SPIRE

Scan Map Observations with Missing Detectors

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1. Introduction

This note follows on from the *Cross Linked Scan Map Observations* note [1] and describes how the different scan angles are affected by missing detectors.

Previous notes in this series (SPIRE-UCF-NOT-002758 & 002759) assume that the arrays have 100% yield, i.e. no bad or missing detectors. However, we know that some pixels are either dead or very noisy and this is likely to affect the scan maps to a lesser or greater degree depending on the scan direction chosen. Orthogonal scanning complicates the issue also. The various options are investigated in the following sections.

In all instances the integration time maps shown on the left are for complete arrays while those on the right are arrays with missing detectors. All three arrays are shown; PSW first, PMW second, PLW last.

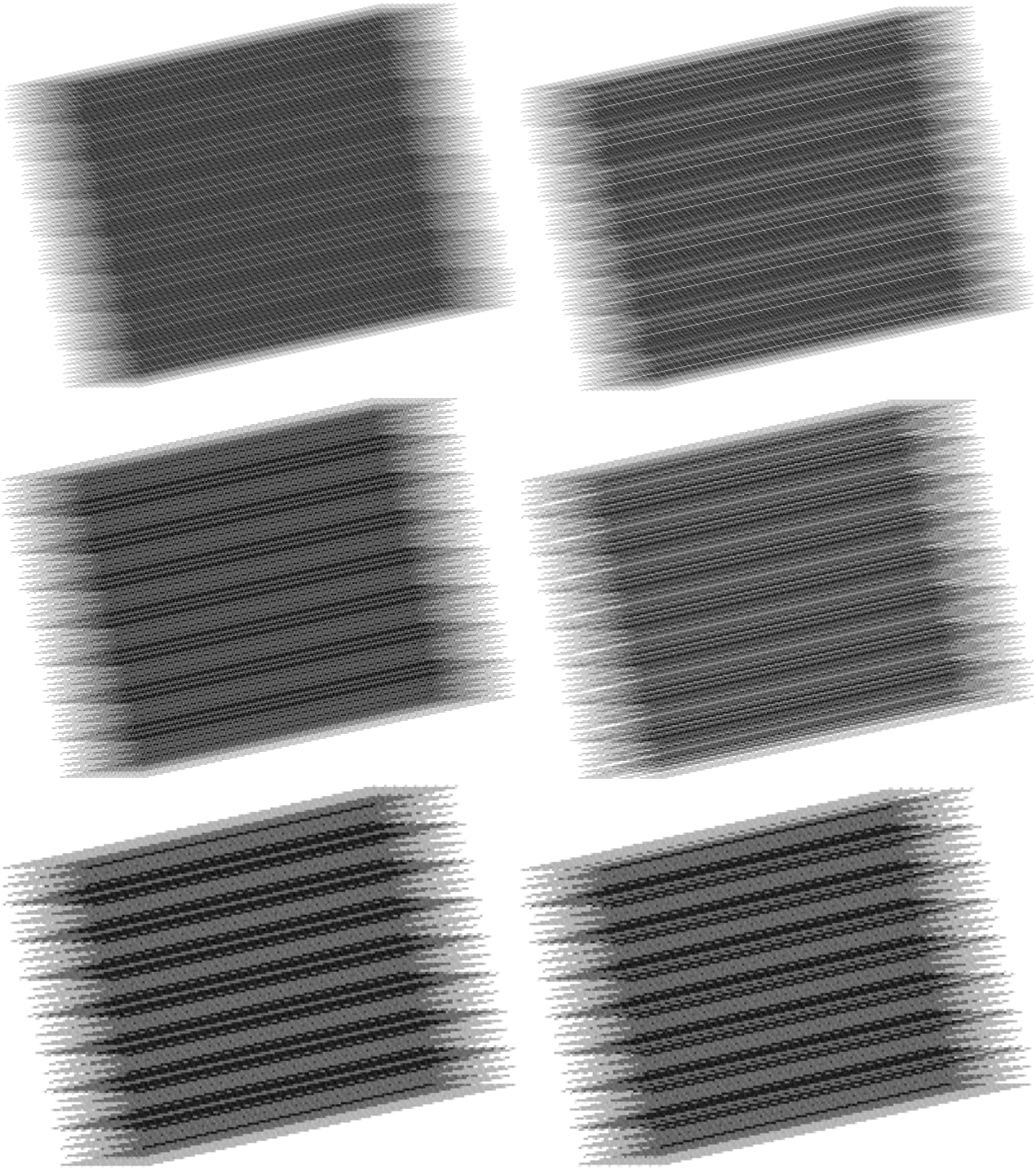
Colour scales are all min-max, so in each case white is zero and black is the maximum within that map.

