OPERATION OF DIAMOND LIGHT SOURCE XBPMS WITH ZERO BIAS

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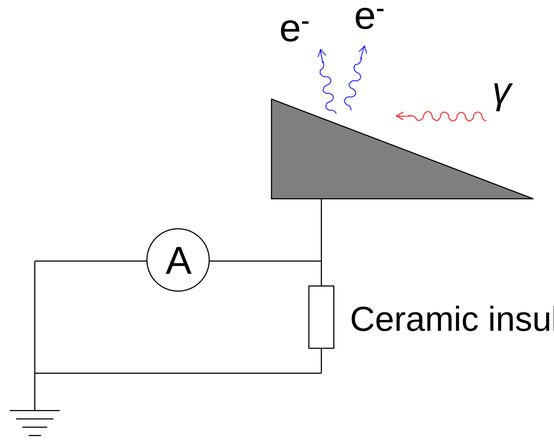
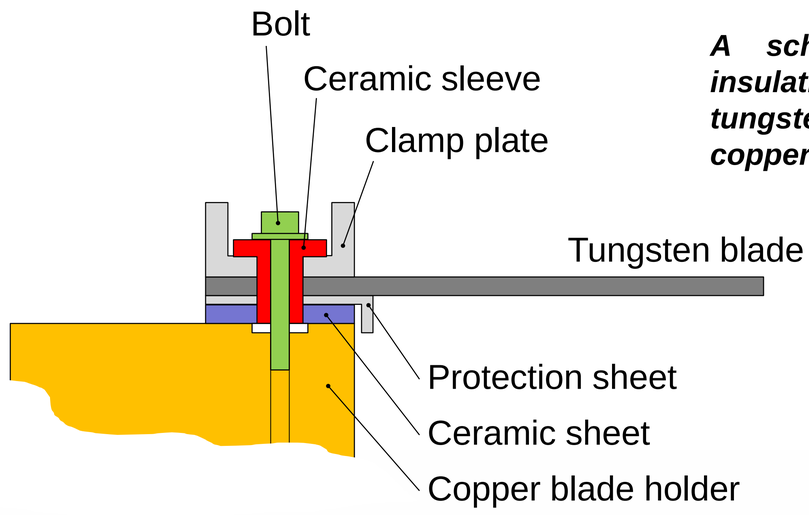
Abstract

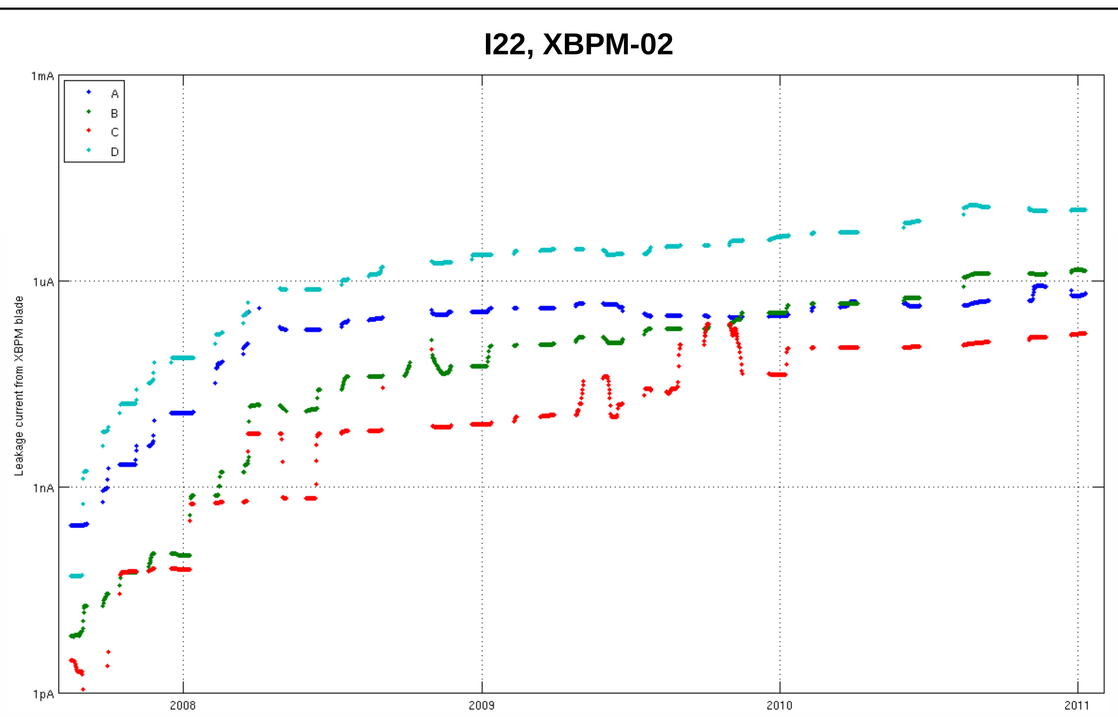
Tungsten blade X-ray Beam Position Monitors (XBPMs) have been used at Diamond Light Source since 2007, however a long-standing problem with these devices has been the growth of leakage current through the ceramic insulation within the XBPMs over time, often becoming greater than 10% of the signal current after a few years of operation. The growth of these leakage currents has been found to be exacerbated by the application of a negative bias (-70V) to the tungsten blades, a bias suggested by the original designers of our XBPMs for optimum position sensitivity. This bias is applied in order to accelerate free electrons away from the surface of the blades and to prevent cross-talk, however, we have found that the operation of the XBPMs without bias has negligible impact on our measurements. Removal of the bias has been found to prevent the growth of leakage currents over time, and can also significantly reduce the cost of our signal acquisition by removing the need for a low-current amplifier with a bias supply.



