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Design study of the new HiCoReLAN detector

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Modern neutron Multi-Wire-Proportional-Chambers operating with alternative solid-state converter as $^{10}B_4C$ coatings have the potential to surpass the position resolution and count rate capability of ^3He based detectors at comparable detection efficiency [1, 2]. The use of large area converter coatings on sub-mm substrates makes it essential to develop a mechanical concept to avoid their deformations in operation due to their own weight and acting electrostatic forces resulting from the applied HV for gas amplification. HZG has introduced [1] and investigated the idea of stabilizing the converter elements by gas pressure gradient between both sides of the converter to counteract these forces. A gas vessel-free PSD consisting of 24× parallel stacked converters with a detection depth precision <12 mm was designed for a position resolution of 2 mm. The deposition method of $^{10}B_4C$ coatings with thicknesses up to 10 µm on pretreated Al substrates was elaborated [2, 3]. The delay-line read-out of the detector is designed for count rates up to >200kc/s per detector plane. First neutron tests at the ESS test beamline V20 of the new read-out chain connected to a small $^{10}B_4C$ neutron prototype detector verified the envisaged signal to noise ratio.
[1] European Patent: EP 17184906.0 (filed at 04.08.2017)
[2] European Patent Application 2 997 174 (14.07.2014)
[3] G. Nowak et al., J. Appl. Phys. 117, 034901 (2015)

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