Prototype of SuperFGD

(preparation for beam test)

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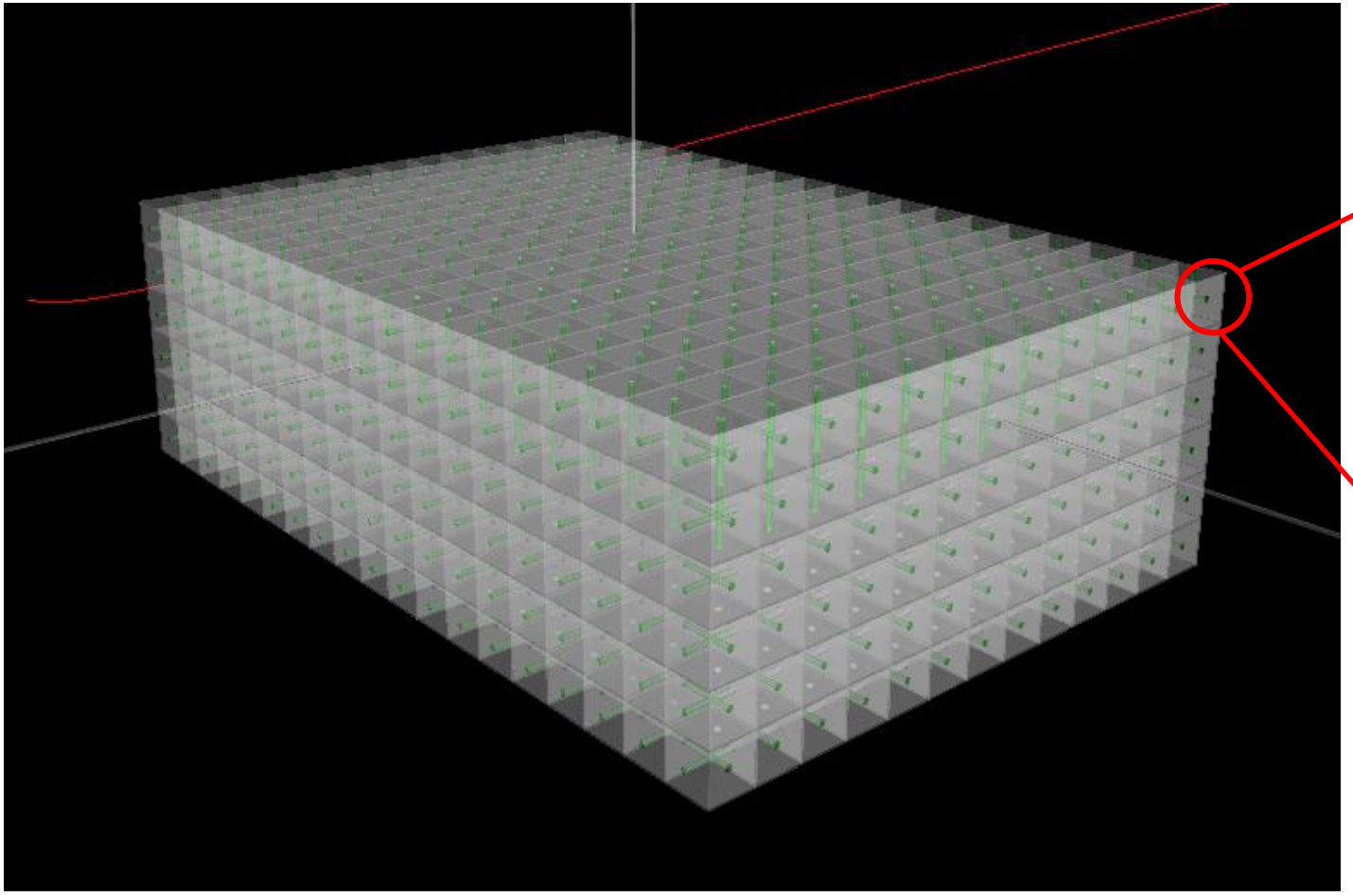
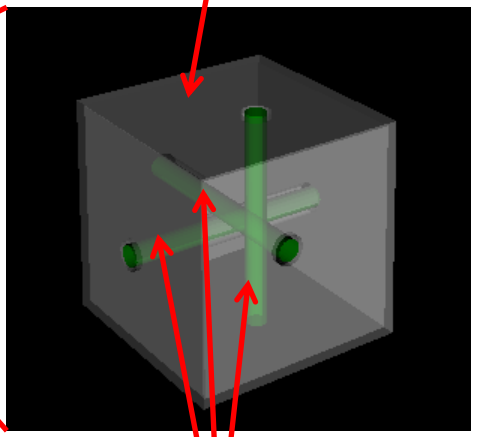
INR-Moscow

5th Workshop on Near Neutrino Detectors
based on gas TPC
Tokai, Japan, 8 October 2017

