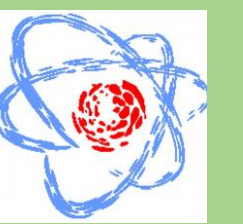
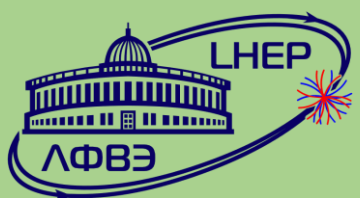


The SPD Beam-Beam Counter scintillation detector prototype tests with FERS 5200 front-end readout system



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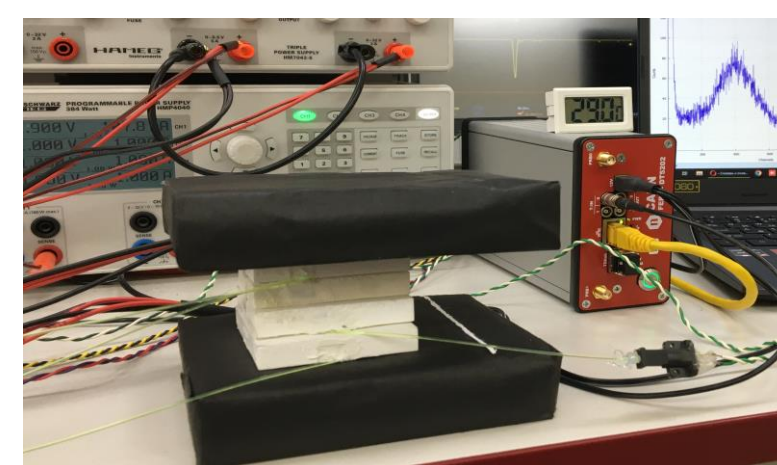
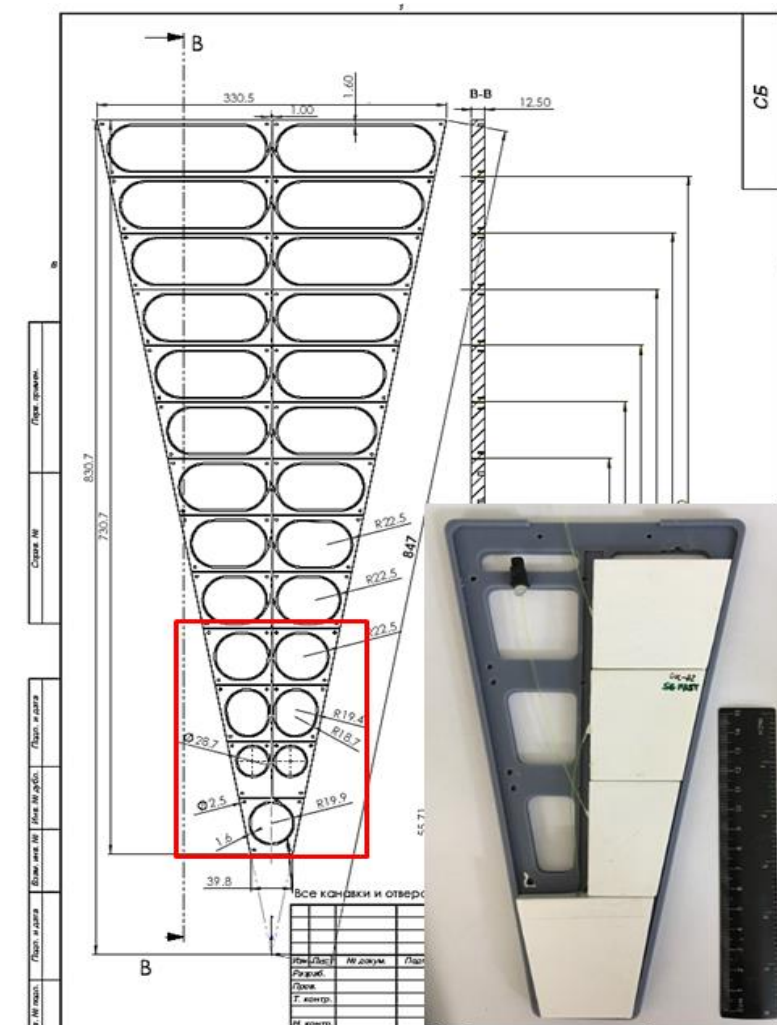
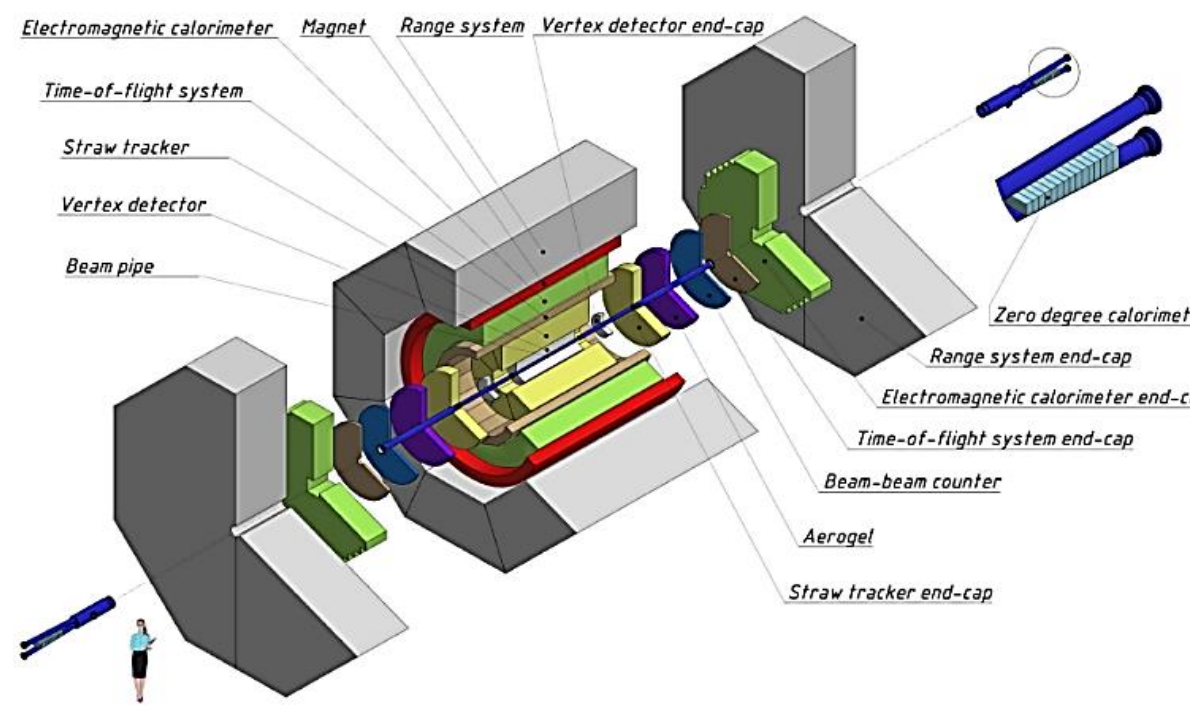
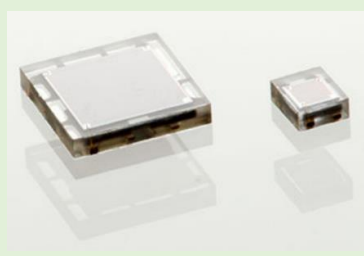
Introduction

