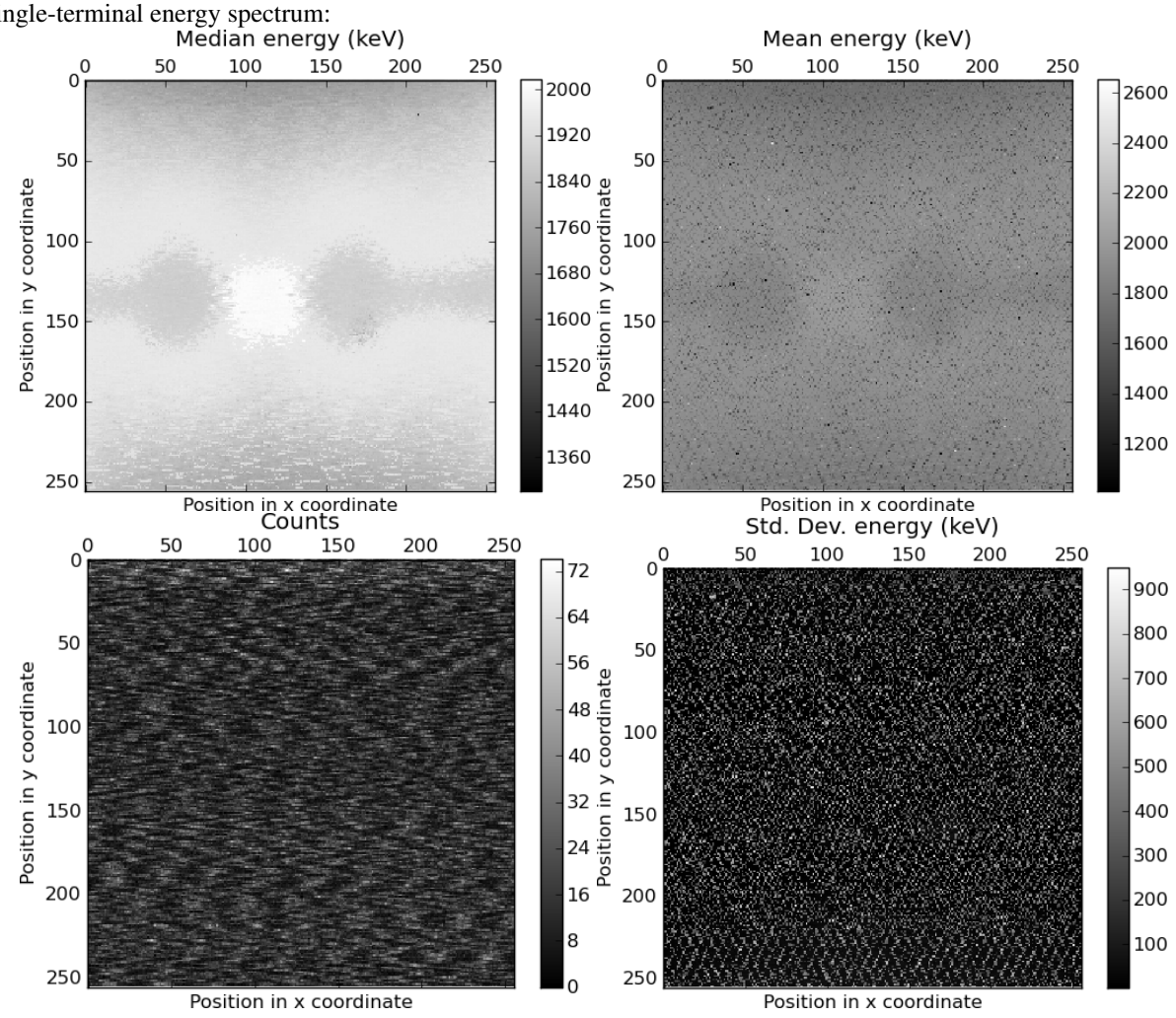
Two-Terminal IBIC 2006 data analysis

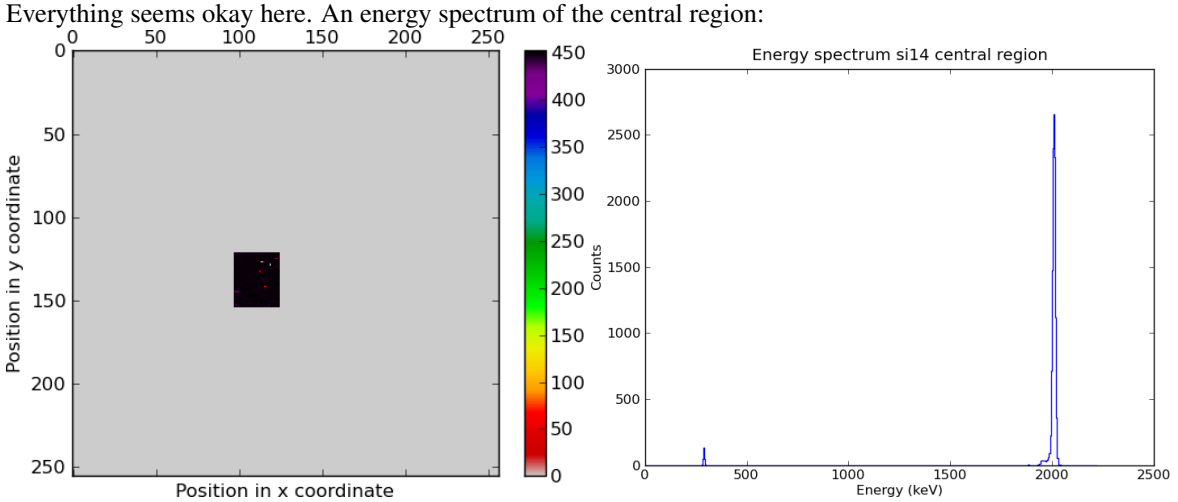
August 23, 2010

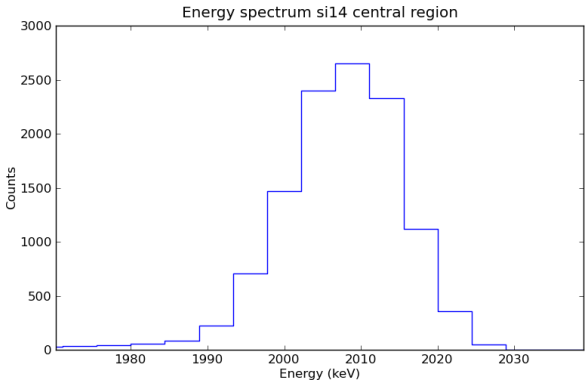
1 Si14 dataset

Single-terminal energy spectrum:



Everything seems okay here. An energy spectrum of the central region:

