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Measurement of the Rydberg constant with cold Rydberg atoms

RYAN CARDMAN, ANDIRA RAMOS, GEORG RAITHEL, Univ of Michigan - Ann Arbor — Progress in precision measurement of the Rydberg constant using microwave spectroscopy of cold Rydberg atoms is discussed. Rydberg atoms in circular states, i.e., in high-orbital-angular-momentum energy levels, have toroidal wave functions. This diminishes energy shifts brought on by the overlap of the valence electron wave function with the ion core, and eliminates QED effects and effects of the nuclear charge distribution on spectroscopic measurements, offering a value of the Rydberg constant decoupled from effects of the proton radius puzzle. In this poster, we describe the two-photon microwave transition from a circular Rydberg state of principal quantum number n to a near-circular state of principal quantum number n+2. The atoms are initially prepared in an optical molasses, laser-excited into an F-state using a three-step excitation, and circularized. We also present details on the microwave horn system that emits sub-THz microwaves into the apparatus to drive the transitions. The atom distribution between initial (circular) and final (near-circular) Rydberg states is analyzed using state-selective field ionization. The expected systematic uncertainties of the measurement are discussed.

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