Oscillation (wiggles) in the US BM modules

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Oscillation Status

Of 142 modules tested – 128 LTT test done
62% have wiggles
17% only in negative
44% only on both pos/neg

Scurves taken from cold test
(except for modules that didn't go through LTT yet)

• Difference in the oscillation results for cold/warm
(cold is much worse – in same cases scurves at warm don't show oscillation while at cold yes)

Scurves Oscillation – first study

• Modules where tested in multiple combinations of active chips or using the trim to displace the threshold.
Oscillation disappears (or is significantly reduced)

- when switching activity is reduced by isolating every other chip
- or excluding only one chip in a particular case
- setting the shaper current much lower than the nominal value (ISH=20).
- trim every other channel thresholds (by 5 mV) namely changing the number of discriminator transitions at any given threshold

This indicates that this is a regenerative effect involving many channels and that the number of channels is more important than the geometric arrangement of the channels

• We introduced a method to quantify the oscillation (Abe's plot)

- We fit the region of low threshold (the first 10 points of the ln(occ) plot)
. which is significantly larger for most of the chips with large wiggles
- By looking at the mean square deviation of the fit
we can identify all but three cases of oscillation

• No oscillation was found at the hybrids level (except in two cases)

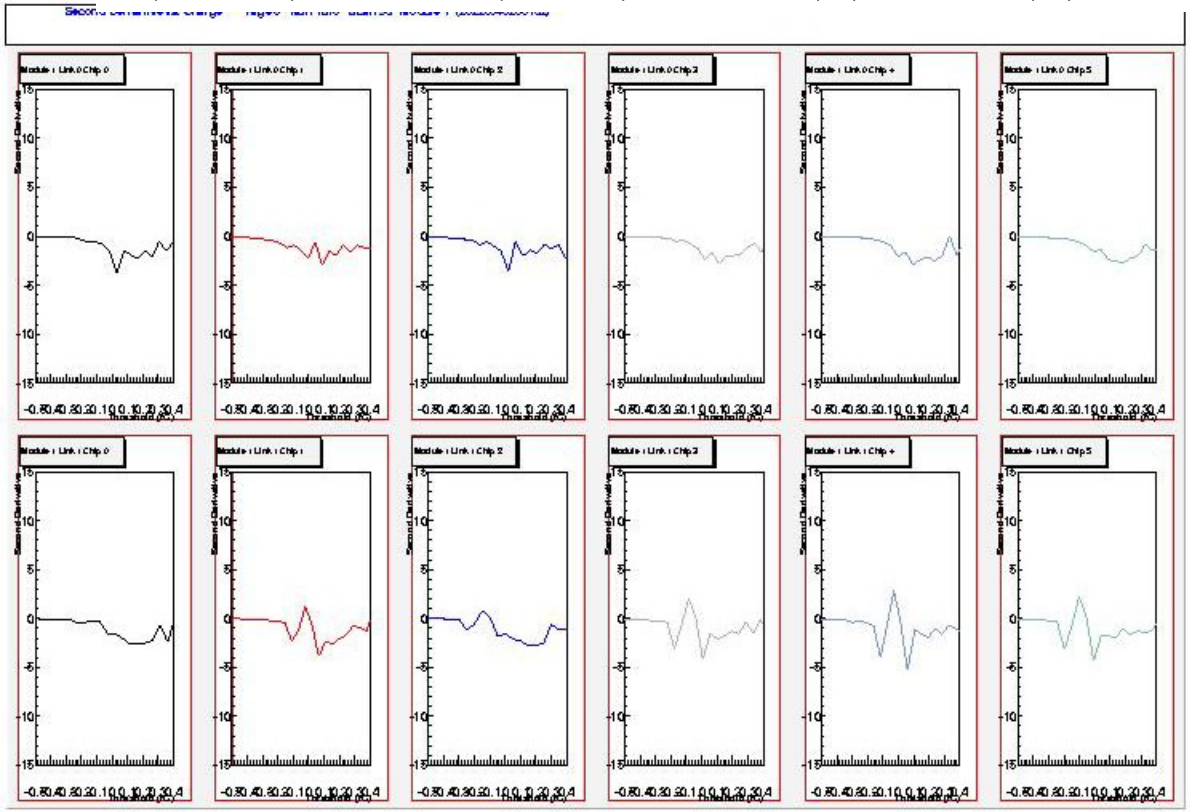
• The grounding scheme has been checked and we don't see evidence of pick up noise
(we also introduced noise filters cards)

