SW_f-TPPM-4: A Shorter Sequence

The effectiveness of SW_f-TPPM-11 and SW_f-TPPM-7 sequences is marginally enhanced on supercycling, the oscillatory behavior is removed, and the fluctuations in the intensities are suppressed. The price one pays is that these sequences are relatively lengthy and hence new sequences which are shorter are to be preferred. In an attempt to achieve this objective the efficiency of decoupling for the supercycled SW_f-TPPM-4 sequence was studied as a function of phase angle. Even though the sequences fail to suppress the fluctuations in intensities and to give effective decoupling at all the phase angles analyzed, it performs relatively well at the phase angle of 40°. These observations are presented in Figure 1.

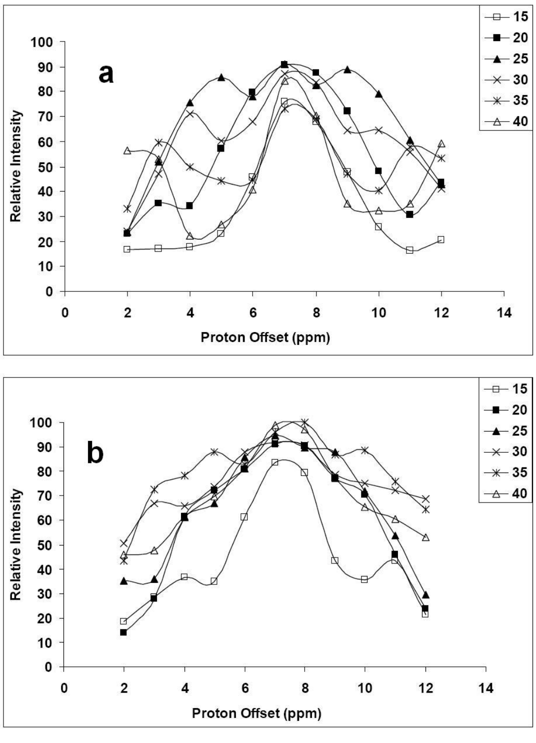

Figure 1. The relative intensities of the decoupled ^{13}C spectra of benzene at an RF power of 2.85 kHz using (a) SW_fTPPM-4 and (b) its supercycled version. Phase angles of 15, 20, 25, 30, 35, and 40° are used. The proton offset varies between 2 to 12 ppm with respect to TMS.

Role of Phase Angles in SW_f-TPPM sequences: Simulation Studies

A careful analysis of the trajectories of proton magnetization vector during SW_f-TPPM sequences reveals that the magnetization vector rotates according to the specified sequence from +z axis. Since the phase angle has a key role in determining the trajectory of proton magnetization vector during the sequence, the final position varies as a function of phase angle. The trajectory ends neither at +z or –z during SW_f-TPPM sequences as shown in Fig. 2. Here different phase angles are used for SW_f-TPPM-11 decoupling and the termini of the proton magnetization vector are marked.

But the trajectories traced by the proton magnetization vector during their supercycled SW_f-TPPM versions always come back and end close to the z axis irrespective of the phase angles. This is illustrated in Fig. 3 using supercycled SW_f-TPPM-11 sequence. This is true for all the other SW_f-TPPM sequences. For instance, Fig. 4-5 shows the behavior of proton magnetization vector during SW_f-TPPM-4 and its supercycled version respectively, at different phase angles. In these spheres, the trajectories are clearer than former examples. Irrespective of the phase angles supercycling brings back the proton magnetization trajectories into the starting point.

