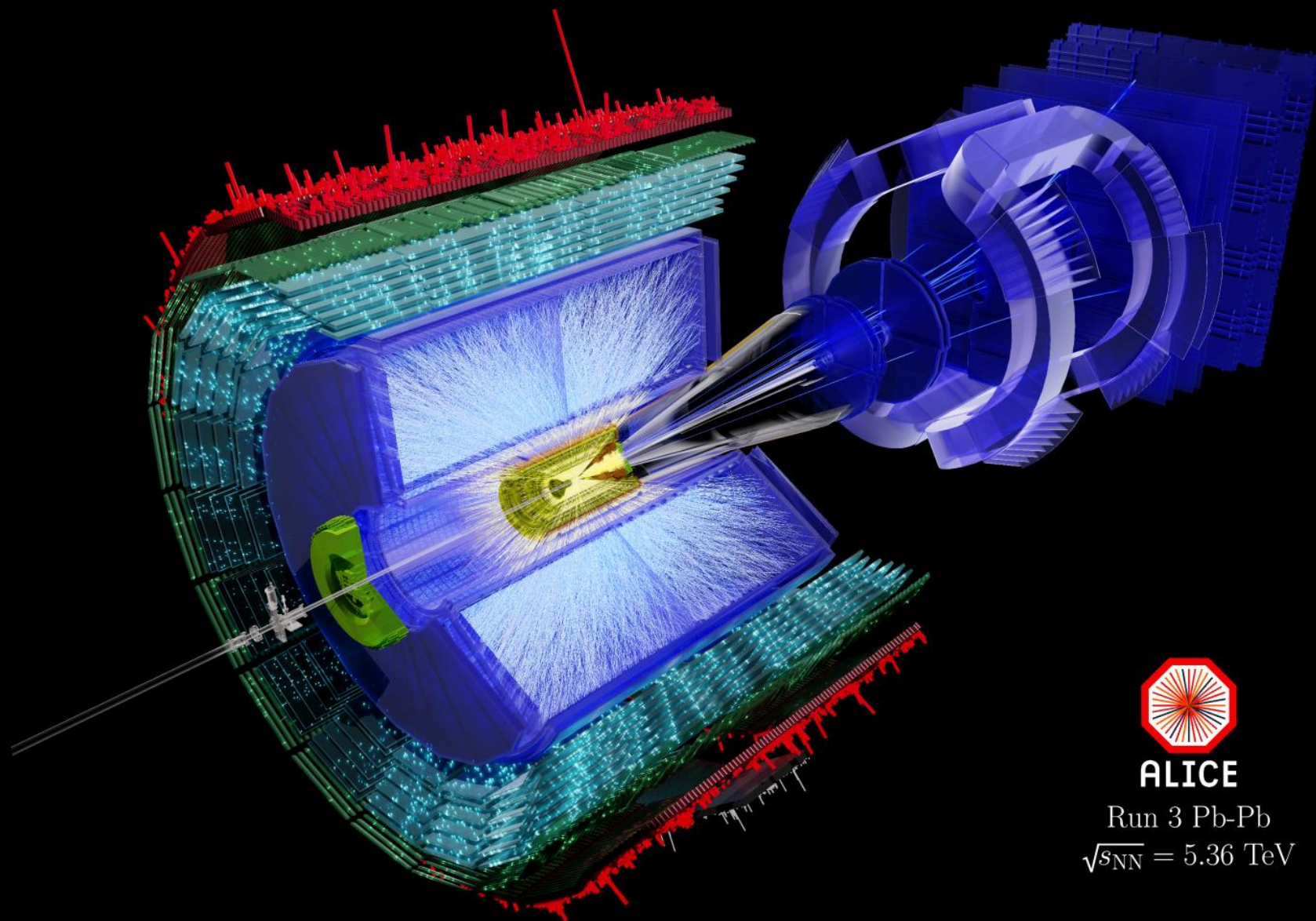


Эксперимент ALICE в 2024 году

A 3D perspective view of the ALICE detector. The central part shows a dense field of yellow lines representing particle tracks emanating from a central point. This is surrounded by concentric rings of blue and grey structures representing the detector's various components, including the inner tracking system and the outer calorimeters. The entire structure is set against a dark blue background.

Группа ПИЯФ: Н. Бурмасов, М. Жалов, Д. Иванищев, В. Иванов, Е. Крышень, М. Малаев,
В. Никулин, Е. Рощин, А. Рябов, В. Рябов, Ю. Рябов, А. Ханзадеев

