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Relativistic Attosecond Sources from Intense Multi-colour Laser Pulses

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The generation of coherent attosecond pulses of radiation in the extreme ultraviolet (XUV) range provides the required spatial and temporal resolution to study a wide range of phenomena involving fast electron dynamics. [1]

Single sub-femtosecond XUV pulses as well as near-PHz repetition rate trains of such pulses have been demonstrated from gas targets however these are far too weak for XUV-pump/probe spectroscopy to be fully implemented. [1]
Coherent high order harmonic X-ray generation can be achieved however through the interaction of an initially solid target with an ultra short, intense laser pulse to create a near discontinuous plasma–vacuum boundary. [2] The interaction of light with solid-density plasmas offers the opportunity to reach much higher attosecond pulse intensities and generation efficiencies.

Using a two colour field (fundamental frequency and second harmonic) has been demonstrated experimentally [3] and in simulations [4] to be a route to achieve an optimal high harmonic yield in laser-matter interactions. By tuning the relative phase between the two frequency components of the incident beam, the driving electric field waveform and the resultant electron motion can be controlled. Strong attosecond pulses are associated with sharp transitions in the driving electric field with potential generation efficiencies that are significantly higher than for a typical single colour laser.[4]

The effect of tuning the relative phase of the second colour on the resulting high harmonic spectral shape is studied for a range of parameters and the link between this and the plasma surface dynamics is investigated and discussed.

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