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Order as revealed by coherent diffraction

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We are generally taught that a crystal is disordered if its diffraction pattern consists in Bragg reflections and diffuse scattering. However, more insight in the diffraction theory shows that a crystal can be perfectly ordered and still exhibit diffuse scattering. This is the case of the Rudin-Shapiro sequence, whose pair correlation function is similar to a random sequence one. In this paper, we show that this is true only for the infinite sequence. Indeed, finite crystals exhibit speckles patterns which can be measured by coherent diffraction. With the help of the Rudin-Shapiro sequence, we demonstrate that the intensity distribution of such patterns contains information on high order correlation functions, which are irrelevant in infinite crystal diffuse scattering pattern. This surprising result indicates that the concept of order should be revisited in the light of coherent beams.

[1] Ravy, S. (2013). *Acta Cryst.* A69, 549-558.

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