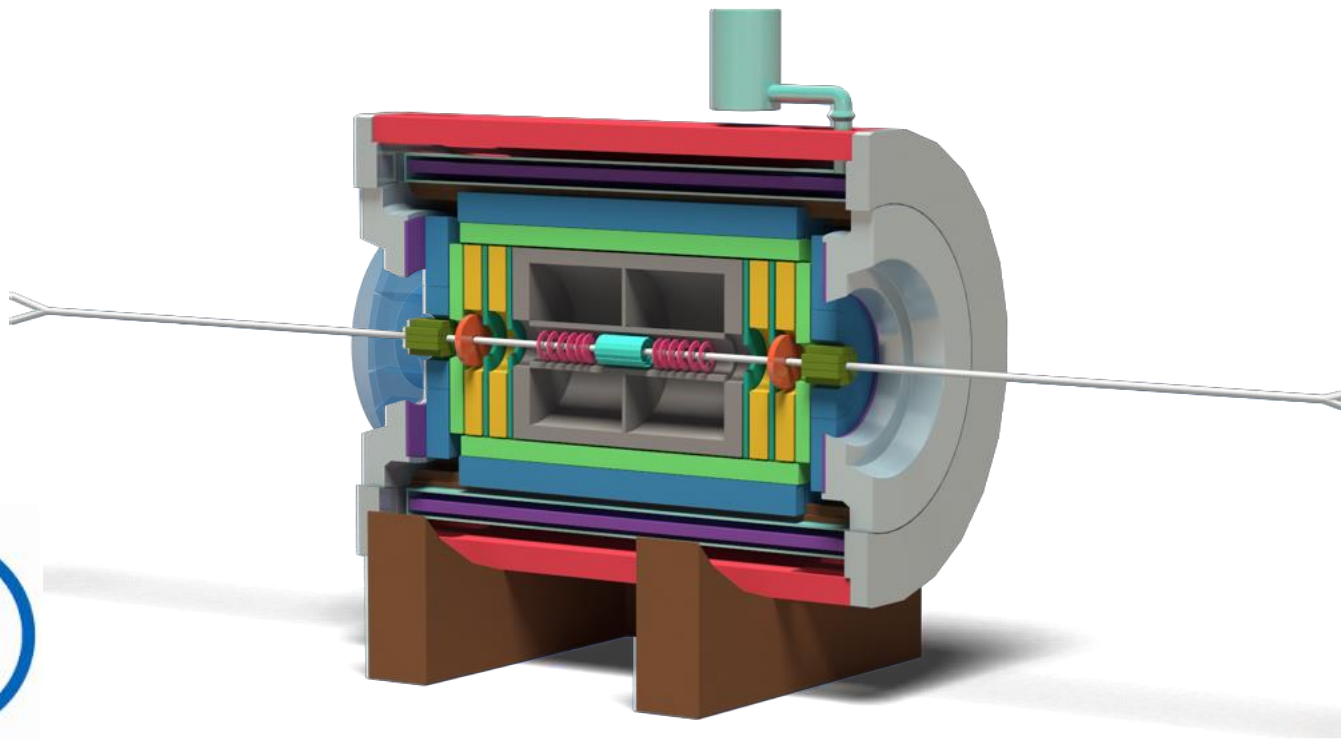
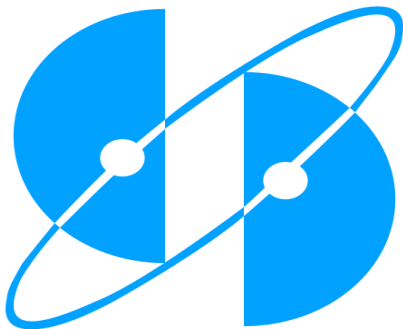


