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Visualizing the propagation of the neutron spin state at the MIEZE spectrometer RESEDA

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Modulation of intensity with zero effort (MIEZE) is a neutron spectroscopy technique with high energy resolution, closely related to the established neutron spin echo (NSE) method. The essential feature of MIEZE is an intensity modulated neutron beam with a focal point (echo point) several meters downstream the sample. Successful employment of the MIEZE technique requires careful preparation of the neutron spin states prior to scattering in the sample. Two radio-frequency spin flippers (RF-flipper) first split the neutron spin states energetically and recombine them at the detector position if tuned correctly to the so called MIEZE condition. While this phenomenon is precisely captured by analytical classical vector or quantum mechanical spinor models, they are based on simplifying assumptions and the results are hardly intuitive. This is where modern computational tools can improve our understanding on both fronts. First, it allows the incorporation of real world instrument conditions. Second, the spin states can be visually captured at every point in time.
Here, we present the first steps in using the Quantum Toolbox in Python (QuTiP) to simulate the neutron spin states as they propagate along the RESEDA beamline. Every step along the different neutron precession devices, the neutron spin gathers a phase, which we will visualize in short video clips presented on a tablet next to the poster in the attempt to further the understanding of MIEZE in the user community.

Primary authors: JOCHUM, Johanna K.; BEDDRICH, Lukas (Heinz Maier-Leibnitz Zentrum (MLZ)); Mr LVOVICH, Roman (RESEDA FRM II)

Presenter: Mr LVOVICH, Roman (RESEDA FRM II)

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