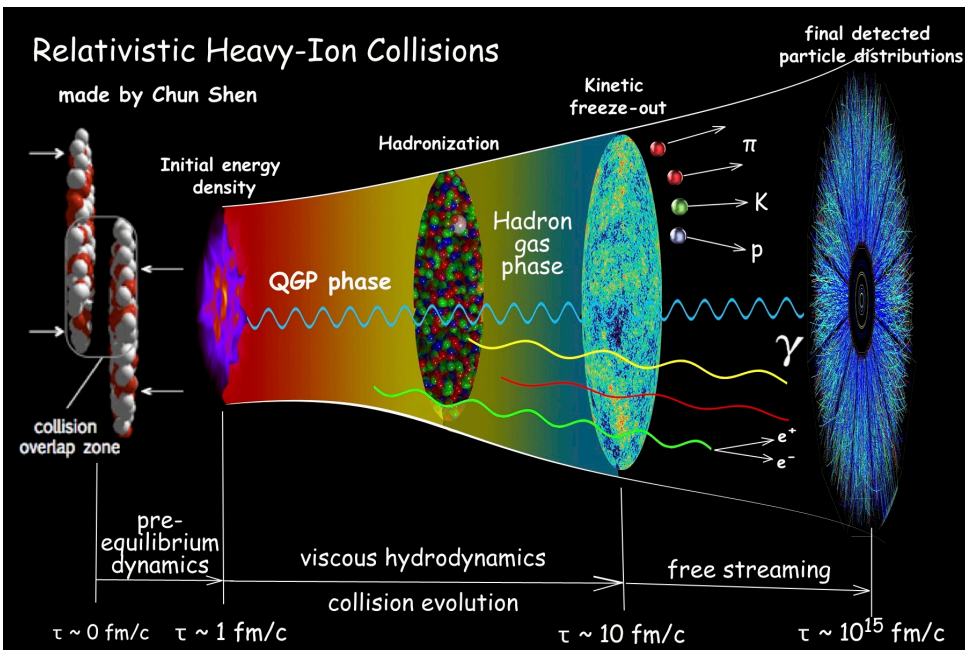


Beam-Beam Counter (BBC) design proposal for relativistic ion-ion physics program at SPD

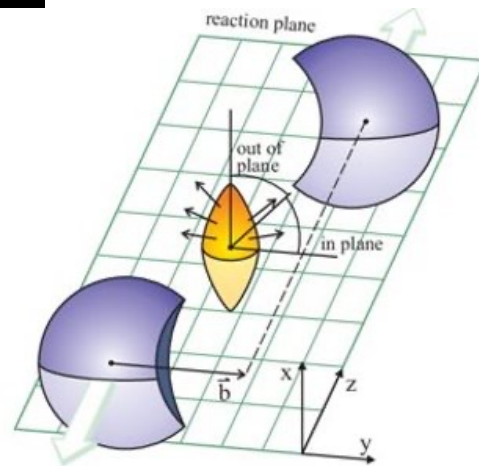
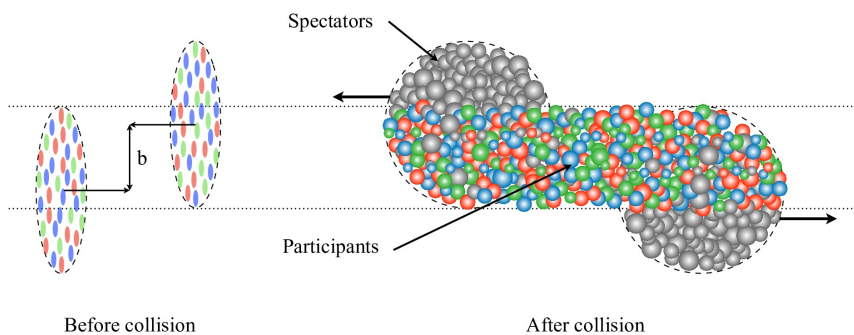
Grigory Nigmatkulov

National Research Nuclear University MEPhI

Picture of Heavy Ion Collisions



- Non-equilibrium evolution at early times
 - initial state at from QCD? Color Glass Condensate? ...
 - thermalization via strong interactions, plasma instabilities, particle production, ...
- Local thermal and chemical equilibrium
 - strong interactions lead to short thermalization times
 - evolution from relativistic fluid dynamics
 - expansion, dilution, cool-down
- Chemical freeze-out
 - for small temperatures one has mesons and baryons
 - inelastic collision rates become small
 - particle species do not change any more
- Thermal freeze-out
 - elastic collision rates become small
 - particles stop interacting
 - particle momenta do not change any more

