Progress in the creation of a matrix track detector

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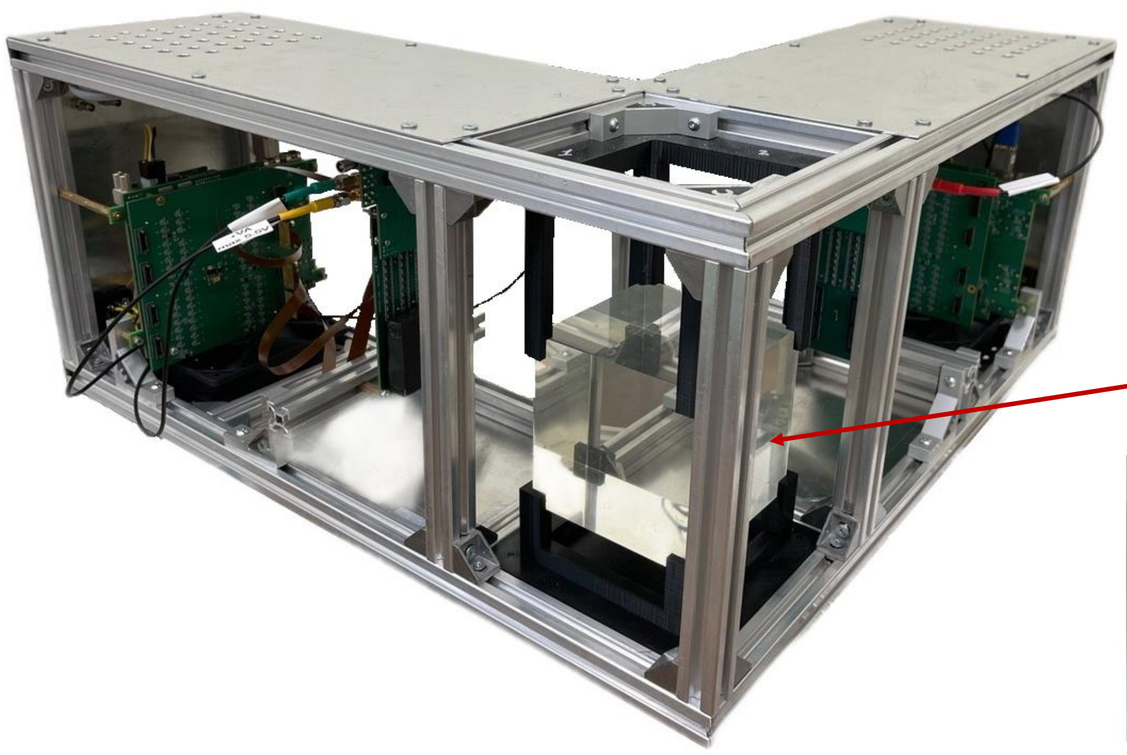
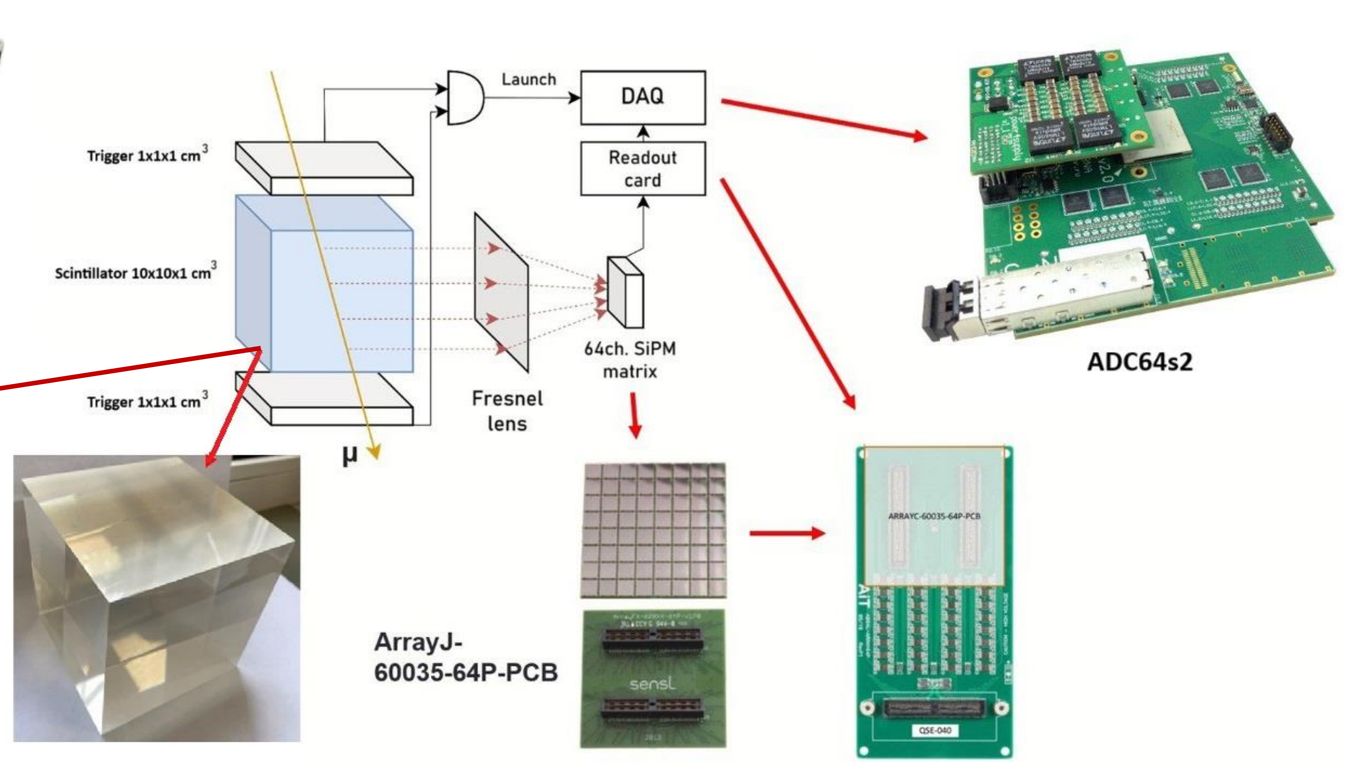
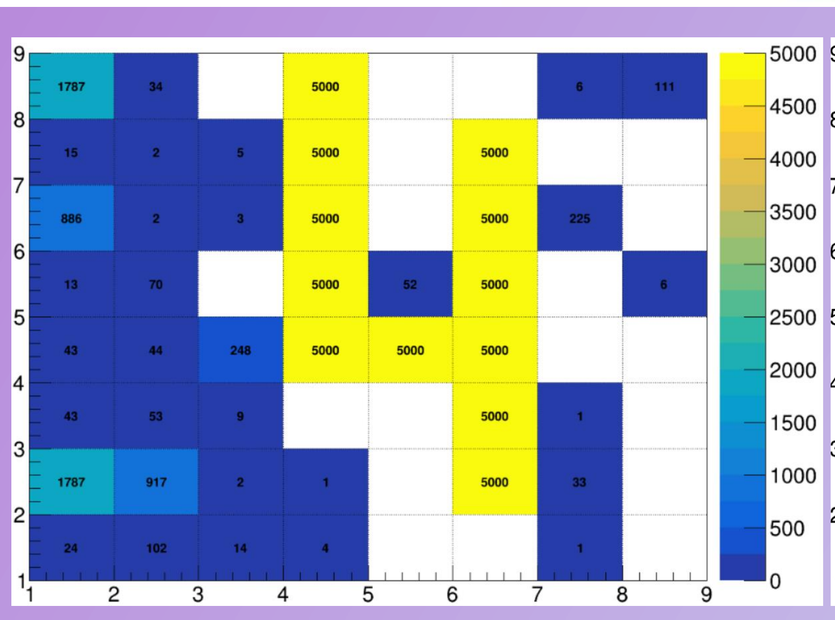
Abstract. A track scintillation detector based on SiPM matrices has been developed. The detector has two arms oriented at 90 degrees relative to each other. To obtain an image of the particle track, it is necessary to focus the scintillation light on the SiPM matrix. The report describes the measurement process using Fresnel lenses.

