Development of very-high Rate and Resolution Neutron Detectors in DETNI

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For time- and wavelength-resolved neutron scattering experiments with up to 10^8 n/s per detector module and two-dimensional position resolution of up to 50-100 µm FWHM in the current (2004-2008) EU Joint Research Activity DETNI of NMI3 (http://jra1.neutron-eu.net/jra1) three neutron detector types and a dedicated event-triggered ASIC family are being developed. These high-contrast single-event counting detectors shall replace integrating detectors e.g. in diffraction or radiography and tomography experiments. The ASIC type delivers single micro-strip, pulse-height (energy) and time readout with 2 ns time resolution. The latter is sufficient to suppress chance coincidences between the X- and Y-planes, whilst the energy resolution is used for background suppression and for improving the position resolution by center-of-gravity determination. Except for neutron scattering, e.g. at next generation pulsed spallation neutron sources like ESS, modified versions of two of these detector types and the ASIC family will also be suitable for X-ray detection. These detectors are (i) double-sided silicon micro-strip detectors (Si-MSD) with 51x51 mm^2 size and 80 µm pitch, of which four are combined in one detector module and (ii) hybrid low-pressure micro-strip gas chamber (MSGC) detectors of 254x254 mm^2 sensitive size with columnar CsI converter layers. For thermal neutron detection in both cases ≈3 µm thick ^{157}Gd converters are used, in the MSGC case in composite ^{157}Gd/CsI converters with columnar CsI of <1 µm thickness. For X-ray detection in the MSGC a CsI converter thickness of a few tenths of µm can be used. In this invited talk the detector principles and the present state of development will be reported.

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