• No correlation was found with hybrid Lot

Scurves Oscillation – 2nd derivative

To mathematically decide on when the module has oscillation, and to locate at what threshold the oscillation occurs, we calculate the 2nd derivative of the log(Occ) vs threshold

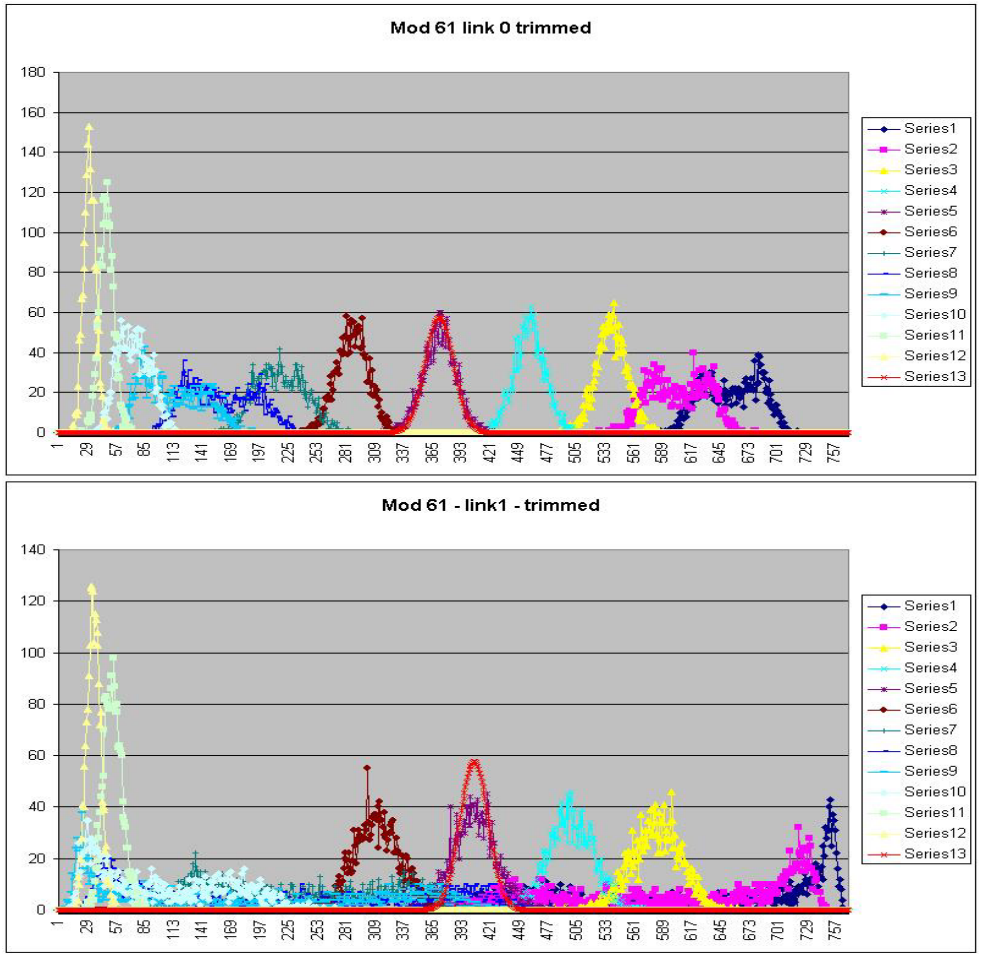
$$f(x+d1)/d1 + f(x-d2)/d2 - f(x)/d1 - f(x)/d2$$



This method works well up to 0.3 fC and above that statistics dominate the results