The **Spin Physics Detector** is an experiment at NICA designed to study the spin structure of the proton and deuteron and the other spin-related phenomena using polarized beams. The collision energy is up to 27 GeV and the luminosity is up to $10^{32} \text{ cm}^{-2} \text{ s}^{-1}$ in pp mode.

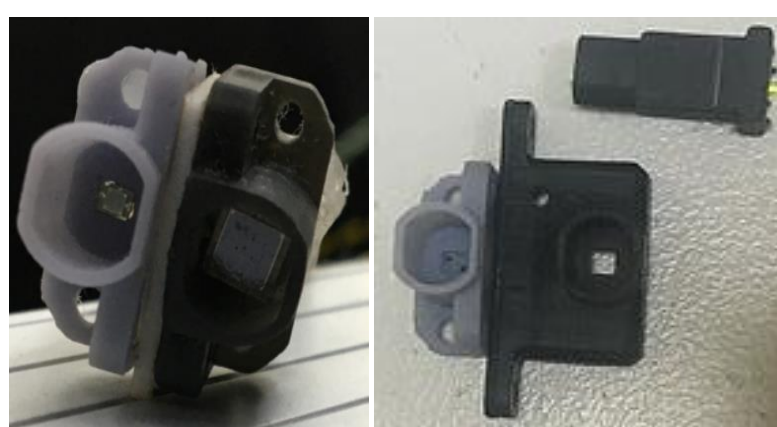
The SPD will include complex subsystems, and one of them is the **Beam-Beam counters (BBC)**. Two scintillator-based detectors, BBC, will be installed symmetrically upstream and downstream the interaction point. The main purpose of the BBC is the permanent monitoring of the beam polarization using the azimuthal asymmetry of the inclusive charged particles yield.

The proposal **geometry of BBC** contains 16 sectors with 25 tiles in each one. Currently, the selection of the final options for the build of **7 detector prototype sector tiles** is actual task. The **BBC prototype options** consist of: "Uniplast" produced scintillators, scintillation optical fibers, optical cements, sizes of SiPM.

In this talk, we present the tests of the BBC prototype based on the tiles with the WLS and SensL SiPM readout. The prototype was tested with **1x1 mm²** and **3x3 mm²** SensL SiPM with the FERS-5200 front-end readout system. The amplitude and timing resolutions for different tiles using cosmic rays are obtained.

