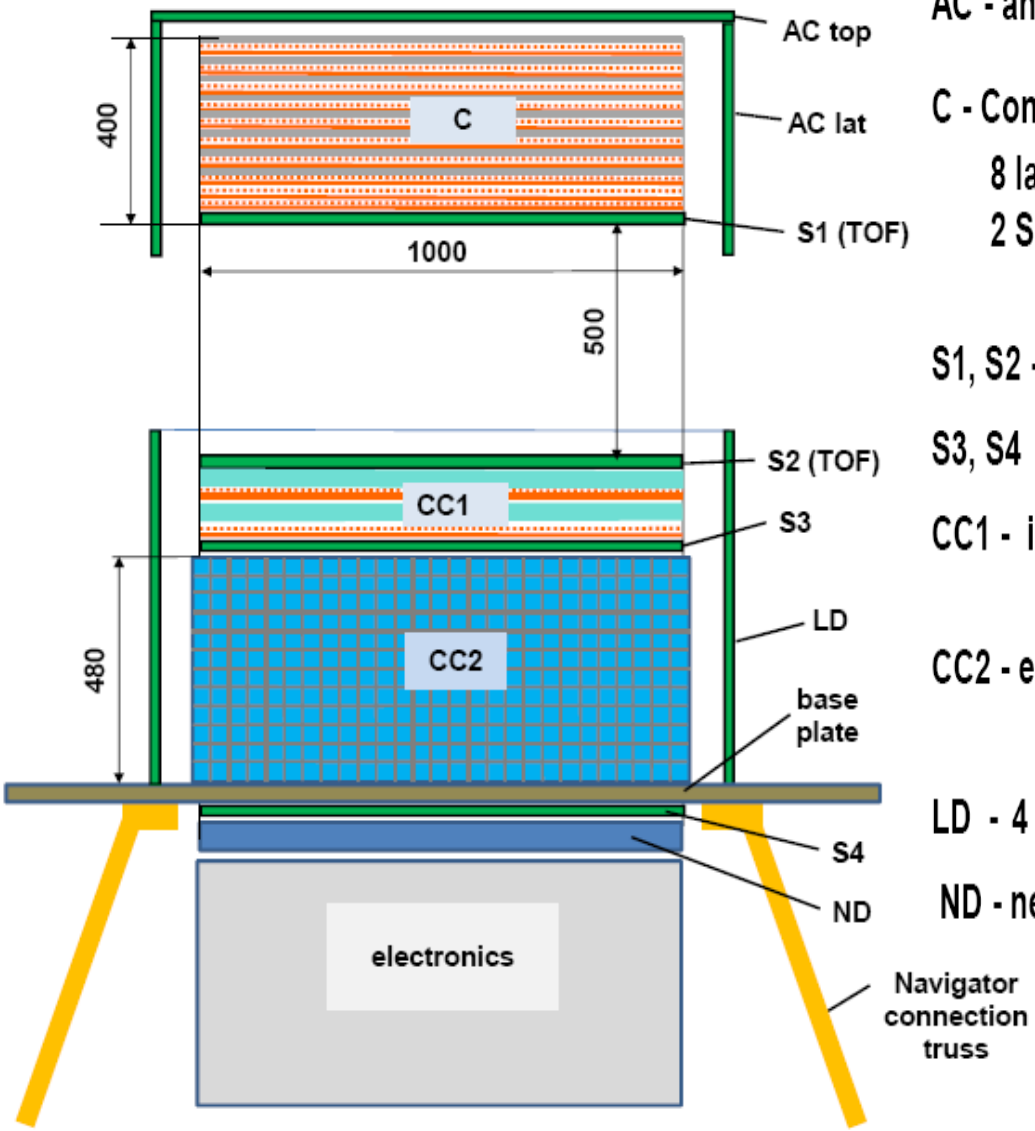
NATIONAL RESEARCH NUCLEAR UNIVERSITY
“MEPHI”

NEUTRON DETECTOR FOR «GAMMA-400» SPACE OBSERVATORY

Trieste, 2-4 May, 2013



AC - anticoincidence detectors (AC top , AC lat)

C - Converter-Tracker - total 1 Xo

8 layers W 0.1 Xo +Si (x,y) (pitch 0.1mm)

2 Si(x,y) no W

S1, S2 - TOF detectors

S3, S4 calorimeter scintillator detectors

CC1 - imaging calorimeter (2Xo)

2 layers: CsI(Tl) 1Xo + Si(x,y) (pitch 0.1 mm)

