

Spin manipulation in atomic and molecular systems for nuclear spin applications

Nuclear spin polarization has important applications across various fields, including physics and medicine. It also offers several advantages, such as cross-section enhancement, in the five-nucleon fusion reactions, namely the D-T and D- ^3He reactions. This work presents a theoretical study of spin dynamics in the hyperfine regime for selected atomic and molecular systems and explores alternative techniques to generate or enhance nuclear spin polarization in these systems. Particular emphasis is placed on coherent spin manipulation strategies and the role of hyperfine interactions in transferring angular momentum from electronic (in atoms) or rotational (in molecules) to nuclear degrees of freedom.

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