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A new ring scintillation detector wihout blind areas for neuton diffraction

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We developed a new ring neutron detectors based on ZnS/LiF scintillators and solid-state photomultipliers (SiPM) for powder neutron difractometers. This detector can capture full Sherrer's ring and therefore can provide the most effective regustration of scaterred by sample neutrons. The design of the detector allows completely avoiding blind areas. The developed detectors consisst from linear scintillation counters developed and fabricted in INR RAS [1]. This counters use for light readout a lightguide with diffuse reflection. The light readout by this method is more effective than the wavelenght shifting fibers - up to 80 photoelectrons [2-3]. These ring detectors are successfully tested on time-of-flight diffractometers at spallation source RADEX of INR RAS [3]. The efficiency of thermal neutrons registration can reach 70%. It is also possible to create multi-layer detectors to increase efficiency. We also developed counters with trapezoidal lightguide for assembling of the ring detector. This method allows us to achieve 0 % of blind areas. This method has patented [4]. Proposed schemes will make it possible to create highly efficient, compact and lightweight detectors that do not require high voltage (because used solid-state photomultipliers). Due to the miniaturized sizes of photodetectors, these detectors have proved to be an effective and inexpensive alternative to 3He-filled detectors.

[1] Marin V.N., Sadykov R.A., Trunov D.N. et al. Tech. Phys. Lett. (2015) 41: 912.

[2] Litvin V.S., Marin V.N., Karaevsky S.K. et al. Crystallogr. Rep. (2016) 61: 106.

[3] Marin V.N., Sadykov R.A., Trunov D.N. et al. Instrum Exp Tech (2018) 61: 1.

[4] Patent RU 177857, 17.12.2017.

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