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Title:	Analytic theory of finite pulse effects involving spin-1 nucleus in rotating solids.
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Abstract:	Understanding the response of nuclear spins subjected to oscillating fields has remained an active pursuit in methodology development in NMR spectroscopy. While methods to study the dynamics of spin-1/2 nuclei exist, such studies involving quadrupolar spins (spins with I>1/2) have always been fraught with difficulty. In particular, the evolution of nuclear spins subjected to radio-frequency (RF) pulses in periodically driven multi-level systems has remained a challenging problem owing to the domineering presence of the quadrupolar interactions. Although, development of analytic methods in static solids have enhanced our basic understanding of the experiments, straightforward extensions to rotating solids remain less trivial. In particular, a uniform analytic framework that explicates the interplay between the sample spinning frequency, amplitude of the RF pulse and the quadrupolar coupling constant remains an open problem in rotating solids. Consequently, optimizations based on numerical methods have gained prominence in the development of NMR methods in quadrupolar nuclei. While investigations based on numerical methods are easier to implement and provide results, they do not necessarily afford insights into the physical phenomena under study. As an alternative, analytic methods based on Floquet theory are explored in the thesis for studying the excitation process in multilevel systems. Specifically, effective time-propagators derived from analytic methods are proposed to describe the effects of RF pulses in rotating solids in three-level (S=1) systems. Through comparisons with simulations emerging from exact numerical methods, the suitability and exactness of the analytic methods is examined over wide-range of experimental parameters. Additionally, the interference effects observed in spin-1/2 nuclei coupled to quadrupolar spins (say S=1) are also discussed.
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