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Nuclear magnetic resonance imaging with 90-nm resolution[1] M. POGGIO, C. L. DEGEN, H. J. MAMIN, D. RUGAR, IBM Research Division, Almaden Research Center, 650 Harry Rd., San Jose, CA 95120 — Using magnetic resonance force microscopy (MRFM), we demonstrate two-dimensional nuclear magnetic resonance imaging (MRI) with 90-nm lateral resolution for ^{19}F nuclei in calcium fluoride. In terms of detectable volume, this represents a 60,000 fold improvement over the highest resolution conventional MRI. The high sensitivity of our measurement is achieved using a custom-made silicon cantilever with a 60-μN/m spring constant and a nanometer-scale FeCo magnetic tip that produces magnetic field gradients up to 14 G/nm. The spin manipulation protocol, called cyclic CERMIT, uses low duty cycle cantilever-driven adiabatic reversals to manipulate statistical spin polarization and generate a detectable cantilever frequency modulation. Work is underway to further improve measurement sensitivity, including the development of an efficient RF source aimed at reducing cantilever temperatures during imaging into the low millikelvin range. This and other improvements may allow MRFM to push deeper into the nanometer range.

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