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IPB: ATLAS and other activities

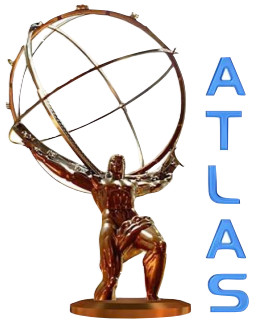
Jelena Jovićević on behalf of IPB team,
Institute of Physics Belgrade

RECFA visi to Serbia
November 29, 2024

[Previous RECFA visit to Serbia in 2012 - ATLAS report.](#)



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IPB@ATLAS

- Brief history of the Serbia in ATLAS;
- Presentation of the ATLAS Serbia group;
- Funding and grants;
- Physics measurements;
- Trigger, luminosity and detector performance;
- Detector operation and upgrade;
- Education and outreach.

Brief history of the Serbia in ATLAS

- 2003 - Protocol for the ATLAS hardware contribution signed by CERN, ATLAS, and Serbian Ministry of Education and Science;
- In kind contribution to the ATLAS forward shielding system (2004 test and assembly in, Serbia, 2008. installation in ATLAS).
- 2005: Serbia signed Memorandum of Understanding for M&O
- 2014 - Signed agreement between CERN & IPB;



Current ATLAS group members

Physicists w/ PhD (6):

Djordje Šijački (TL)

Jelena Jovičević

Lars Beemster

Lidija Živković (HoL)

Marija Vranješ Milosavljević (DTL)

Nenad Vranješ

PhD students (4):

Andjela Paunović

Veljko Maksimović

Evelin Bakoš

Ema Maričić

All physicist w/ PhD spent between 3 and 13 years working in the field abroad.

Engineers w/ PhD (2):

Goran Mladenović

Dejan Jevtić

Master students (1):

Andjela Bešir

4 Bachelor/ intern students from 2 universities in Serbia

● Female
● Male



Funding



Physicists w/ PhD (6):

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Jelena Jovičević

Lars Beemster

Lidija Živković

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Republic of Serbia

MINISTRY OF SCIENCE,
TECHNOLOGICAL DEVELOPMENT AND INNOVATION

Employed at the Institute of Physics in Belgrade and funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia

Engineers w/ PhD (2):

Goran Mladenović

Dejan Jevtić

IPB associated members from the Faculty of Mechanical Engineering, University of Belgrade - work for ATLAS financed through projects at CERN



Master students (1):

Andjela Bešir

**4 Bachelor/ intern students
from 2 universities in Serbia**

Beneficiaries of the scholarships provided by the state

Physicists w/ PhD (6):

Djordje Šijački

Jelena Jovičević

PhD students (4):

Andjela Paunović

Veljko Maksimović



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MO:

- All payments to the experiment regulated well in time by Ministry of Science, Technological Development and Innovation of the Republic of Serbia.

Challenges:

- No fundings for longer stays at CERN - important for young researchers, training of engineers, contribution to hardware projects;
- Difficulty to employ foreigners;
- No ability to employ (Serbian national) PhD student who obtained master's degree in educational systems not compatible with Serbian ECTS (e.g. UK);

Andjela Bešir

**4 Bachelor/ intern students
from 2 universities in Serbia**

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Publications and coordination roles in ATLAS



Publications:

- 0.3% of all authors in ATLAS;
- Significant contribution to:

	IPB	ATLAS	ratio
Papers	58	1350	4%
PUB notes	16	424	4%

- Significantly contributed to 4% of publications:
- Significant contribution to 10 ongoing measurements;

