AbstractID: 11482 Title: The Effect of Brownian Motion on Nanoparticle Magetization

The magnetization of nanoparticles in a sinusoidal applied field is a balance between Lorentz forces tending to align the nanoparticle magnetizations and Brownian motion tending to randomize the nanoparticle magnetizations. The result is a distorted sinusoid where the distortion is larger for larger applied fields or smaller nanoparticle Brownian motion. The ratio of the harmonics of the magnetization is one way to characterize the distortion and therefore the Brownian motion of the nanoparticles. The harmonics can be measured in vivo because there is no other signal present and the bandwidths can be extremely small if the signal is measured over many cycles. We have explored how the material in which the nanoparticles reside affects the harmonics. We compared the effects of phase changes and viscosity changes on the harmonics and found a coherent pattern. It showed the ratio of the harmonics decreases with temperature but exhibits a very large increase as it passes through a phase change from ice to water. The change is roughly equal to what a 20^{o}K change in temperature would produce. The measurements are accurate to less than one degree. The nanoparticle signal is very sensitive to phase changes and to viscosity changes. Further, the changes in the harmonics induced are significant enough to easily be observed in vivo. Brownian motion measurements should have a wide array of uses including identification of ablated regions in ablation therapy, identification of cellularity in cancer and inflammatory responses such as rheumatoid arthritis. Moreover it is a measure of the microscopic surroundings of the nanoparticles so antibody targeted nanoparticles can reflect the environment adjacent to the targeted cells without averaging over a wider volume such as an MRI voxel.