Horizontal Slice Emittance Measurements with Lola

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Vertically stretched bunches during quadrupole scan
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Longitudinal profiles

- Streak: 16.6 fs / pixel = 0.61 ps / mm
Bunch emittance (100%) and Twiss parameters

- 10 background and 10 beam images are used to determine the rms width for each quadrupole current
- only statistical errors are included
Subdivision into slices

reference point:
peak in vertical profile

Slice width: 0.4 mm (y), 0.24 ps (z)
Horizontal slice widths
Horizontal slice emittance (100%) and mismatch

Normalized slice emittance (100%)

- Maximal slice emittance: $10.9804 \pm 0.15477$ mm mrad
- Minimal slice emittance: $3.8137 \pm 0.10268$ mm mrad
- Bunch emittance: $7.8184 \pm 0.059794$ mm mrad

Mismatch with respect to the bunch Twiss parameters

Mismatch phase $\theta_x$ [degree]
Horizontal slice emittance (90%) and mismatch

Normalized slice emittance (90%)

maximal slice emittance: 5.1806 ± 0.11234 mm mrad
minimal slice emittance: 1.4463 ± 0.04362 mm mrad
bunch emittance: 3.8462 ± 0.039421 mm mrad

Mismatch with respect to the bunch Twiss parameters

Mismatch phase $\theta_x$ [degree]

Mismatch parameter M

$\Delta t$ [ps]
Horizontal slice emittance and mismatch
(slightly different optics)

Normalized slice emittance (100%)
maximal slice emittance: 10.7316 ± 0.15963 mrad
minimal slice emittance: 3.0956 ± 0.079684 mrad
bunch emittance: 6.7915 ± 0.075931 mrad

Mismatch with respect to the bunch Twiss parameters

Mismatch phase $\phi_X$ [degree]

Mismatch parameter $M$

$\Delta t$ [ps]

Emittance $\epsilon_X$ [um]
Possible Improvements of horizontal slice emittance measurements

• Measurement with fixed vertical beta function at the screen

• Reconstruction of the particle distribution in the (y,z)-plane using tomography
  
  → calculation of the true horizontal slice widths?
  
  → determination of the longitudinal resolution