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Spectroscopic signatures of dressed Rydberg-Rydberg interactions in Sr RICK MUKHERJEE, KADEN HAZZARD, Rice University — Ultracold Rydberg-dressed atoms exhibit strong, long-range interactions that can potentially create exotic phases of matter and entangled states that are useful in quantum computation and metrology. Rydberg-dressed atoms are obtained by off-resonantly admixing a Rydberg state $|R\rangle$ into a long-lived electronic state, often the ground state. As a tool to observe dressed Rydberg interactions, we theoretically consider a spectroscopic method that relies on strontium's unique long-lived ($\approx 23\mu$s) electronic excited state ${}^3\mathrm{P}_1$. Specifically, we consider an effective two level system: the electronic ground state $|G\rangle$ and the Rydberg dressed state $|D\rangle = |{}^3\mathrm{P}_1\rangle + \epsilon|R\rangle$ with $\epsilon \ll 1$. Using spin language to describe this two level system, our proposed Ramsey scheme rotates the spins by angle θ, allows the atoms to interact for a time t, and then measures the final spin vector. Our calculation is exact and includes experimental complications, such as dissipation and pulse timing errors. Excitingly, the dependence of the spin vector on time and θ can be used to experimentally measure the strength and power law dependence of the dressed Rydberg atom interaction.

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