Demezhan Myktybekov

VBLHEP

EMC Radiation length research for
MPD experiment

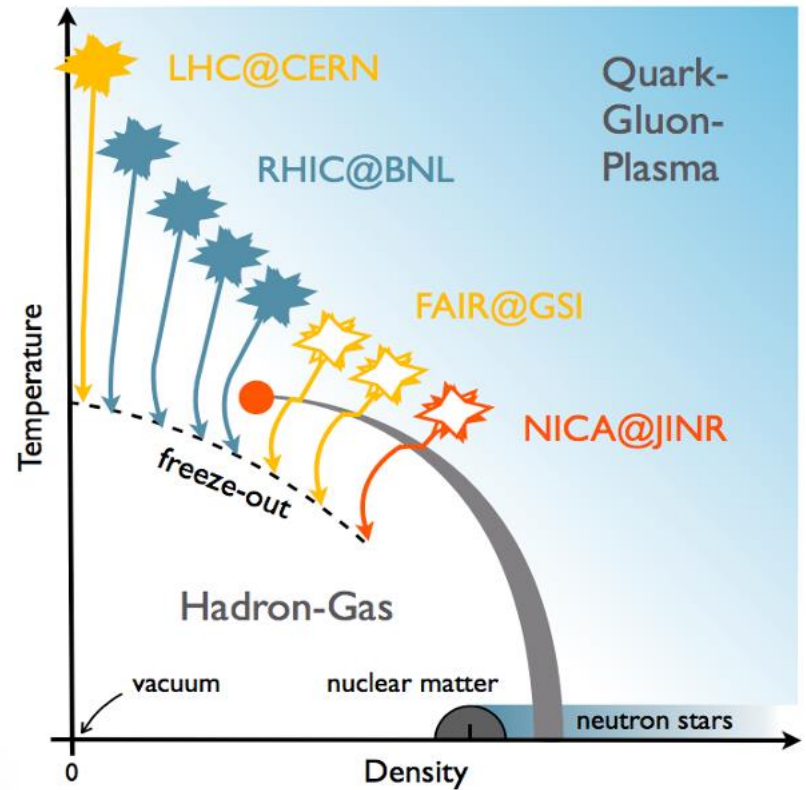
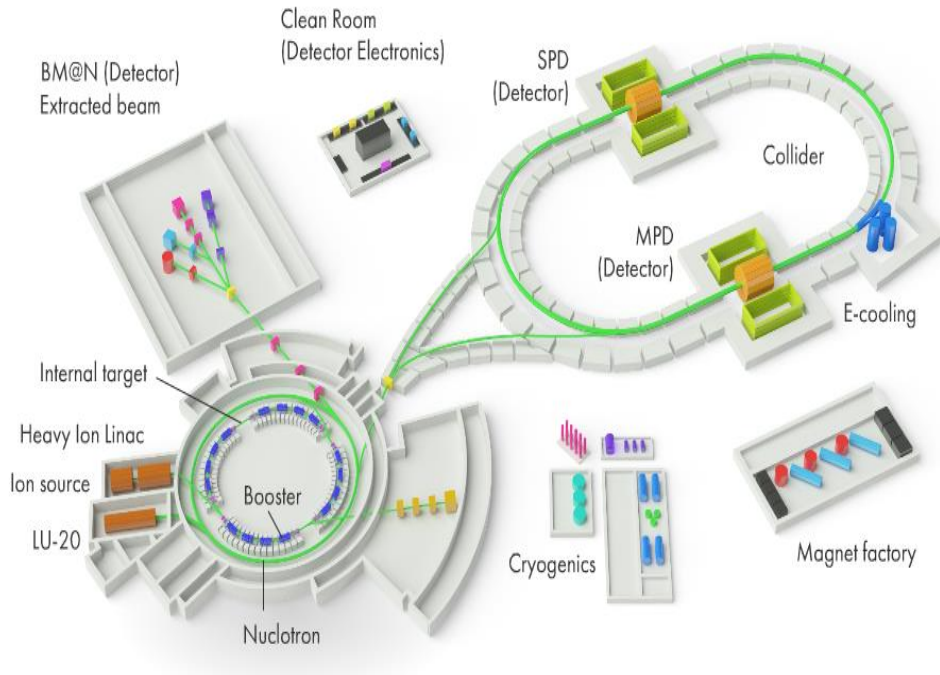
11-16 October 2021



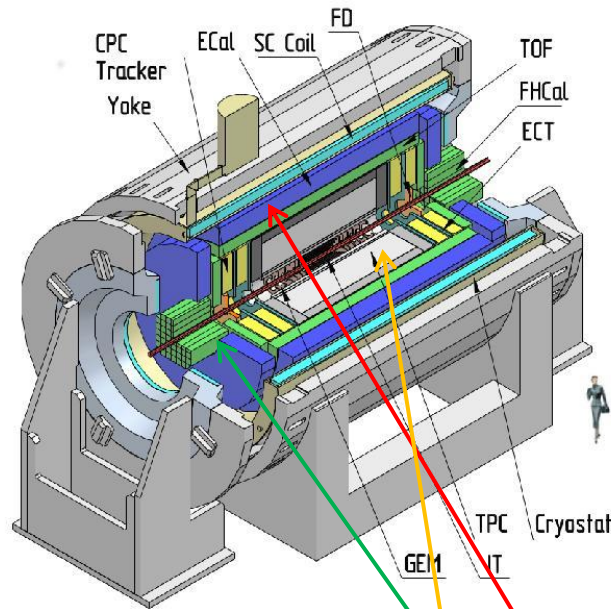
NICA – MPD experiment

Search and study of new, previously not observed forms of baryonic matter – quark-gluon plasma.

The major goal of the NICA/MPD Project is the study of in-medium properties of hadrons and the nuclear matter equation of state, including a search for possible signals of deconfinement and/or chiral symmetry restoration phase transitions and the QCD critical endpoint in the region of the collider energy $\sqrt{s_{NN}} = 4 - 11$ GeV.

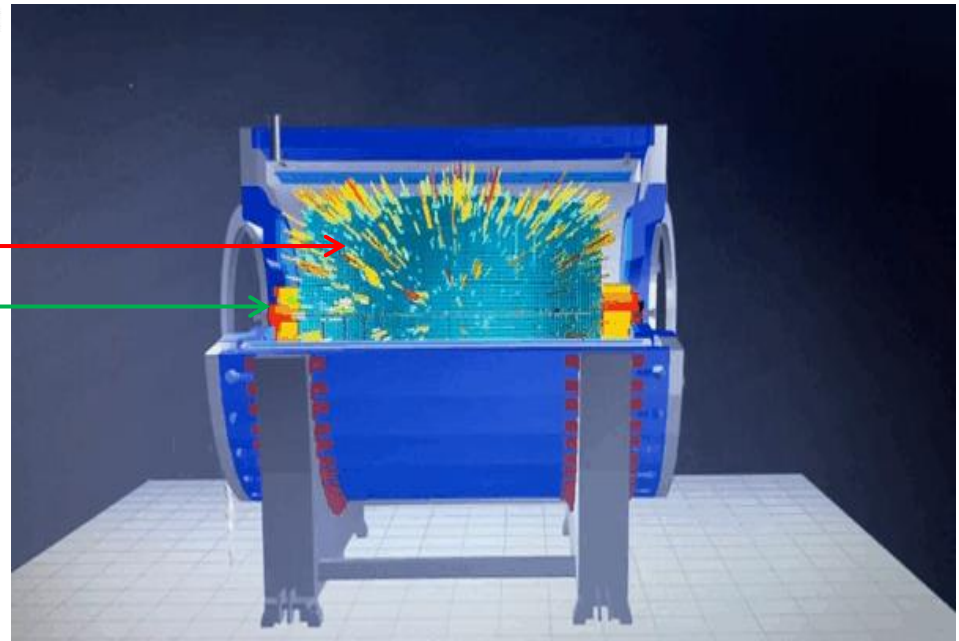


Multi-Purpose Detector



4 π spectrometer capable of detecting charged hadrons, electrons and photons in heavy-ion collisions at high luminosity

- Electromagnetic calorimeter
- Forward Hadron Calorimeter
- Time-Projection Chamber



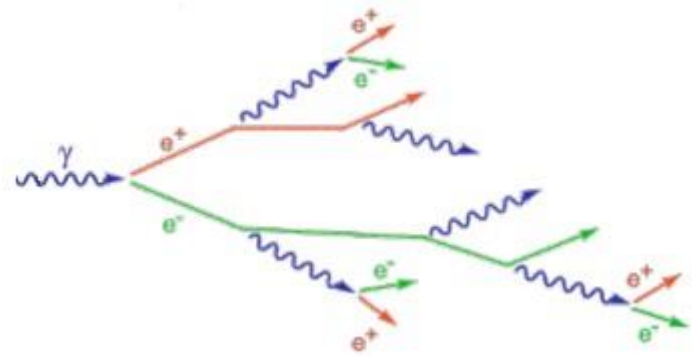
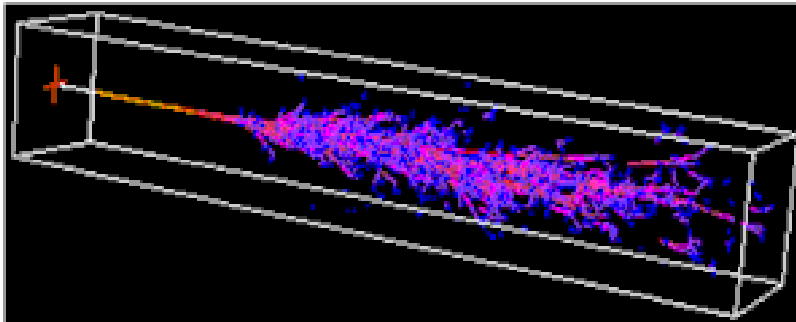
Electromagnetic Calorimeters

Radiation length

Detection of electron/photon showers

The formation of an electromagnetic shower using the example of a photon entering the calorimeter. A photon entering the calorimeter creates an electron-positron pair. If the energy of the electrons (positrons) is greater than the critical E_c , (Critical energy is the energy at which the specific losses for bremsstrahlung become equal to the specific ionization losses.) they produce bremsstrahlung (photons). The number of particles in the shower will grow rapidly.

- $(dE/dx(E=E_c))_{\text{rad}} = (dE/dx(E=E_c))_{\text{ion}}$.
- If $E > E_c$ the domination of bremsstrahlung.
- $(dE/dx)_{\text{rad}} \approx -E/X_0$,
 $E = E_0 \exp(-x/X_0)$,
- X_0 – Radiation length – average thickness of material, in which the energy of photon is decreasing by e.
 $X_0 = 180A/Z^2$ [g/cm²]



Richard Wigmans. [Advances in Hadron Calorimetry](#). Annu Rev Nucl Part Sci. 1991.41: 133-185

Christian W. Fabjan and Fabiola Gianotti. [Calorimetry for Particle Physics](#)

Material budget for EMC

N layers	Material(structure)	A
8	Frame + Wrap	comp
210	Scintillator	14
210	Lead	207
	Scintillator	14
7	Frame + Wrap	comp

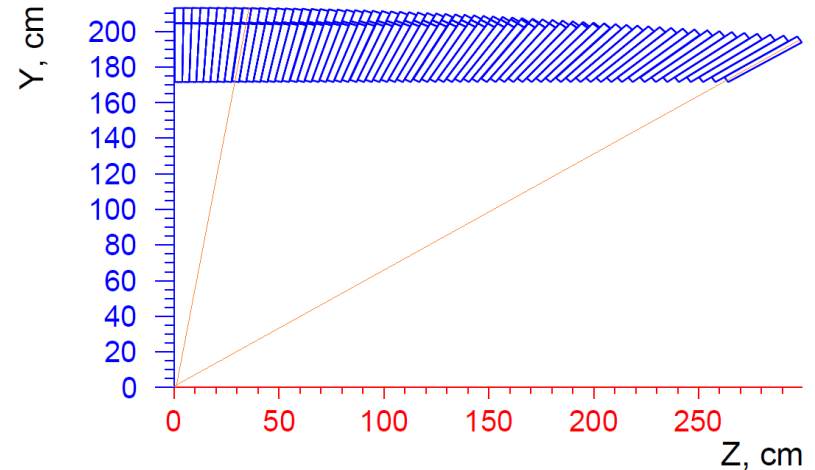
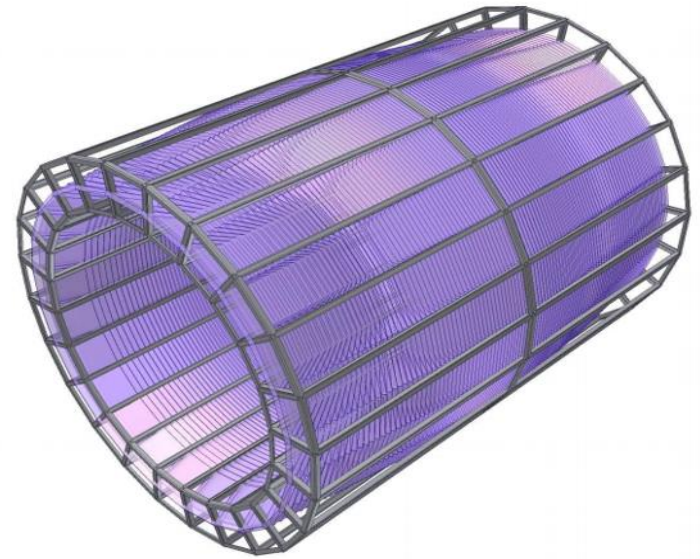
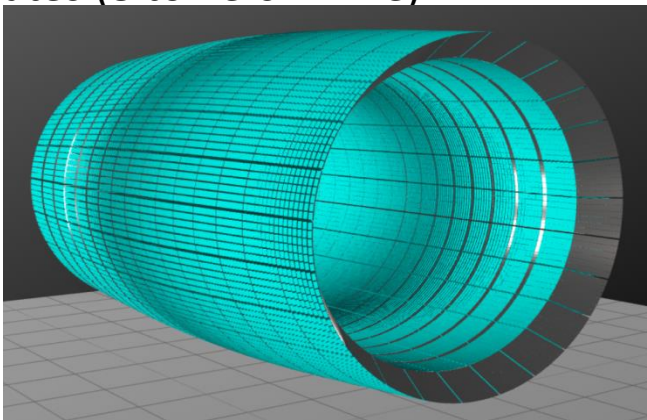
Projection geometry:

38400 towers*:

Symmetrical by Z-axis

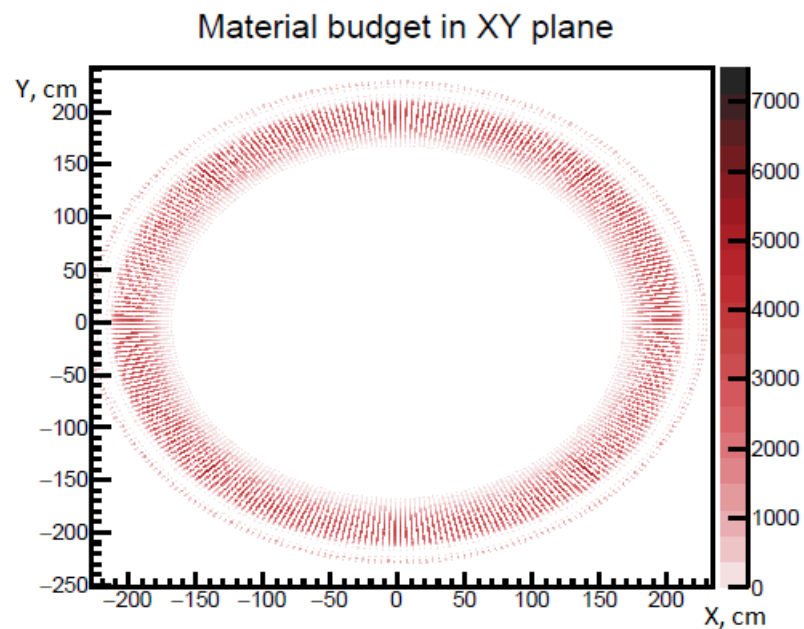
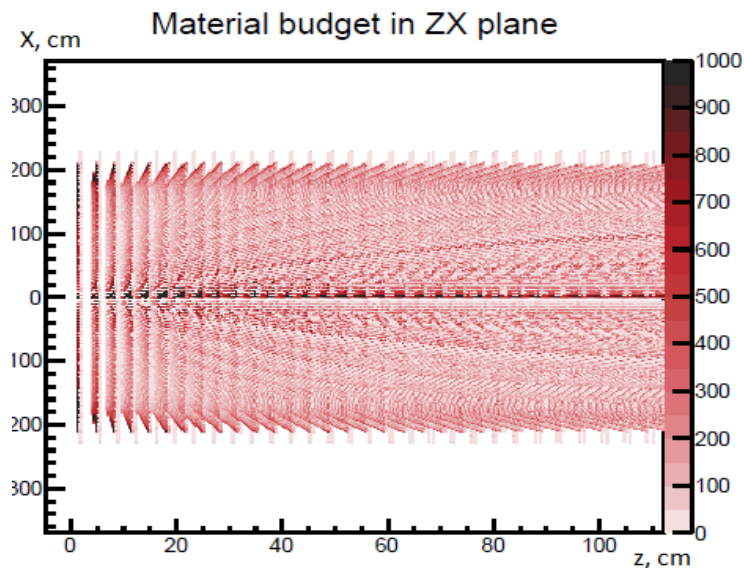
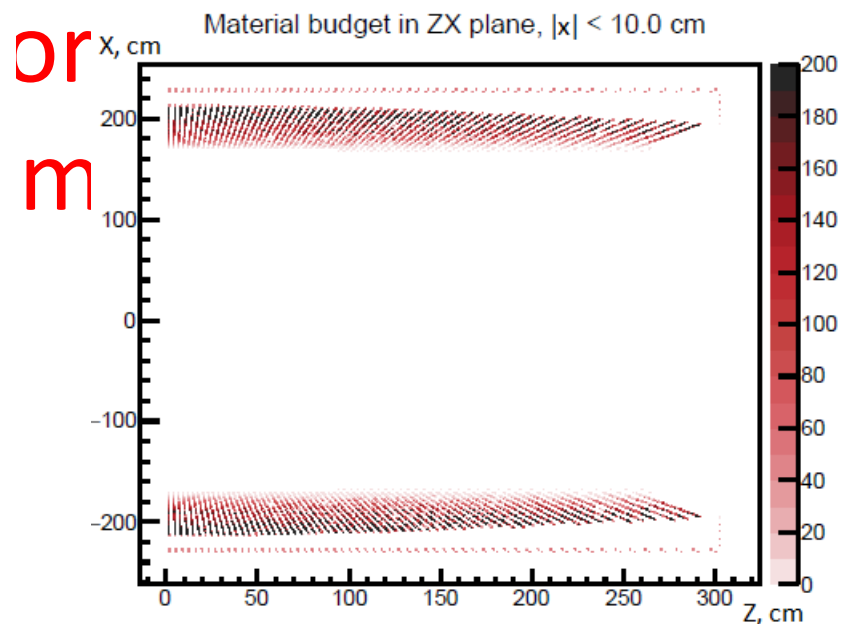
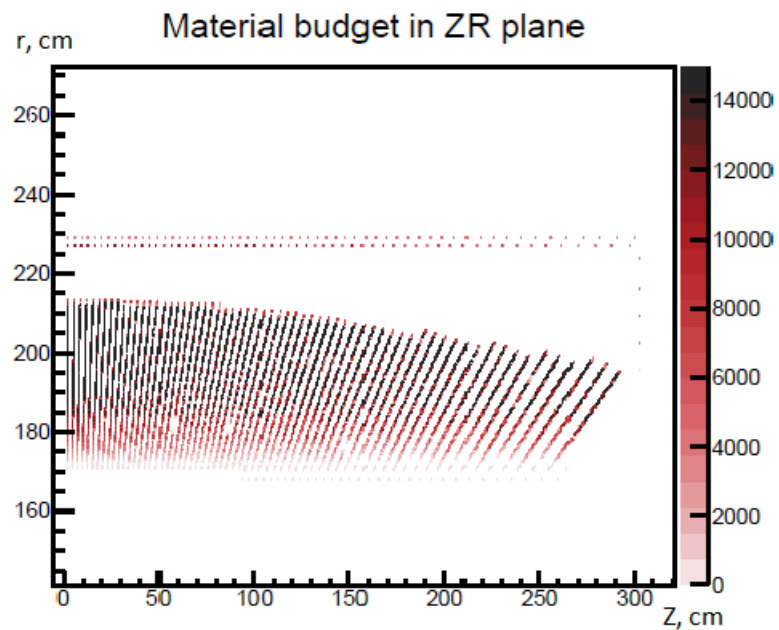
25 sectors (6*2 towers in sector)

