New results obtained in the ALICE experiment with a participation of the JINR team

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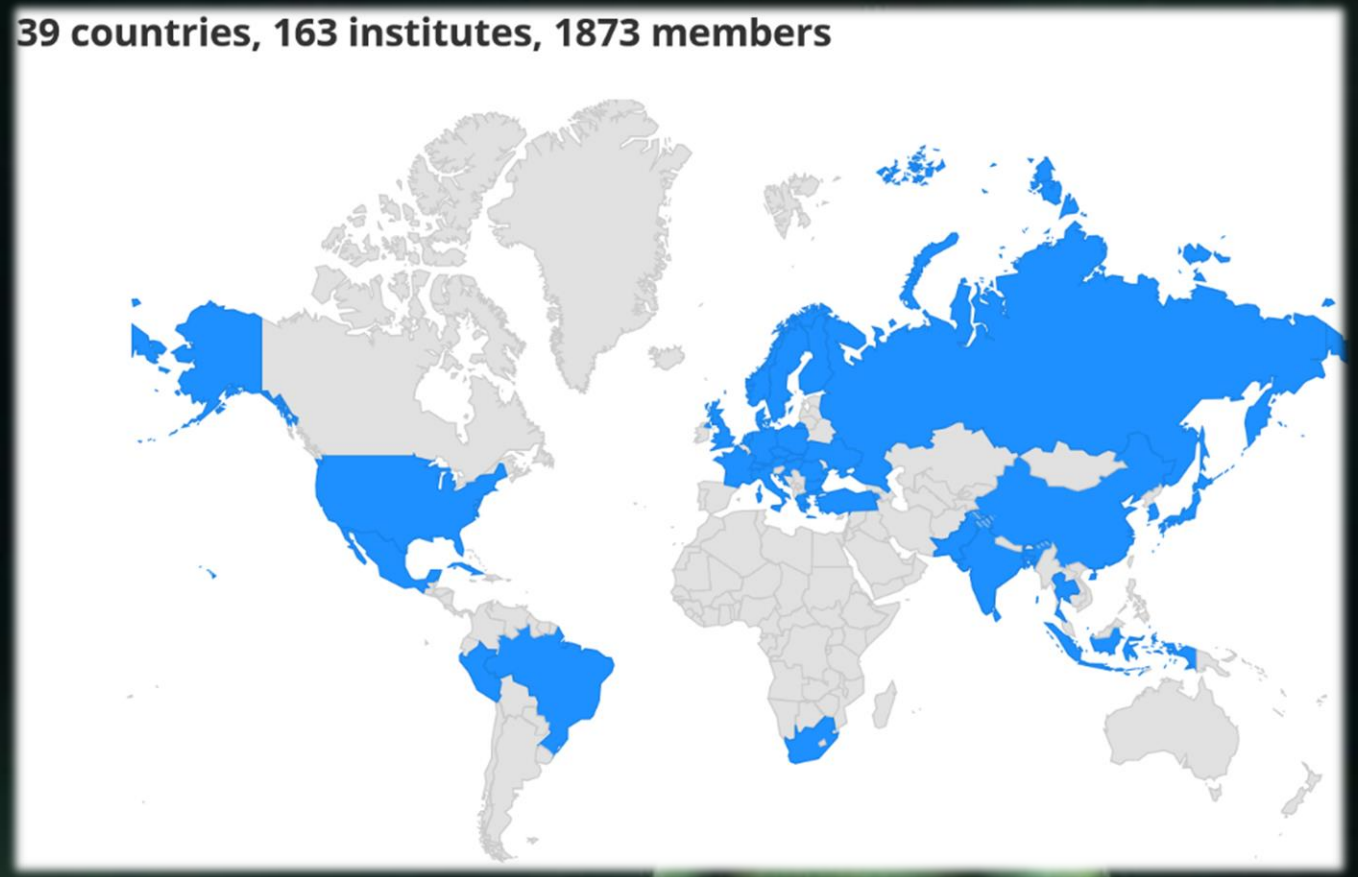
61st PAC, Dubna, January 20, 2025

ALICE

The ALICE JINR group:

- ✓ 13 physicists: 6 - analysis, 7 – FIT (Fast Interaction Trigger) detector
- ✓ 2 PhD students
- ✓ 1 expert for the root software updating and GRID computing management



