

## **Fast pulses and slow atoms: synthesizing molecules and controlling decoherence**

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Methods of coherent control have wide application in the manipulation of simple molecules: two very different such applications will be outlined.

First, I shall describe progress on a general approach to the formation of ultracold ground state molecules by synthesis from pairs of cold atoms using shaped ultrashort optical pulses. This method combines an effective and widely applicable control technology to the problem of preparing molecules in the ground state of all their degrees of freedom.

Second, I shall discuss the application of closed loop control to the mitigation of decoherence in vibrational wavepackets excited in such molecules. This provides a number of challenges, but gives evidence that closed loop methods are effective in locating regions of phase space that are less susceptible to dephasing than others, without any prior knowledge of the system-bath interactions. Further, it is possible to completely characterize the quantum map describing the quantum state evolution in a simple and "cheap" manner.