FARICH status

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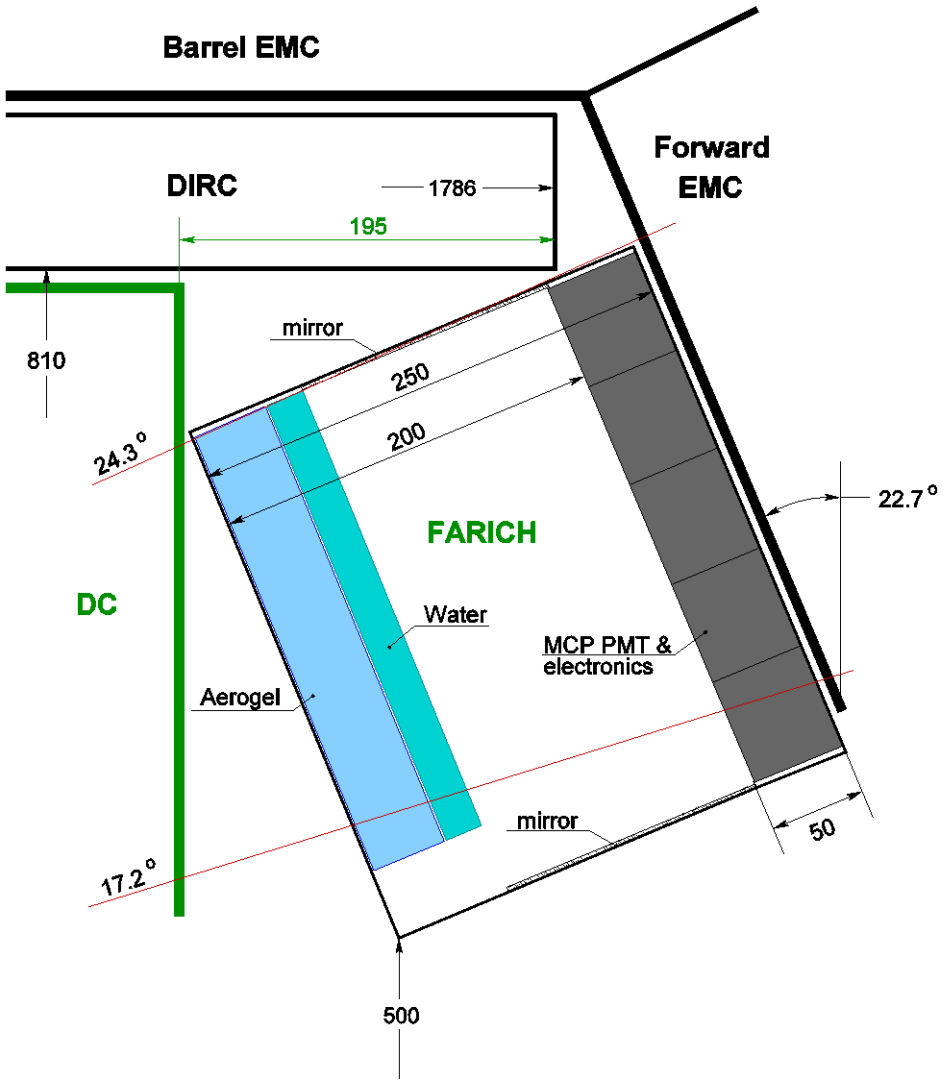
Outline

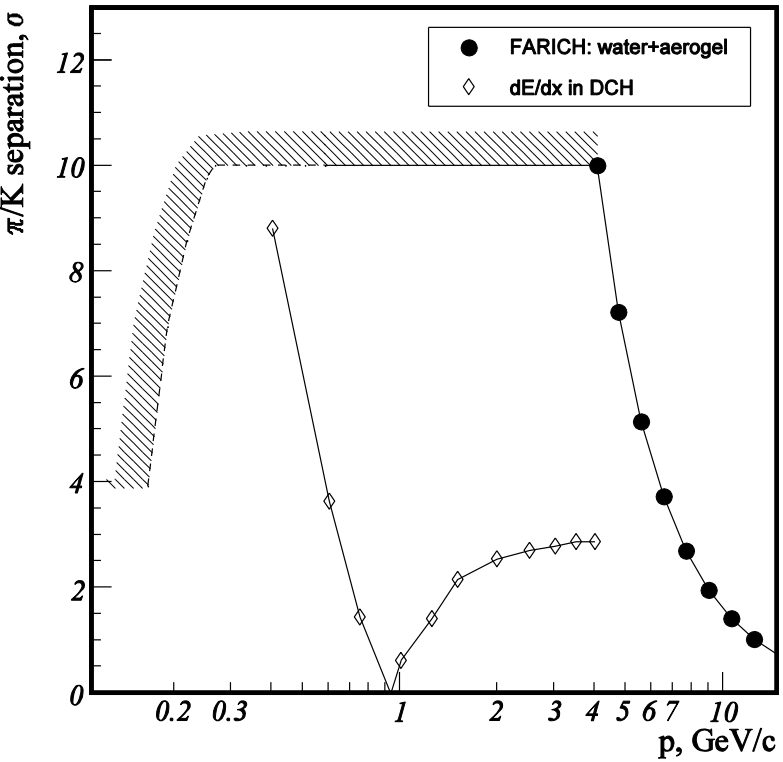
- Introduction
- PID with 6 mm pixels (MC results)
- FARICH status
- Test beam line status
- Conclusion

FARICH with 3 mm pixels



- Expansion gap 200 mm
- Burle MCP PMT with 3.2x3.2 mm pixels (16x16 matrix), photoelectron collection efficiency 70%, geometrical factor 85%
- 3-layer focusing aerogel, n_{max}=1.07, total thickness 30 mm
- Number of PMTs ~ 450
- Number of channels ~ 115000
- Amount of material, (X_0) = 3.5%(aerogel)+ 2.5%(water)+ 14%(MCP PMT)+8% (support, electronics, cables) ~ 28%