8 crates (8 towers in line)



*Emc_v3

TDR_ECAL_v3.6_2019

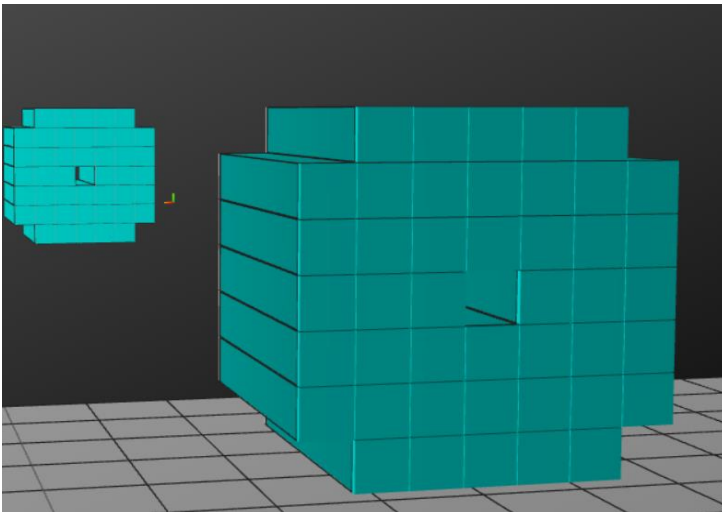
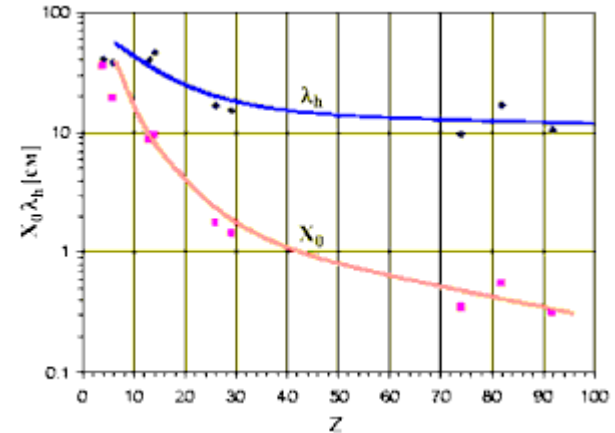


Hadronic (nuclear) length

Forward Hadronic calorimeter (FHCal*)

- Detection of hadron showers (fragments and spectators)
- Similar to the radiation length, but for λ_h the scale is different. The length of the nuclear interaction is approximately proportional to the nuclear radius