Coordination roles since 2012	
Collaboration board and committees	<ul style="list-style-type: none"> • Collaboration Board Chair Advisory Group (2020 - 2021); • Speakers Committee Chair (2020), Member (2018-2021); • Speakers Committee Advisory Board Deputy Chair (2024-ongoing).
Activity coordination	<ul style="list-style-type: none"> • Trigger Menu and Signature Performance (2022-ongoing); • Trigger b-jet (2015-2017, 2022 - 2024); • Trigger Contact to Simulation group.
Physics & performance group coordination (sub-conveners)	<ul style="list-style-type: none"> • Physics of W & Z boson (2017-2019); • SUSY Upgrade HL/HE-LHC (2018-2019); • Higgs-top physics (2021-2023); • Flavor tagging software (2018-2020).
Coordination within LHCHWG	<ul style="list-style-type: none"> • Fiducial, Differential and Template XS (ongoing); • Extended Higgs sector (ongoing).
Analysis coordinator /	<ul style="list-style-type: none"> • for 13 publications
Editorial Board	<ul style="list-style-type: none"> • for 14 publications
Additional	<ul style="list-style-type: none"> • various liaison positions between physics and detector groups; • expert reviewer roles; • Internal meetings organisers.

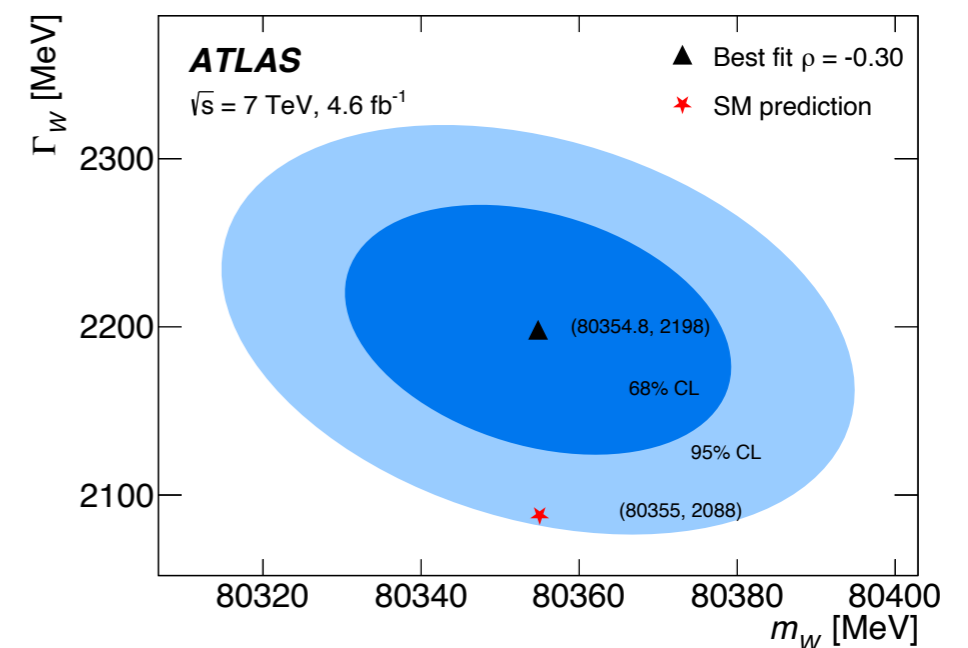
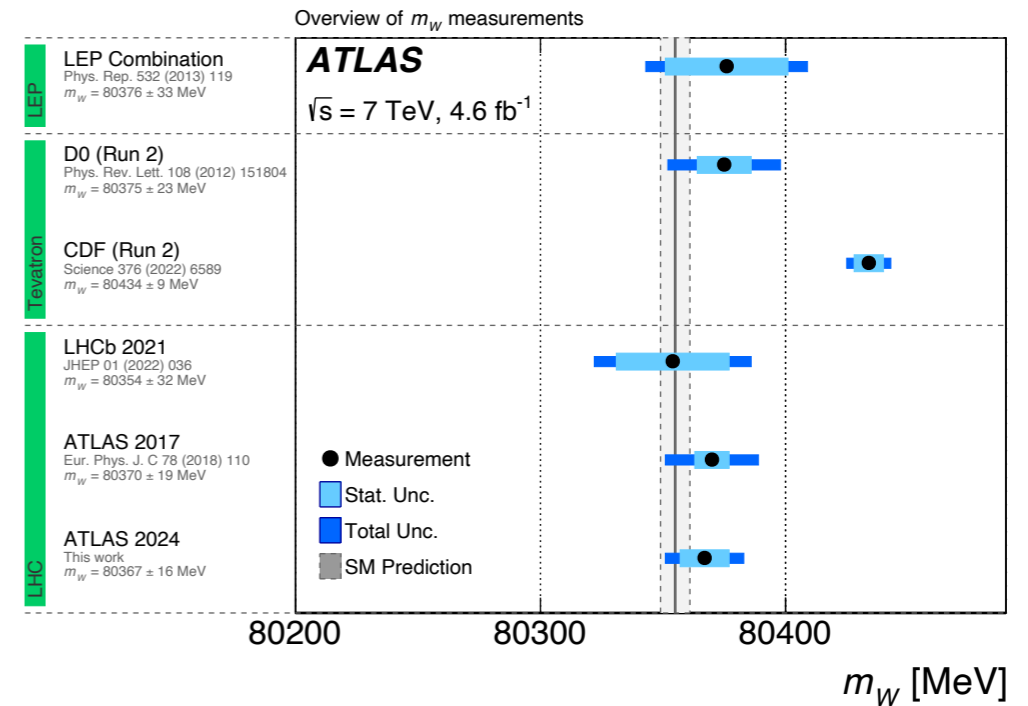
Physics measurements

