



Application to join MPD collaboration from NRC "Kurchatov Institute", Moscow

Dmitry Blau

Quark Matter Laboratory at NRC “KI”

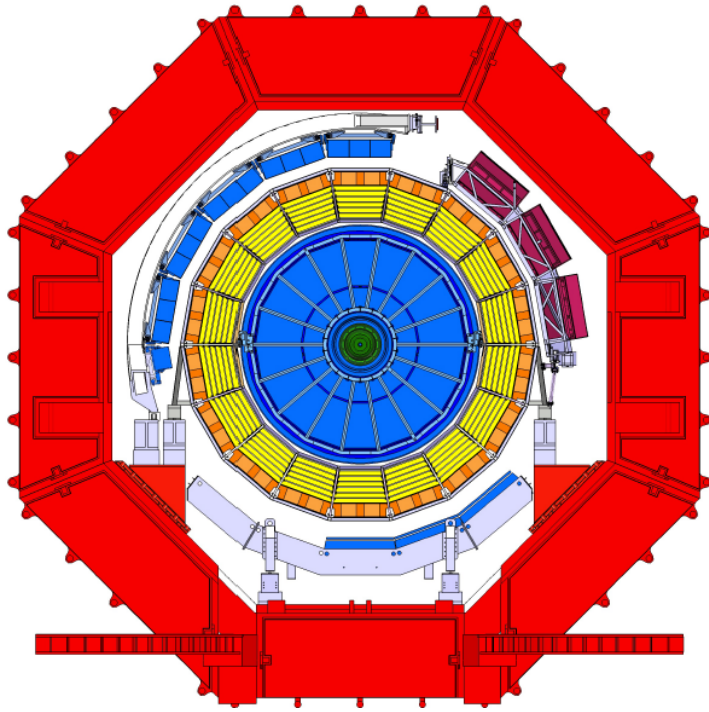
- Our laboratory is participating in heavy ion experiments for more than 30 years:
 - ✓ SPS: WA80 and WA98
 - ✓ RHIC: PHENIX
 - ✓ LHC: ALICE
 - ✓ SIS18: FOPI
 - ✓ FAIR: CBM
- Mostly our expertise is electromagnetic calorimetry in high energy experiments.
 - ✓ PHOS for ALICE
 - ✓ LEDA at WA98 (later PbG1 at PHENIX)



Who we are

- Dmitri Peresunko, senior researcher, PhD. Member of WA98, PHENIX, ALICE collaborations. Currently convener of PWG-GA (neutral mesons and photons) at ALICE.
- Dmitry Blau, senior researcher, PhD. Member of PHENIX, ALICE and CBM collaborations. Leader of FAIR-Russia Research Center project for anisotropic flow studies for NICA and FAIR.
- Students from MEPhI and MIPT.
- Recently we also joined BM@N collaboration.

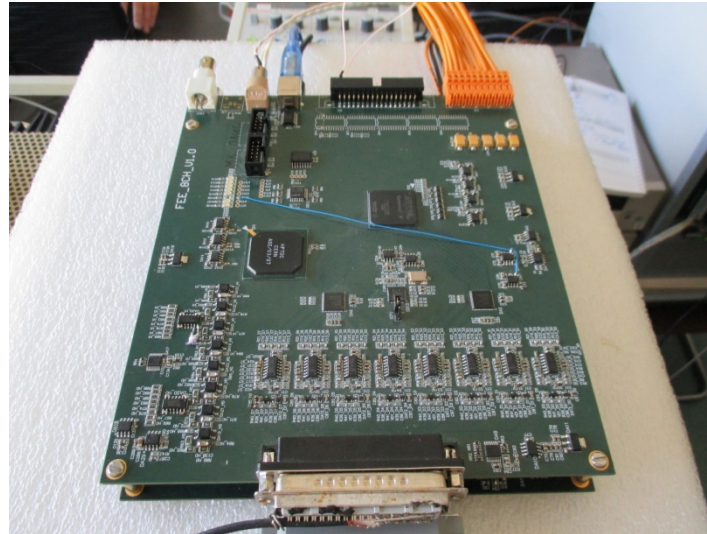
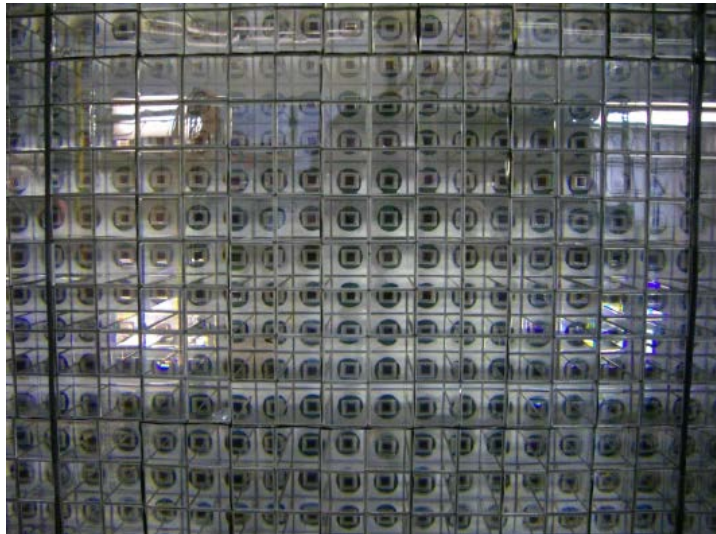
PHOS spectrometer