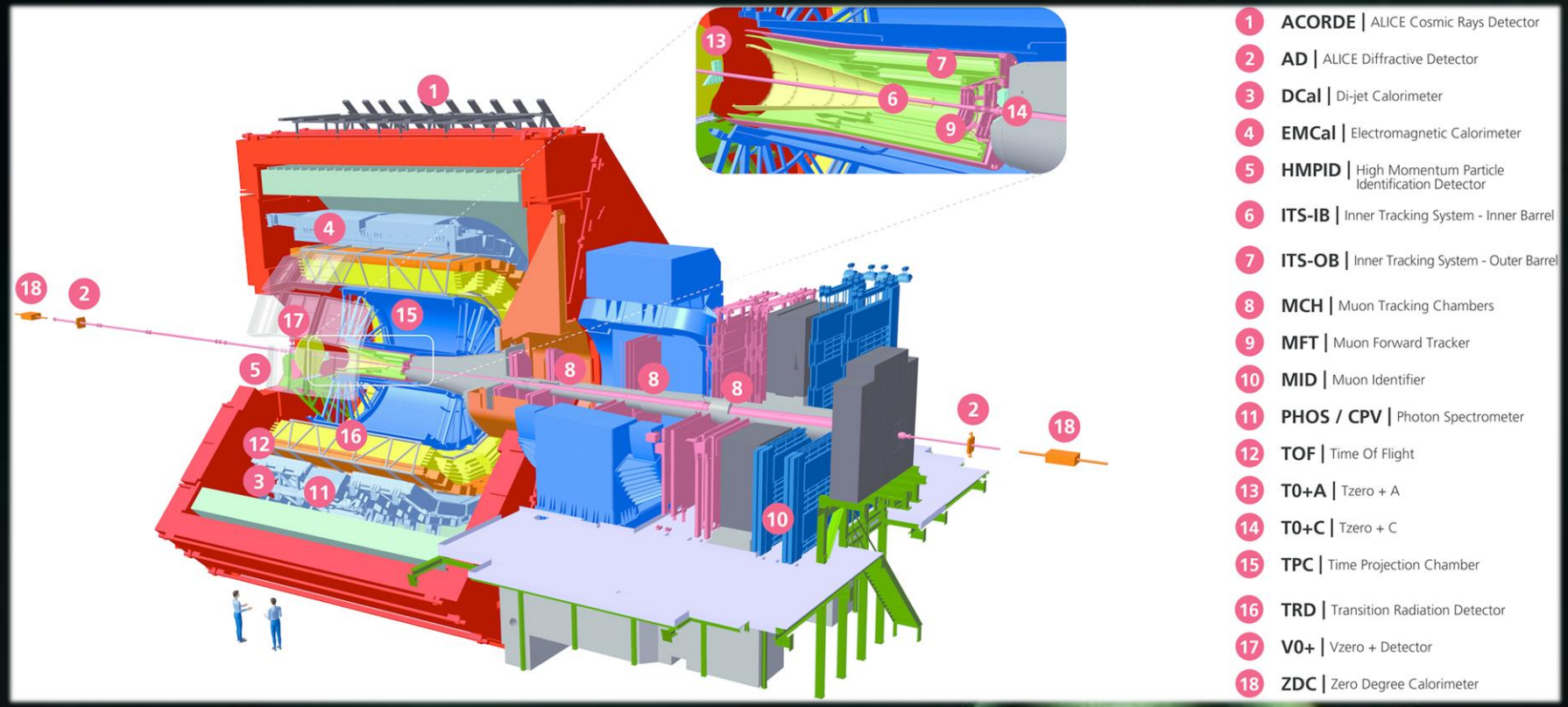
ALICE

Main activities of the Dubna team in ALICE:

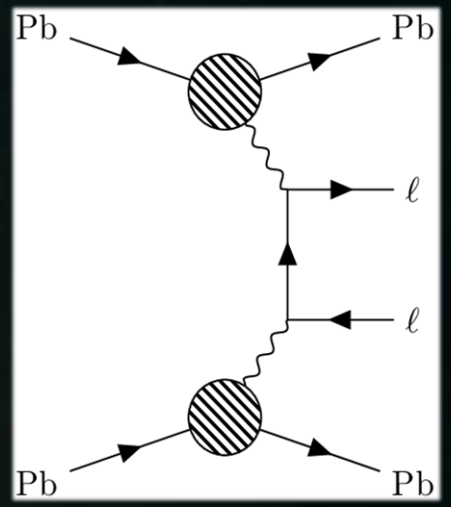
- ✓ Bose-Einstein correlations (femtoscopy physics):
  - Analysis of two-charged kaon correlations in pp, p-Pb, and Pb-Pb collisions.
  - Update of the analysis software.
- ✓ Ultraperipheral collisions:
  - Study of muon and vector meson photoproduction in p-Pb and Pb-Pb collisions.
- ✓ Resonance production.
- ✓ Thermal model of particle production in pp and A-A collisions.
- ✓ GRID computing and software activities.
- ✓ Participation in the ALICE shifts and service tasks.
- ✓ Support and development of FIT detector control systems.

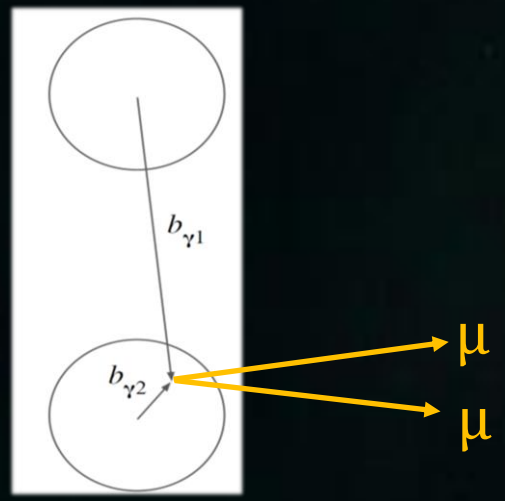
ALICE detector, actual Run 3 configuration:

- ✓ Tracking and vertex:
  - TPC
  - ITS
  - MCH, MFT
- ✓ Particle identification:
  - TPC
  - TOF
- ✓ Centrality determination or veto:
  - V0
  - ZDC
- ✓ Veto:
  - AD



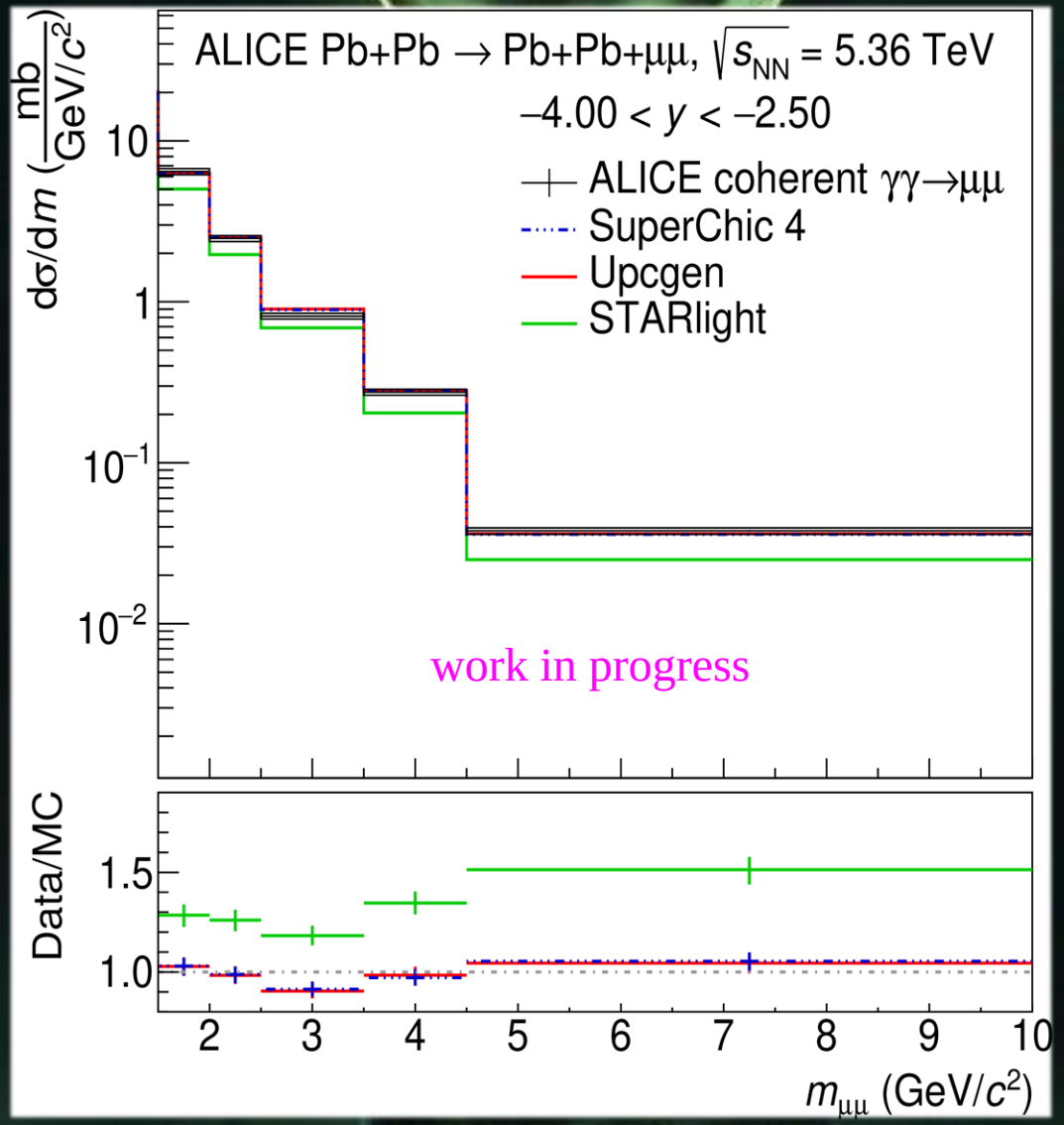
New results (Run 3) for dimuon continuum production in UPCs:



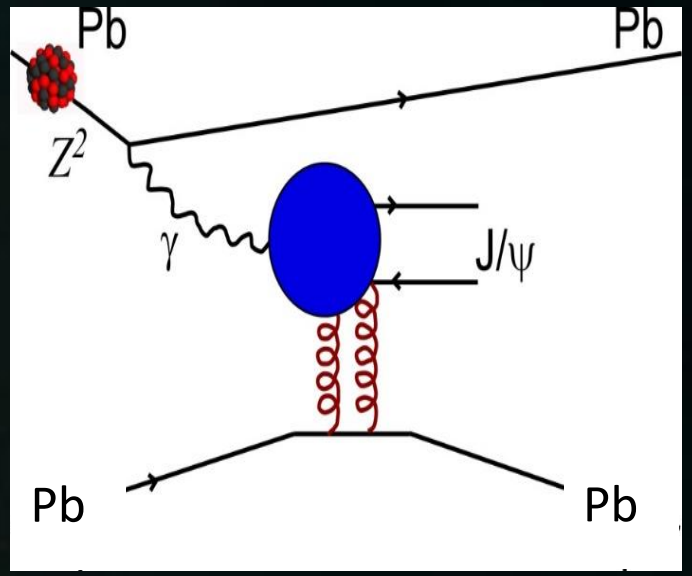


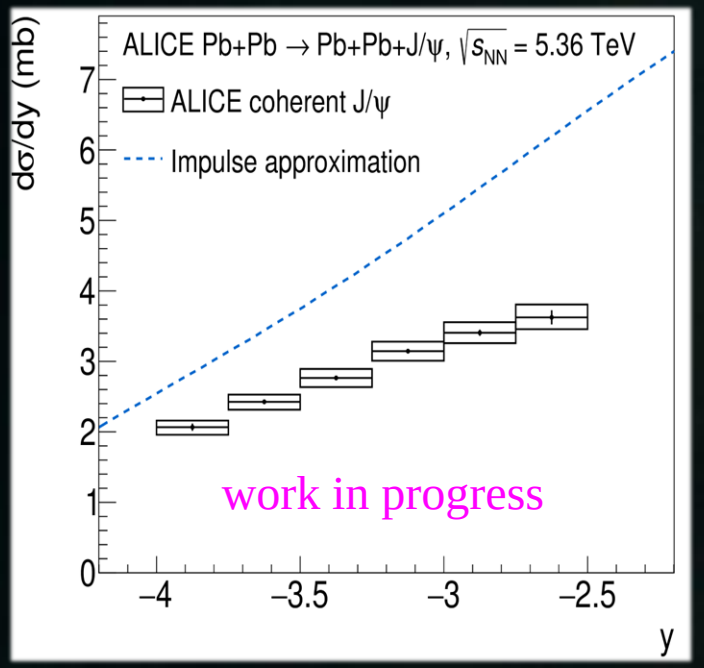
- ✓ Motivation: check "standard candle" QED process in strong EM fields of colliding heavy ions.
- ✓ *STARLight* generator (standard in UPC physics) underestimates the measured cross section by 20-50%.
- ✓ Good agreement with *SuperChic* [Harland-Lang, Ryskin, Khoze et al.] and *Upcgen* [N. Burmasov, E. Kryshen et al.]: taking into account the flux of photons at impact parameters smaller than the nuclear radius (see the sketch above).