FARICH Monte Carlo results (3 mm pixels)



- Number of photons 80 (water) + 20 (aerogel)
- Good PID → π/K separation at 5 GeV/c is 6σ, μ/π separation from 0.15 to 1.4 GeV/c (3 σ)
- Good overlap with dE/dx PID
- Focusing is optimized for momentum measurement (optimum focusing at βγ=4)

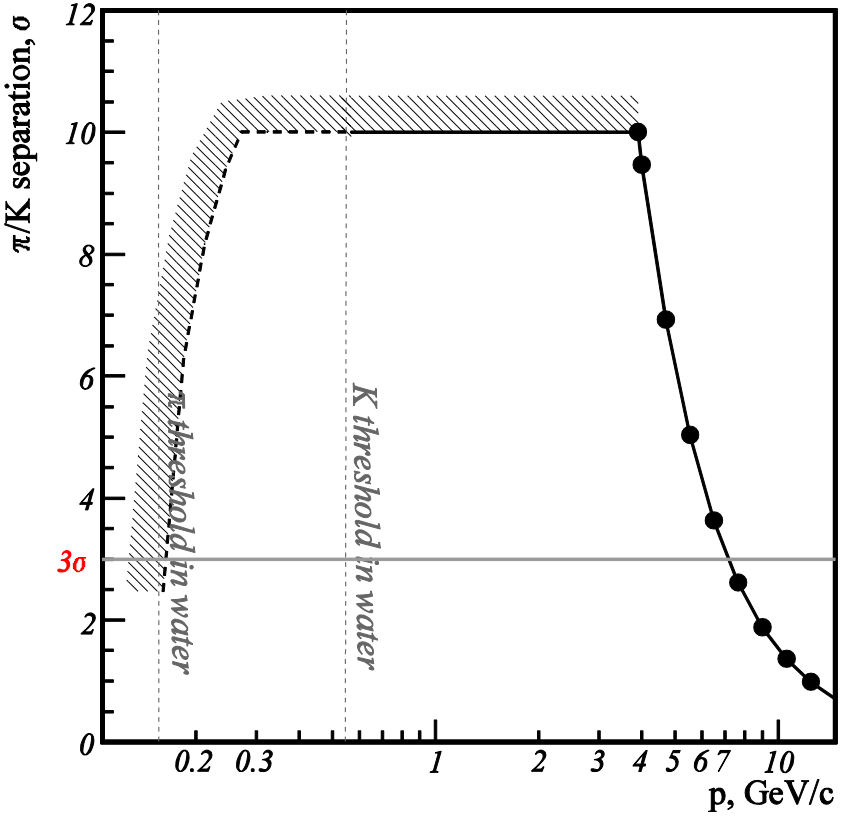
Water radiator

- How to do it? → Transparent volume made from lucite and filled with water.
- Problem → Cherenkov light from lucite produce additional background.
- Solution I → Lucite thickness must be as small as possible (1 + 1 mm ?). To withstand walls deformations from hydrostatic pressure we suggest to bind them with thin strings.
- Solution II → Aerogel with n=1.2÷1.3. Such aerogel could be produced by pin hole drying method tested at KEK and Novosibirsk.

FARICH cost

- cost driving factors:
  - Number of PMTs
  - Electronics
- We suggest to increase pixel size by a factor of 2 (3.2 mm → 6.4 mm):
  - 4 times less number of channels → 28800
  - new candidate for photon detector → 144 channels Hamamatsu HAPD

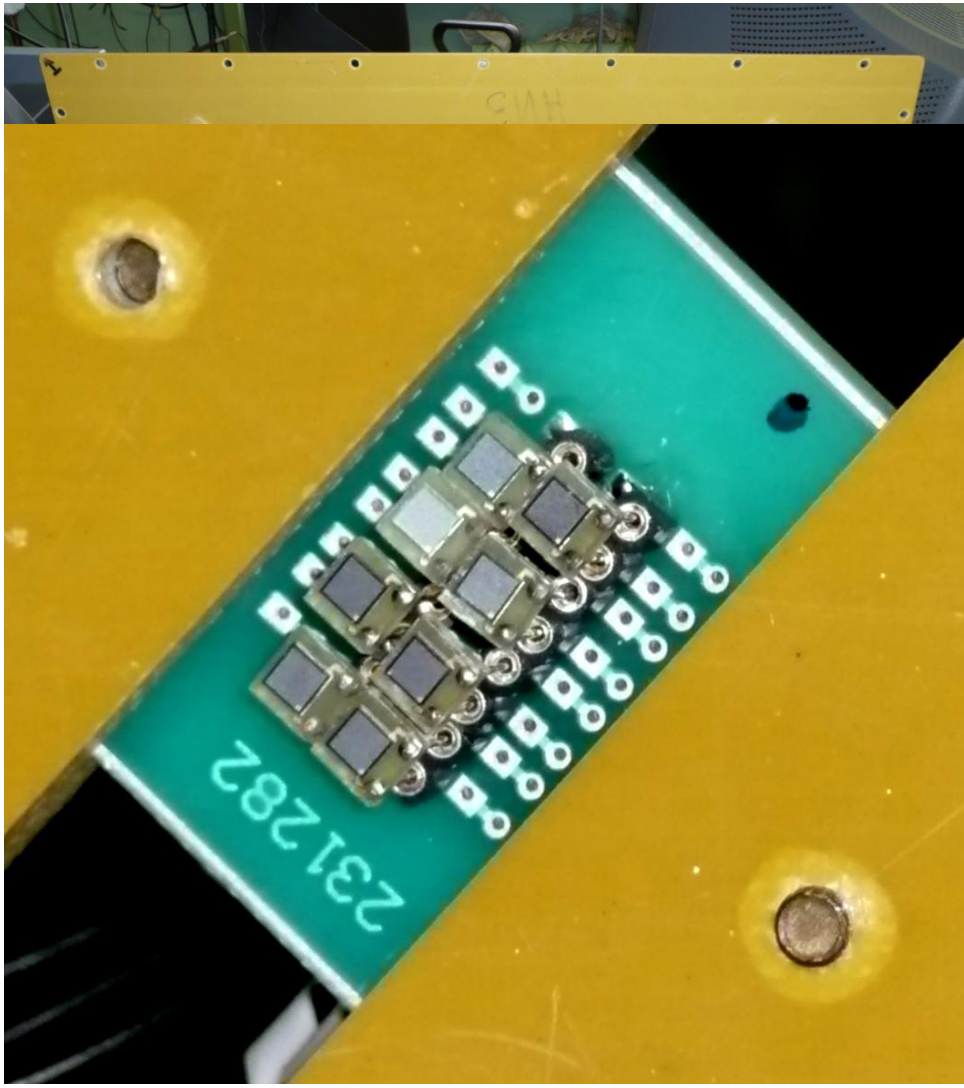
6 mm pixel FARICH Monte Carlo simulation