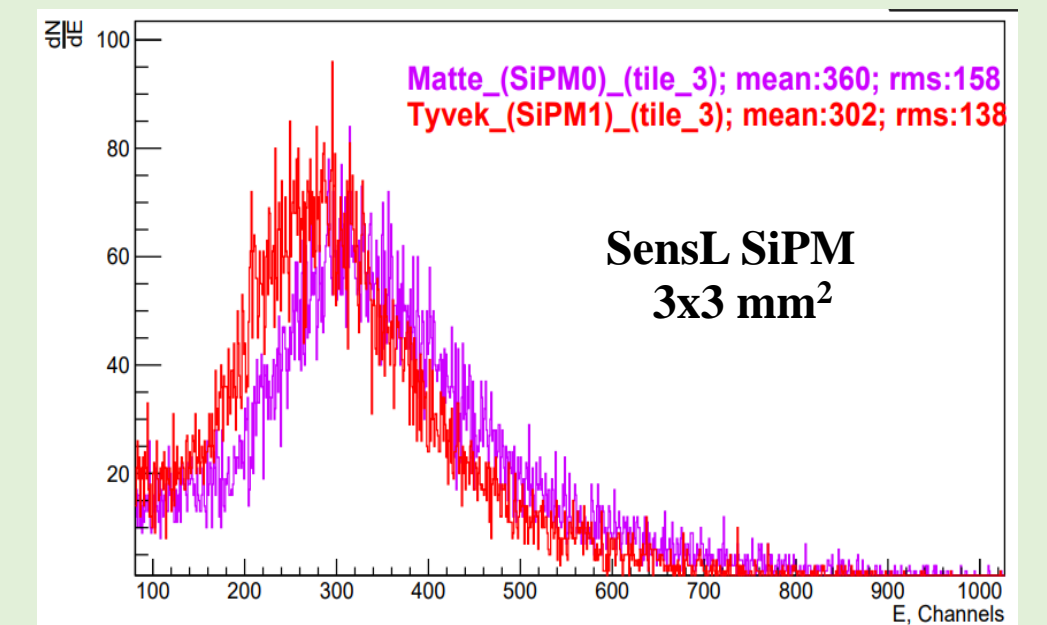


Trigger time resolution ~650 ps



Scintillator's cover selection

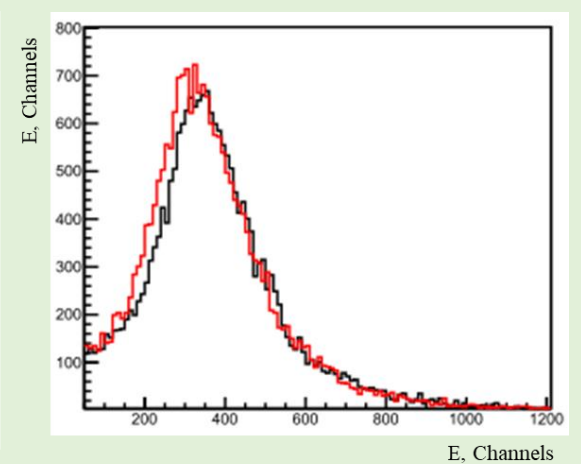
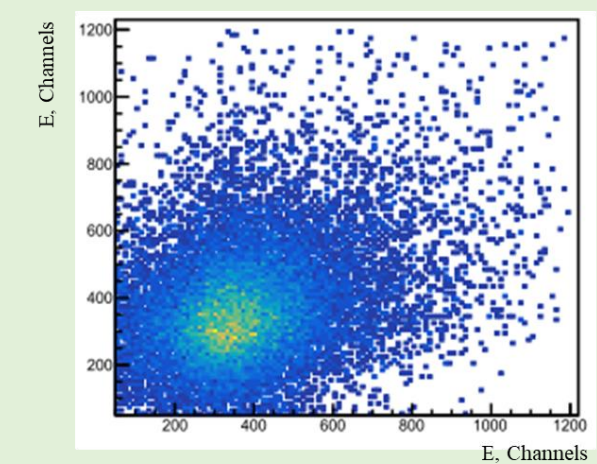
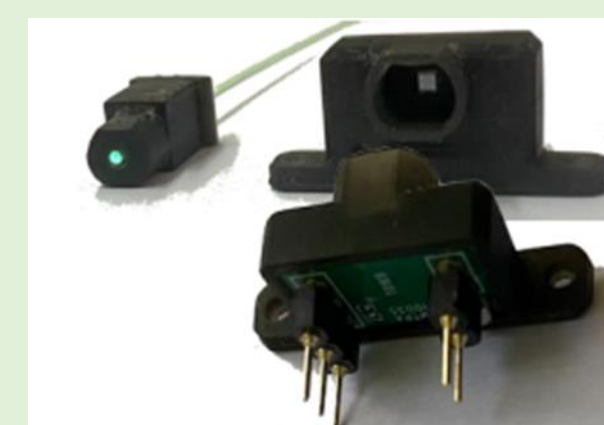
We used tile covered with white acrylic paint (matte) and tile, double covered with a unique non-woven material made from high-density polyethylene continuous filaments (Tyvek)



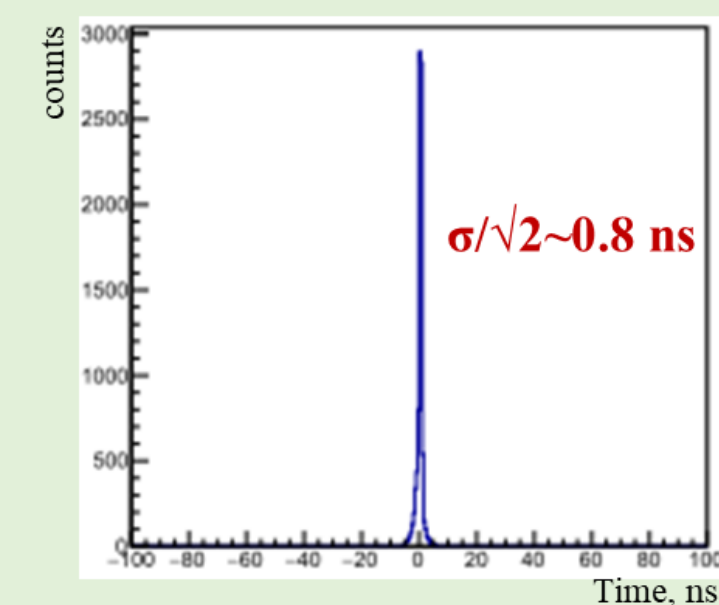
The result is similar, and due to the fact that the option with Tyvek covered tiles carries the technological complexity of mass production, the option with matted one is more acceptable.

SensL SiPM 1x1 mm² tests

The SiPMs of one series, but of a **different form factors**, were compared. In the first case, the contacts are soldered to the board at the manufacturer's factory, and in the second one at the request of researchers (in a outside organization).