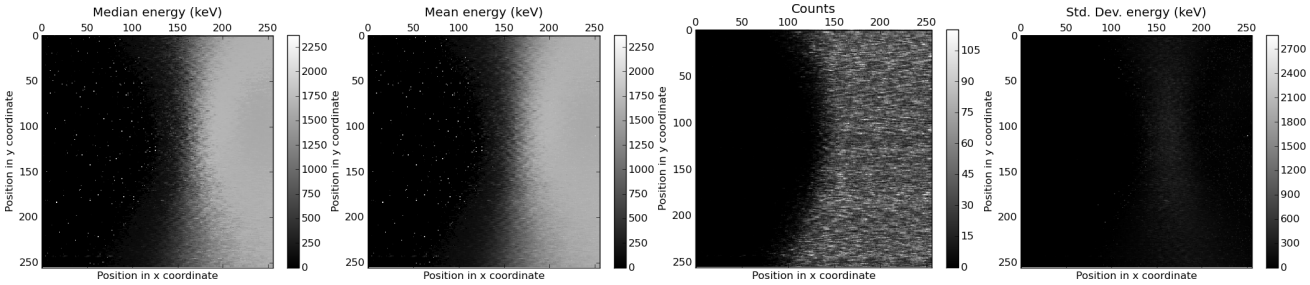




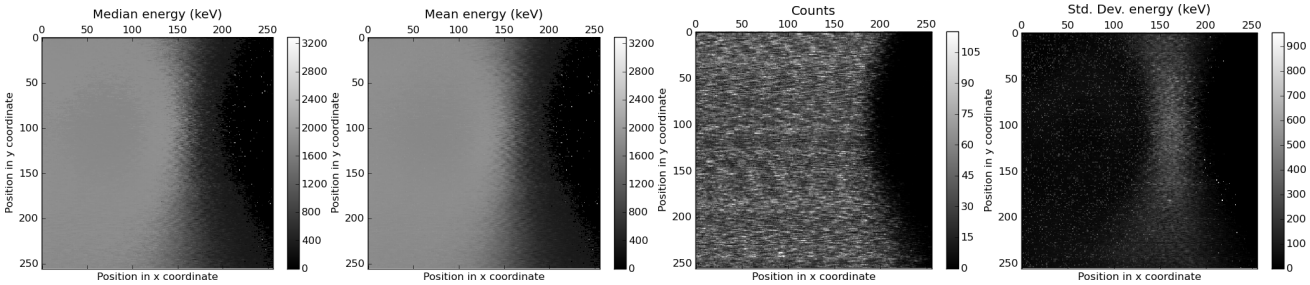
This shows the detector energy resolution looks to be about right (Std. Dev. ~10keV). Note: I have just guessed at the energy calibration here – I guessed that Channel 450 was 2000keV and Channel 0 was 0 keV.

2 E3 Dataset

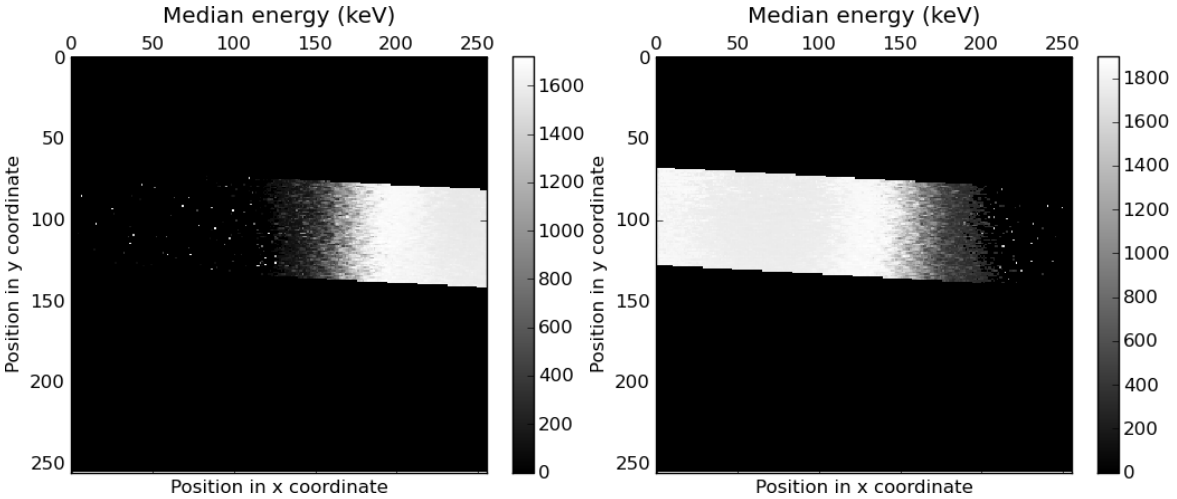
2.1 Station 1:



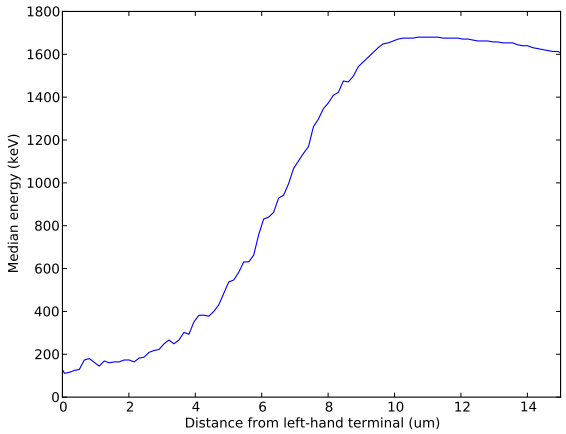
2.2 Station 3:

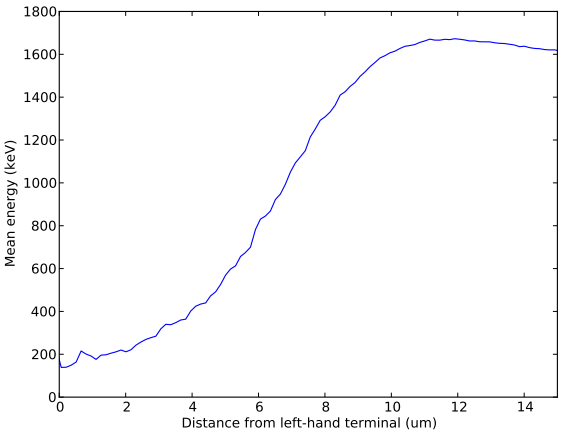


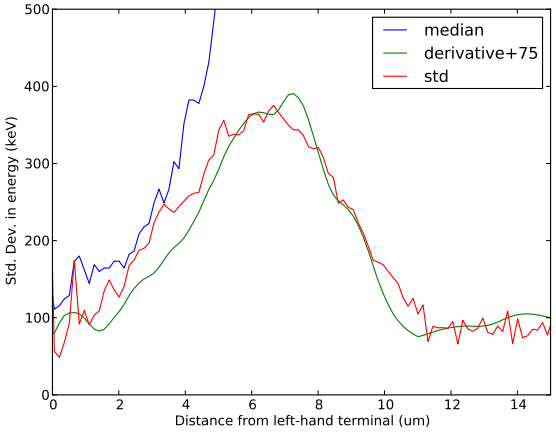
2.3 Central Region

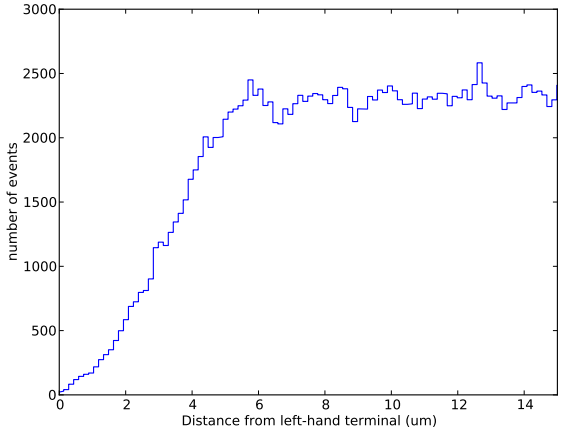


With **very rough calibration**, for station 1:

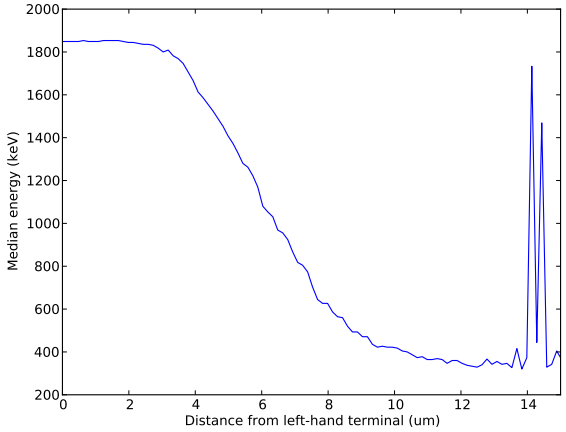


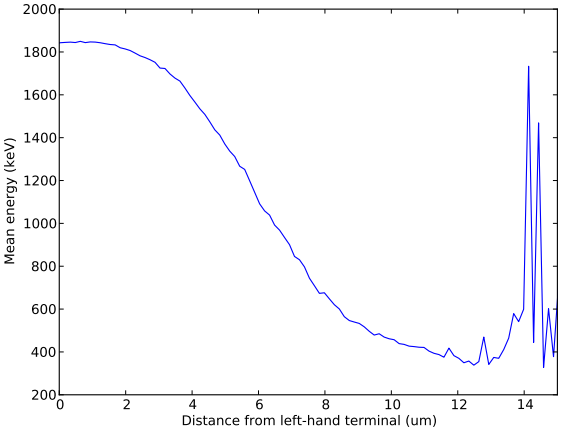


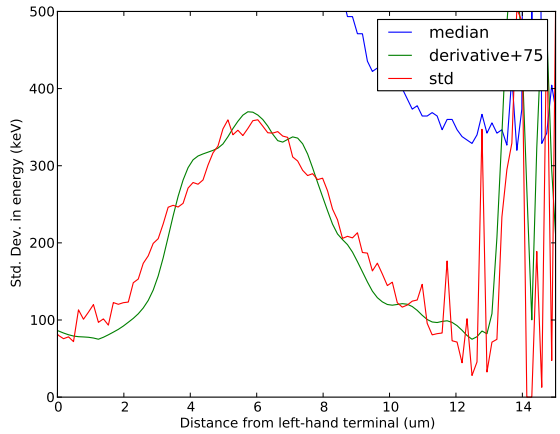


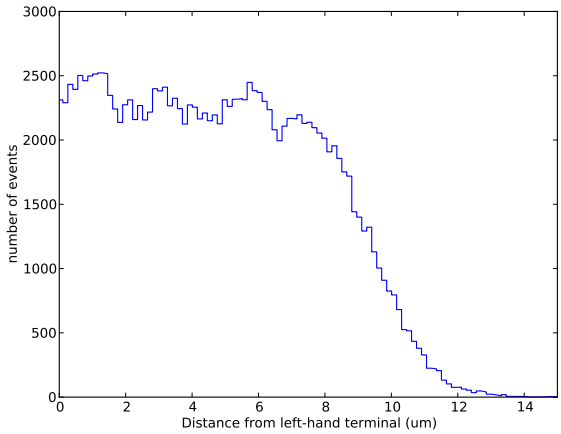


And for station 3:





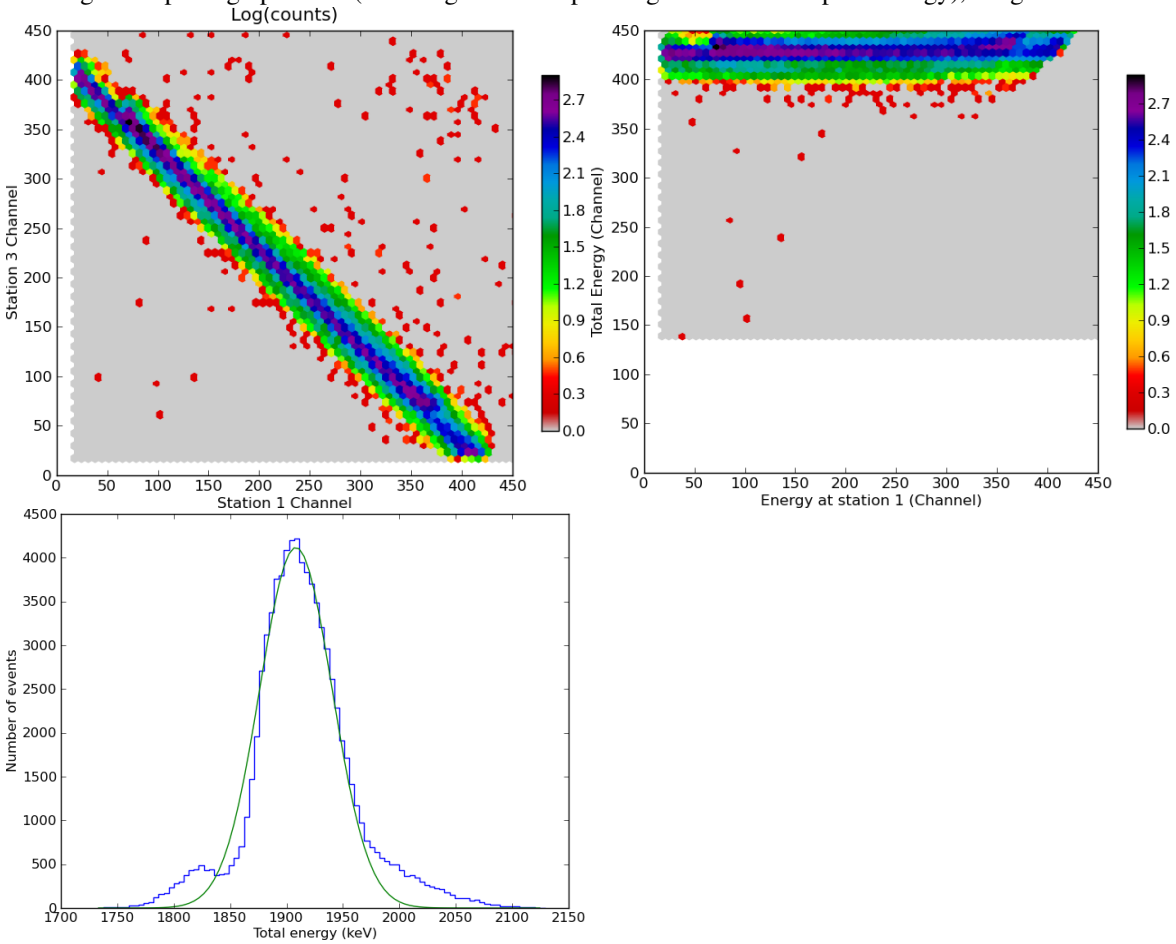




This data quite convincingly shows the expected behaviour, with large standard deviation in energy in the central region, which could easily be due to beam spot size (i.e. error in x coordinate) – the standard deviation looks like the (absolute value plus 75keV of the) gradient of the median-energy graph.

2.4 E. vs. E

By cheating when pairing up events (choosing the better pair to get closer to the peak energy), we get:

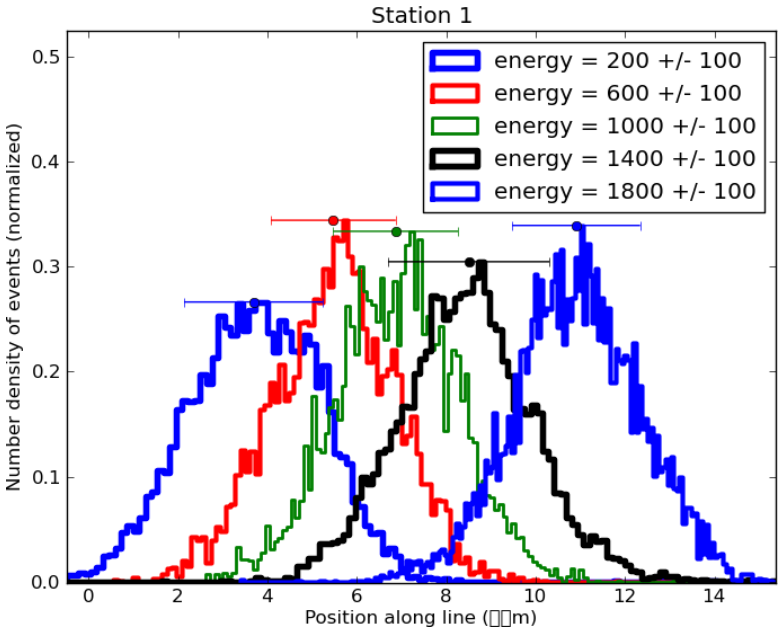


The standard deviation of the Gaussian fit in this final graph is 32 keV (~7 channels), considerably larger than the earlier measurement which had a standard deviation of about 10keV (~2 channels).

