Avoidance and Removal of Phase Vortices in Reconstruction of Noisy Coherent X-ray Diffraction Patterns

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Phasing the oversampled X-ray diffraction from a coherently illuminated crystal provides sufficient information to reconstruct the density function of the diffracting crystal. This phasing, which is accomplished through use of an error reduction or hybrid input-output algorithm, can result in non-physical phase vortices in the reciprocal space reconstruction if the noise level of the data is too high. These vortices can cause significant error in the reconstructed image and are very difficult to remove since they are global defects in the phase- two vortices of opposite chirality must annihilate each other to be removed. While acquiring data with low levels of noise is preferable, it is sometimes not possible in experiments with time dependence or very small particles. Patching the amplitude and phase around vortices with random values can sometimes remove them from two-dimensional patterns, but this procedure is not feasible in three dimensions. Attempts are being made to avoid vortices or drive them by selection of starting conditions or modification of the input data.