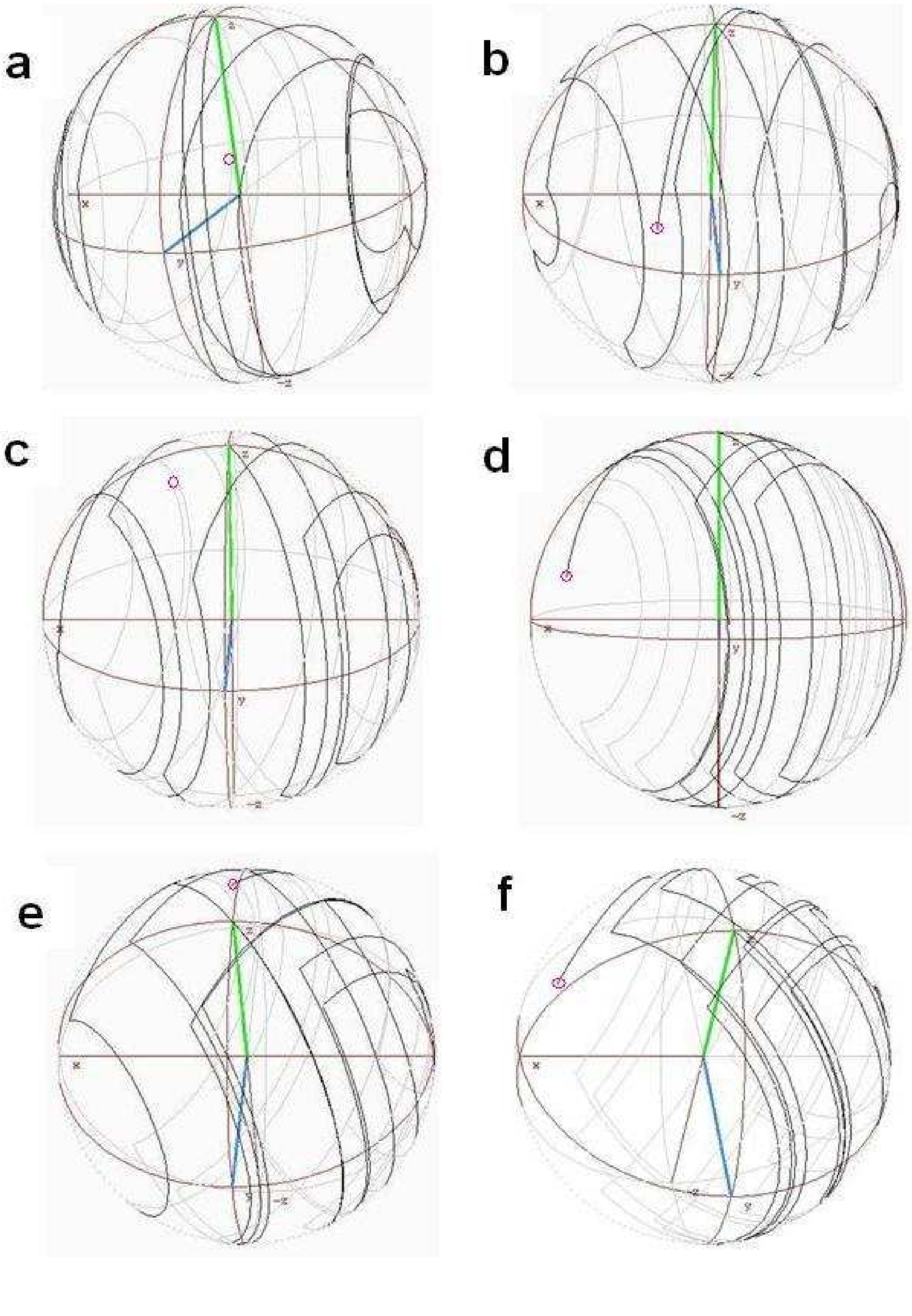

Figure 2. The simulated trajectory of proton magnetization vector during SW_f-TPPM-11 sequence. The phase angles are (a) 15°, (b) 20°, (c) 25°, (d) 30°, (e) 35° and, (f) 40° with a decoupling power of 2.85 kHz.

