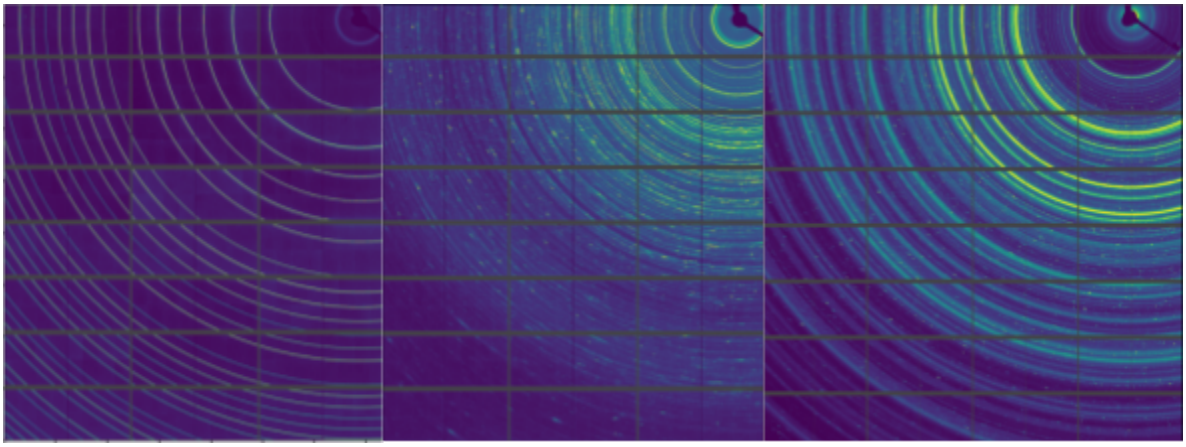
# Powder Diffraction Data: What We Collect, What We Lose, and What We Ignore

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The dramatic evolution of synchrotron sources, offering exceptional brilliance and tiny beams, has enabled two-dimensional powder diffraction data collection with great information wealth. However, the resulting small illuminated volume often violates the fundamental statistical assumption of a large, randomly oriented ensemble of crystallites, leading to difficult data. These resulting 'spotty' diffraction images are commonly discarded, despite containing crucial microstructural information often masked by traditional integration methods. This work demonstrates that far from being a nuisance, a comprehensive statistical appraisal of these data can transform discarded patterns into a valuable resource[2,3,4]. We present a statistical approach to interpret spotty data, moving beyond simple powder integration to reveal specific microstructural effects, such as grain size. These tools lead to the elucidation of underutilised materials properties. Furthermore we shall show how statistical analysis can offer us insight into the identification of the limits of our technique.



A statistical appraisal of the data does lead to wonderful discoveries. It will be my pleasure to share them with you.

***Figure 1.*** *Excellent Reference data on the left contrasts to the samples showing grain effects in the centre and right.*

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