The detectors removed from the arrays are as follows:
PSW: B5, C10, C11, C12, G8
PMW: B6, C8, E4, E5, F5, F7, G6, G9
PLW: A6

The detectors removed are either known to be dead or are very noisy, based on the noise analysis by Berhard Schultz for the PFM3 test campaign [2]. All other detectors are assumed to usable, although if any detectors are subsequently found to be bad this will obviously affect these results.

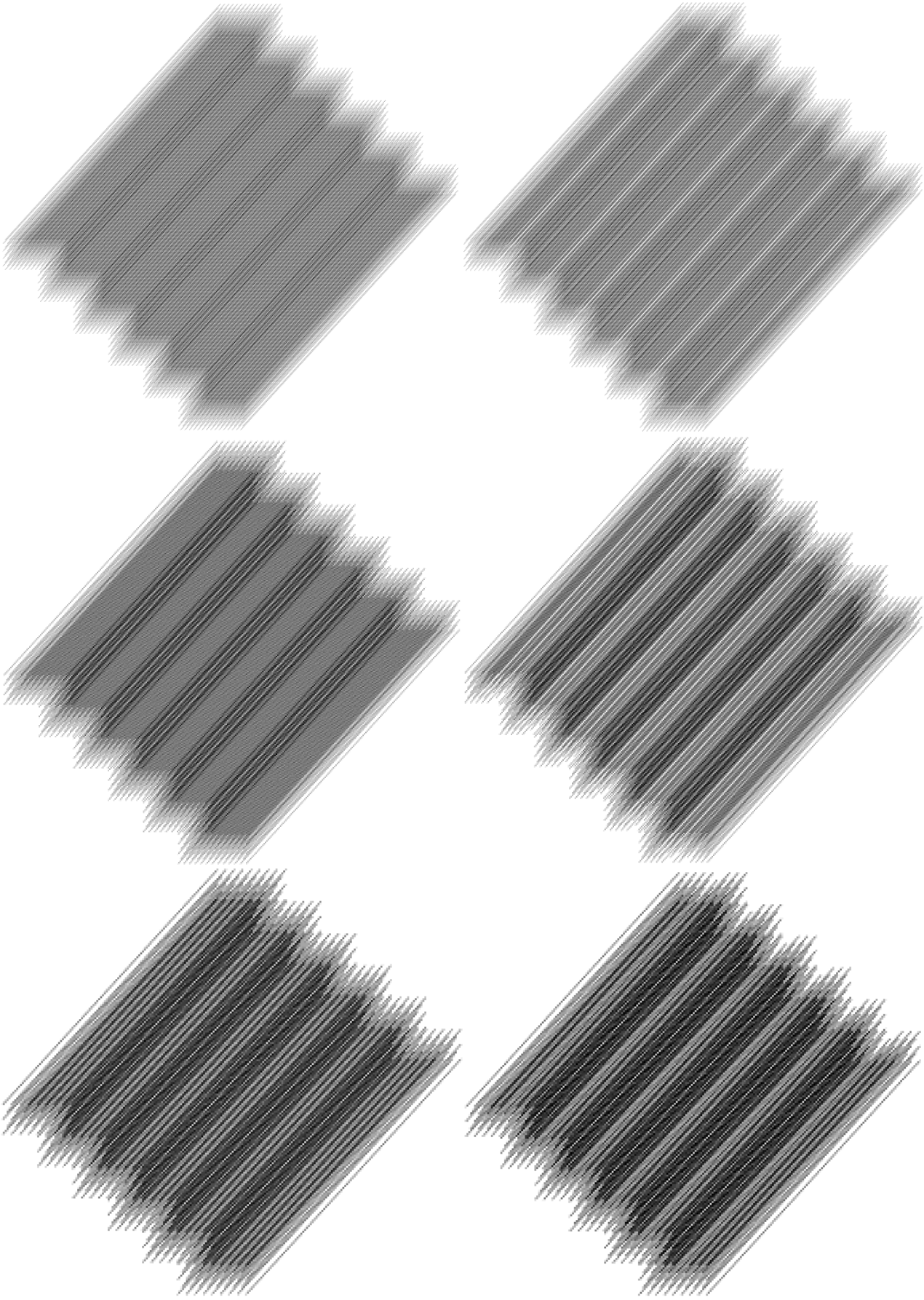
For each scan direction, long, diagonal or short, there are two array orientations that could be used and the pattern of missing detectors may favour one over the other. For this note, however, only one array orientation is shown for the long and short scans as this is enough to enable conclusions to be drawn. Both orientations are shown for the diagonal scans as these are combined to form the cross-linked observation.

