

# **Results of the JINR team in ATLAS and proposal for project extension**



I. Yeletskikh

On behalf of the JINR ATLAS team

# JINR team in ATLAS Collaboration



- 66 Physicist
- 15 Physics PhD student
- 12 Physics masters/diploma student
- I Undergraduate/summer student
- ▶ 3 Engineer with PhD
- ▶ 37 Engineer without PhD
- 1 Engineering student
- ▶ 17 Technician or equivalent
- 2 Administrator/other



- ▶ 48 on Authorlist (A)
- ▶ 1 Signing-Only (a)
- ▶ 37 counted for M&O (M)
- 0 qualifying members (q)
- ▶ 45.25 for Operation Tasks (O, o)

**DLNP**: Atanov N., Atanova O., Batusov V., Bednyakov V., Boyko I., Chizhov M., Davydov Yu., Dedovich D., Demichev M., Didenko A., Dolovova O., Dydyshko Y., Elkin V., Ershova A., Gerasimov V., Glagolev V., Gongadze A., Gongadze I., Gongadze L., Gostkin M., Gritsai K., Ivanov Y., Kalinovskaja L., Karpov S., Karpova Z., Kharchenko D., Kostyukhina I., Kruchonak U., Koultchitski Y., Lyabline M., Lyashko I., Lykasov G., Lyubushkin V., Lyubushkina T., Malyukov S., Minashvili I.(jr.), Nefedov Y., Plontikova E., Potrap I., Prokhorov A., Ramakoti E., Rusakovich N., Sapronov A., Serochkin M., Shalyugin A., Shelkov G., Shiyakova M., Souslov I., Tropina A., Tsiareska P., Vasyukov A., Yeletskikh I., Yermolchyk V., Zhemchugov A. **LIT**: Alexandrov E., Aleksandrov I., Gromova N., Iakovlev A., Kazymov A., Mineev M., Shigaev V., Zrelov P. **VBLHEP**: Ahmadov F., Cheplakov A., Fillipov Y., <u>Kukhtin V.</u>, Ladygin E., Makarov A., Manashova M., Soloshenko A., Shaykhatdenov B., Turtuvshin T., Zimin N.

Total FTE estimation: 36.2

#### **Measurements of heavy quarks Yukawa couplings**

Signal strength of  $H \rightarrow bb$  in the VH production channels has been measured relative to that predicted by Standard Model.



 $\mu_{VH}^{bb} = 0.92_{-0.15}^{+0.16} = 0.92 \pm 0.10 \text{ (stat.)}_{-0.11}^{+0.13} \text{ (syst.)},$  $\mu_{VH}^{cc} = 1.0_{-5.2}^{+5.4} = 1.0_{-3.9}^{+4.0} \text{ (stat.)}_{-3.5}^{+3.7} \text{ (syst.)}.$  Higgs boson production via ggF and VBF is measured in the  $H \rightarrow WW^* \rightarrow lvlv$  decay channel.



compared to the SM predicted values of  $10.4 \pm 0.5$  and  $0.81 \pm 0.02$  pb for ggF and VBF [11],<sup>9</sup> respectively. The combined cross section times branching ratio,  $\sigma_{ggF+VBF} \cdot \mathcal{B}_{H \to WW^*}$ , obtained from fitting a single POI, is measured to be

$$\sigma_{ggF+VBF} \cdot \mathcal{B}_{H \to WW^*} = 12.3 \pm 1.3 \text{ pb}$$
  
= 12.3 ± 0.6 (stat.)  $^{+0.8}_{-0.7}$  (exp. syst.) ± 0.6 (sig. theo.) ± 0.7 (bkg. theo.) pb

compared to the SM predicted value of  $11.3 \pm 0.5$  pb.

#### **Resonant production of charmonia pairs: fully charmed tetraquarks**



Searches for other decay channels

 $m_{4\mu}^{con}$  [GeV]

### **BSM** searches

Z.Karpova,

S.Karpov,



New mass/cross-section limits are set for the ADD and RS1 models (top plots) as well as for model-independent approach.

