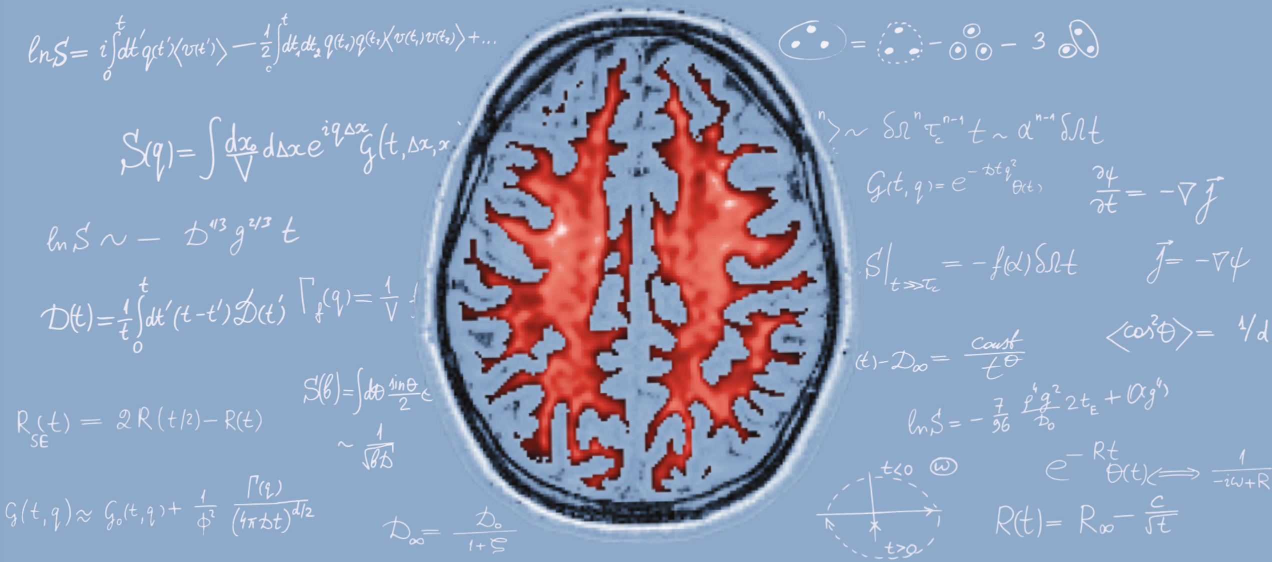

Physics of NMR Relaxation in Biological Tissue and Structured Media

a block course in five lectures

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10 — 14 March 2025, 11:00 — 13:00 + meet-the-teacher sessions afternoon (14:30 — 16:30).
Venue: MPI CBS, Stephanstrasse 1a

Magnetic resonance imaging (MRI) is indispensable for the modern medicine. While advancement in image acquisition have recently enabled sub-millimeter in vivo imaging, this resolution is a way too coarse to resolve individual biological cells, which are two to three orders of magnitude smaller. A similar challenge exists for NMR in porous media, with their fine microstructure. Getting statistical information about cells from in vivo imaging is the goal of the rapidly growing field of microstructural MRI. It is based on the fact that certain properties of MR signal, such as relaxation rates and measured diffusion coefficients, carry information about microscopic spin environment. Furthermore, these seemingly constant properties, cease to be constant in structured media such as biological tissues. Their dependence on time and the interplay with the measurement method reveal features of microstructure, despite averaging on the scale of image resolution. Adequate theory inspires measurement design and provides data interpretation in terms of the microstructure. It also reveals fundamental links to other domains of physics such as interactions and transport in disordered media.

The proposed block course is dedicated to the first step towards the microstructural MR, that is analysing how the tissue microstructure affects the observable transverse and longitudinal relaxations of water proton spins.

The course heavily relies on problem solving, the only way to real understanding (please, bring your pen and paper). Participants are supposed to be familiar with the basic principle of magnetic resonance, complex numbers, basic algebra and calculus.