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**Rydberg Atom Lattices** R.M.W. VAN BIJNEN, E.J.D. VREDENBREGT, K.A.H. VAN LEEUWEN, S.J.J.M.F. KOKKELMANS, Eindhoven University of Technology — Ultracold atomic gases are used extensively to realize textbook examples of condensed matter phenomena. Typically, such experiments deal with neutral atoms interacting via short-range VdW potentials much weaker than the Coulomb interactions between electrons in solids. In contrast, we study highly excited Rydberg atoms arranged on a self-assembled lattice, representing a more accurate dilute model system for e.g. metallic conductors. Here, the interaction strengths approach Coulombic potentials, while retaining the controllability characteristical of cold atom experiments. Rydberg lattices can also cross over to the plasma regime with a quantumdegenerate electron gas by increasing the Rydberg excitation, making such systems a scientific playground for studying various fundamental phenomena. We plan an experimental and theoretical investigation of such self-assembled Rydberg lattices, following a recent proposal by T. Pohl et al. Using a tailored excitation scheme, the correlated crystal state is built up from a disordered atomic gas. We give a theoretical treatment of this scheme and the Rydberg crystal ground states, and discuss its feasibility.

Rick van Bijnen
Eindhoven University of Technology

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