A Shielded, Optically Pumped, RF Atomic Magnetometer

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A shielded atomic magnetometer using a paraffin-coated caesium cell and employing double resonance techniques, is used to detect weak, oscillating magnetic fields. Applications of such a device will include zero- and ultralow-field nuclear magnetic resonance (ZULF NMR) measurements, where small magnetic fields in the kHz range are generated. Experiments of this type remove the need for costly superconducting magnet systems involved in conventional NMR, and yield structural information relating to the chemical bonds between nuclei in a molecule, providing a unique zero-field spectrum which can be used as a fingerprint for chemical identification, including liquid explosives. Whilst conventional NMR experiments use inductive sensors to measure high frequency magnetic fields, atomic magnetometers measure magnetic fields directly, resulting in better performance at the frequency range required for ZULF NMR. In this work, a scheme employing individual pump and probe lasers is optimised regarding intensity and frequency. A sensitivity of 5 fT/√Hz is estimated.

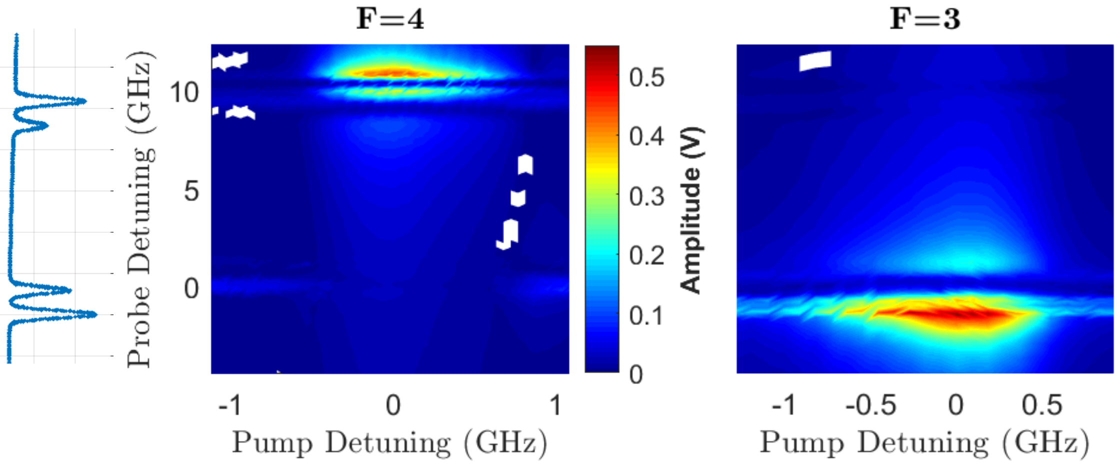

Figure 1: Amplitude response to a 1 nT applied signal as a function of pump (D2) and probe (D1) laser frequencies. Probe detunings are relative to the F=4 → F'=3 transition. *Left*: Pump resonant with F=3 ground state transition. *Right*: Pump resonant with F=4 ground state transition.

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