Nonadiabatic alignment of molecules dissolved in superfluid helium droplets

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We show that the powerful alignment methods, based on moderately intense nonresonant laser pulses, can be transferred from isolated molecules in the gas phase to molecules embedded in superfluid Helium droplets. We demonstrate both alignment in the adiabatic limit where the laser pulse used is much longer than the inherent rotational periods of the molecule and in the nonadiabatic limit where the pulse is much shorter than the rotational periods.[1] We show that adiabatic alignment is essentially the same for isolated molecules and for molecules in droplets whereas the nonadiabatic alignment dynamics for molecules in droplets differs strongly from that of isolated molecules. It is shown that multiple short pulses, synchronized appropriately, can enhance the degree of alignment in the nonadiabatic regime. Our studies uses 1,4 diiodobenzene as an example but other molecules were studied as well.

The ability to align molecules in He droplets opens new opportunities for time-resolved studies of chemical reaction dynamics of molecules in the presence of a solvent and for studying the properties of superfluid helium.

References:
[1] Dominik Pentlehner, Jens H. Nielsen, Alkwin Slenczka, Klaus Mølmer, Henrik Stapelfeldt, Phys. Rev. Lett. A **110**, 093002 (2013).