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High-spatial resolution neutron imaging by using current-biased kinetic inductance detector

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We developed a neutron transmission imager based on a superconducting current-biased kinetic inductance detector (CB-KID). The CB-KID comprises X and Y meanderlines and a 10B conversion layer for neutrons. A 4He or 7Li ion from the 10B(n, α)7Li reaction creates two hot spots in both the X and Y meanders. A pair of electromagnetic-wave pulses of opposite polarities propagate toward the ends of meanderlines[1]. The position of the nuclear reaction point can be evaluated from a difference in arrival timestamps of the two pulses at the two ends. We used a set of analog signal discriminators with fixed thresholds and a time-to-digital converter (TDC) with 1-ns time resolution to recover the signals from 25-Hz pulsed neutrons of J-PARC. The energy-integrated spatial resolution reached 22 μm[2]. Further improvements in spatial resolution can be achieved by using a pair of CB-KIDs to compensate the randomness of the emitted direction of light ions from the 10B reaction. PHITS (Particle and Heavy Ion Transport code System) is a Monte Carlo particle transport simulation code developed to deal with the transport of all particles over wide energy ranges, using several nuclear reaction models and nuclear data libraries[3]. PHITS simulations demonstrated that the neutron imaging can be enhanced appreciably with two CB-KIDs.
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Less than 5 years of experience since completion of Ph.D

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