SuperFGD

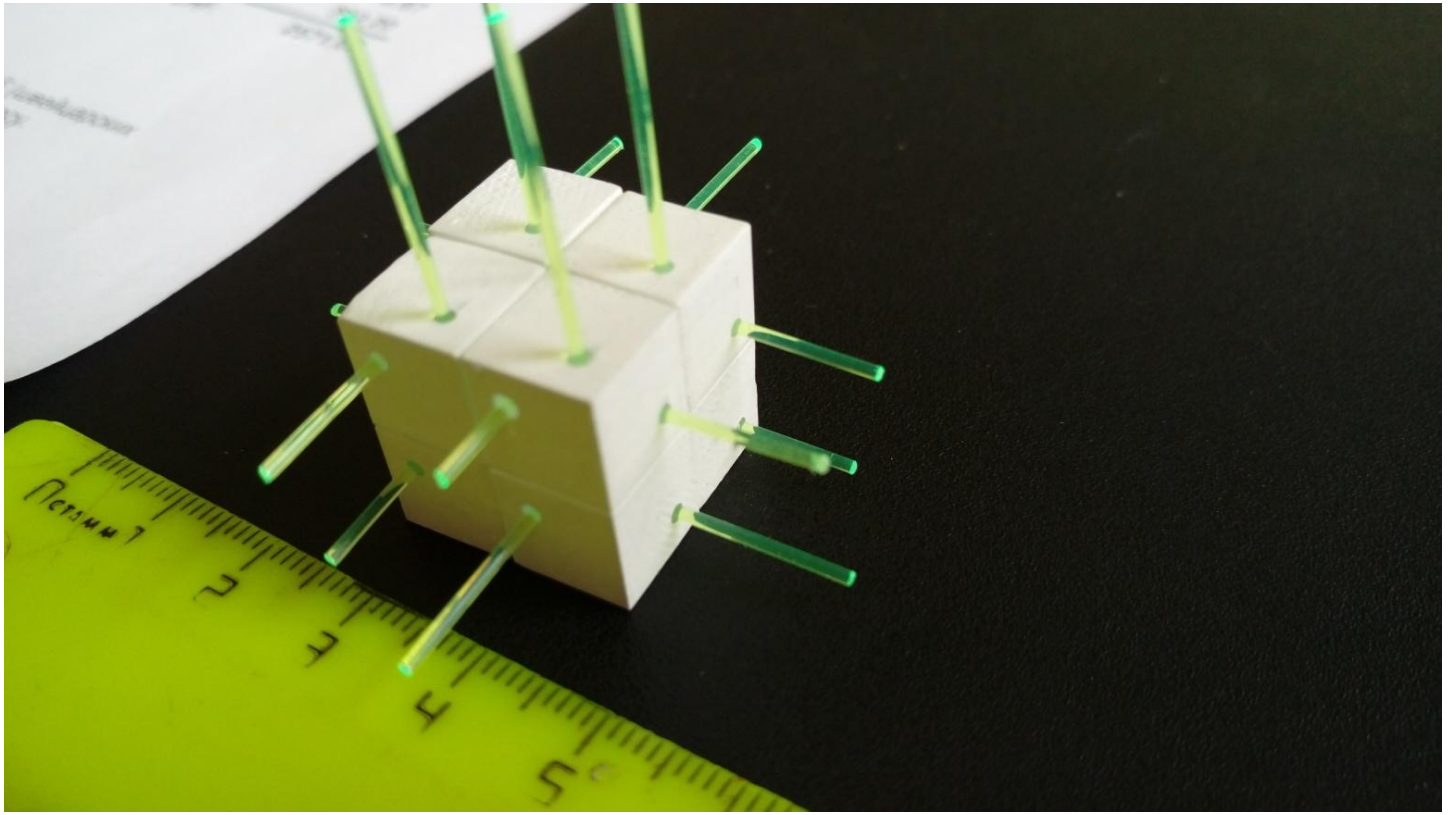




Cubes

arXiv:1707.01785

Cubes: 10x10x10 mm^3
Material: extruded polystyrene + p-terphenyl
White chemical reflector: thickness ~ 50 mkm
3 holes: each of 1.5 mm diameter
WLS fibers: Kuraray Y11,