Scurves Oscillation – Residuals

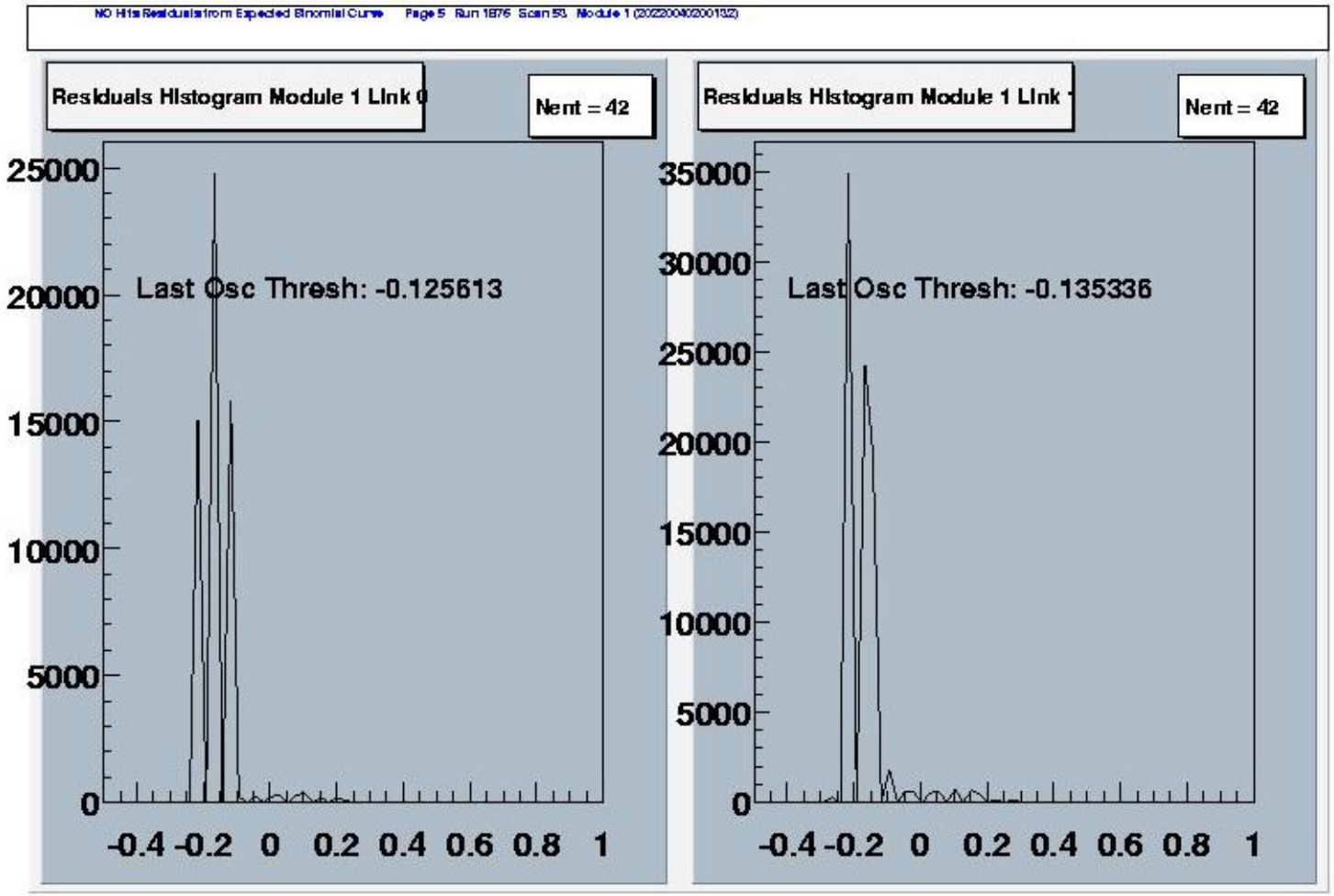
Using the hit distributions we calculate the residuals of the fit with a binomial distribution with the same average occupancy



