Bloch simulation and MR fundamentals visualized

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Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

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The MMCE conference offers a unique opportunity to reflect on established concepts. In two earlier MMCE meetings, I have discussed aspects of particular relevance to educators and students in the field of MR:

1. Myths often affecting introductory MR. These include wrong notions that nuclear magnetic moments align either parallel or anti-parallel to the magnetic field, and that spectra reflect sudden jumps between quantum eigenstates [1].
2. The validity of classical spin-visualizations, and the meaning that can be attributed to such from a Quantum Mechanics perspective [2].

This year's presentation concerns Bloch simulations and visualization of MR fundamentals for early MR education. It is a natural continuation where seeds sown earlier yield a crop. Having established the validity of apparantly classical visualizations from a quantum perspective (when interpreted with care), the topic is discussed with the help of interactive simulations using freely available educational software.

The presentation is targeted at people with a need to understand and communicate basic aspects of MR. Hence it is partly given as a tutorial on familiar concepts. The main tools employed is the CompassMR web page and app [3] aimed at Day 1 of NMR/MRI education, and the Bloch Simulator web application [4] that are useful for 3D visualization of uncoupled spin ½ dynamics. The latter is used to interactively explore a wide range of basic concepts and phenomena, including on and off resonance dynamics, frames of reference, relaxation, dephasing, echo formation, coherence pathways, and spatial encoding.

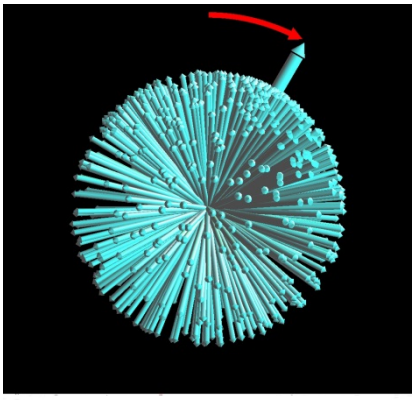

Figure: *Spin distribution rotated by RF field.*

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[4] Hanson L. G., A Graphical Simulator for Teaching Basic and Advanced MR Imaging Techniques, RadioGraphics 2007, 27(6):e27, http://drcmr.dk/bloch