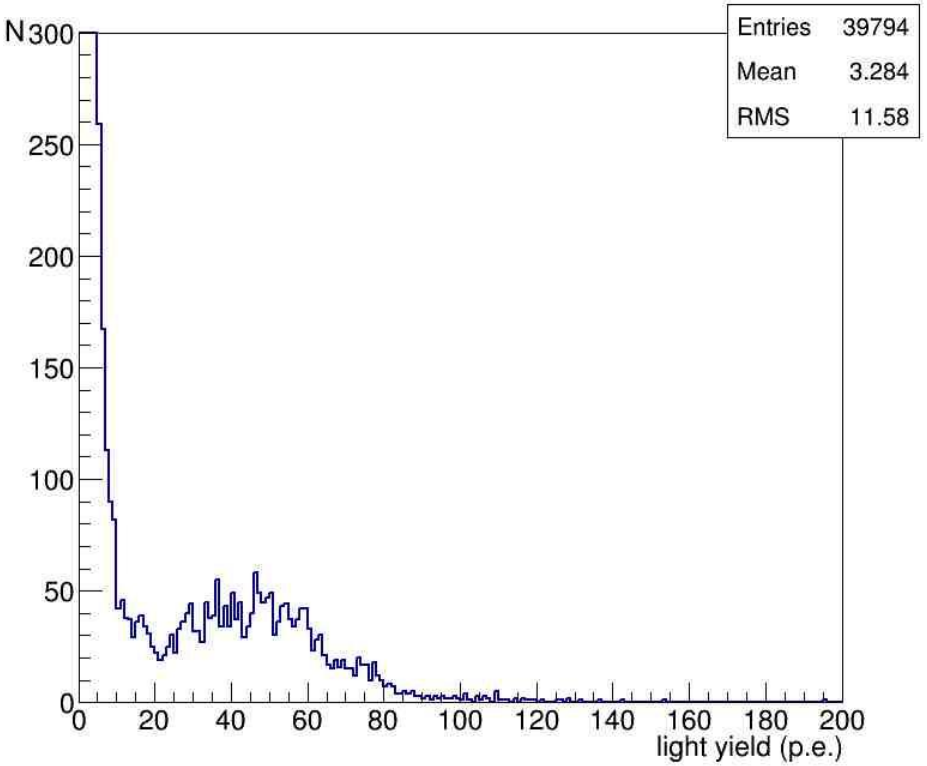
Produced by Uniplast, Vladimir

LY/MIP/1 fiber

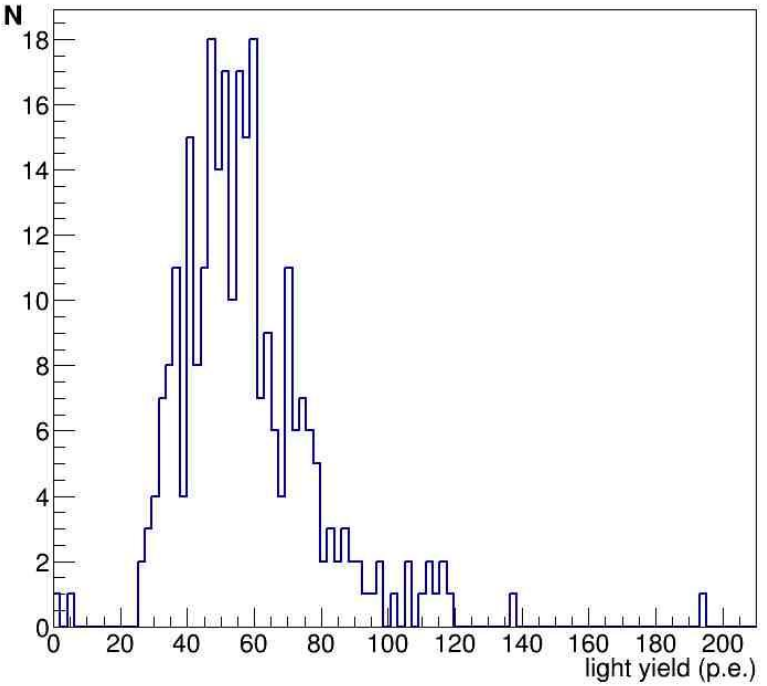
Central cube

Fiber length 1.3 m
Far end covered by teflon tape
Distance 1.0 m from MPPC

No small counter in trigger



small counters in trigger

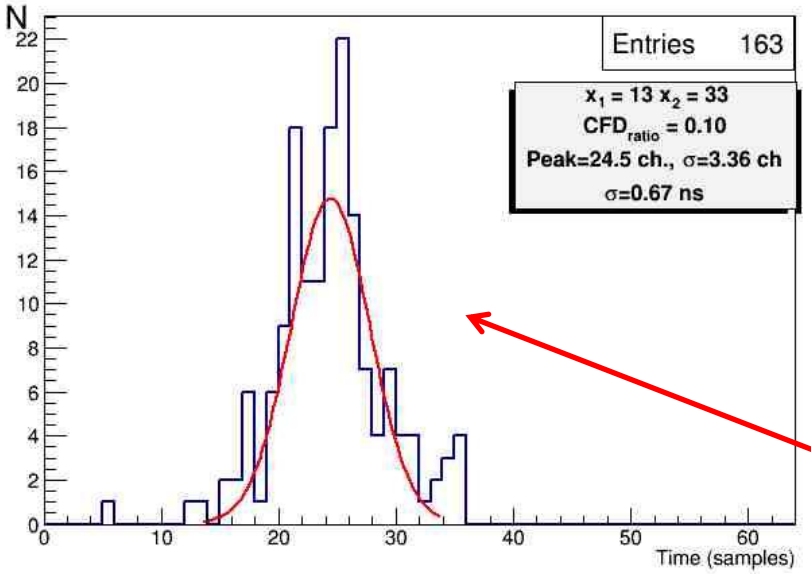


Average light yield:
50-60 p.e./MIP at 1 m from MPPC

Reflector at fiber far end: l.y. increased by ~ 50%

Time resolution

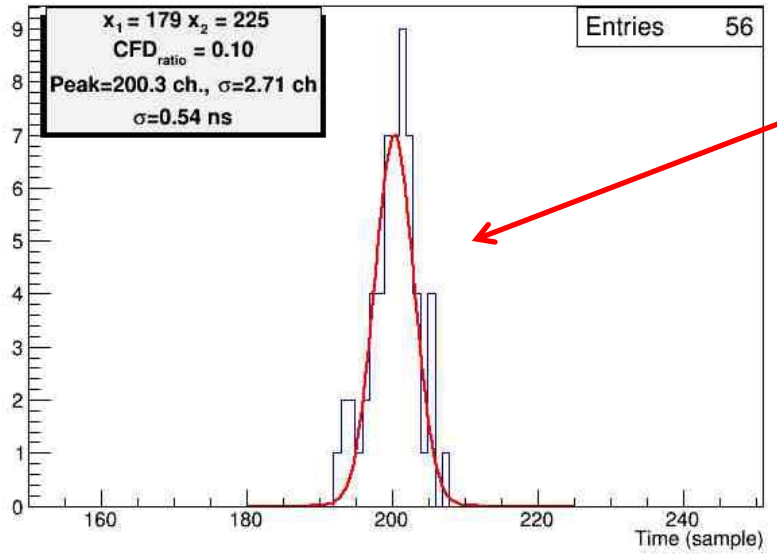
1 ch = 200 ns/1024 ≈ 0.2 ns



1 fiber readout (1D)