SM:

- W mass measurements at 7 TeV;
- Exclusive $W \rightarrow \pi\rho, W \rightarrow \pi\rho$ decays;
- Drell-Yan triple-differential cross section at 8 TeV
- W/Z cross section at 13.6 TeV;
- Triboson prospects for HL-LHC

Top physics:

- $tt+cc$ at 13 TeV;
- Search for quantum gravity effects in tt at 13 TeV;
- tt cross section at 13.6 TeV w/ 29/fb;



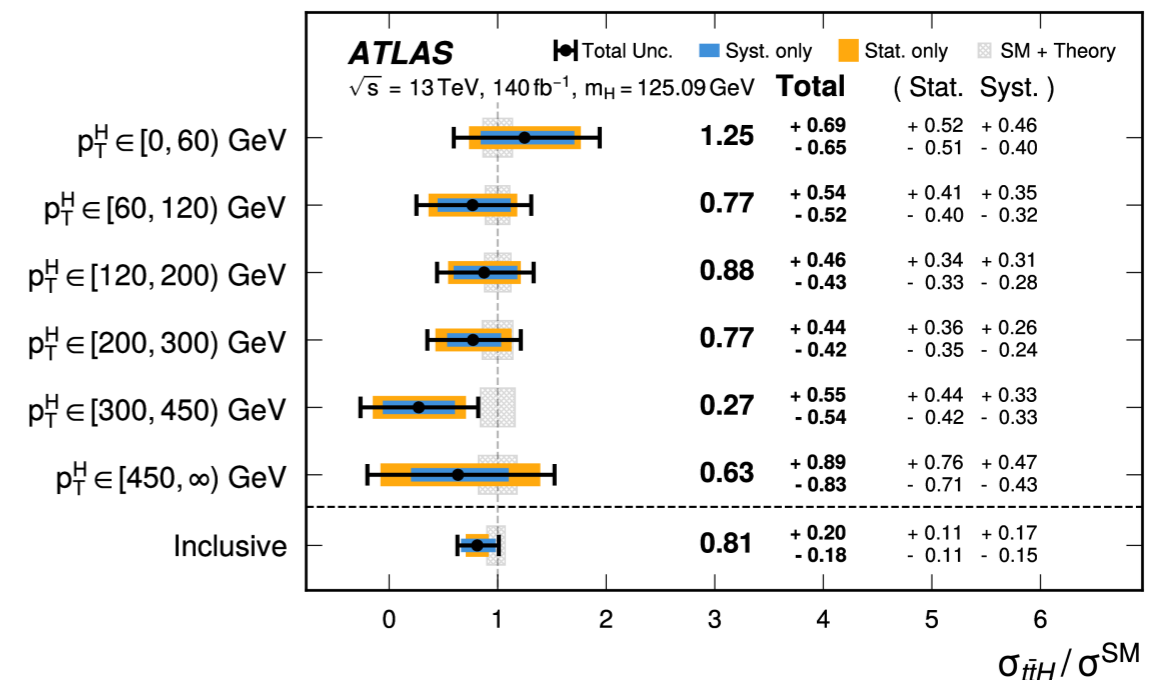
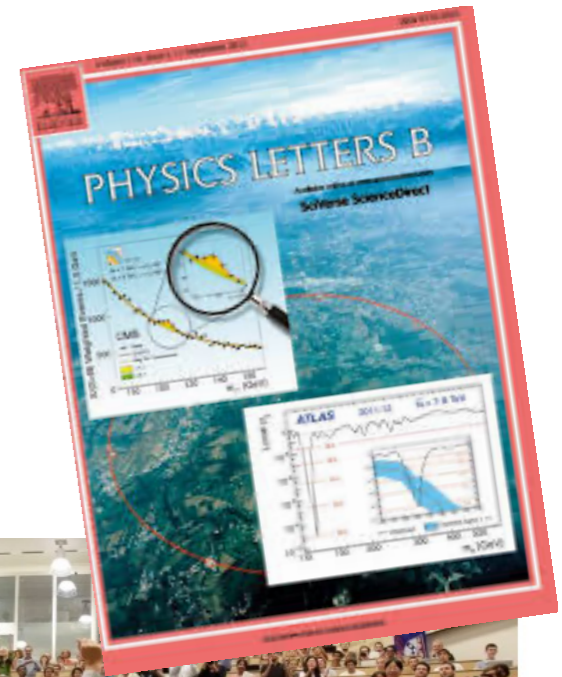
Higgs physics:

- $H \rightarrow WW$ at 7 & 8 TeV inclusive and fiducial cross-section;
- $H \rightarrow 4l$ at 7 & 8 TeV, mass, differential and fiducial cross section;
- ttH at 13 TeV, cross-section and CP-properties;
- Theory uncertainty calculations;
- combinations at 13 TeV;
- HH at 13.6 TeV.

BSM Higgs:

- Heavy neutral Higgs bH , $H \rightarrow bb$;
- $SH \rightarrow bbbb$ search;

Contributed to the discovery in 2012!

