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Mulitplexing TAS measurements assisted by active learning

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Three-axis spectrometers (TAS) are versatile instruments to study inelastic neutron scattering. They allow high energy resolution investigations of fundamental excitations across various energy and momentum coordinates. However, traditional TAS methods are limited by point-by-point measurement in reciprocal space, which can be time-consuming and less effective for rapid kinetic studies. A promising method to more efficient TAS measurements is the multiplexing technique, such as Multiplexing-PUMA at MLZ. This method allows simultaneous measurements across multiple (Q, E_f)-channels, enabling broader reciprocal space mapping while maintaining high data quality.
The ARIANE (Artificial Intelligence-Assisted Neutron Experiments) approach has proven effective in optimizing single-point TAS measurements [1]. By applying machine learning techniques, it improves data acquisition efficiency. Building on this foundation, we propose an innovative extension of the ARIANE framework for multiplexing measurements in TAS. This extended approach will employ an active learning algorithm to dynamically identify regions of interest in the (Q,ω)-space. It will suggest and measure 11 different locations, provided it complies with the physical constraints of the PUMA multiplexing setup. This will significantly enhance information gain and overall experimental efficiency, maximizing the utilization of neutron beam time for users.

Reference: [1] Parente et al., Nat. Comm. 14, 2246 (2023)

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