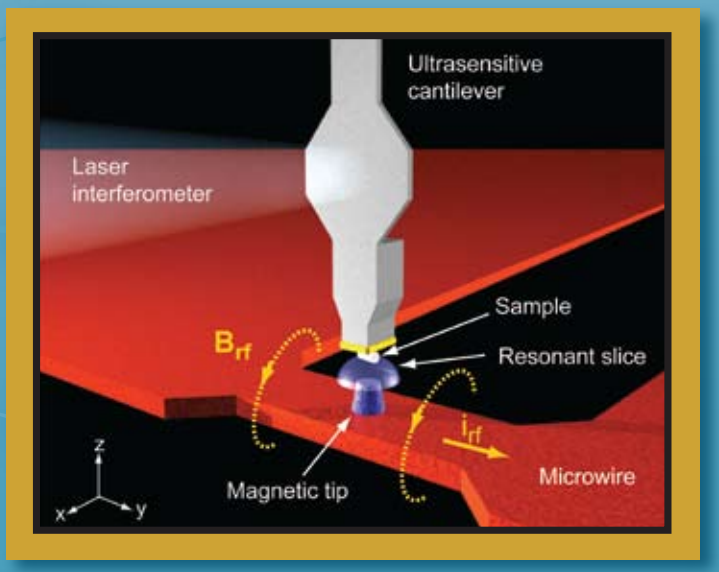
Advanced Instrumentation Seminars

April 29, 2009
1:30 pm, 1st Floor
Kavli Auditorium

Nanoscale Magnetic Resonance Imaging –

The Quest for a Molecular Structure Microscope

Guest Speaker –
Daniel Rugar
IBM Research Division



Can a microscope be built that can directly image the 3D atomic structure of individual biomolecules?

Motivated by this question, we are working to dramatically enhance the resolution of magnetic resonance imaging (MRI) using a technique called "magnetic resonance force microscopy" or MRFM. MRFM achieves a 100 million-fold improvement in sensitivity over conventional MRI by replacing the traditional inductive pickup with ultrasensitive detection of magnetic force. Combining this sensitivity improvement with novel methods for spin manipulation, we have successfully detected nanoscale ensembles of nuclear spins, such as ^{1}H, ^{13}C, ^{19}F and ^{31}P. By carefully measuring the magnetic force from the nuclear spins as a function of position, a 3D image of nuclear spin density can be reconstructed. As a first demonstration, we show a 3D reconstruction of the hydrogen in a test sample of tobacco mosaic virus particles. Spatial resolution on the order of 4 nm was obtained. Prospects for pushing the resolution below 1 nm and turning this technique into a useful tool for structural biology will be discussed.

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