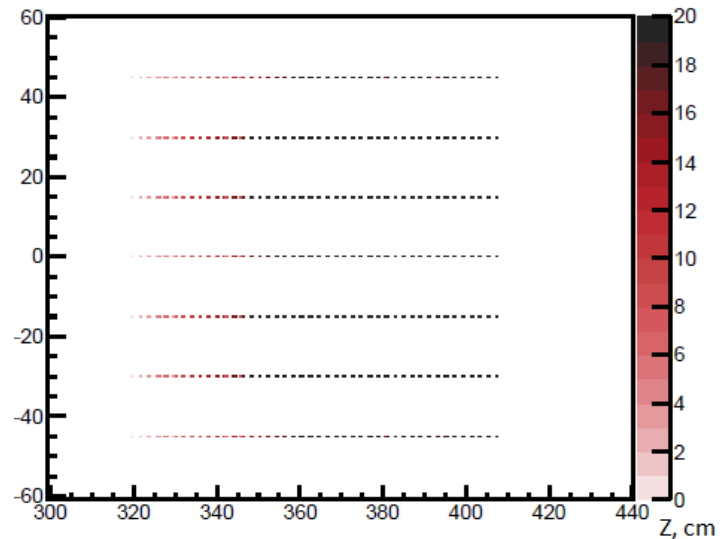
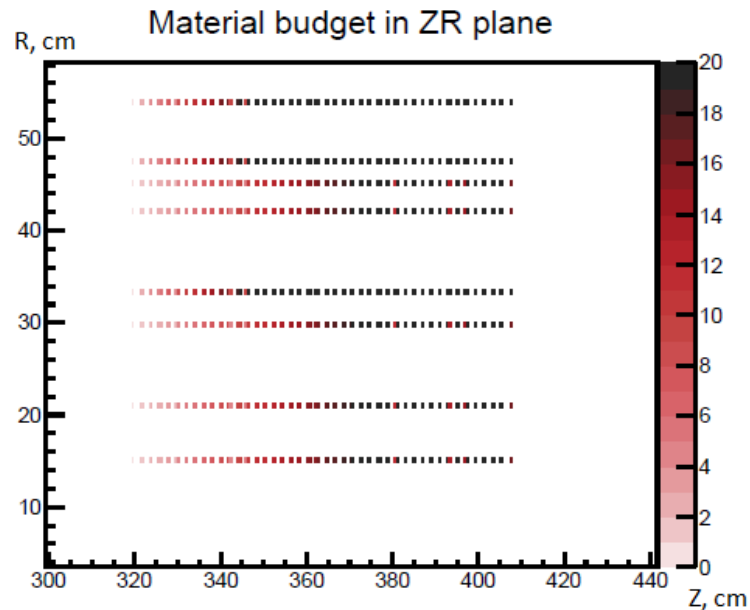
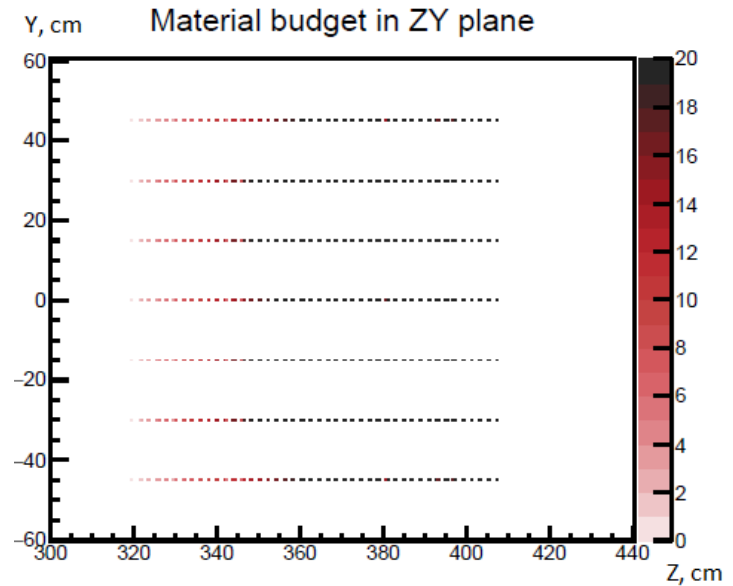
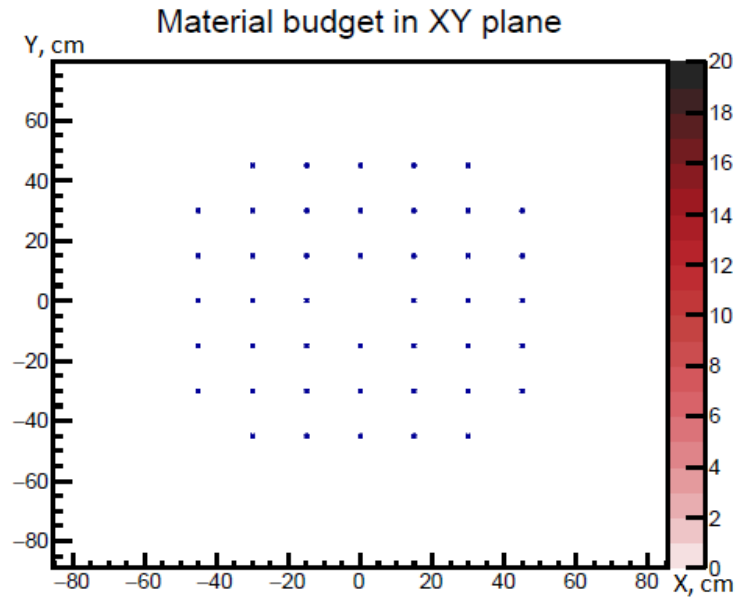
$$\lambda_h \approx 35A^{1/3} [\text{g/cm}^2].$$



N layers	Material	A
1	Carbon-fiber plastic + Fe frame support	12, 56
42	3 * Scintillator + lead	14, 207
1	Carbon-fiber plastic + Fe frame support	12, 56

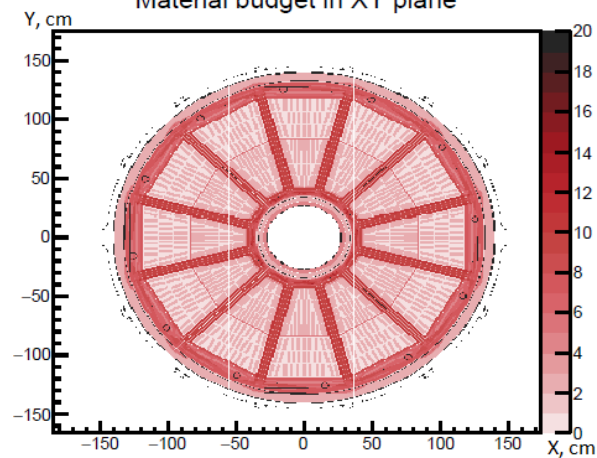
create_rootgeom_zdc_oldnames_7sect_v1_no_overlaps_w_pipe_magnet
MPD_TDR_FHCal_28_05_2018

Material budget for FHCaI

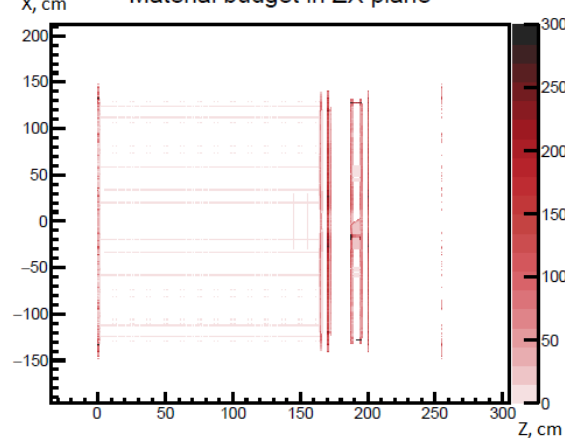


Material budget for TPC*

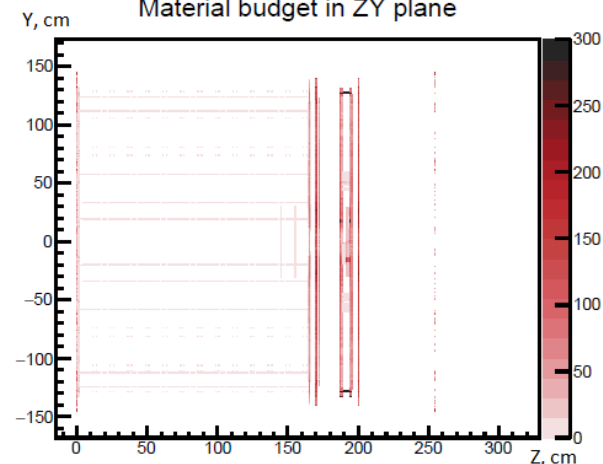
Material budget in XY plane



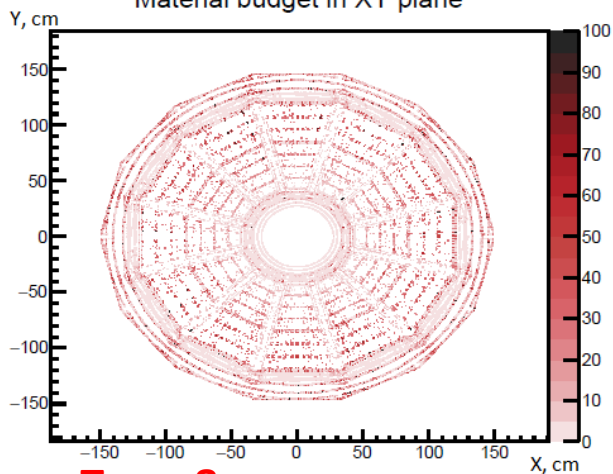
Material budget in ZX plane



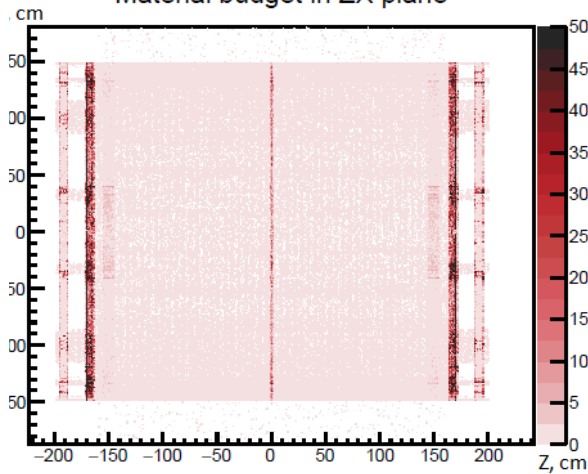
Material budget in ZY plane



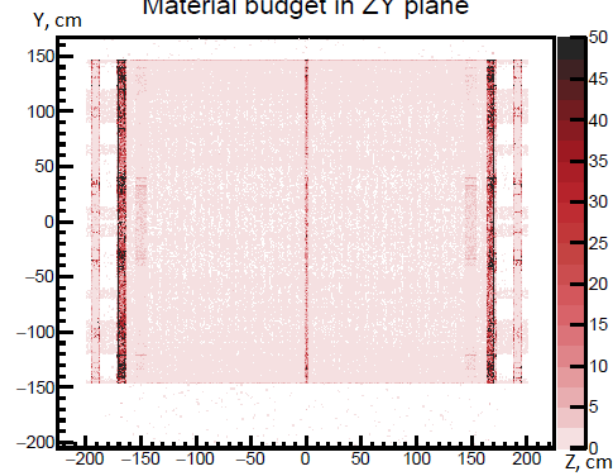
Material budget in XY plane



Material budget in ZX plane



Material budget in ZY plane



Tpc_v8

TpcTdr-v07

Summary:

- Structural and material check of detectors;
- Optimization and detailed analysis of EMC and FHCaI;
- Physical analysis in outer regions of TPC in small pseudorapidity

Thank you for attention!
myktybekov@jinr.ru