Short-Pulsed Alkali Magnetometer for Precision in Ambient Fields

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WARF: P110354US01

Inventors: Thad Walker, Brian Lancor, Robert Wyllie

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing an ultrasensitive, alkali-based magnetometer capable of detecting small fluctuations in a target despite the presence of external magnetic fields.

Overview

Detection of magnetic fluctuations is vital to endeavors from space navigation to oil exploration. UW–Madison researchers previously developed a method that utilizes sensitive alkali atoms—polarized by high-frequency sine-waves—within a magnetometer to detect magnetic fields and rotations (see WARF reference number P110198US01). Critically, the system suppresses the noise of the alkali atoms' own magnetic influence using a unique combination of noble gases.

Still, interference by large external magnetic fields, such as the Earth's, aggravates interactions between the alkali atoms, causing dephasing and disrupting readings. Countervailing magnetic forces can be produced by special coils, but precision is difficult and requires external field levels to be nulled to near zero. For extremely subtle readings, as in medical imaging, a new method minimizing the effect of spin exchange collisions and operational in the presence of ambient magnetic fields is desirable.

The Invention

UW–Madison researchers have developed a method of spin polarization using an AC-coupled short pulse, permitting ultrasensitive magnetometry in the presence of Earth-level magnetic fields. By suppressing the spin-relaxation due to interactions between the instrument's alkali atoms, the short pulses attain high transverse spin polarization free of dephasing collisions.

With increased sensitivity, the new design permits detection of minute fluctuations on par with other alkali-based magnetometers that require a near zero magnetic field environment.

The magnetometer includes a gas chamber exposable to an external magnetic field. An electromagnet is positioned to apply a local magnetic field to the chamber. By modulating the rotational change of the alkali atoms with a controllable time-dependent magnetic field, the atoms can be retained in a state in which collisions do not dephase their magnetic orientation.

Applications

- Ultrasensitive medical and biological resonance imaging

Key Benefits

- Resonance frequency not dependent on polarization level
- Dephasing collisions suppressed
- Sensitivity is on par with devices operating at near zero magnetic field levels.

Additional Information

For More Information About the Inventors

- Thad Walker

Related Technologies

- WARF reference number P110198US01 describes the researchers' improved magnetic resonator system that reduces the effect of the magnetic fields of alkali atoms for more accurate and precise magnetometers.

Tech Fields

- Analytical Instrumentation, Methods & Materials : Sensors

For current licensing status, please contact Jeanine Burmania at jeanine@warf.org or 608-960-9846