CC2 - electromagnetic calorimeter

CsI(Tl) 23 Xo 3.6x3.6x3.6 cm^3 - 28x28x12=9408 crystals

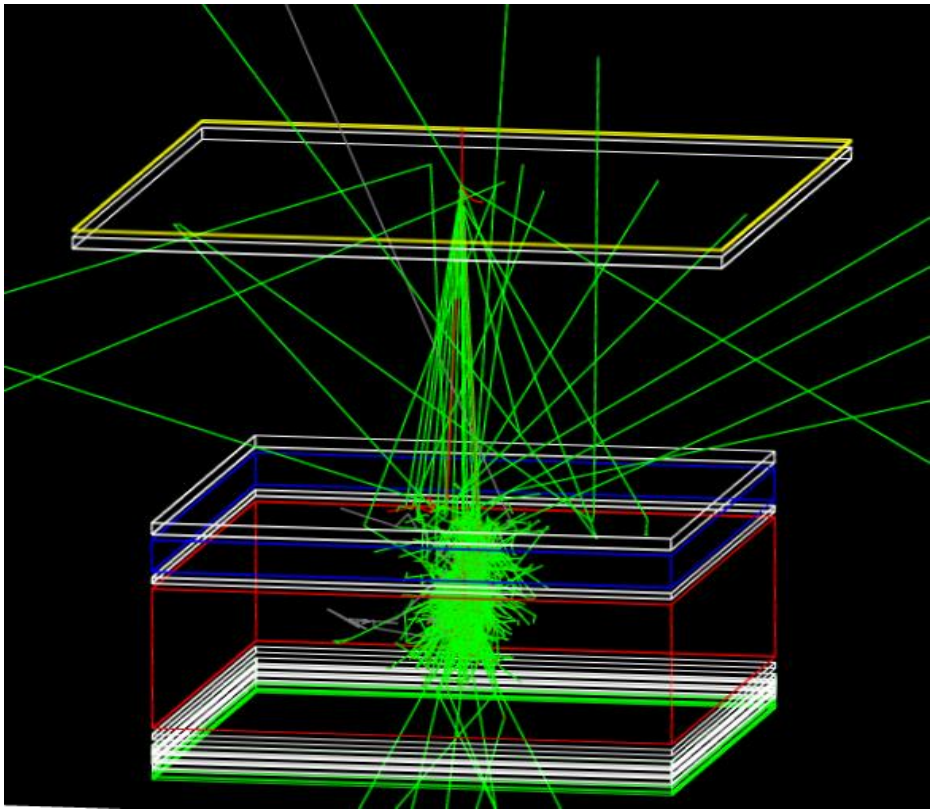
LD - 4 lateral calorimeter detectors

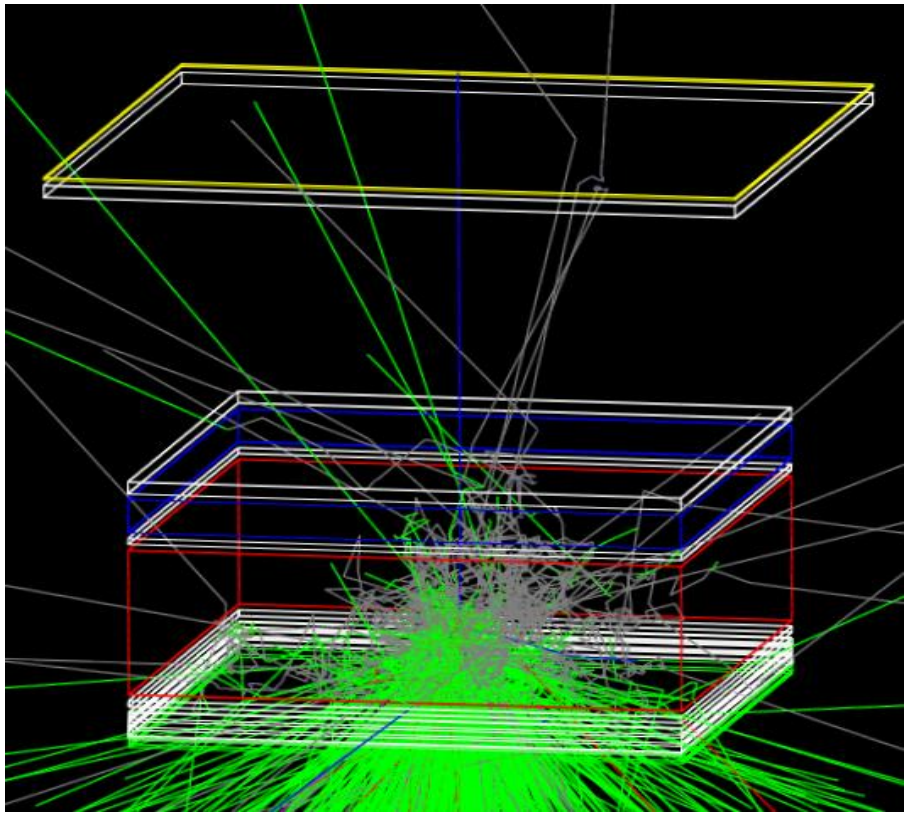
ND - neutron detector

"GAMMA-400" space observatory design scheme

Trieste, 2-4 May, 2013

CASCADE PROGRESSION SCHEME