- Based on scintillating crystals PbWO₄
- 12544 channels, high granularity (2.2 cm side)
- Broad dynamic range: 10 MeV – 100 GeV
- Excellent energy resolution

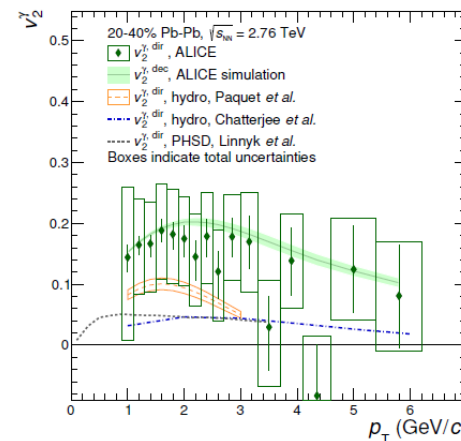
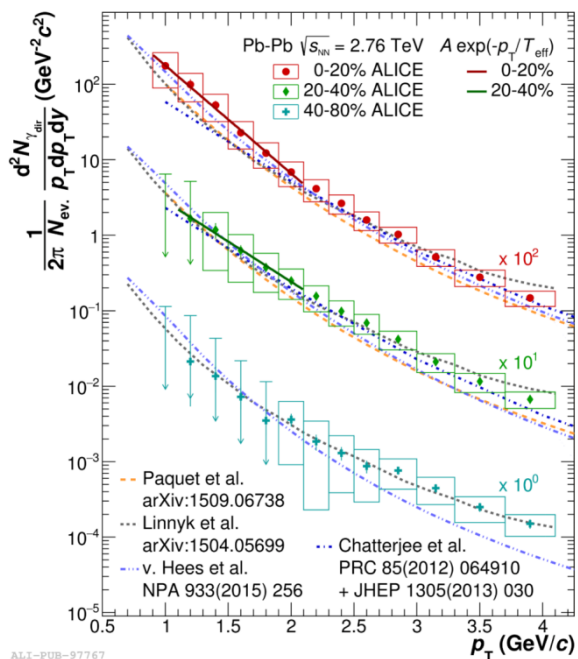
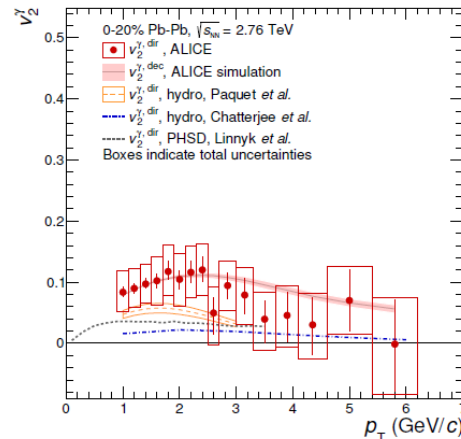
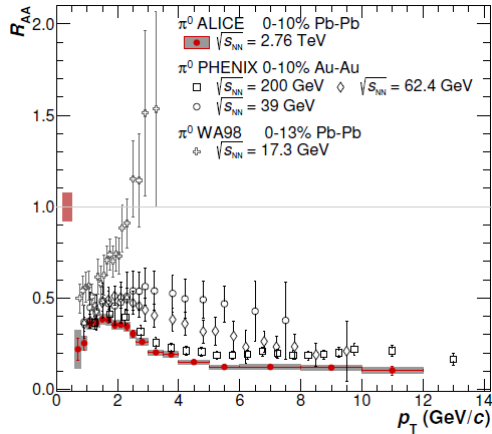
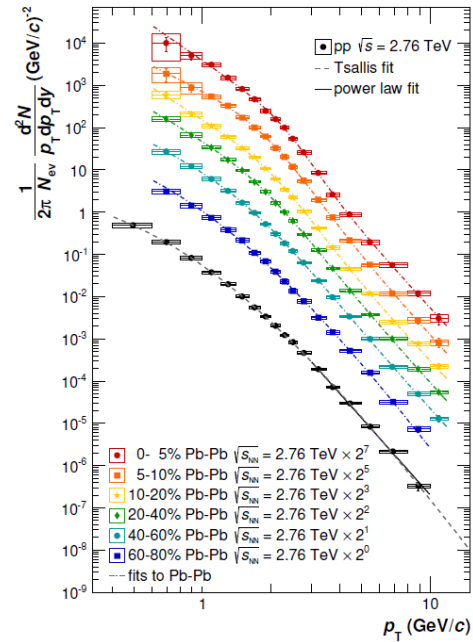
$$\frac{\Delta E}{E} = \frac{1.3\%}{E (\text{GeV})} \oplus \frac{3.3\%}{\sqrt{E (\text{GeV})}} \oplus 1.12\%$$