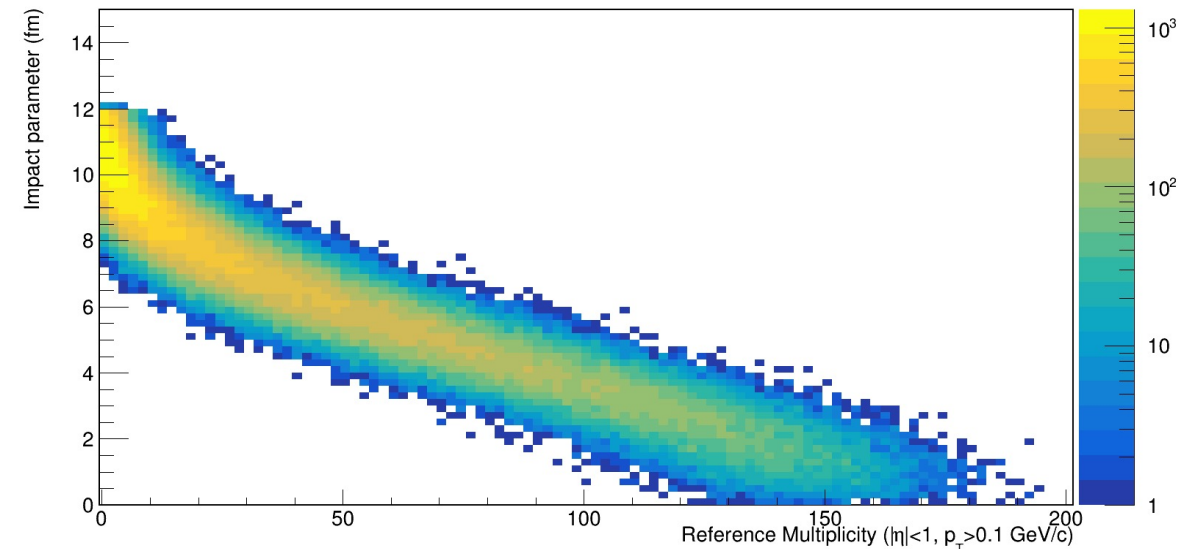
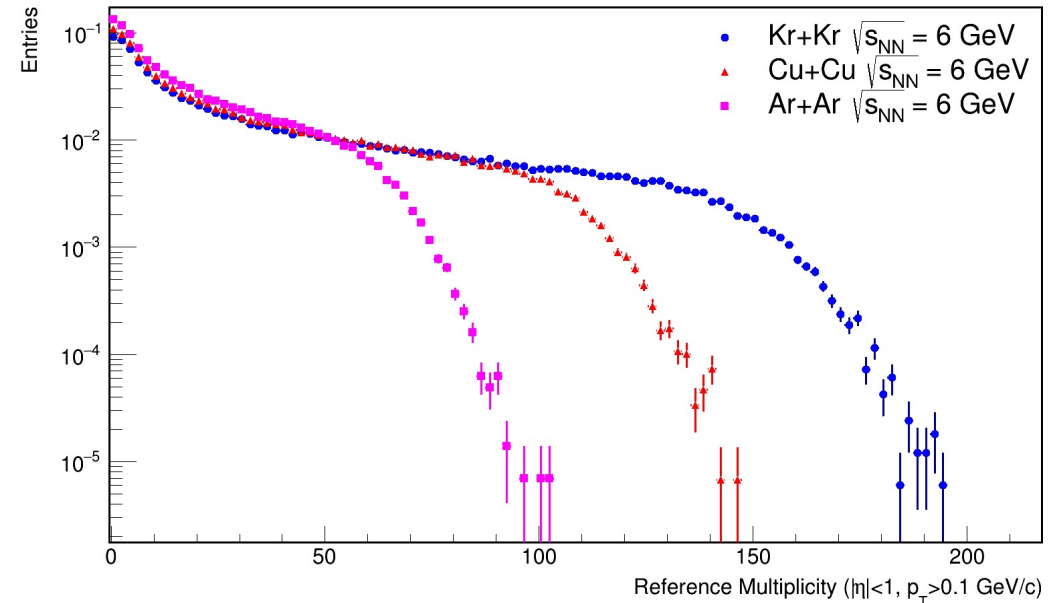