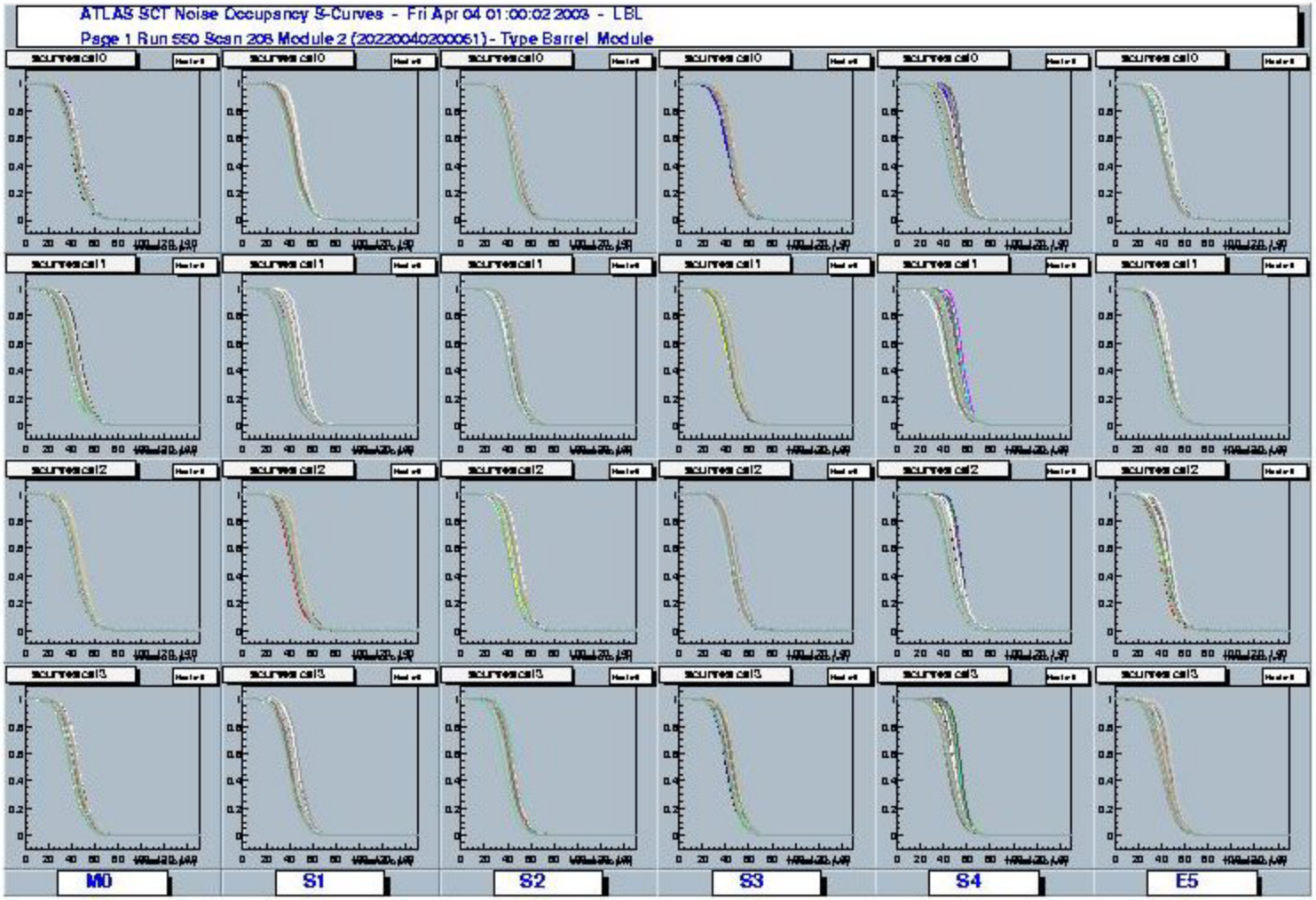
A calculated binomial curve is plotted for threshold = 45 mv.

