Towards a quantum degenerate gas of $^{48}\text{Ti}$

KAYLEIGH CASSELLA, SCOTT EUSTICE, DAN STAMPER-KURN, University of California, Berkeley, UNIVERSITY OF CALIFORNIA, BERKELEY TEAM — Titanium is fundamentally different from all the elemental atomic gases brought to quantum degeneracy to-date. Titanium’s lowest energy electronic configuration $[\text{Ar}] 3d^24s^2$ yields a ground level $a^3F_2$ that is characterized by non-zero orbital angular momentum yet a magnetic moment equivalent to that of the alkali-atoms. Hence, titanium’s tensor polarizability supports anisotropic atom-light interactions, which can be implemented in a quantum degenerate gas that is free from the strong long-range dipolar interactions observed in systems of lanthanides. While a closed transition does not exist out of the ground state, a metastable state, $a^5F_5$ at 6843 cm$^{-1}$ with electronic configuration $[\text{Ar}] 3d^34s$, has a spin-allowed transition to an excited energy level $g^5G_6^0 ([\text{Ar}] 3d^34p)$ at 498.1713 nm. Existing spectroscopic data support the feasibility of laser-cooling and magneto-optical trapping (MOT); this transition is both closed and broad ($\Gamma = 2\pi \times 10.51$ MHz). We discuss the cooling and trapping scheme already underway: a spin-flip Zeeman slower followed by a MOT. We report on experimental progress towards a trapped, Doppler temperature gas of bosonic $^{48}\text{Ti}$, the most abundant isotope, and future plans to achieve quantum degeneracy.

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