σ=0.67 ns

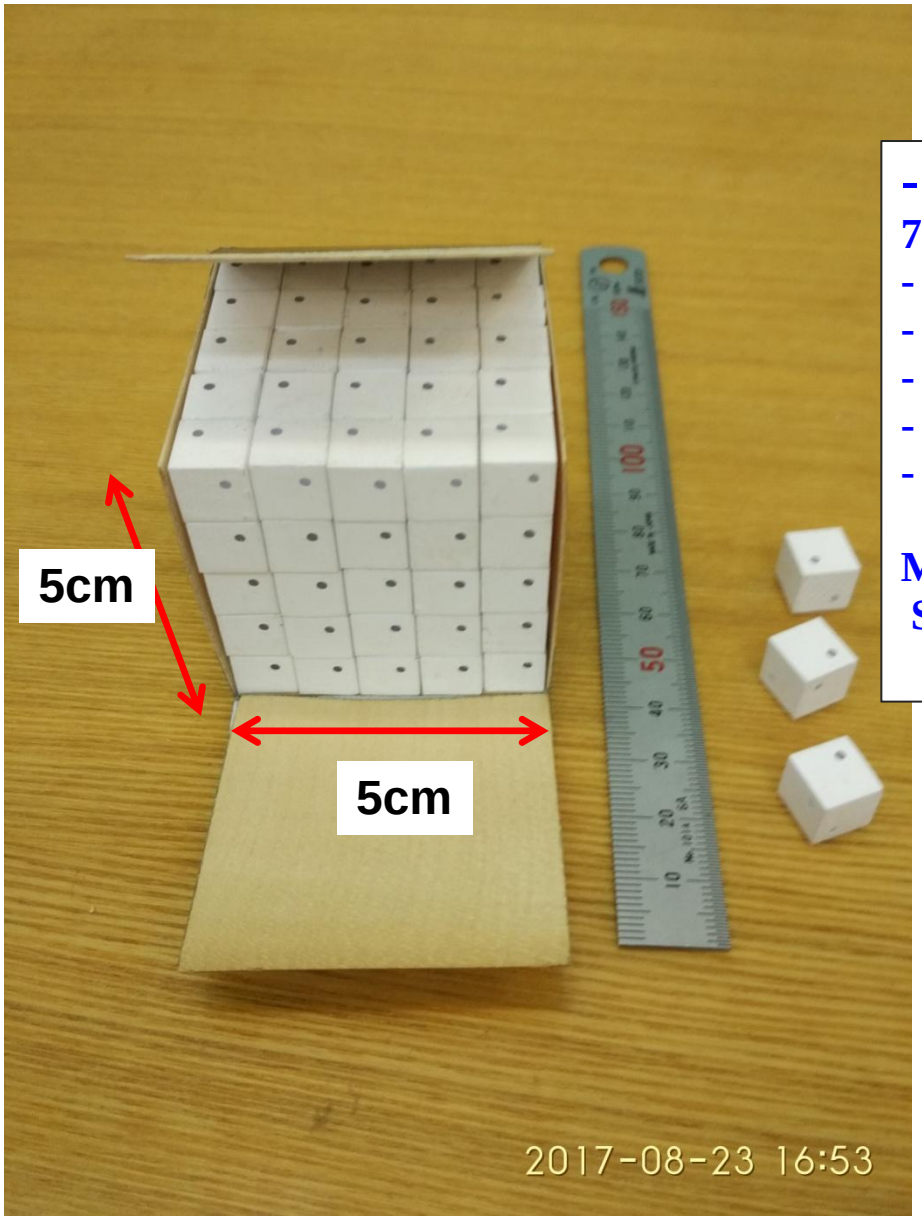
the same cube



2 fiber readout (2D)

σ=0.54 ns

Small detector prototype



- 125 cubes of 1 cm^3 will be tested

75 WLS fibers with 75 SiPM readout

- Length of Kuraray 1 mm Y11 WLS fibers 130 cm
- 3 fibers inserted in one cube, no glue
- Distance between MPPC and cube in each fiber 100 cm
- Reflector at far end of the fiber - teflon tape
- Trigger counters 3x3 mm^2

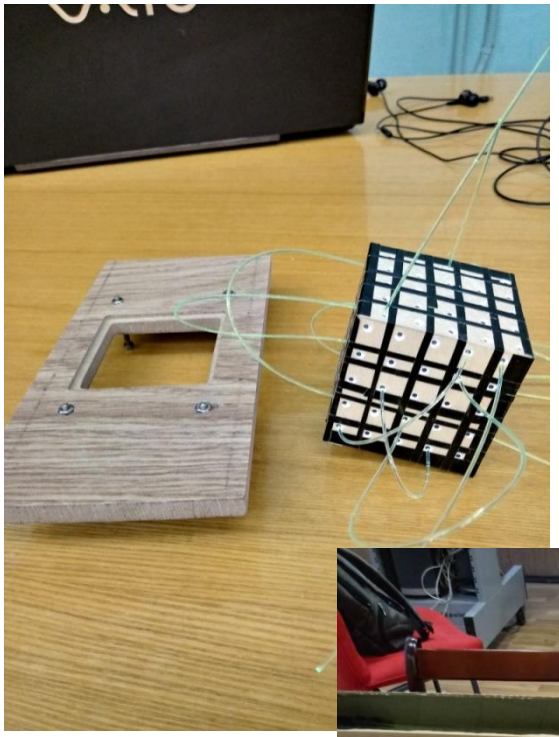
MPPC :

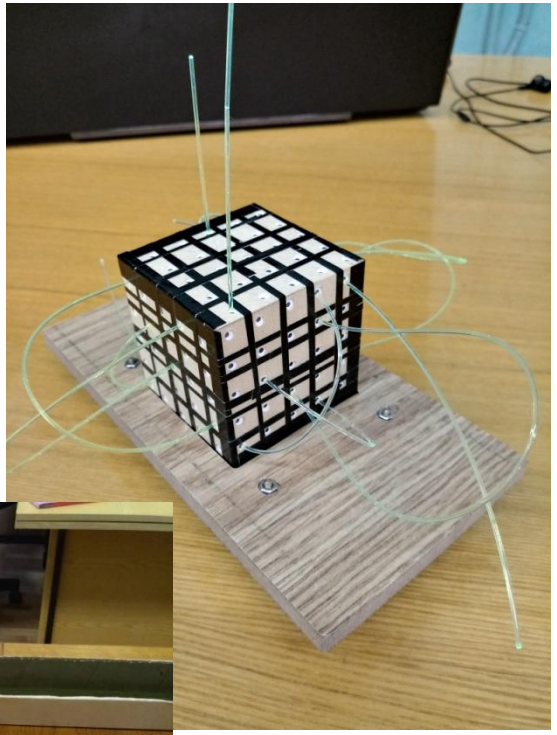
S12571-025C, pixel size 25 microns,

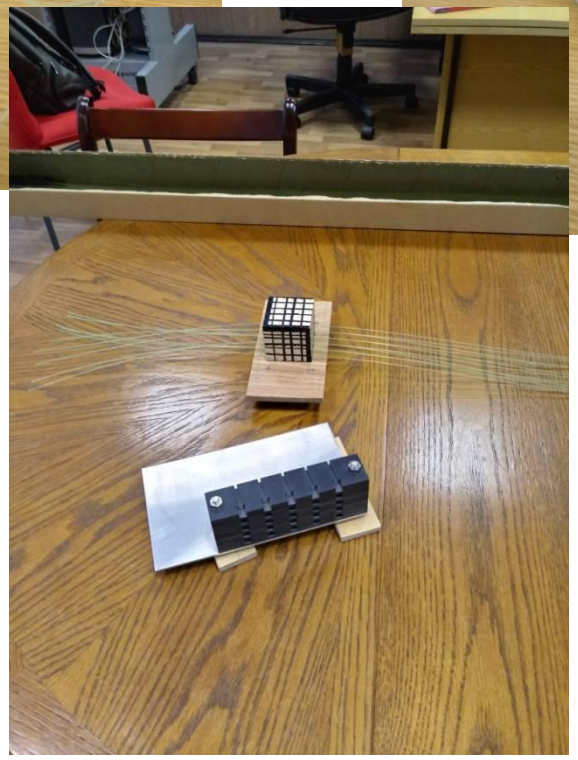
PDE about 33% for green light.

