Abstract Submitted
for the DAMOP11 Meeting of
The American Physical Society

Detection of Rydberg States of Helium by Black Body Ionization[1]

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, ℓ 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° and they are arranged for the STIRAP excitation process: atoms encounter the red light before the blue. The excitation is between two large (7×17 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.

[1]Supported by ONR

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Date submitted: 02 Feb 2011 Electronic form version 1.4