

Absolute Photo - Ionization Rate Measurements Using Ion Imaging Techniques

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Photo-ionization rate measurements generally suffer from a large uncertainty in the laser intensity since ions created in the waist of the beam are extracted along with ions created outside the waist. Thus a larger range of intensities may contribute to the measured ion yield. In this work, the ion production region is imaged using an ion optics “zoom lens”, as shown below in the figure. A 2-dimensional position-sensitive detector gives x-y information, while time-of-flight gives z-information. The extraction field is insufficiently strong to provide a 4π steradian collection angle. The laser intensity characteristics are separately determined, and by comparing these with the spatially resolved ion yield data, an accurate determination of relative ionization rates versus laser intensity can be made. These are made absolute by directly measuring the target density. In the particular case presented here, light from a femtosecond laser is directed into a chamber containing rubidium vapor. The target density is determined by measuring absorption of a separate cw diode laser. The technique is general and can also be used to determine relative ionization rates from laser-excited rubidium.

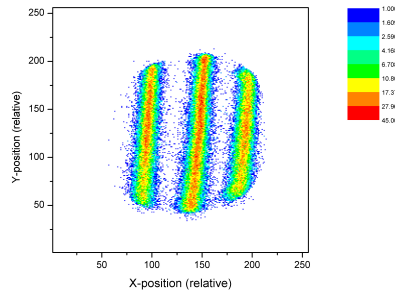


Figure 1: Images of ions created in the beam of a femtosecond laser. The three separate stripes are from data collected for three different paths of the laser. This allowed a direct measurement of the magnification of the ion lens system.