Diffusion-weighted magnetic resonance imaging at ultra-high field

Propositions corresponding to the PhD-thesis entitled

Diffusion-weighted Magnetic Resonance Imaging at Ultra-High Field:

from ex vivo to in vivo imaging of the human brain

Francisco J. Fritz, defended on 11th January 2021

1. The use of relaxometry and diffusion MRI techniques can reveal non-invasively the biological macro and microstructure of the brain.
2. Ex vivo human brain MRI studies bridge in vivo MRI studies and histology.
3. k_T-dSTEAM and k_T-SSFP are well suited for the acquisition of sub-millimetre and multi contrast MR data, surpassing the challenges of using a 9.4 T human scanner for ex vivo whole human brain acquisitions.
4. Parallel transmit (pTx) imaging solves the severe B_1+ inhomogeneity at ultra-high fields for single and multiple RF-pulses sequences.
5. Ultra-high resolution data and highly sampled multi-contrast MRI images on the same specimen offers an unique opportunity of revealing the biological microstructure features in the brain using data-expensive signal models.
6. The correct and comprehensive signal modelling for the primary spin echo and the stimulated echo in STEAM are critical for enabling better acquisitions and multi-contrast analysis.
7. MESMERISED is a highly time efficient multi-contrast pulse sequence mapping for multi-component relaxometry, diffusion, and exchange analysis developed for in vivo MRI studies at 7 T.
8. An ideal MR study requires an optimised sequence, an efficient coil and an ideal subject or specimen, in that order.
9. Each MR sequence possesses advantages and disadvantages, and the most suitable sequence for the research question depends as much on the physics and signal analysis as on available hardware.
10. *In science, we have to be particularly cautious about* 'why' *questions. When we ask,* 'Why?'*, we usually mean* 'How?'. *- Lawrence Krauss.*