The neutron detector is designed as an additional instrument for separating electron and proton cascades

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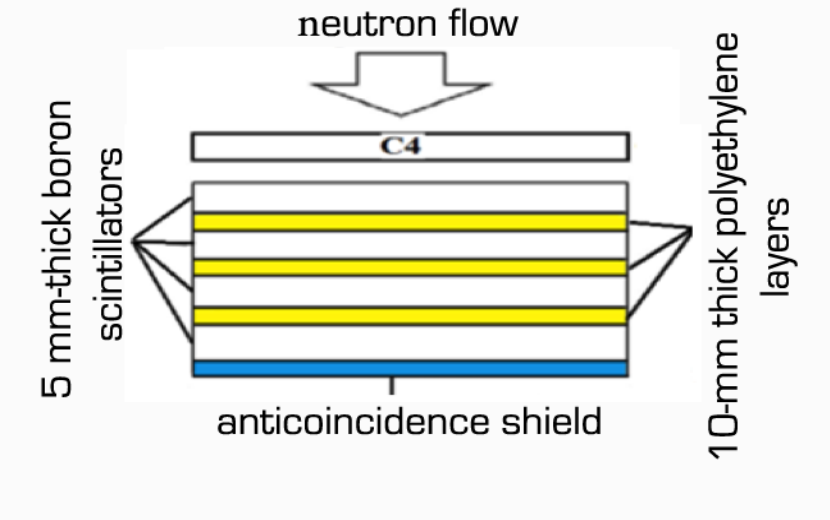
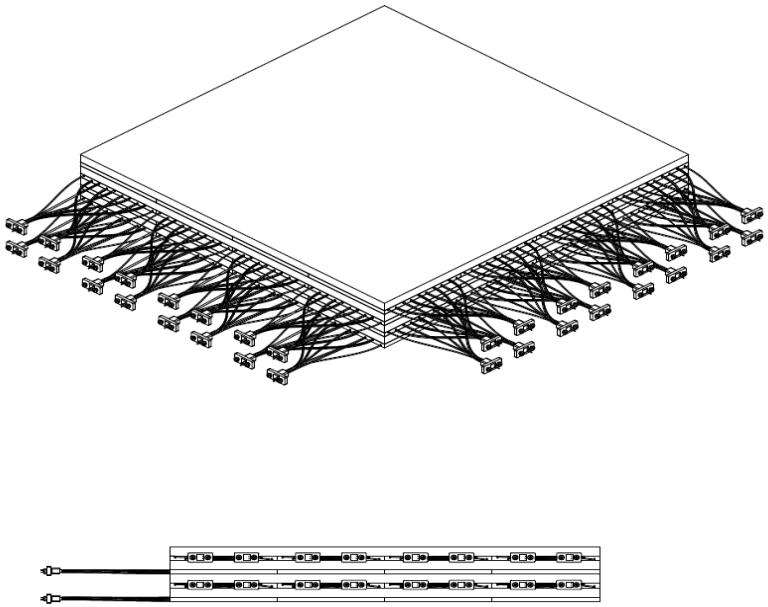
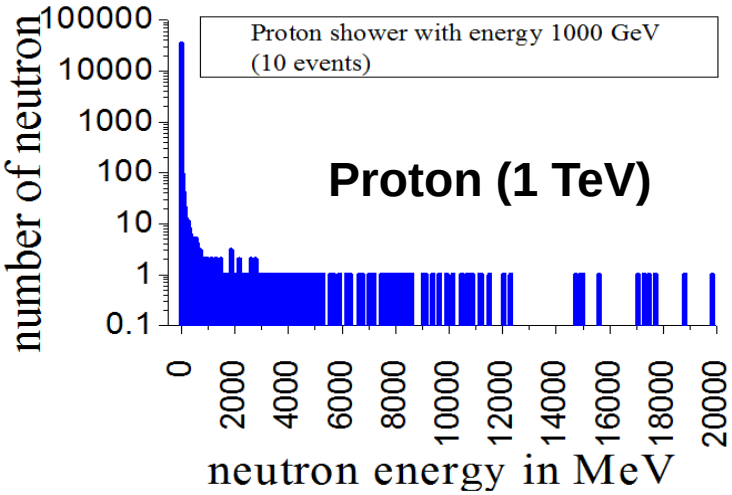
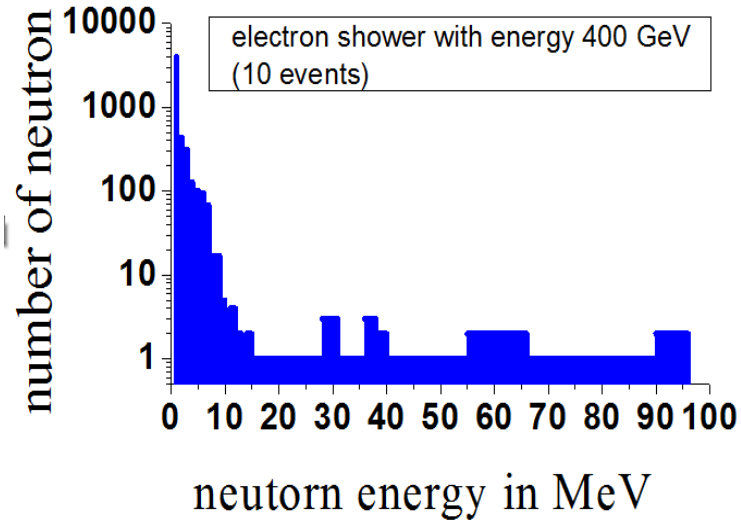
SCHEMATICS OF THE NEUTRON DETECTOR



