Optically pumped magnetometers in strongly perturbing environment

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Optically pumped magnetometers (OPMs) has been established as highly convenient magnetic field sensors under shielded and magnetically silent conditions, typical for laboratory environment. Numerous applications call for operation under strong magnetic perturbations. Typical perturbation examples are prominent power line field, intentionally produced millitesla fields needed to polarize sample (in MRI and MPI), or vicinity of the magnetic mechanisms and devices in airborn and spaceborn platforms. While latter were among the first successful applications of scalar OPMs, performance thereof remained far from the theoretical limits and the spectacular results demonstrated under well-controlled laboratory conditions.

Following the successes in operating the OPMs in AC-only shielded room [1], and in the closest vicinity of self-shielding millitesla magnetization coil [2], we test oscillating OPM designs enabling high bandwidth and thus allowing phase-locked operation tracking up to tens microtesla field variations. For example, Cs OPM featuring 56 kHz bandwidth not only demonstrates the fast responce, but also is capable to withstand several microtesla strong steps in ambient magnetic field and gradient (see Fig. 1). We will report on our investigation of the further measures to enhance the OPM performance in strong oscillating fields and gradients.

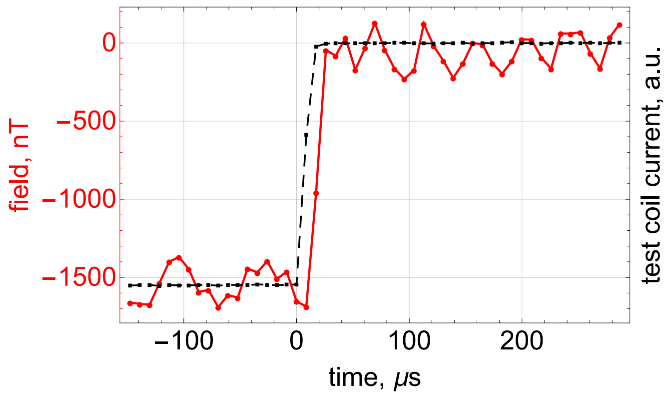

Figure 1. The step responce of the unshielded, single beam fast M_x-type phase feedback OPM with bandwidth of 56 kHz. Red solid line: magnetic field extracted from sensors oscillation frequency; black dashed line: current of the test coil, measured with 500 kHz bandwidth probe. Prominent oscillation in the detected field at 20 kHz belongs to the ambient field noise.

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