Photo double excitation of helium in a strong DC electric field

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The study of doubly-excited states of helium has long been used as a sensitive test of the understanding of electron correlations. Synchrotron radiation provides a high resolution source of photons in the energy range required for excitation of these states, which is inaccessible using laser sources. To date, studies of the influence of a high electric field on the behaviour of doubly excited states have been limited, and a new apparatus has been constructed which allows fields of up to 90 kV/cm to be applied to the interaction region where the states are formed.

Photons from beamlines at both the Photon Factory and the Advanced Light Source, Berkeley, have been used to study doubly-excited autoionising states of helium in a high electric field. The states appear as resonances in the detected ion yield, metastable yield and photon decay spectra. Initial experiments at the Photon Factory showed prominent effects due to Stark shifting and mixing of the resonances observed in the ion yield spectrum. The evolution of the states as a function of the field strength was, however, quite different to that predicted by a recent theoretical calculation [1]. The extremely high resolution at the ALS allowed a detailed investigation of these effects to be commenced. Application of novel techniques, taking advantage of the time structure of the synchrotron radiation, has allowed the separation of the photon decay and metastable yield channels. The doubly excited resonances have thus been able to be observed in 3 different decay channels, allowing further insight into the structure of these states and their behaviour in a strong electric field.

Experiments have recently been extended to investigate the Stark effects on singly and doubly excited states in neon, above the first ionisation threshold, and some progress has been made in describing the bevahiour of these states as the field in the interaction region is varied.

Results will be presented for helium and, if time permits, neon. Detailed comparison with available theory will be made and further studies proposed for these systems.

[1] Chung et al., J. Phys. B **34**, 165 (2001)

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