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Building 25f, Room 456

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**Spin manipulated molecular beams and their application
as ultra sensitive surface probes**

Two different research activities will be briefly reviewed in this talk, both of which involve nuclear spin manipulation of low-energy particle beams. One activity is using the helium spin echo (HSE) technique to study surface dynamics. In the HSE experiment, a beam of helium-3 is used to perform an inelastic scattering experiment. The nuclear spin of helium-3 is used as an internal clock for the beam particles resulting in a phenomenally high energy resolution, and a unique ability to study atomic-scale surface motion on a pico to nano-second timescale [1].

A second recent research activity involves using the source of the helium-3 spin echo apparatus to magnetically focus and spin separate a beam of water molecules [2]. In this experiment ortho and para water molecules are separated by passing the beam through a strong magnetic field gradient. The high purity beam which is obtained in this experiment offers a method for studying the properties of the two spin isomers and their interaction with surfaces. In addition, since our apparatus selects a well defined spin state it has the potential to dramatically increase the sensitivity of an NMR experiment (~5 orders of magnitude), a property which could make sub-monolayer proton NMR studies possible in the near future.

[1] *Phys. Chem. Chem. Phys.*, **11**, 3355 (2009)

[2] *Science* **331**, 319 (2011).