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Tomography of faint spinning objects: From molecules to viruses[1]

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A new generation of powerful algorithms is poised to enable the determination of the three-dimensional structure of objects ranging from single molecules to beating hearts and breathing lungs. At one extreme, new algorithms are paving the way to atomic-level mapping of the conformations of biological molecules with femtosecond time resolution. At the other, they are driving ultra-low-dose tomography of non-stationary, faintly scattering macroscopic objects. These approaches combine concepts from information theory, graph theory, Riemannian geometry, and scattering physics to reconstruct objects at signal levels orders of magnitude below what was previously thought possible. We describe how data from a new generation of X-ray Free Electron Lasers or existing electron microscopes can be used to reconstruct the structure and conformational continuum of individual molecules, viruses, and potentially living cells.

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