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Beyond Crystals and Plane Waves - Generalizing the von Laue Condition

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The success of X-ray crystallography is due to the relationship between the symmetries of plane wave radiation and crystal structure. The resulting sharply peaked diffraction patterns allow to reconstruct translational symmetry information directly via the von Laue condition. A natural question to ask is whether one can design radiation that is in a similar way related to certain non-crystalline structures such as the so-called 'objective structures' whose symmetries were analyzed recently in [1]. Ideas and results surrounding these questions are discussed. It is shown that the use of novel forms of radiation might have the potential to improve the structural analysis of structures such as nanotubes, fullerenes, protein substructures or tails and capsids of certain viruses, which are non-crystalline but highly symmetric.

[1] R. James, *Journal of the Mechanics and Physics of Solids*, 2006, 11, 2354-2390

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