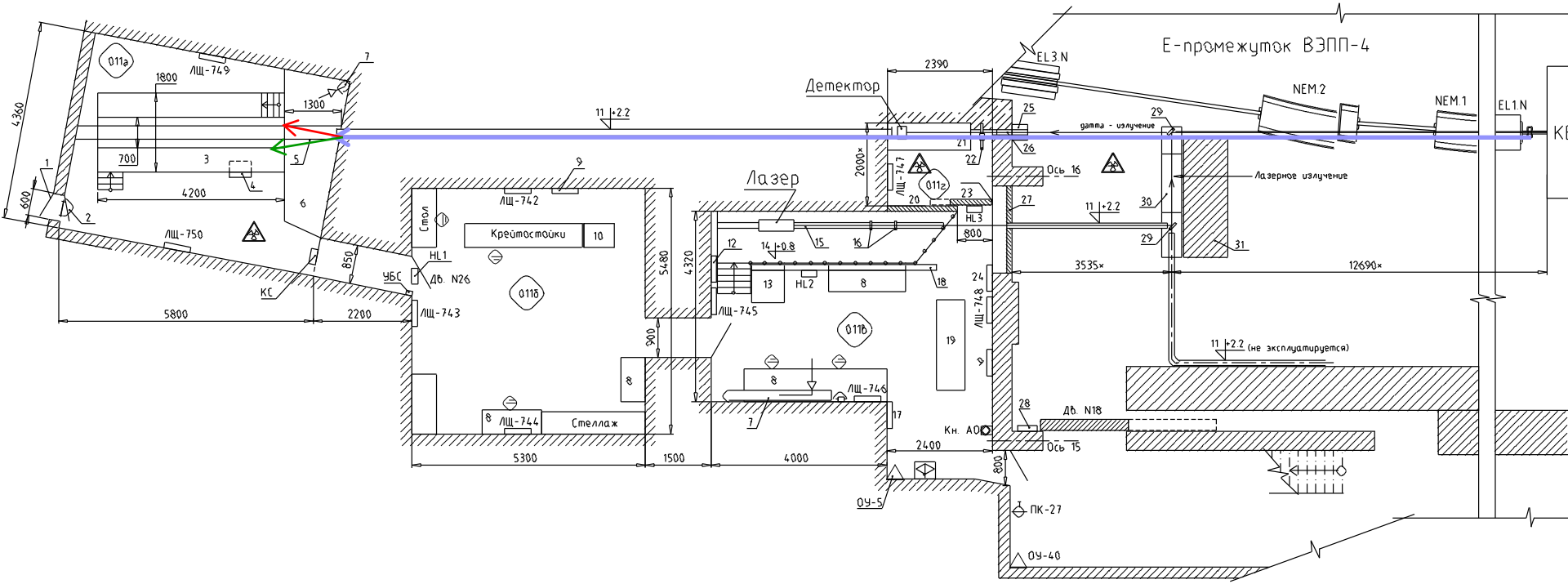
- Optimum focusing at βγ=8 → improves velocity measurement at high momentum
- The same number of photons → 80 (water) + 20 (aerogel)
- π/K separation is the same as for 3 mm pixel option:
  - ‘threshold’ mode → from 0.15 to 0.6 GeV/c
  - ‘signal’ mode → from 0.6 to 7 GeV/c (6σ at 5 GeV/c)
- μ/π separation from 0.15 to 1.4 GeV/c (‘signal’ mode)

FARICH prototype status

- All SiPMs are tested (amplification, noise rate)
- Tests of boards with discriminators are in progress
- Tests with photo-diode are in progress
- All components are available, assembly is in progress

