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Nuclear analytical facilities on a cold neutron beam at MLZ, Garching

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The cold neutron beam at MLZ offers unique conditions for nuclear analytical chemistry. The analytical facility accommodates several instruments being under development or recently upgraded. This paper summarizes the progress, and the possibilities these instruments offer.
The focusing guide is being replaced with a truly-curved elliptical guide ensuring a more homogeneous beam with a smaller divergence and with coinciding focal points, which serves all instrumental setups much better. The detectors and their cooling systems have been renovated and upgraded. At the same time, new spectrometers are employed enabling better Compton suppression, improved timing for coincidence measurement together with list-mode acquisition. These feature will be used in new dynamic in-beam activation analytical measurements.
Prompt Gamma Activation Analysis (PGAA) is a routine technique used since the reactor start. It exploits the advantages of the strong neutron beam with measuring small samples (with masses less than a mg), or activating them in the nearly parallel cold neutron beam with counting the activity in a dedicated low-background chamber. In-beam activation analysis (ibNAA) proved to be an important addition to PGAA. This technique can be further developed with many repeated irradiation and counting cycles using a transfer system to a low-background position on the top of the PGAA setup. The irradiation and counting times could be as short as 1 s, while the transfer times a few tenths of a second. With this cyclic in-beam setup, several hard-to-measure elements, like F, Ag, Pb, even O-19 isotope become available with much better sensitivities.
PGAI is a possible alternative setup enabling imaging combined with PGAA. It is still in development phase.
Detecting the neutron-induced charged particles offers a further broadening of the analytical horizon. Activation products emitting no gamma rays can be detected using scintillator detectors, e.g. liquid scintillation counting directly irradiating the sample in liquid form. Another hard-to-measure element P can thus be determined even on trace levels.
A new instrument has recently been introduced at the PGAA facility; Neutron Depth Profiling (NDP) also detects the neutron-induced charged particles (protons, tritons and alpha particles) emitted in the surface layers (max 50um). This allows for the determination of the concentration profiles of certain light nuclides, like Li-6, B-10, or He-3.
The FRM II reactor has not been operational for more than year. Its restart is planned for the fall this year in thermal mode. The guide system, optimized for cold neutrons, will provide a lower flux. The new setups can be tested in this operational mode. The instruments will be available for external users with limited capacities.

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