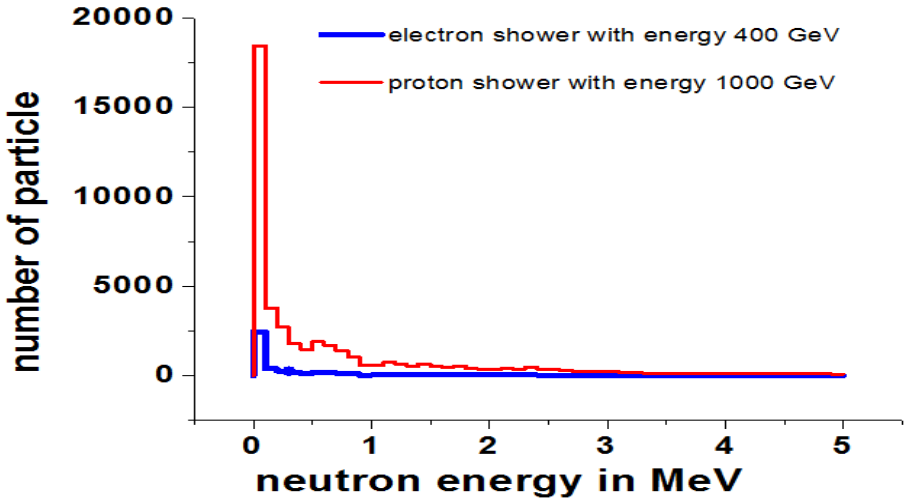


CALCULATED ENERGY SPECTRA OF NEUTRONS FOR PROTON AND ELECTRON CASCADES



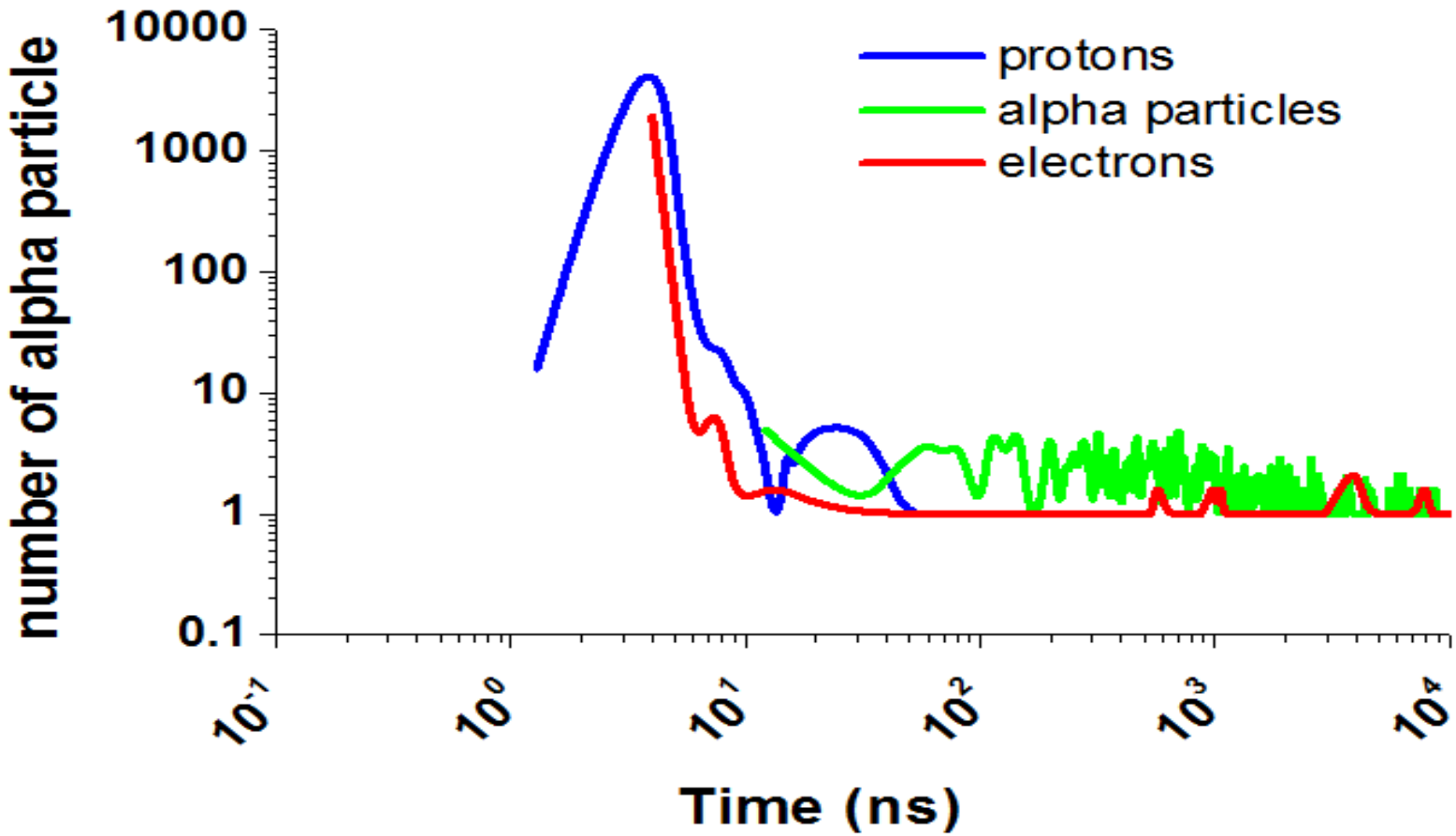


Electron (400 GeV)

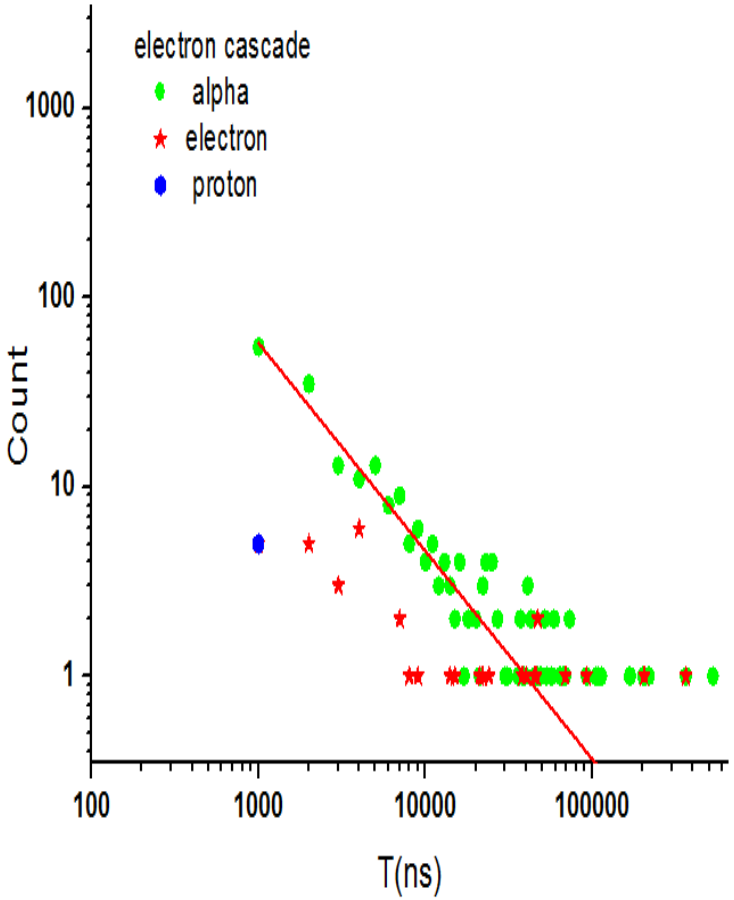


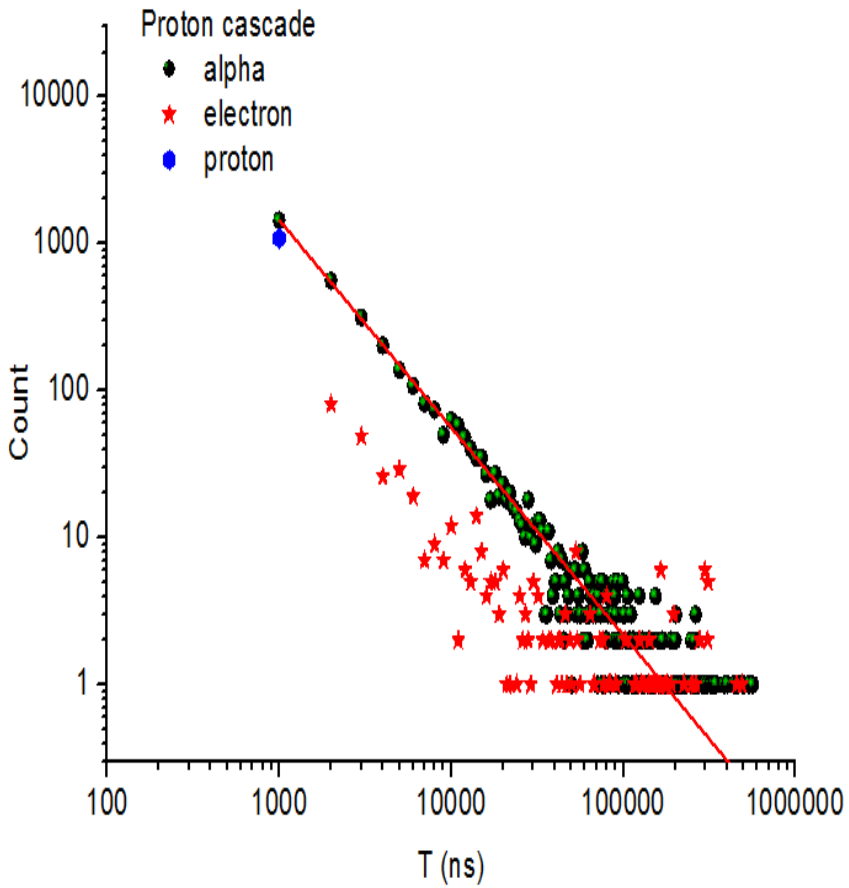
Number of neutron difference between proton and electron showers (for 10 events of initiated charged particle)

