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Optical Feshbach resonances in 171 Yb: a versatile tool for the implementation of quantum information processing and study of superfluids

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Recently, alkaline-earth-like atoms have garnered more and more interest as carriers for quantum information and as an interesting system to study quantum fluids. This is due to several different factors, one of which is their ground state with zero electron angular momentum that allows for the storage of quantum information in the nuclear spin, leading to very long coherence times and the possibility to optically recool the qubits. Additionally, the existence of the extremely narrow intercombination lines allows for the implementation of optical Feshbach resonances. This can then be used to optically control the nuclear spin and thus to realize relatively fast quantum gates despite long coherence times, as we showed in our recent work on Yb 171 and as I will elucidate in this talk. Furthermore, the optical Feshbach resonances can be used to selectively vary the p-wave and s-wave scattering lengths of 171 Yb atoms with high spatial and temporal resolution with implications for p-wave superfluidity.