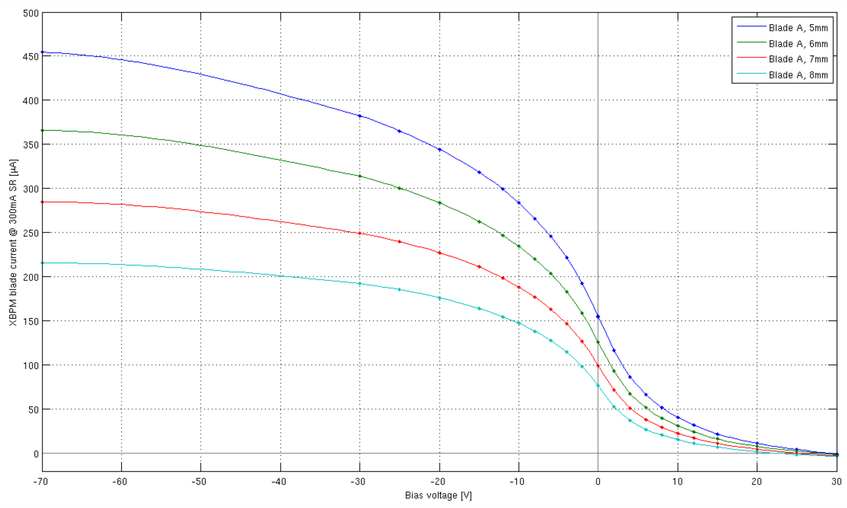
An illustration outlining the principal of operation behind the XBPMs, and the source of the leakage current we have found.



A schematic showing the insulation, and how the tungsten blade is fixed to the copper blade holder.



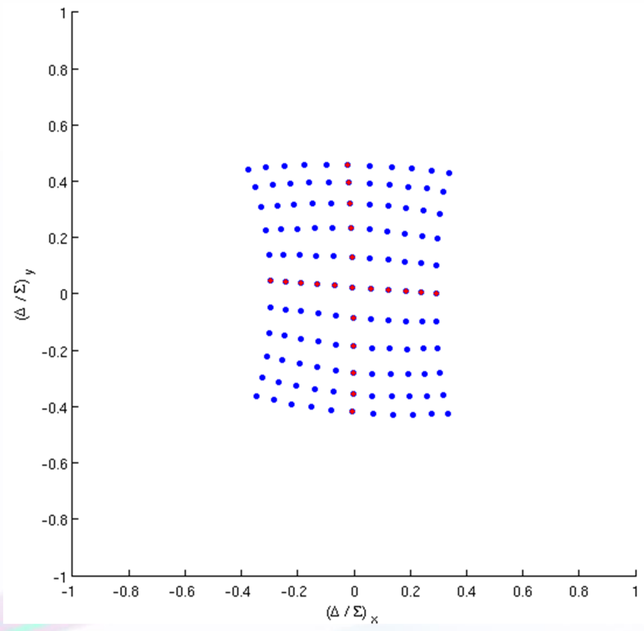
Leakage currents seen on one of our XBPMs when a -70V bias is applied. This represents >10% of the signal current seen with beam.



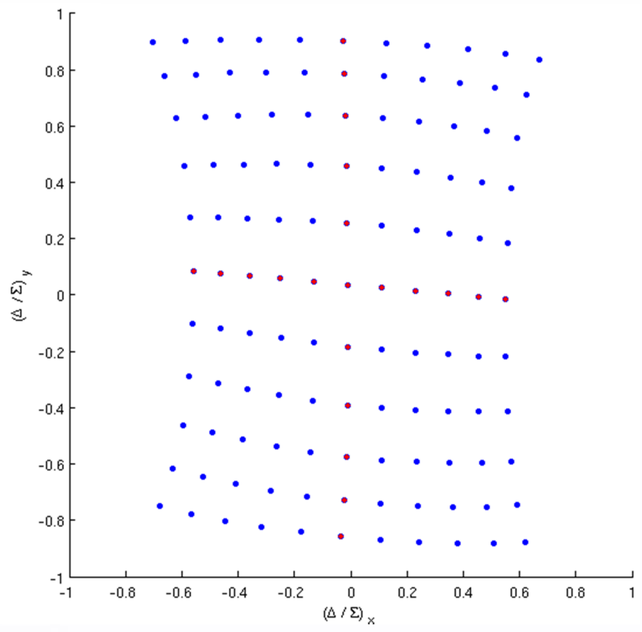
The blade currents seen at 300mA for various ID gaps and bias voltages.

XBPM linearity test results:

-70V bias

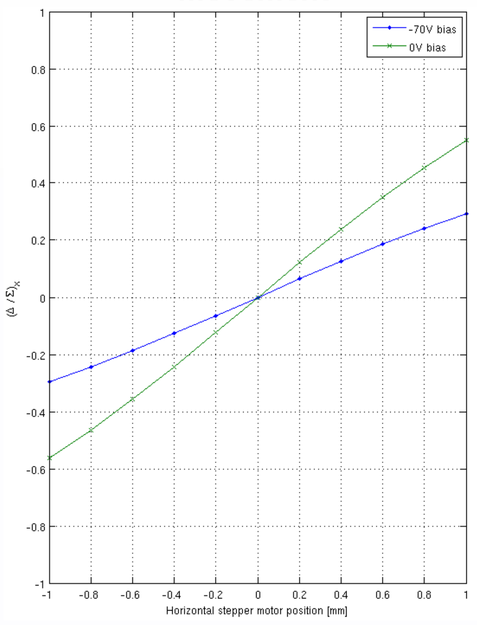


0V bias

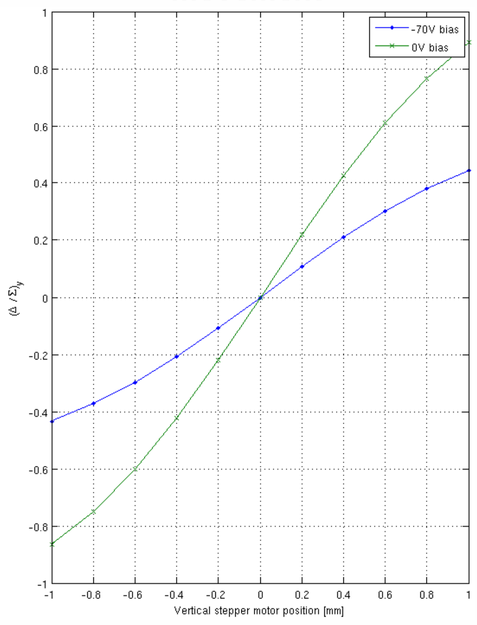


Results from a 2D stepper motor scan of the I24 XBPM-01 with, and without, bias. The recorded △/Σ position measurements are shown, with points evenly spaced: each represents a 200μm stepper-motor movement.

Horizontal stepper-motor movement



Vertical stepper-motor movement



It was found that the linearity of the XBPM position measurements remained, and that the scale factors were improved by the removal of the bias. This has the unanticipated effect of making the position measurement more sensitive.

For more information please visit www.diamond.ac.uk or contact Chris Bloomer at chris.bloomer@diamond.ac.uk