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Spin squeezing and supersolids using Rydberg-dressed strontium atoms MATTHEW JONES, DANIELLE BODDY, DANIEL SADLER, GRAHAM LOCHEAD, ALISTAIR BOUNDS, CHARLES ADAMS, ELIZABETH BRIDGE, Joint Quantum Centre Durham-Newcastle (Durham University) — Coherent excitation of cold atoms to Rydberg states provides a new platform for quantum many-body physics. We present new perspectives provided by divalent atoms such as strontium. We show that laser excitation of the second valence electron enables spatially, resolved state-selective detection of Rydberg atoms with single-atom sensitivity.[1] Narrow intercombination lines enable two-photon excitation to the Rydberg state with low decoherence, providing an ideal system to investigate "Rydberg dressing". Here, a strong, off-resonant coupling to the Rydberg state introduces a new tunable, soft-core interaction between the atoms, with potential for the formation of a Rydberg supersolid phase.[2] With the MPIPKS Dresden we show that applying this dressed interaction to strontium lattice clocks can also lead to the generation of significant squeezing that could be used to improve the signal-to-noise ratio.[3] We present our experiments seeking to observe Rydberg dressing via intercombination lines in ultracold Sr atoms.

[1]J. Millen et al. Phys. Rev. Lett. **105** 213004 (2010); G.Lochead et al., Phys. Rev. A **87** 053409 (2013)
[2]N. Henkel et al., Phys. Rev. Lett. **104** 195302 (2010)
[3]L. Gil et al., arXiv:1306.6240 (2013) accepted for Phys. Rev. Lett.

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