Scurves Oscillation – Residuals

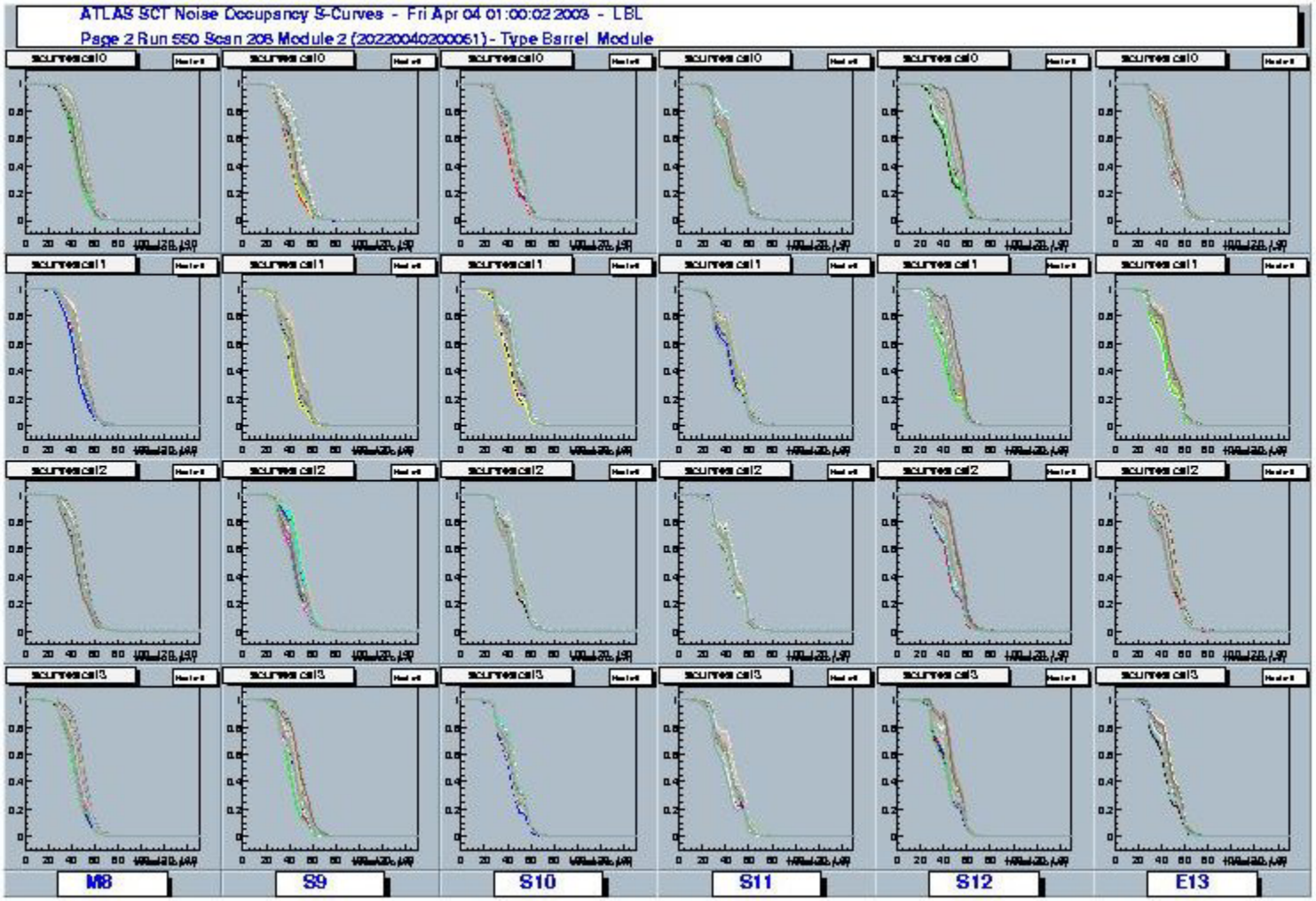
This method has been introduced locally in the Noise Occupancy test
And made available to be used by other group