2. Single Long Axis Scanning

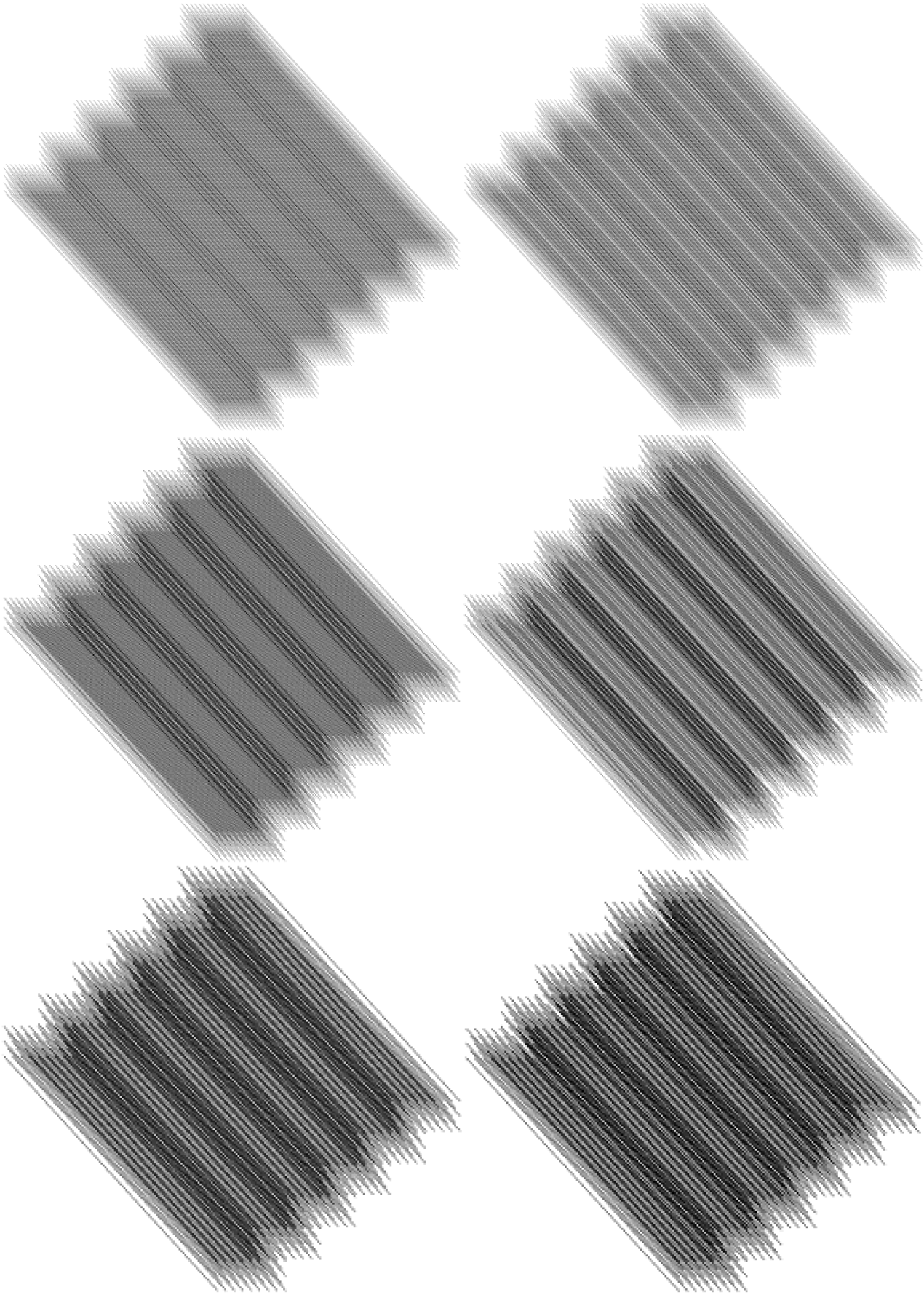


3. Single Diagonal Axis Scanning

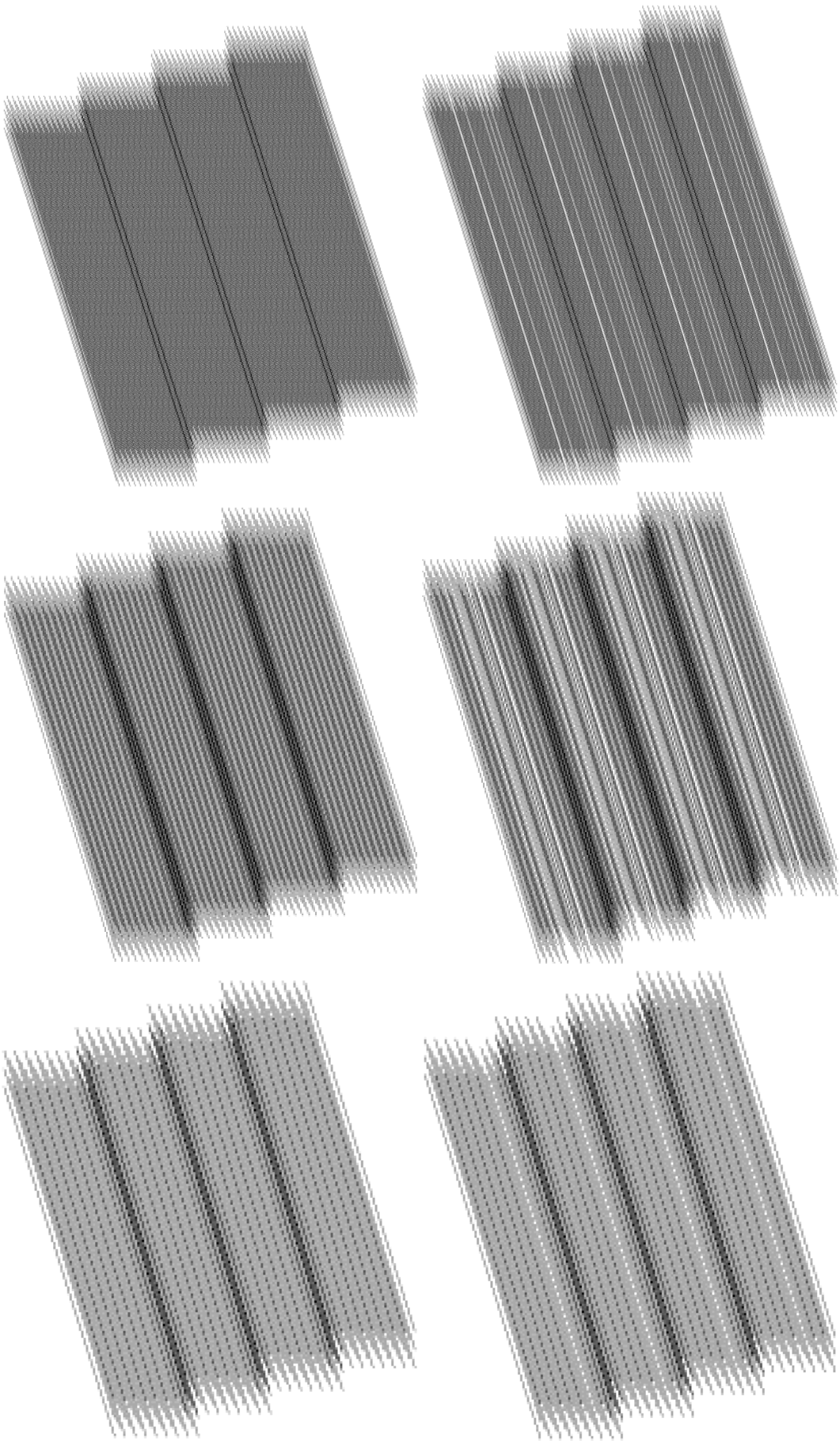
3.1 Direction 1



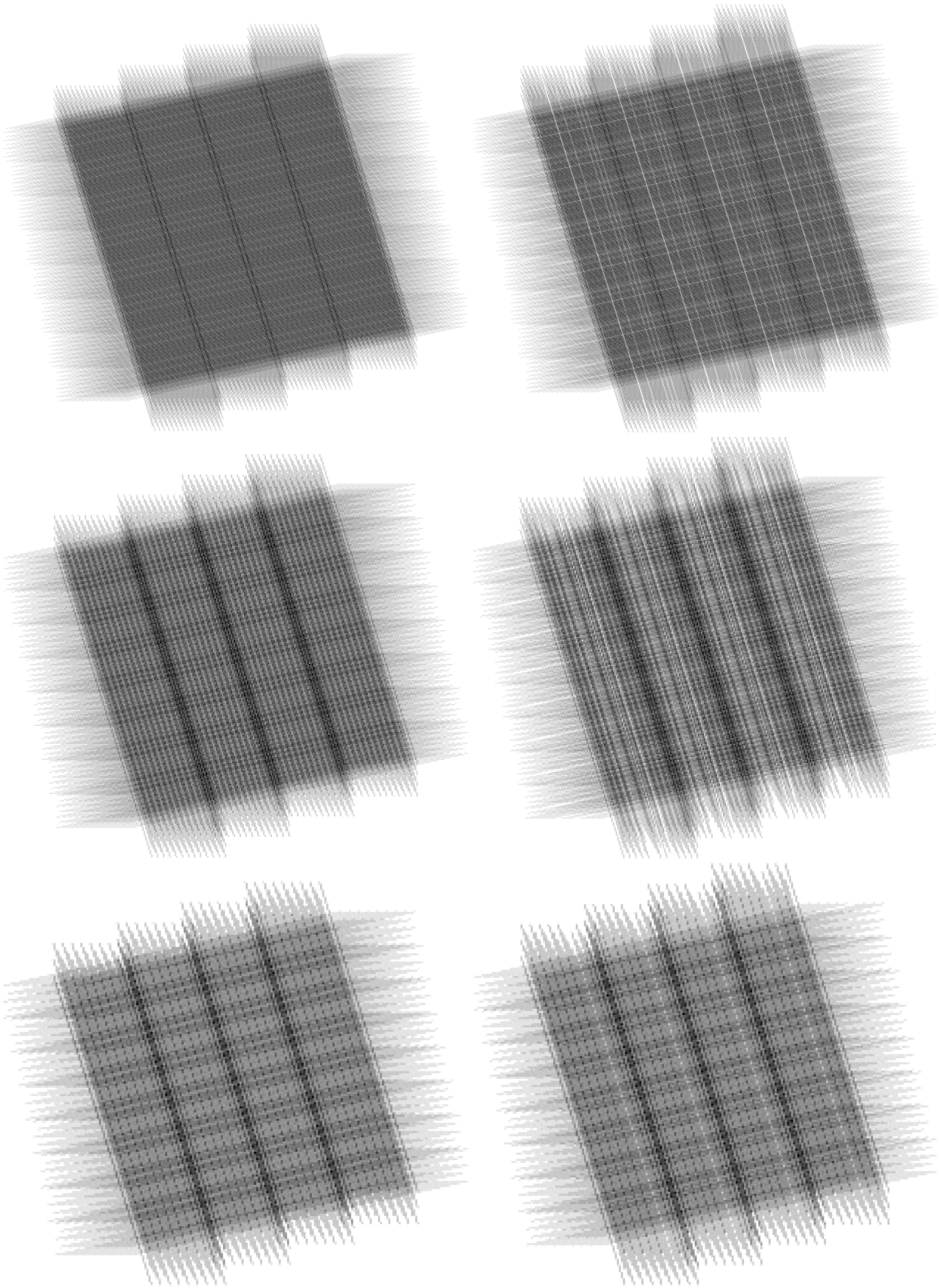
3.2 Direction 2



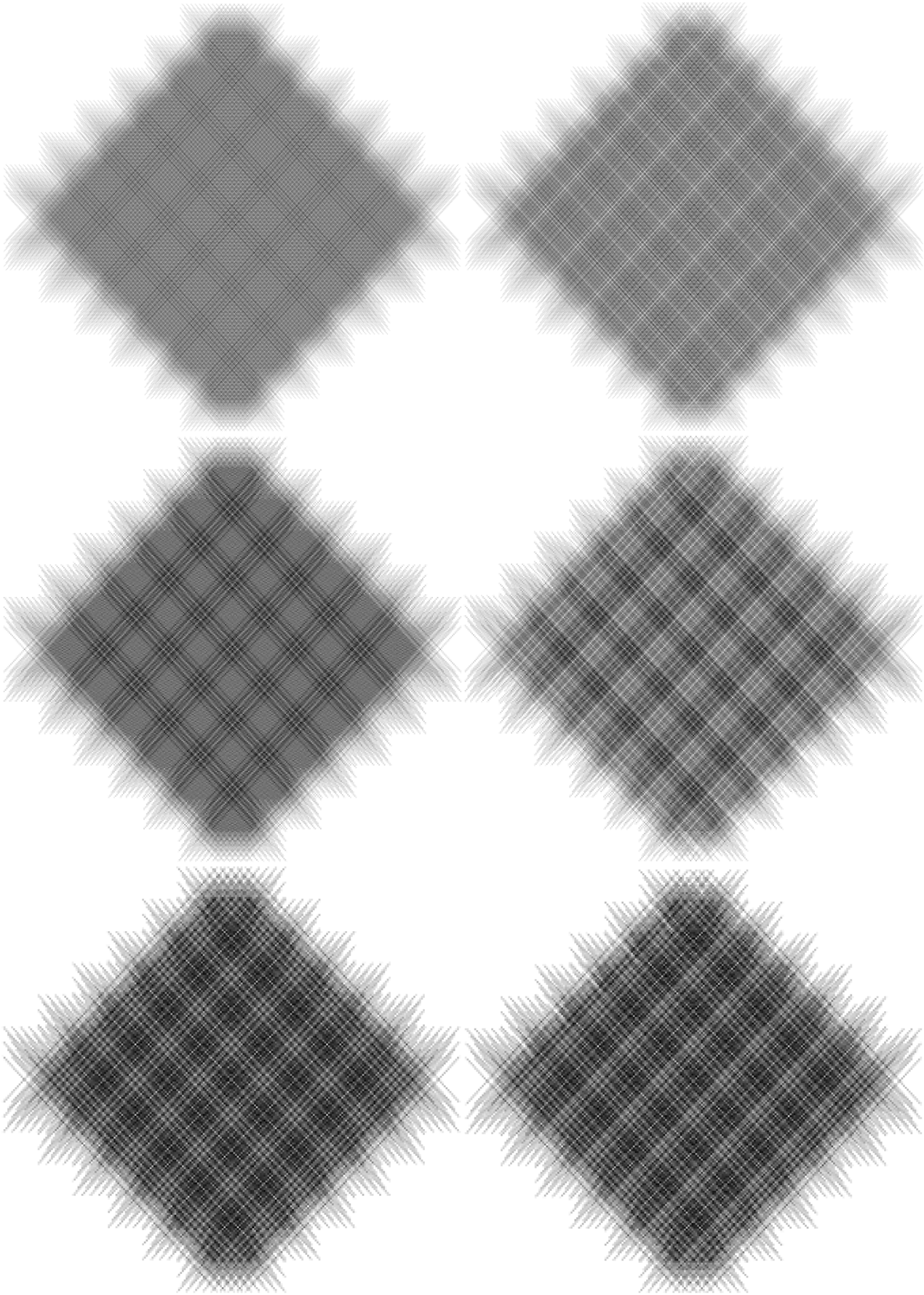
4. Single Short Axis Scanning



5. Cross-linking with Long + 2 Short



6. Cross-linking with two Diagonal Scans



7. Discussion

There are a lot of images to digest in this note so this section discusses the important points. Firstly, missing detectors have a much greater effect when short or diagonal scanning than when long scanning. When long scanning there are never any pixels with no data (within the user