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High-resolution, low-latency, bunch-by-bunch feedback systems for nano-beam production and stabilization

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High-precision intra-bunch-train beam orbit feedback correction systems have been developed and tested in the ATF2 beamline of the Accelerator Test Facility at the High Energy Accelerator Research Organization in Japan. Two systems are presented:

- 1) The vertical position of the bunch measured at two stripline beam position monitors (BPMs) is used to calculate a pair of kicks which are applied to the next bunch using two upstream kickers, thereby correcting both the vertical position and trajectory angle. This system was optimised so as to stabilize the beam offset at the feedback BPMs to better than 350 nm, yielding a local trajectory angle correction to within 250 nrad. Measurements with a beam size monitor at the focal point (IP) demonstrate that reducing the trajectory jitter of the beam by a factor of 4 also reduces the observed wakefield-induced increase in the measured beam size as a function of beam charge by a factor of c. 1.6.
- 2) High-resolution cavity BPMs were used to provide local beam stabilization at the interaction point. The BPMs were demonstrated to achieve an operational resolution of ~20 nm. With the application of single-BPM and two-BPM feedback, beam stabilization of below 50 nm and 41 nm respectively has been achieved with a closed-loop latency of 232 ns.

In-person participation

Yes

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