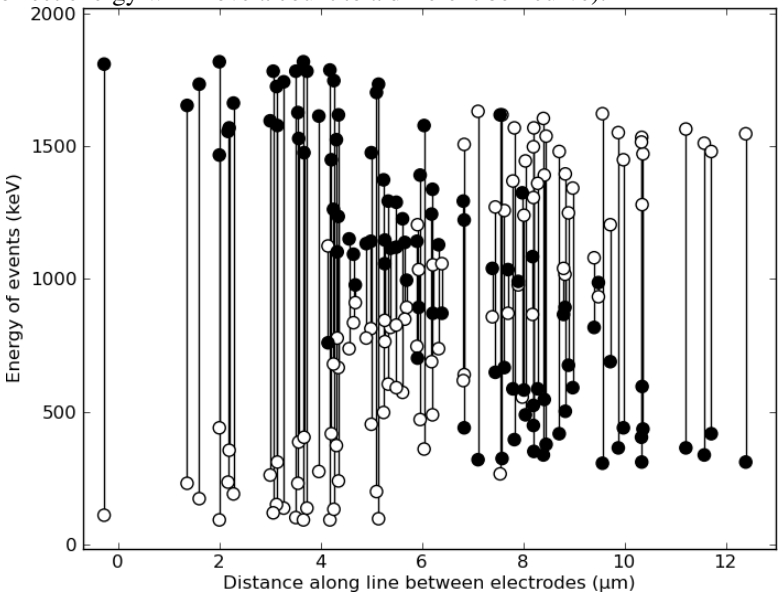
3 Beam Width Analysis

A plot of the positional error for a given energy shows a std. dev. of 4.8 px (1.5um by rough calibration[1]) on average:

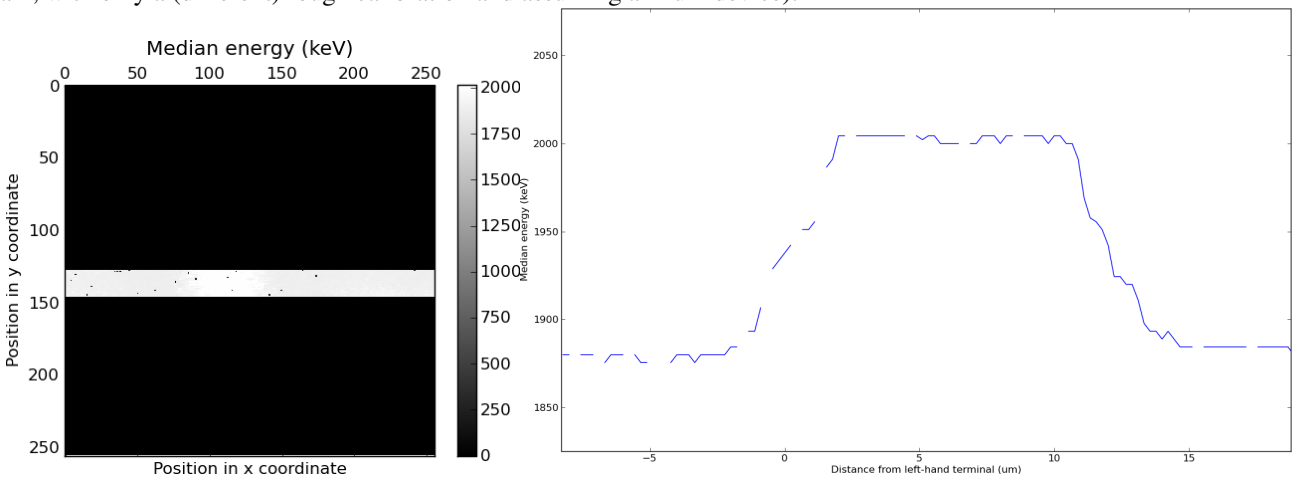
[1] and assuming this is a 12um-between-terminals-device



this positional error includes error from the beam spot size AND energy inaccuracy from the station recorder (a slightly incorrect energy will move a count to a different bell curve).