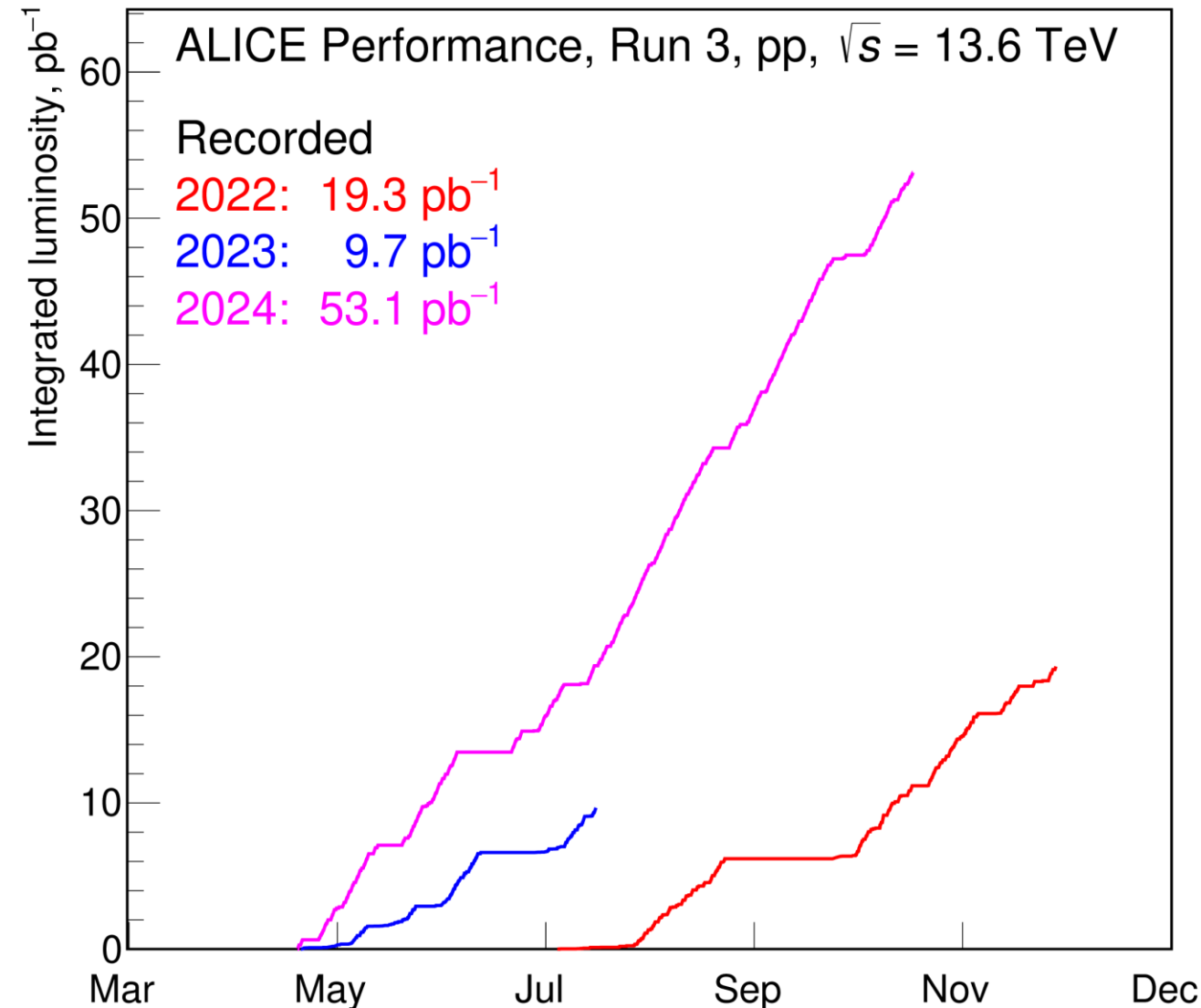
pp and Pb-Pb data taking in Run 3



ALICE

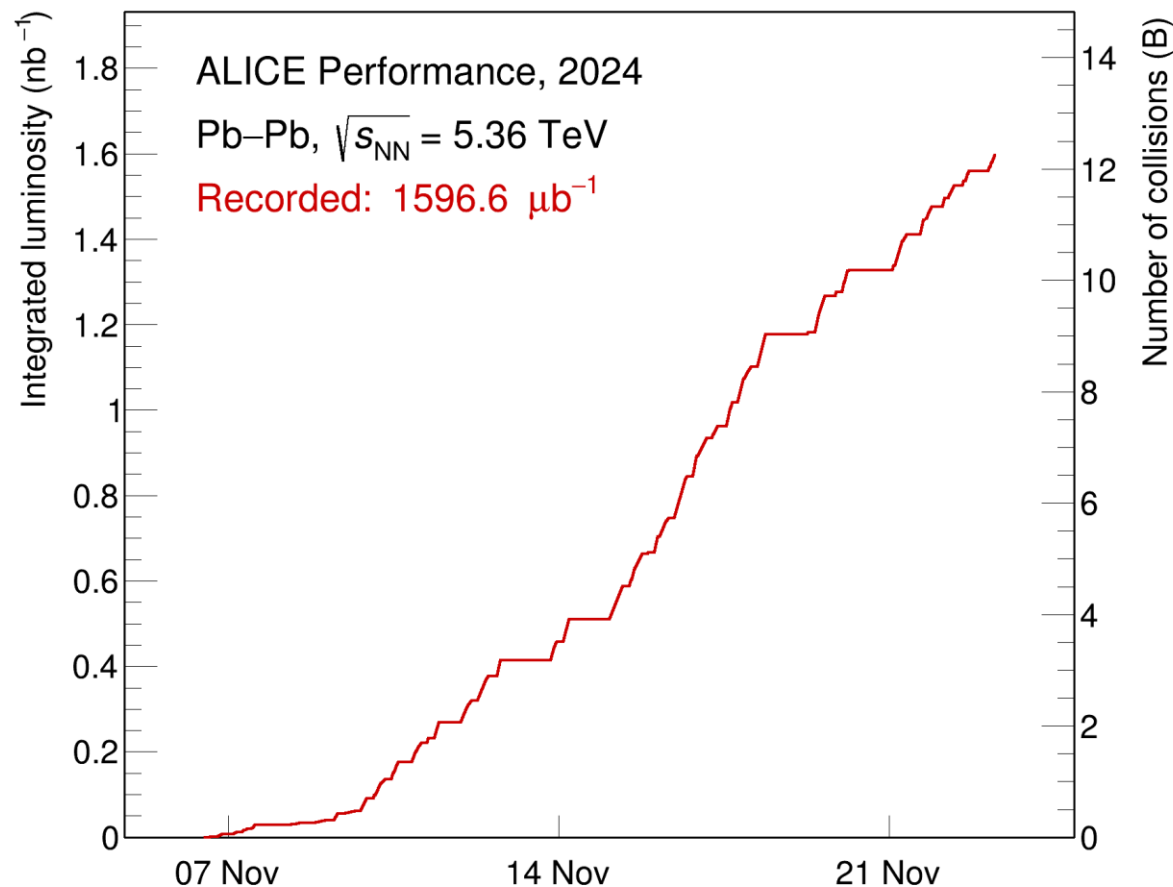
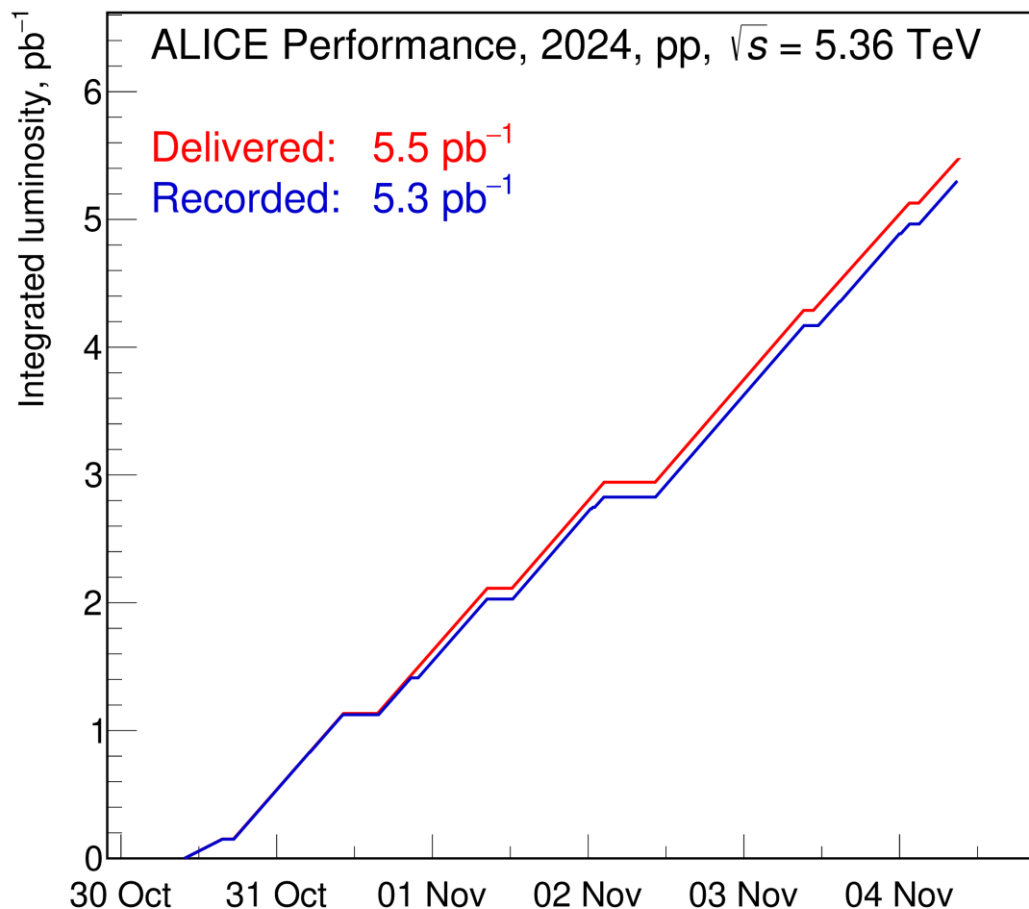
Run 3 Pb-Pb
 $\sqrt{s_{NN}} = 5.36$ TeV

Data taking: pp @ 13.6 TeV



- DAQ efficiency is > 95% (vs. last year ~80%)
- Main goal in pp: data taking @ 500 kHz ($\mu \sim 0.03$) in the continuous readout mode
- All the data are processed by the Offline Trigger selection
 - Full data volume calibrated and reconstructed (~7-12 PB/week)
 - Analysis Level selections to trigger on interesting chunks of data
 - 4-6 weeks processing to reduce the data volume to ~4% of the original size

Data taking: Pb-Pb and pp reference



- 1 week of pp@5.36 TeV, permanently stored on disk (largest min. bias pp sample!)
- 2.5 weeks of Pb-Pb@5.36 TeV, taken at IR $\sim 50\text{kHz}$ (x100 more min. bias compared to Run 2)
- Next year: short OO and pO runs + 4 weeks of Pb-Pb

Highlights of selected results

A journey through QCD



ALICE, EPJC 84 (2024) 813

> 300 pages

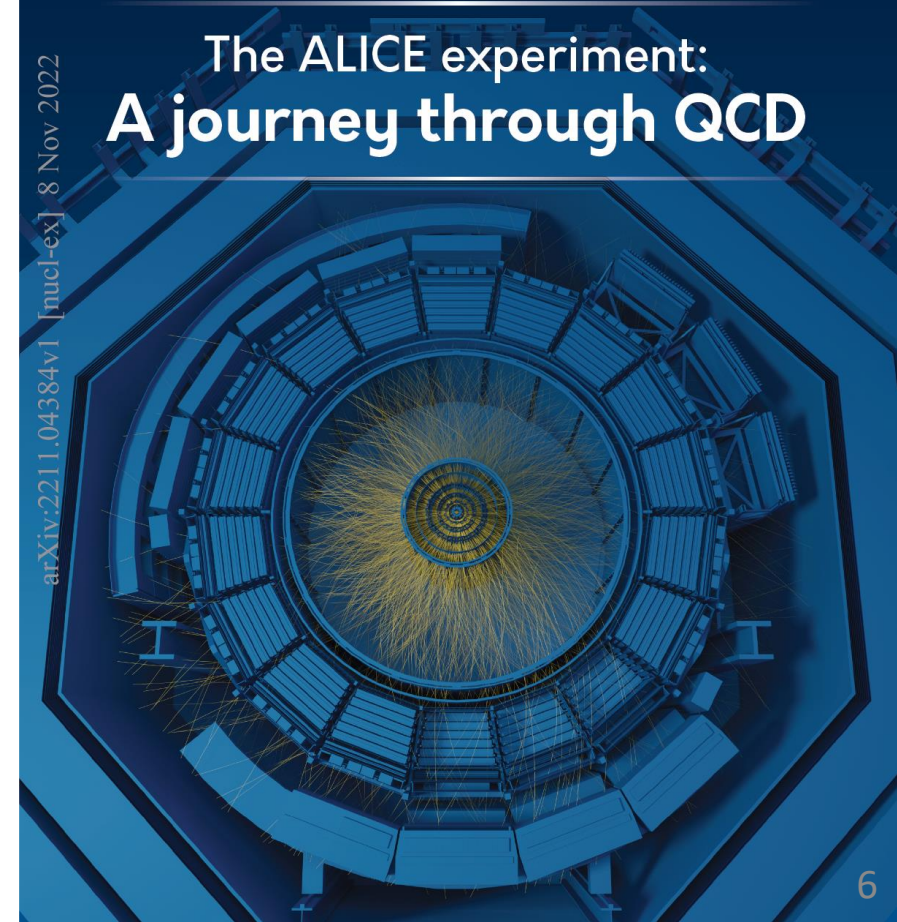
CERN-EP-2022-227

27 October 2022

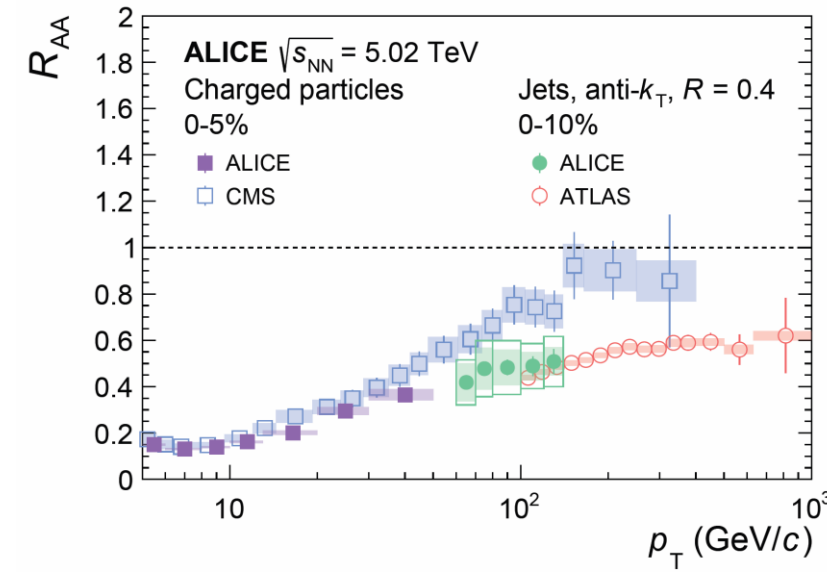
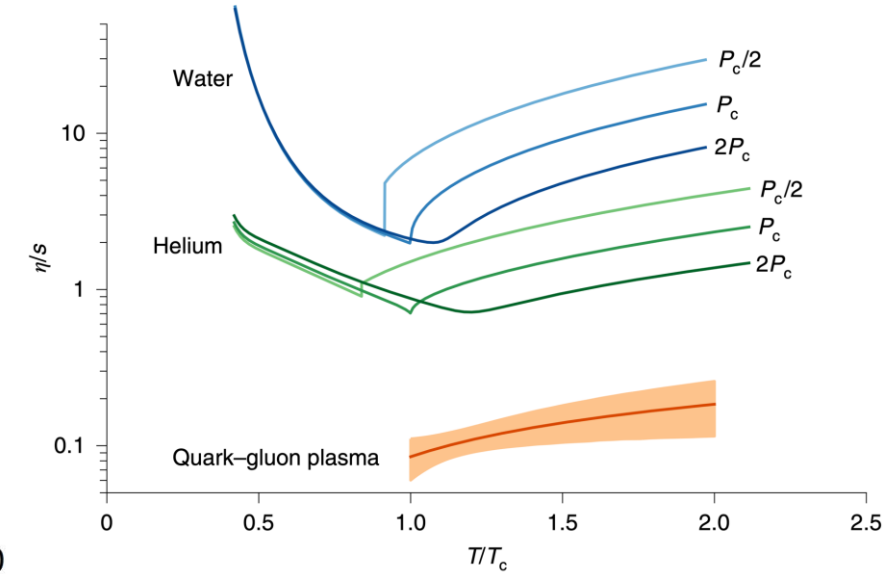
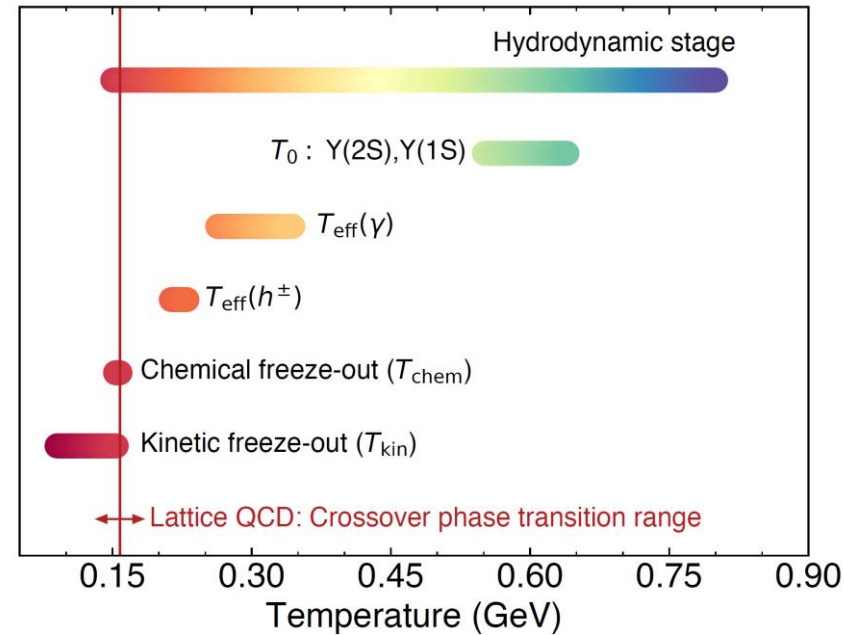
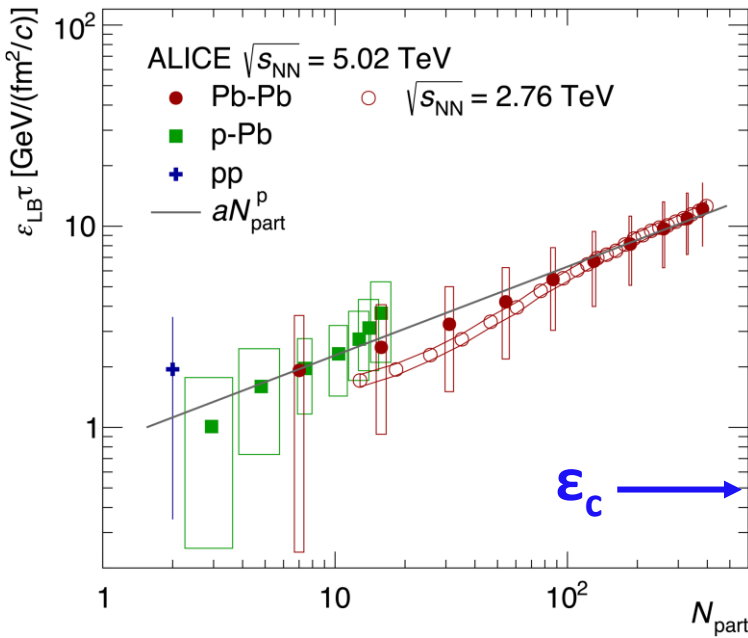


