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Magnetic field mapping and the detection of explosives using radio-frequency atomic magnetometers[1] ROBERT COOPER, DAVID PRESCOTT, KAREN SAUER, George Mason Univ — Magnetic field mapping from an array of magnetometers is used to distinguish local from far away sources. The magnetometer's Larmor frequency is easily tuned to the signal of interest using a small DC magnetic field. Of interest is the detection of unique radio-frequency signals from an explosive arising during nuclear quadrupole resonance. The signals are however weak, on the order of fT, and can be swamped by interference in an unshielded environment. Optically pumped ^{87}Rb vapor cells are used to detect fT size signals with background interference up to 200 times larger at a frequency 2 Hz off of the cell's Larmor frequency. Four cells with a baseline of 25 cm allow the detection of local sources on inner sensors while suppressing constant and linear interference present on all four cells. Critical to robust interference rejection is calibration of the sensors in real-time to compensate for a changing magnetic environment. A phase-encoded reference signal uniquely identifies it from other sources and can be applied continuously. To be effective, however, the reference signal itself must be well calibrated. Electron spin-resonance used for this calibration is unexpectedly found to be polarization dependent under certain conditions.

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