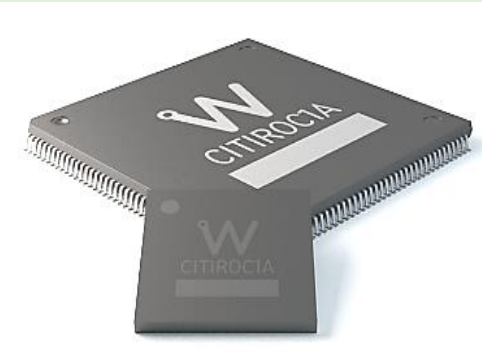
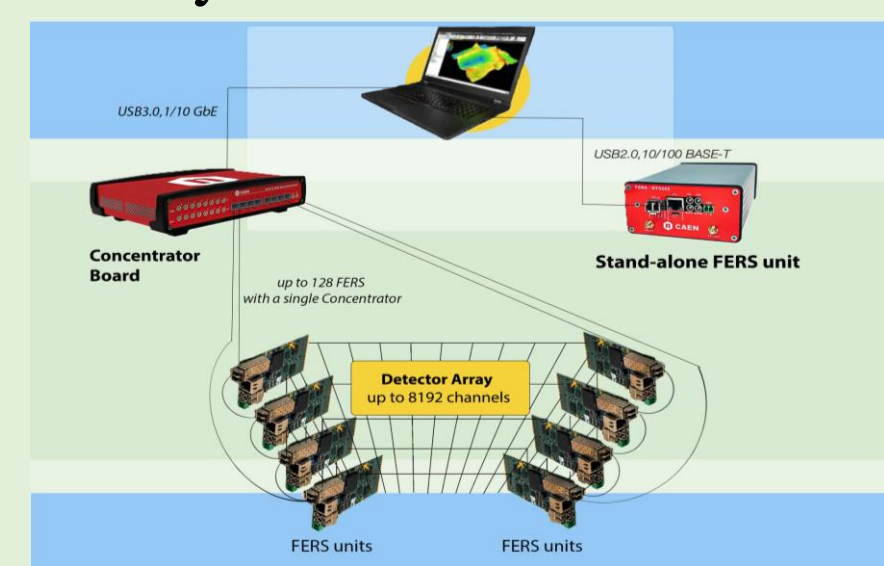


The important result was the absence of a significant difference between the SiPM of various form factors. In conditions of minimizing the space for the detector, and in the absence of a visible difference, the smaller size has the higher priority. In addition, the first case is about 3 times more expensive, which affects to the final cost of the detector.