ALICE review of Run 1-2 studies:

- QGP properties in heavy-ion collisions
 - Macroscopic properties
 - Interactions of partons with QGP medium
 - Hadronization
 - Electromagnetic effects
 - Initial state ← **Большой вклад группы ПИЯФ**
- QGP-like effects in small systems
- Many other aspects of QCD and beyond



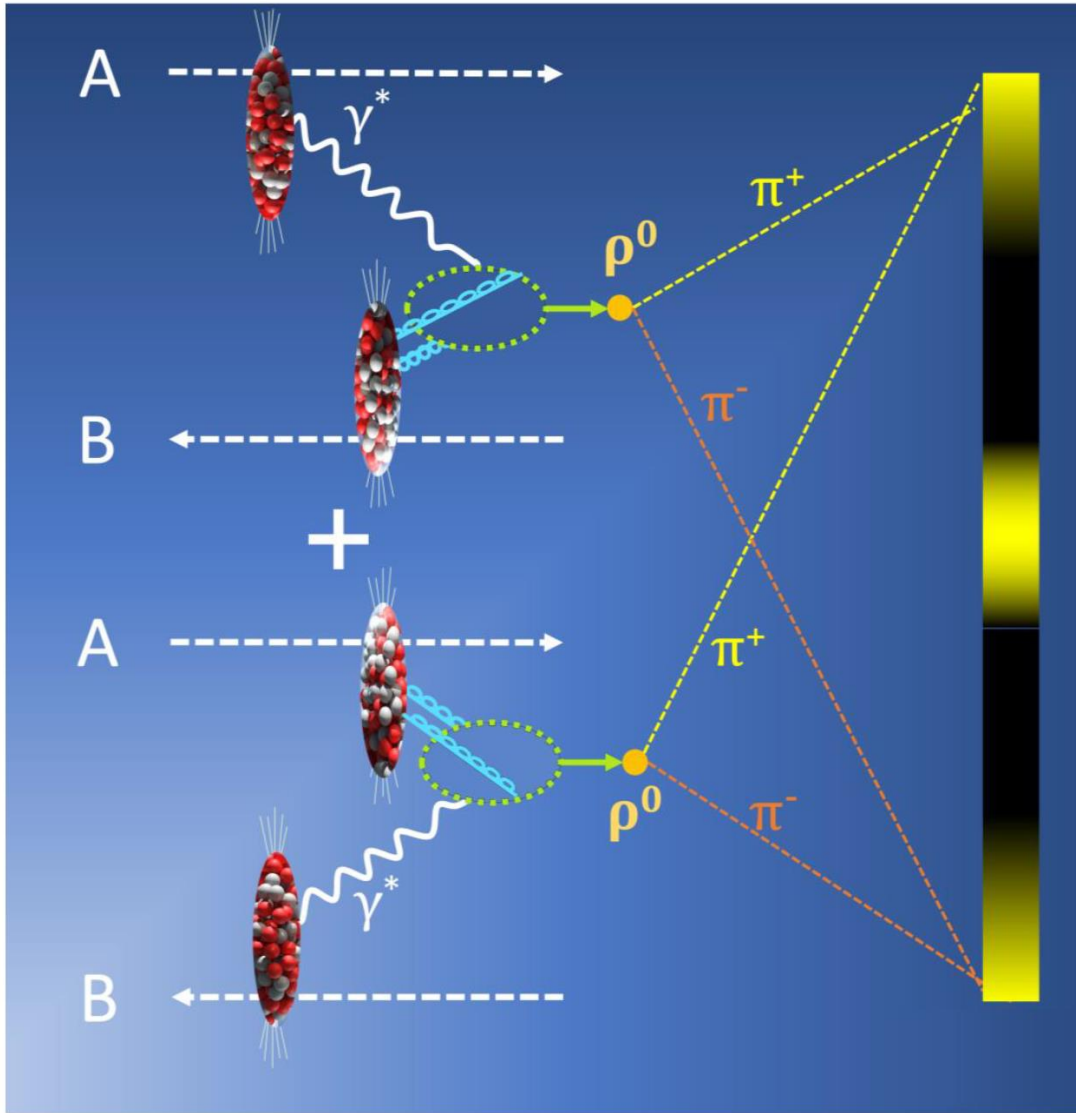
Количественная характеристика свойств КГП



ALICE, EPJC 84 (2024) 813

- Плотность энергии в начальном состоянии в 30 раз больше критической
- Температура на различных стадиях от 600 ГэВ до 150 ГэВ
 – Больше критической $T_c \sim 150$ ГэВ
- Вязкость: $\eta/s \sim 0.1$
- Радиационные потери энергии: 8 ± 2 ГэВ
- Ядерная экранировка в начальном состоянии: $R_g(x=10^{-3}, Q \sim 2.4 \text{ ГэВ}^2) \sim 0.65$

Interference effects in UPCs

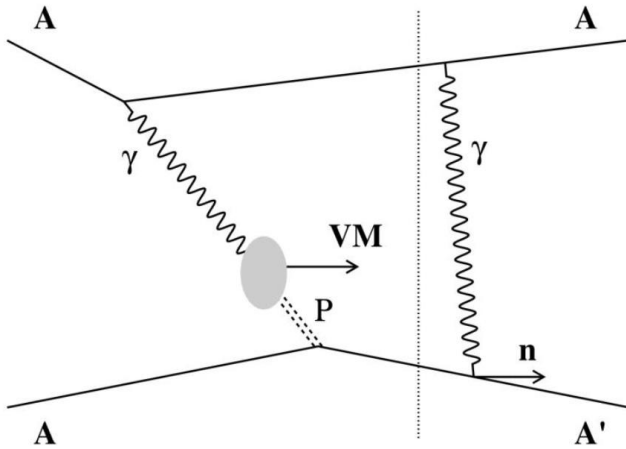


- In UPCs, each nucleus can act as the source of the photon or as the target in the interaction
→ two indistinguishable amplitudes contribute to the cross section

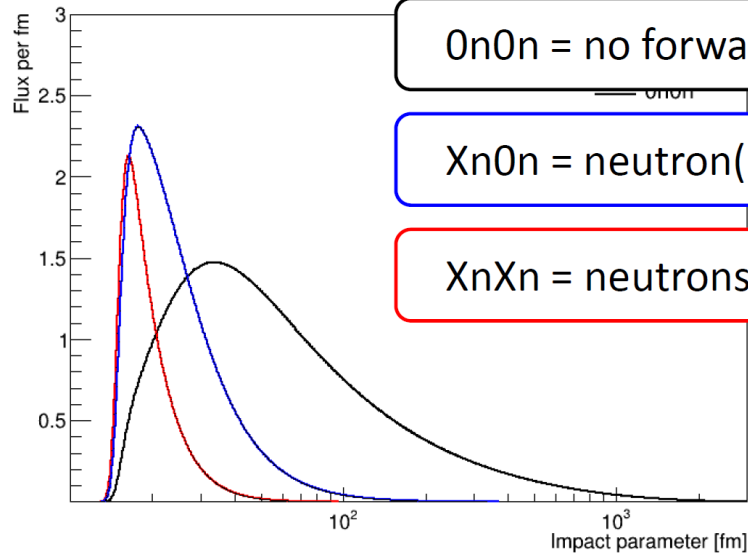
- At midrapidity the coherent ρ photoproduction cross section reads:

$$\sigma(p_T, b, y = 0) = \left| A(p_T, b) - A(p_T, b) e^{i\vec{p} \cdot \vec{b}} \right|^2$$

How to select impact parameter ranges?



- Events are classified in different EMD classes using neutron detection in ZDCs
- Different mean impact parameters in different classes

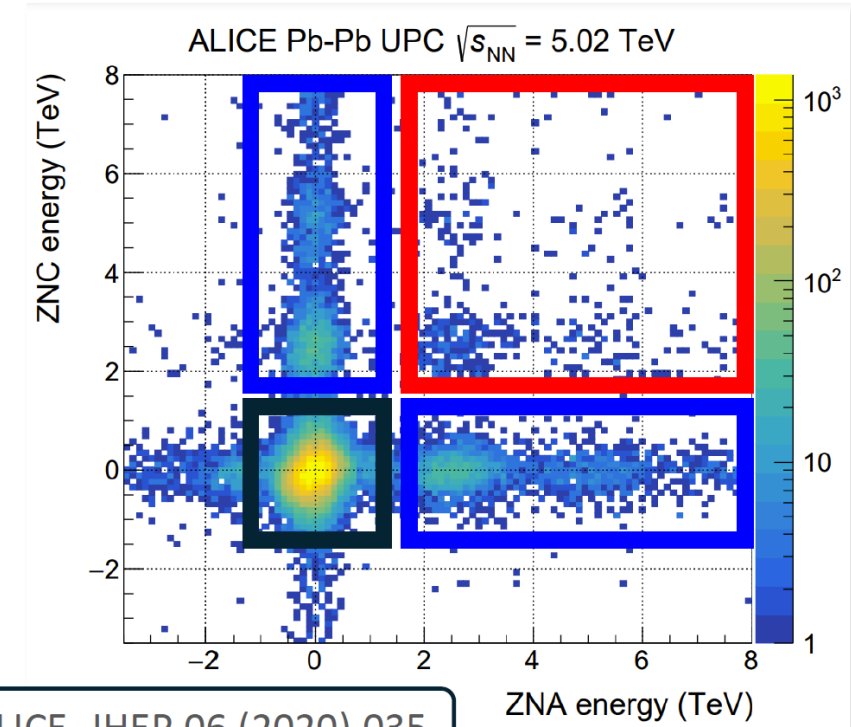


0n0n = no forward neutron

Xn0n = neutron(s) on one side of the IP

XnXn = neutrons on both sides of the IP

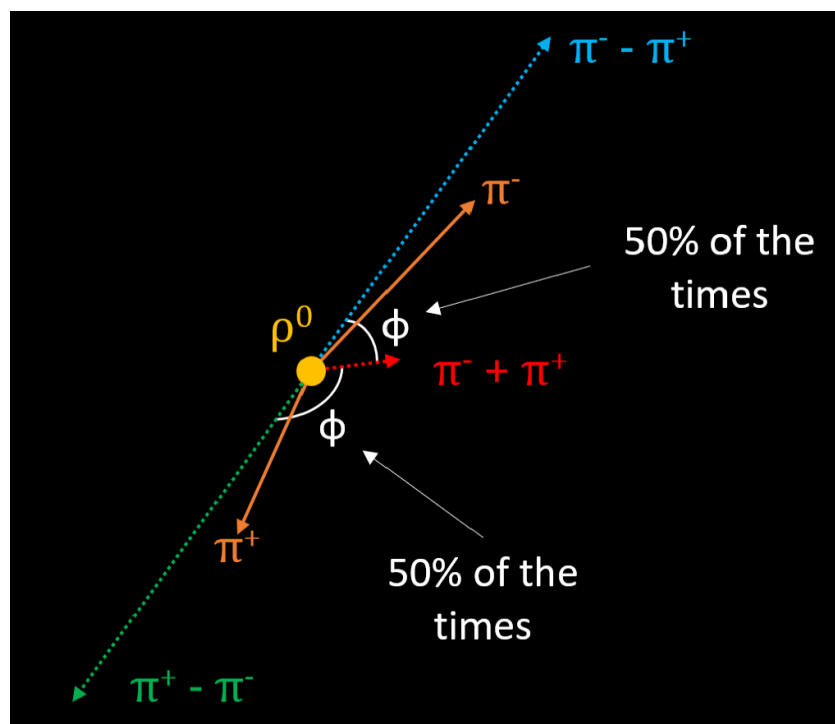
Broz et al., Comput. Phys. Comm. (2020) 107181



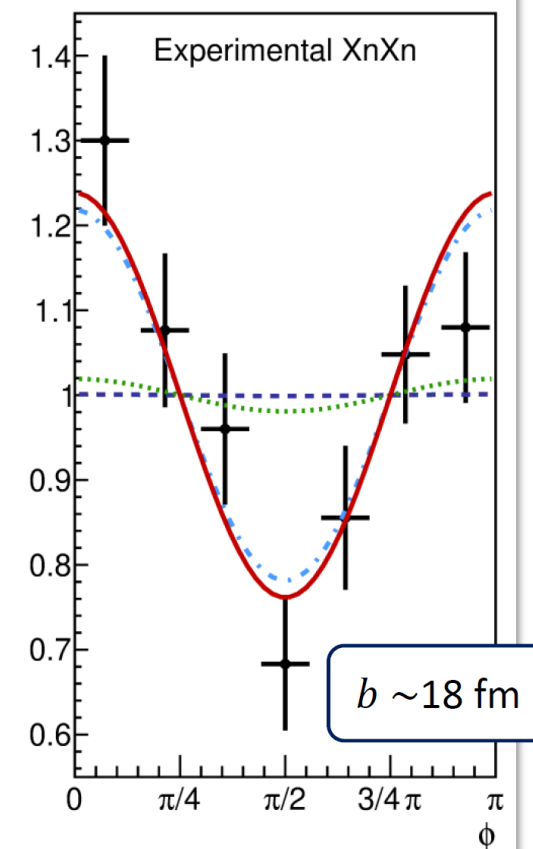
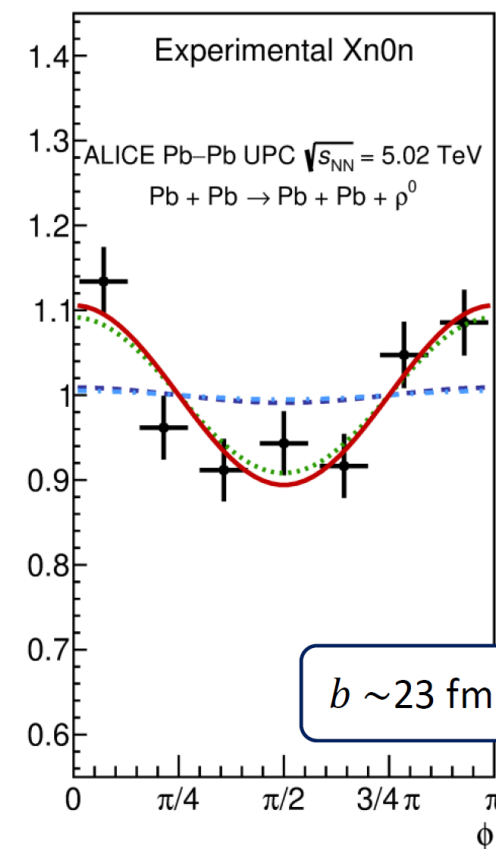
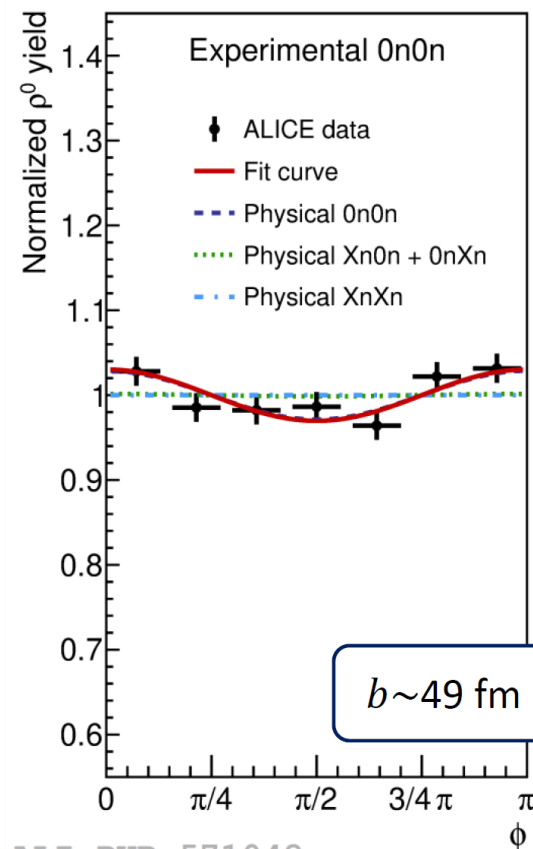
ALICE, JHEP 06 (2020) 035

EMD class	Median b from n_0^n
0n0n	49 fm
Xn0n	23 fm
XnXn	18 fm

Angular anisotropy in ρ^0 decays



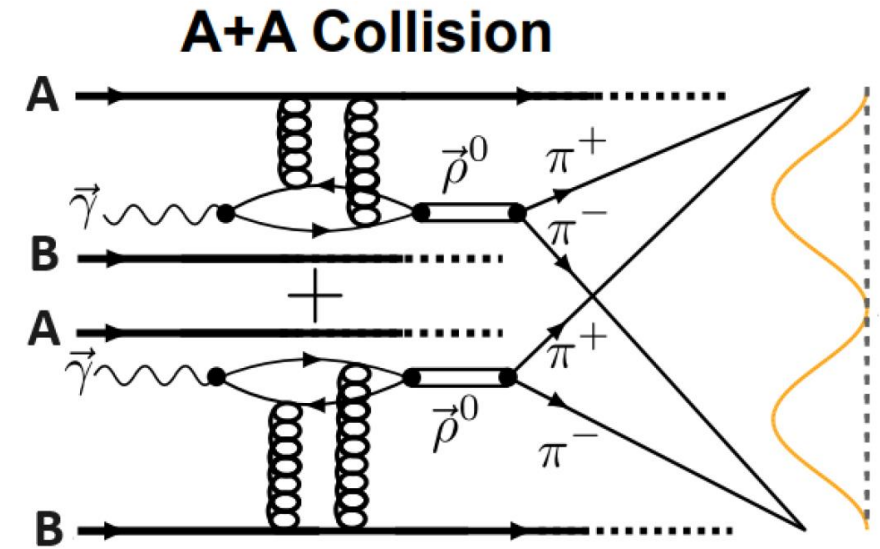
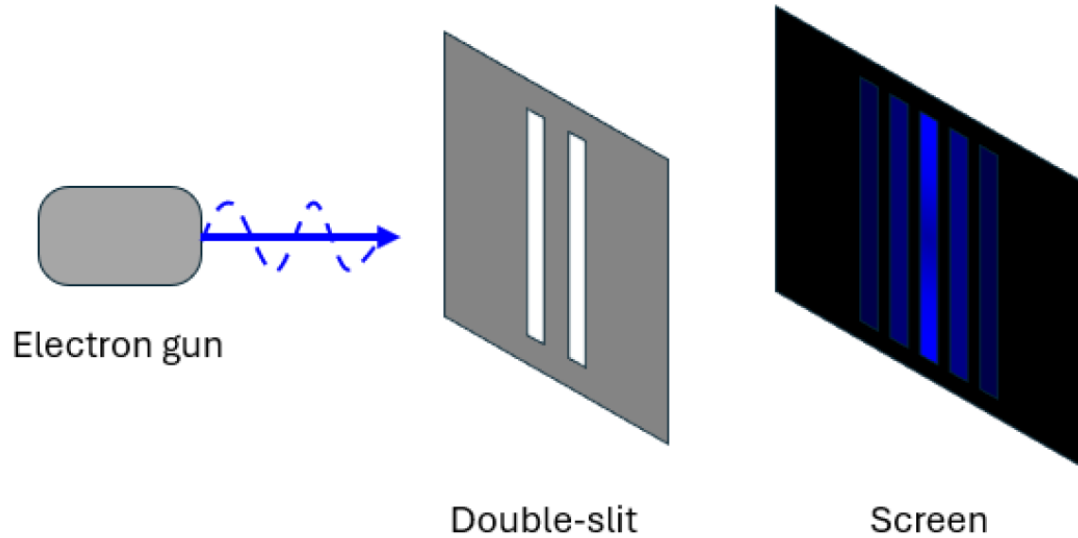
$$\vec{p}_{\pm} = \vec{p}_{T,1} \pm \vec{p}_{T,2}$$



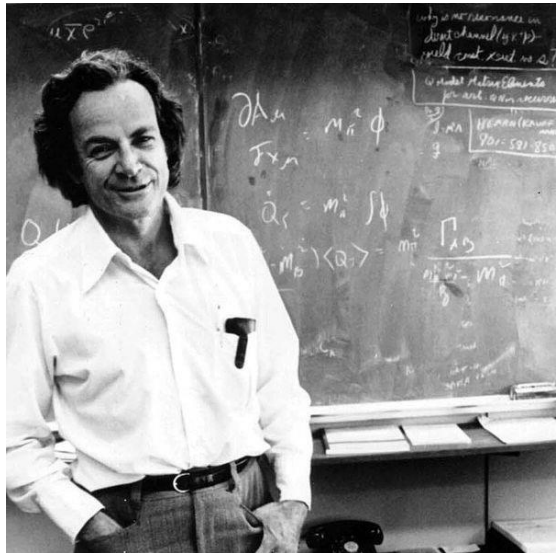
ALI-PUB-571042

- First measurement of the impact-parameter dependent angular anisotropy in the decay of coherently photoproduced ρ^0
- The amplitude (a_2) of the modulation increases by one order of magnitude as b decreases $\rightarrow$ compatible with expectations from interference

A double-slit experiment at the femtometer scale



STAR, Sci.Adv. 9 (2023) eabq3903



I will take just this one experiment, which has been designed to contain all of the mystery of quantum mechanics, to put you up against the paradoxes and mysteries and peculiarities of nature one hundred per cent. Any other situation in quantum mechanics, it turns out, can always be explained by saying, 'You remember the case of the experiment with the two holes? It's the same thing'.