Small detector

For beam test at CERN



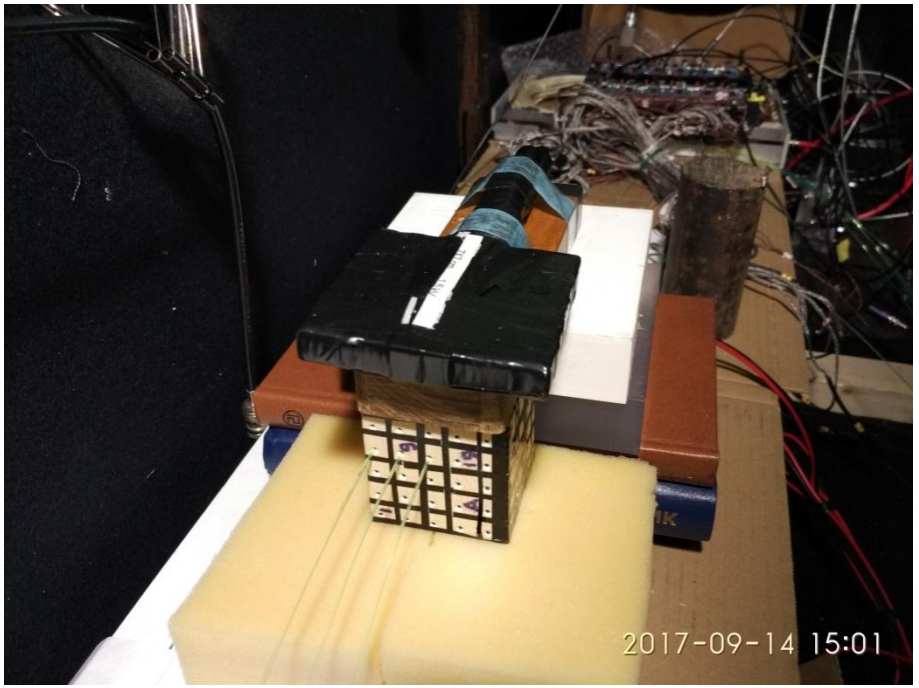


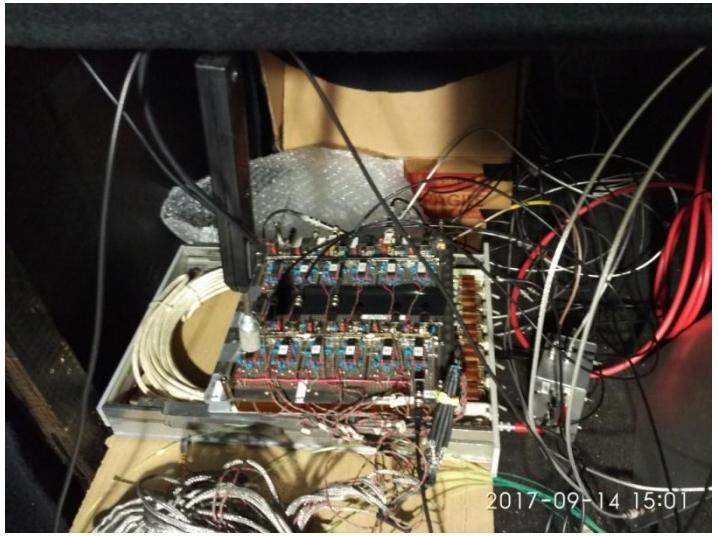


WLS fibers

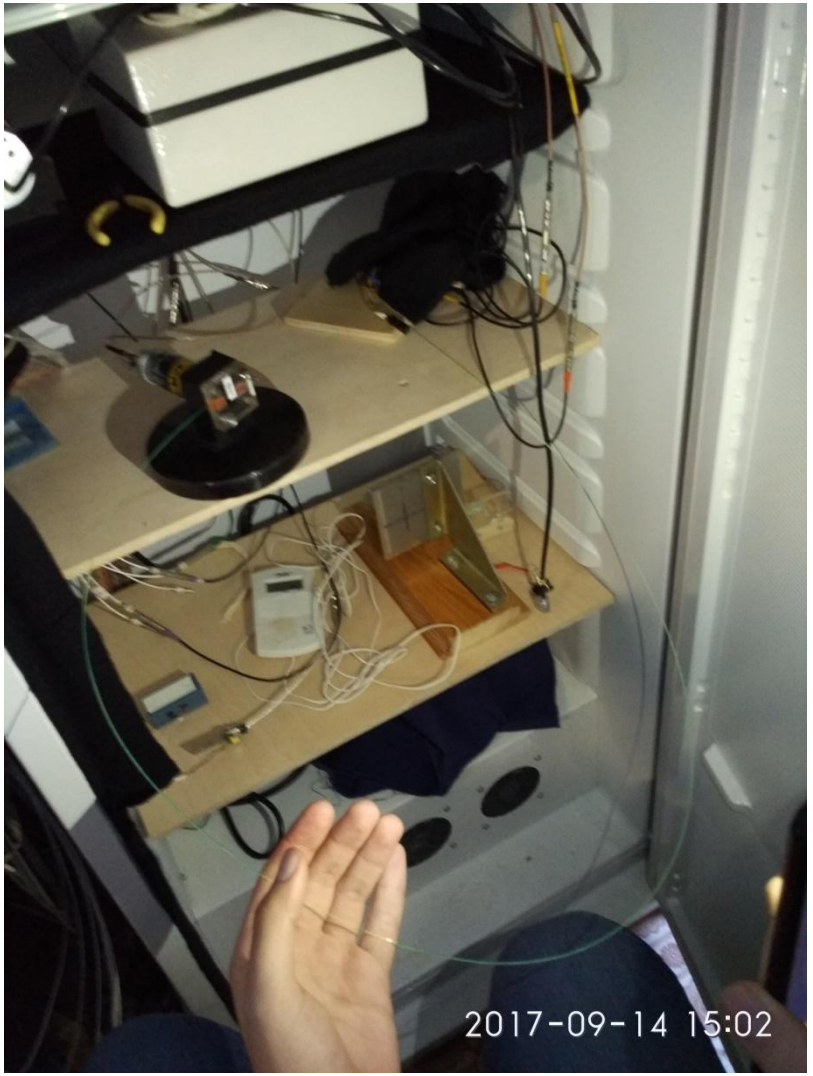
100 fibers of 1.3 m long with opticall connectors are prepared and tested

