Abstract Submitted
for the DAMOP05 Meeting of
The American Physical Society

Detection of NMR and Radio Frequency Fields with Alkali-Metal Magnetometers IGOR SAVUKOV, SCOTT SELTZER, MICHAEL ROMALIS, Princeton University — We describe several applications of ultra-sensitive high-density alkali-metal magnetometers for NMR and NQR detection. Using a spin-exchange relaxation-free (SERF) atomic magnetometer operating at low field we demonstrate first detection of NMR signals from thermally-polarized water sample. We also demonstrate detection of less than 10^{13} ^{129}Xe atoms whose NMR signal is enhanced by a factor of 540 due to Fermi-contact interaction with the alkali atoms. This technique allows detection of less than 10^{9} ^{129}Xe spins in a flowing system suitable for remote NMR applications. We also present a new tunable RF magnetometer that can detect fields in a wide range of frequencies and demonstrate sensitivity of 2 fT/Hz$^{1/2}$ at 100 kHz. A detailed analysis of fundamental sensitivity limits indicates that it can achieve sensitivity of 0.01 fT/Hz$^{1/2}$ and can rival other methods for detection of nuclear quadrupole resonance (NQR) at several MHz.

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Date submitted: 28 Jan 2005 Electronic form version 1.4