Time-Resolved Two-Colour Photoionization from the 5P and 6P states of Rb

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Synopsis. Results are presented for two-colour photo-ionization from Rb. Both 5P and 6P states were simultaneously excited by radiation from a Titanium Sapphire (Ti:S) and dye laser, switched into the experiment using high speed electro-optic modulators (EOM's). Results from time-resolved studies will be presented as a function of both energy and angular distribution of the resulting photo-electrons.

Rubidium is a well-studied target, as it is used in most cold atom experiments, as well as for cold electron production from cold atoms [1]. It is therefore important to understand how these photo-electrons are produced. The low ionization potential of Rb (~4.18eV) means the atoms can be ionized using radiation from two lasers. The most common technique excites the 5P state at ~780nm, followed by ionization using radiation with wavelength <479nm.

In the experiments described here ionization from both 5P and 6P states is studied. In this case the blue radiation is at ~421nm, so that photo-electrons from the 5P state have energy ~0.36eV, whereas from the 6P state they have ~1.72eV. The 6P state cascades to 4D and 6S states, which further decay to the 5P state. Additional signals hence arise from these states when the 6P state is resonantly excited.

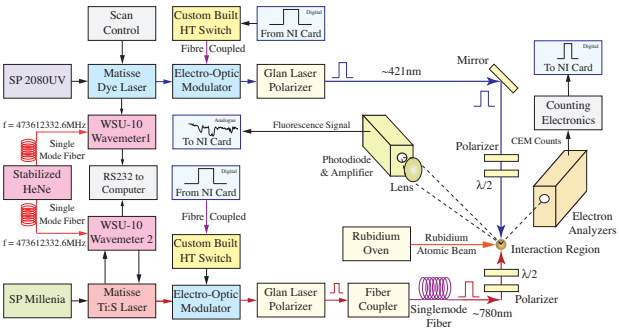

Figure 1. Diagram of the experiment for 2-colour time-resolved photoionization studies of Rb. Ionization signals are detected by two electron analyzers, whereas fluorescence is detected by a photodiode.

To resolve contributions from different cascade routes, the experiment adopts a time-resolved mode, the laser beams being switched into the interaction region using EOM's (Fig. 1). Both angular and energy contributions can then be studied as a function of laser detuning and the different pathways to ionization.

Figure 2 shows results in the energy domain, where the hyperfine structure (HFS) of Rb is resolved. Fluorescence signals are seen in 2(a) as the Ti:S laser is scanned in frequency. 2(b) shows the corresponding photo-electron signal at 0.36eV when the blue laser is off resonance. 2(c) shows results when the blue laser is on resonance from the ^{85}Rb 5S F=2 to 6P F'=3 state. A background due to cascade contributions is seen. When both lasers are on resonance, a minimum is found in the electron yield.

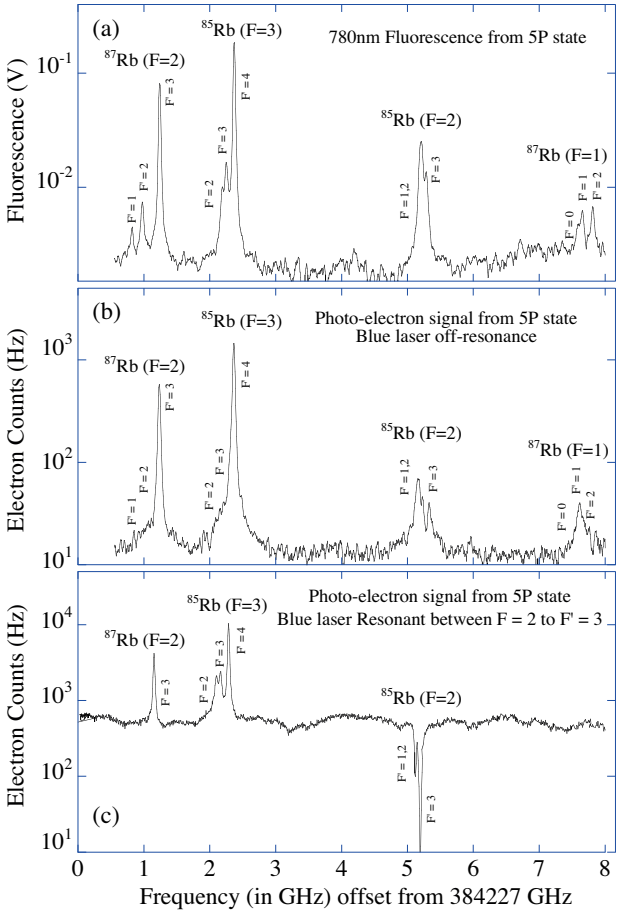

Figure 2. Frequency scans from the 5P state. (a) fluorescence signal. (b) photo-electron signal (blue laser detuned). (c) Blue laser on-resonance from the F = 2 ground state to the F' = 3 6P state.

Results from these studies will be presented at the conference.

References

[1] AJ McCulloch *et al.* 2011 *Nat. Phys.* **7** 7 785

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