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Lattice experiments with Raman dressed Bose-Einstein condensates[1]

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Dressing dilute-gas BECs with radiation fields, such as lasers, radio frequency or microwave fields, provides a rich arena to investigate unusual quantum phases and quantum dynamics. In recent years, Raman dressing a BEC with counterpropagating laser beams has proven to be a very successful pathway to investigate diverse phenomena including spin-orbit coupling, the breaking of Galilean invariance, Roton-like excitation minima and a supersolid-like phase. The flexibility of the system can be enhanced even further when additional radiation fields are employed in conjunction with a Raman-dressing laser field. In our experiments we study several novel systems along these lines. By combining Raman dressing with radio frequency coupling between hyperfine states, for example, a stationary or moving lattice structure can be created for the atoms even though neither Raman dressing nor radio frequency coupling alone would induce such a structure. Such a system has peculiar properties and applications that we investigate in our experiments. As a second example, combining Raman dressing with a suitably chosen optical standing wave generates a phase diagram featuring stripe phases that become accessible in the experiments. The current status and future perspectives of the experiments will be discussed.

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