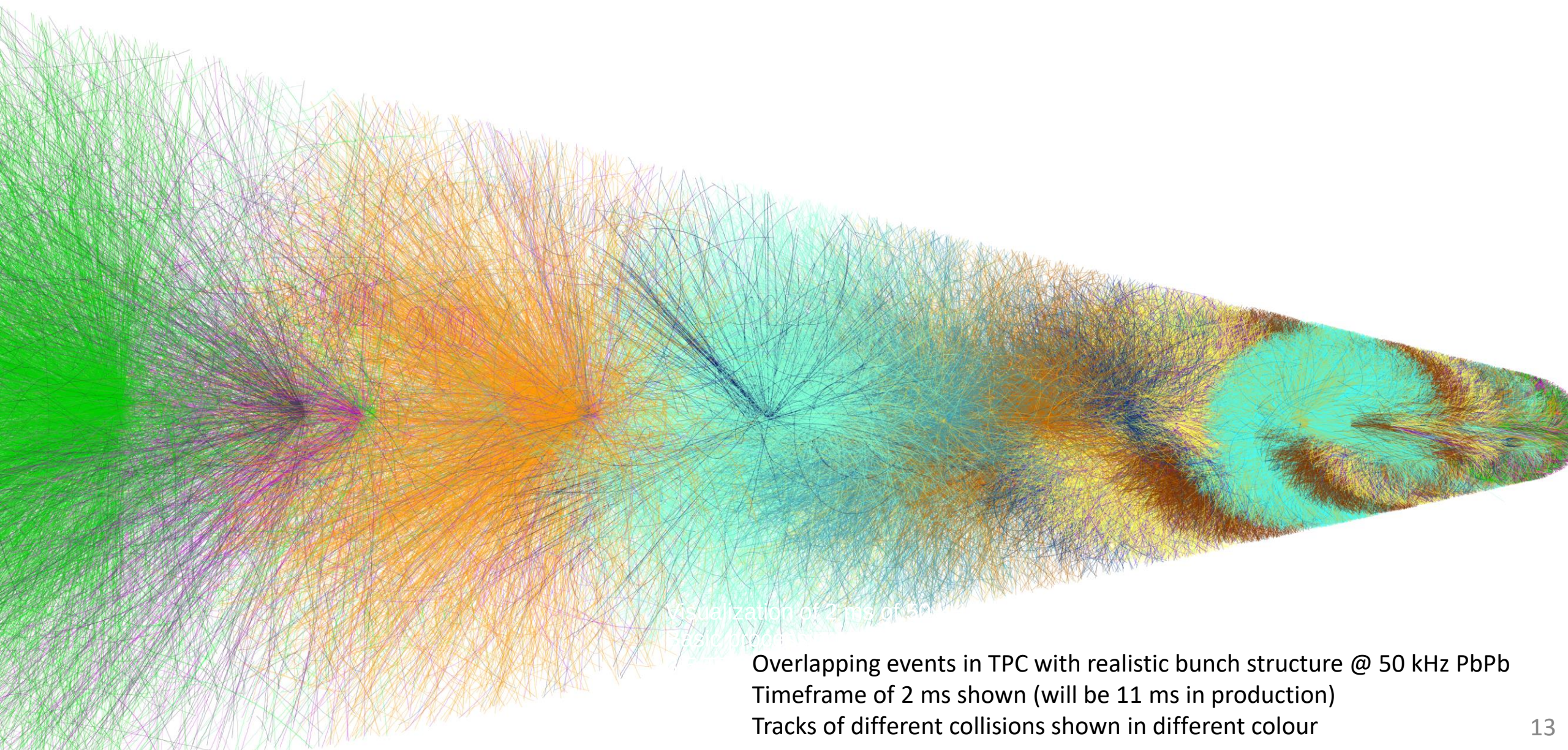
Richard Feynman in "The Character of Physical Law, chapter 6"

Задачи группы ПИЯФ в 2024 году



- Участие в обработке данных по рождению короткоживущих резонансов
- Участие в обработке данных по рождению дилептонов и векторных мезонов в ультра-периферических Pb-Pb столкновениях, включая проведение соответствующих теоретических расчетов
- Разработка и поддержка централизованной системы отбора событий для Run 3
- Разработка и поддержка системы мониторинга и расчета светимости
- Участие в сменах (включая on-call смены мюонного плеча)

Data processing challenge in Run 3



Visualization of 2 ms of 50 kHz PbPb
Basic physics

Overlapping events in TPC with realistic bunch structure @ 50 kHz PbPb
Timeframe of 2 ms shown (will be 11 ms in production)
Tracks of different collisions shown in different colour

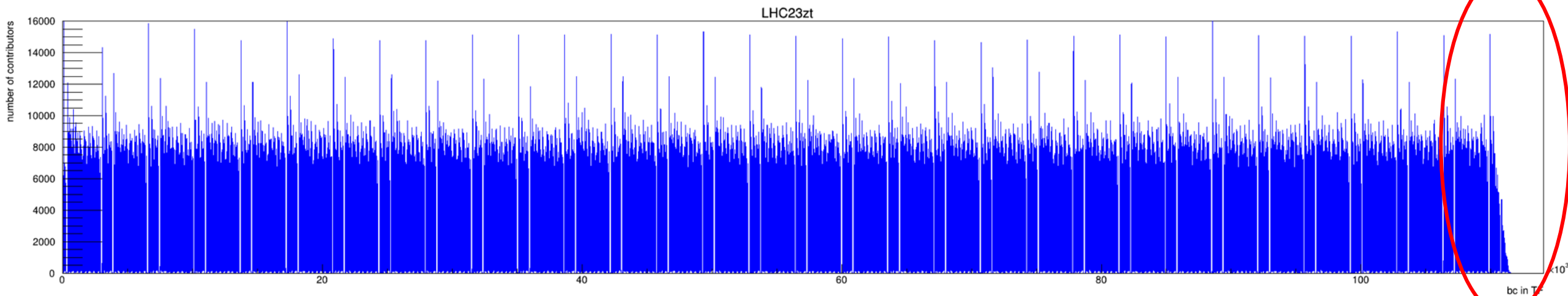
Централизованная система отбора событий



Main duties:

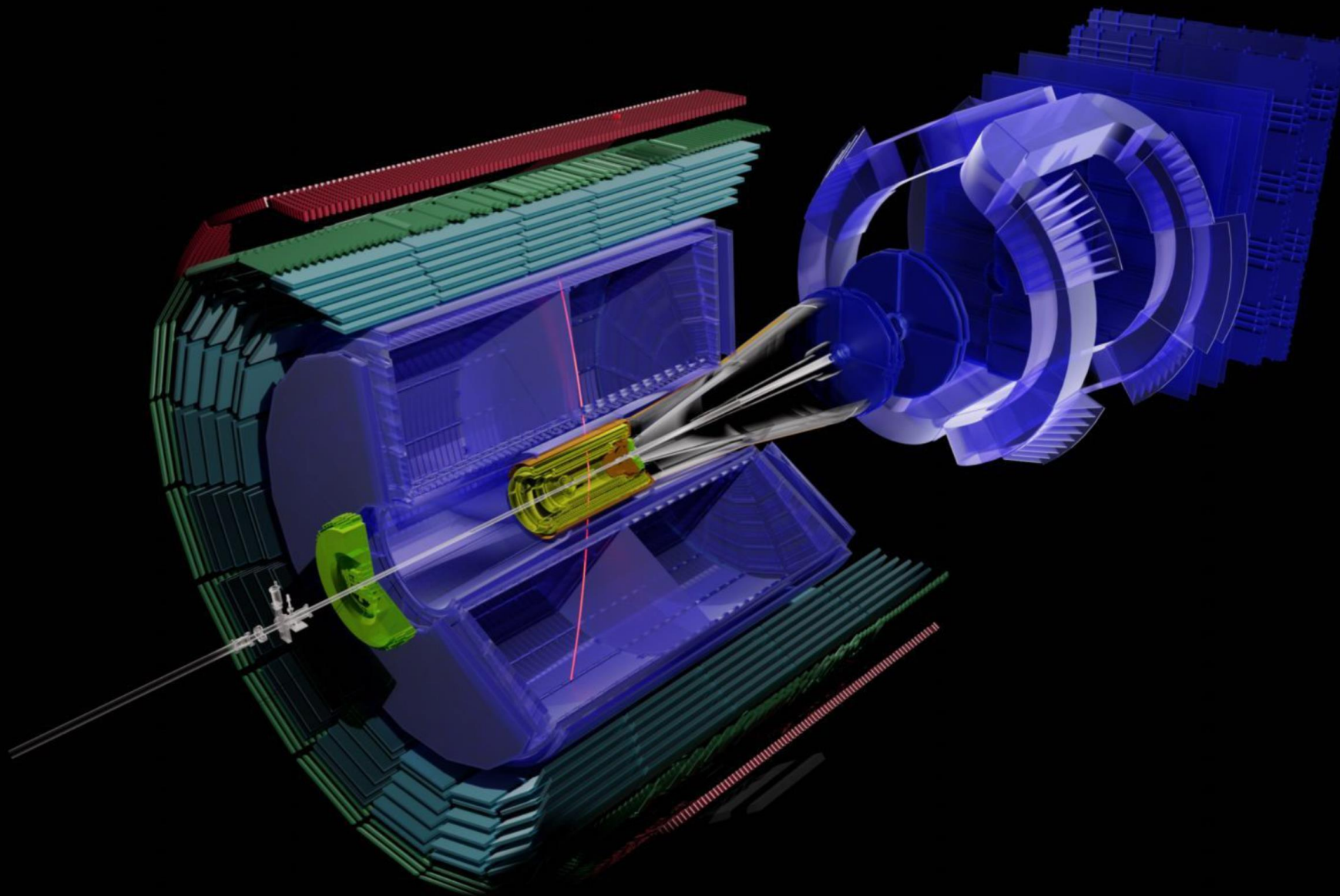
- Matching of primary vertices and forward detector info (new in Run 3)
- Selection of triggered events
- Tools for beam-gas and pileup rejection
- Preserve compatibility with Run2-converted data
- Quality control of event selection
- Luminosity and statistics monitoring tools
- Maintenance of event selection QA site: <https://evsel-qa.web.cern.ch/data/>
- Reports at coordination meetings of the Data Preparation Group