TIME DEPENDENCE OF CHARGED PARTICLE OCCURRENCE IN THE SCINTILLATORS



Time distribution of particles in the scintillator for proton cascade (energy 1000 GeV)



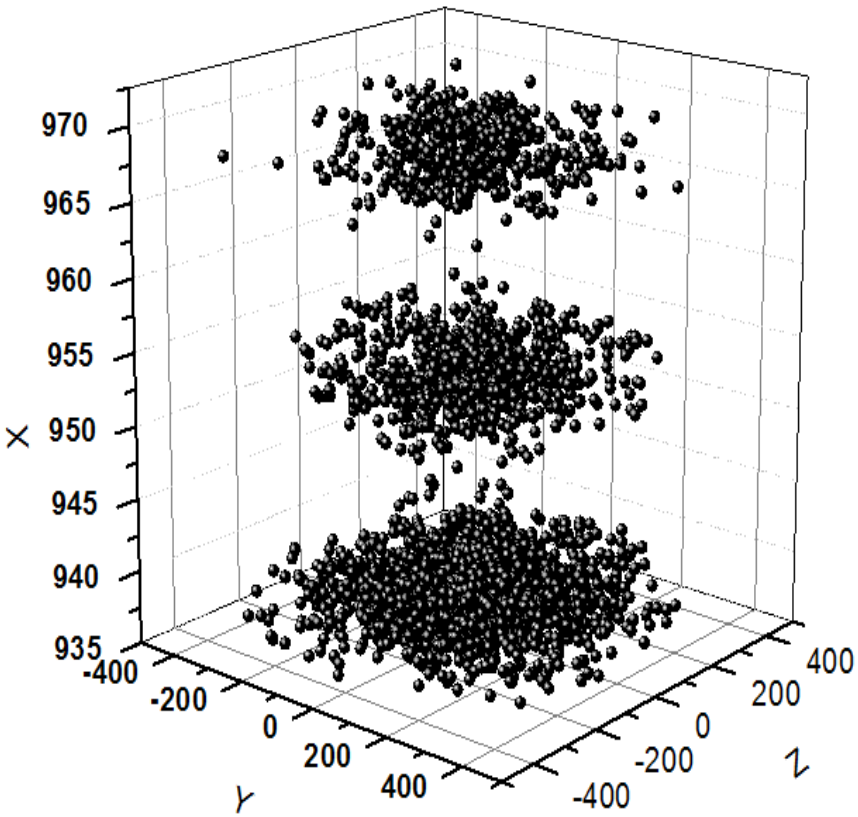


Fitting parameters obtained by using $Y = ax^{-b}$ fit-function

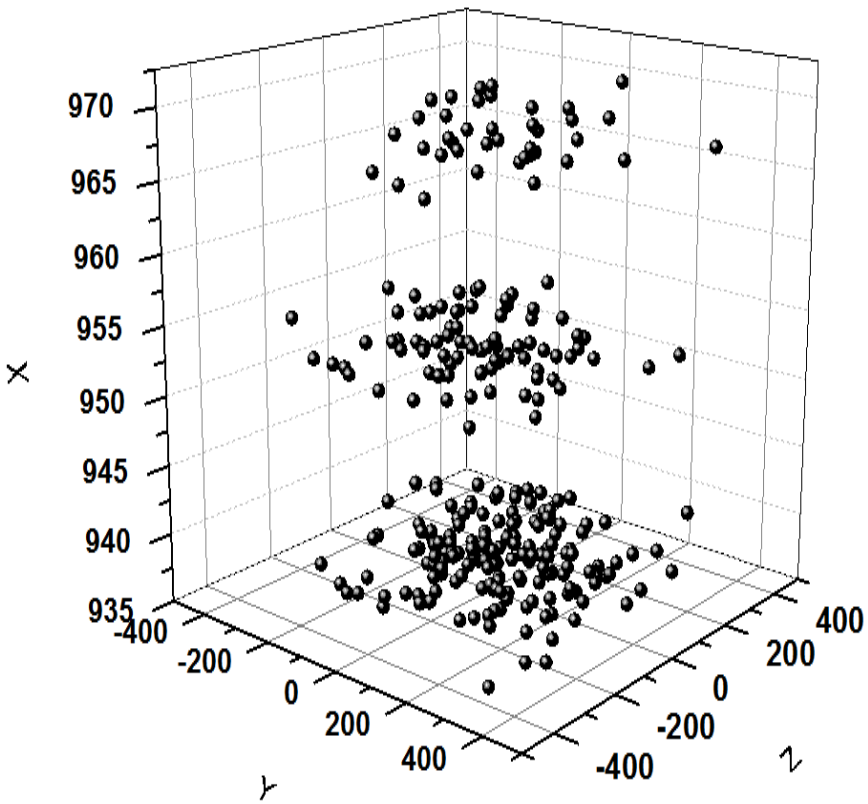
a = 114 ± 7*10^3, b= 1.09 ± 0,01 — for the electron cascade

a = 249 ± 4*10^5, b = 1.410 ± 0,002 — for the proton cascade

SPATIAL DISTRIBUTION OF PARTICLE DETECTION COORDINATES IN THE LAYERS OF BORON SCINTILLATOR

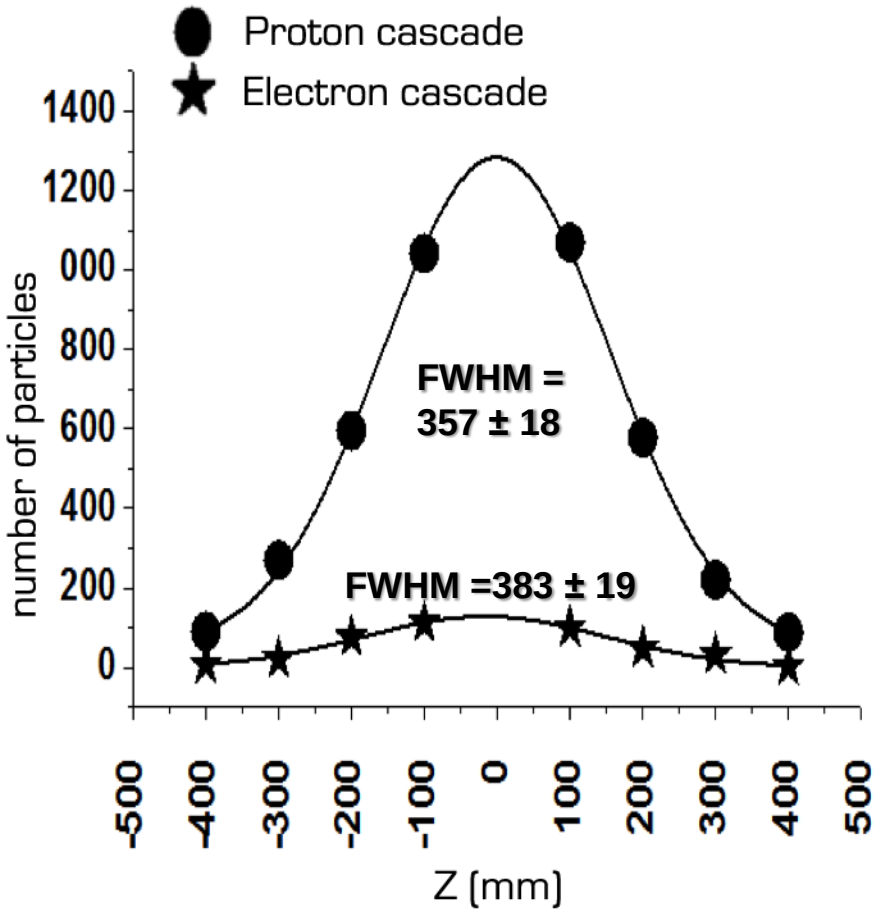


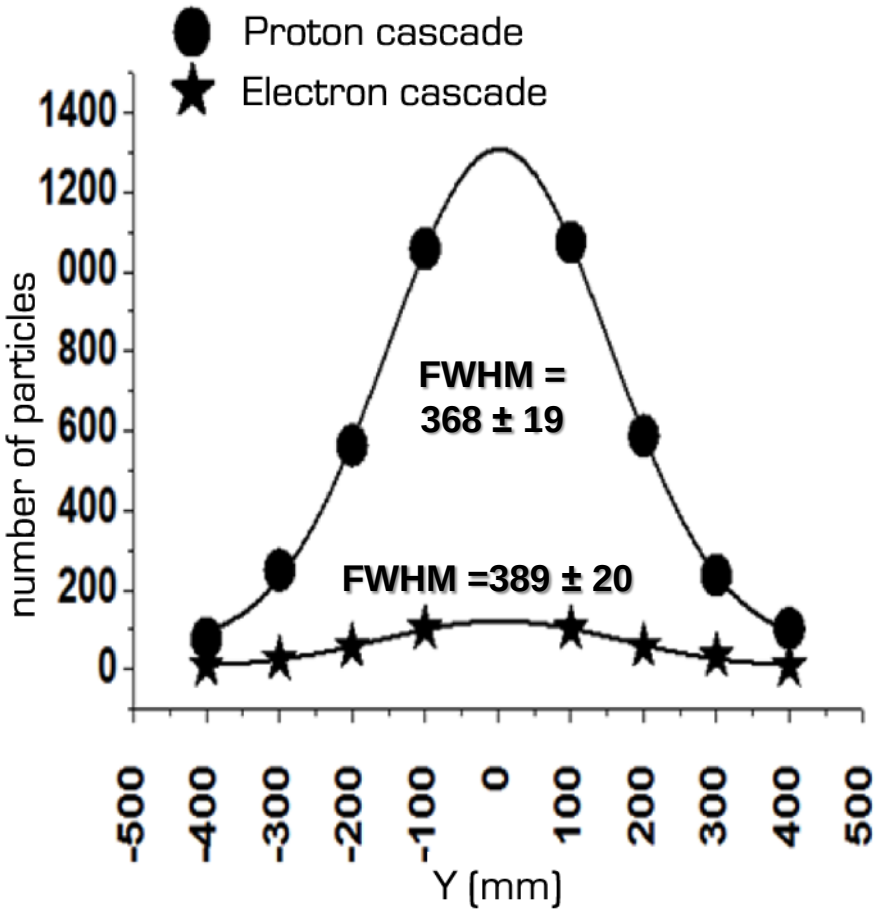
Proton cascade (energy 1000 GeV, 10 events)



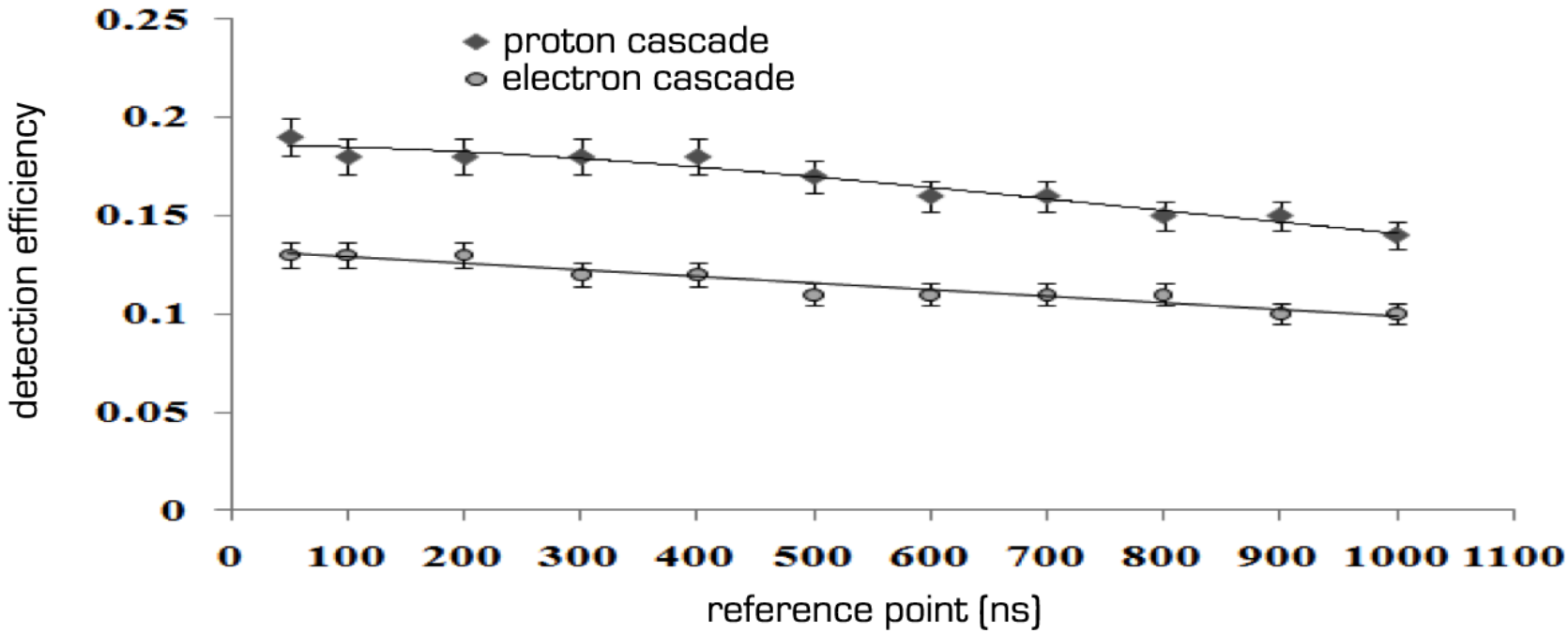
Electron cascade (energy 400 GeV, 10 events)

