Coherent laser excitation and control of donor states in Si

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The spin degrees of freedom of group V donors in Si satisfy many of the criteria required for qubits [1,2]. Stoneham *et al* suggested that the orbital Rydberg states of such donors can also be used to control these spins coherently [3,4], leading to the possibility of a Si based quantum computer. I shall explain how this control is supposed to happen, and identify the population (T_1) and dephasing (T_2) lifetimes of the Rydberg states as critical parameters of the scheme. In order to measure these quantities we have used the free electron laser FELIX [5] to perform pump-probe and photon echo experiments, from which T_1 [6] and T_2 [7] can be extracted and I shall describe these experiments and their analysis in some detail. As well as the lifetimes we are able to extract several other important physical parameters, and I shall also discuss their implications for coherent excitation of Rydberg states of donors in Si.

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