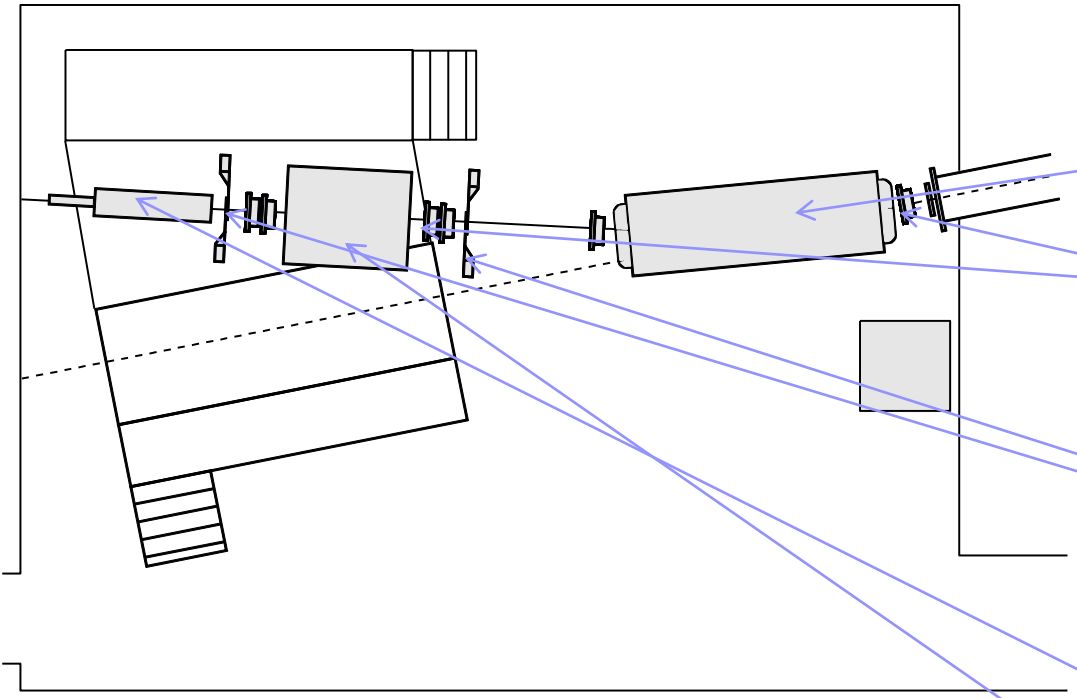


Test beam at VEPP-4M, Novosibirsk



- E_{max}beam = 5.5 GeV
- We insert the converter in the beam halo to produce bremstrahlung gammas or use the bremstrahlung gammas from the residual gas
- We convert gamma-quanta to electron-positron pairs in the target.
- To select electrons (positrons) with the required energy we use the magnet

Test beam apparatus



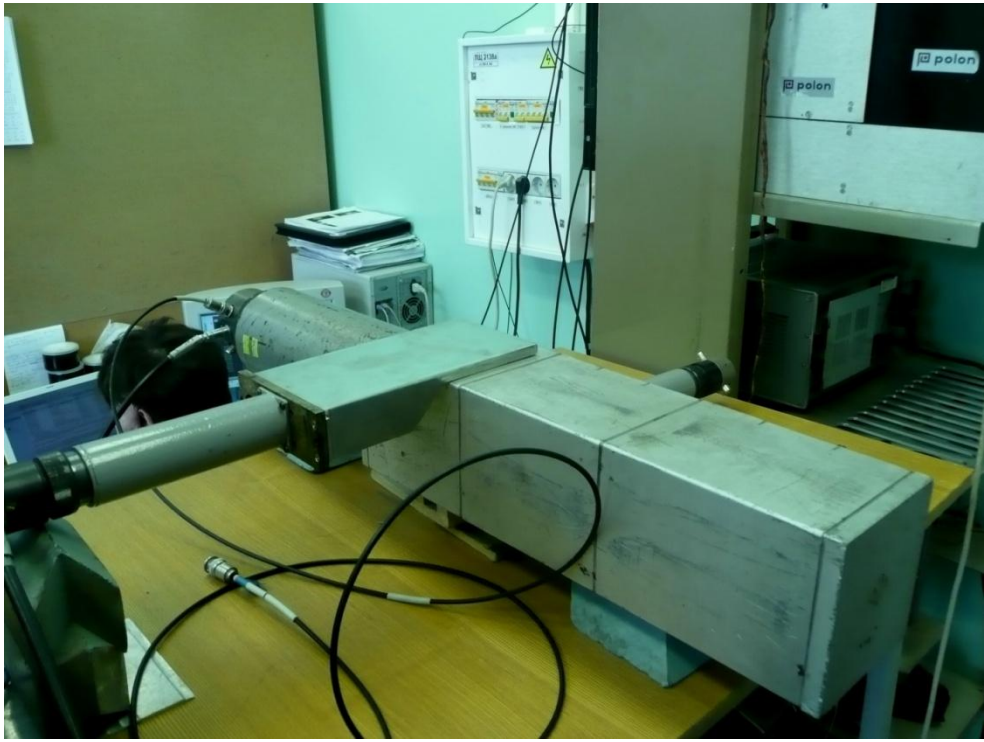
- Magnet
- Coordinate chambers
- Veto and trigger counters
- NaI calorimeter
- FARICH prototype

