LASER-INDUCED ALIGNMENT AND ORIENTATION OF QUANTUM-STATE-SELECTED LARGE MOLECULES

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For many experiments in chemistry and physics, i. e., reactive scattering, X-ray or electron diffraction experiments, a high level of control over the spatial orientation of molecules would be very beneficial. It is well known that molecules can be aligned and oriented in space using strong dc electric fields or laser pulses. [a] Here, we demonstrate that the degree of laser-induced alignment and orientation can be considerably improved, if quantum state selected samples are used. [b] A strong inhomogeneous electric field is used in a Stern-Gerlach-type experiment to disperse iodobenzene molecules in a supersonic jet according to their rotational quantum state. Molecules in the lowest rotational quantum states are deflected most and can be used as targets for further experiments. This method is widely applicable to all, small and large, polar molecules and should eventually enable experiments on pure samples of strongly aligned or oriented ground-state molecules offering new prospects in molecular sciences.

[a] H. Stapelfeldt and T. Seideman, *Rev. Mod. Phys.*, **75**, (2003), 543
[b] L. Holmegaard et al., *Phys. Rev. Lett.*, **102**, (2009), 023001