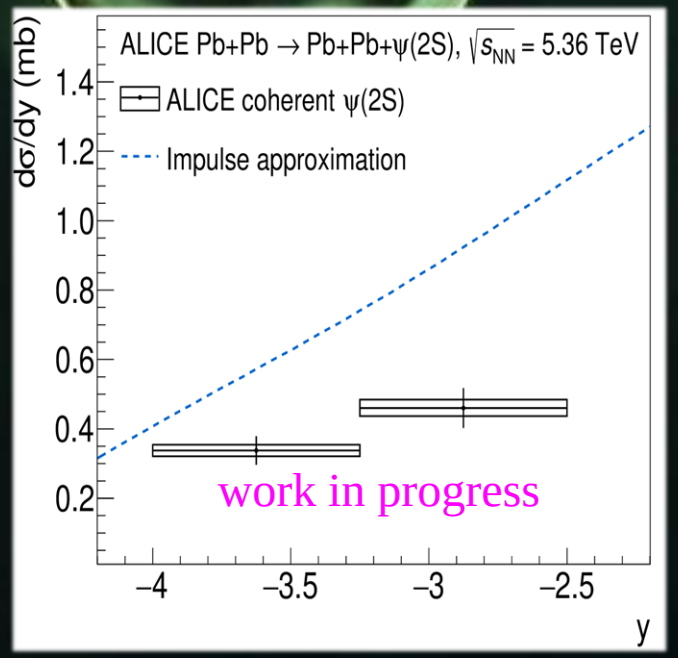
Paper in preparation.



Coherent charmonium photoproduction in UPCs (Run 3):



