Simultaneous determination of the spin polarizations of noble gas and alkali metal atoms based on the dynamics of the spin ensembles

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We demonstrate a new method of measuring the spin polarizations of noble gas and alkali metal atoms based on the dynamics of the spin ensembles. Utilizing the novel dynamics of the spin-polarized alkali and noble gas atoms under low magnetic field [1], this method can be used to simultaneously measure the polarizations, thus simplifying the previous separated measurement procedures [2]. In addition, this method is operated in a low magnetic field condition, requiring no complex magnetic field coils or feedback loops compared to the previous methods, hence this simplified configuration is very suitable for miniaturized devices. This method is performed on a K-Rb-^{21}Ne comagnetometer at various pump light intensities and temperatures. The measured polarizations are consistent with the theoretical model.

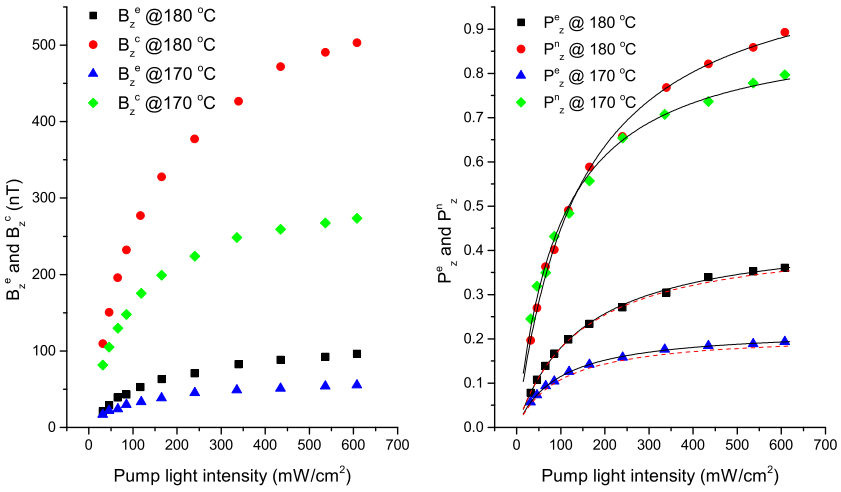

Figure 1. The measured effective magnetic fields and the polarizations of Rb and ^{21}Ne atoms at various pump light intensities and temperatures. The measured polarizations are fitted well by the solid curves based the theoretical equations. As a further check, the measured polarizations of ^{21}Ne P_z^n are compared with the calculated P_z^n (dashed curves) based on the measured polarizations of Rb P_z^e, the theoretical values of spin-exchange rate of Rb-^{21}Ne and the relaxation rate of ^{21}Ne. Besides, the P_z^n are scaled up 5 times for clarity.

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