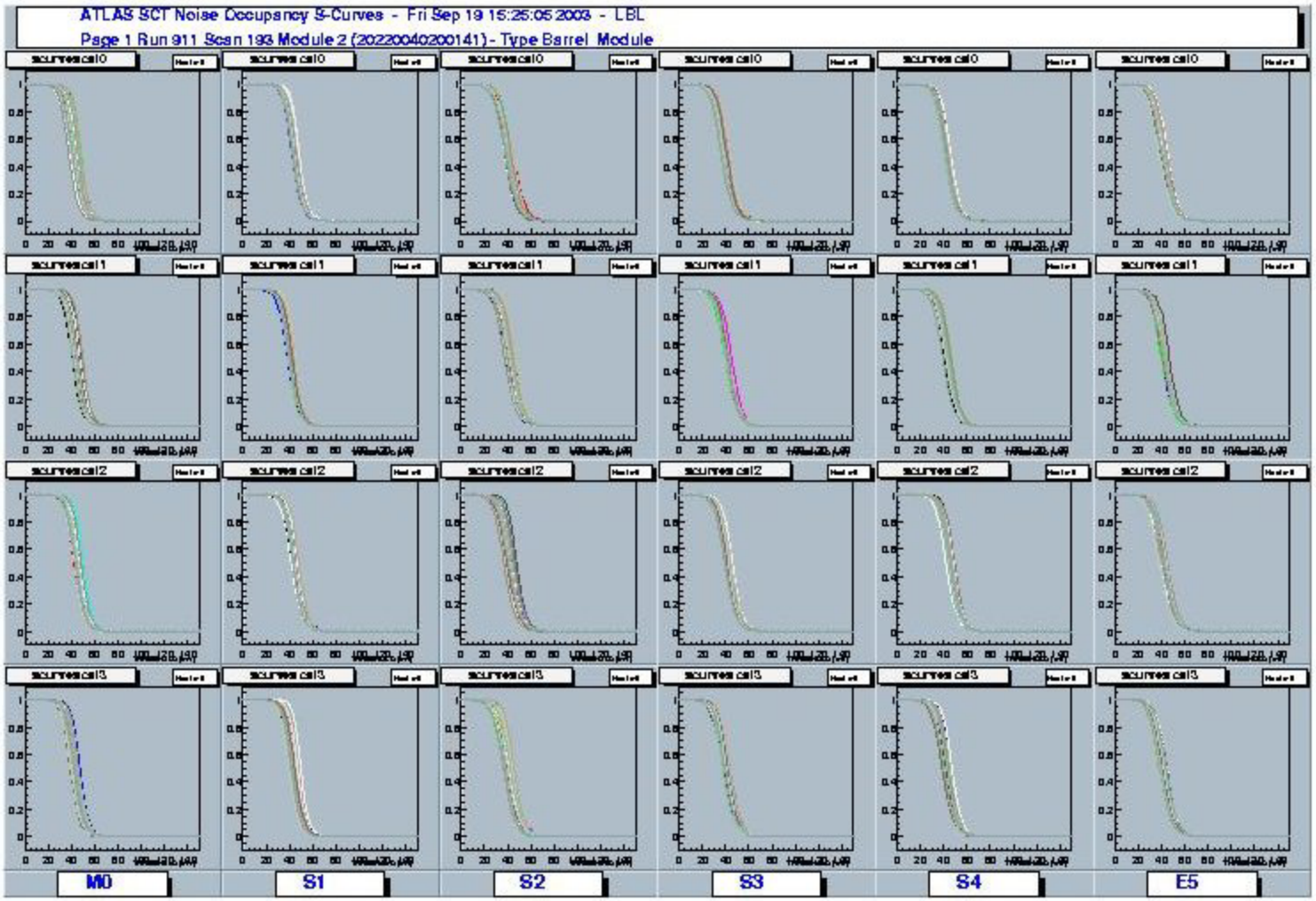
Scurves
Module 00061 - link 0



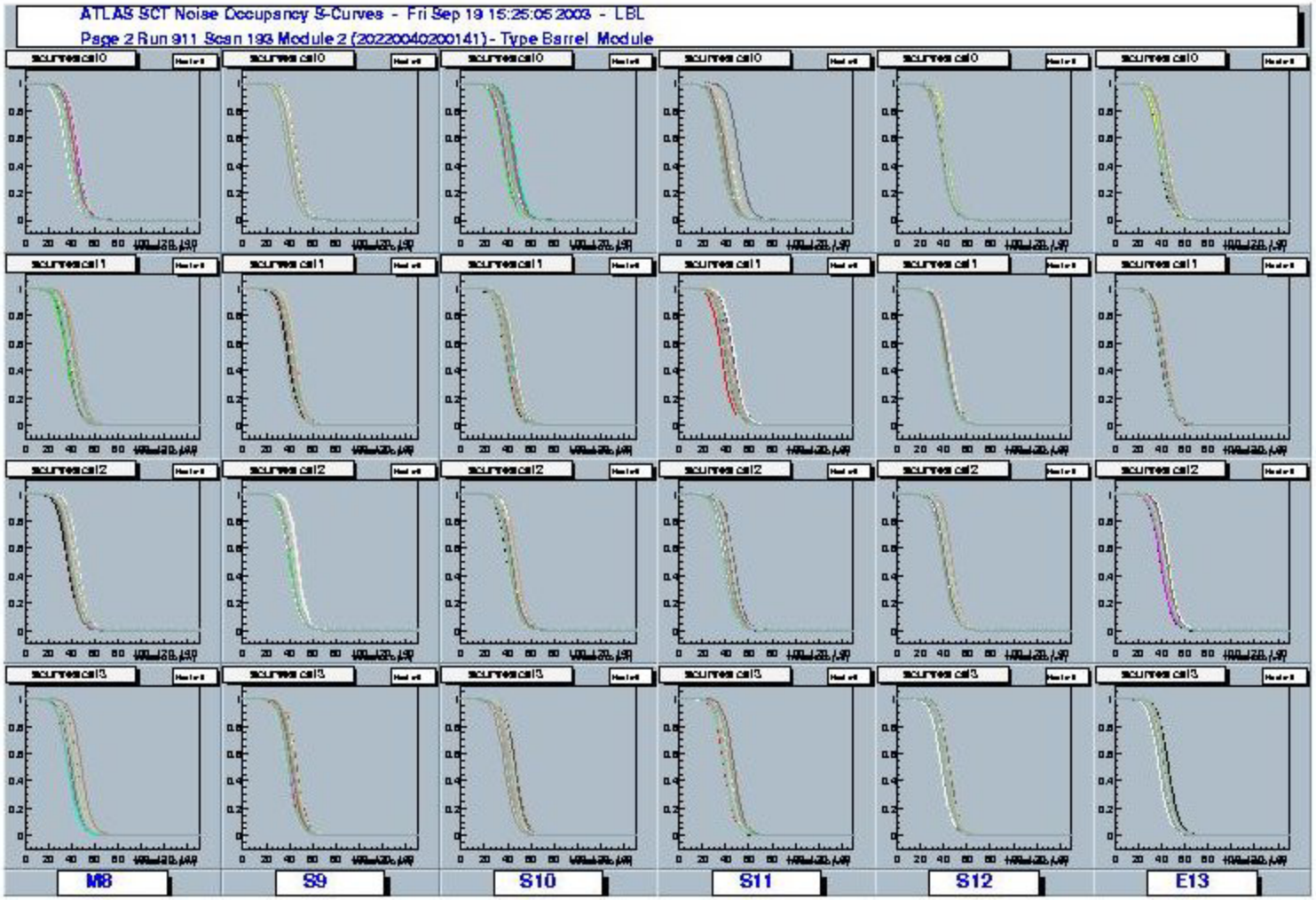
Scurves
