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Research Interests: crystallization, reaction dynamics, photochemistry, photodissociation, spectroscopy, polarization



My group is interested in the interaction between light and matter. To this end we use polarized laser light to both stimulate chemical processes and to study the resulting structures and dynamics.

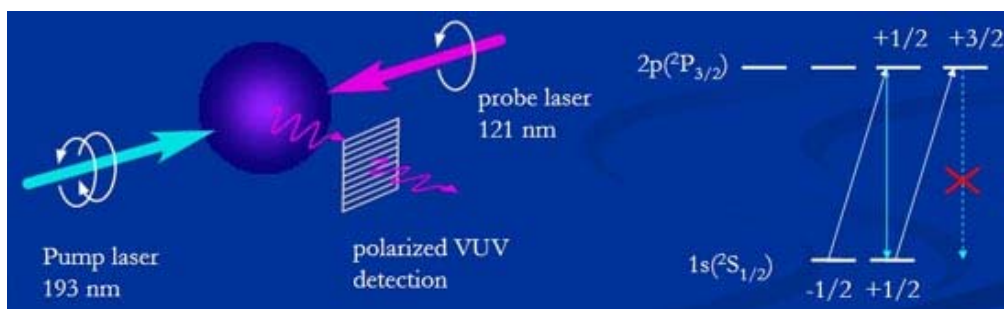
Temporal and spatial control of crystal nucleation

We have been studying the effect of low-power pulses (~6 ns) of near-infrared laser light on crystal nucleation. Our work is based on the discovery by accident of this phenomenon in 1996 by Bruce Garetz and co-workers, which they termed **nonphotochemical laser-induced nucleation (NPLIN)**. In fact nucleation with light is not new. John Tyndall in 1869 had already discovered this: producing radicals with light causes droplets and particles to form in the earth's atmosphere (resulting from the reactions of the radicals). What is different with NPLIN is that it is *non*-photochemical: the light does not damage the molecules or the solvent. In recent work, we have shown that it is possible to nucleate a single crystal of KCl using a single laser pulse fired at a supersaturated solution^[1]. We have also demonstrated the ability to control the nucleation in 3D using an agarose gel laced with supersaturated KCl solution^[2].



Optical detection of spin-polarized hydrogen atoms

In collaboration with Peter Rakitzis at IESL in Greece, we have developed ground-breaking methods for pulsed-laser production and detection of spin-polarized H atoms (SPH)^[3]. SPH are being used by particle groups, e.g., at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory, as a means to unravelling the mysteries of proton spin. The methods we have developed outstrip production densities and detection sensitivities of conventional methods by several orders of magnitude. Our method allows detection of the spin polarization on a nanosecond timescale thereby opening up the potential to measure new physics at low densities under single-collision conditions.



SELECTED RECENT PUBLICATIONS

1. R. N. Muir, A. J. Alexander, *Phys. Chem. Chem. Phys.* **5**, 1279 (2003): "Structure of monolayer dye films studied by Brewster angle cavity ringdown spectroscopy".
2. A. J. Alexander, *Anal. Chem.* **78**, 5597 (2006): "Flowing Liquid-Sheet Jet for Cavity Ring-Down Absorption Measurements".
3. A. J. Alexander, *J. Chem. Phys.* **123**, 194312 (2005): "Determination of the helicity of oriented photofragments".