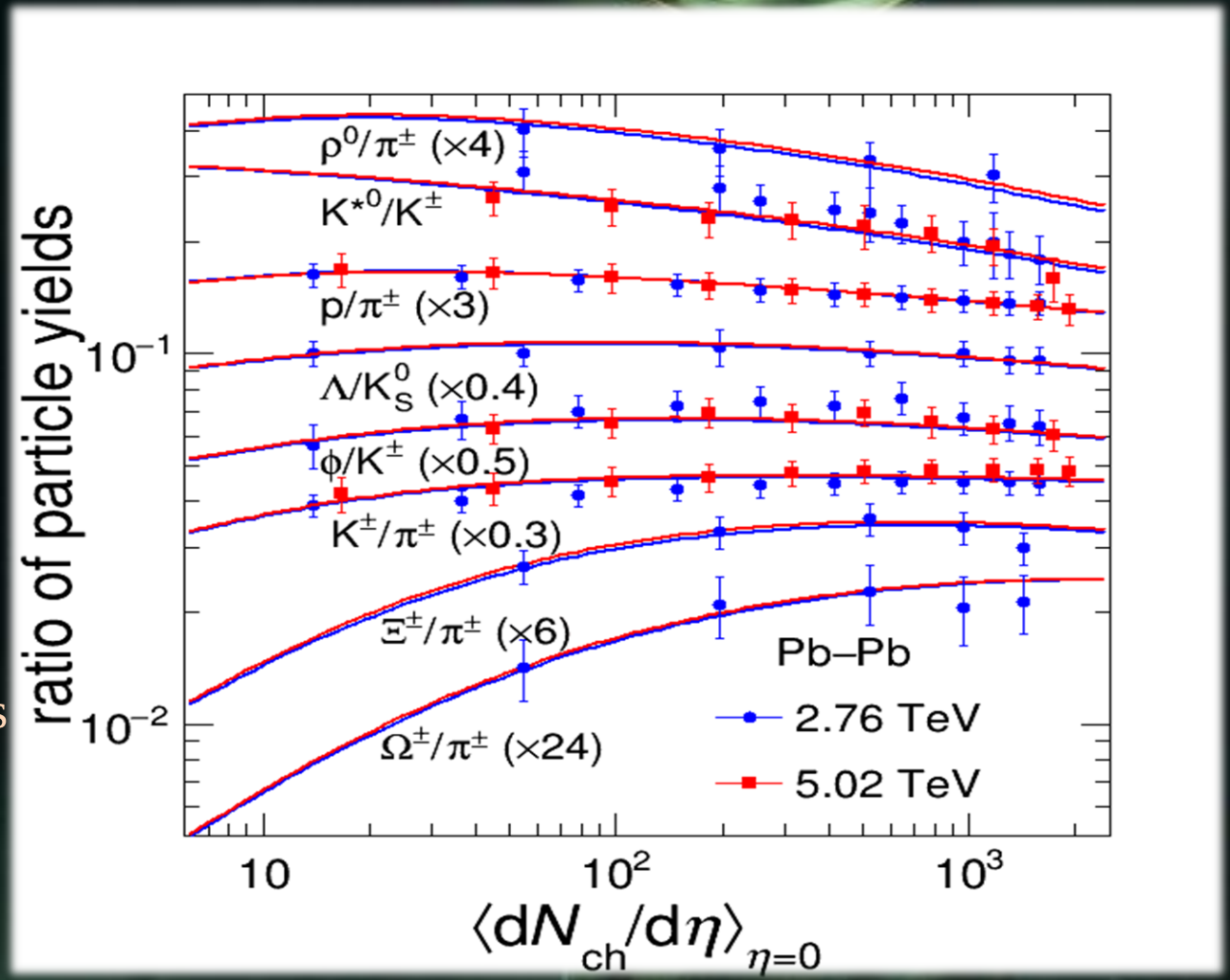




- ✓ Motivation: the cross section is sensitive to low-x gluon density and nuclear shadowing effects.
- ✓ First measurement of ψ(2S) cross section at forward rapidity in Run 3.
- ✓ More precise results on J/ψ compared to Run 2.
- ✓ Clear evidence of strong nuclear shadowing of gluon density can be seen.
- ✓ The results were reported at the ALICE Physics Forum (10.04.2024).

New results for *Three-component model of particle production* in Pb-Pb collisions at the LHC [modification of the previous model version: S. Grigoryan, Eur. Phys. J. (2021) 328]:

- ✓ Three components:
  - Boltzmann-Gibbs thermal distribution for flow effect
  - Tsallis distribution for resonance decays
  - power-law form for QCD hard processes
- ✓ A good agreement of the model and experimental results is obtained and shown, for example, for the ratio of different particle yields including strange ones and resonances in Pb-Pb collisions at two energies.

