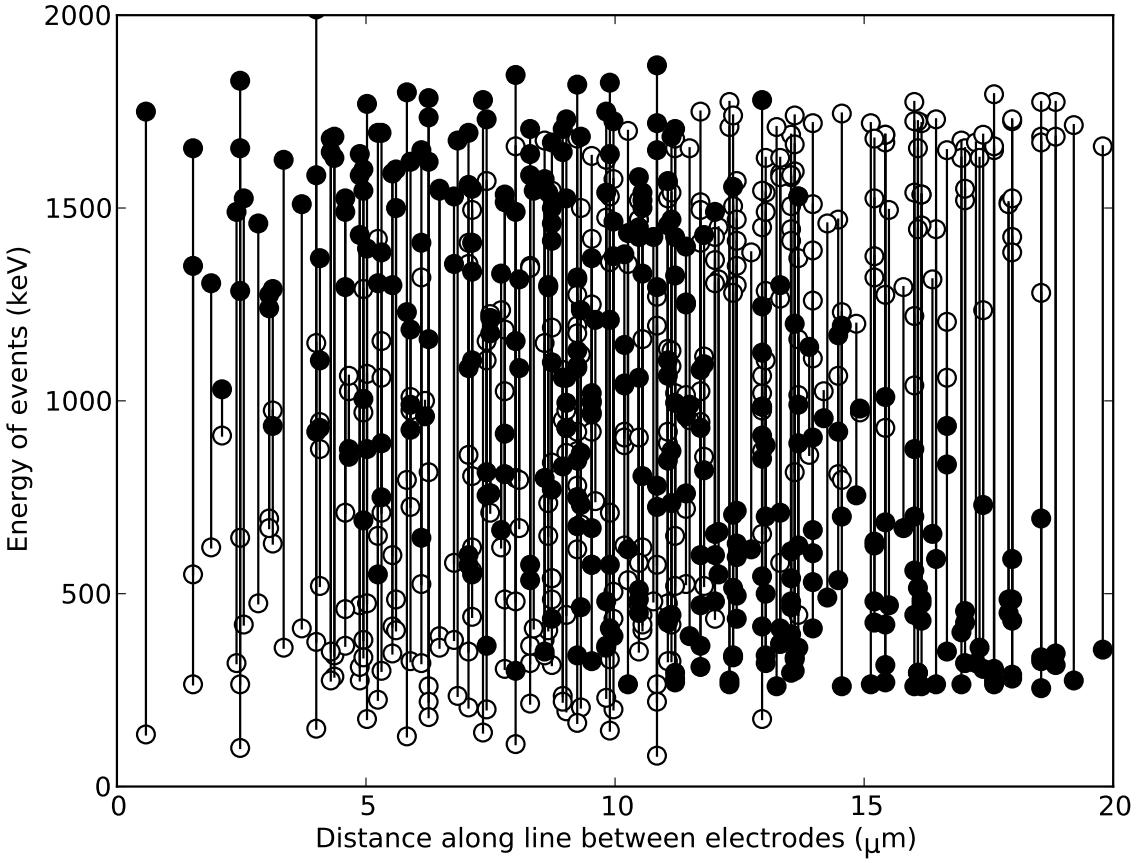
Two-terminal IBIC noise

July 21, 2010

1 Experimental result



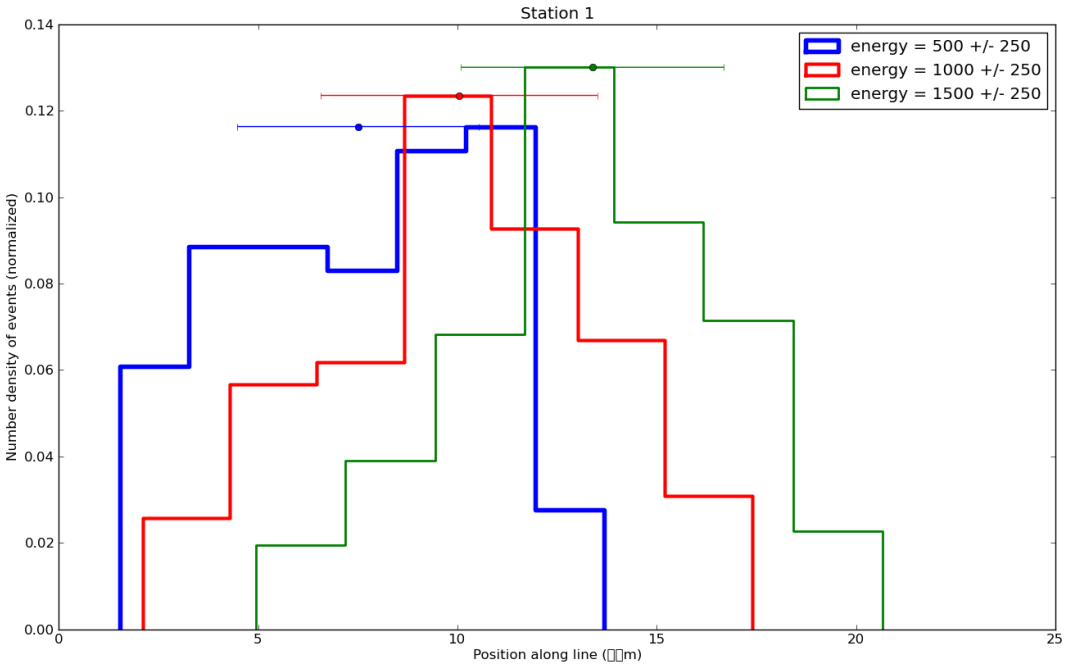
This data shows that there is some correlation between the distance from a terminal and the amount of charge collected by that terminal.

2 Pixel resolution

