# Readout electronics for the FARICH prototype (status and perspectives)

#### Ivan Kuyanov

Budker Institute of Nuclear Physics, Novosibirsk, Russia

IX SPD collaboration meeting

Yerevan, 13 may 2025

# FARICH prototype at the BINP VEPP-4 test facility



| Electron beam parameters: |                  |
|---------------------------|------------------|
| Energy range              | up to 2.5 GeV    |
| Averaged intensity        | up to 100 e⁻ / s |
| Energy spread             | 2.6%             |

Purpose of the tests beam:

- Testing the prototype photodetector and readout electronics
- Testing of Cherenkov aerogel radiators

## FARICH prototype readout

#### **Photon Detector:**

4x H12700 MaPMTs (Hamamatsu):

- flat panel
- 8x8 anode pixels of 6mm size (52mm detector size)





#### **Electronics:**

GSI TRB3 platform:

- 2 TRB3 boards (four FPGA-based TDCs with < 20 ps RMS time precision between two channels and 256 channels in total.
- 21 PADIWA (16x channels discriminator) 336 channels (cover 5 64-channel PMTs)
- 2 DIRICH module (discriminator + TDC) 768 channels (cover 12 64-channel PMTs)
- 1104 channels in total (17 64-channel PMTs).
- Each TRB board transmits data via Gbitethernet switch to a PC
- GSI DABC software used for DAQ from TRB

13.05.25

I. Kuyanov IX SPD collaboration meeting

# FARICH prototype readout



I. Kuyanov IX SPD collaboration meeting

100

0

-200

-100

200 X<sub>xit</sub>-X<sub>track</sub>,mm

## FARICH prototype readout. Perspectives.

GSI platform is very convenient, flexible and scalable, but prototype needs to be upgraded to allow full ring registration with new photomultiplier.

The proposed candidate is a MCP PMT "Ekran FEP".

To read 36 photomultipliers, 2304 electronic channels are required!

It is necessary to look for a replacement for the current electronics from GSI!

Square MCP PMT from "Ekran FEP" 8x8 anode of 3mm size



#### DMXG64 ASIC

The DMXG64 ASIC was developed in BINP for various GEM-based detectors:

- 64 input channels with low-noise charge sensitive amplifier
- analog memory for 100 samples
- minimum time gap of 100 ns between measurements
- maximal signal up to 2 × 10<sup>6</sup> electrons
- equivalent noise charge (ENC) for input low channel capacity (<10 pf) < 4 × 10<sup>3</sup> electrons







V. Aulchenko et al 2017 JINST 12 C05004

#### The GEM-based detector in the Laser Polarimeter facility



The detector electronics have modular design and encompass several boards:

- readout board with GEMs and pad readout structure
- ten FE-boards
- CPU board (DE10-Nano develompment kit)

Dead time < 250µs at 4 kHz trigger rate

Each FE-boards contains two DMXG64 64 channel ASICs with 14bit ADC (1 MSPS) and Altera MAX10 FPGA for reads out.

The FE board can work standalone without CPU board.

 $T_{r/o} \le 6.4 \mu sec$  to read out 64 pixels (1 frame 100ns).



V. Kaminskiy et al 2020 JINST **15** C08019

### DMXG64 based FE-boards for reading FARICH PMTs

Preliminary tests have shown that the board can register 1pe pulses from PMT Hamamatsu.

Adapters from PMTS hamamatsu and Ekran FEP to FE-boards are produced.

Further research into the operation of the PMTs with the FE-board is needed.

BINP has a sufficient number of produced DMXG64 to create the required number of channels of the FARICH prototype electronics.

The current parameters FE-board should be good for the FARICH prototype, but for further experiments it is possible that the board needs to be upgraded. (Faster ADC, reduction DMXG64 chip frame length)



### Summary

The FARICH prototype needs to be modernized to enable registration of the full ring.

The proposed candidate for FARICH photo detectors is a MCP PMTs "Ekran FEP".

It is necessary to increase the number of electronic channels.

It is possible to replace the TRB3 platform with laser polarimeter facility electronics based on a DMSG64 chip developed at BINP.

The current parameters FE-board should be good for the FARICH prototype, but for further experiments it is possible that the board needs to be upgraded: Faster ADC, reduction DMXG64 chip frame length.

Further research into the operation of the PMTs candidats for FARICH prototype with the FE-board is needed.