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Angular distributions of photoelectrons ejected from Neon in the presence of XUV and IR laser fields

R. Morgan*[1] and H. W. van der Hart†[2]

* Centre for Theoretical Atomic Molecular and Optical Physics
Queens University Belfast, Belfast, BT7 1NN, N. Ireland

Synopsis We use the R-matrix with time-dependence method to investigate the effects of two-colour laser fields on the angular dependence of photoelectron emission from Neon. Results are compared to both experimental and soft-photon approximation (SPA) results.

The rapid development of both high intensity and ultrashort light sources, e.g. free electron lasers (FELs) have led to some great breakthroughs in atomic science, unlocking the potential for experimental observation of electron dynamics with attosecond timescale resolution [1, 2, 3] and even control of these dynamics [4].

These advances however do come at a cost: the need for powerful theoretical methods which can describe and interpret experimental results on the dynamics of an atomic system that are simultaneously accurate and computationally feasible.

Theoretical models of varying complexity can be used to solve problems in these areas. These range from simple models which can cost very little in terms on computational power to complex models which describe the whole dynamics of an atomic system with high precision but are, in general, far more costly in terms of computing power. The latter contains ab initio calculations, such as the R-matrix with time-dependence (RMT) [5, 6, 7].

Recent experimental results of angular dependence of neon irradiated by intense two-colour fields have highlighted some interesting modulations in emission angle [8]. These experimental findings were compared to strong-field approximation calculations (SFA). However, the comparison showed some qualitative differences.

Using RMT we can investigate this system from first principles and compare outcomes to both experimental and theoretical model findings. Photoelectron angular distribution spectra are obtained for a range of intensities showing an increase in angular modulation and sideband formation as intensity increases. Our ab initio results are in very good agreement with experimental results for the central line; however for the second side band, our calculations compare better to the SFA model. We also compare RMT calculations with the soft-photon approximation [9].

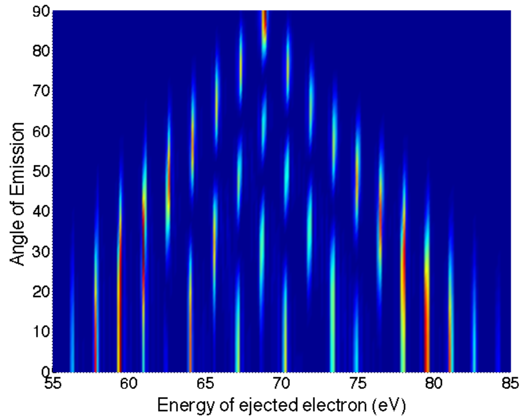

Figure 1. Photoelectron angular distribution spectra for the photoionisation of Neon irradiated by a combination of XUV laser at 90.5 eV photon energy and IR laser operating at 800 nm and intensity of 5×10^{12} W/cm^2.

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[1]E-mail: rmorgan12@qub.ac.uk
[2]E-mail: h.vanderhart@qub.ac.uk