Search for deviations from SM predictions is performed in  $Z\gamma$ ,  $W\gamma$  final states with full Run2 dataset between 1 and 6.5TeV (left plots).

The largest deviation from expectation is  $2.5\sigma$  for spin-0 channel at 3.64TeV.



(c)

### **Other BSM searches**

E.Khramov, E.Cherepanova, V.Bednyakov, I.Yeletskikh, M.Chizhov, E.Soldatov.



- The EventIndex is the global catalogue of all ATLAS events
- For each event, each data format and each processing version, it contains:
  - Event identifiers (run and event number)
  - Location (GUID of the file containing it) and provenance
  - Trigger and other useful metadata
- Main use case is event picking for detailed analysis and/or displays
- The core data storage system was reimplemented during 2021 and deployed in 2022 for the start of LHC Run3
  - Hbase for the dataset and event tables
  - Phoenix interface for SQL queries
  - New client query service CLI implemented
- Web service is available outside of CERN (need CERN SSO authorization)

### https://atlas-event-picking.cern.ch/eventpicking

Request	Number of events	Version	Time	
γγ -> WW	50k	1.0.0	2 weeks	
		manual	3 months	
γγ -> WW	136k	Beta version	3 months	
B <sub>c</sub> * -> B <sub>c</sub>	16K	1.2.37	84h	
Z -> TauTau	11К	1.2.37	40h	



### **Phase-I muon spectrometer upgrade (New Small Wheels)**









### MicroMeGas technology implementation in JINR





All 32 large Micromegas quadruplets for NSW were made in Dubna

### **Phase-I of Liquid Argon Calorimeter upgrade**

### Base plate development

### MC simulation and mini-modules irradiation



+ G4

+ AF3

Energy [GeV]

- MC

- MC

--- MC

10<sup>2</sup>

50 GeV

20 GeV

10 GeV

500

1000 ∆Z[mm

-1000

-500

 $\sim$ 

Sci 6 (2022)

Comput Softw Big

JINR contributed to the development of AtlFast3 – fast calorimeter simulation which showed much better simulation quality as compared to AF2 while keeping good CPU efficiency.

Measurements of the hadronic shower shapes (transverse and longitudinal) in calorimeter are performed at TestBeam facilities.

Corrections are obtained for modeling of the calorimeter response.

Cuts are optimized to distinguish different particle types.



For 2025 we get ATLAS software development grant for electron/photon identification/efficiency software, electron calibration tool.

# Plans for 2026-2030

- Higgs physics
- Exotic hadrons and hadron spectroscopy
- Standard model measurements
- BSM searches
- Simulation and theoretical support
- Software development
- Further participation in upgrade

### **Measurements of Yukawa coupling of top quarks**



Probing the CP nature of the top-Higgs Yukawa coupling is one of the important tests of SM. Current measurements of the phase of this coupling are consistent with SM but suffer from high uncertainties – several complementary measurements in different cjannels have to made.

One of them directly sensitive to phase is Higgs production in association with single top quark. Phases other than 0 predict higher cross-section of tH production



Full Run2 searches for tH production are planned to be published from both ATLAS and CMS. Looking forward to Run3 analysis and Run4 data.

N.Huseynov, I.Boyko, O.Dolovova, A.Tropina, A.Didenko, I.Yeletskikh

### Hidden charm tetraquarks and pentaquarks

m(J/wpK) [GeV]



ATLAS data confirmed pentaquarks (at the level of only  $\sim$ 2.5 sigma) in Runl data. Currently analyses are ongoing w.r.t. Pc and Zc, Zcs states with Run2 data.

