

## Rydberg crystals, and how to make them in theory

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## Rydberg lattices

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Lattices of Rydberg atoms are a scientific playground for studying fundamental phenomena in condensed matter physics. A recent paper by T. Pohl et al. [1] proposed a method to build up such a lattice from a disordered gas by applying a tailored laser pulse. In Eindhoven, we plan an experimental realization and theoretical investigation of such self-assembled Rydberg lattices.

Here, we give a theoretical treatment of the lattice formation process, and investigate the criteria for the adiabatic transitions through several Rydberg configurations leading to a lattice state. Important parameters are the atomic density, the dimensionality of the system, and the laser power and detuning. Additionally, the temperature of the initial gas defines the time scales on which the system can be treated in the frozen gas limit. Finally, we investigate basic properties of the Rydberg crystal ground states, such as their structure and finite size effects.

[1] T. Pohl, E. Demler, and M. D. Lukin, Phys. Rev. Lett. 104, 043002 (2010)

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