According to Lenneke's notes on page 40 of her lab book, x209n1X was a 20 μm device. She calculates the pixel resolution to be 0.315 micron/px, giving 80×80 micron scans.

3 Scan Resolution

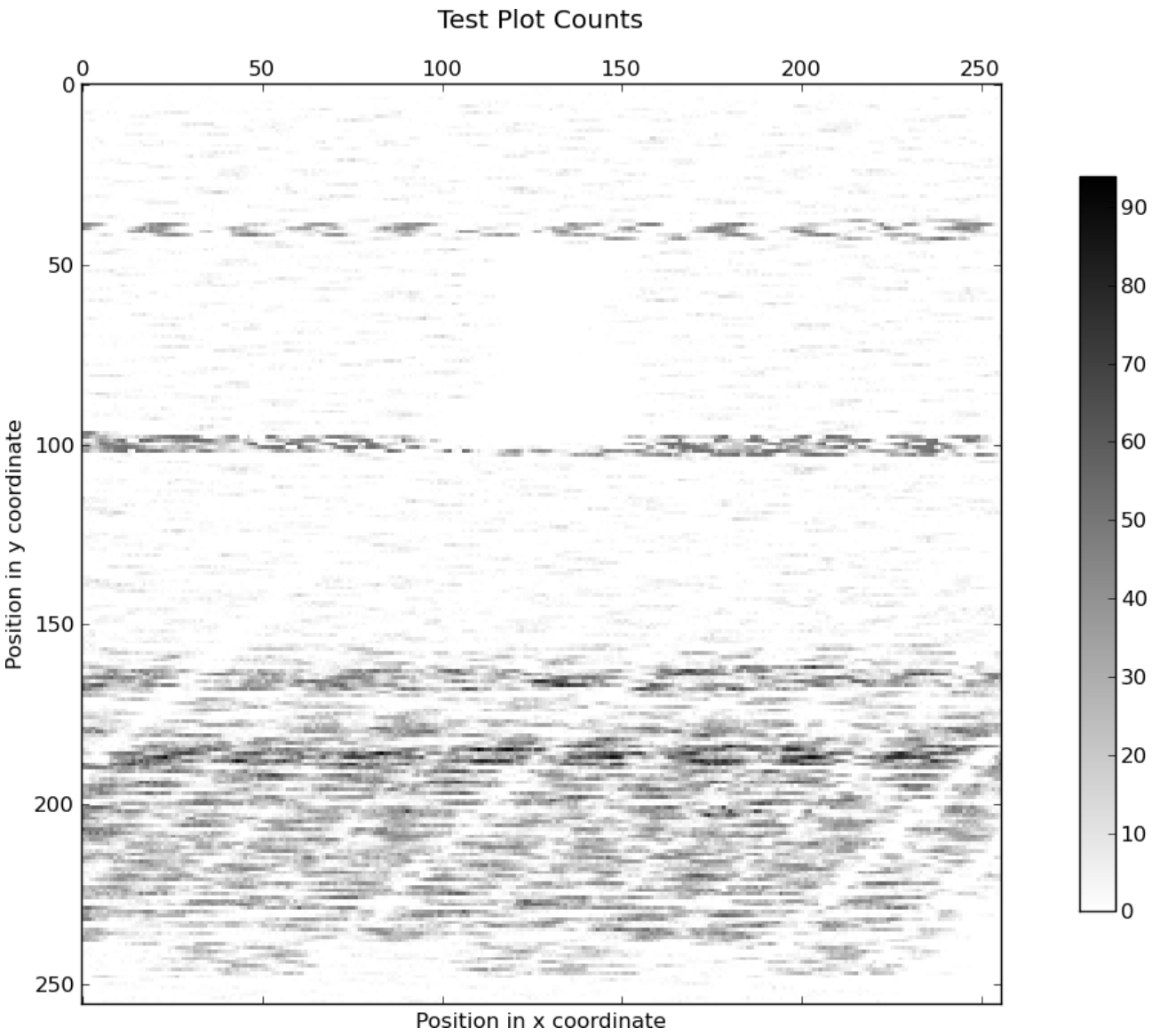
The scan showed a resolution of about 3 micron (1 standard deviation).