Experimental hall with beam line components supports

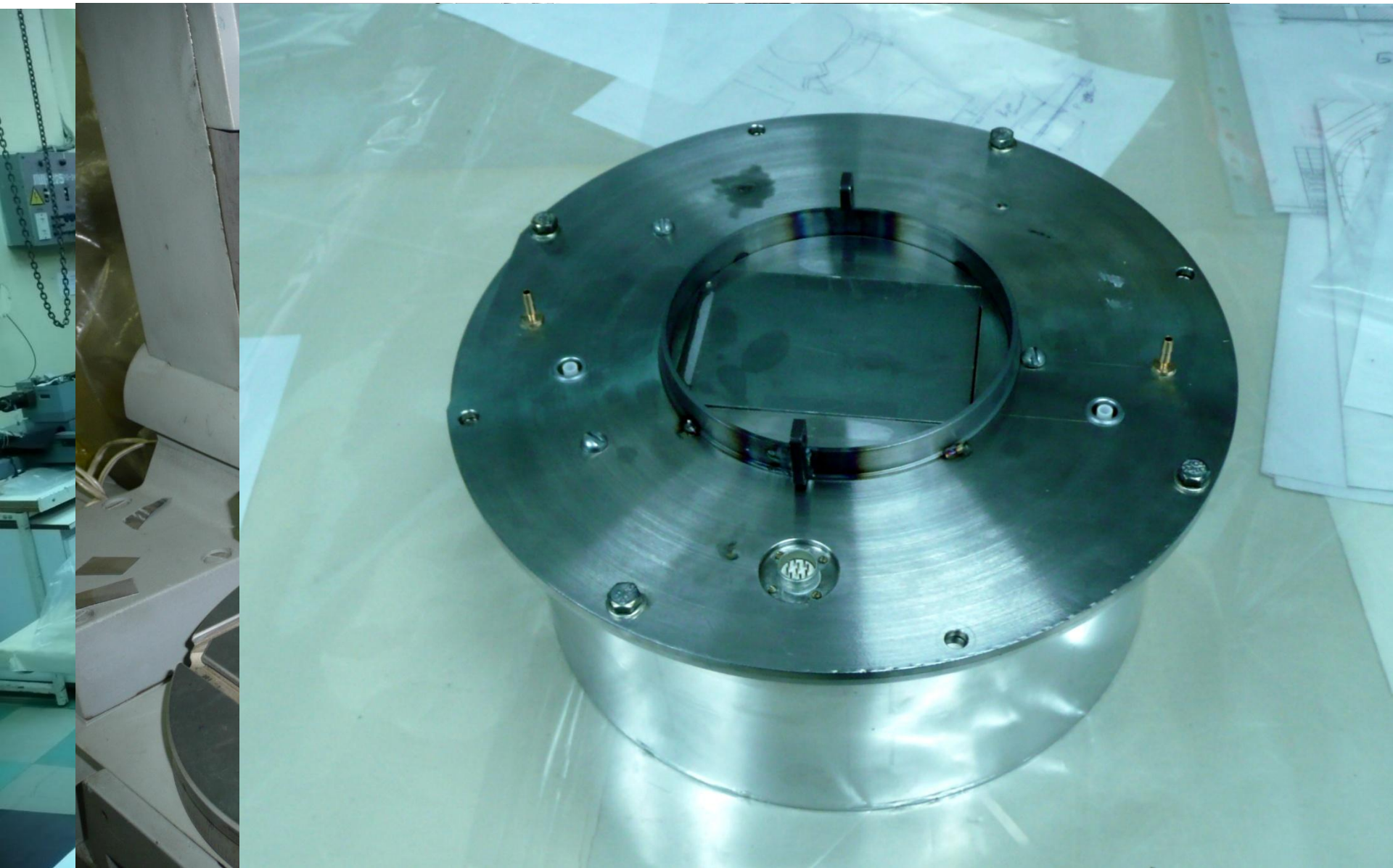
Two coordinate movement system with remote control

Trigger and Veto scintillation counters

NaI calorimeter



Drift chambers



Plans with test beam and prototype

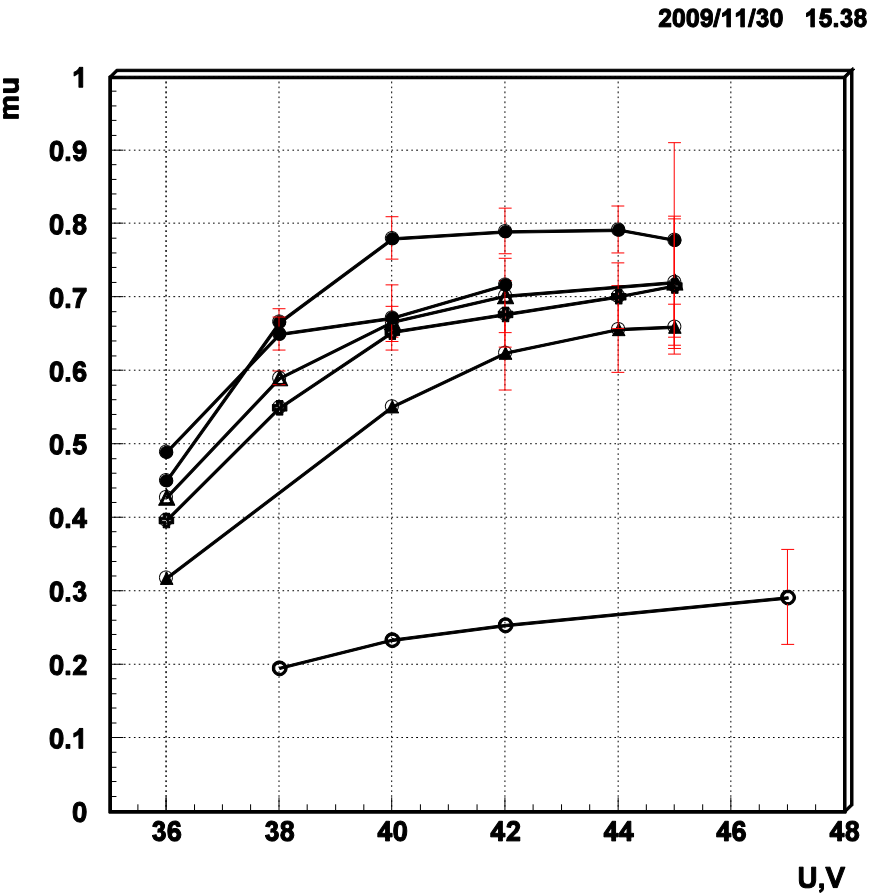
- The main delay is the magnet power supply system. It will be ready in May-June.
- VEPP-4M winter-spring run will finish on June 15. Next run will start in October.
- FARICH prototype beam tests will start in October 2010.

