

Digital-locking optically pumped cesium magnetometer

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Lamp-based optically pumped Cesium magnetometer (CsOPM) is a kind of commercial quantum magnetometers. In whatever military or civil magnetic field measurement, the practical optically pump magnetometer possesses a very important application value as well as prospect.

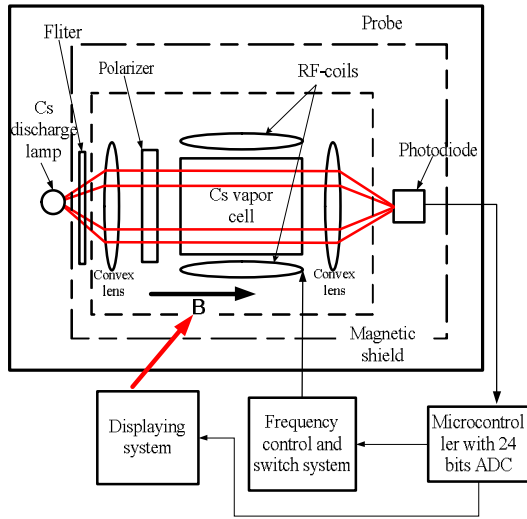


Fig. 1: Schematic diagram of the probe of detecting Zeeman transition signal and the digital servo system of locking the Zeeman transition frequency.

The probe is lamp-based and as compact as 17 cm * 6 cm * 6 cm in size¹. The design of the servo system is to use frequency switching (at two frequencies) to create two corresponding voltages from the probe. When the voltages are equal, the center of the two frequencies shall be the Zeeman transition frequency (shown in Fig. 2). The strategy does NOT need the information of synchronized clock, small signal modulation and phase discrimination, which means fewer feedback information and simpler processing are possibly enough to fulfill a better servo system. The measurement of the magnetic field is experimentally realized with the sensitivity of about 40 pT/Hz^{1/2}. The magnetometer is portable and highly compact with good sensitivity and possesses respectable potential of practical usage in the future.

This paper presents a portable lamp-pumped and digital-locking cesium atomic magnetometer, including the probe of detecting Zeeman transition signal and the digital servo system of locking the Zeeman transition frequency based on C8051F020 (shown in Fig. 1).

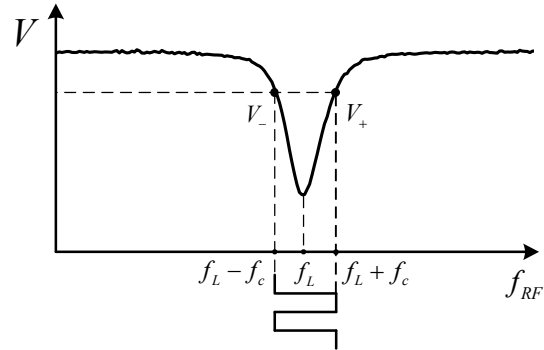


Fig. 2: Digital-locking strategy based on frequency switching between $f_L - f_c$ and $f_L + f_c$. When the voltages (V_- and V_+) are equal, the center of the two frequencies shall be the Zeeman transition frequency f_L .

¹ R. Y. Shi, Y. H. Wang, "Analysis of influence of RF power and buffer gas pressure on sensitivity of optically pumped cesium magnetometer", Chin. Phys. B, vol. 22, p. 100703, 2013.