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Narrow-line cooling and imaging of Ytterbium atoms in an optical tweezer array SAMUEL SASKIN, JACK WILSON, BRANDON GRINKEMEYER, JEFF THOMPSON, Princeton University — Engineering controllable, strongly interacting many-body quantum systems is at the frontier of quantum simulation and quantum information processing. Arrays of laser-cooled neutral atoms in optical tweezers have emerged as a promising platform, because of their flexibility and the potential for strong interactions via Rydberg states. Existing neutral atom array experiments utilize alkali atoms, but alkaline-earth atoms offer many advantages in terms of coherence and control. We present a technique to trap individual alkaline-earth-like Ytterbium (Yb) atoms in optical tweezer arrays. The narrow $^1S_0$ - $^3P_1$ intercombination line is used for both cooling and imaging in a magic-wavelength optical tweezer at 532 nm. The low Doppler temperature allows for imaging near the saturation intensity, resulting in a very high atom detection fidelity. This platform will enable advances in quantum information processing and quantum simulation. We also present work on spectroscopy of Yb Rydberg states, which is incomplete in the literature, and initial exploration of the properties of Yb Rydberg states in optical tweezers. We expect the strong hyperfine coupling in the Yb Rydberg states to possibly enable novel schemes for two-qubit gates and implementing spin Hamiltonians.

Samuel Saskin
Princeton University

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