Tests of detector and Y11 fivers





Fiber test

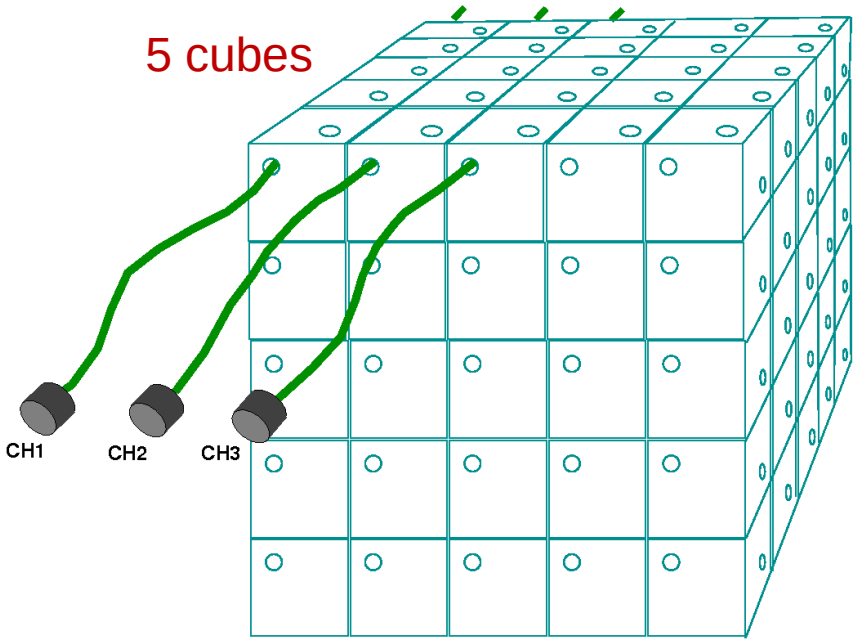


Test at INR

Cosmic test of 125 cubes

WLS fiber length = 1.3 m

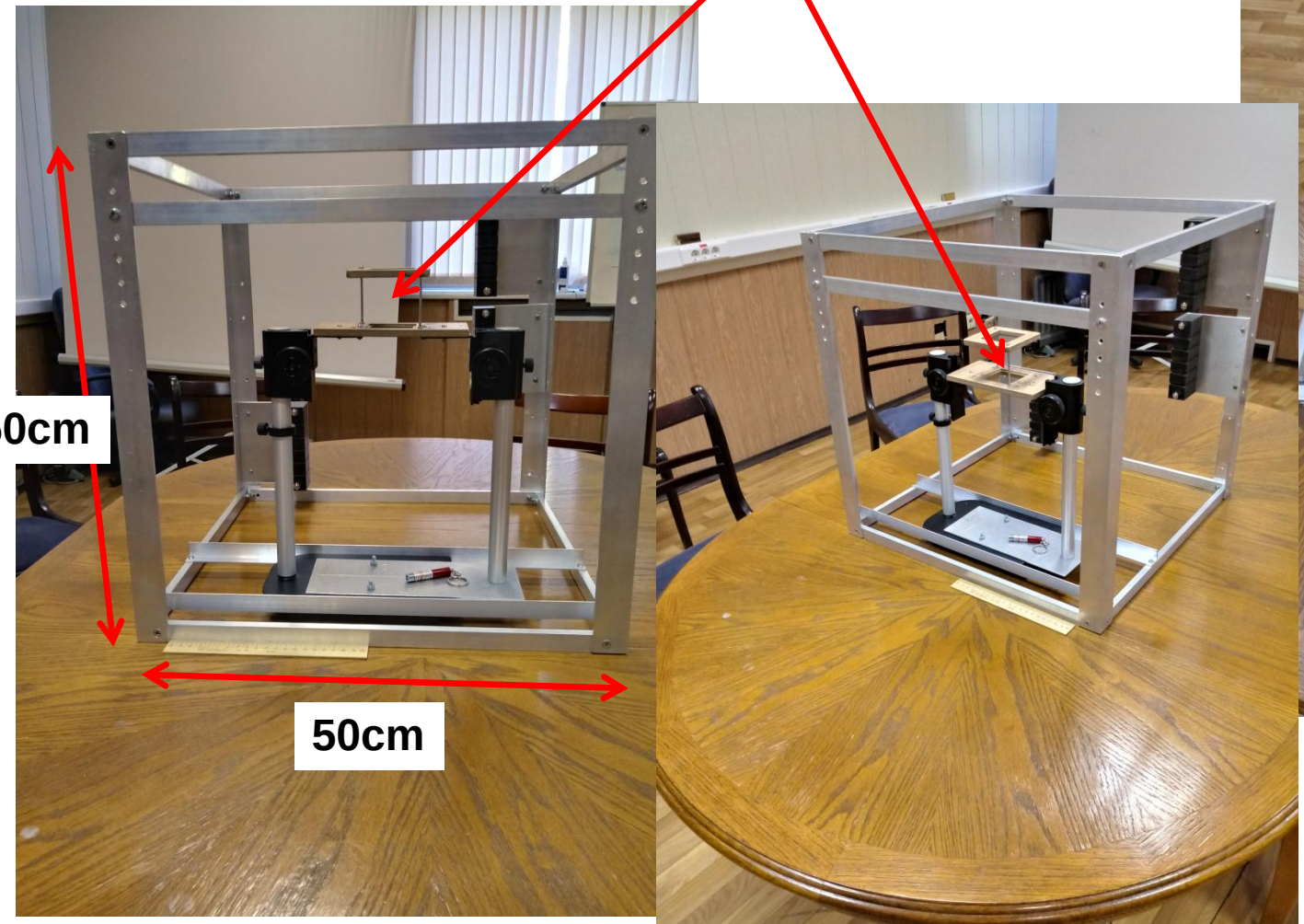
5 cubes



Average L.Y. = Σ5 cubes/5

Light Yield (p.e./MIP)		
CH1	CH2	CH3
50.5	56.2	42.6
54.7	59.3	45.6
53.6	58.7	44.1
53.2	59.2	45.0
48.3	54.8	39.8
46.1	54.2	37.3
45.9	56.6	42.1
50.1	54.3	41.6
		43.8

