A Sub-micron Resolution, Wide-band, Stripline BPM System for Driving Bunch-by-bunch Feed-back and Feed-forward Systems at ATF

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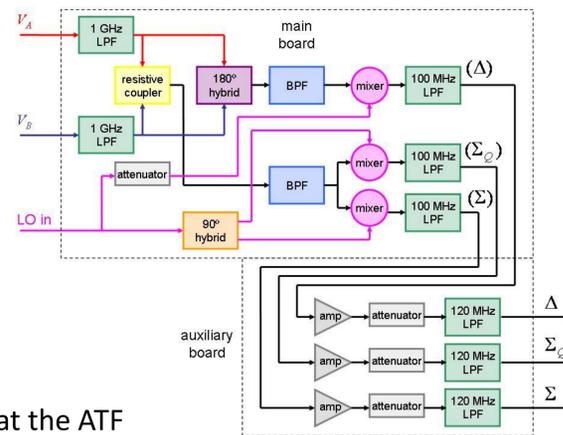
Abstract

A low-latency, sub-micron resolution stripline beam position monitoring (BPM) system has been developed and tested with beam at the KEK Accelerator Test Facility (ATF2), where it has been used as part of a beam stabilisation system. The fast analogue front-end signal processor is based on a single-stage RF down-mixer and a position resolution below 400 nm has been demonstrated for beam intensities of ~1 nC, with single-pass beam. The BPM position data are digitised by fast ADCs on an FPGA-based digital feedback controller, which is used to drive either a pair of kickers local to the BPMs and nominally orthogonal in phase, in closed-loop feedback mode, or a downstream kicker in the ATF2 final focus region, in feedforward mode. The beam jitter is measured downstream of the final focus system with high resolution, low-Q, cavity BPMs, and the relative performance of both systems in stabilising the beam is compared.
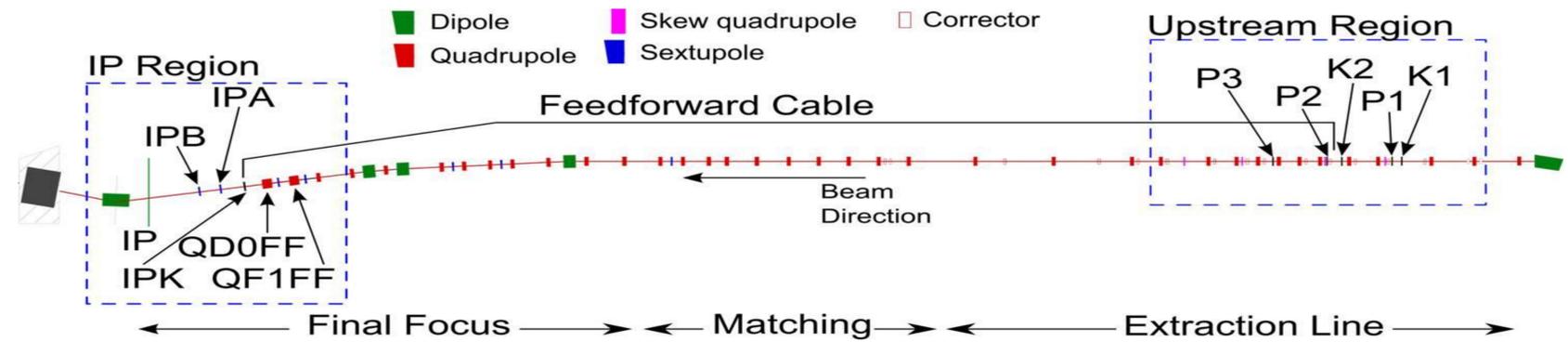
BPM Processor Design

