Laser induced alignment of molecules in Helium droplets

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Laser induced alignment, the method to confine the principal axes of molecules along axes fixed in the laboratory frame, is now used in a range of applications in physics and chemistry. With a few exceptions all studies have focused on isolated molecules in the gas phase.

Extension of alignment to molecules in a solvent is of great interest but it faces several fundamental obstacles – at least for the case of a classical solvent. As an alternative we focus on molecules in the quantum solvent of helium droplets and show that laser-induced alignment is possible.

Alignment is conducted in both the adiabatic and the impulsive regime where the alignment field is turned on much slower or much faster, respectively, than the rotational period of the molecules.

For a long laser pulse, in the adiabatic regime, the molecules are capable of following the slow rise of the laser field and a very strong degree of alignment is observed – very similar to the case of isolated molecules. In the impulsive regime the alignment dynamics differs significantly from that observed in the gas phase. In general, it is much slower and shows no sign of the periodic revival structures characteristic of isolated molecules. The alignment dynamics in the He droplets is not captured by any existing theories.

[1] D. Pentlehner et al., *Phys. Rev. Lett.* **110,** 093002 (2013).

[2] D. Pentlehner et al., *Phys. Rev. A* **87,** 063401 (2013).