System properties can be probed via:

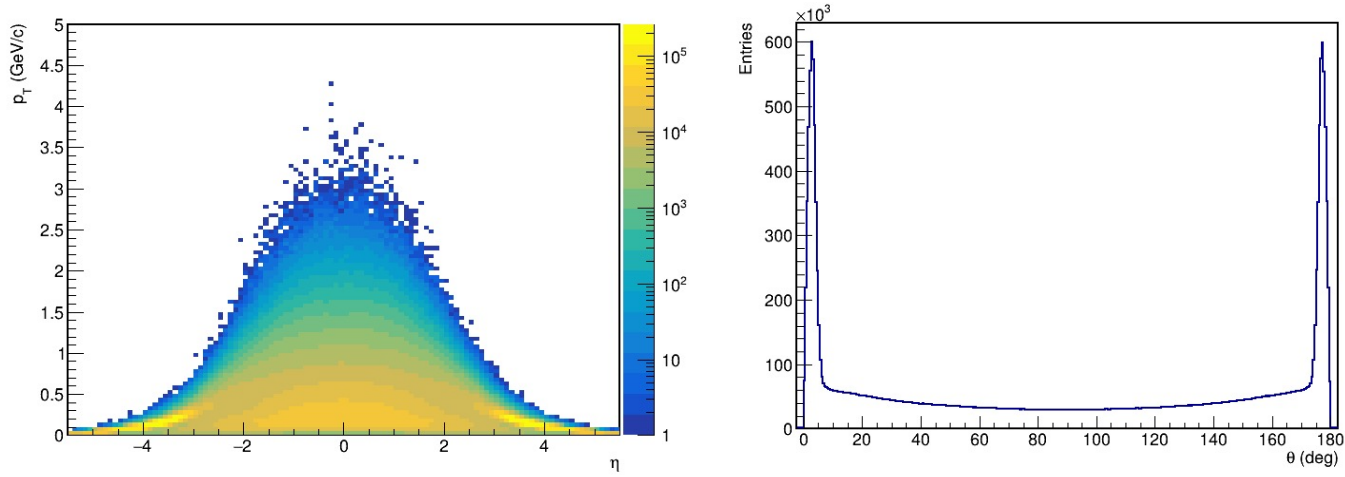
- Transverse momentum particle spectra
- Momentum and angular correlations
- Azimuthal anisotropies
- Global and local polarization of particles
- Etc...

Toy Simulations of Ion-Ion Collisions

- Use UrQMD model to simulate $^{40}\text{Ar}+^{40}\text{Ar}$, $^{63}\text{Cu}+^{63}\text{Cu}$, $^{84}\text{Kr}+^{84}\text{Kr}$ collisions at $\sqrt{s_{\text{NN}}}=6$ and 12 GeV
- No detector response
- Idea: look at the expected occupancy of BBC and charged particle multiplicities in midrapidity
- Work in progress...

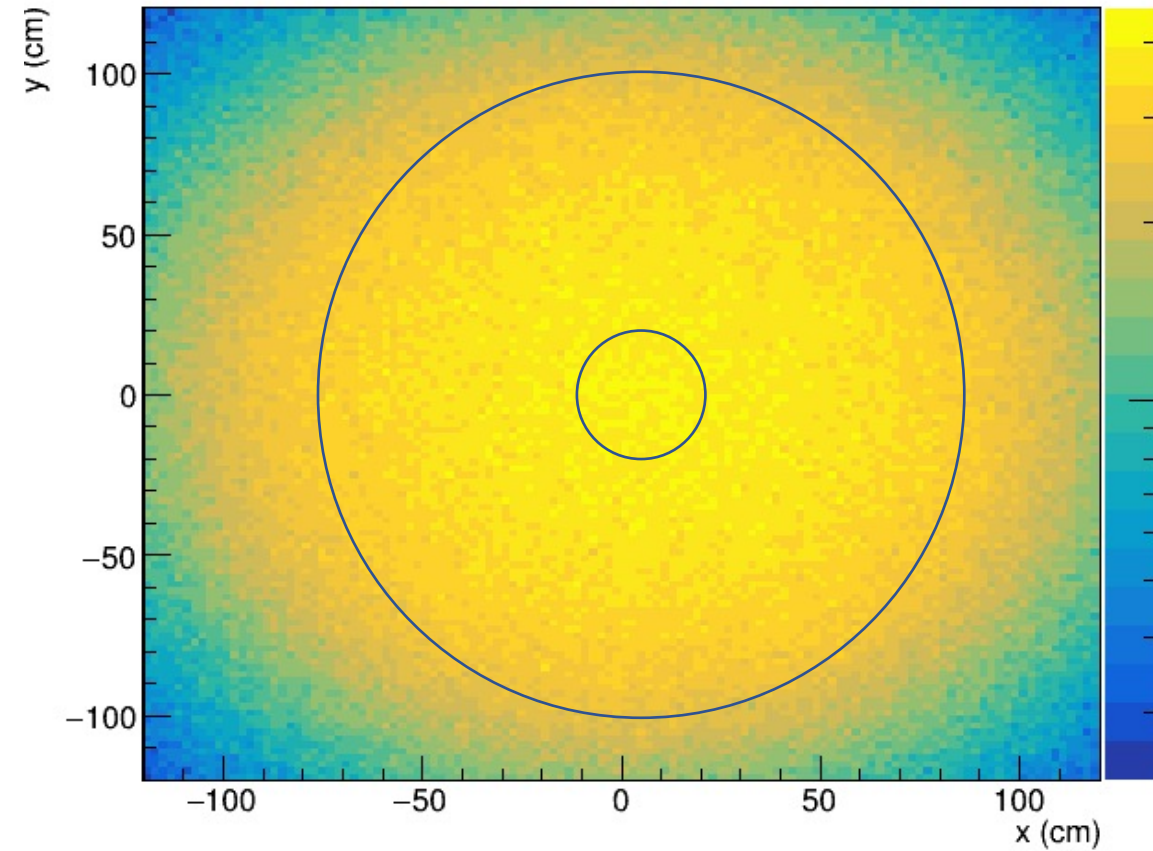


Toy Simulations of Ion-Ion Collisions ($^{84}\text{Kr}+^{84}\text{Kr}$ at 6 GeV)

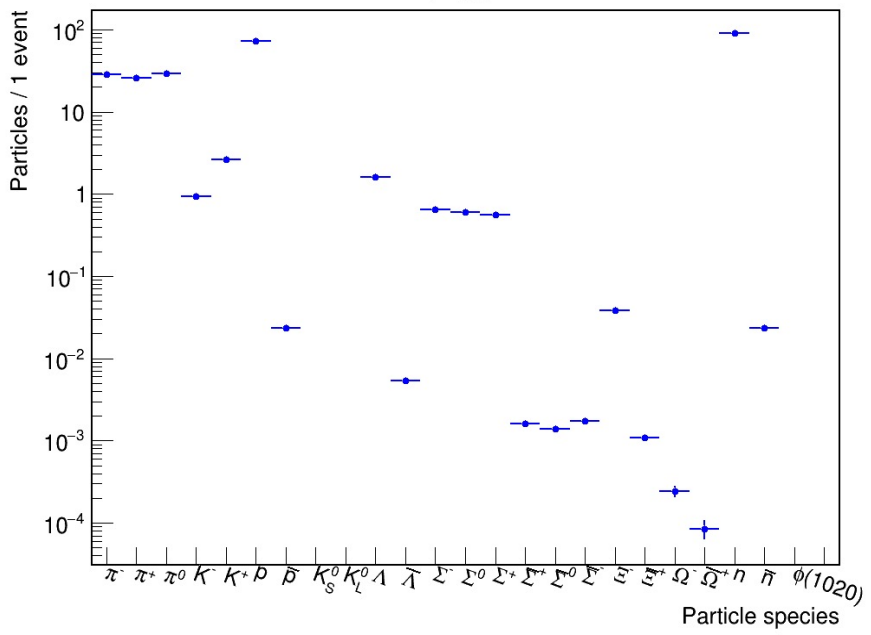


Z (BBC) = 1790 cm
 Rinner = 10 cm
 Router = 83 cm

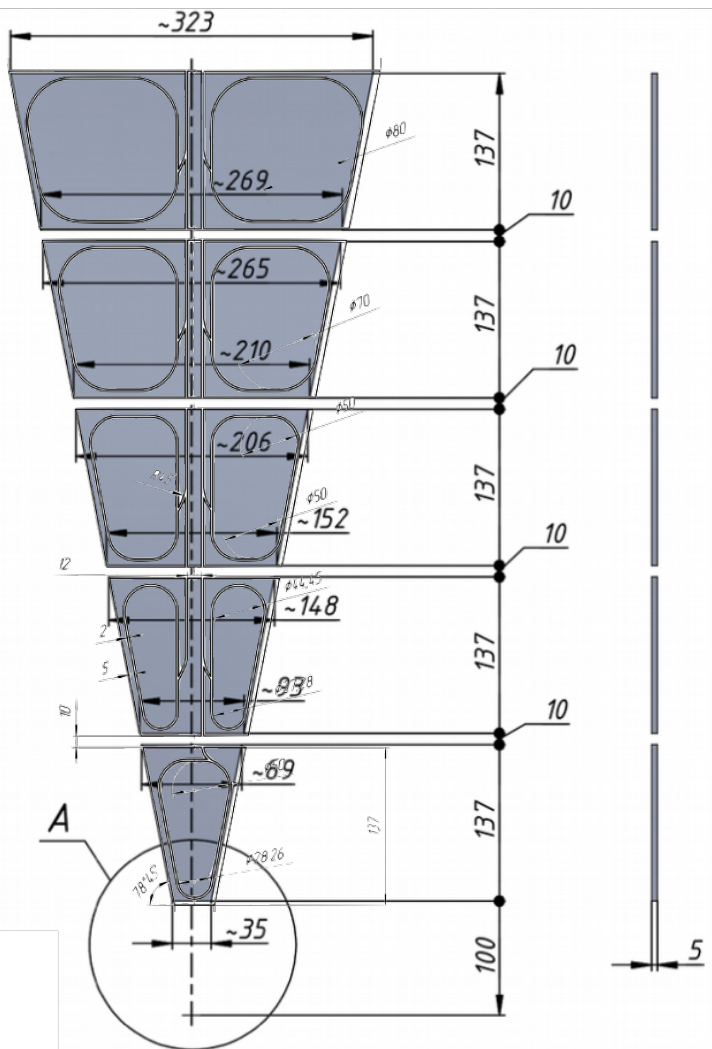
Raw estimation of particle density in BBC



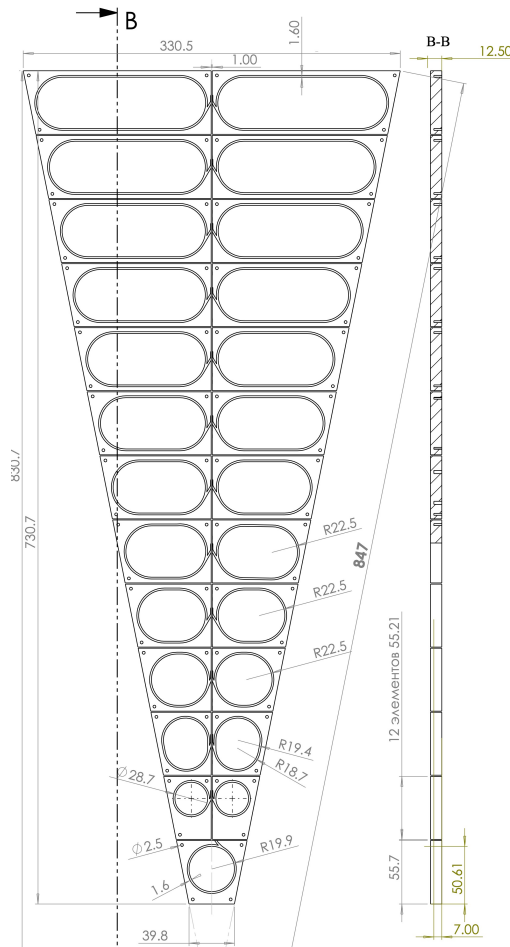
Kr+Kr at $\sqrt{s_{NN}} = 6$ GeV



Detector Design Concepts



1st (current) option



Out proposal

Grooves depth 7 mm

We consider **two granularity concepts**

- Tile height 137 mm – 9 tiles in sector
- Tile height 55.7 mm – 25 tiles in sector (similar to STAR EPD)

Thickness options

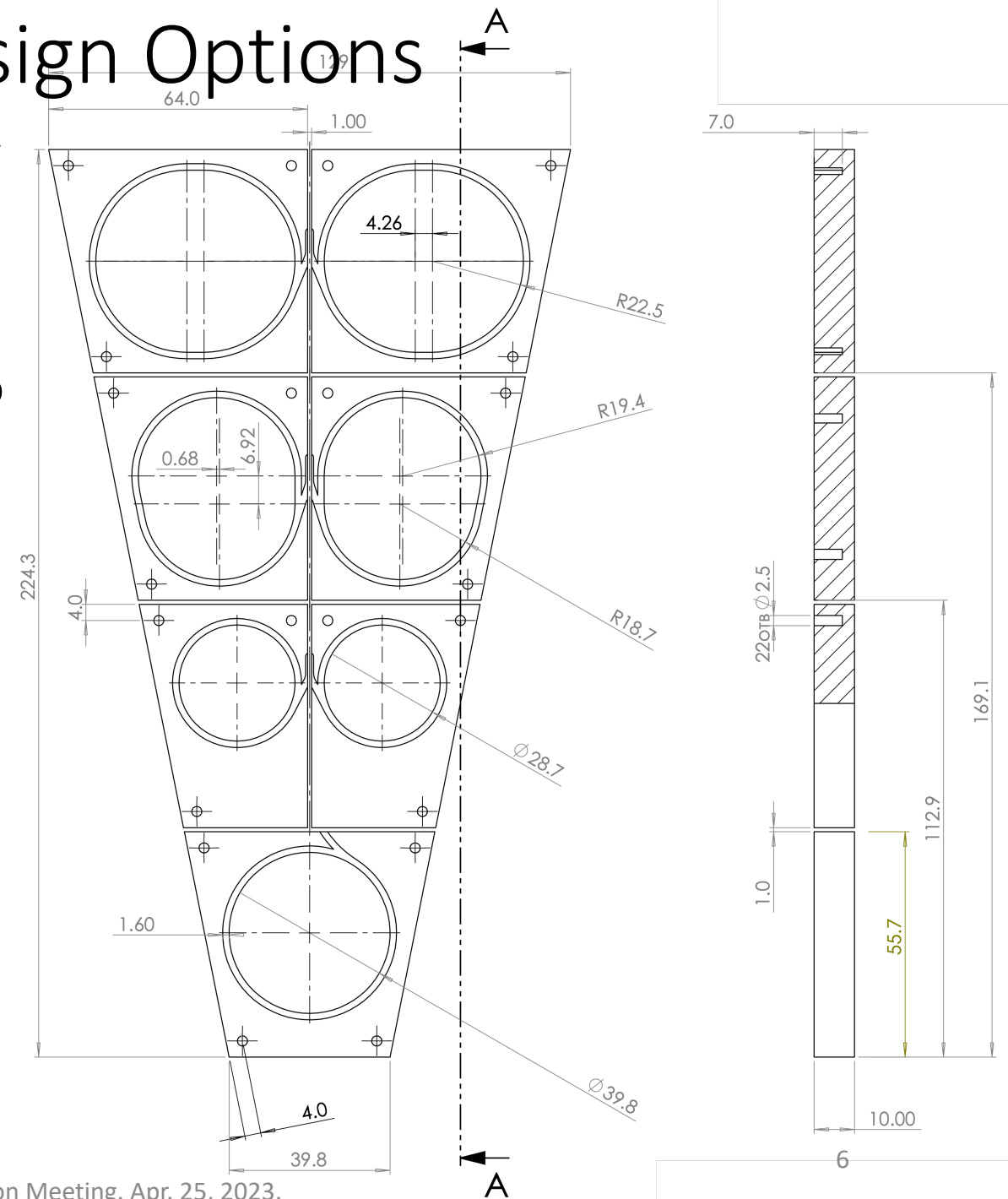
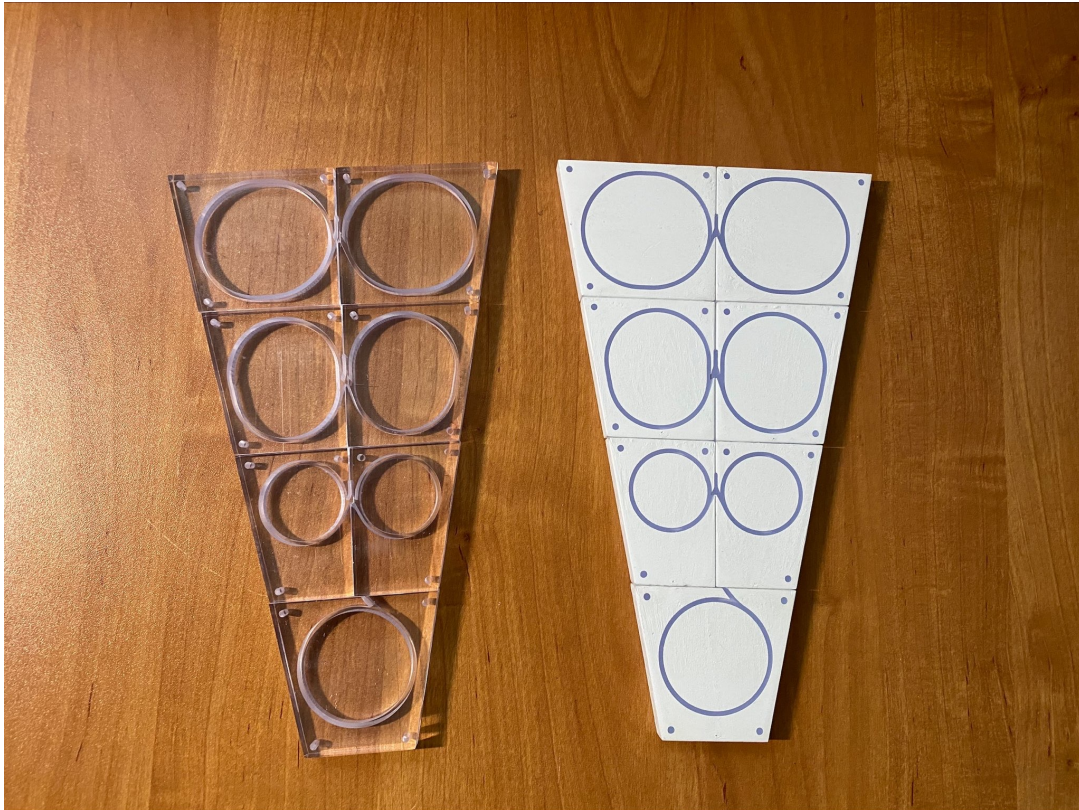
- 12.5 mm
- 10 mm
- 5 mm (less desirable)

