Tilt in longitudinal-horizontal plane

- Example
- Development of the tilt during quadrupole scan
- Comparison with longitudinal phase space distribution for two cases:
  - Bunch compression in BC3 (ACC23 off-crest)
  - On-crest operation
Example: Tilted bunch

Calibration: horizontal center of the head during scan of LOLA phase

Longitudinal density profile

Tilt: ~ 40 µm/ps or ~ 120 mrad!
Tilt during scan of 6 quadrupoles

Settings:
• BC2 off
• BC3 on
• ACC1 on-crest
• ACC23: -26 deg
• ACC45: on-crest
• E = 630 MeV
• Q = 1nC

Range used for calculation of the tilt
Tilt during quadrupole scan

Angle: 120 mrad

Angle: 340 mrad
Longitudinal phase space

Images during the scan:
Calculated dispersion

Kicker contribution in case of on-axis beam without angle: ~ +10 mm

Scan index

D [mm]
Properties of the tilt

• The tilt depends strongly on the orbit
• Scan of a steering-free quadrupole upstream of ACC23 showed nearly no variation of the tilt -> main contribution in the high energy part
• A reconstruction of the tilt upstream of the scanned quadrupoles (LQF) gives no reasonable solution -> significant contribution downstream of Q9ACC4
• Steering through LOLA has nearly no effect

Basically in agreement with dispersion - assumption
Tilt during scan: on-crest operation (?)

Settings:
- BC2 off
- BC3 on
- ACC1 on-crest
- ACC23 on-crest
- ACC45: on-crest (?)
- $E = 630$ MeV
Tilt during the scan

![Graph showing tilt during the scan]
Longitudinal phase space

Images during the scan:

Long bunches: additional effects?
Calculated dispersion

Full relative energy deviation of the bunch

![Graph showing calculated dispersion with different energy deviations.]
Conclusions & Outlook

• For short bunches, dispersion seems to be the dominating cause for the tilt
• Possible experiment to check this: scan of phase (e.g. of ACC23) over a wide range with gradient adaption