Conclusion

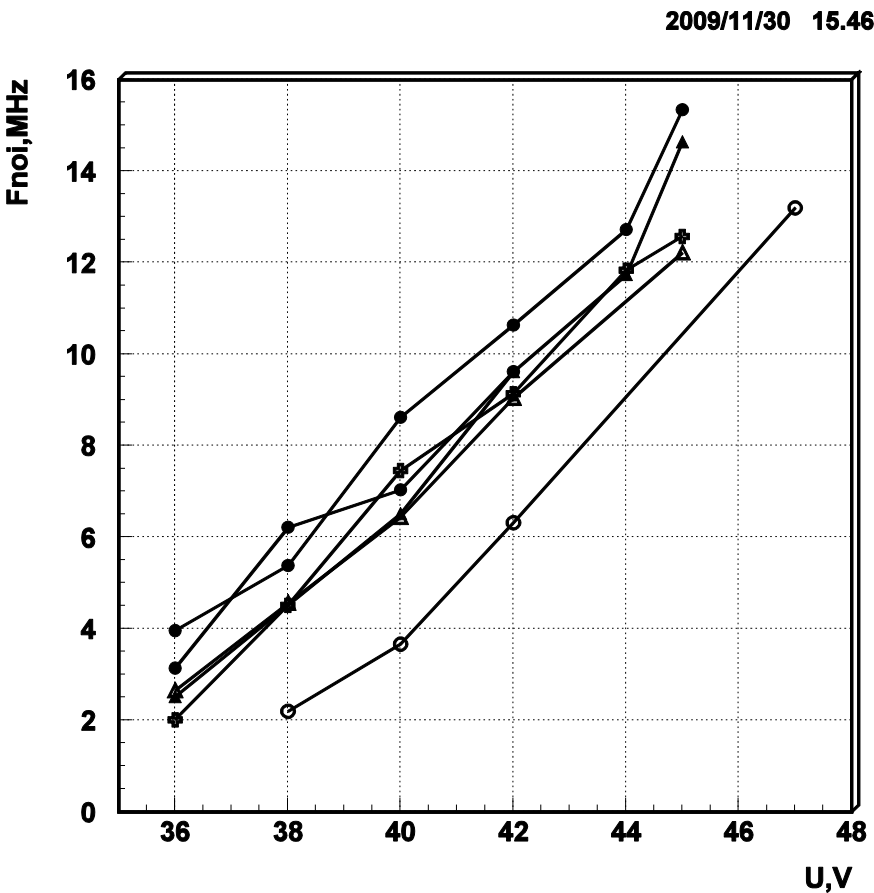
- FARICH with 6 mm pixels provide good π/K identification in the wide momentum region.
- Number of channels is reduced by a factor of 4 up to 28800 pieces.
- Tests with FARICH prototype equipped with MRS APD photon detectors are scheduled on October-November 2010.