- R&D for future upgrade is ongoing: new FEC is being developed (KI team together with JINR team – A. Vodopyanov, P. Nomokonov et. al)
- *Instruments and Experimental Techniques*, 2018, Vol. 61, No. 5, pp. 639–644



256 channel detector based on PbWO₄ crystals is being developed in our laboratory which can be used as forward calorimeter (i.e for EP measurements, similarly to MPC at PHENIX). See backup for details

Expertise in data analysis



➤ Spectra of neutral mesons in pp and Pb-Pb collisions

- ALICE Collaboration. Neutral pion and η meson production in proton-proton collisions at $\sqrt{s}=0.9 \text{ TeV}$ and $\sqrt{s}=7 \text{ TeV}$. *Phys. Lett. B* 717 (2012), 162-172;
- ALICE Collaboration. Neutral pion production at midrapidity in pp and Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76 \text{ TeV}$. *Eur. Phys. J. C* 74 (2014), 3108;
- ALICE Collaboration. Production of π^0 and η mesons up to high transverse momentum in pp collisions at 2.76 TeV. *Eur. Phys. J. C* 77 (2017), 339;

➤ Spectra of direct photons in Pb-Pb collisions

- ALICE Collaboration. Direct photon production in Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76 \text{ TeV}$, *Phys. Lett. B* 754 (2016) 235-248.

➤ Elliptic flow of direct photons in Pb-Pb collisions

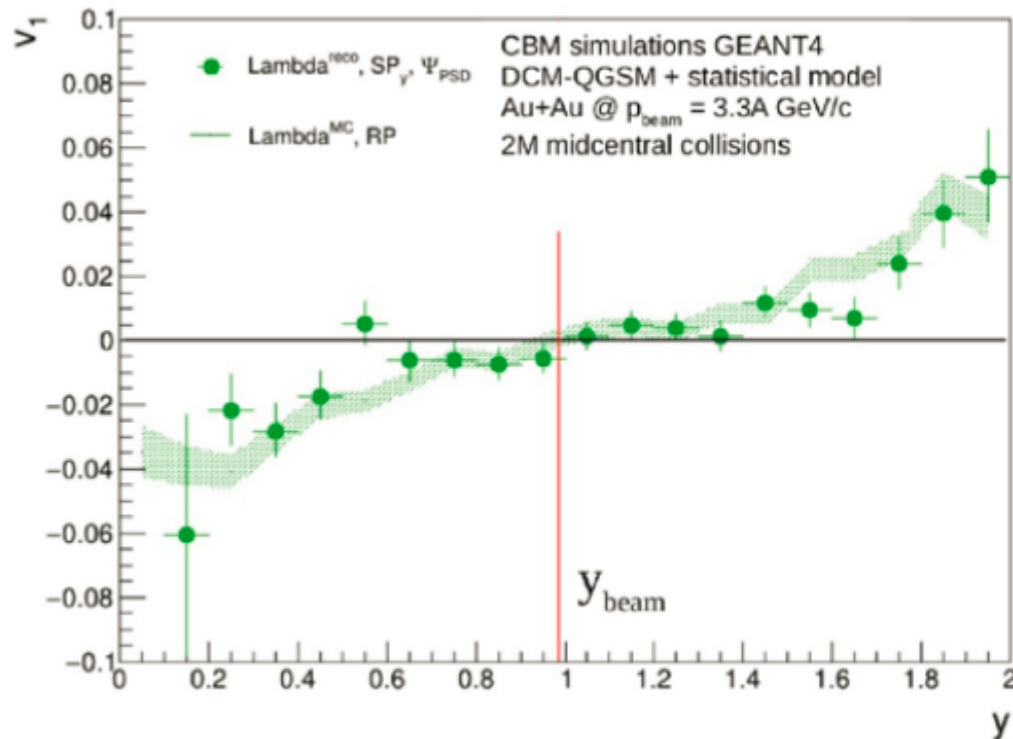
- arXiv:1805.04403, submitted to PLB

List of other principal publications

- 1) WA98 Collaboration. Freezeout parameters in central 158/A-GeV Pb-208 + Pb-208 collisions. Phys.Rev.Lett. 83 (1999) 926-930.
- 2) WA98 Collaboration. Observation of Direct Photons in Central 158A GeV 208Pb+208Pb Collisions. Phys.Rev.Lett. 85 (2000) 3595
- 3) WA98 Collaboration. Centrality and transverse momentum dependence of collective flow in 158 A GeV Pb+Pb collisions measured via inclusive photons. Nucl. Phys. A 762 (2005) 129-146
- 4) WA98 Collaboration. Suppression of High-pT neutral pion production in central Pb+Pb collisions at $\sqrt{s_{NN}}=17.3$ GeV relative to p+C and p+Pb Collisions. Phys.Rev.Lett. 100 (2008) 242301
- 5) WA98 Collaboration. Photon and η production in p+Pb and p+C collisions at $\sqrt{s_{NN}}=17.4$ GeV. Nucl. Phys. A 898 (2013), 14-23
- 6) WA98 Collaboration. Interferometry of direct photons in central Pb-208+Pb-208 collisions at 158-A-GeV, Phys.Rev.Lett. 93, 022301 (2004).
- 7) PHENIX Collaboration. Azimuthally anisotropic emission of low-momentum direct photons in Au+Au collisions at $\sqrt{s_{NN}}=200$ GeV, Phys.Rev. C94 (2016) no.6, 064901
- 8) PHENIX Collaboration. Centrality dependence of low-momentum direct-photon production in Au+Au collisions at $\sqrt{s_{NN}}=200$ GeV. Phys.Rev. C91 (2015) no.6, 064904
- 9) PHENIX Collaboration. Dielectron production in Au+Au collisions at $\sqrt{s_{NN}}=200$ GeV, Phys.Rev. C93 (2016) no.1, 014904
- 10) PHENIX Collaboration. Enhanced production of direct photons in Au+Au collisions at $\sqrt{s_{NN}}=200$ GeV and implications for the initial temperature. Phys.Rev.Lett. 104 (2010) 132301
- 11) CBM Collaboration Challenges in QCD matter physics. Eur. Phys. J. A 53 (2017) 60

Participation in CBM

- Kurchatov group participate in CBM:
 - ✓ ECAL development
 - ✓ Performance studies for collective flow measurements in collaboration with GSI, MEPHI and INR RAS
- Experience with simulation environment similar to MPDROOT/BMNROOT and modern event generators
- Results for strange hadrons v_1 performance studies shown by T. Galatyuk at CERN Town Meeting 24.10.2018



Directed flow of Λ
(full scale MC simulations)

“Input” model v_1 is
recovered using
“data-driven” method

Participation in BM@N

- Kurchatov group joined BM@N. We are interested in studies of di-leptons, electromagnetic probes and collective flow at NICA energies
- Application to RFBR grant for performance studies with BM@N for neutral mesons, direct photons spectra and flow and di-leptons was submitted
- This performance studies can be extended to MPD: similar type of calorimeter is used, similar simulation and reconstruction software

Backup slides

256 channel prototype at NRC KI

- 256 channels based on PHOS-type PWO crystals. Strip units with crystals and APDs are assembled currently for 128 channels. Mechanical construction is ready.