Low track reconstruction efficiency at the end of time frame due to incomplete TPC info

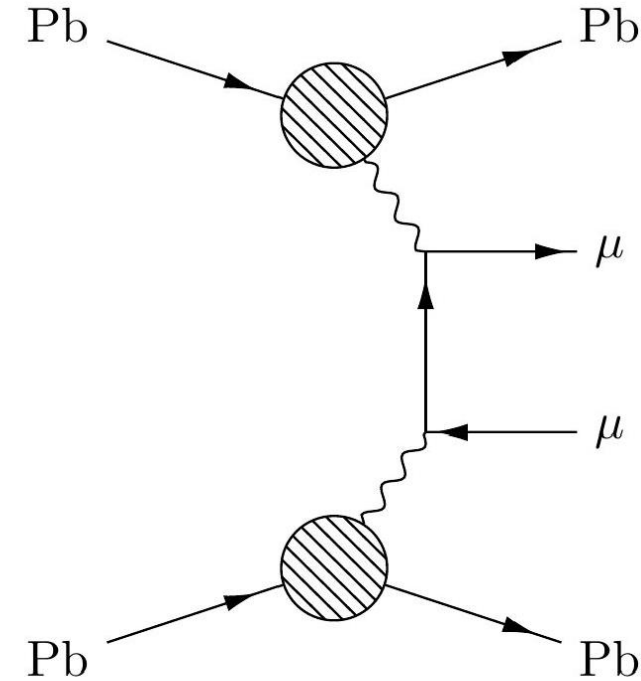
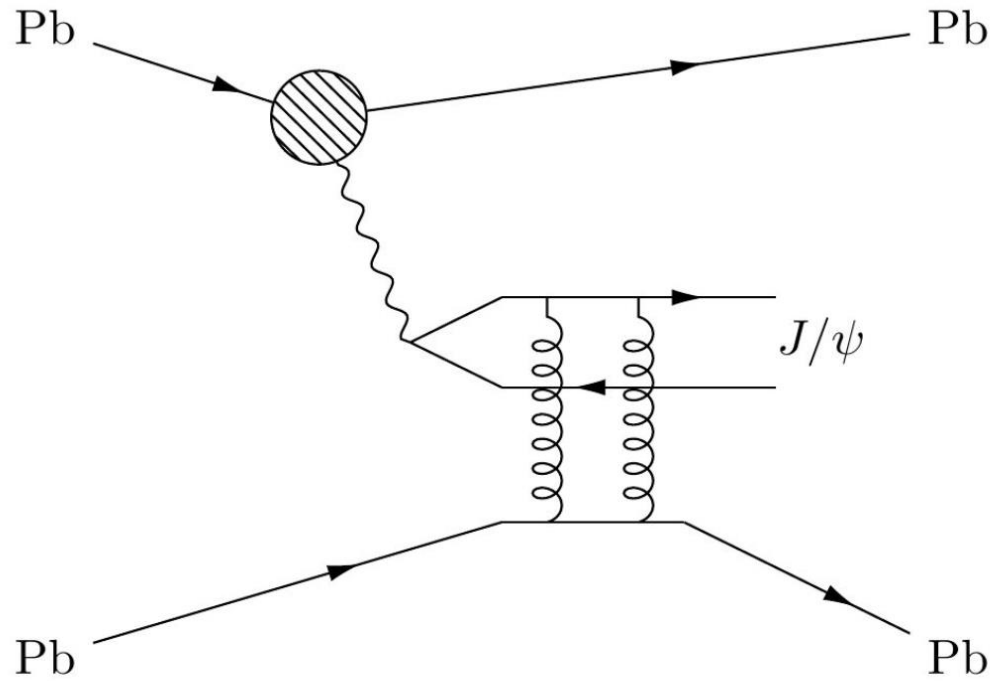


1 Time frame = 32 orbits

UPCs in Run 3



Vector meson photoproduction and dimuon continuum in UPCs



$$\left. \frac{d\sigma_{\gamma A \rightarrow J/\psi A}}{dt} \right|_{t=0} = \frac{M_{J/\psi}^3 \Gamma_{ee} \pi^3 \alpha_s^2(Q^2)}{48 \alpha_{\text{em}} Q^8} \left[x g_A(x, Q^2) \right]^2$$

Ryskin: Z. Phys. C 57 (1993) 89

Исследование партонной плотности в ядрах при малых бьёркеновских x

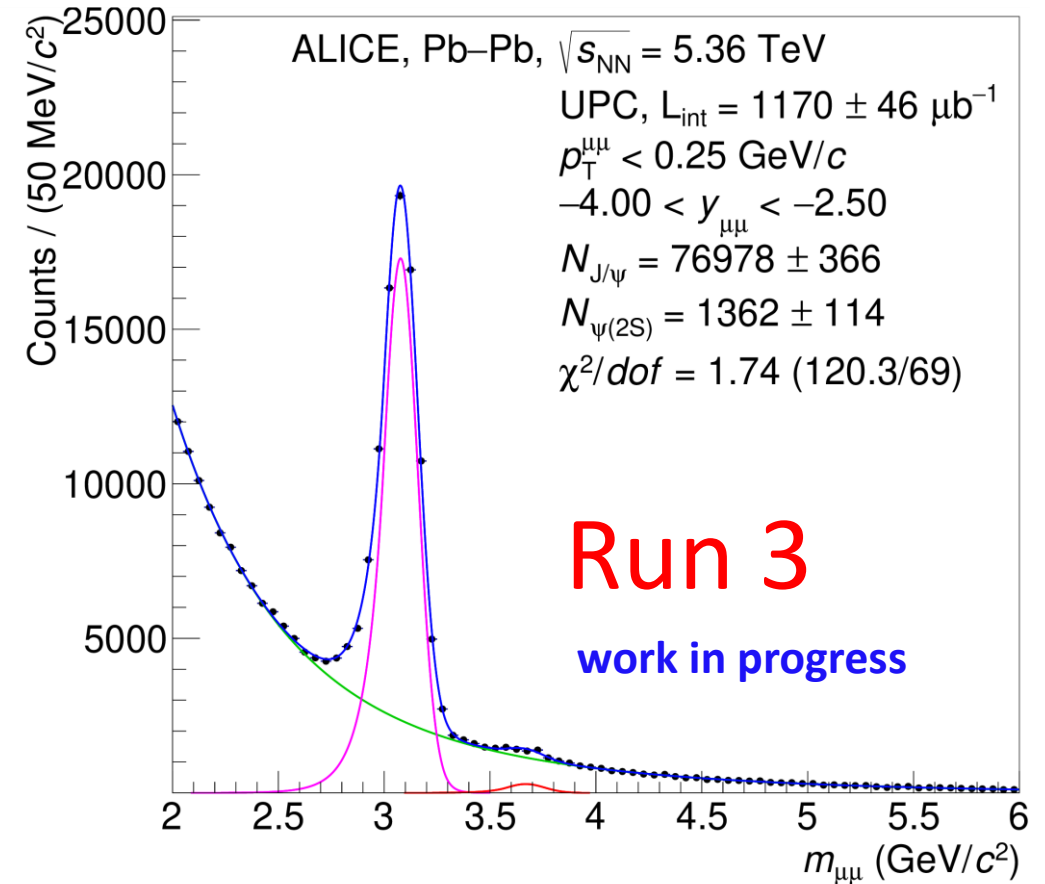
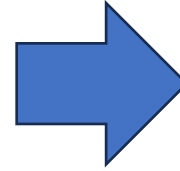
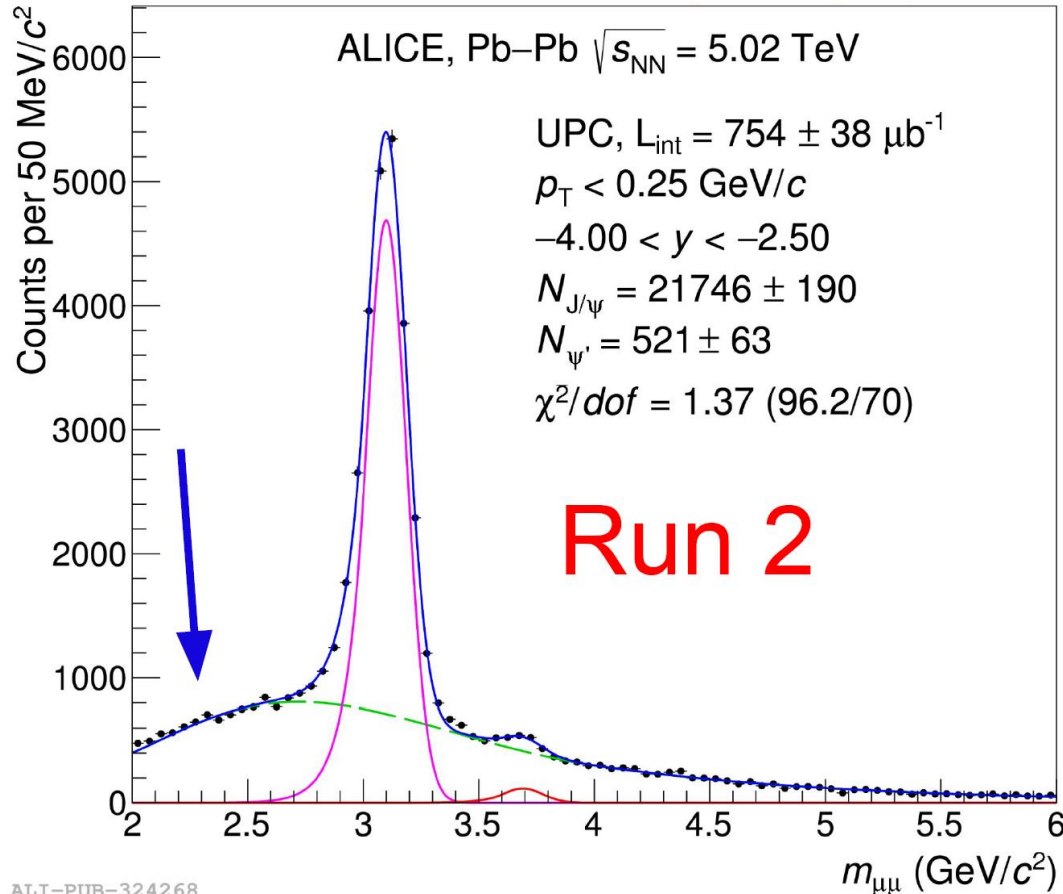
$$\frac{d\sigma}{dz} = \frac{\pi \alpha^2}{s} \beta \left(2 + 4 \beta^2 \frac{\beta^2 (1 - z^2) z^2 + 1 - \beta^2}{(1 - \beta^2 z^2)^2} \right) \quad z = \cos \theta$$

Breit & Wheeler, PR46 (1934) 1087

Проверка применимости приближения эквивалентных фотонов в условиях сильных ЕМ полей

Run 2 → Run 3

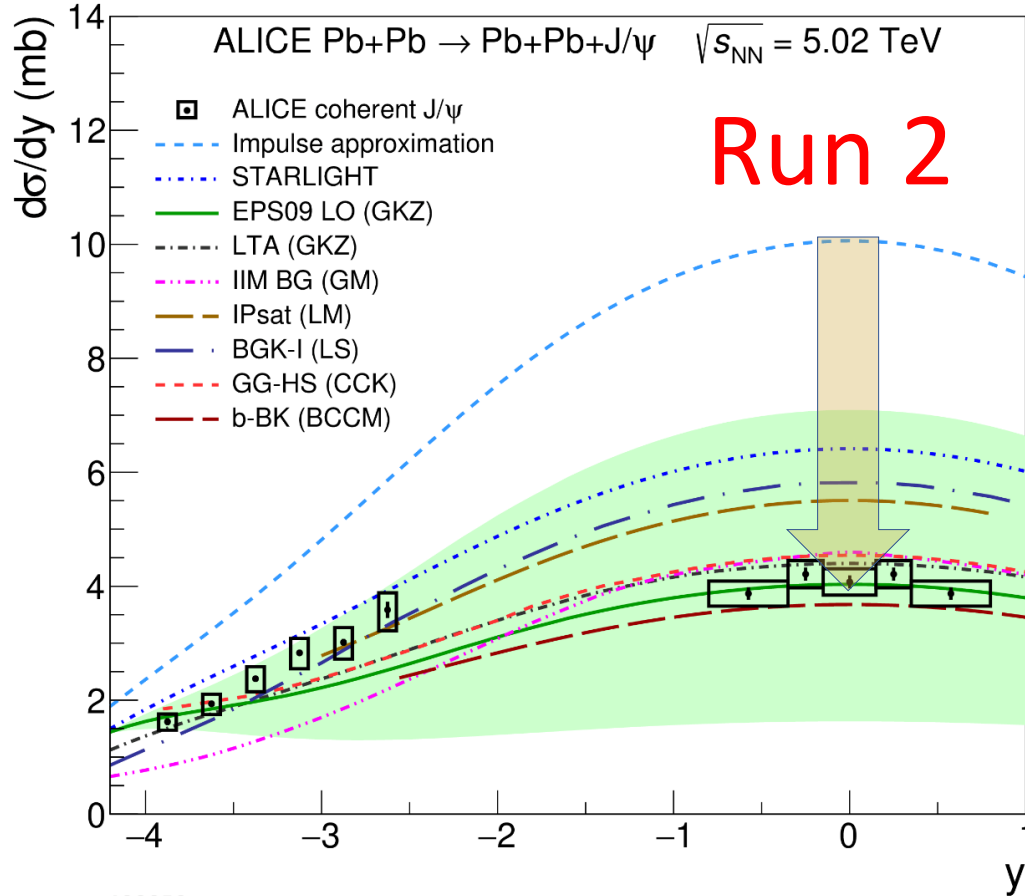
ALICE, PLB 798 (2019) 134926



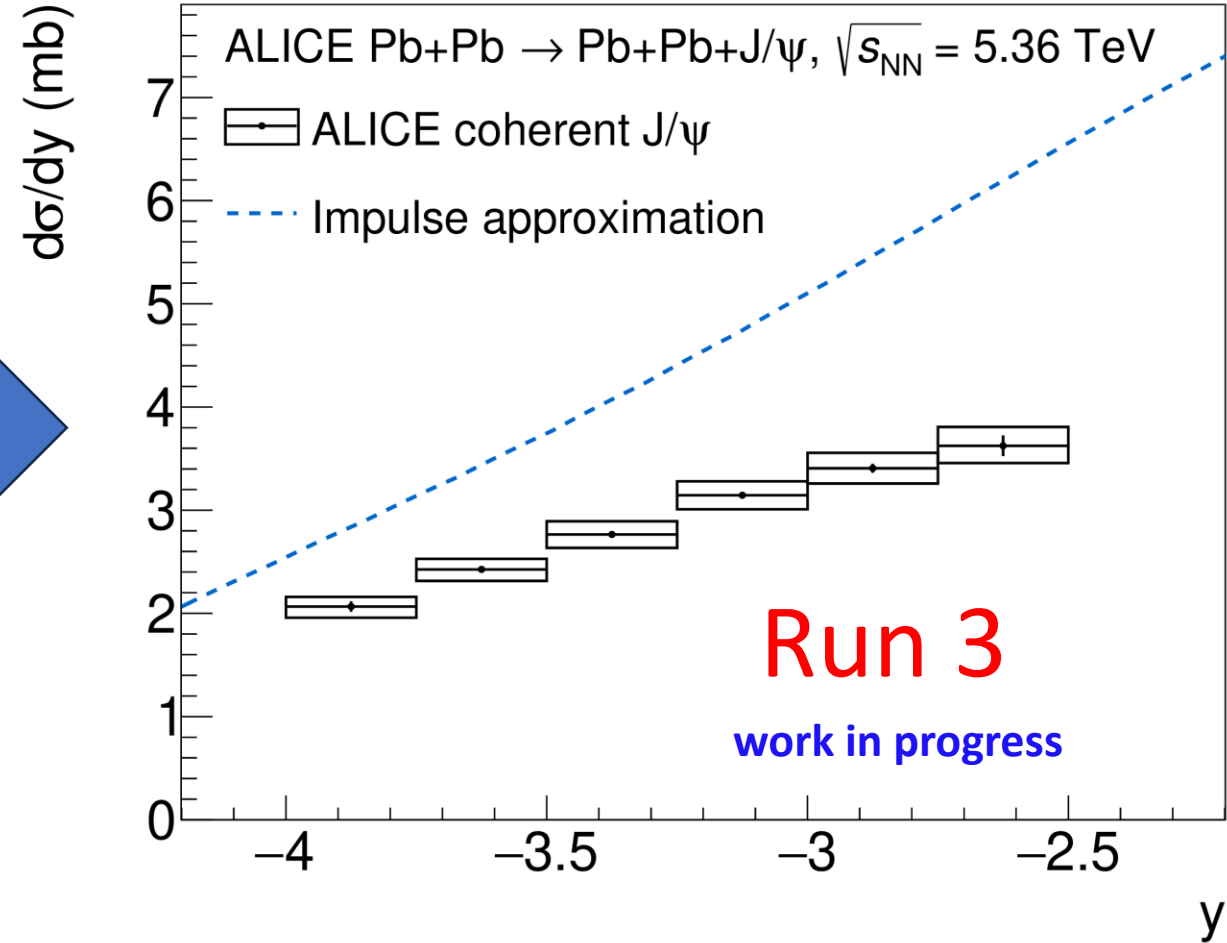
- Значительное увеличение светимости
- Бестриггерный набор данных дает возможность продвинуться в область малых масс
- Нет эффектов, связанных с резким изменением эффективности в области J/ψ

Coherent J/ψ cross section

ALICE, PLB 798 (2019) 134926, PLB 817 (2021) 136280

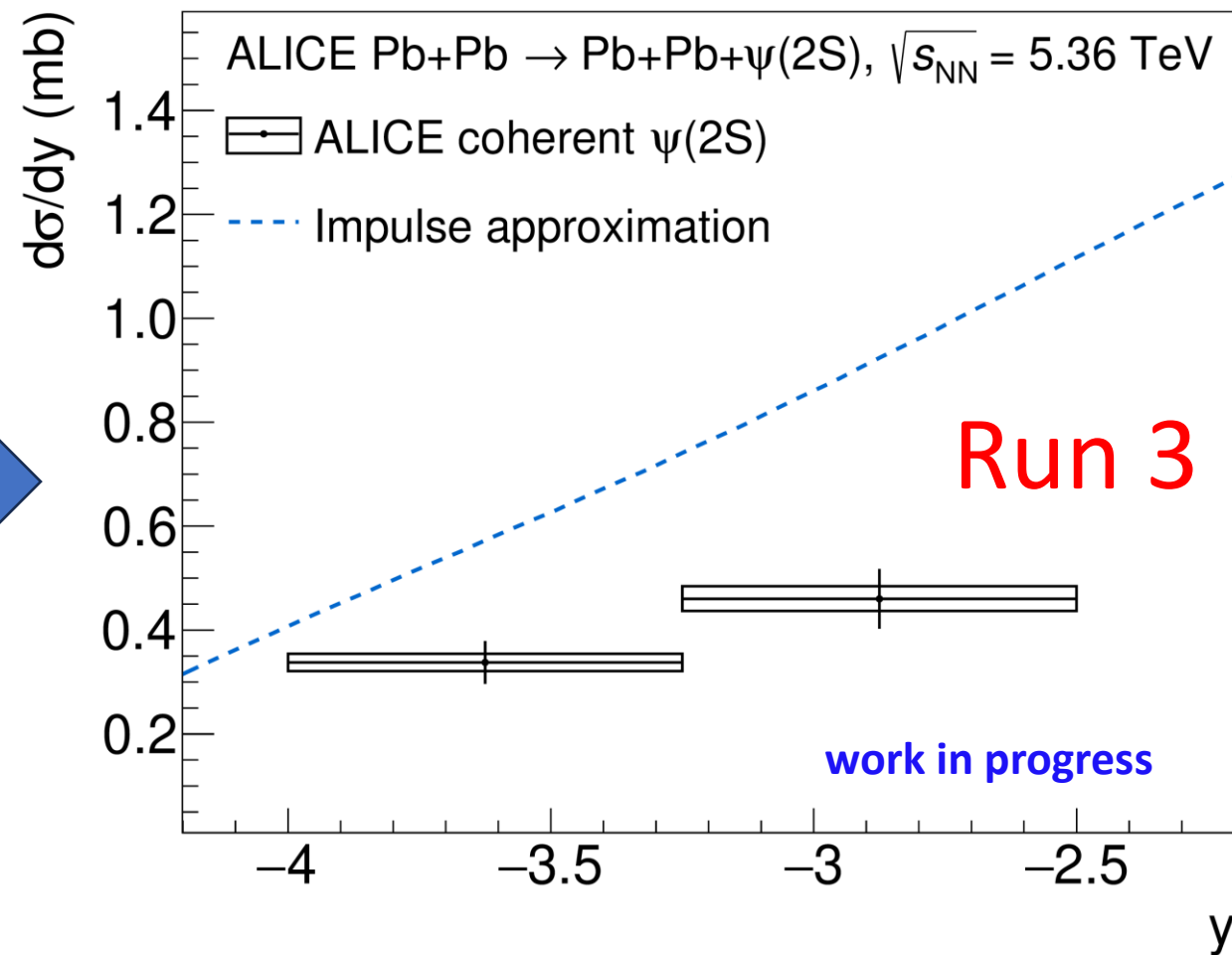
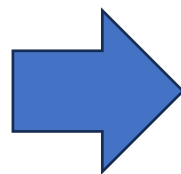
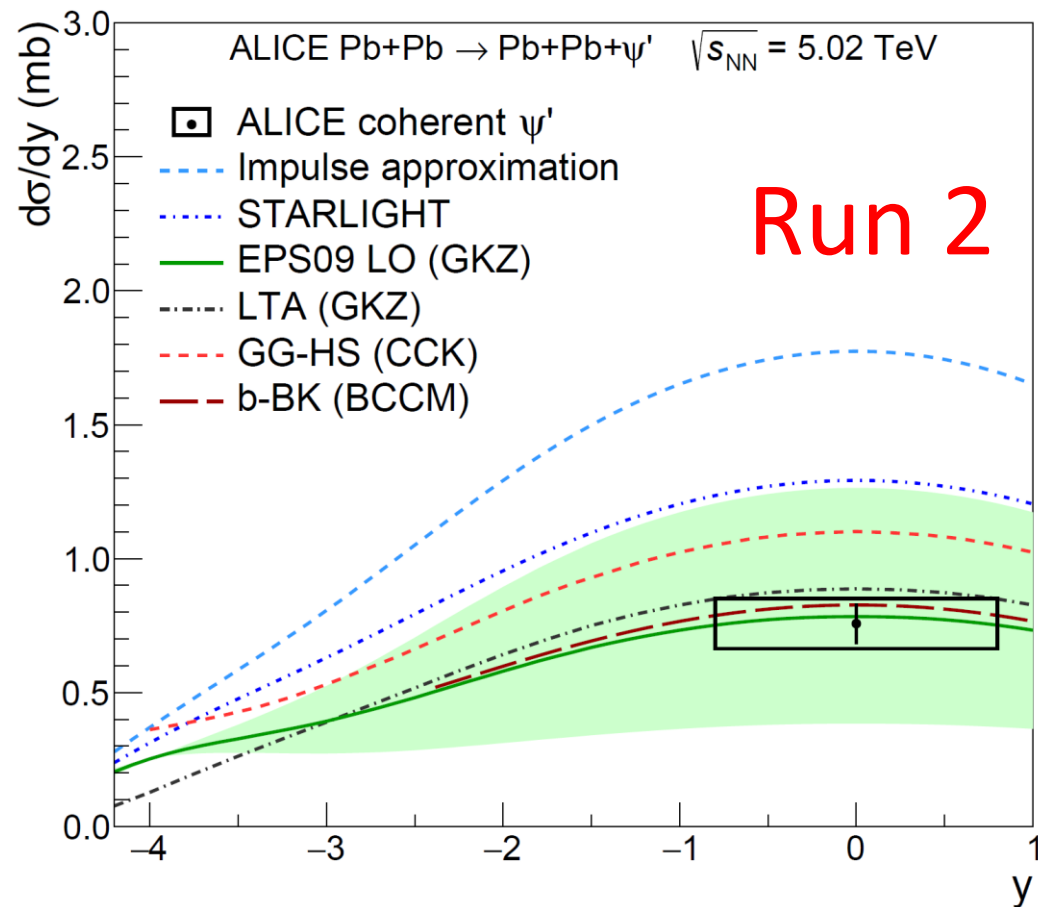