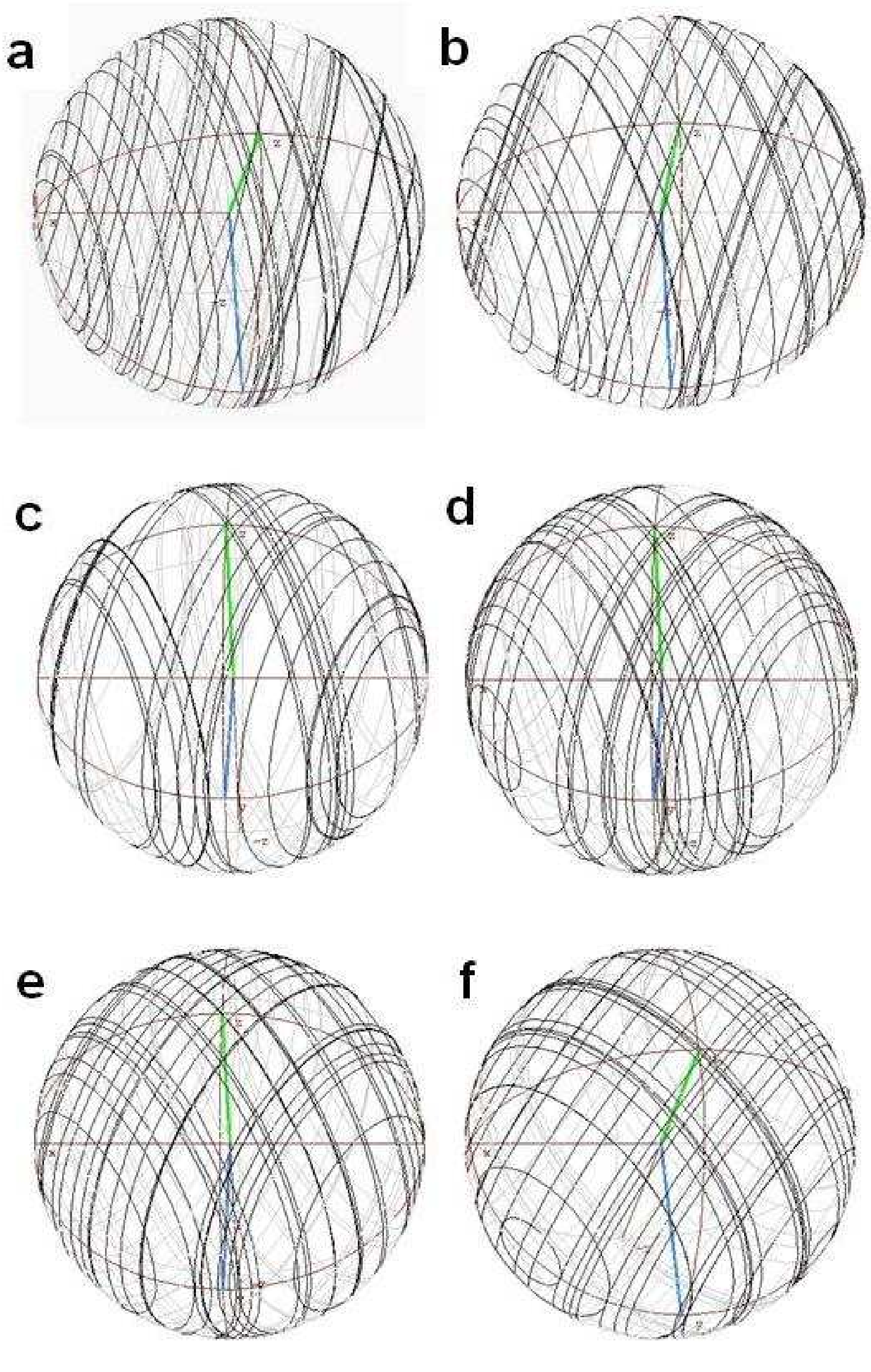

Figure 3. The simulated trajectory of proton magnetization vector during supercycled SW_f-TPPM-11 sequence. The phase angles are (a) 15°, (b) 20°, (c) 25°, (d) 30°, (e) 35° and, (f) 40° with a decoupling power of 2.85 kHz.

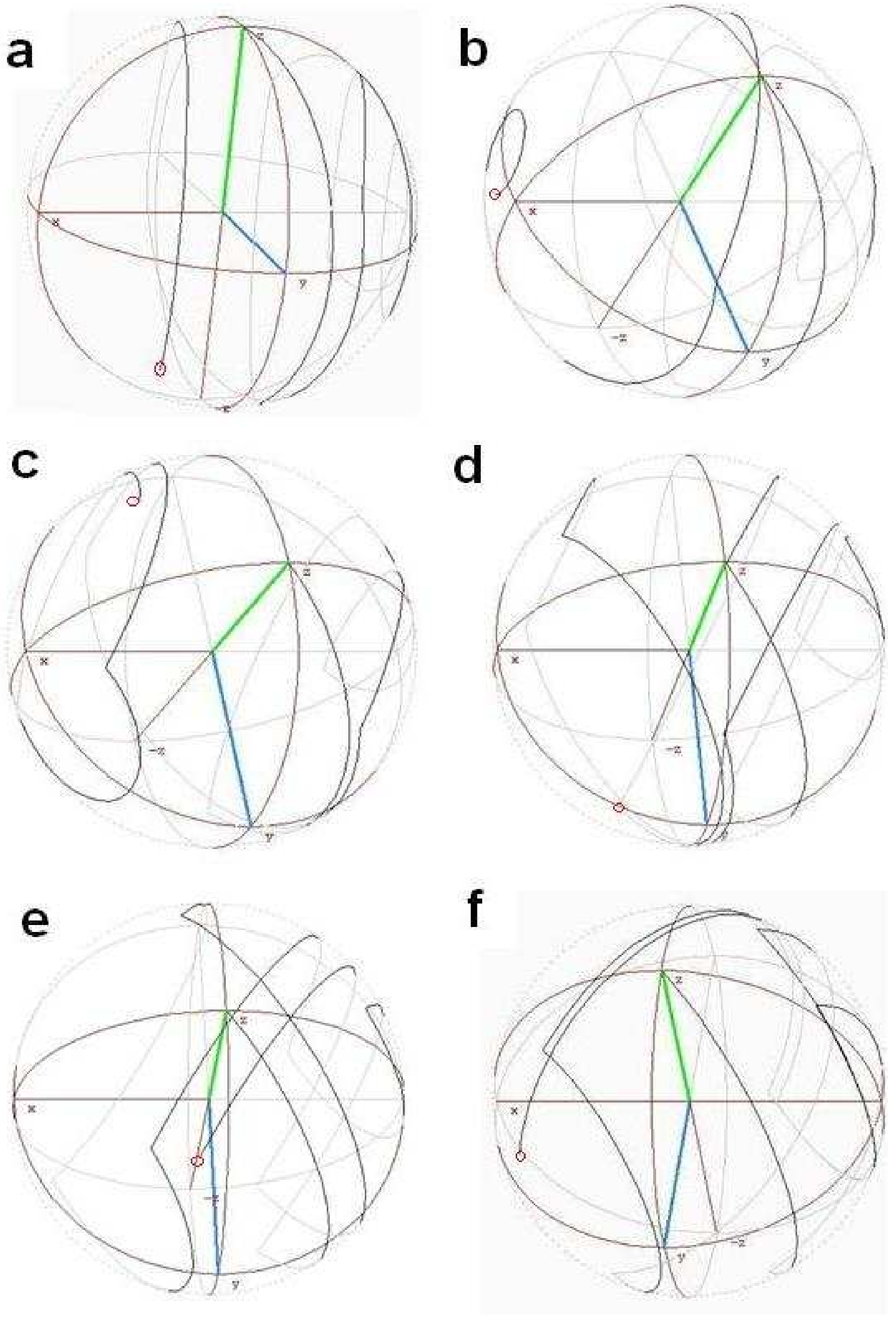

Figure 4. The simulated trajectory of proton magnetization vector during SW_f-TPPM-4 sequence. The phase angles are (a) 15°, (b) 20°, (c) 25°, (d) 30°, (e) 35° and, (f) 40° with a decoupling power of 2.85 kHz.

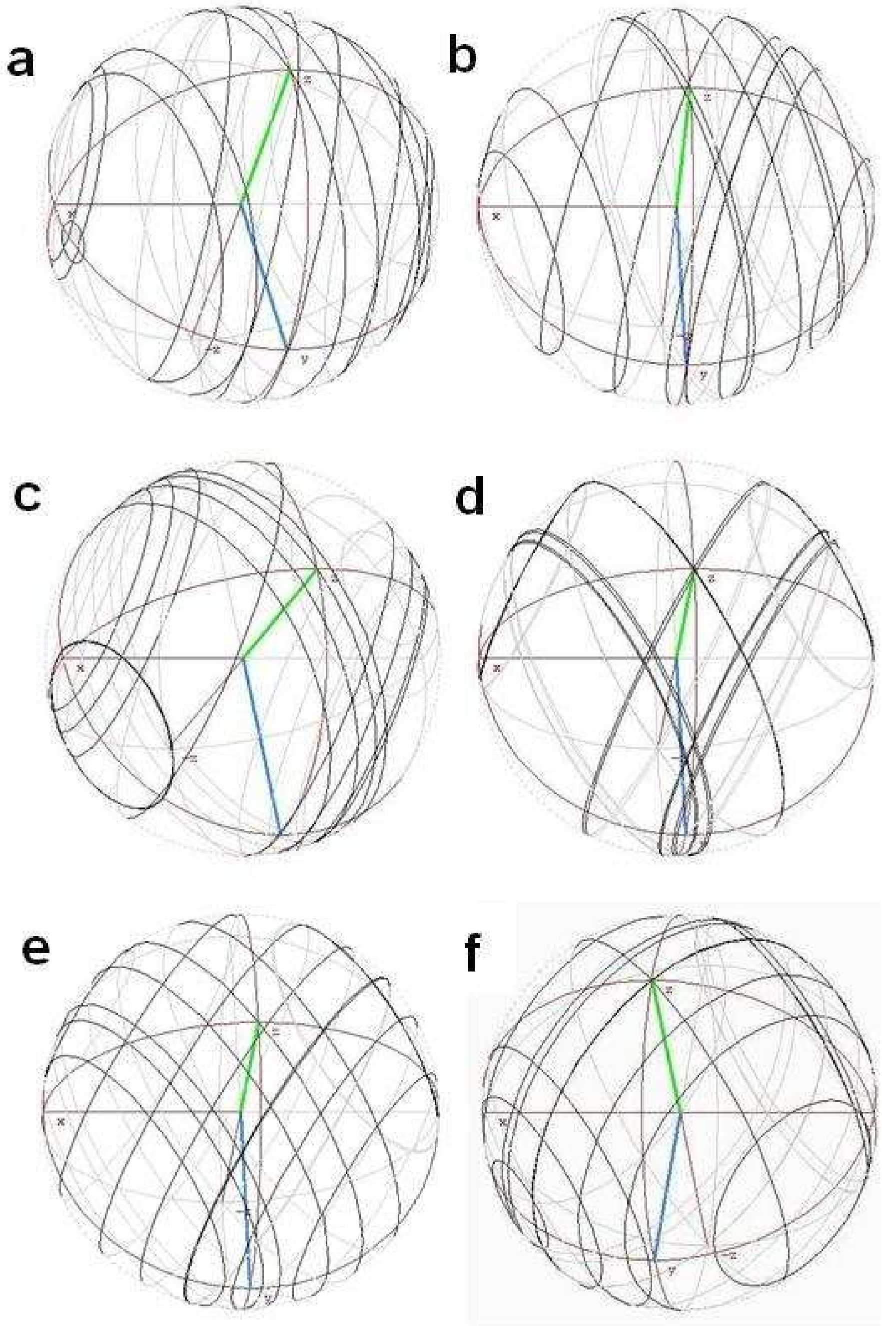

Figure 5. The simulated trajectory of proton magnetization vector during supercycled SW_f-TPPM-4 sequence. The phase angles are (a) 15°, (b) 20°, (c) 25°, (d) 30°, (e) 35° and, (f) 40° with a decoupling power of 2.85 kHz.