APPROXIMATION OF PARTICLE DETECTION COORDINATES ON Y AND Z AXES BY THE GAUSSIAN DISTRIBUTION



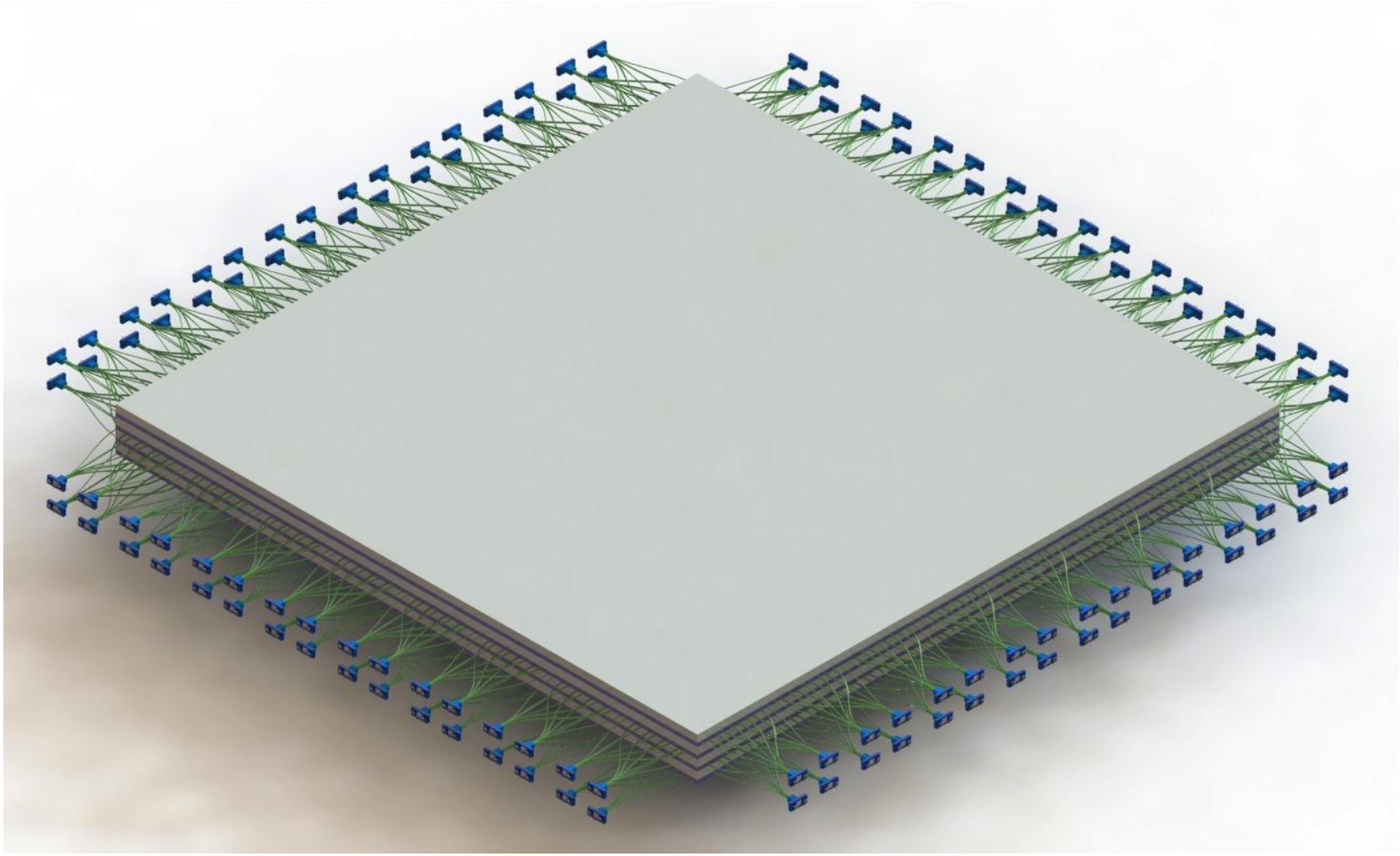


DETECTION EFFICIENCY DEPENDENCE AS A FUNCTION OF REFERENCE TIME



Protons/Electrons energy (GeV)	25/10	250/100	1000/400
Amount of detected neutrons for cascade (10 events)	2912/56	9185/620	39530/2720
p/e separation factor	52.0	14.8	14.5

COMPLETE DETECTOR WITHOUT ELECTRONICS PERIPHERY (3D MODEL)



