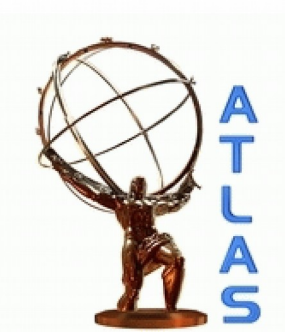
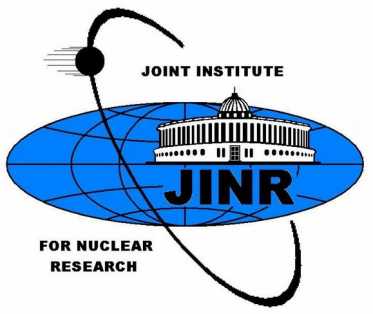




Physics research with ATLAS detector at the LHC Run-III (JINR participation)

1081 theme prolongation for 2020-2024

E. Khramov

19 June 2019

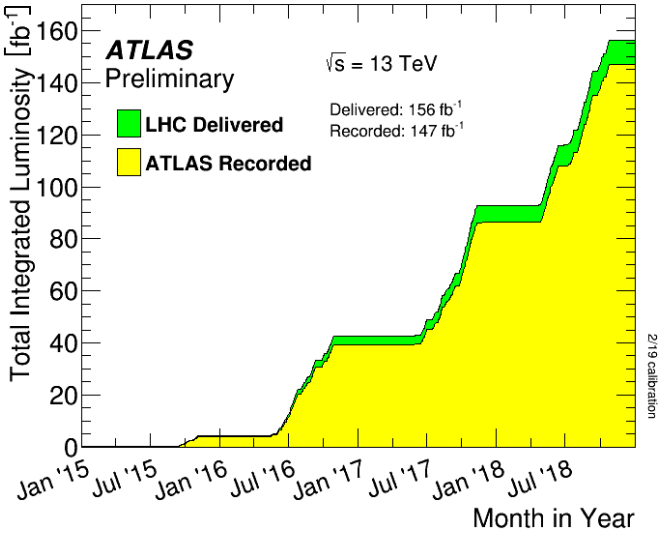
The ATLAS Collaboration

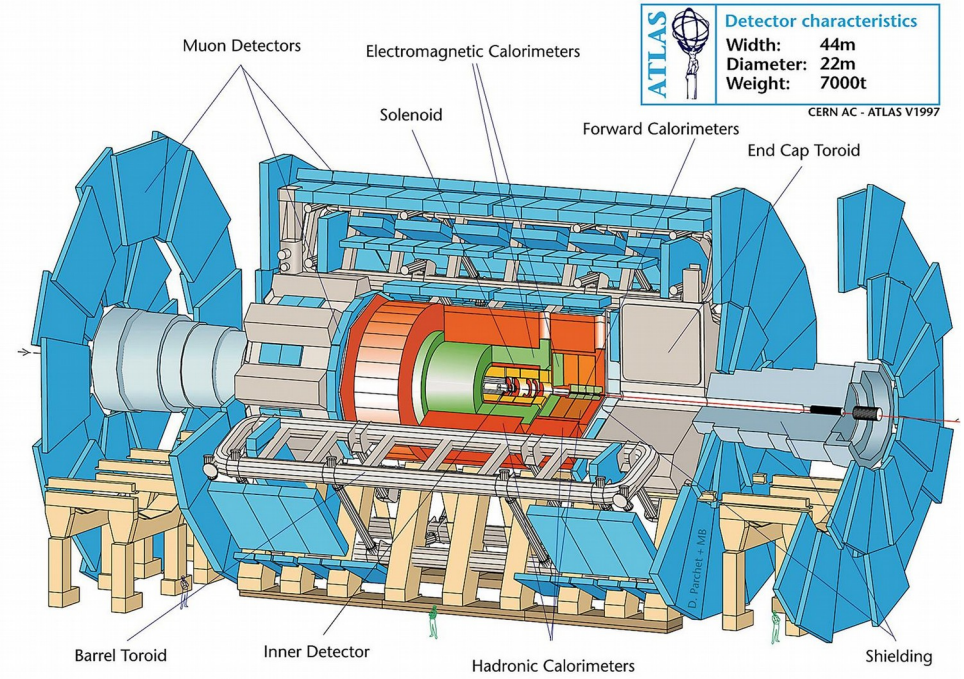
NUMBER OF INSTITUTES: 221

NUMBER OF AUTHORS: 1786

NUMBER OF PARTICIPANTS: 8128

NUMBER OF COUNTRIES: 41





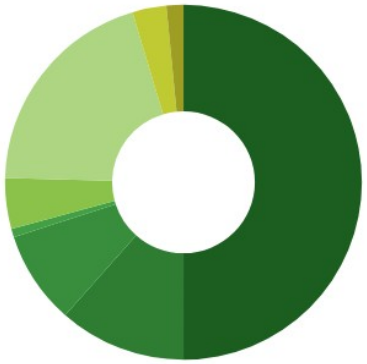
JINR-ATLAS team was deeply involved in designing, construction, tests and assembly of the major systems of ATLAS:

- Inner Detector
- Tile Calorimeter
- Liquid Argon Endcap Calorimeter
- Muon detector
- Common Items:
  - Magnet system
  - Warm Structure, etc.

JINR in the ATLAS Collaboration

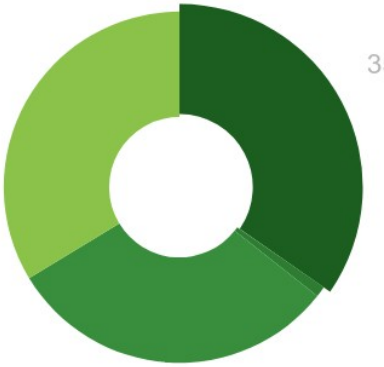
- Institutes Active Members - total: 130

- Professional Status



- **65** Physicist
- **15** Physics PhD student
- **11** Physics masters/diploma student
- **1** Undergraduate/summer student
- **6** Engineer with PhD
- **26** Engineer without PhD
- **0** Engineering student
- **4** Technician or equivalent
- **2** Administrator/other

- Lists



- **35** on Authorlist (A)
- **1** Signing-Only (a)
- **31** counted for M&O (M)
- **0** under qualification (q)
- **34** for Operation Tasks (O, o)

DLNP: Batusov V., Bednyakov V., Boyko I., Budagov Y., Chelkov G., Chizhov M., **Chubinidze Z.**, Dedovich D., Demichev M., Elkin V., Ershova A., Gladilin L., Glagolev V., Gongadze A., Gongadze L., Gostkin M., Huseinov N., Ivanov Y., Kalinovskaja L., Karpov S., Karpova Z., Kharchenko D., Khramov E., Kostyukhina I., Koval O., Kruchonak U., Kultchitsky Y., Lyabline M., Lykasov G., Lyubushkin V., Lyubushkina T., Malyukov S., Minashvili I., Minashvili I.(jr.), Nefedov Y., Plontikova E., Potrap I., Prokoshin F., Rusakovich N., Sadykov R., Sapronov A., Shiyakova M., Tsiareshka P., Turchikhin S., Yeletskikh I., Zhemchugov A., Shalyugin A., Stepenenka Y., Usov Y., Usubov Z., **Vasyukov A.**

LIT: Alexandrov E., Aleksandrov I., Gromova N., Iakovlev A., Kazymov A., Mineev M., Oleinik D., Petrosyan A., Shigaev V., Zrelov P.

VBLHEP: Ahmadov F., Cheplakov A., Javadov N., Kukhtin V., Ladygin E., **Manashova M.**, Soloshenko A., Zimin N., Fillipov Y., Shaykhatdenov B., Turtuvshin T.

JINR in the ATLAS Human resources

A total number of personnel in the JINR group participating in the ATLAS Physics program is 32**+3** including 6 professors, 12 postdocs and 14**+3** young scientists, students and engineers. The whole Team provides 29 FTE.

Besides the participation in the analysis itself members of the ATLAS-JINR Team are also playing managerial roles in the Collaboration. In the recent period we were taking responsibilities of conveners and sub-conveners of the ATLAS Working Groups (WG) as well as technical contacts persons with others Working Groups, such as Standard Model WG, B-Physcs sub-group, Trigger Performance etc.

Major part of them is engaged in the project for many years. They have well recognized reputation within the Collaboration and beyond, solid background and necessary skills to fulfill all our obligations.

DLNP: Batusov V., Bednyakov V., Boyko I., Budagov Y., Chelkov G., Chizhov M., **Chubinidze Z.**, Dedovich D., Demichev M., Elkin V., Ershova A., Gladilin L., Glagolev V., Gongadze A., Gongadze L., Gostkin M., Huseinov N., Ivanov Y., Kalinovskaja L., Karpov S., Karpova Z., Kharchenko D., Khramov E., Kostyukhina I., Koval O., Kruchonak U., Kultchitsky Y., Lyabline M., Lykasov G., Lyubushkin V., Lyubushkina T., Malyukov S., Minashvili I., Minashvili I.(jr.), Nefedov Y., Plontikova E., Potrap I., Prokoshin F., Rusakovich N., Sadykov R., Sapronov A., Shiyakova M., Tsiareshka P., Turchikhin S., Yeletskikh I., Zhemchugov A., Shalyugin A., Stepenenka Y., Usov Y., Usubov Z., **Vasyukov A.**

LIT: Alexandrov E., Aleksandrov I., Gromova N., Iakovlev A., Kazymov A., Mineev M., Oleinik D., Petrosyan A., Shigaev V., Zrelov P.

VBLHEP: Ahmadov F., Cheplakov A., Javadov N., Kukhtin V., Ladygin E., **Manashova M.**, Soloshenko A., Zimin N., Fillipov Y., Shaykhatdenov B., Turtuvshin T.

JINR in the ATLAS M&O

During the 2015-2018 period JINR has successfully secured all requested OTs of Class 1 and 2 providing:

1. 1.47 FTEs with 1.39 FTEs requested in 2015
2. 1.38 FTEs with 1.38 FTEs requested in 2016
3. 1.23 FTEs with 1.18 FTEs requested in 2017
4. 1.37 FTEs with 1.20 FTEs requested in 2018
5. 0.48 FTEs requested in 2019

The main task is participation in the ATLAS SLIMOS/TI - Safety shifter and we would like to continue to cover this kind of shifts in that way.

At the beginning of the 2015-2018 period the Class 3 shifts were covered at the level of ~30%.

1. 3.81 FTEs with 9.86 FTEs requested in 2015
2. 4.14 FTEs with 9.43 FTEs requested in 2016
3. 4.36 FTEs with 8.83 FTEs requested in 2017
4. 4.62 FTEs with 8.87 FTEs requested in 2018
5. 8.05 FTEs requested in 2019

This coverage was mainly due to “Grid Data Processing & Analysis” and “DAQ/HLT Control & Configuration” and authorship qualification tasks. There are several minor tasks usually provided by JINR Team members in the detector sub-systems

JINR in the ATLAS M&O

Experience over the past years has shown that there is a shortage of person power in the so-called operation and service areas. It was decided to implement so-called Institutional Commitments: when ATLAS institutions commit to carry out certain tasks on a long-term basis and to provide service or certain deliverables to detector operation or to the other activity areas (Trigger, Data Preparation, Computing & Software, and Physics).

The ATLAS-JINR Team management introduced special requirements to secure Class-3 shifts quota:

1. Each postdoc and young scientist of our physics analysis team should take responsibility for at least 0.25 FTEs. It was done by participation in the TileCal software development, B-physics trigger efficiency calculation, optimization and its software maintenance.

2. In 2018 on the base of JINR the team for the “Event Indexing” task. Initially there were four participants working partially and they provided ~1.5 FTEs, and since 2019 one more participant with 1 FTE has joined this team.

3. This year the team of four participants has got ATLAS software development grant and we expect that they will participate at the level of ~2 FTEs.

4. By suggestion of prof. Karl Jakobs during his visit to JINR in May 2018 we started to participate in the FastCaloSim project with 2 postdocs of ~0.5 FTE

JINR in the ATLAS Physics 2015-2019

1. Study of the applicability of the Standard Model and verification of SM predictions (including interactions of heavy ions), defining the structure of the proton at ultra-high energies (PDFs), tuning and improvement of relevant computer codes and events generators etc.

- 1 prof., 2 postdocs (2.5 FTE), 4 journal publications, 2 conf. notes

2. Search for (and study the characteristics of) additional exotic (including chiral Z*, W*) bosons in Drell-Yan and two-jet processes.

- 1 prof., 1 postdoc (1 FTE), 4 journal publications, 5 conf. notes

3. Search for manifestations of Supersymmetry (or Beyond-SM physics) mainly in inclusive events with many (more that 4-6) hadron jets accompanied by an energetic lepton and large missing energy.

- 1 postdoc (1 FTE), 2 journal publications, 3 conf. notes

4. Search for (supersymmetric) charged Higgs bosons via their specific decay modes (3 leptons, etc).

- 1 postdoc, 1 master student (2 FTE), analysis is ongoing

JINR in the ATLAS Physics 2015-2019

5. Search for a valence-like nonperturbative component of heavy quarks in the proton (intrinsic heavy quarks) via specific final state topology in the pp-interactions

+

6. A new comprehensive study of the gluon structure of the proton, etc.

– 1 prof., 1 postdoc, 1 PhD student (2.5 FTE), 7 journal publications, 4 conf. notes

7. Search for new hadrons and baryons containing heavy c- and b-quarks, study the properties.

– 1 prof., 2 postdocs, 1 engineer (3.5 FTE), 4 journal publications, 7 conf. notes

It is important to stress, that almost all of the points (2,3,5,6,7) were proposed for ATLAS at JINR

During the 2015 – 2019 period of the current project it was published 29 papers and 36 other publications with significant participation of the JINR staff, more than 25 talks at 18 different conferences and meeting excluding working meeting within the Collaboration

Organization and participation in the Physics&Computing Russian Institutes meeting

Organization and participation in the “25th anniversary of JINR in ATLAS” on 24-29 April 2017

Observation of H→bb decays and VH production with the ATLAS detector

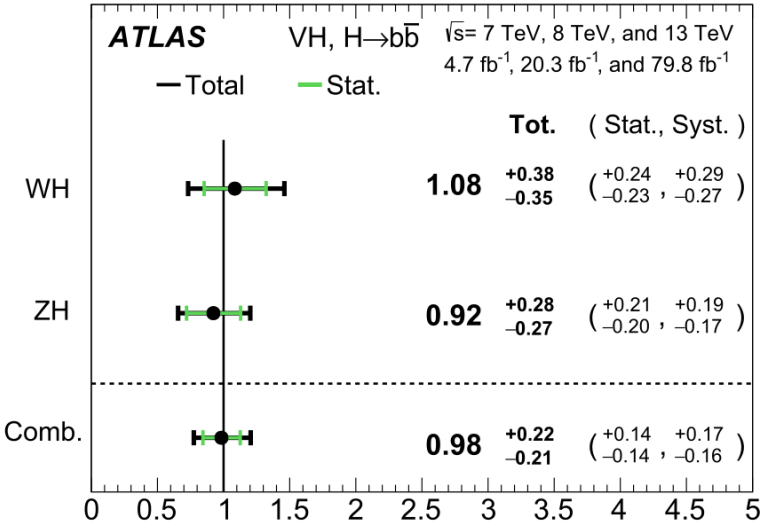
Phys. Lett. B 786 (2018) 59

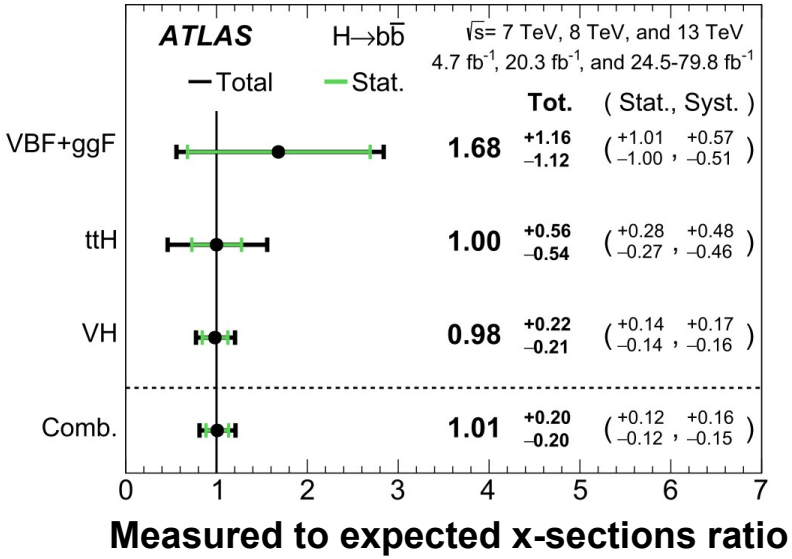
0-lepton channel to search for $ZH \to \nu\nu b\bar{b}$

1-lepton channel to search for $WH \to \ell\nu b\bar{b}$

2-lepton channel to search for $ZH \to \ell\ell b\bar{b}$

Higgs boson produced in association with a vector boson yields an observed significance of 5.3 standard deviations





JHEP01(2015)069

JHEP 12 (2017) 024

Phys. Lett. B 786 (2018) 59

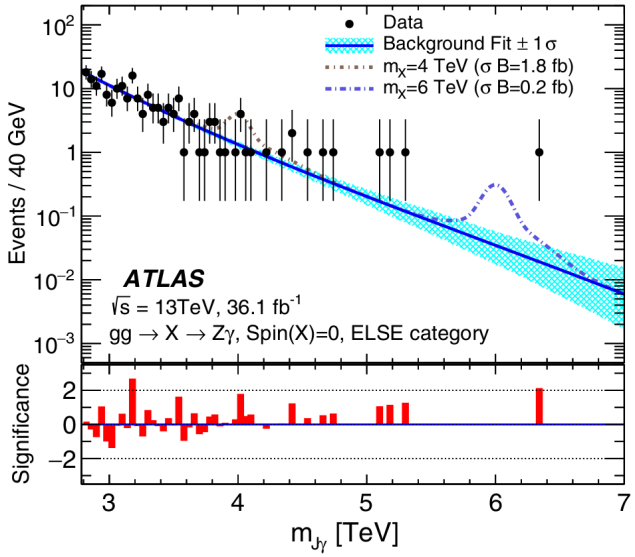
arXiv:1903.04618 (submitted to JHEP)

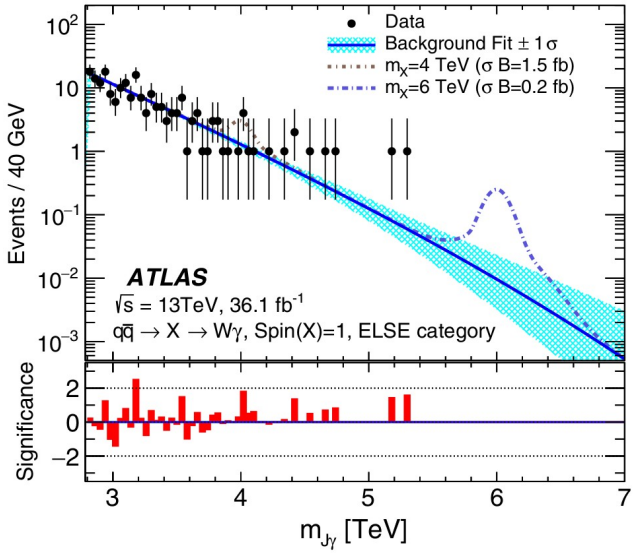
ATLAS-CONF-2017-041

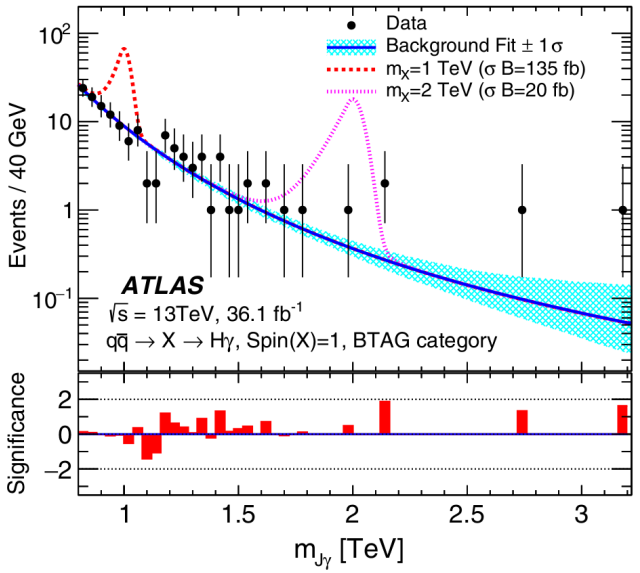
ATLAS-CONF-2018-036

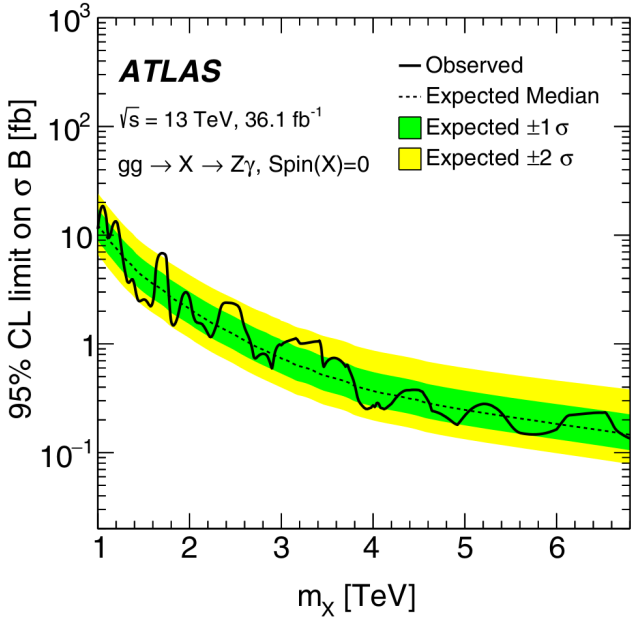
ATLAS-CONF-2018-053

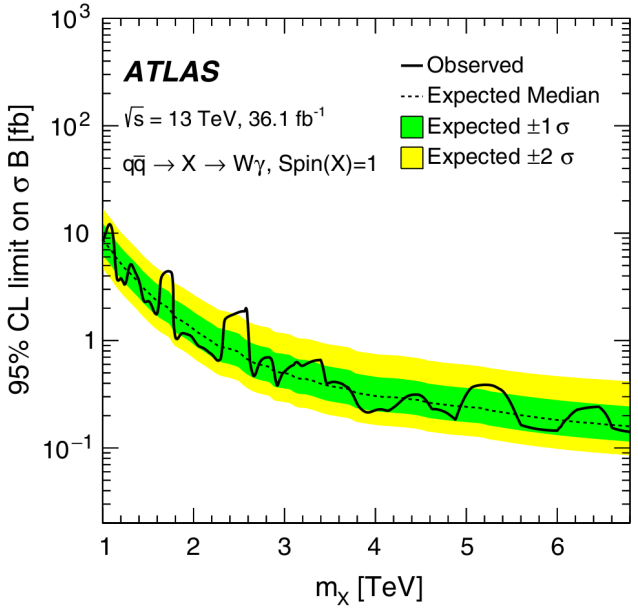
Search for heavy resonances decaying to a photon and a Z/W/H(→J) boson











Phys. Lett. B 764 (2017) 11

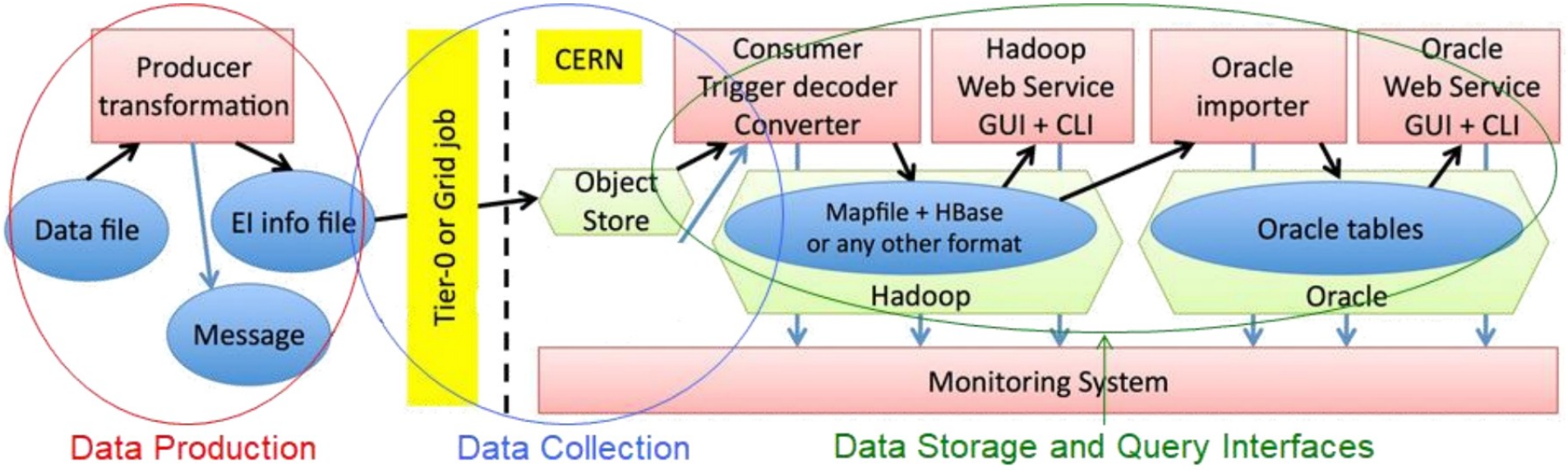
Phys. Rev. D 98 (2018) 032015

ATLAS-CONF-2016-010

The data are found to be consistent with the expected background in the entire mass range investigated and upper limits are set on the production cross section times decay branching ratio to W/Z/H + γ of a narrow scalar boson with mass between 1 TeV and 6.8 TeV

Events Indexing

EventIndex is a system to index the data or Monte Carlo events in the ATLAS experiment



Application:

- Event picking
- Event selection or counting based on trigger decisions
- Checking data consistency
- Producing trigger chain overlapping matrices
- Producing data stream overlapping matrices
- Quick assessment of datasets content

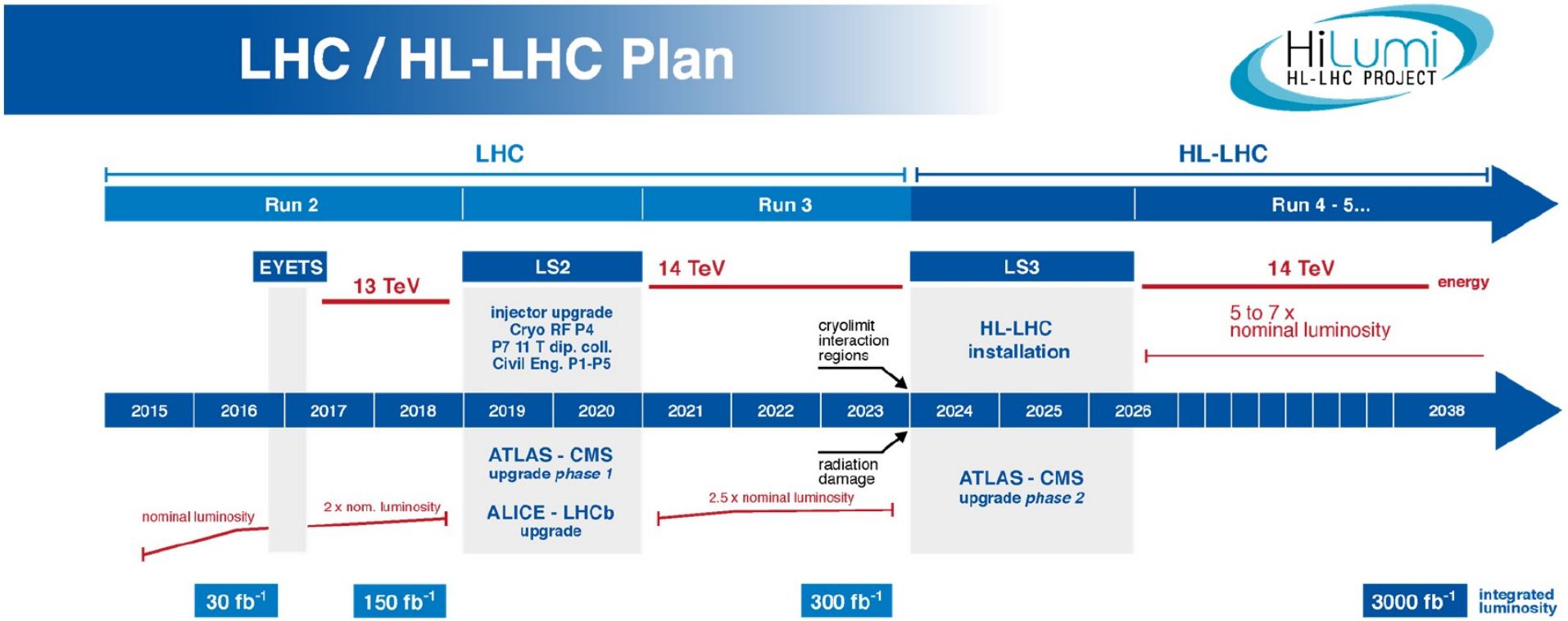
J.Phys.Conf.Ser. 898 (2017) no.3, 032016

J.Phys.Conf.Ser. 1085 (2018) no.3, 032052

Other JINR-ATLAS Team achievements

1. VH(→bb)
   - 1 postdoc, 1 master student (2 FTE), 3 journal publications, 3 conf. Notes
2. BSM → V/H(→J)+gamma
   - 1 postdoc, 2 journal publications
3. Quantum Black Holes
   - 2 postdocs (2 FTE)
4. SM precision measurements (W /Z + b-jet x-section)
   - 1 postdoc (1 FTE)
5. B_c excited states
   - 1 prof., 2 postdocs, 1 engineer (3.5 FTE)
6. Pentaquark
   - 1 prof., 1 postdoc, 1 master student (2 FTE)
7. ttH
   - 1 postdoc (0.8 FTE), 1 conf. note
8. tH
   - 2 postdocs, 1 engineer (1.2 FTE)
9. BEC
   - 1 prof., 2 engineers (3 FTE), 2 journal publications, 3 conf. notes

LHC and ATLAS upgrade programme



Expect after LS2: $\mathcal{L} = 2.2 \cdot 10^{34}\,\mathrm{cm}^{-2} \cdot \mathrm{s}^{-1}$, 25 ns bunch spacing, $\langle \mu \rangle = 60$

Phase-1 includes

- additional chambers in the forward muon spectrometer
- upgrade of the calorimeter trigger electronics
- new Level-1 trigger processors
- new Level-1 topological trigger processor
- fast track trigger (FTK)

Plans for 2020–2024 period

1) Study of the applicability of the Standard Model and verification of SM predictions (including interactions of heavy ions), defining the structure of the proton at ultra-high energies (PDFs), tuning and improvement of relevant computer codes and events generators etc.
2) Search for the chiral Z*/W* bosons in the two-jet decays and in more complex topology of their associative production including heavy b and t quarks.
3) Search for (supersymmetric) charged Higgs bosons via their specific decay modes (3-leptons, etc).
4) Analyses on associated productions of the SM Higgs with ttbar pair and search for production with single top.
5) Search for a valence-like nonperturbative component of heavy quarks in the proton (intrinsic heavy quarks) via specific final state topology in pp-interactions.
6) Search for new hadrons and baryons containing heavy c- and b-quarks, study of their properties.
7) Measurement of the Drell-Yan triple-differential cross section and effective leptonic weak mixing angle in Z-boson decay
8) A new comprehensive study of the gluon structure of the proton.
9) Search for quantum black holes in lepton+jet channel at 13 TeV.
10) VH(→bb)
11) BSM→V/H(→J)+gamma
12) BEC
13) Participation in the event triggers indexing infrastructure development.
14) Maintenance and development of the TDAQ system.
15) MT software development

Requested project budget

	Expenditure items	Full cost	1st year 2020	2nd year 2021	3rd year 2022	4th year 2023
	Direct expenses for the Project					
1.	**Computers Tb, kCPU-hours**	**1000, 1000**	**200, 200**	**200, 200**	**200, 200**	**200, 200**
2.	**Design bureau**	**1000 h**	**200 h**	**200 h**	**200 h**	**200 h**
3.	**Computer connection, GRID**	**50 k$**	**10 k$**	**10 k$**	**10 k$**	**10 k$**
4.	**ATLAS detector maintenance**	**1500 k$**	**300 k$**	**300 k$**	**300 k$**	**300 k$**
5.	**Payments for agreement-based research**	**250 k$**	**50 k$**	**50 k$**	**50 k$**	**50 k$**
6.	**Travel allowance, including:** **a) non-rouble zone countries** **b) rouble zone countries** **c) protocol-based**	**1150k$** **1000 k$** **150 k$**	**230 k$** **200 k$** **30k$**	**230 k$** **200 k$** **30k$**	**230 k$** **200 k$** **30k$**	**230 k$** **200 k$** **30k$**
	Total direct expenses	**2950 k$**	**590 k$**	**590 k$**	**590 k$**	**590 k$**

The first one is the “ATLAS detector maintenance” with 300 kUSD per year. This amount should cover JINR contribution to the Collaboration for our 34 active authors.

The second position “Working trips/Travel allowance” should cover Collaboration request for Operation Tasks of Class 1 and 2 that requires permanent presence of three shifters at CERN that is approximately 3*12*4kUSD = 144 kUSD per year. The rest ~86 kUSD of this position should cover travel expenses for coverage of the Operation Tasks of Class 3, for physics analyses purposes and for conferences.

Conclusion

- During Run-II we have successfully participated in the ATLAS Physics program
- We have realized enough attractive ideas in the ATLAS research program proposed by ATLAS at JINR
- ATLAS-JINR team participate in almost all ATLAS Physics WG
- We significantly participate in the Detector upgrade
- We contribute to detector maintenance: Class 1, 2, and 3 shifts and plan to increase participation
- We have clear program for Run-III
- We are going to strengthen our analysis activity
- We have contacts with Russian ATLAS community

We ask for prolongation of the "Physics research with ATLAS detector at the LHC Run-III (JINR participation)" project for the next five years 2020–2024

Backup slides

Replies to comments

D.I. Kazakov: "The other important issue is the involvement of new young members in the JINR group. My impression is that JINR ATLAS group should pay more attention to this problem, recruiting students and PhD students, arranging their education and involvement in research at early stages."

→ "Sure, we are working with Russian institutes and universities. Always reply to requests for manpower from the UC JINR. Currently we have ~50% of young participants."

A.V. Kulikov: "It is not clear from the text, how many JINR scientists are involved in physics analysis. For some reason it is indicated the number of persons participating in the ATLAS upgrade program, but the upgrade is not the subject of this very project and is not discussed here at all."

→ "It was a mistypo in the "Human Resources" chapter. Corrected to the ATLAS Physics program"

A.V. Kulikov: "For completeness, it would also be desirable to compare the physics program of the current project with the program of the CMS project in JINR, which is another general purpose detector at LHC: what are the differences (if any) or peculiarities."

→ "Agree, this would be very useful for complete understanding. But to keep the report of the readable size it was decided to leave this part aside"

Replies to comments

A. Ereditato: “No mention is given to student theses.”

→

I. Yeletskikh, “Search for new Z* boson in dimuon final state in the proton-proton collision data with the ATLAS detector”, PhD thesis

J. Smiesko, “Intrisic charm in proton”, PhD thesis tbd

K. Alishina, “Reconstruction of the $J/\psi \rightarrow \mu^+\mu^-$, $Z \rightarrow \mu^+\mu^-$ and $H \rightarrow 2\mu^+2\mu^-$ decays”, master thesis

T. Atovullaev, “Reconstruction of the top quark decays”, master thesis

M. Manashova, ”Spin effects in the associated production processes of the Higgs and W bosons”, bachelor thesis

A. Vasyukov, “Search and study of tetraquarks Zc(3900), Zc(4200) in B-mesons decays at the ATLAS experiment”, bachelor thesis

Replies to comments

A. Ereditato: “However, it would be probably better to concentrate the data analysis effort on fewer subjects where the JINR group could have a leadership role with a visible impact within the ATLAS collaboration. In this way, one could fully exploit the huge potential of a large and well-organized group such as JINR-ATLAS.”

→ JINR Team has/had leading positions in QBH, BEC, IC, SUSY in multijets, all B-physics analyses, new tH group, TDAQ dashboards

A. Ereditato: “Another item of concern is the lack of perspectives for the future involvement of students and young researchers and the increasing average age of the JINR contingent.”

→ Out of 32**+3** participants we have 14**+3** young scientists and engineers and 2 postdocs under 35 y.o. and 6 postdocs under 40 y.o. Average age is 44 y.o.

A. Ereditato: “Finally, it would be better to identify data analysis subjects for which the planned upgrade activities (muon system and calorimeters) play a crucial role, in order to design a comprehensive, coordinated and visible contribution of the two groups.”

→ Due to the large amount of work in Upgrade project, most of participants has 1 FTE. Within the Physics analysis group we recommend to choose the Class 3 shifts subject according to their analysis one.

Replies to comments

A. Ereditato: “The budget request is globally adequate, but one could afford a fine tuning. In particular, one should have more information about the relation between the requested 300k$ per year and the number of 34 active authors and the planned scheme for Class 3 tasks. In the same way, the referee would like to know how the funding profile is aligned with the periods within/without the LHC shutdown. Lastly, it would be desirable to have a clear picture of the specific duties/tasks of each of the team members, beyond the mere information on their FTE fraction.”

→ see JINR in the ATLAS M&O. Funding is organized according to the requests with ~1.5 months per person. For now we have managed to secure ~50% of OTPs and this year we expect ~80% coverage.

A. Ereditato: “The referee proposes to approve and grant funding for the first two years of the project and to unblock the second (third) part(s) only after a thorough and successful review of the first phase of the project (2020-2021).”

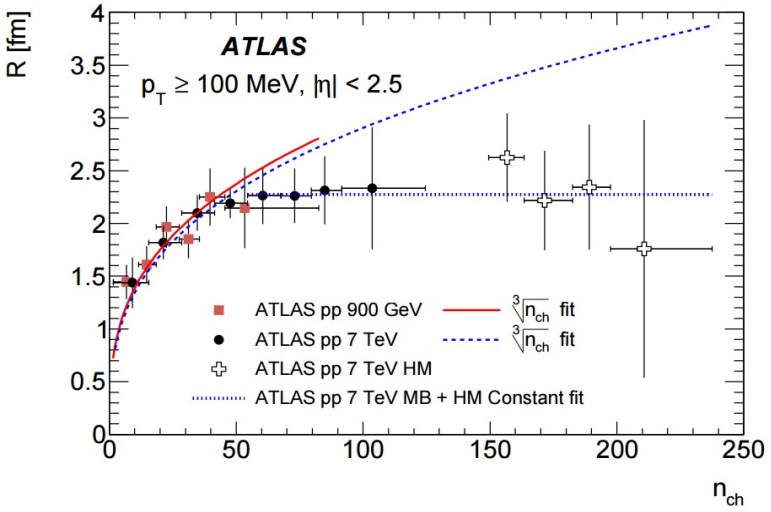
→ The ATLAS experiment is very big and it will not work without long-term commitments of the participating institutes including Dubna. It works not only for the upgrade of the detector and its maintenance, but also for the ATLAS physics program.

JINR in the ATLAS Physics 2015-2019

1. Study of the applicability of the Standard Model and verification of SM predictions (including interactions of heavy ions), defining the structure of the proton at ultra-high energies (PDFs), tuning and improvement of relevant computer codes and events generators etc.

Eur. Phys. J. C75 (2015) 466

BEC



A decrease of the correlation strength λ along with an increase of the correlation source size parameter R (effective radius parameter) are found with increasing charged-particle multiplicity

Phys. Lett. B 758 (2016) 67

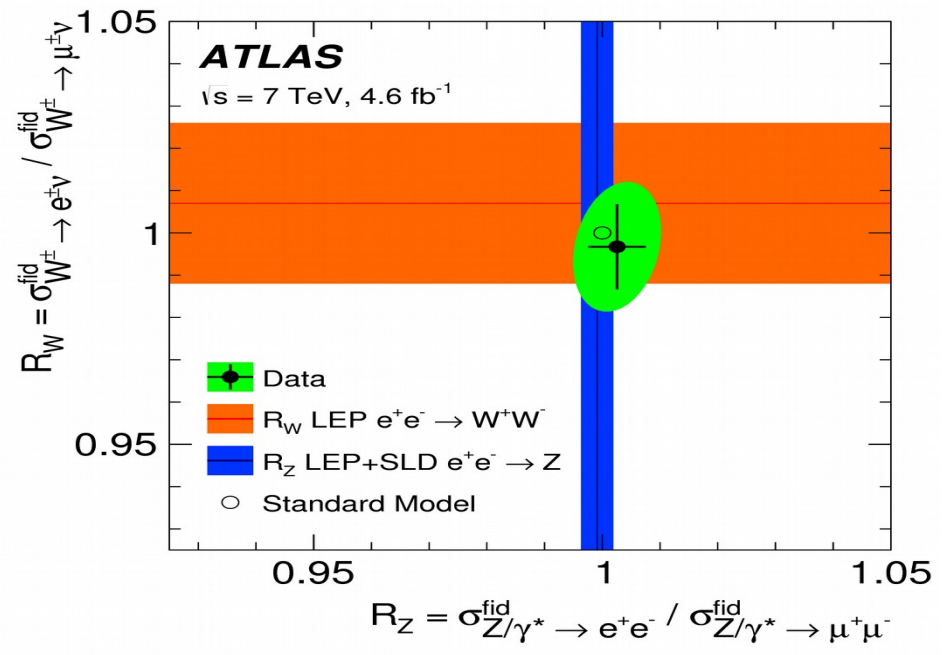
ATLAS-CONF-2015-028

EPJ Web Conf. 192 (2018) 00002

EPJ Web Conf. 120 (2016) 01001

Eur. Phys. J. C 77 (2017) 367

Incl. W→ℓν and Z/γ*→ℓℓ prod. x-sections



JHEP 12 (2017) 059

Eur.Phys.J. C77 (2017) no.5, 280

JETP Lett. 103 (2016) no.2, 131-136

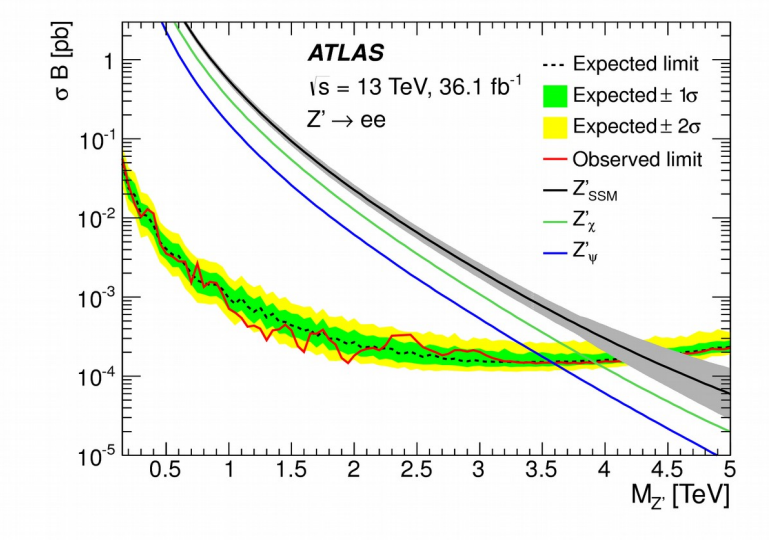
ATLAS-CONF-2018-037

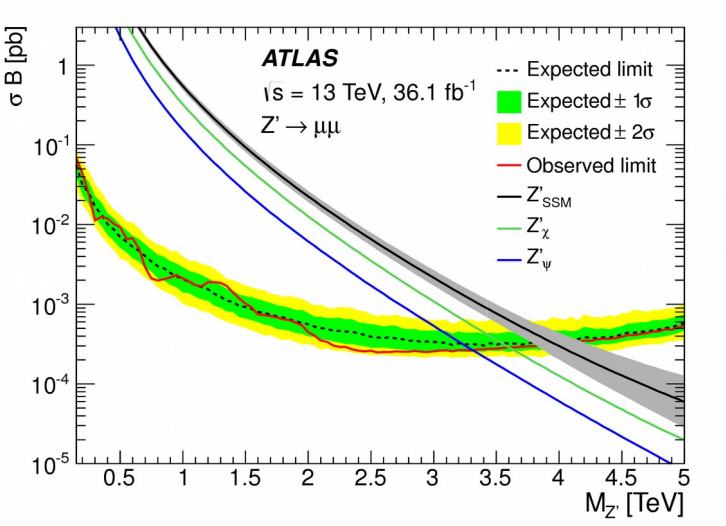
J.Phys.Conf.Ser. 762 (2016) no.1, 012062

JINR in the ATLAS Physics 2015-2019

2. Search for (and study the characteristics of) additional exotic (including chiral Z*, W*) bosons in Drell-Yan and two-jet processes.

JHEP 10 (2017) 182





No significant deviation from the Standard Model prediction is observed.

Upper limits at 95% credibility level are set on the cross-section times branching ratio for resonances decaying to dileptons, which are converted into lower limits on the resonance mass, ranging between 3.8 TeV and 4.5 TeV, depending on the model.

Phys. Lett. B 761 (2016) 372-392

Phys. Lett. B 762 (2016) 334

Eur. Phys. J. C 78 (2018) 401

ATLAS-CONF-2015-070

ATLAS-CONF-2016-045

ATLAS-CONF-2017-027

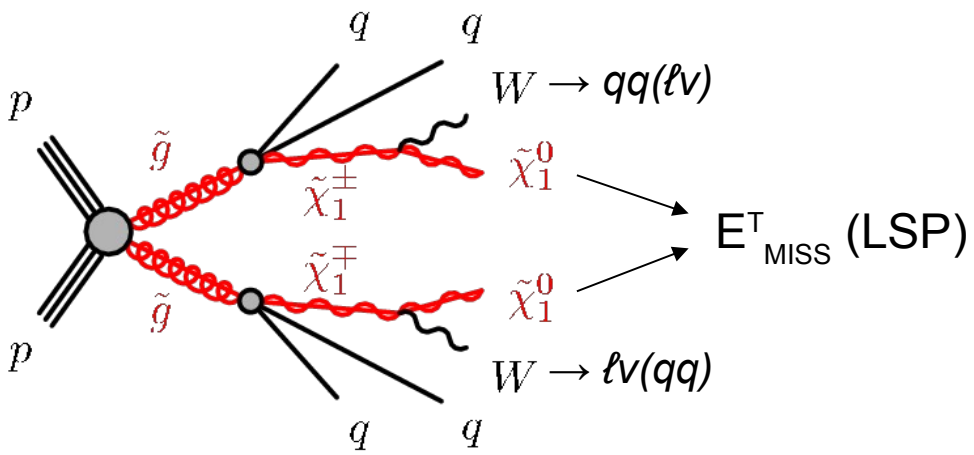
ATLAS-CONF-2015-063

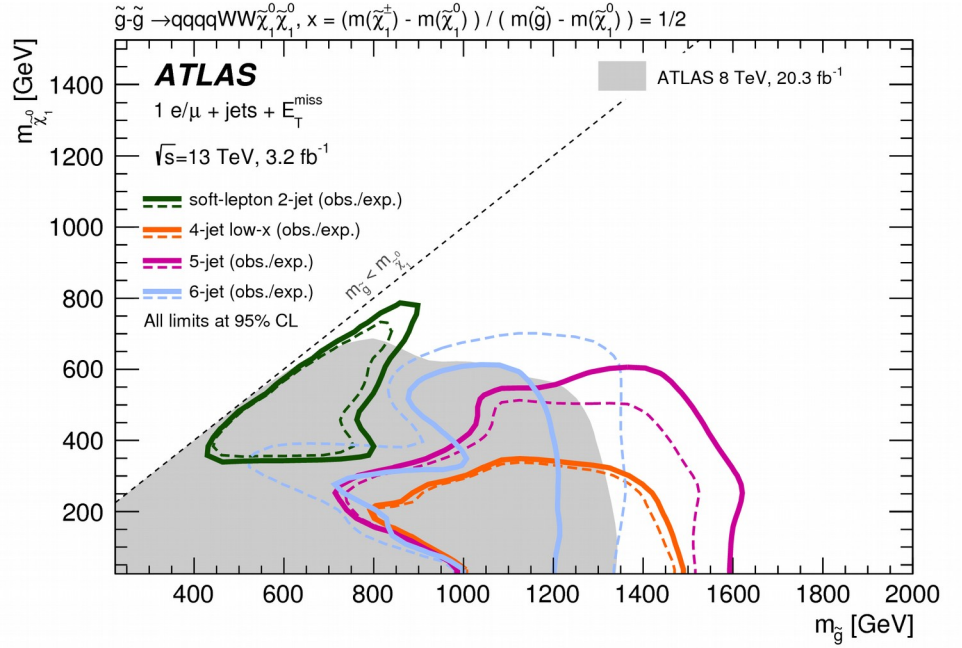
ATLAS-CONF-2017-016

JINR in the ATLAS Physics 2015-2019
Search for SUSY

3. Search for manifestations of Supersymmetry (or Beyond-SM physics) mainly in inclusive events with many (more that 4-6) hadron jets accompanied by an energetic lepton and large missing energy.

Phys. J. C (2016) 76: 565





JHEP 10 (2015) 054

ATLAS-CONF-2015-076

ATLAS-CONF-2016-010

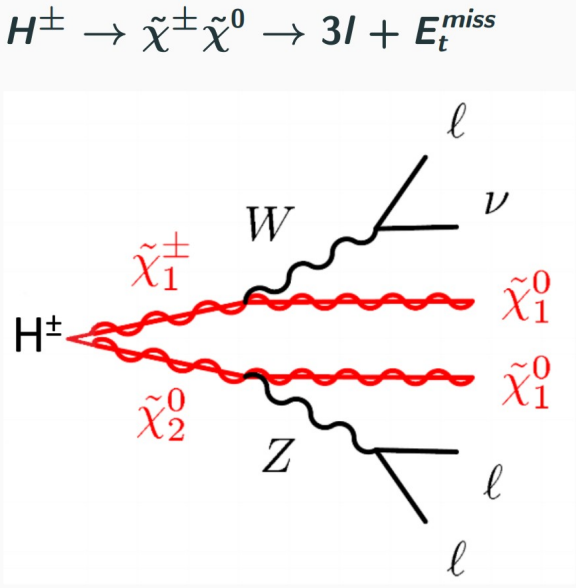
ATLAS-CONF-2016-054

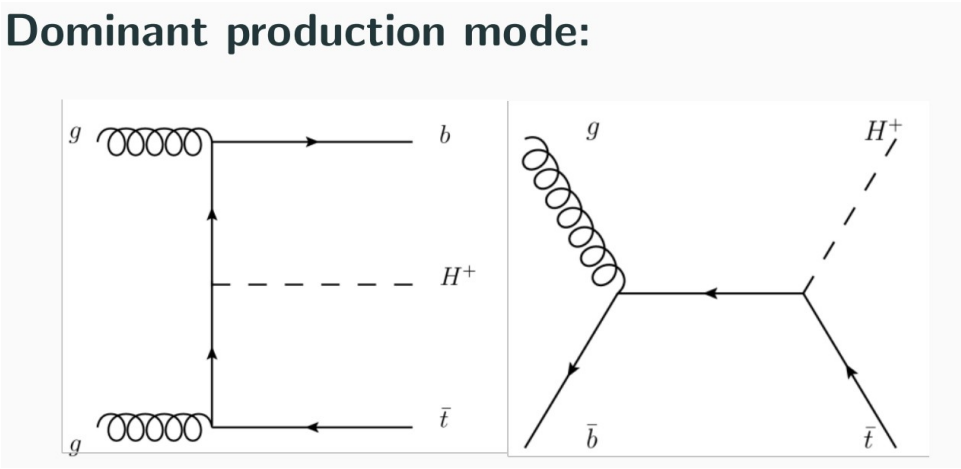
ATL-PHYS-PUB-2015-029

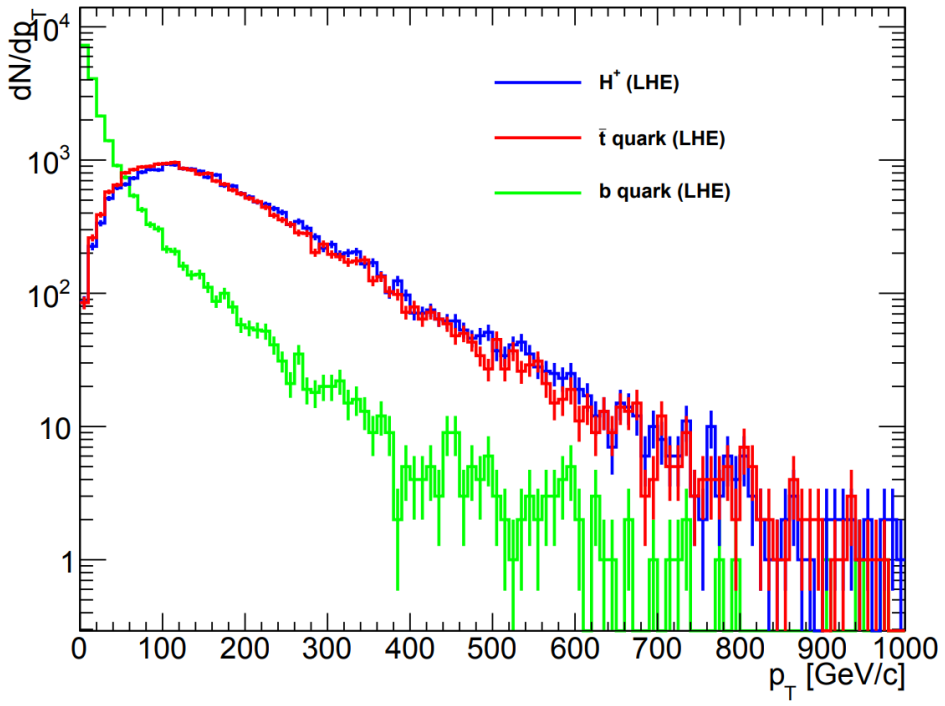
Six signal selections are defined that best exploit the signal characteristics.
The data agree with the SM background expectation in all six signal selections, and the largest deviation is a 2.1 sigma.
The results are interpreted in a simplified model where pair-produced gluinos decay via the lightest chargino to the lightest neutralino. In this model, gluinos are excluded up to masses of approximately 1.6 TeV depending on the mass spectrum of the simplified model.

JINR in the ATLAS Physics 2015-2019

4. Search for (supersymmetric) charged Higgs bosons (2HDM) via their specific decay modes (3 leptons, etc).







Late start of this task due to the qualification works

Long discussions with theoreticians

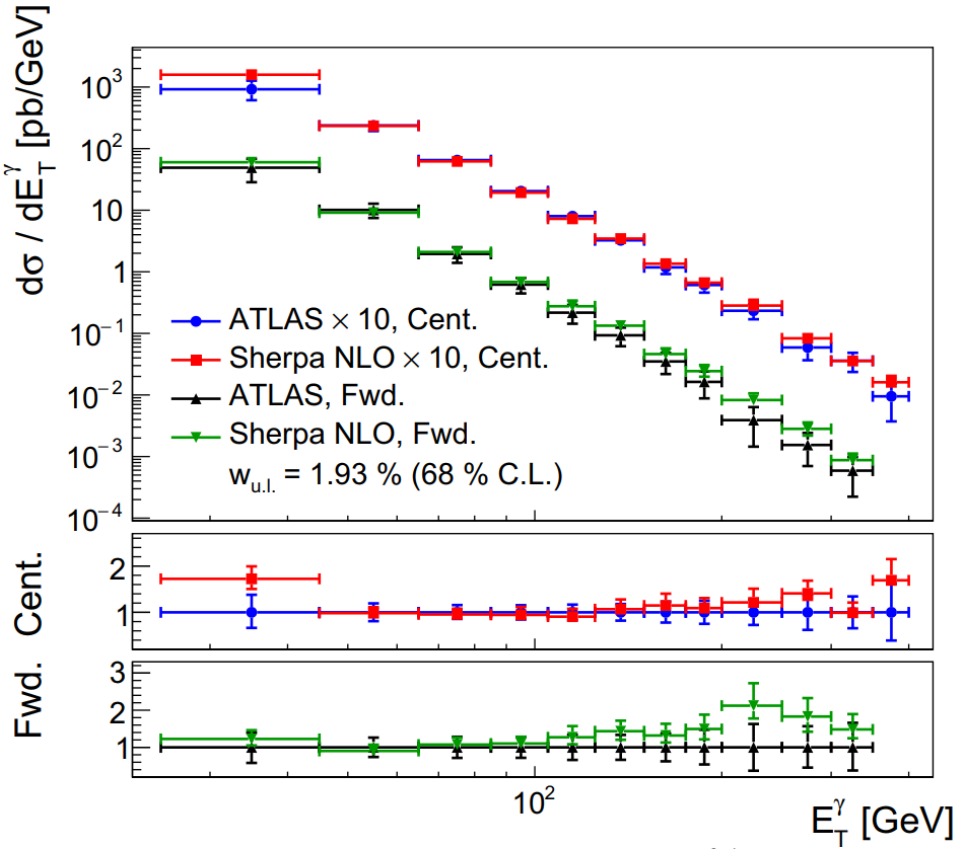
Model is implemented in MadGraph5

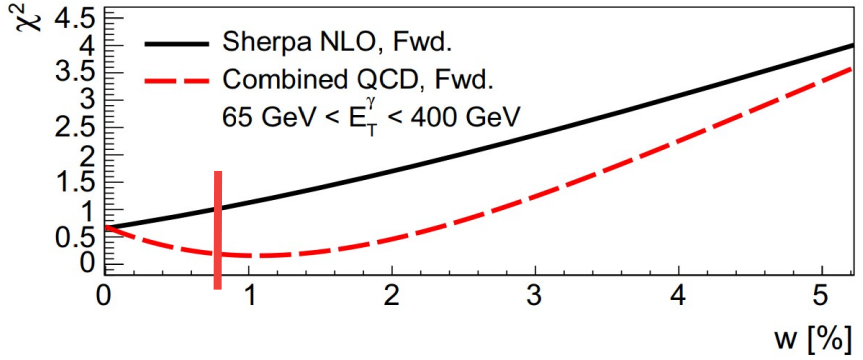
JINR in the ATLAS Physics 2015-2019

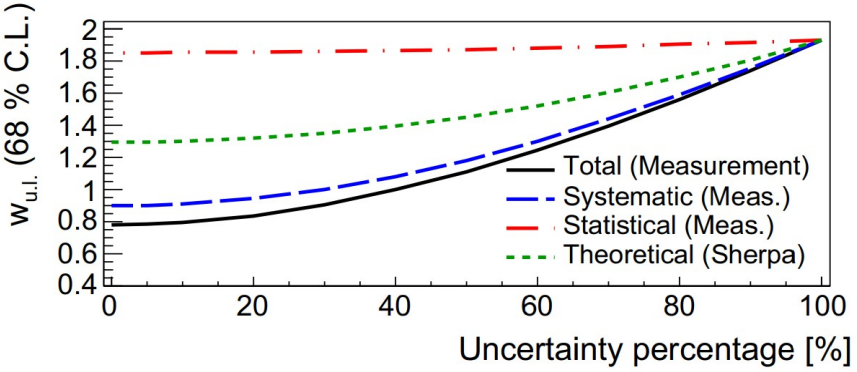
5. Search for a valence-like nonperturbative component of heavy quarks in the proton (intrinsic heavy quarks) via specific final state topology in the pp-interactions.

Eur.Phys.J. C79 (2019) no.2, 92,

γ + c-jet production







Phys.Rev. D97 (2018) no.11, 114019

Prog.Part.Nucl.Phys. 93 (2017) 108

Phys.Rev. D94 (2016) no.5, 053011

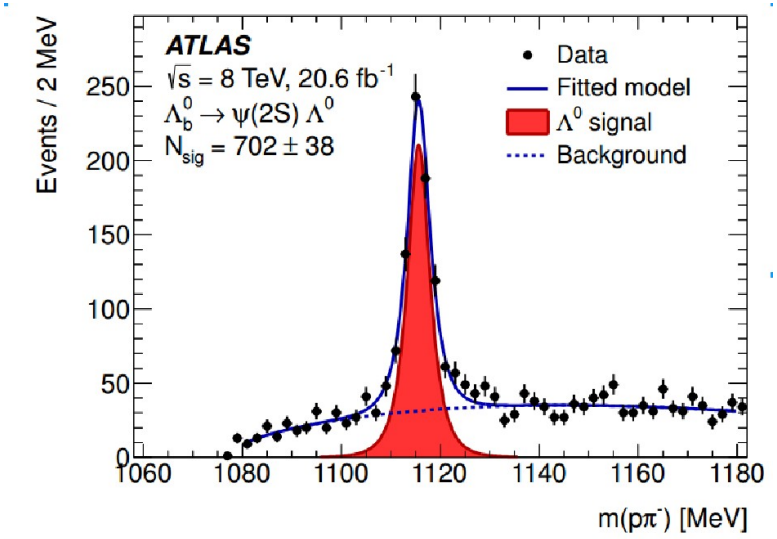
PoS DIS2017 (2018) 033

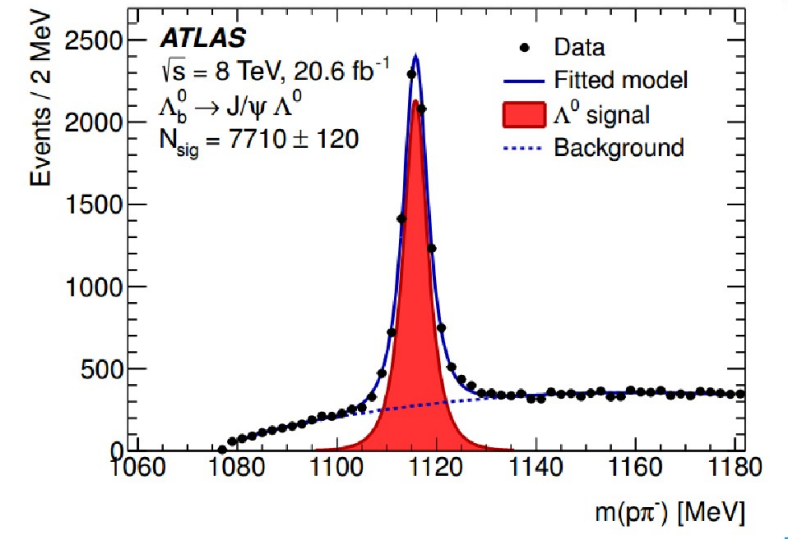
DESY-PROC-2016-04

JINR in the ATLAS Physics 2015-2019

6. Search for new hadrons and baryons containing heavy c- and b-quarks, study the properties.

Physics Letters B 751 (2015) 63-80





$$\frac{\Gamma(\Lambda_b^0 \to \psi(2S)\Lambda^0)}{\Gamma(\Lambda_b^0 \to J/\psi\,\Lambda^0)} = 0.501 \pm 0.033(\text{stat}) \pm 0.016(\text{syst}) \pm 0.011(\mathcal{B})$$

The only available theoretical expectation for the branching ratio of the two Λ^0_b decays (0.8 ± 0.1) exceeds the measured value.

Eur. Phys. J. C 76 (2016) 513

JHEP 10 (2018) 047

Eur. Phys. J. C, 76(1), 1-24 (2016)

ATLAS-CONF-2017-023

CONF-BPHY-2018-06

EPJ Web Conf. 202 (2019) 05001

PoS BEAUTY2018 (2018) 048

EPJ Web Conf. 158 (2017) 02001

Phys.Part.Nucl. 48 (2017) no.5, 801-803

PoS BEAUTY2016 (2016) 009

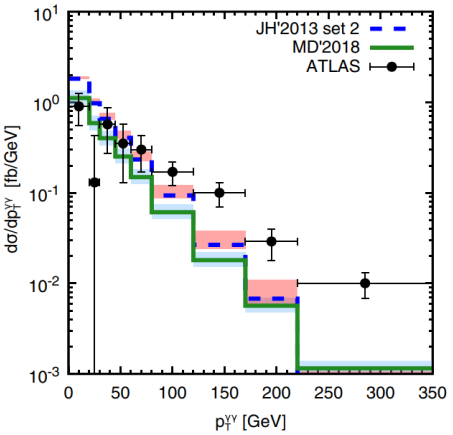
JINR in the ATLAS Physics 2015-2019

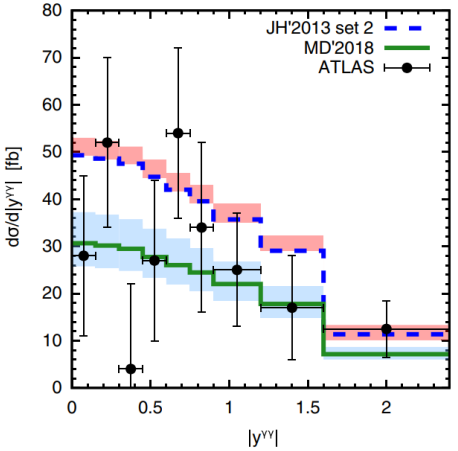
7. A new comprehensive study of the gluon structure of the proton, etc.

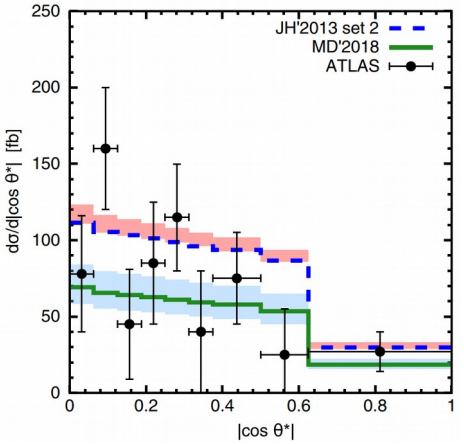
The Catani-Ciafaloni-Fiorani-Marchesini evolution equation to extend the obtained transverse momentum dependent (TMD) gluon density to the whole kinematical region is applied

Phys.Rev. D98 (2018) no.5, 054010

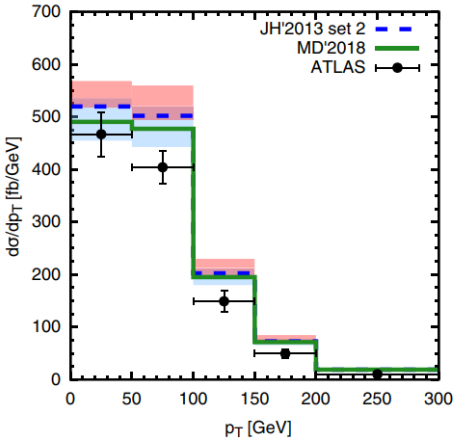
Incl. t-channel H→γγ prod. at √s = 8 TeV

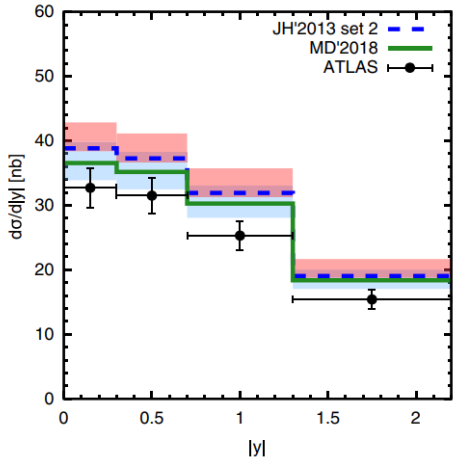






Incl. t-channel single top prod. at √s = 8 TeV





Eur.Phys.J. A54 (2018) no.11, 187

Phys.Rev. D93 (2016) no.1, 014035

PoS DIS2016 (2016) 038

Int.J.Mod.Phys.Conf.Ser. 39 (2015) 1560115

List of publications

In this section the complete list of publications with significant contrubution of the ATLAS-JINR Team members is presented for the period of 2015 – 2019.

Journal publications

1. A. Sapronov et al, Precision measurement and QCD analysis of inclusive $W \to \ell\nu$ and $Z/\gamma^* \to \ell\ell$ production cross sections with the ATLAS detector, Eur. Phys. J. C 77 (2017) 367
2. A. Sapronov et al, Measurement of the Drell-Yan triple-differential cross section in pp collisions at $\sqrt{s}$ = 8 TeV, JHEP 12 (2017) 059
3. A. Sapronov et al, Precision studies of observables in $pp \to W \to l\nu l pp \to W \to l\nu l$ and $pp \to \gamma, Z \to l^+l^- pp \to \gamma, Z \to l^+l^-$ processes at the LHC, Eur.Phys.J. C77 (2017) no.5, 280
4. A. Arbuzov et al, Update of the MCSANC Monte Carlo integrator, v. 1.20, JETP Lett. 103 (2016) no.2, 131-136
5. G.I. Lykasov et al, Employing RHIC and LHC data to determine the transverse momentum dependent gluon density in a proton, Phys.Rev. D98 (2018) no.5, 054010
6. A.V. Lipatov et al, Hard production of a Z boson plus heavy flavor jets at LHC and the intrinsic charm content of a proton, Phys.Rev. D97 (2018) no.11, 114019
7. G.I. Lykasov, Self-consistent analysis of hadron production in pp and AA collisions at mid-rapidity, Eur.Phys.J. A54 (2018) no.11, 187
8. V. Bednyakov et al, Constraints on the intrinsic charm content of the proton from recent ATLAS data, Eur.Phys.J. C79 (2019) no.2, 92,
9. S.J. Brodsky et al, The Physics of Heavy Quark Distributions in Hadrons: Collider Tests, Prog.Part.Nucl.Phys. 93 (2017) 108
10. A.V. Lipatov et al,Probing proton intrinsic charm in photon or Z boson production accompanied by heavy jets at the LHC, Phys.Rev. D94 (2016) no.5, 053011
11. A.A. Grinyuk et al, Significance of nonperturbative input to the transverse momentum dependent gluon density for hard processes at the LHC, Phys.Rev. D93 (2016) no.1, 014035
12. S. Turchikhin et al, Study of the rare decays of B^0_s and B^0 into muon pairs from data collected during the LHC Run 1 with the ATLAS detector, Eur. Phys. J. C 76 (2016) 513
13. S. Turchikhin et al, Angular analysis of $B_d^0 \to K^* \mu^+ \mu^-$ decays in pp collisions at $\sqrt{s}$ = 8 TeV with the ATLAS detector, JHEP 10 (2018) 047

14. S. Turchikhin et al, Study of the B+c→J/ψD+s and B+c→J/ψD⋆+s decays with the ATLAS detector, Eur. Phys. J. C, 76(1), 1-24 (2016)
15. V. Lyubushkin et al, Measurement of the branching ratio Γ(Λ0b→ψ(2S)Λ0)/Γ(Λ0b→J/ψΛ0) with the ATLAS detector, Physics Letters B 751 (2015) 63-80
16. Yu. Kulchitsky et al, Two-particle Bose--Einstein correlations in pp collisions at √s= 0.9 and 7 TeV measured with the ATLAS detector, Eur. Phys. J. C75 (2015) 466
17. Yu. Kulchitsky et al, Charged-particle distributions in √s=13 TeV pp interactions measured with the ATLAS detector at the LHC, Phys. Lett. B 758 (2016) 67
18. I. Yeletskikh et al, Search for high-mass new phenomena in the dilepton final state using proton--proton collisions at √s = 13 TeV with the ATLAS detector, Phys. Lett. B 761 (2016) 372-392
19. I. Yeletskikh et al, Search for new high-mass phenomena in the dilepton final state using 36 fb−1 of proton-proton collision data at √s = 13 TeV with the ATLAS detector, JHEP 10 (2017) 182
20. M. Chizhov et al, Search for new resonances in events with one lepton and missing transverse momentum in pp collisions at √s = 13 TeV with the ATLAS detector, Phys. Lett. B 762 (2016) 334
21. M. Chizhov et al, Search for a new heavy gauge-boson resonance decaying into a lepton and missing transverse momentum in 36 fb-1 of pp collisions at √s = 13 TeV with the ATLAS experiment, Eur. Phys. J. C 78 (2018) 401
22. E. Khramov et al, Summary of the searches for squarks and gluinos using √s = 8 TeV pp collisions with the ATLAS experiment at the LHC, JHEP 10 (2015) 054
23. E. Khramov et al, Search for gluinos in events with an isolated lepton, jets and missing transverse momentum at √s = 13 TeV with the ATLAS detector, Eur. Phys. J. C 76 (2016) 565
24. E. Khramov et al, Search for heavy resonances decaying to a Z boson and a photon in pp collisions at √s = 13 TeV with the ATLAS detector, Phys. Lett. B 764 (2017) 11
25. E. Khramov et al, Search for heavy resonances decaying to a photon and a hadronically decaying Z/W/H boson in pp collisions at √s = 13 TeV with the ATLAS detector, Phys. Rev. D 98 (2018) 032015
26. F. Ahmadov et al, Search for the bb decay of the Standard Model Higgs boson in associated (W/Z)H production with the ATLAS detector, JHEP01(2015)069
27. F. Ahmadov et al, Evidence for the H→bb decay with the ATLAS detector, JHEP 12 (2017) 024
28. F. Ahmadov et al, Observation of H→bb decays and VH production with the ATLAS detector, Phys. Lett. B 786 (2018) 59
29. F. Ahmadov et al, Measurement of VH, H→bb production as a function of the vector-boson transverse momentum in 13 TeV pp collisions with the ATLAS detector, arXiv:1903.04618 (submitted to JHEP)

Other publications:

1. A. Sapronov et al, Measurement of the effective leptonic weak mixing angle using electron and muon pairs from Z-boson decay in the ATLAS experiment at √s = 8 TeV, ATLAS-CONF-2018-037
2. A. Arbuzov et al, Computer system SANC: its development and applications, J.Phys.Conf.Ser. 762 (2016) no.1, 012062
3. G.I. Lykasov et al, Collider test of proton intrinsic charm in γ(Z)+c(b)γ(Z)+c(b) production by pp collisions, PoS DIS2017 (2018) 033
4. G.I. Lykasov et al, The physics of Heavy Quark Distributions in Hadrons: Collider Tests, DESY-PROC-2016-04
5. G.I. Lykasov et al, Significance of gluon density for soft and hard processes at LHC, PoS DIS2016 (2016) 038
6. G.I. Lykasov et al, Significance of gluon density at soft and hard processes at LHC, Int.J.Mod.Phys.Conf.Ser. 39 (2015) 1560115

10) S. Turchikhin et al, Angular analysis of the decay of Bd into K*μμ, ATLAS-CONF-2017-023
11. S. Turchikhin et al, Study of the Bc(2S)± and B∗c(2S)± mesons using B±c→J/ψμ±X decays with the ATLAS detector, CONF-BPHY-2018-06
12. S. Turchikhin, Charm physics at ATLAS, EPJ Web Conf. 202 (2019) 05001
13. S. Turchikhin, Beyond Standard Model searches in B decays with ATLAS, PoS BEAUTY2018 (2018) 048
14. S. Turchikhin, Searches for new physics with heavy flavour at ATLAS, EPJ Web Conf. 158 (2017) 02001
15. L.N. Smirnova and S.M. Turchikhin, Muon and B-physics trigger of the ATLAS experiment in Run 2, Phys.Part.Nucl. 48 (2017) no.5, 801-803, Fiz. Elem. Chast. Atom. Yadra 48 (2017) no.5, 710-713
16. S. Turchikhin, bb-hadron decays at ATLAS, PoS BEAUTY2016 (2016) 009
17. Yu. Kulchitsky et al, Charged-particle multiplicities in pp interactions at sqrt(s) = 13 TeV measured with the ATLAS detector at the LHC, ATLAS-CONF-2015-028
18. Yu. Kulchitsky, Probing QCD with the ATLAS Detector, EPJ Web Conf. 192 (2018) 00002
19. Yu. Kulchitsky, Bose-Einstein correlations and results on minimum bias interactions, underlying event and particle production from ATLAS, EPJ Web Conf. 120 (2016) 01001
20. N. Huseynov et al, Search for the associated production of a Higgs Boson with a top quark pair in multilepton final states with the ATLAS detector, ATLAS-CONF-2016-058
21. I. Yeletskikh et al, Search for resonant and non-resonant phenomena in the dilepton channel using proton-proton collisions at √s = 13 TeV with the ATLAS Detector, ATLAS-CONF-2015-070
22. I. Yeletskikh et al, Search for high-mass new phenomena in the dilepton final state using proton-proton collisions at √s = 13 TeV with the ATLAS detector at the LHC, ATLAS-CONF-2016-045
23. I. Yeletskikh et al, Search for high-mass new phenomena in the dilepton final state using proton-proton collisions at √s = 13 TeV with the ATLAS detector at the LHC, ATLAS-CONF-2017-027

24. M. Chizhov et al, Search for new physics in the charged lepton plus missing transverse energy final state using pp collisions at √s = 13 TeV, ATLAS-CONF-2015-063
25. M. Chizhov et al, Search for new particles in the charged lepton plus missing transverse energy final state using pp collisions at the ATLAS detector, ATLAS-CONF-2017-016
26. E. Khramov et al, Search for squarks and gluinos in events with an isolated leptons, jets and missing transverse momentum at √s = 13 TeV with the ATLAS detector, ATLAS-CONF-2015-076
27. E. Khramov et al, Search for heavy resonances decaying to a Z boson and a photon in pp collisions at √s = 13 TeV with the ATLAS detector, ATLAS-CONF-2016-010
28. E. Khramov et al, Search for gluinos and squarks in events with one isolated lepton, jets and missing transverse momentum at √s = 13 TeV with the ATLAS detector, ATLAS-CONF-2016-054
29. E. Khramov et al, Distribution of the transverse mass in events with an isolated electron or muon in proton-proton collisions at √s = 13 TeV, ATL-PHYS-PUB-2015-029
30. A. Soloshenko et al, Measurement of the tau lepton reconstruction and identification performance in the ATLAS experiment using pp collisions at √s = 13 TeV, ATLAS-CONF-2017-029
31. A. Soloshenko et al, Reconstruction, energy calibration and identification of hadronically decaying tau leptons in the ATLAS experiment for run 2 of the LHC, ATL-PHYS-PUB-2015-045
32. I. Aleksandrov et al, The Resource Manager the ATLAS Trigger and Data Acquisition System, J.Phys.Conf.Ser. 898 (2017) no.3, 032016
33. M. Mineev et al, Experience with SPLUNK for archiving and visualisation of operational data in ATLAS TDAQ system, J.Phys.Conf.Ser. 1085 (2018) no.3, 032052
34. F. Ahmadov et al, Evidence for the H→bb decay with the ATLAS detector, ATLAS-CONF-2017-041
35. F. Ahmadov et al, Observation of H→bb decays and VH production with the ATLAS detector, ATLAS-CONF-2018-036
36. F. Ahmadov et al, Measurements of VH, H→bb production as a function of the vector boson transverse momentum in 13 TeV pp collisions with the ATLAS detector, ATLAS-CONF-2018-053

List of conferences and talks

In this section the full list of conferences where members of the ATLAS-JINR Team took part (25 talks at 18 conferences):

1. EDS-2015
   • E. Plotnikova: Measurements of particle production and their correlations at the LHC with the ATLAS detector
2. ISMD-2015
   • Yu. Kulchitsky: Bose-Einstein correlations and results on minimum bias interactions, underlying event and particle production from ATLAS
3. LHCP-2015
   • A. Cheplakov: Research and Development for the ATLAS Forward Calorimetry at the HL-LHC
   • Z. Karpova: Search for quantum black holes using pp collisions at sqrt(s) = 8 TeV and expected sensitivity at sqrt(s) = 13 TeV with the ATLAS
   • A. Soloshenko: Identification and energy calibration of hadronically decaying tau leptons with the ATLAS experiment in {\bf pp} collisions at {\bf $\sqrt{s}$}=8 \TeV
   • S. Turchikhin: ATLAS HF spectroscopy and exotic states
4. CHEP-2016
   • E.Alexandrov: The Resource Manager of the ATLAS Trigger and Data Acquisition system
5. Beauty-2016
   • V. Lyubushkin: ATLAS Searches for new states (including pentaquarks)
   • S. Turchikhin: ATLAS Decay properties (Lambda_B, B_c)
6. GRID-2016
   D. Oleynik: Integration Of PanDA Workload Management System With Supercomputers for ATLAS
7. Lowx-2016
   Yu. Kulchitsky: Measurements of the underlying-event properties with the ATLAS detector
8. NewTrends-2016
   I. Yeletskikh: Searches for new physics at TeV scale in dilepton final states at ATLAS experiment
   Yu. Kulchitsky: Two-particle Bose-Einstein correlations in pp collisions at sqrt{s} = 0.9 and 7 TeV measured with the ATLAS detector
9. Quarks-2016
   A. Soloshenko: Latest results from the 13 TeV LHC collisions from ATLAS
10. Hadron-2017
   I. Yeletskikh: Status of exotic states at LHC
11. NEC-2017
   D. Oleynik: Optimizing new components of PanDA for ATLAS production on HPC resources

12. QFTHEP-2017
    - S. Turchikhin: Searches for new physics with heavy flavour
13. Beauty-2018
    - S. Turchikhin: Beyond Standard Model searches in B decays with ATLAS
14. Charm-2018
    - S. Turchikhin: Prospects of Charm Physics at ATLAS
    - S. Turchikhin: Multiple charm (onium) production at the LHC
15. GRID-2018
    - E. Alexandrov: BigData tools for the monitoring of the ATLAS EventIndex
    - M. Mineev: Trigger information data flow for the ATLAS EventIndex
16. NewTrends-2018
    - G. Lykasov: Constraints on the intrinsic charm content of the proton from recent ATLAS data

17. QCD@work-2018
    - Yu. Kulchitsky: Probing QCD with the ATLAS Detector

18. QCD-2019
    - S. Turchikhin: Spectroscopy and production of quarkonia and heavy flavour at ATLAS

JINR in the ATLAS SWOT Analysis

The approach developed by our colleagues from the ATLAS-JINR Upgrade Team was used as a good starting point for the present analysis.

Strength

1. Participation in a large and challenging international projects in a competitive and high-tech, internationally oriented, research arena
2. Excellent scientific publication and citation records
3. Collaborations with groups at the leading international scientific center (CERN) in particle physics and other physics laboratories
4. Large interest of the general public and media

JINR in the ATLAS SWOT Analysis

The approach developed by our colleagues from the ATLAS-JINR Upgrade Team was used as a good starting point for the present analysis.

Weaknesses

1. The growing age of staff scientists and engineers

   - The efforts are undertaking to attract young students to join the project

   - JINR and CERN have founded the Russian Physics Teacher Programme

2. Many analyses in the ATLAS Collaboration have publication deadlines due to the high class conferences date. This is especially important for the search analyses. But nonetheless, it is rather hard to precisely predict and therefore perform the definite plan of the analyses work, publications and expenses for working trips.

JINR in the ATLAS SWOT Analysis

The approach developed by our colleagues from the ATLAS-JINR Upgrade Team was used as a good starting point for the present analysis.

Opportunities

1. LHC shows huge discovery potential which attracts scientists at all levels (master students, PhD students, postdocs and staff physicists)

2. JINR experiments often require completely new and challenging analysis methods, data acquisition and production requirements and ATLAS offers all those possibilities and contacts with new research and analysis communities

3. The experience gained in the ATLAS experiment is shared with our colleagues from the other projects of the Institute

4. The Big Grid - e-science grid–project JINR-LCG2 - provides researchers at JINR with state-of-the-art computing services and an opportunity to establish contacts and/or collaborations with many other research disciplines.

Threats

No threats are identified