Module 00061 - link 1



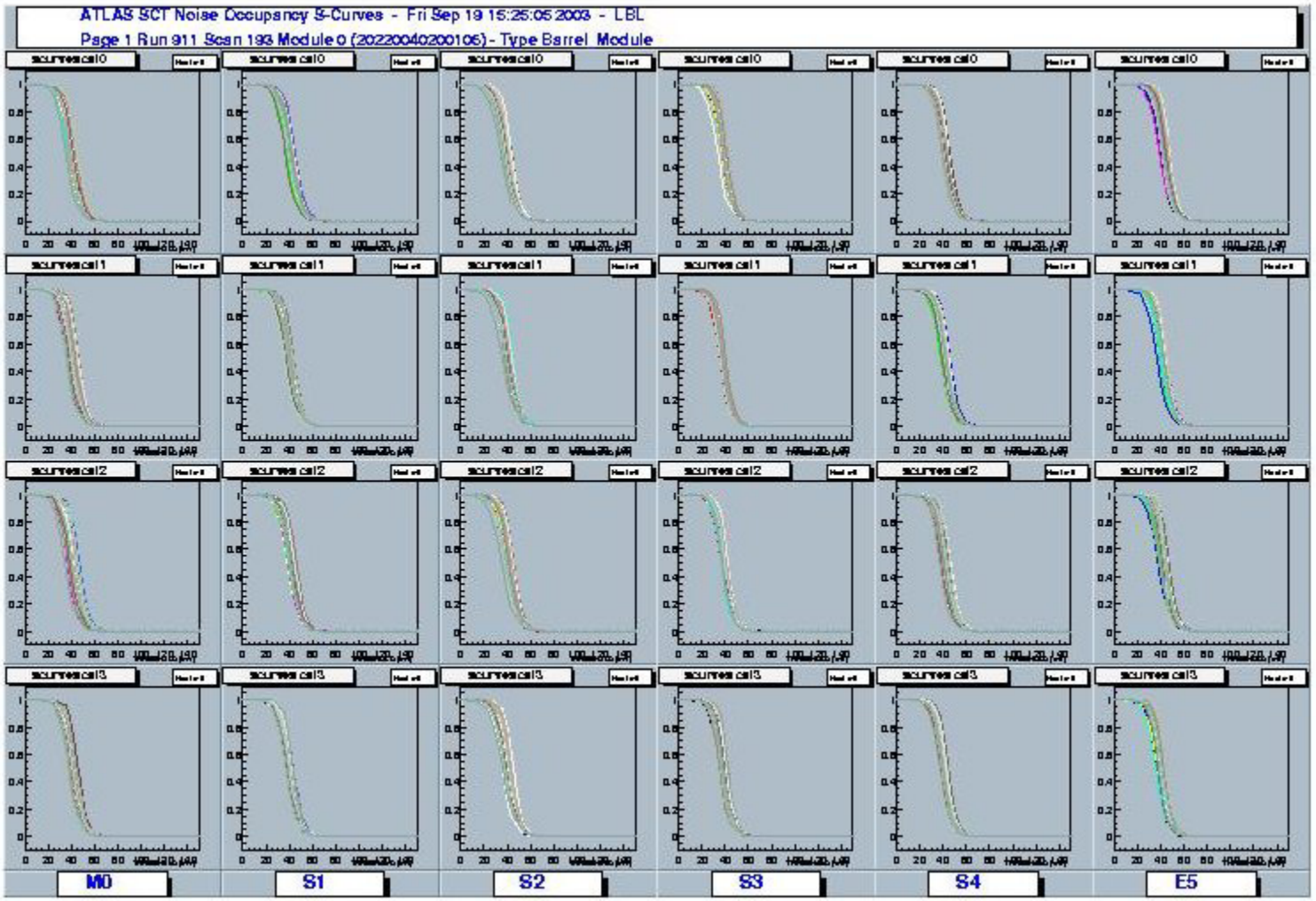
Scurves
Module 00141 - link 0



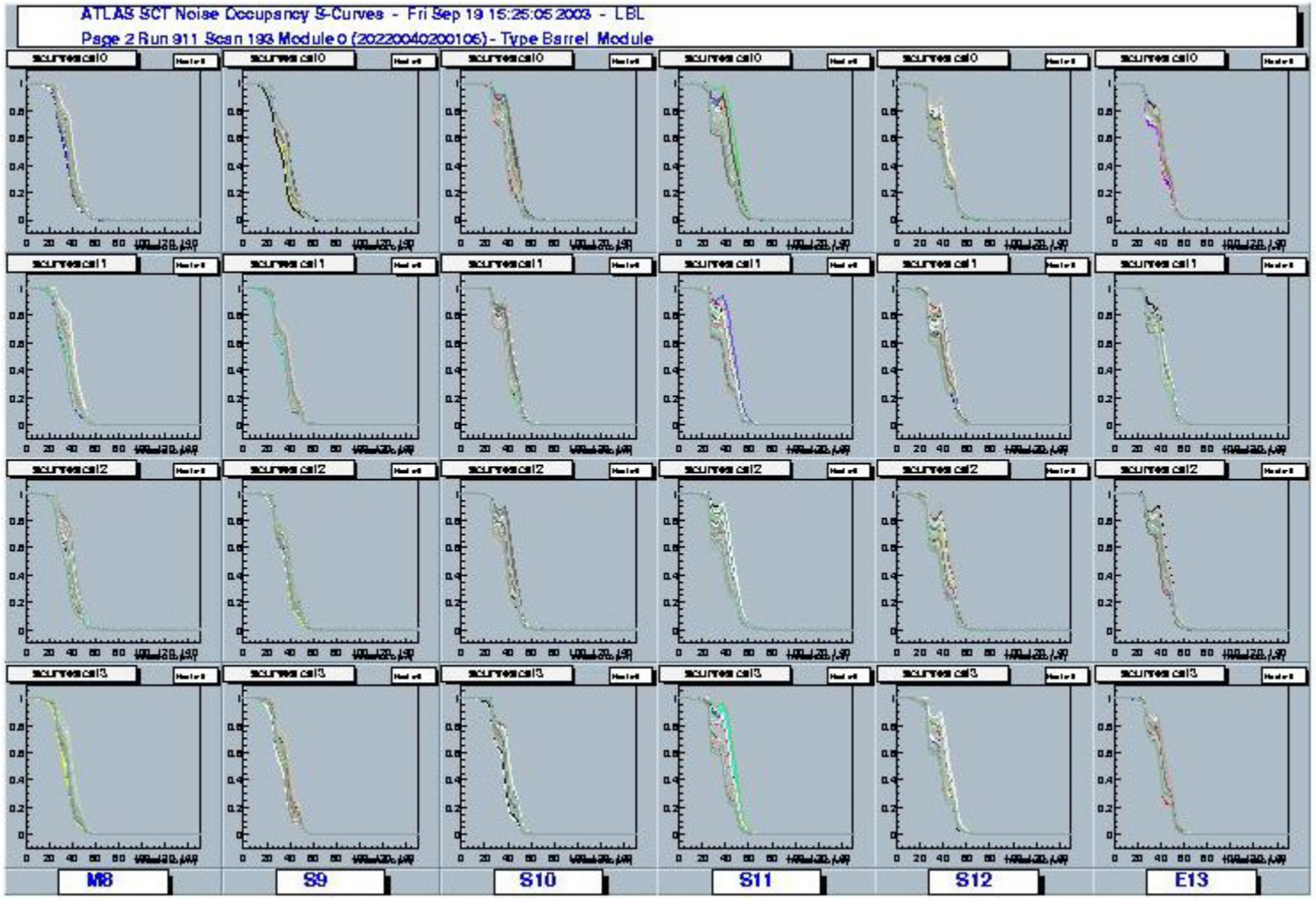
Scurves
Module 00141 - link 1



Scurves
Module 00106 - link 0



Scurves
Module 00106 - link 1



Scurves Oscillation – Threshold Range