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Ultrasensitive comagnetometer with cooperative coherence transfer

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Comagnetometers have enabled significant progress in searches for physics beyond the standard model and inertial navigation, owing to the ability to substantially suppress magnetic noise. We present a novel type of comagnetometer based on the **cooperative coherence transfer** (CCT) mechanism [Submitted]. The **nonreciprocal coupling** is introduced to enable optimized **transfer energy matching** and improve the **transfer efficiency**. We demonstrate this mechanism in a ^{21}Ne-Rb-K comagnetometer, yielding a **15-fold** enhancement of the magnetic noise suppression effect compared to the conventional self-compensation (SC) regime [Phys. Rev. Lett. 89. 253002 (2002)]. Consequently, an ultrahigh sensitivity of $7.7 \times 10^{-7}\,^{\circ}/\mathrm{s}/\sqrt{\mathrm{Hz}}$ from 0.2 to 1.0 Hz, equivalent to 8.7×10^{-24} **eV**$/\sqrt{\mathbf{Hz}}$, is achieved, demonstrating **the highest energy resolution** [Quantum Sci. Technol. 7. 014001 (2022)]. This platform facilitates potential improvements of **over 4 orders of magnitude** in constraints on dipole-dipole interaction and monopole-dipole interaction, with broad application prospects.

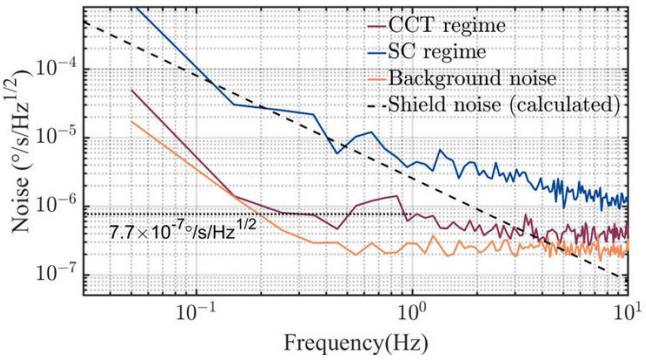

Figure 1: Noise spectrum of the comagnetometer. The background noise is obtained from the noise spectrum of unpolarized atoms. The shield noise, arising from the ferrite magnetic noise, is calculated based on the measured data.

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