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Electric field effects on cold Rydberg atom nD - nD pair collisions

DONALD W. BOOTH, ARNE SCHWETTMANN, JAMES P. SHAFFER, University of Oklahoma, JADER S. CABRAL, LUIS F. GONÇALVES, LUIS G. MARCASSA, Universidade de São Paulo — Rydberg atom interactions are important for quantum information processing due to the dipole blockade effect. Collisions between Rydberg atoms provide an experimental method for making sensitive tests of these interactions as well as aiding our understanding of Rydberg atom pair excitation processes. We present experimental results that show a significant yield of $(n+2)P$ atoms after the excitation of nD Rydberg atoms in a Rb MOT, where $27 \leq n \leq 41$. These results can be attributed to binary collisions between Rydberg atoms. We compare these results to calculations using the Landau-Zener method to calculate transition probabilities at avoided crossings in the two-atom potential energy curves, taking into account the effects of AC Stark shift due to the laser pulse and DC Stark effect due to the background electric field. The calculations indicate that binary collisions between nD - nD pairs result in some transfer into $(n+2)P$ -($n-2$)F pairs.

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