The position error (beam spot size) itself can be measured using the earlier test scans, and is found to be about 1.2um (again, with only a (different) rough calibration and assuming a 12um device):



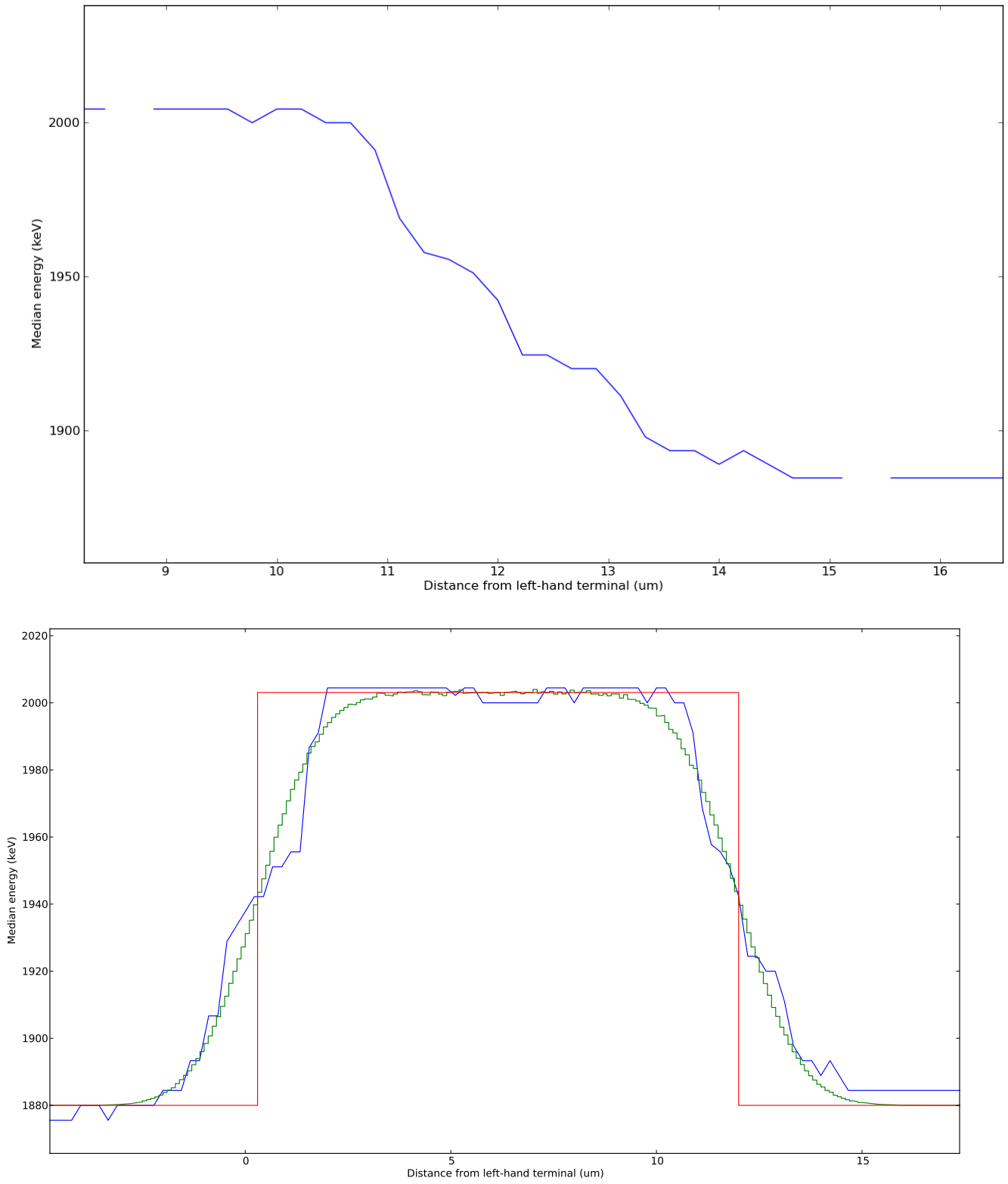


Figure 1: A fit to the si14 standard-IBIC test data. Fit is a normally-blurred square wave (with std. dev. of 1.2 um).

4 Conclusion

The horizontal spread in the black-and-white scatter plot above can be safely attributed to beam spot size, and an upper limit of well under 1um can be placed on positioning noise due to the random distribution of charge to each detector (i.e. the fundamental limitation of the method).