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Developments at the Nuclear Analytical Facilities at MLZ, Garching

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The prompt gamma activation analysis (PGAA) facility has continuously been developed at Heinz Maier-Leibnitz Center (MLZ). Four Compton-suppressed HPGe detectors equipped with modern cooling systems and 64k digitals spectrometers have been used for analytical and nuclear-physics experiments in the strongest cold neutron beam of the world. The standard PGAA setup consists of a 60-% and a low-energy HPGe detector both surrounded by BGO scintillators. A low-background chamber with a similar equipment has been added to count decay gamma rays of short-lived activation products thus enabling in-beam neutron activation analysis (ibNAA). [1]
NAA has recently been added to the instrument pool available to external users. The samples are irradiated in the highly thermalized channels of the reactor and a rabbit system transfers them to the counting labs where three HPGe detector equipped with digital spectrometers count them.
The planned upgrade project at MLZ, MORIS offers us a unique opportunity to initiate developments at our facility far beyond the standard implementation of gamma-ray spectrometry from neutron capture. The presentation summarizes also these plans.
The feasibility of Prompt Gamma Activation Imaging (PGAI) was shown in the frame of the ANCIENT CHARME projects several years ago [2]. It is based on the narrow collimation of the neutron beam to, and of the gamma rays emitted from predefined spots of complex objects. The method is highly time-consuming and after the first studies, there has never been enough beam time to use it routinely in spite of the obvious need for it. We plan to use a detector cluster consisting of seven HPGe detectors each of which would observe one voxel along the line activated by the neutron beam. This alone would speed up the experiment, but with applying multiple collimator channels within the gamma shielding, we hope to gain nearly two orders of magnitude in the duration of single scans.
To broaden the circle of the analyzed elements, our goal is to detect all possible particles emitted by the activation products, e.g. beta particles which in several cases are not followed by gamma radiation. This would be important e.g. in determination of the phosphorus dopant in silicon semiconductors. This requires a combination of a scintillator counting in 4π solid angle with a HPGe detector.
We also plan to test a new setup at the fast-neutron radiography station NECTAR. It would exploit imaging with inelastically scattered fast neutrons in coincidence with gamma rays identifying the emitter element.

References
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