A two-arm 128-channel track detector has been developed. The detector is based on the Onsemi SiPM matrix (8x8 photodetectors) [1]. The matrix was used as a position-sensitive element in the detector. The radiation from the particle track passing through the active part of the detector (scintillator) will be focused and projected onto two matrices through the optical system (set of lens) [2]. Information about triggered SiPMs from the matrix was supplied through a special board with integrated signal amplifiers to the data acquisition system (two ADC64s2 produced by JINR). All elements of the detector are located in metal frame and light-insulated.

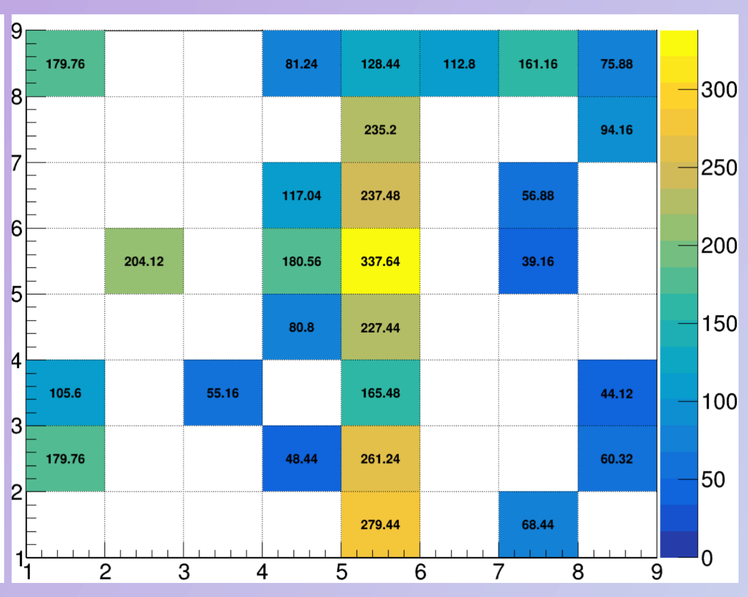




The calibration was performed using a blue laser. The laser signal was applied individually to each SiPM channel via 1 mm optical fibers and special 64 channel holder. This calibration system allows to get a direct correspondence of the SiPM with the channel in the ADC. As a result of the individual channels calibration, a series of visual measurements was carried out. Thus, we have full correspondence of the ADC channels and SiPMs (see figure «four»).



Calibration using a laser signals



Muon track using a Fresnel lens

After calibration, measurements were carried out with a short-focus Fresnel lens with a focal length of 2 cm. The lens was installed at a distance of 10 cm from the thin scintillator (10x10x1 cm^3). Two 1x1x1 cm^3 trigger counters were used to selection the area under study. As a result, well-recognized tracks from cosmic muons have been obtained from both arms of the detector.

Summary

- A two-arm track scintillation detector has been developed and calibrated;
- Well-recognized tracks from cosmic muons with a short-focus Fresnel lens were obtained;
- The next stages of the work is supposed to tests the detector with CAEN electronics (DT5550W Readout System for SiPM matrices) and new 12x12 matrix (optionally), and liquid scintillators as an active part.

References:

[1] 64-channel SiPM matrix (Onsemi ArrayJ-60035-64P-PCB). URL: https://www.onsemi.com/pdf/datasheet/arrayj-series-d.pdf

[2] Ustinov, V.V., Kutinova, O.V., Sakulin, D.G., Sukhov, E.V., Ustinov, D.V.. Prototype of a Track Scintillation Detector Based on SiPM Matrices. Physics of Particles and Nuclei Letters, 2024, Vol. 21, No. 4, pp. 743–746.

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