Development of Two-Dimensional Neutron Imager with a Sandwich Configuration


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(A) Abstract

+ We are conducting experiments to examine the equivalence principle in Quantum regime.
+ Time-resolved neutron imager is an essential device for the experiment.
+ We have developed boron-coated SOI-CMOS based imager, called 16B-INTPIX.
+ It showed fine spacial resolution less than 4 microns as a sigma of line spread function[1].
+ To mitigate/correct the one of error sources on the neutron positioning, new neutron imager with sandwich configuration, 16B-INTPIX4-sw, has been developed.
+ This presentation shows the first measurements of neutron with this new imager configuration.

(B) Testing Equivalence Principle

+ Discussions regarding the expression of the equivalence principle within the framework of quantum theory are not mature.
+ We expect to develop and test models for that, by analysing a spacial and a temporal behaviour of quantum bound states of ultra-cold neutrons (UCNs) under the gravity.

= (1) demonstration of the binding system of UCNs[2] =

= (2) testing equiv. principle in quantum regime[3] =

(C) Neutron Imager with Sandwich Configuration

sandwich configuration

signal cluster [1]

specification of the base sensor (INTPIX4):
- pixel size: 17 x 17 microns²
- number of pixel: 832 x 515 pixel
- readout time: 280 ns/pixel
- wafer thickness: 300 microns

(D) Response Tests

- at Los Alamos Neutron Science Center (LANSCE)

+ The cleaner remove higher energy UCNs.
+ It was set to extract 100 neV UCNs.
+ UCN flux was measured to be 1.8 1/cm²/s by ZrS/16B reference detector

(E) UCN Signals

Li-particle origin
alpha-particle origin

coloured circle: paired event
front-side sensor
111 => 46 events
back-side sensor
133 => 46 events
+ acceptance of the confidence condition is about 1/3

position difference of the paired cluster

estimated neutron position

no converter here

Acknowledgements

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We appreciate Dr. Toshinobu Miyoshi for his significant contribution in the early stages of the development.

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