SiPM tests

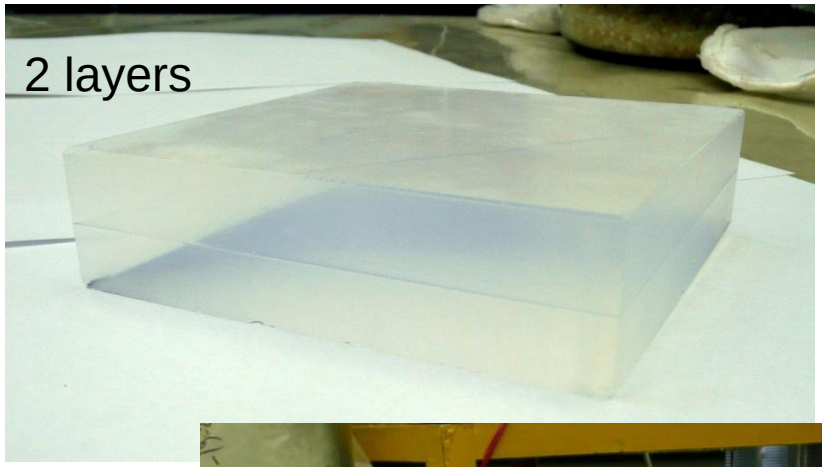
Relative photon detection efficiency

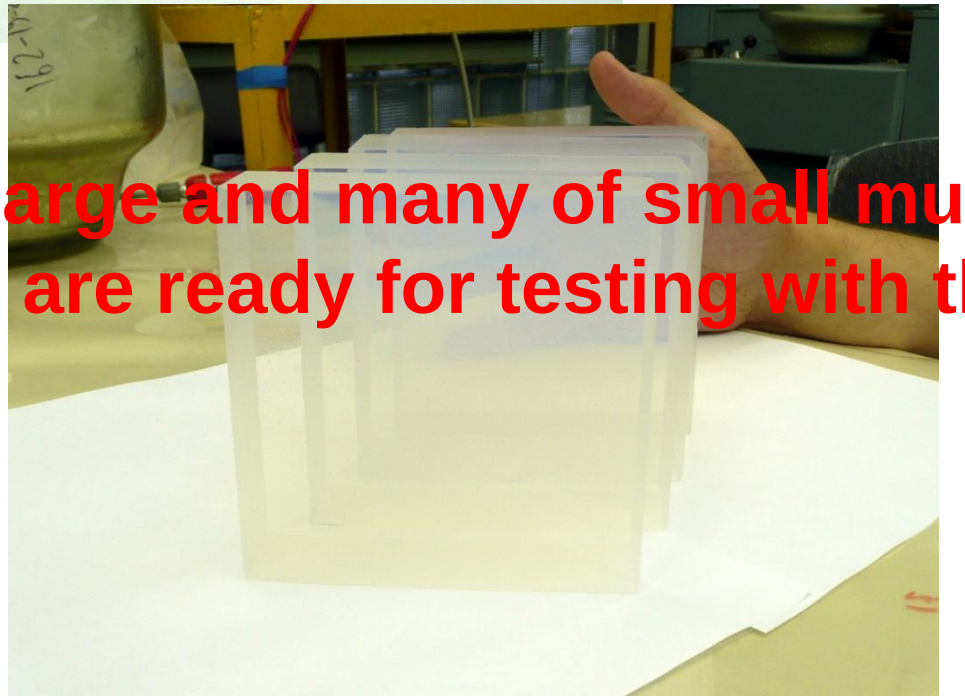


Noise rate



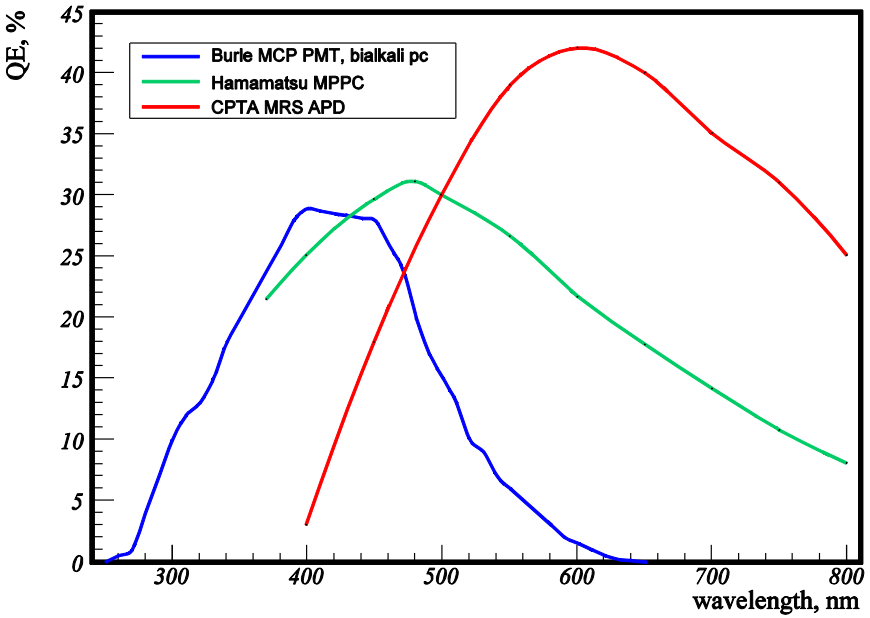
Aerogel photos

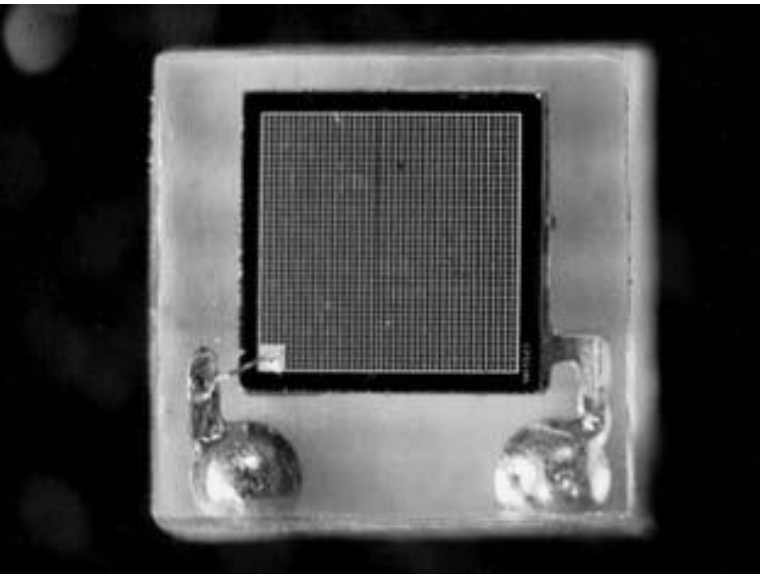




These 4 large and many of small multylaer aerogel blocks are ready for testing with the beam

