High sensitive atomic co-magnetometer for rotation rate measurement with a low-pressure K-Rb-^{21}Ne vapor cell

Jiong. Huang[1] , Wenfeng Fan[1], Kai Zhang[1], Linlin Yuan[1], Hongyu Pei[1], and Wei Quan [2]

[1] School of Instrumentation Science and Opto-electronic Engineering, Beihang University, Beijing 100190, China
[2] Research Institute for Frontier Science, Beihang University, Beijing 100190, China

The atomic co-magnetometer (ACM) has been widely used in fundamental physics research such as tests of Lorentz and CPT violation, searches for anomalous spin forces, and electric dipole moments. Besides, it also has the potential to be a miniaturized gyroscope for inertial navigation due to its ultra-high sensitivity to the rotation rate[1]. However, various disturbances degrade the performance of the ACM in the practical environment. A typical disturbance is the low-frequency magnetic field noise. Although this noise can be suppressed by the self-compensation mechanism of the hybrid atomic spin ensembles, the suppression effect is limited and highly susceptible to system parameters[2]. We report Here the self-compensation characteristics of the hybrid atomic spin ensembles in the ACM with a low-pressure K-Rb-^{21}Ne vapor cell (less than 1 atm). The experimental results show that the hybrid atomic spin ensembles in the low-pressure environment have a stronger ability to suppress low-frequency magnetic field noise than those in the high-pressure environment. The rotation rate measurement sensitivity and the long-term performance of the ACM can be improved by approximately 1.7 times and 1.5 times respectively under the optimized conditions. The influence of the vapor cell temperature on the self-compensation capability of the hybrid atomic spin ensembles is also studied.

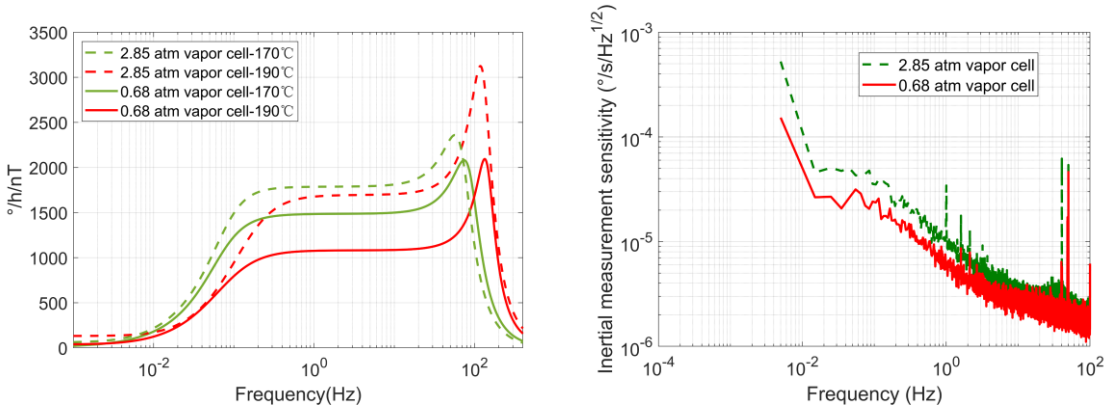

Figure 1: Amplitude-frequency response (Left) under the transverse magnetic field excitation and inertial measurement sensitivity (Right) of the ACM with different pressure vapor cells.

References

[1] Jiang L, Physical Review Applied **12**, 024017. (2019).
[2] Fan W, IEEE Sensors Journal 19, 9712-9721. (2019).