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Orientation Waves as the Order Parameters for Crystals ROLFE PETSCHEK, Dept. of Physics, Case Western Reserve University, Cleveland, Oh 44106-7079 — Even rather simple particle-particle interactions can result in very complicated crystal structures. Simple Landau or density theories that use particle density as the primary order parameter generically suggest that crystal structures should generically be simple – e.g. bcc, particularly if the interactions are short ranged and uncomplicated. Convincing evidence is presented that the order parameters for the complicated crystal that forms in the crystallization of hard tetrahedra is an orientation wave: dependent on the periodic ordering of a third and sixth rank traceless symmetric tensor rather than a density is presented. A simple Landau / density-like theory presentation of such orientation waves is presented. Such orientation waves are known to be order parameters for the blue phases which have crystalline symmetry, in which a second rank tensor varies periodically in space. It is argued that the complicated nature of the Landau theory of high rank tensor order parameters makes it plausible that they result in complicated crystals and quasicrsystals. This, in turn, suggests that complicated crystals and quasicrystals have high rank tensor order parameters.

Rolfe Petschek
Dept. of Physics, Case Western Reserve University, Cleveland, Oh 44106-7079

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