Movable support frame



Beam test at CERN

Test beam for SHIP muon detectors

18 October – 1 November 2017

Very small SuperFGD to be tested

Array of 5 x 5 x 5 cubes, each 1 cm^3 -> 125 cubes

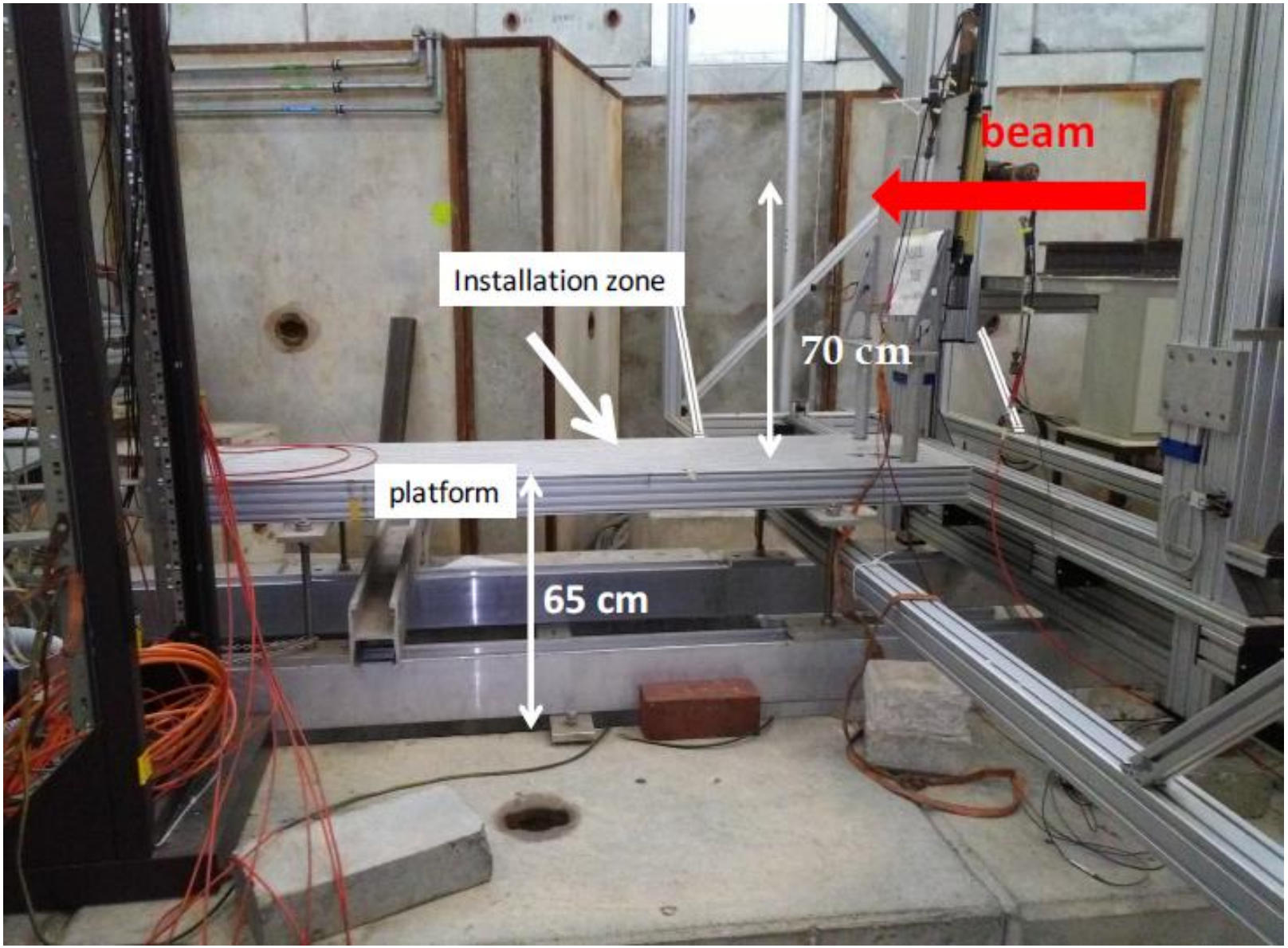
3D readout using 1.3 m Y11 fibers + MPPC 1x1mm^2

75 readout channels → WLS fibers, connectors , MPPC
→ electronics
- Amplitude 75 ADC channels CITIROC ASICs
- Timing 15 channels, digitizer 5 GHz

Small trigger counters 3x3 mm^2

Participants from INR: O.Mineev, A.Khotjansev, A.Mefodiev, S.Fedotov, and Yu.K.