ALI-PUB-499958



- More precise measurement at forward rapidity
- Rapidity trend compatible with LHCb

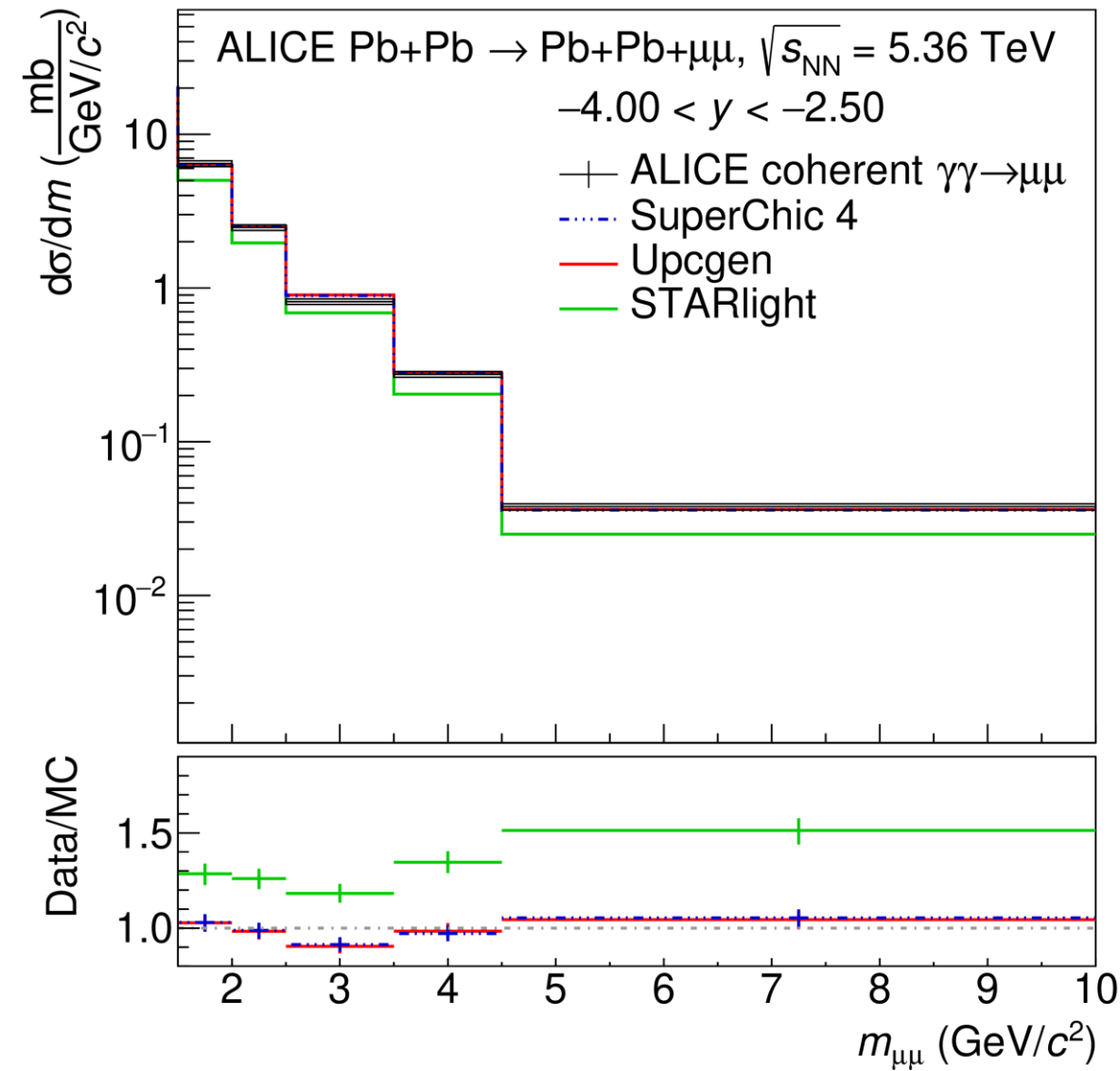
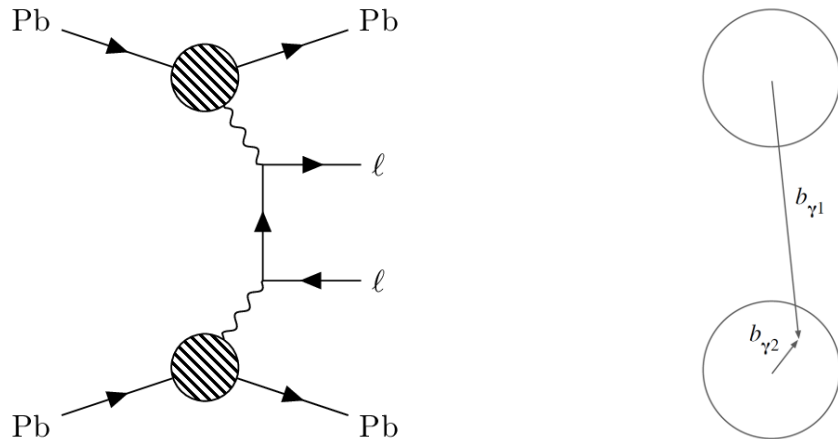
Coherent $\psi(2S)$ cross section



- First coherent $\psi(2S)$ cross section measurement at forward rapidity
- Suppression similar to J/ψ

Dimuon continuum production

- Измеренное сечение на 20-50% выше, чем предсказывает генератор STARLight
- Хорошее согласие с генераторами SuperChic (Harland-Lang, Ryskin et al) и Upcgen (Burmasov, Kryshen et al), где учитываются вклад с прицельными параметрами фотонов меньше радиуса ядра



Доклады и публикации по ALICE



Доклады:

- Н. Бурмасов, Исследование фотон-фотонных и фотон-ядерных взаимодействий в ультрапериферических столкновениях ядер на коллайдере LHC. Научная сессия секции ядерной физики ОФН РАН, Дубна, 4 апреля 2024
- Е. Крышень. Исследование ядерных экранировок в ультрапериферических столкновениях на БАК. Зимняя школа ПИЯФ. 21 марта 2024
- N. Burmasov, Quarkonia photoproduction and dilepton production in UPCs with ALICE, 42nd International Conference on High Energy Physics, Прага, 17-25 июля 2024
- Н. Бурмасов. Фоторождение векторных мезонов в ультрапериферических столкновениях на Большом Адронном Коллайдере. Семинар ОФВЭ. 17 сентября 2024

Публикации:

- 47 коллаборационных публикаций, из них 4 в которых мы принимали участие:
 - The ALICE experiment: a journey through QCD, EPJC 84 (2024) 813
 - ALICE luminosity determination for Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, JINST 19 (2024) P02039
 - First Measurement of the $|t|$ Dependence of Incoherent J/ψ Photonuclear Production. PRL 132 (2024) 162302
 - Measurement of the impact-parameter dependent azimuthal anisotropy in coherent p^0 photoproduction in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV. PLB 858 (2024) 139017
- N. Burmasov, Perspectives of tau $g-2$ measurements with the ALICE experiment at the LHC, IJMPA 2443023 (2024)

ALICE – Russia 30 Years of Collaboration



Dedicated plenary session at the ALICE week in July

14:00

ALICE – Russia: 30 Years of Collaboration

🕒 20m

Speaker: Luciano Musa (CERN)

LMUSA_Russia_Jul...

14:30

Update on the PHOS detector ¶

🕒 20m

Speaker: Yuri Kharlov (Institute for High Energy Physics of NRC Kurchatov Institute (RU))

PHOS-20240708.pdf

15:00

Update on the FIT detector

🕒 20m

Speakers: Tatiana Karavicheva (Institute for Nuclear Research (INR)), Tatiana Karavicheva (Russian Academy of Sciences (RU))

FIT_TK-09-07-2024....

15:30

R&D and productions for the Inner Tracking system of ALICE

🕒 20m

Speaker: Grigori Feofilov (St Petersburg State University (RU))

Feofilov-09070224-...

I loved you so sincerely and tender -
God bless you with such love of
someone else.

Alexander Pushkin
&
Russian FIT team

- Thanks a lot for your attention!



Comparison with LHCb and CMS