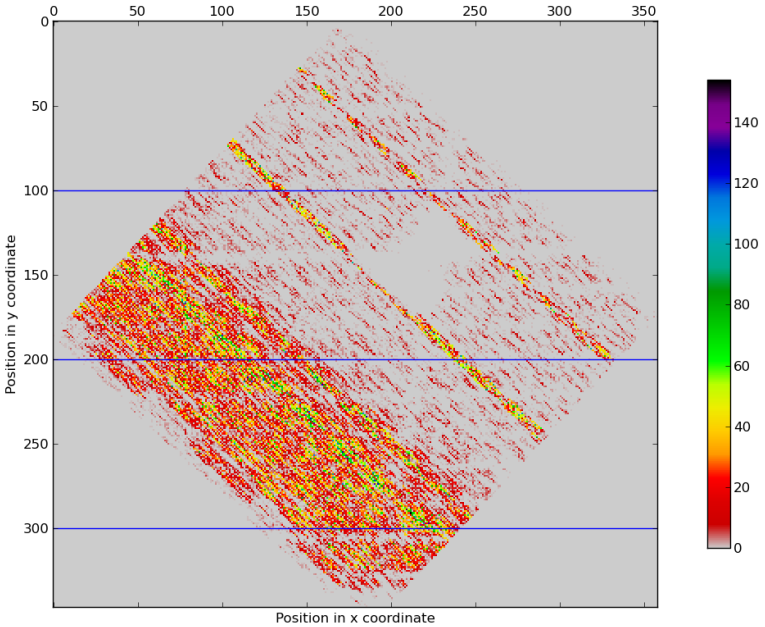
4 Beam Spot Size from test data?

The test images used a 400 mesh grid (64 micron/period). According to Wikipedia, standard grids of this size have 38 micron openings (i.e. the wires are 26 micron wide).

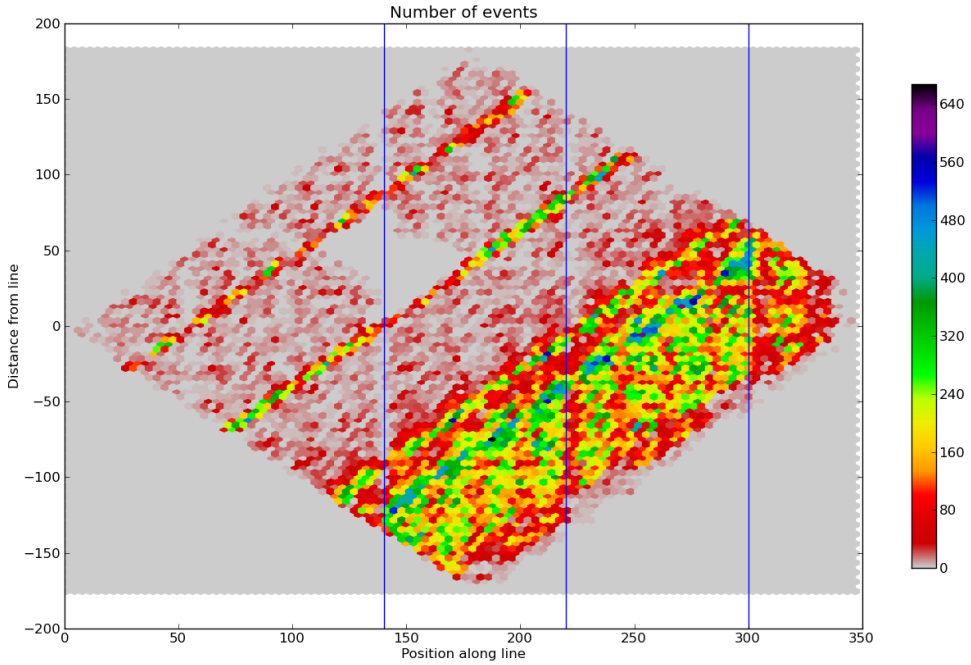
We have some test data taken around page 40 of Lenneke's lab notebook:



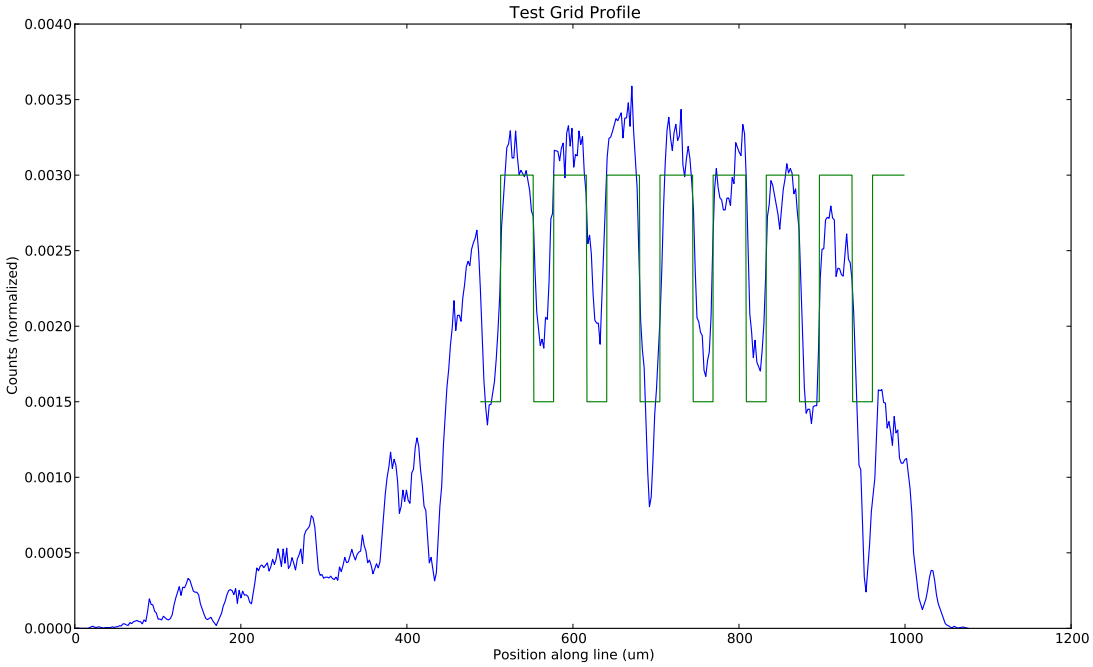
Rotating this image 43 degress clockwise gives flat wires:



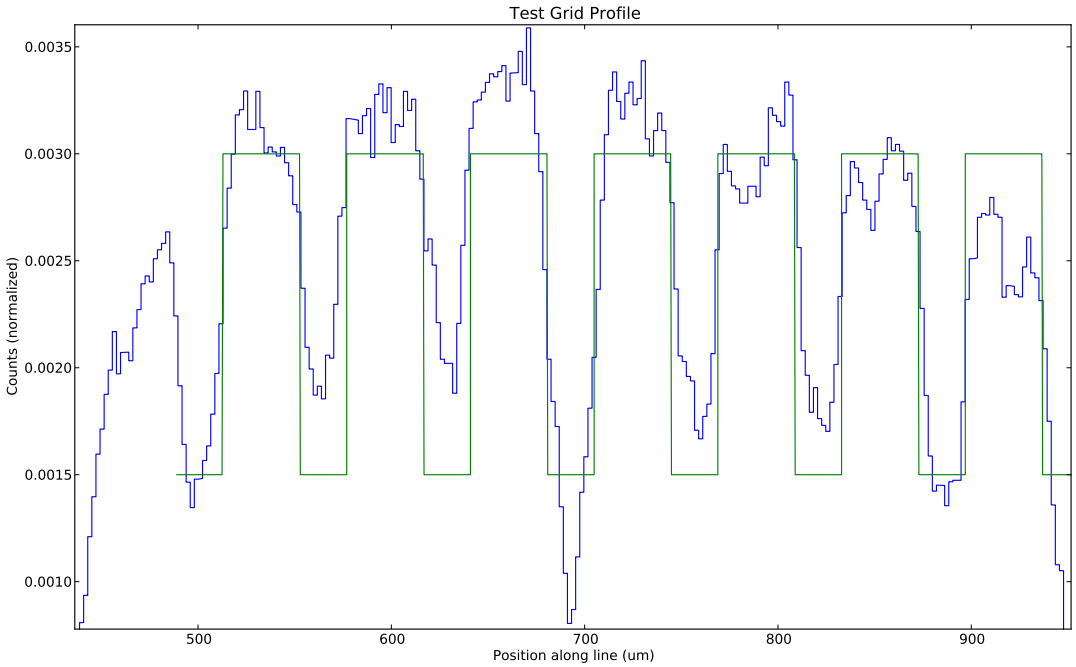
So we can draw a line from (0,0) to (239,250) and expect the gaps to map on to our line:



And then collapsing the vertical axis of this plot gives



which shows the wires (on one axis, at least) quite clearly (they are the dips in the number of counts). It looks as though there are three thin wires between each wide one. The periodicity of this image has been scaled at 2.07 um / px to make the dips 64 micron apart (green square wave). This may make it hard to determine a resolution of 3um if pixels are 2um apart!

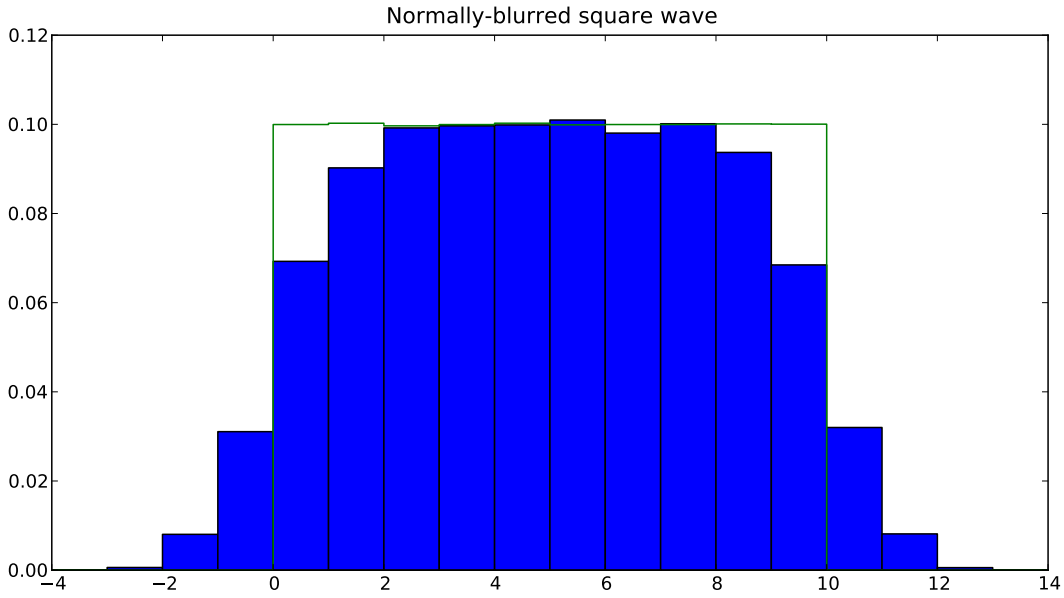


The bins in this plot are 1.414 um wide (any less leads to huge amounts of noise). Given that most of the edges of the wires are two or three steps (3-5um) it is safe to say that the position noise in this image is between 2-5 um.

I will now proceed to fit each edge individually.

Edge widths in steps: 4, 3, 5, 4, (skip large wire), 6, 3, 3, 2, 3, 2. Average: 3.5. It is safe to take a value of 3 as it is very unlikely that the edge will be sharper than the beam resolution but quite possible that a kink in the wire etc. causes it to be blurred.

A normally-blurred square wave looks like this (green outline is unblurred):



This looks like it has about three steps for the edge – which corresponds to three standard deviations in the incident beam (the standard deviation of the blur was 1 in the above plot – the usual “normal” distribution.

So one step is one standard deviation and the above test shows the beam had a standard deviation of 1.5 microns.

This is quite a rough number. The confidence interval is probably more like something between 1–3 microns.