Magnetometer z optičnim črpanjem in njegova uporaba pri nizkofrekvenčni radiofrekvenčni spektroskopiji ter elektrofizioloških meritvah

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Kvantitativna magnetometrija se je začela z Gaussom in njegovim magnetometrom 1832 in nadaljevala s Hallom, Foersterjem in njunima magnetometroma do več vrst magnetometrov, ki so jih razvili iz nekaterih spektroskopij pa vse do kvantnih magnetometrov (SQUID magnetometer). Ti magnetometri omogočajo natančne meritve zemeljskega magnetnega polja, magnetizma različnih snovi pa vse do meritev magnetnih polj, ki izvirajo iz elektrofizioloških aktivnosti. Z drugimi besedami - z njimi lahko merimo magnetna polja velikosti od 10^{-5} T pa do 10^{-15} T in manj. Magnetometer s parami alkalnih kovin (K ali Rb ali Cs), o katerem bomo govorili, lahko doseže občutljivost nekaj 10^{-16} T (nekaj desetink fT) in njegova teoretska občutljivost presega občutljivost danes najbolj občutljivega SQUID (superconductive quantum interference device) magnetometra. Čeprav so magnetometri s parami alkalnih kovin poznani že od 1957 (Dehmelt[1,2], Bell in Bloom[3], Kastler[4]), je bil potreben stabilen, uglasljiv diodni laser, da je bilo mogoče v zadnjem desetletju doseči omenjeno visoko občutljivost. Predstavili bomo princip delovanja takega magnetometra in se zadržali podrobneje pri magnetometru s parami kalija (K). Nato bomo prikazali dve praktični uporabi takega magnetometra pri RF spektroskopiji nizkih frekvenc (^{14}N NQR) in pri kvazi DC meritvah vzbujene aktivnosti možganske skorje, ki registrira audio signale.

Reference

[1] H. G. Dehmelt, *Phys. Rev.* **105** (1957) 1924-1925.

[2] H. G. Dehmelt, *Phys. Rev.* **105** (1957) 1487-1489.

[3] W. E.Bell and A. L. Bloom, *Phys. Rev.* **107** (1957) 1559-1565.

[4] A. Kastler, *J.Optical Soc. Amer.* **47** (1957) 460-465.

Optically Pumped Magnetometer: Its Application in Low Frequency RF Spectroscopy and in Electrophysiologic Measurements

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Usually, C. F. Gauss with his magnetometer (1832) is considered as the first-one in the group of researchers, followed by Hall, Foerster and others with their magnetometers, who contributed to the quantitative magnetometry. The development continues with magnetometers coming as applications of some spectroscopies and we will stop it at macroscopic quantum devices SQUID magnetometers. All these magnetometers enable us to measure with high precision magnetic fields from the Earth's magnetic field to magnetization of different materials and also magnetic fields caused by the electrophisiologic activities of some organs. That means, we can measure magnetic fields from 10^{-5} T to 10^{-15} T and less. Optically pumped magnetometers, using vapors of alkaline metals (K or Rb or Cs), which we shall consider, can today achieve the sensitivity of about 10^{-16} T (few tens of fT) and their theoretical sensitivity is even better than this of SQUID (superconducting quantum interference device) magnetometer. Magnetometers with vapors of alkaline metals are known since 1957 (Dehmelt[1,2], Bell and Bloom[3], Kastler[4]), however, it was necessary to have a stable tunable diode laser in order to achieve in the last decade the mentioned sensitivity. The principles of the optically pumped magnetometer with potassium (K) atoms vapor will be presented. Followed by the application of such magnetometer in the low frequency RF spectroscopy (^{14}N NQR), as well as in quasi DC measurements of stimulated activity of audio cortex.

References

[1] H. G. Dehmelt, *Phys. Rev.* **105** (1957) 1924-1925.

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