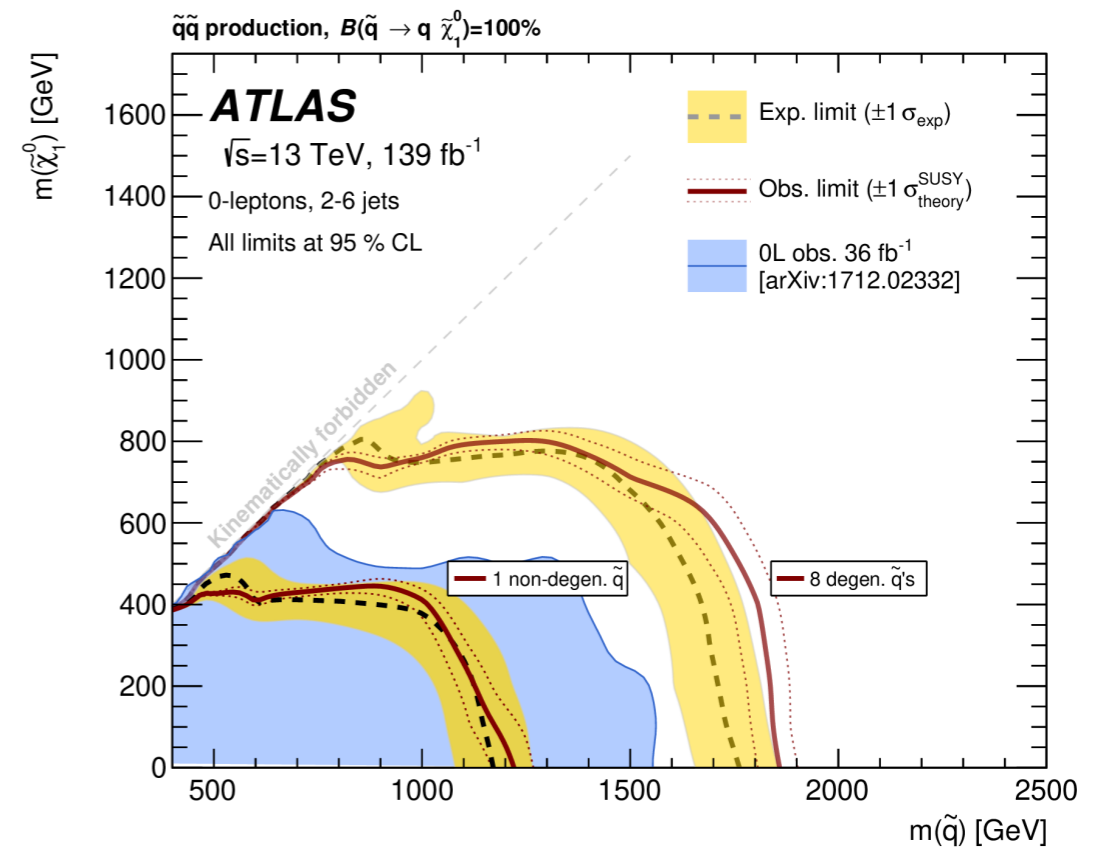


Supersymmetry (SUSY):

- Searches for squarks and gluinos @ 7,8 & 13 TeV, exploring extensive set of final states and models;
- Combination of SUSY searches;
- HL-LHC sensitivity to all types of supersymmetric particles, dark matter, long lived particles,

Search for exotic particles:

- W' at 7 & 8 TeV;
- Online for new signals with b-quarks;



Trigger, luminosity, detector performance

Trigger:

- Trigger performance @ 13 & 13.6 TeV,
- Most significant to menu, b-jet & muon trigger;
- Release and Validation;

Luminosity:

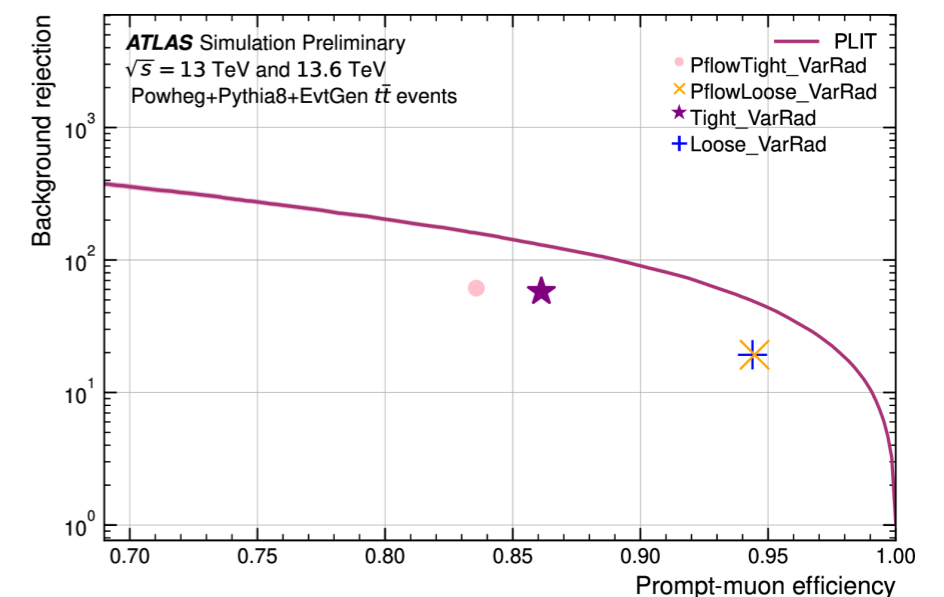
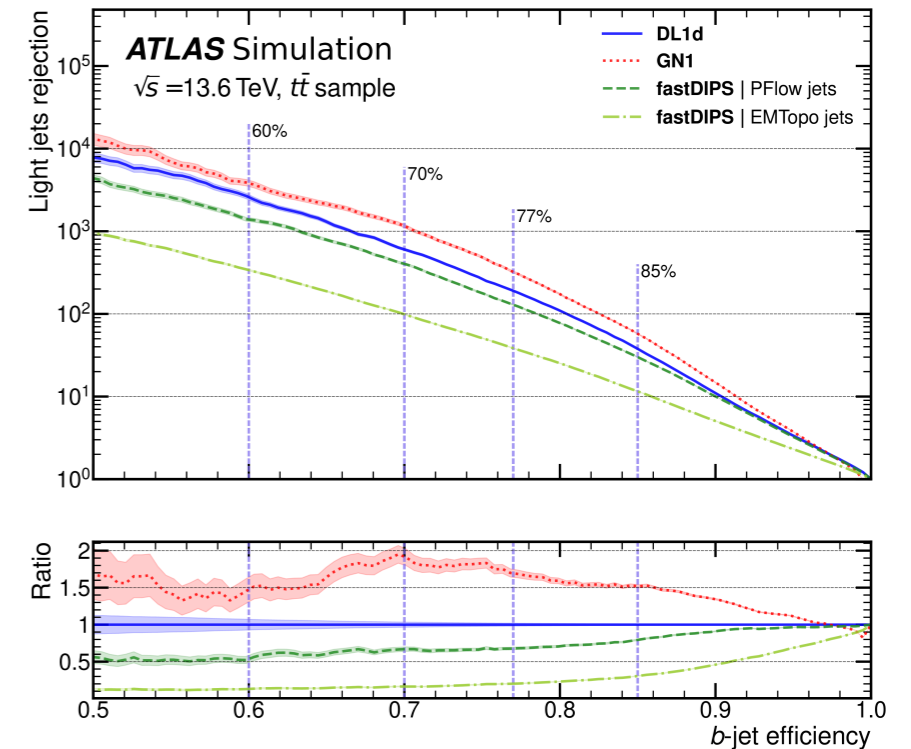
- Measurements at 8 & 13 TeV (0.83% precision);
- 900 GeV measurement;

Jet Flavour tagging:

- Ftag software and calibration at 13 TeV;
- Boosted Boson Tagging 8 TeV

Lepton reconstruction and identification performance:

- Development of the prompt lepton isolation tagger using transformers as a machine learning technique for Run2 and Run3 - ongoing work.
- Muon performance at 8 TeV:



Operations and upgrade

Detector Operation:

- **Trigger:** Data Quality shifts, Online release coordination, trigger menu on-call, b-jet trigger on-call;
- **Luminosity:** Data Quality;
- **Control room:** Shift Leader.

