High Resolution Neutron Detection using GridPix chips

Markus Köhli, Fabian P. Schmidt, Markus Gruber, Jochen Kaminski, Klaus Desch

The world of detectors used in thermal neutron scattering experiments has changed. By each on the future Helix 9 facility, critical to perspectives of the large scale research infrastructure, new superconducting technologies evolve. All of these elements can be realized due to developments in particle physics and are consistent with recent aspects of lattice QCD. The Time Projection Chamber principle is a high resolution, rapid reading technology to detect the time of arrival of individual particles. Current GridPix technology is developed to equip the detector with an extremely compact, robust structure, providing the readout for an array of about 100,000 pixels. The results show a high spatial and time resolution of about 25 μm and 100 ps, respectively.

References

University of Bonn
M. Köhli et al., M. Lupberger, et al
Software Operation for Octoboards serving customizable Scalable Readout System (SRS)

The Timepix 4 Microstrip Detector Chip

GridPix 8-chip board

Readout Electronics

Scalable Readout System (SRS)

Event reconstruction

Innovative Neutron Detection

towards a neutron time projection chamber

- using pixel chips
- equipped with InGrid meshes
- for high time and spatial resolution

Detector Method

A Time Projection Chamber consists of a large volume filled with a gas. Particles leave ionization tracks which are converted into an electronic signal outside the beam. This allows for time and spatial resolution.

Test Detector

Trigger & Track Principle for the neutron TPC

Event Reconstruction

Formulae

Timepix 4 TPC

Specifications:
- Chip size 25 × 25 mm²
- Time resolution 250 ps
- Spatial resolution 50 μm

Readout: lithium drifted silicon

Pixel size 525 μm × 525 μm

Spectra:
- TOT Spectrum from tracks
- TOT Spectrum from single pixels

Results

The Timepix 4 microstrip detector was tested at different neutron energies and was compared to a traditional time projection chamber. The reduction in pixel size provides an enhanced spatial resolution of about 25 μm and 100 ps.

References

ICNS Proceedings. doi: 10.1016/j.physb.2018.03.026

M. Köhli et al., M. Lupberger, et al
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