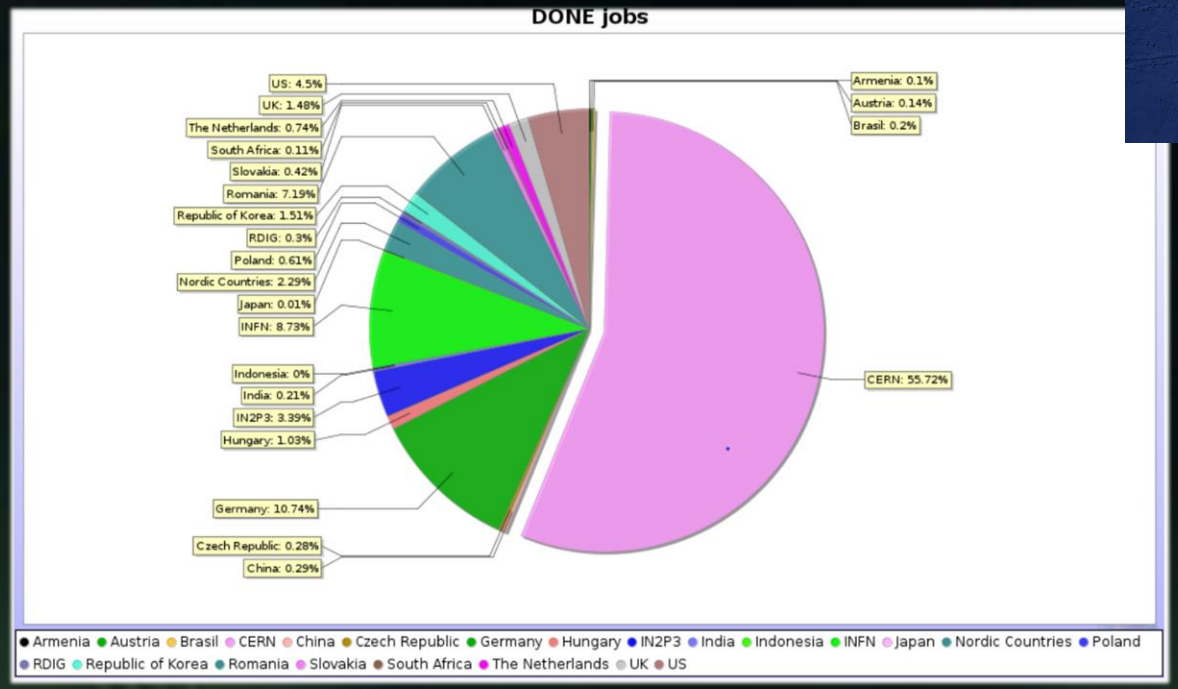


Paper in preparation.

JINR ALICE GRID participation:

Resources of JINR ALICE GRID farm:

- ✓ 13500 CPU cores
- ✓ 2000 Tb Disk-SE



- ✓ Stable and smooth operation 24×7
- ✓ Worldwide
- ✓ ~1.4M CPU cores
- ✓ 62 computer centers (1 - T0, 8 - T1, 51 - T2, 2 - AF)
- ✓ 170 sites

JINR contribution to the ALICE-GRID is near 0.3%.

Conference presentations:

- ✓ K. Mikhaylov (NRC, JINR, on behalf of the ALICE Collaboration), “Charged kaon femtoscopy with ALICE at the LHC”. Session of Russian Academy of Sciences, Dubna, April 1-5, 2024.
- ✓ E. Rogochaya (JINR, on behalf of the ALICE Collaboration), “Particle-emitting source dynamics via femtoscopy at the LHC energies with ALICE”. PASCOS 2024, Quy Nhon, Vietnam, July 7-13, 2024.
- ✓ N. Burmasov, “Study of photon-photon and photon-nuclear interactions in ultra-peripheral collisions at the LHC”. Scientific session of nuclear physics section of RAS, Dubna, April 4, 2024.
- ✓ E. Kryshen, “Study of nuclear shadowing in ultraperipheral collisions at the LHC”. PNPI winter school, Gatchina, Russia, March 21, 2024.
- ✓ N. Burmasov, “Quarkonia photoproduction and dilepton production in UPCs with ALICE”. 42nd International Conference on High Energy Physics, Prague, Czech Republic, July 17-25, 2024.
- ✓ N. Burmasov, “Photoproduction of vector mesons in ultraperipheral collisions at the LHC”. PNPI seminar, Gatchina, Russia, September 17, 2024.

ALICE publications with key contributions of the JINR group:

- ✓ ALICE Collaboration (S. Acharya et al.). Femtoscopic correlations of identical charged pions and kaons in pp collisions at $\sqrt{s}$ = 13 TeV with event-shape selection // Phys. Rev. C 109 (2024) 2-024915.
- ✓ ALICE Collaboration (S. Acharya et al.). Exclusive four pion photoproduction in ultraperipheral Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV // arXiv:2404.07542.
- ✓ ALICE Collaboration (S. Acharya et al.). Studying the interaction between charm and light-flavor mesons // arXiv:2401.13541.
- ✓ E. Kryshen (PC, chapter 4). The ALICE experiment: a journey through QCD // EPJC 84 (2024) 813.
- ✓ N. Burmasov. Perspectives of tau $g-2$ measurements with the ALICE experiment at the LHC // IJMPA 2443023 (2024).
- ✓ ALICE Collaboration (S. Acharya et al.). Proton emission in ultraperipheral Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV // arXiv:2411.07058.
- ✓ A. Borissov. Production of Σ hyperons and search of Σ hypernuclei at LHC with ALICE. Phys. Atom. Nucl. 86 (2023), 6, 1336-1340.
- ✓ A. Borissov. Σ hyperons production in pp and p-Pb collisions at LHC with ALICE. Phys. Part. Nucl. 55 (2024), 4, 1070-1074.