 $J/\psi + \psi(2S) \rightarrow 4\mu + 2\pi$ 





 $J/\psi + \psi(2S) \rightarrow 4\mu$ 

Analysis of fully charmed tetraquarks is ongoing to reveal their properties w.r.t. production mechanisms and internal structure Study of  $B_c$  mesons provides important inputs for theory being a unique bound state of heavy quarks. So far –  $B_c(2S)$  doublets are observed experimentally: CMS PRD 102 (2020) 092007, LHCb PRL 122 (2019) 232001, ATLAS PRL 113 (2014) 212004

There is prediction of  $B_c^*$  state with mass mass difference w.r.t. ground state of 50-70MeV. The analysis depends substantially on the reconstruction of soft photons.



Example of  $B^{+*}$  reconstruction representing one of the backgrounds and using the same soft photon reconstruction. For the photon reconstruction, Event Picking service was used, developed by JINR team.

CP violation in  $B_s \rightarrow J/\psi \phi(1020)$  decays due to interference between direct decays and  $B_s$  flavour mixing.

The main observable is CPV phase  $\varphi_s$  predicted by global fits to be **-37 ± 1** mrad

ATLAS analysis was performed using 2015-2017 data, full Run2 analysis is now ongoing...



### Physics and software program plans

- Search for Higgs boson production in association with top quarks (N. Guseynov, I. Boyko, A. Didenko, O. Dolovova, A. Tropina, et al.)
- Study of Higgs boson production via gluon and vector boson fusion (E. Ramakoti)
- Measurements of Higgs boson production cross-sections in gauge boson-associated channels (F. Akhmadov)
- Search for manifestations of BSM physics models, particularly quantum black hole (QBH) production in the lepton+jet channel (S. Karpov, Z. Karpova)
- Investigation of excited  $B_c$ -meson properties and spectra (T. Lyubushkina)
- Measurement of the CP-violating phase in Bs-meson decays (V. Lyubushkin)
- Study of tetraquark and pentaquark states in B-meson decays (A. Vasyukov, I. Yeletskikh)
- Investigation of double charmonium production and fully charmed tetraquark states (I. Yeletskikh, A. Didenko)
- Measurement of production cross-sections and branching ratios for heavy hadrons in various decay channels
- Study of the Proton Structure at LHC Energies (G. Lykasov)
- Participation of JINR scientists in data quality control and quality control for different object reconstruction in detector will continue
- Software for Liquid Argon Calorimeter (simulation, geo-model, monitoring)
- Development and support of the ATLAS conditions databases, database monitoring
- Support of TDAQ system, development of the operational monitoring systems, network monitoring, slimos
- 6.12 FTE Class3 delivered in 2024
- A lot of this software experience is used in other JINR projects: SPD, Baikal-GVD, etc.

## LHC long term operation plan









# **Overview of ATLAS Upgrades**





Detailed scope described in 7 TDRs approved by the CERN Research Board in 2017, 2018, 2020

I.Yeletskikh, 62nd meeting of the PAC for Particle Physics, 23.06.2025

JINR contributions

## **Phase-2 muon spectrometer upgrade**

Development and production of new RPC chambers for muon spectrometer, which includes:

Assembly and tests of PRC singlets

Production and tests of Strip Chambers

Development, production, installation of gas system

Electric supply management

Detector comissioning, installation in cavern, etc.

RPC\_Panel\_01, ground side



### **Phase-2: High Granularity Timing Detector**





JINR commitments:

Development and production of DCS system; Designing, development, production and testing of instrumentation stand; Participation in test beam studies, assembly works, comissionsning and integration works





HGTD services: 3D-model and instrumentation stand

### **Phase-2 LAr upgrade**

Tests of high-frequency operational amplifiers LTDB





Ionization tests (SPS)



LAr ionization chamber with <sup>90</sup>Sr ß-source (100mCi of Sr and Y - OBNINSK)



W, 5X

beam

JINR commitments:

Development and testing of preamplifire and shaper for HEC; Production and testing of optic patch-cords; Development and test of the analog schemes.





Proposed schedule and resource request for the Project / LRIP subproject

		Cost (thousands	Cost/Resources, distribution by years					
	Exp	enditures, resources, funding sources	of US dollars)/ 1 <sup>st</sup> 2 <sup>nd</sup> 3 <sup>rd</sup> 4 <sup>th</sup> Resource year year year year requirement s		5 <sup>th</sup> year			
International cooperation Materials Equipment, Third-party company services Commissioning R&D contracts with other research organizations		International cooperation	3810	770	770	770	770	770
		Materials	900	480	270	90	30	30
		Commissioning						
		R&D contracts with other research organizations	270	60	60	50	50	50
Software purchasing		Software purchasing	50	10	10	10	10	10
		Design/construction	10	5	5			
		Service costs (planned in case of direct project affiliation)						
		Resources						
red	Standard hours	- the amount of FTE,	181	36.2	36.2	36.2	36.2	36.2
esou		- accelerator/installation,						
2 -		- reactor,	200	200				
Sources of funding	JINR Budget	JINR budget (budget items)	5040	1325	1115	920	840	840
	ning Itary s)	Contributions by partners						
	Extra fudr (supplemen estimate	Funds under contracts with customers						
		Other sources of funding						

## **Project extension proposal**

APPROVAL SHEET FOR PROJECT / LRIP SUBPROJECT

TITLE OF THE PROJECT/LRIP SUBPROJECT ATLAS. Detector upgrade and physics studies at LHC SHORT DESIGNATION OF THE PROJECT / SUBPROJECT OF THE LRIP ATLAS PROJECT/LRIP SUBPROJECT CODE 02-2-1081-1-2010/2025 THEME / LRIP CODE 02-2-1081-2009 NAME OF THE PROJECT/LRIP SUBPROJECT LEADER Bednya kov V.A.

AGREED JINR VICE-DIRECTOR DATE SIGNATURE NAME CHIEF SCIENTIFIC SECRETARY SIGNATURE NAME DATE CHIEF ENGINEER DATE SIGNATURE NAME Kunneb S.A 24.05.25 LABORATORY DIRECTOR SIGNATURE DATE 24.05.25 Herberron C.A CHIEF LABORATORY ENGINEER NAME DATE SIGNATURE LABORATORY SCIENTIFIC SECRETARY Simonenes 1. 14.05.25 THEME / LRIP LEADER PROJECT / LRIP SUBPROJECT LEADER 13002020 DATE APPROVED BY THE PAC SIGNATURE NAME DATE

We ask PAC to support extension of the project «ATLAS. Detector upgrade and physics at LHC» for the 2026-2030 period

Laboratory Economist

Project (LRIP subproject) Leader

## THANK YOU FOR ATTENTION!

### BACKUP

# Results from 2019-2025 (backup)

- List of publications
- Other results (not mentioned in main presentation)
- Software

# **Higgs physics**

- F. Ahmadov, A.Soloshenko, T.Turtucshin et al., Measurements of WH and ZH production with Higgs boson decays into bottom quarks and direct constraints on the charm Yukawa coupling in 13TeV pp collisions with the ATLAS detector, arXiv:2410.19611, accepted by JHEP
- F. Ahmadovet al.,., Measurements of WH and ZH production in the H→bb<sup>-</sup> decay channel in pp collisions at 13 TeV with the ATLAS detector, Eur. Phys. J. C 81 (2021) 178
- F. Ahmadov et al., Measurement of VH, H→bb<sup>-</sup> production as a function of the vector-boson transverse momentum in 13 TeV pp collisions with the ATLAS detector, JHEP 05 (2019) 141
- E.Ramakoti et al., Measurements of Higgs boson production by gluon-gluon fusion and vector-boson fusion using H→WW\*→evµv decays in pp collisions at s√=13 TeV with the ATLAS detector, Phys.Rev.D 108 (2023) 032005
- Boiko I.R., Guseinov N.A., Eletskikh I.V., Didenko A.R., Dolovova O.A., Tropina A.D., Using Artificial Neural Networks to Search for the Production of the Higgs Boson Together with a Single Top Quark, PHYSICS OF ELEMENTARY PARTICLES AND ATOMIC NUCLEI. EXPERIMENT, Volume 21, pages 481–488, (2024)
- I.R. Boyko A.R. Didenko, O.A. Dolovova, N.A. Huseynov, A.D. Tropina, I.V. Yeletskikh, A New Evolutionary Algorithm for Optimizing the Search of a Rare Higgs Boson Production Channel, PHYSICS OF ELEMENTARY PARTICLES AND ATOMIC NUCLEI. EXPERIMENT, Volume 21, pages 615–618, (2024)

# Standard Model measurements Proton structure

- V. A. Bednyakov, S. J. Brodsky, A. V. Lipatov, G. I. Lykasov, M. A. Malyshev, J. Smiesko & S. Tokar, Constraints on the intrinsic charm content of the proton from recent ATLAS data, Eur. Phys. J. C79 (2019) 2, 92
- N. A. Abdulov, H. Jung, A. V. Lipatov, G. I. Lykasov, and M. A. Malyshev, Employing RHIC and LHC data to determine the transverse momentum dependent gluon density in a proton, Phys. Rev. D 98 (2018), 054010
- S.Turchikhin, G.Lykasov et al., Measurements of the production cross-section for a Z boson in association with b-jets in proton-proton collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector, JHEP07(2020)044
- Yu. kultchitskiy, P.tereshko, E.Plotnikova et al., Two-particle Bose-Einstein correlations in pp collisions at s√=13 TeV measured with the ATLAS detector at the LHC, Eur. Phys. J. C 82 (2022) 608
- A.Lipatov, G.Lykasov, M.Malyshev, S.Turchikhin, Probing the proton structure with associated vector boson and heavy flavor jet production at the LHC, Phys.Rev.D 106 (2022) 5, 054017
- A.Lipatov, G.Lykasov, M.Malyshev, Towards the global fit of the TMD gluon density in the proton from the LHC data, Phys.Rev.D 107 (2023) 1, 014022, arXiv:2211.03727
- A.V. Lipatov, G.I. Lykasov, M.A. Malyshev, Refined TMD gluon density in a proton from the HERA and LHC data, Phys.Lett.B 848 (2024) 138390
- G.I.Lykasov, M.N.Sorokovikov, S.J.Brodsky, Intrinsic charm and D+D- asymmetry produced in proton-proton collisions, arXiv:2501.02507
- L.Maslennikov, N.Hyseynov et al., Measurement of the total and differential cross-sections of tt<sup>-</sup>W production in pp collisions at s√=13 TeV with the ATLAS detector, JHEP05(2024)131

# **Direct searches for beyond SM phenomena**

- E. Cherepanova et al, A search for the decays of stopped long-lived particles at ps = 13 TeV with the ATLAS detector, JHEP 07 (2021) 173
- E.Khramov et al., Search for high-mass Wy and Zy resonances using hadronic W/Z boson decays from 139 fb-1 of pp collisions at  $s\sqrt{=}13$  TeV with the ATLAS detector, JHEP07(2023)125
- S.Karpov, Z.Karpova, Search for quantum black hole production in lepton+jet final states using proton-proton collisions at s√ = 13 TeV with the ATLAS detector, Phys. Rev. D. 109 (2024) 032010

# **B-physics and light states**

- L.Gladilin et al., Search for a Structure in the B0sπ± Invariant Mass Spectrum with the ATLAS Experiment, Phys. Rev. Lett. 120 (2018) 202007
- S. Turchikhin et al, Angular analysis of Bd0→K\*→ll prod. x-sectionsµ+µ− decays in pp collisions at √s = 8 TeV with the ATLAS detector, JHEP 10 (2018) 047
- I.Yeletskikh, L.Gladilin et al., Search for exotic states in ATLAS: pentaquarks , PoS(Beauty2019)01
- I.Yeletskikh et al., Observation of an excess of di-charmonium events in the four-muon final state with the ATLAS detector, Phys. Rev. Lett. 131 (2023) 151902
- L.Gladilin, T.Lyubushkina, S.Turchikhin et al., Study of B+c→J/ψD+s and B+c→J/ψD\*+s decays in pp collisions at s√=13 TeV with the ATLAS detector, JHEP 08 (2022) 087

# **Detector performance and simulation**

- I. Boyko, G. Chelkov, E. Cherepanova, A. Gongadze, D. Kharchenko, U. Kruchonak, A. Lapkin, D. Rastorguev, V. Rozhkov, P. Smolyanskiy et al., Measurement of the radiation environment of the ATLAS cavern in 2017–2018 with ATLAS-GaAsPix detectors
- S.Turchikhin et al., ATLAS data quality operations and performance for 2015-2018 data-taking, JINST 15 (2020) P04003
- I.Yeletskikh et al., AtlFast3: the next generation of fast simulation in ATLAS, Computing and Software for Big Science, volume 6, Article number: 7 (2022)
- V.Lyubushkin et al., The ATLAS Trigger System for LHC Run 3 and Trigger performance in 2022, JINST 19 (2024) P06029
- E.Soldatov et al., Electron and photon efficiencies in LHC Run 2 with the ATLAS experiment, JHEP 05 (2024) 162
- S. Bondarenko, Y. Dydyshka, L. Kalinovskaya, R. Sadykov, V. Yermolchyk, Hadron-hadron collision mode in ReneSANCe-v1.3.0, Comput.Phys.Commun. 285 (2023) 108646, arXiv:2207.04332
- S. Bondarenko, Ya. Dydyshka, L. Kalinovskaya, A. Kampf, R. Sadykov, V. Yermolchyk, Polarized charged-current Drell-Yan process in ReneSANCe generator, arXiv:2411.11120
- I.Alexandrov et al., Deployment and Operation of the ATLAS EventIndex for LHC Run 3, EPJ Web of Conferences 295, 01018 (2024)
- E.Alexandrov et al., Towards a new conditions data infrastructure in ATLAS, EPJ Web of Conferences 295, 01013 (2024)
- E. Alexandrov, A. Formica, M. Mineev, Evolution of the ATLAS CREST Conditions DB Project, Phys. Part. Nuclei, 55, 441-443

### **Measurement of Z-boson + b-jets differential cross-sections**

#### S.Turchikhin, G.Lykasov





Electroweak boson + heavy jets production as well as asymmetry in heavy meson production may be used to probe intrinsic heavy quarks.



Best modeling of Z+b and Z+c at 7 TeV and 8 TeV pp-collisions is achieved with Sherpa 5FS.

Sensitivity to intrinsic charm in proton is limited by parton shower and high order OCD corrrections. Current limit on IC contribution is  $\sim 2\%$ .

13 TeV data analysis may increase this sensitivity.

G.Lykasov, V.Bednyakov, G.Lykasov, 30 A.Prokhorov, M.Malyshev, S.Turchikhin

JINR group took active part in performance studies, in particular, in measurements of E/gamma reconstruction efficiencies, muon trigger efficiencies in Run 2 data.



### **SM measurements**



JINR team develops MC generators and radiation correction libraries: DIZET, MCSANC, ReneSANCe



# Measurement of vector boson production cross sections and their ratios using pp collisions at $\sqrt{s}$ = 13.6 TeV with the ATLAS detector

Theoretical predictions are calculated using ReneSANCe generator



A precise determination of the strong-coupling constant from the recoil of *Z* bosons with the ATLAS

#### experiment at $\sqrt{s} = 8$ TeV

Higher order effects on the cross-section normalization from QED initial-state radiation and from electroweak virtual corrections are considered at next-to-leading order are calculated using ReneSANCe 33

I.Yeletskikh, 23.06.2025

## JINR participation in ATLAS Phase-I upgrade (2013-2022)



MUON	LAr		TILE			
ATLAS COLLARORATION CERN-RB-2014-00 Addendum No. 11 to the Memorandum of Understanding for Collaboration in the Construction of the ATLAS Detector	ATLAS COLLABORATION CERN-RRB-20 Addendum No. 12 to the Memorandum of Understanding for Collaboration in the Construction of the ATLAS Detector	014403)	ATLAS COLLABORATION CERN-BRB-2014-052 Addendum No. 13 to the Memorandum of Understanding for Collaboration in the Construction of the ATLAS Detector			
Construction of the ATLAS New Small Wheel (NSW) Sub-Detector	Upgrade of the Liquid Argon Calorimeter Trigger electronics		Upgrade of the ATLAS Tile Calorimeter			
7783504 Page 1	1730.3014	Page 1	1703.3014 Page 1			
Muon Spectrometer - NSW project: - Infrastructure development - Production of large Micromegas quadruplets - NSW assembly and commissioning			<ul> <li>TILE scintillator calorimeter:</li> <li>Min.bias trigger modules</li> <li>Development of new electronics for the readout Demonstrator</li> </ul>			
Liquid Arg - Design of preshaper - Radiation - Simulation						

degradation

### Phase-I muon spectrometer upgrade (New Small Wheels)



## Tile calorimeter Phase-I upgrade



New rad.hard. scintillators (Kharkov, Ukraine): UPS-923A (425nm) and "Green" (530nm) at IBR-2M

Sample#	1	2	3	4	5	6
n-fluence, n/cm <sup>2</sup>	0	2.1x10 <sup>12</sup>	3x10 <sup>13</sup>	2.8x10 <sup>14</sup>	2.6x10 <sup>15</sup>	1.7x10 <sup>16</sup>





# JINR in ATLAS upgrade

- Commitments to ATLAS w.r.t. RPC panels production and delivery are completely fulfilled.
- JINR takes active part in the new HGTD (High Granularity Timing Detector) development and production:
  - The scheme of modules layout and peripheral electronics was suggested, number of identical components maximized
  - The outer ring is designed and modelled





15° section of outer ring, 3D printed from PEEK





# JINR in ATLAS upgrade

- JINR takes active part in the new HGTD (High Granularity Timing Detector) development and production:
  - Layout of the electrical and optical services inside the HGTD designed
  - Systems for temp., humidity and pressure monitoring designed
  - 3D model of services is developed and prototyped
  - Dedicated tool for half-disks assembly is prototyped
  - Cable routing is developed and prototyped



pigtails,

fanouts.

## **Participation in TDAQ online project**

- Resource Manager development and support
  - The Resource Manager is one of the core components of the **Data Acquisition system** of the ATLAS experiment at the LHC.
  - The Resource Manager marshals the right for applications to access resources which may exist in multiple but limited copies, in order to avoid conflicts due to program faults or operator errors.

### • P-BEAST Dashboard support

- This web application offers an interface to visualize any operational monitoring data published by the TDAQ system through configurable and customizable dashboards.
- An example of an operational dashboard is shown in Figure.



## Measurement of the hadronic shower shapes in ATLAS TileCal

- TestBeam data 2023 have been analized.
- Cuts for selection of beam hadrons/muons/electrons are developed
- Noise level in data is estimated and subtracted
- Transverse and longitudinal shower profiles are measured. Some discrepancies with Geant4 are observed
- Two JINR students completed ATLAS QT



# Plans

- Finalize energies above 50 GeV (need to produce MC)
- Understand remaining puzzles:

   Total energy deposition
  - dependence on  $\Delta Z$
  - □ Feature in MC: 10 GeV in a single PMT
- Prepare article
- Tune Geant4 interaction model for better description of transverse profile