Introduction

With the support of DOE grant DE-FG05-85ER13394 we have worked on problems related to the dynamics of doubly excited, two electron atoms. Primarily we have worked on autoionization, because the inverse process, dielectronic recombination, leads to power loss in fusion plasmas. However, the insights gained from our experiments are directly applicable in other areas as well. Two examples illustrate this point. Zero kinetic energy (ZEKE) electron spectroscopy in combination with laser excitation is now widely used by physical chemists to determine the energy levels of molecular ions of complex molecules. As it happens the physical situation in ZEKE spectroscopy is very similar to that in dielectronic recombination, and both forced autoionization and the effects of fields play very important roles. Proposed methods for coherent control of chemical reactions are based on the time domain manifestation of configuration interaction, that coherent superpositions of configuration mixed states oscillate between the nominal pure configurations. The interaction between bound states of different nominal configurations, while apparently different from autoionization is essentially the same, as demonstrated by forced autoionization.

The approach we have used in our experiments is laser excitation of alkaline earth atoms in atomic beams. We have measured autoionization rates as well as the energy and angular distributions of the ejected electrons. Such measurements have provided the most stringent tests of theoretical approaches. We have examined the effects of external fields on autoionization and recombination and have shown explicitly that very small fields have enormous effects. Finally, we have carried out time domain experiments using a 100 fs titanium:sapphire laser to validate proposed methods of coherent control. This work is described in the following publications.
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Publications resulting from grant DE-FG05-85ER13394

O.C. Mullins, Y. Zhu, and T.F. Gallagher, "Determination of the channel interaction in barium for five 5d7d perturbers: the $^3{D}_2$, $^3{F}_2$, $^3{P}_1$, $^3{S}_1$, and $^3{P}_0$ states", Phys. Rev. A32, 243 (1985).


Publications resulting from grant DE-FG05-85ER13394 (continued)