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Other scientific activities:

- ✓ Participation of E. Rogochaya, A. Borissov, and E. Kryshen in the ALICE Review Committees for the ALICE publications.
- ✓ Participation in 73 ALICE DCS shifts.

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Conclusions:

- ✓ A new analysis was carried out for the UPC study in Pb-Pb at 5.36 TeV. The results were obtained on dimuon continuum and coherent charmonium production at forward rapidity. The comparison with different models was performed. The evidence of strong nuclear shadowing of gluon density was shown.
- ✓ New results were obtained in the three-component thermal model for different particle productions, including strange ones and resonances in Pb-Pb collisions at the LHC.
- ✓ The final paper drafts for the 1D and 3D femtoscopic analyses of $K^{\pm}K^{\pm}$ correlations in p-Pb and Pb-Pb collisions at 5.02 TeV were issued and almost ready for publication.
- ✓ Our team continues to provide a stable operation of the JINR-ALICE GRID system .

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JINR-ALICE group's plans for 2025-26 years:

- ✓ Finalization of the publications on 1D and 3D femtoscopic analyses of $K^{\pm}K^{\pm}$ correlations in p-Pb and Pb-Pb collisions at 5.02 TeV.
- ✓ Continuation of the 1D femtoscopic analysis of $K^{+}K^{-}$ correlations in p-Pb collisions at 5.02 TeV.
- ✓ Finalization of the analysis and publication of a paper on dimuon continuum and coherent charmonium production at forward rapidity in ultraperipheral Pb-Pb collisions at 5.36 TeV.
- ✓ Finalization of the article on Σ^{0} hyperon production in pp collisions at 7 TeV.
- ✓ Preparation of a publication on the new version of the thermal model of particle production in A-A collisions.
- ✓ Support and development of the central event selection framework, event selection QA and luminosity monitoring tools (FIT detector control systems).
- ✓ ALICE GRID support in the JINR computing system.
- ✓ Participation in the ALICE shifts and service tasks.

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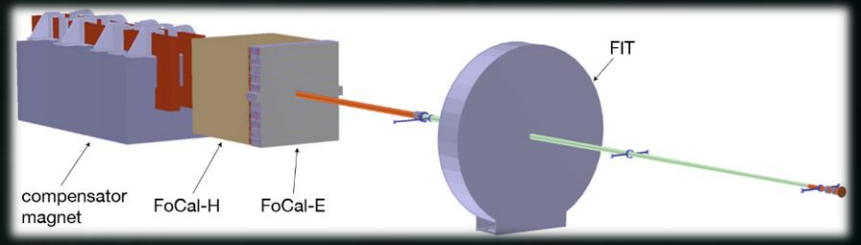
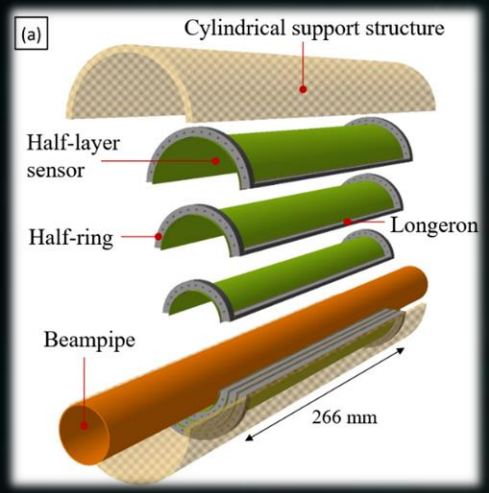
THANK YOU FOR YOUR ATTENTION!

Backup: ALICE schedule

Forward Calorimeter:



ITS 3:



ALICE 3: