Correlation Channels in Sequential Double Ionisation

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We present a quantum mechanical method to study the effects of Correlation channels on Sequential Double Ionisation (SDI) in strong elliptical fields. Recent experiments [1] have shown that the independent electron approximation is not sufficient to explain the observed electron spectrum and release time of electrons in SDI from laser fields with high intensities and close to circular ellipticities.

Classical methods [2, 3] to explain the different imprints of correlation effects, for example, oscillation in ratio of yield for parallel to anti-parallel electrons, evolution of three to four band structure in the recoil ion momentum distribution with laser intensity, and correlated angular distributions for the emitted electrons have been developed but we present the first quantum mechanical treatment of the phenomenon.

Our method is based on the recently developed analytical R-matrix (ARM) method [4, 5], wherein we partition the configuration space into a core dominated and laser field dominated region, and along with it use the eikonal-Volkov approximated (EVA) [6] electron states to describe the wavefunction for the continuum electrons, taking into account the long-range Coulomb potential effects from the residual ion. In order to incorporate effects of ion transitions caused by correlation potential existing between the first ionising electron and the residual ion being left behind, we use the method outlined in [7] to include multielectron effects, thus going beyond the Single Active Electron (SAE) approximation for SDI. We also extend the method to apply to effects of the correlation potetial on the quantum trajectories.

The correlation amplitude, which can be expressed as the ratio of the indirect-to-direct ionisation amplitude [7], is shown in Fig. 1. Since the ionisation to the ground of Ar^{++} is many orders of magnitude more likely from the ^1S than $^2P_{3/2}$, the correlated channel is the dominant pathway for SDI in Argon.

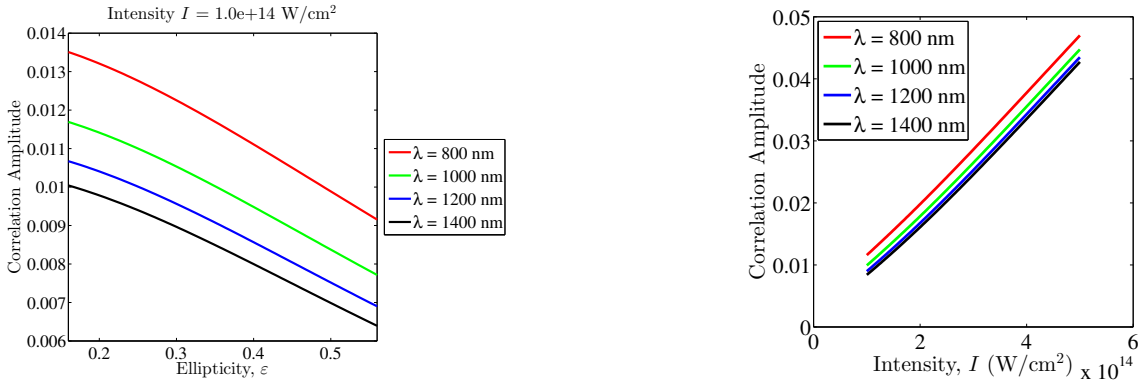

Figure 1: *Variation of correlation amplitude with ellipticity and field strength for laser induced coupling between ^1S and $^2P_{3/2}$ state of Ar^+, that contributes to correlated sequential ionisation pathway.*

References

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