SFB/TRR 21 - Colloquium

20. December 2013, Stuttgart

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Microfabricated optically-pumped magnetometers

Atoms can be used as sensors with high sensitivity and good long-term stability. Combining laser-spectroscopy on atoms with MEMS fabrication technology opens the door for high-precision sensors that can be produced in large quantities at low cost. Our sensors are designed around millimeter-scale alkali vapor cells, fabricated using silicon micromachining techniques.
Microfabricated optically-pumped magnetometers achieve high sensitivities, high spatial resolution, and low-power operation due to the small size of the sensing volume. They have the ability to achieve close proximity to magnetic sources and the potential for low-cost parallel fabrication of components. Over the past eight years, we have improved the field sensitivity by a factor of nearly 10,000 from 40 $\mathrm{pT}/\sqrt{\mathrm{Hz}}$ to 5 $\mathrm{fT}/\sqrt{\mathrm{Hz}}$, and we have designed and demonstrated integrated low-power sensor heads as well as fiber-optically coupled instruments. The measurement of biomagnetic sources is one interesting application for these magnetometers and we have recorded the magnetic field emitted the human heart and brain with an array of 25 sensors. In the future, this technology will lead to portable and flexible magnetoencephalography (MEG) systems that do not require cryogenics.

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