Optical cooling of nuclear spins in semiconductor microcavities

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Cooling of different physical systems down to ulralow temperatures often gives an access to new physics or new technological capabilities. Thermodynamics is believed to be universally applicable to many-body systems well isolated from the environment, including, for example, atoms in optical traps; however its validity for specific systems needs experimental verification. Here we explore the possibity of optical cooling of the spin system of lattice nuclei in a semiconductor microcavity, and of real time optical calorimetry directly veryfying the laws of thermal physics at microKelvin temperatures. We show that strains present in such structures do not prevent establishing of the thermal equilibrium in the spin system, which manifests itself in reversible remagnetization across the zero external magnetic field, optically monitored in real time. The heat capacity of the nuclear spin system is shown to be determined by quadrupole interactions, which gives a possibility of its control via strain engineering.

References

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