MRS APD parameters

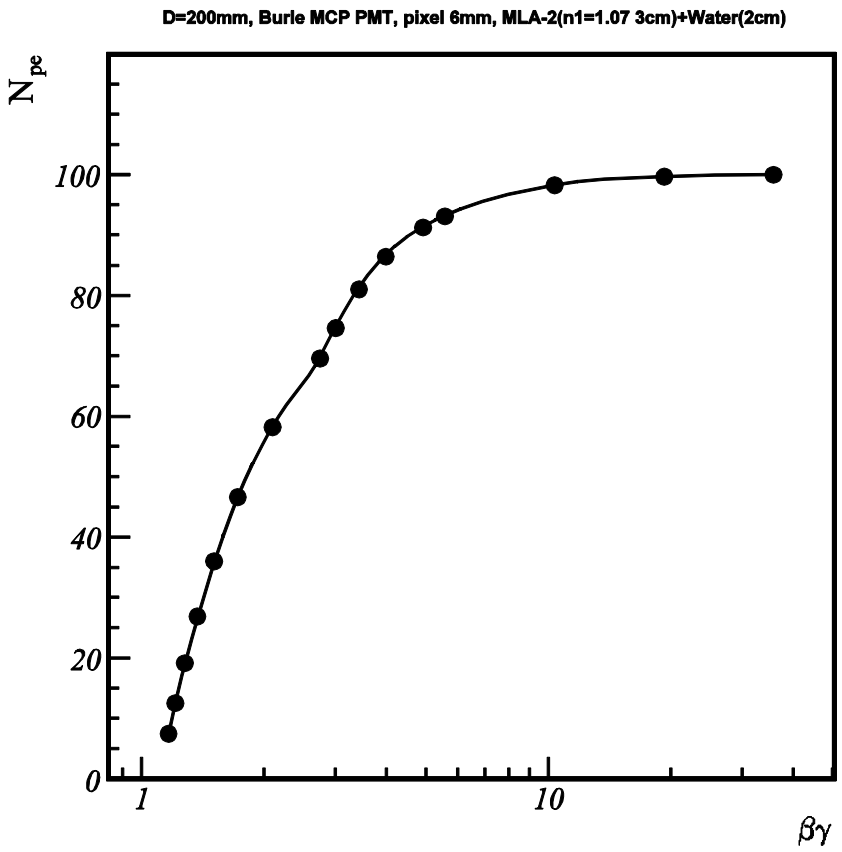




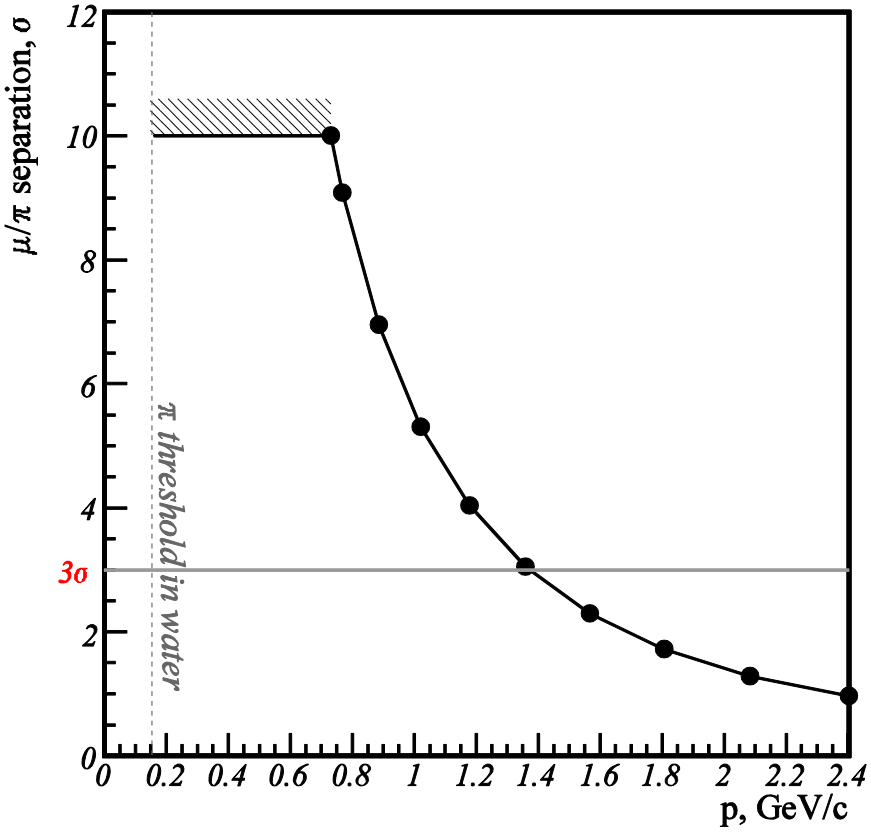
- Producer - Center of Perspective Technology and Apparatus – CPTA, Moscow http://www.spta-apd.ru/
- Genuine name - MRS APD (other names: silicon photomultiplier, PPD,MPPC…)
- 2.1x2.1 mm sensor
- 4x4 mm case size
- PDE=40% @ 600 nm
- Gain ~ $4 \cdot 10^5$
- Time resolution ~100 ps
- Dark counts ~10 MHz (0.5pe threshold)

6 mm pixel FARICH expected performance (continued)

Number of photons

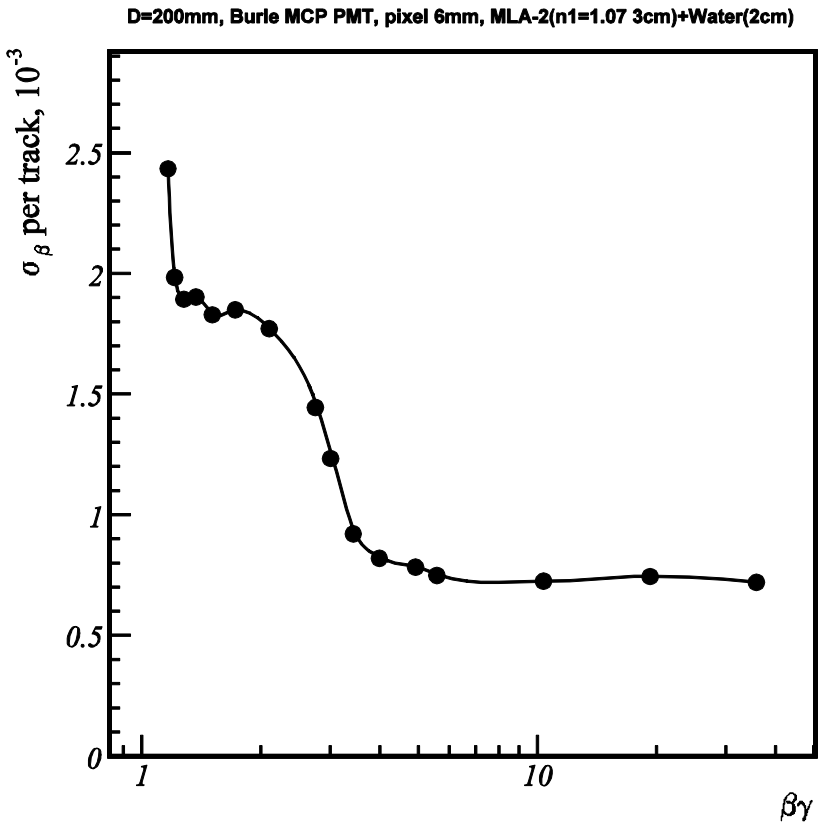


μ/π separation



6 mm pixel FARICH expected performance (continued)

Velocity resolution



Momentum resolution