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Experimental realization of a Rydberg optical Feshbach resonance in a quantum many-body system[1] TANITA EICHERT, OLIVER THOMAS, CARSTEN LIPPE, HERWIG OTT, Technische Universitaet Kaiserslautern — Tuning the scattering length between two particles via Feshbach resonances led to some of the most important advances in atomic physics. We have realized a Rydberg optical Feshbach resonance in rubidium by coupling two ground state atoms to an ultra-long range Rydberg molecular state using a laser field and demonstrate their exemplary application leading to different revival times in collapse and revival experiments in an optical lattice. Long lifetimes of Rydberg molecular states allow us to maintain long sample lifetimes on the order of milliseconds while changing the background scattering length of 99 Bohr radii by up to 50 Bohr radii. Rydberg optical Feshbach resonances open up a whole new field: In contrast to optical Feshbach resonances using intercombination transitions in strontium and ytterbium, Rydberg optical Feshbach resonances are feasible with a plenitude of Rydberg molecular states and all atomic species that are able to create Rydberg molecules. This large number of available molecular states allows to optimize the ratio between the change in scattering length and loss rates in further research.

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