Detection of Rydberg States of Helium by Black Body Ionization

XIAOXU LU, YUAN SUN, HAROLD METCALF, Stony Brook University — We are studying the detection of He Ryberg atoms excited in two steps from the metastable $2^3S$ state (He*). The lower transition connects to the $3^3P$ state via $\lambda = 389$ nm light and the upper one to the $n, \ell$ states via $\lambda = 785 - 815$ nm ($n \sim 13 - 45$). The He* atoms in a thermal beam ($v \sim 1070$ m/s) cross the two laser beams at $90^\circ$ and they are arranged for the STIRAP excitation process: atoms encounter the red light before the blue. The excitation is between two large ($7 \times 17$ cm) plates 6 mm apart that can be used to apply an electric field for Stark spectroscopy or field ionization, or be heated to provide a black-body radiation bath. An ion detector readily detects the presence of Rydberg atoms and we have made several Stark maps that agree well with calculated energies. We believe the observed signals are produced by black-body ionization at a very low rate, but sufficient to ionize less than 1% of the atoms in a region viewed by our detector. Many measurements provide support for this hypothesis.

Supported by ONR

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