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# Invitation

# LMU-Seminar

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**Title:** **Extending magnetic resonance spectroscopy with contemporary technology**

**Speaker:** **Dr. Andrin Doll**
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**Time:** **Wednesday, April 9th 2019, 14:00**

**Place:** **WBGB/019**

## Abstract:

The sustained progress in device technology is an important resource for spectroscopists, as it continuously extends the tools available to interact with matter. In this talk, I will show two examples of such technology-enabled extensions, namely (i) arbitrary excitation pulses at microwave frequency for broadband electron spin excitation implemented at ETH Zürich and (ii) the use of giant magnetoresistive sensors for detection of spin precession at microscopic scale at CEA Saclay. The first part about broadband excitation employs frequency-swept excitation pulses. These pulses exhibit spin dynamics according to Landau-Zener crossings, which can be traced at high fidelity under optimized experimental conditions. The advantages of these pulses are exemplified by a novel pulse sequence implemented at 34 GHz with an ensemble of molecular rulers that hold two nitroxide spins at a well-defined distance. In particular, this pulse sequence combines the ability to separate dipolar spin-spin interactions with Carr-Purcell dynamical decoupling for a prolonged phase memory time.

The second part about giant magneto-resistive (GMR) sensors elucidates to which extent the exceptional picotesla sensitivity of these magnetic sensors can be combined with magnetic resonance detection. The challenges of this approach are outlined by nuclear magnetic resonance (NMR) at 30 MHz / 0.7 T. In particular, the polarizing field of 0.7 T imposes an uncommon regime for GMR sensing that requires special consideration. Moreover, the GMR sensor itself causes NMR-relevant local magnetic stray fields due to its ferromagnetic layers and due to the current for resistance readout. Within this context, it is explained how GMR-detected NMR signals with narrow linewidths of 1 ppm have to be interpreted. In addition, a strategy for compensation of the GMR stray field is discussed. Since the strength of the polarizing field is a critical factor, work in progress towards GMR-detected continuous-wave electron spin resonance at 150 MHz / 5 mT is presented. A notable detail in this experiment is the use of an ultra low-cost software-defined radio as spectrometer.