FONT analogue signal processor design

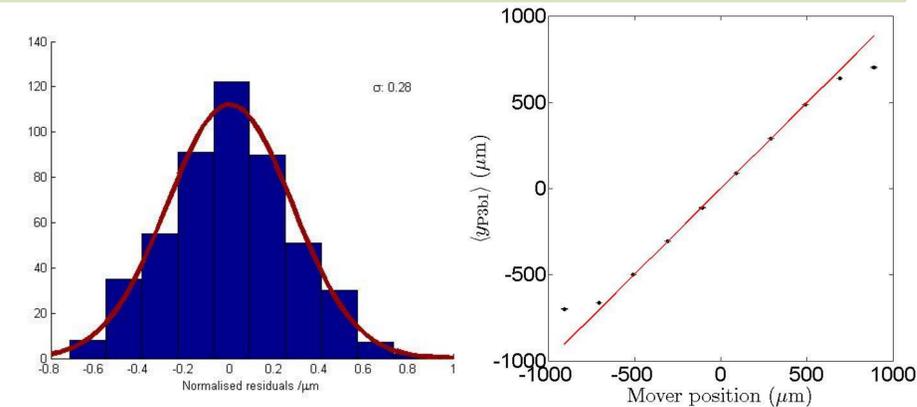### Stripline BPM FONTP1 at the ATF
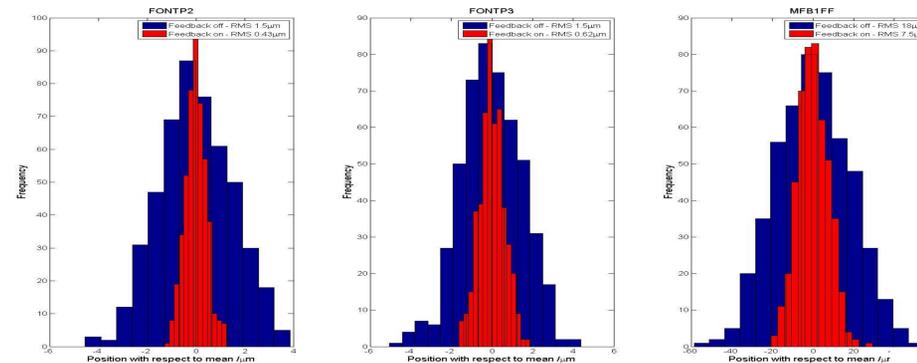

Accelerator Test Facility

BPM Performance Results

Histogram of normalised residuals for the system of three BPMs with FONTP2, FONTP3, and MFB1FF, obtained by predicting the position at one BPM given the measured positions in the other two, and the transfer matrices as derived from the model. A Gaussian fit to the data is plotted (red) and the width is given in microns.
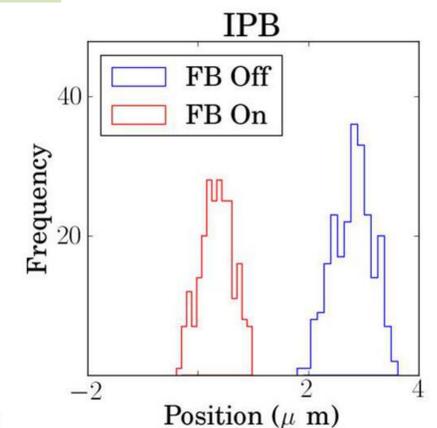

Example BPM calibration illustrating the dynamic range of the processor, showing Δ/Σ for each mover setting (blue) and linear fit to data (red). The calibration is obtained for the linear region where $|\Delta/\Sigma|<1$

System Performance Results

Histograms of position distribution with feedback off (blue) and feedback on (red) showing the effect of the upstream feedback system at FONTP2, FONTP3, and MFB1FF. RMS values for the jitter are given at each BPM.

Distribution of vertical position for the second bunch at IPBPM-B, with (red) and without (blue) the application of upstream feedback.

Vertical jitter at for the second bunch at IPBPM-B as a function of the QD0FF current, with feedforward correction on (green) and off (blue).