A Simple Method for the Preparation of Pseudopure States for NMR Quantum Computing

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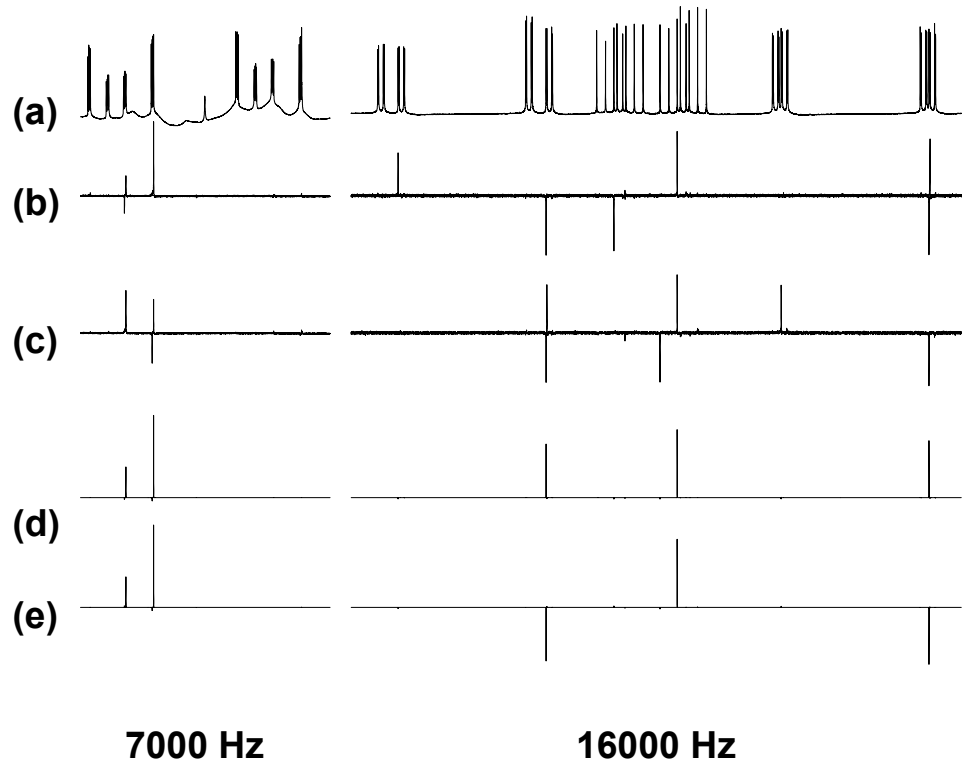
Quantum computing is a very active area of research in physics, chemistry, and computer science. The use of NMR to carry out quantum computing often requires the preparation, transformation, and detection of pseudopure states. The use of pairs of pseudopure states (POPS) as a basis for quantum computing is very convenient because of the simplicity in experimental execution. We have further demonstrated that the product of the NMR spectra corresponding to two sets of POPS that share a common pseudopure state has the same peak frequencies as those of the common (single) pseudo-pure state. This is by far the simplest method to prepare pseudo-pure states for multi-qubit spin systems.



(a) ^{1}H and ^{19}F NMR spectra of a 5-qubit system at the thermal equilibrium state. (b) Spectra for a pair of pseudopure states (POPS). (c) Spectra for another POPS. (d) Spectra obtained by (b)·(c). (e) Spectra obtained by |b|·(c).

The Effect of Weak Pulses applied to Systems with Broad Peaks in Nuclear Magnetic Resonance

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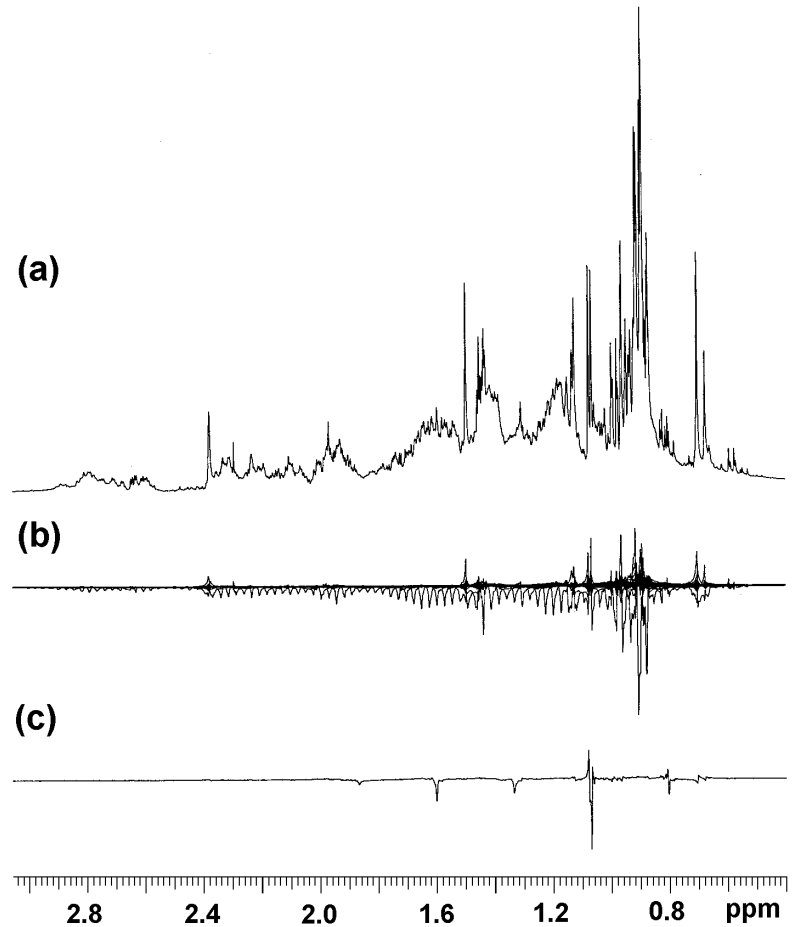
Previously we reported that the application of a multi-frequency weak radio-frequency pulse to a liquid crystal produces sharp inverted peaks, which can be used to store and process binary information.

Now we have found that inverted sharp peaks can also be observed in isotropic samples with many overlapping peaks. The spectra on the right were obtained for a solution of cholesterol in deutero-chloroform.

Computer simulations show that this unusual phenomenon is due to the cumulative effect of a weak pulse acting on many peaks that are slightly off-resonance on both sides of the irradiating frequency. This effect is the same for systems with either extensive spin-spin or dipole-dipole couplings.



(a) Normal spectrum. (b) Composite plot of 100 spectra, each obtained with a weak pulse. (c) Spectrum obtained with a 5-freq. weak pulse.