RADEN におけるパルス中性子イメージングに向けた μNID 検出器の開発
Development of the μNID Neutron Imaging Detector for Pulsed Neutron Imaging at RADEN

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The energy-resolved neutron imaging system, RADEN [1], located at beamline BL22 of the J-PARC Materials and Life Science Experimental Facility (MLF), began operation in November 2014 as the world's first dedicated pulsed neutron imaging instrument. In addition to conventional radiography, RADEN was designed to take full advantage of the pulsed neutron beam of the MLF to perform *energy-resolved neutron imaging*, techniques which allow us to directly image the macroscopic distribution of microscopic quantities such as crystallographic structure, internal strain, elemental density and temperature, and internal/external magnetic fields. To carry out these measurements in the high-intensity environment at RADEN, we use cutting edge detector systems, recently developed in Japan, employing technologies such as micropattern detectors and high-speed, Field Programmable Gate Array based data acquisition systems to provide the necessary sub-μs time resolution, high count rates, and strong background rejection [2].

In this presentation, we will discuss one such detector, the μPIC-based Neutron Imaging Detector (μNID) [3]. Incorporating a micropattern detector known as the Micro-Pixel Chamber (μPIC) and ^{3}He gas as the neutron absorber, this detector currently achieves a spatial resolution of 0.28 mm (FWHM), time resolution of 0.6 μs, neutron count rate of 0.6 Mcps, ultra-low gamma sensitivity of less than 10^{-12}, and detection efficiency of 18% for thermal neutrons. Ongoing development is expected to significantly improve the spatial resolution (by nearly a factor of two) and neutron count rate (by more than an order of magnitude) through upgrades to all components of the detector system. Recent results of this development work will be presented.

References

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