Proposed by V.Ladygin

<https://indico.jinr.ru/event/3189/contributions/17389/>

Prototypes: Design Options

- 12 sets of 7-tiles scintillator prototypes were produced by Uniplast (Vladimir)
 - 6 sets with chemical mating
 - 6 sets polished
- Tests and works are planned together with the JINR group



Prototypes: Fibers and Optical Cement Selection

Joint efforts of JINR and MEPhI

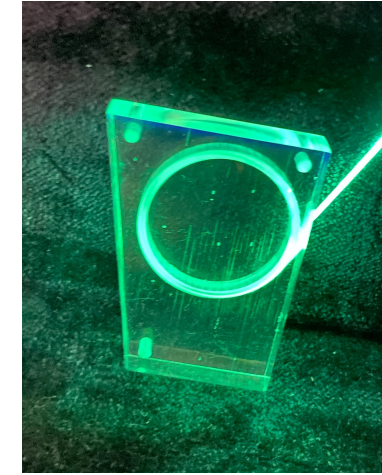
Fiber candidates

WLS options:

- Kuraray Y-11 green WLS, 476nm
- Saint-Gobain BCF-91A - green WLS, 494nm
- Saint-Gobain BCF-92 - green WLS, 492nm

Clear options:

- Kuraray Clean fiber
- Saint-Gobain BCF-98



Optical cement candidates:

Glue	Viscosity	Transparency	Refractive index
Eljen EJ-500	800 sPa*s	60-95% 300-350 nm, 95-100% 350-600 nm	1.574
Saint-Gobain BC-600	800 sPa*s	>90% 308-340 nm, >95% 340-400 nm, >98% >400 nm	1.560
EPO-TEK 302-3M	800 - 1600 sPa*s	>95% @460-1620 nm	1.5446 @589 nm
CKTH-MEД E2	601-1200 sPa*s	>95%	<1.606 [1]

We have in hands now
for the prototype →

3d-printed fiber-to-SiPM connectors for prototypes



[1] O Mineev *et al* Scintillator detectors with long WLS fibers and multi-pixel photodiodes 2011 *JINST* 6 P12004 10.1088/1748-0221/6/12/P12004

First Tile and WLS Geometry Description

GEANT 4

