Heading-error-free optical atomic magnetometry in the Earth-field range

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Alkali-metal atomic magnetometry is widely used due to its high sensitivity and cryogen-free operation. However, when operating in geomagnetic field, it suffers from heading errors originating from nonlinear Zeeman (NLZ) splittings and magnetic resonance asymmetries, which lead to difficulties in mobile-platform measurements. We demonstrate an alignment based ^{87}Rb magnetometer, which, with only a single magnetic resonance peak and well-separated hyperfine transition frequencies, is insensitive or even immune to NLZ-related heading errors. It is shown that the magnetometer can be implemented for practical measurements in the geomagnetic environments and the photon-shot-noise-limited sensitivity reaches 9 fT/$\sqrt{\text{Hz}}$ at room temperature.

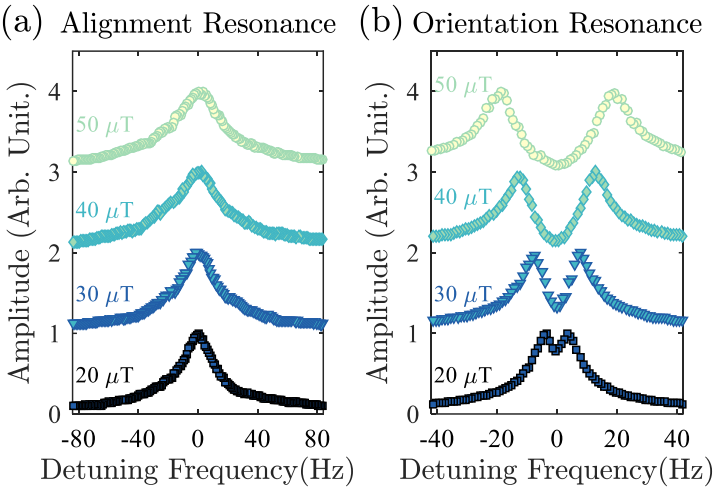

Figure 1: Magnetic resonances of alignment and orientation polarization with background magnetic field of different strengths.

References

[1] Rui Zhang, Dimitra Kanta, Arne Wickenbrock, Hong Guo, and Dmitry Budker, arXiv:2204.05071 (2022).