defined map area) because there are always sufficient working detectors to fill in the gaps left by missing ones. In the other two situations there are strips of the map that contain no data, although this is worse for the short scanning than for the diagonal scanning.

When combining orthogonal scans – be it one long plus two short, or two different diagonal scans – the gaps in the maps are effectively filled in by the overlapping data. Either situation results in (reasonably) uniform coverage of the sky.

So the question comes down to: will orthogonal scanning be the default observation from the start? If it will then the best option is probably to implement the two diagonal scan directions, since both scans have the same scan leg separation and the same integration time per map. The alternative, of performing one long scan then two short scans (to equalise the integration time for the two orthogonal directions) seems more complicated to implement.

However, if the answer to the question is no, then the first observations to be performed by SPIRE will be disadvantaged. If we decide to go with diagonal scanning, in the hope that orthogonal scanning will become the standard at some point, then the first observations will have maps with missing strips of data. In this case it would be better to implement long axis scanning to ensure that all observations will result in fully covered maps, regardless of cross-linking. When orthogonal scanning is implemented it would require the inelegant solution of performing two short scans for every one long scan, with different scan leg separations for the different scan directions.

An additional question to ask is: if we implement the diagonal scanning as the default, will this result in the quicker implementation of the orthogonal scan mode? If this is the case then we should absolutely go with diagonal scanning, as cross-linked data is certainly a good thing.

One last point to consider: for the very brightest sources that require only a single scan, in whatever direction, will missing strips of data be a big problem? From the images in section 3 and 4 it can be seen that missing data in diagonal scanning is not quite as bad as it is in short scanning so it might not be a problem if we go with diagonal scanning. However, are we willing to take that risk?

One thing is certain, short scanning on its own is a bad idea. If any more detectors fail, for whatever reason, the data quality would be seriously affected. Long axis scanning provides the best buffer against this sort of eventuality.

8. References

[1] *Cross Linked Scan Map Observations*, Tim Waskett, Bruce Sibthorpe, SPIRE-UCF-NOT-002759

[2] SDAG 15 minutes, SDAG_15_July_10_2006_Minutes.pdf