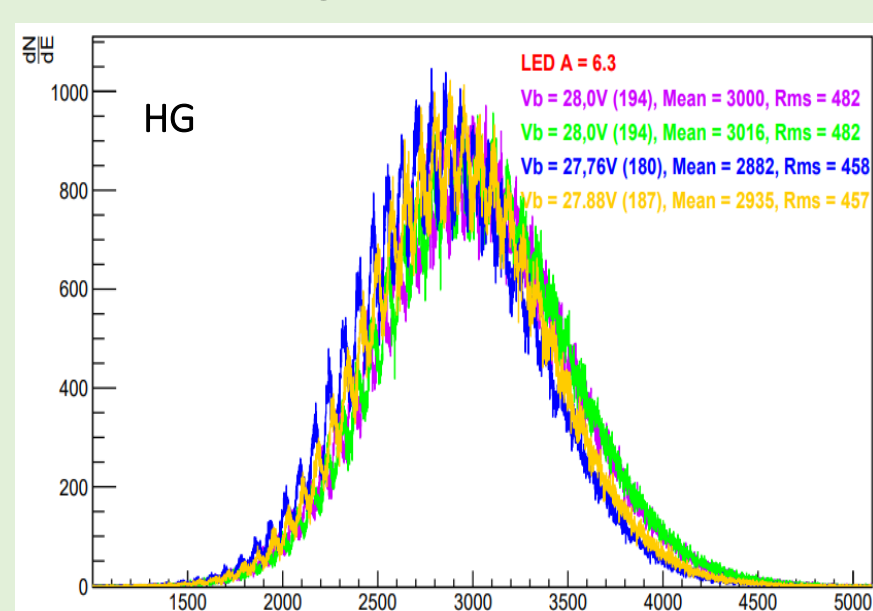
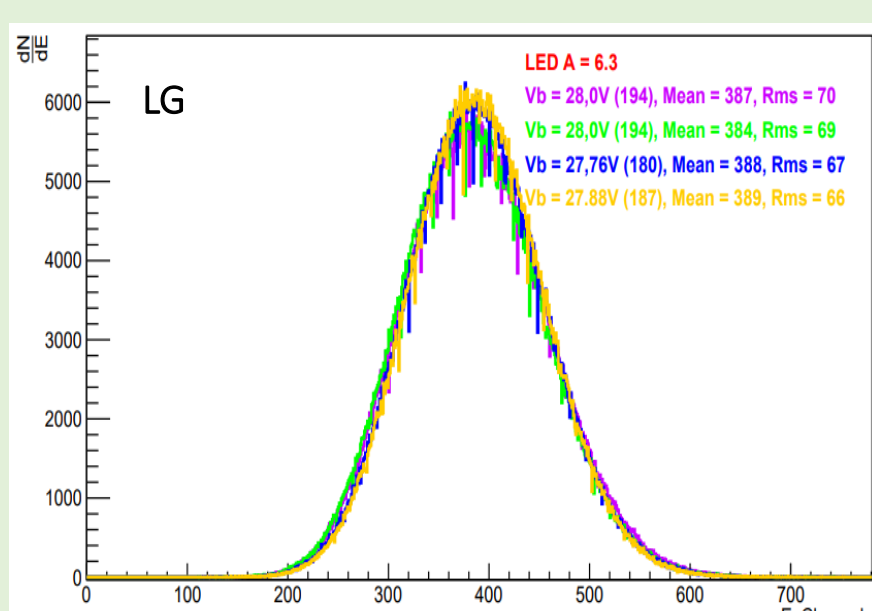
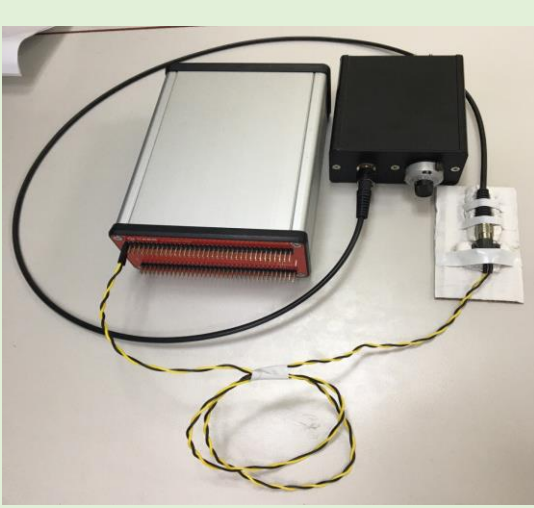
The hardware of BBC part

The accepted option for BBC measurements is CAEN FERS 5200, this one is an extendable high-speed front-end readout system based on the **DT5202**, DT5203 modules for SiPM. The **DT5202** stand-alone module has two Citiroc chips, with 32 channels for each chip, with good noise rejection and high-resolution timing (better than 100 ps). Each channel has **low and high gain preamplifiers** providing a wide dynamic range. The DAQ of FERS has several modes: spectroscopy, timing, and their hybrid.



Calibration method

The quick method was proposed. The main advantage of this method is the same conditions for calibration candidates. The **calibration device** consist of CAEN LED Driver (SP5601), and fiber which transmitted light pulses to surface of SiPM. The LED allows to use the trigger signal for DAQ. The **selected voltages** for low and high gain were obtained and were used for the following tests with cosmic rays.



Conclusion

The tiles scintillation detector prototype tests with CAEN FERS-5200 system has been started. The first result of time resolution is obtained.

Comparison of matted tiles and Tyvek covered have been done. The result is generally similar, but the use of matted tiles is more technologically valid.

The SiPM of various form factors have been tested. The result is similar. The smaller size has a higher priority as the final option for the BBC.

Tests to select the final WLS and optical cement options are required. The next step is assembly and tests of 7-tiles sector with selected materials.

Tests in JINR (summer 2023)