T10 area at CERN

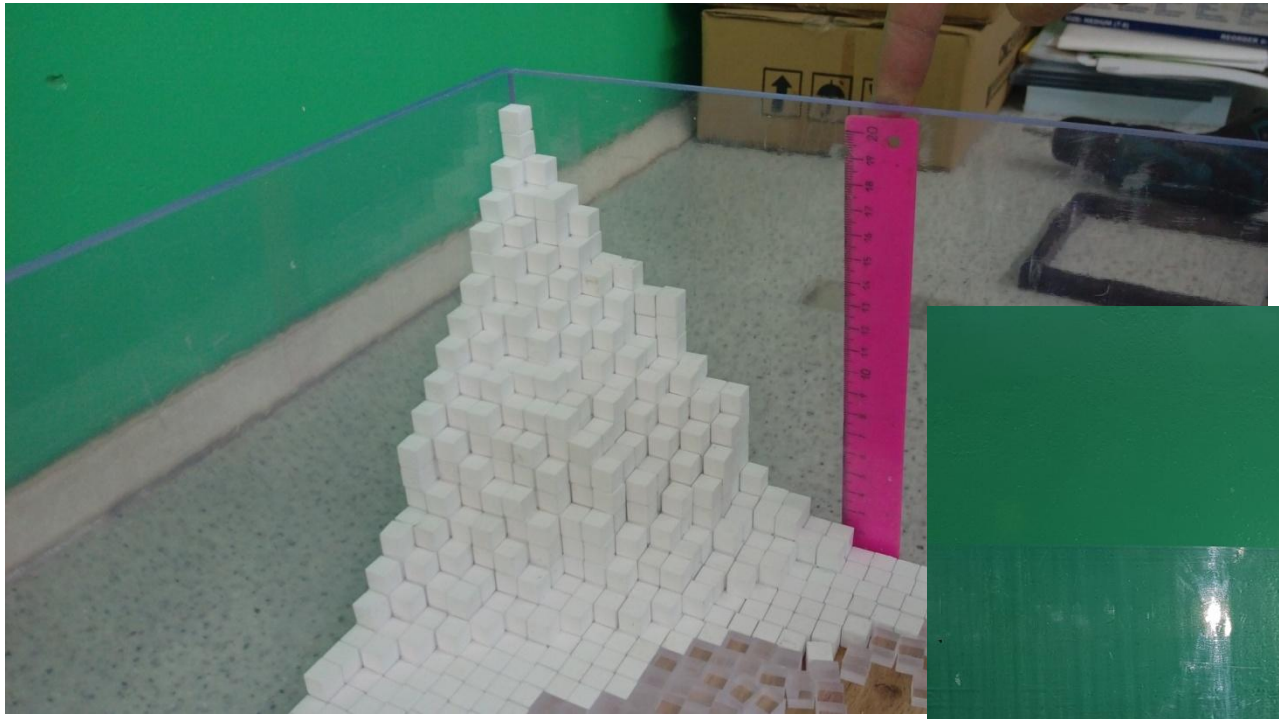


Measurements

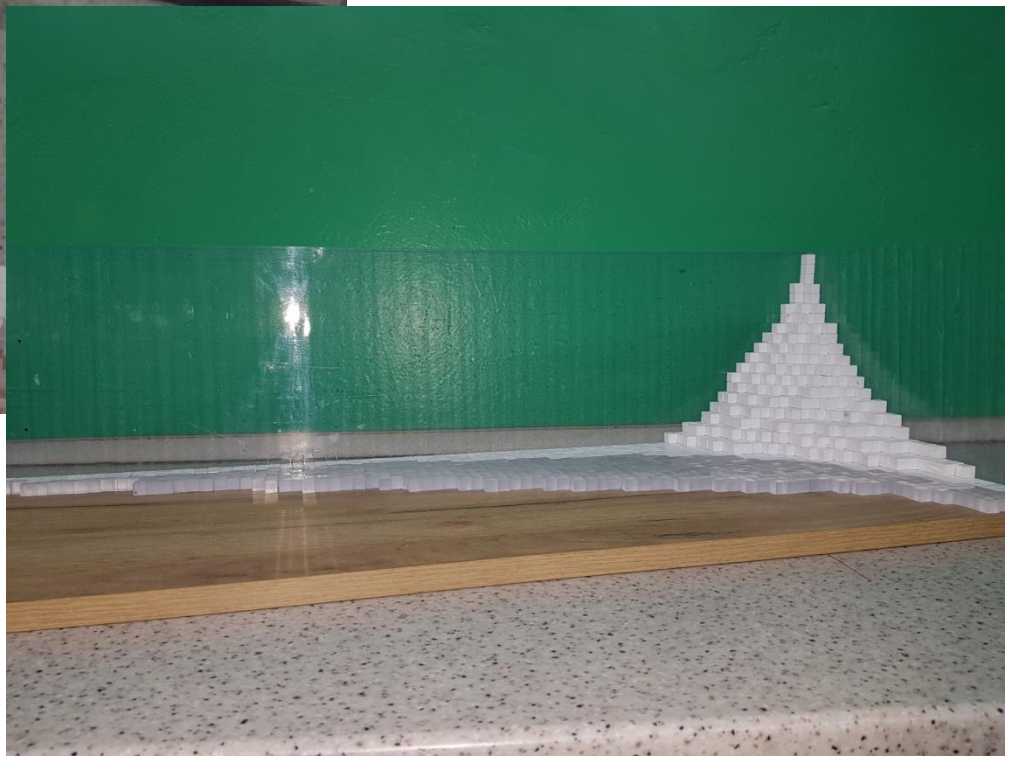
T10, low intensity, electrons, pions

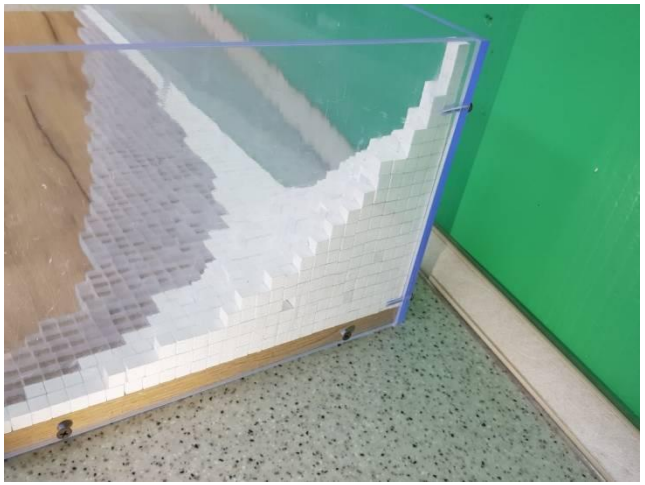
- **Light yield of each cube (1 fiber, 2 fibers, 3 fibers)**
- **Cross-talk between cubes (separation from MPPC dark rate)**
- **Time resolution (a fraction of cubes can be measured)**
- **Scan across the detector (measurement of l.y. uniformity)**
- **Tracks at several configurations (for example, rotation at 45 deg)**

New cubes



Manufacturing of 10000 cubes in progress





Conclusion

Small detector prototype is ready for beam test

Scintillator cubes, mechanics, fibers…
will be brought to CERN next week

Beam test starts on 18 October

Manufacturing of 10000 cubes in progress