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Nonlinear Pressure Shifts of ^{133}Cs Hyperfine Frequencies FEI GONG, YUAN-YU JAU, WILLIAM HAPPER, Princeton University — The hyperfine (microwave) magnetic-resonance frequencies of optically pumped alkali-metal atoms in buffer-gas have long been used in compact, portable frequency standards. Van der Waals molecules, consisting of an alkali-metal atom loosely bound to a buffer gas atom, can form in such vapor cells. The molecules strongly affect the spin relaxation of alkali metal atoms in Ar, Kr and Xe gases at pressures of a few Torr, where the collisionally limited lifetime of the molecules is comparable to the characteristic period of the spin-rotation interaction between the rotational angular momentum N of the molecule and the electron spin S of the alkali-metal atom. The hyperfine-shift interaction, the modification a nearby buffer-gas atom makes to the Fermi contact interaction between S and the nuclear spin I of the alkali atom, can contribute to the width of the microwave resonance line, and it is responsible for the pressure shifts of the hyperfine resonance frequencies that are so important for clocks. Major improvements have been done to the apparatus and the process of data taking since last time. The experimental results show that Van der Waals molecules also modify the effects of the hyperfine-shift interaction. For Ar or Kr pressures of a few tens of Torr or less, the shift of the microwave resonance frequency of Cs is not linear in the buffer gas pressure.

Fei Gong
Princeton University

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