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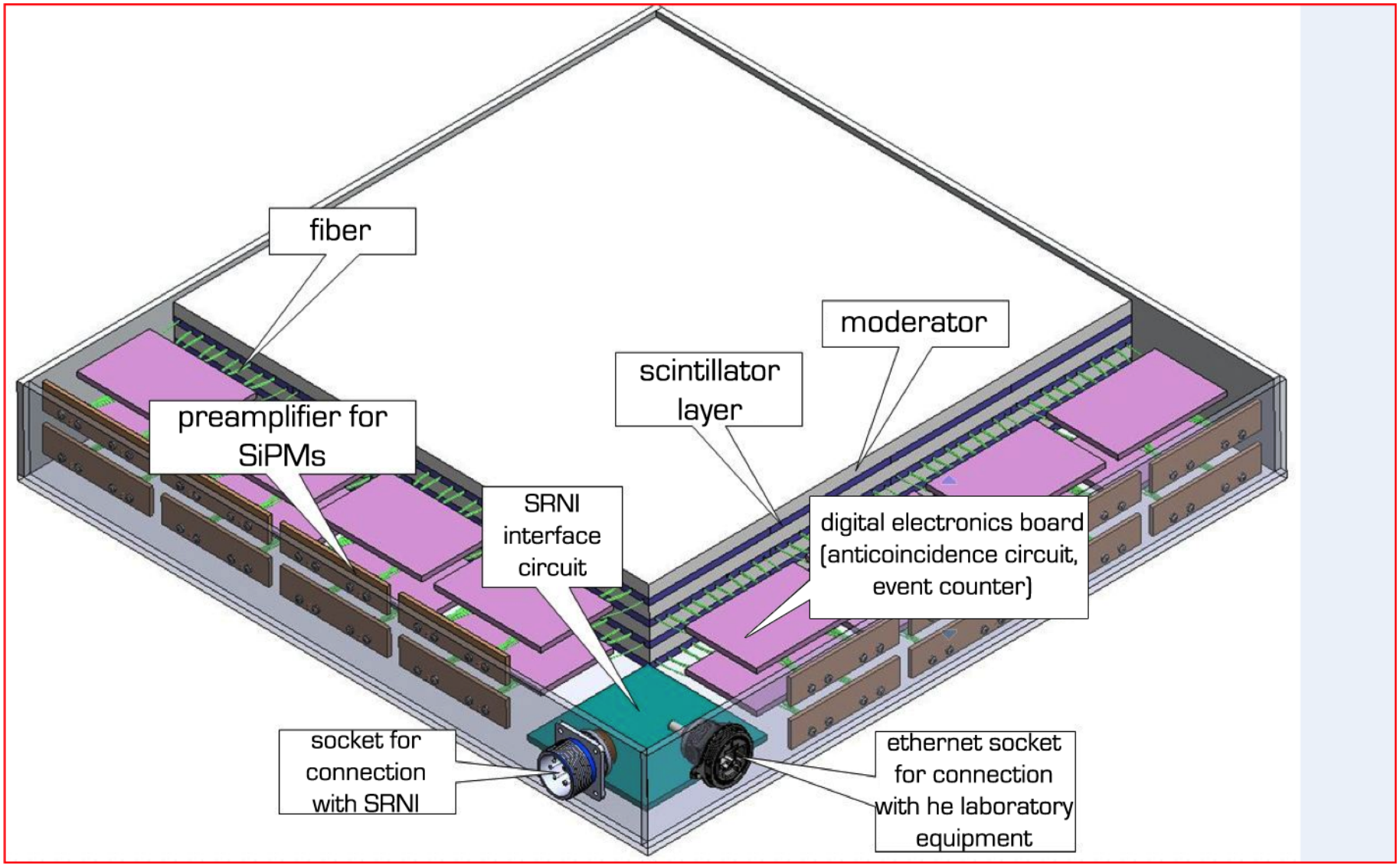
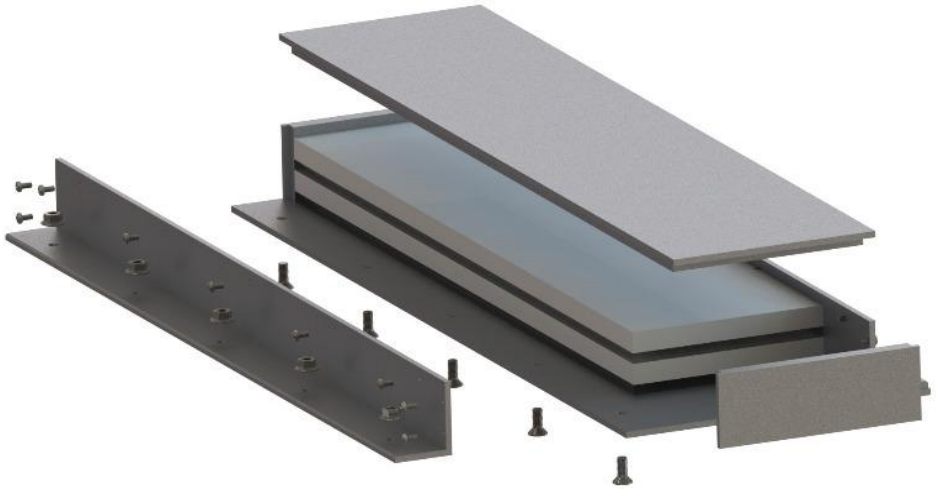
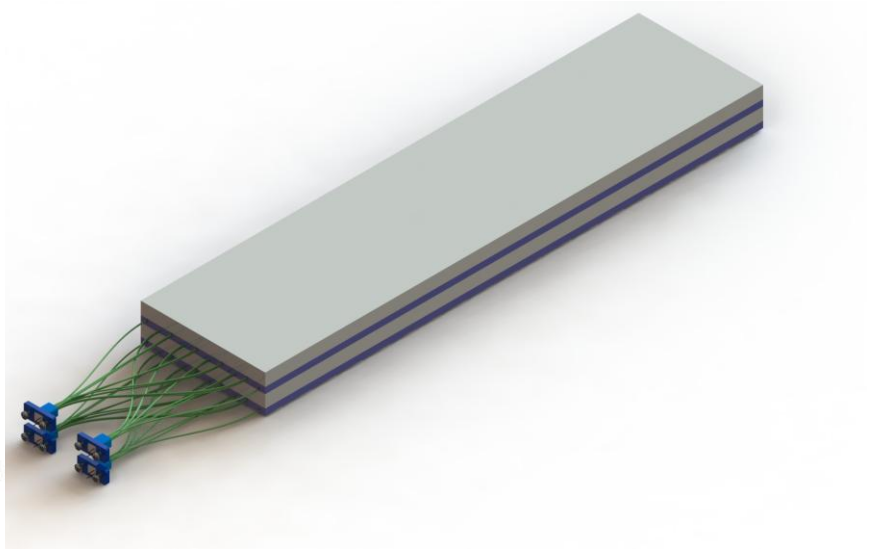
SCHEME OF THE DETECTOR ELECTRONICS



ASSEMBLY SCHEME OF THE LABORATORY PROTOTYPE



DESIGN SCHEME OF THE LABORATORY PROTOTYPE



Two strips. Dimensions of sensitive area of strip:
400 x 100 x 40 mm

THANK YOU FOR YOUR ATTENTION