# *COMPOSITE PULSES AND PULSE SEQUENCES WITH BROADBAND, NARROWBAND OR PASSBAND PERFORMANCE*

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We have derived composite pulses for use in NMR spectroscopy which possess broadband, narrowband or passband excitation or inversion profiles with respect to the radiofrequency field strength. The basic sequences are designed using arguments based on symmetry and simple average Hamiltonian theory. Their on-resonance performance can subsequently be improved to an arbitrary degree by using iterative expansion schemes to generate longer, more highly refined, sequences.

The broadband composite 90° pulses which result from this procedure excite transverse magnetization with nearly constant amplitude and phase over a very wide range of values of the radiofrequency field strength. They are therefore suitable models for designing broadband multiple-pulse techniques with very much wider bandwidths with respect to scalar, dipolar or quadrupolar couplings than previously proposed experiments. Broadband INEPT and Jeener-Broekaert experiments have been demonstrated.

The passband composite 90° pulses can be used as models for designing multiple-pulse techniques with rectangular excitation profiles as a function of resonance offset. These pulse sequences are therefore ideal for suppression of intense solvent resonances, especially since they excite transverse magnetization with little variation in phase.