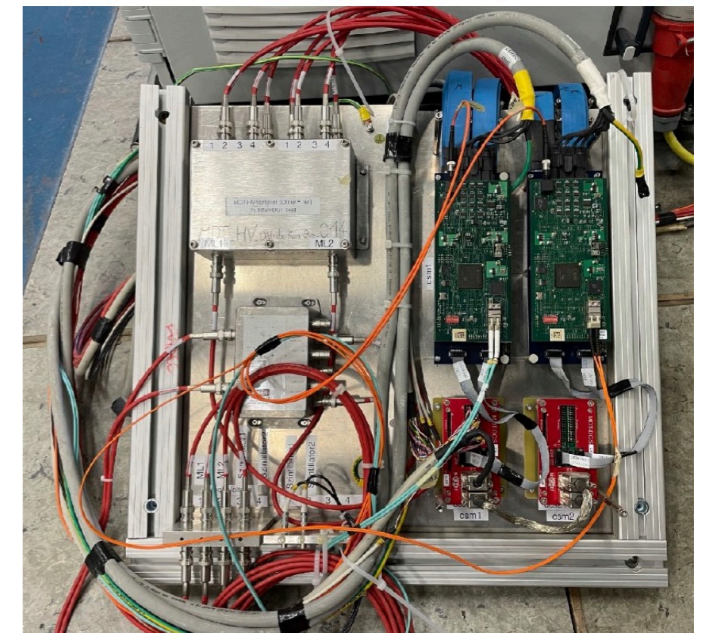
Operations and upgrade

Detector Upgrade:

- No national funds for upgrade, relies on individuals w/o funding for training.

Upgrade of the Muon Spectrometer Readout (LS2)

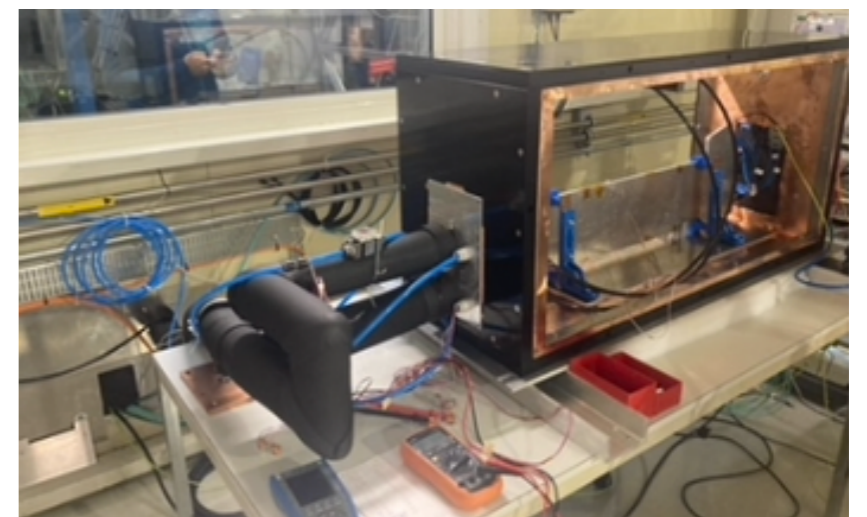
- Developed the CSMPProcessor module to replicate MROD functions & manage MDT specific settings;
- Implemented data fragment building and formatting in the swROD within the new FELIX system.
- Conducted tests confirming the FELIX system can handle increased data rates for Run 3.



High Granularity Timing detector (ongoing):

- Development of the DCS for the Demonstrator - aim towards final HGTD DCS;
- Demonstrator tests in b180;

Planned: Trigger performance and menu development.

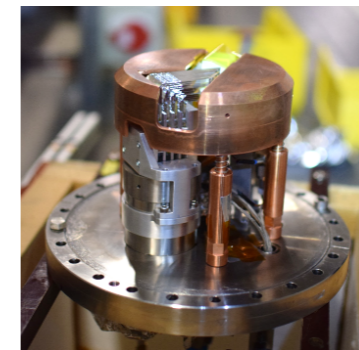


Operations and upgrade

Roman Pots (AFP/ALFA) - LS2 + Run 3

- Design/development and production of Out-of-Vacuum (OoV) solution for AFP Time-of-Flight (ToF) detector, AFP cable holder, Roman Pot (RP) Heat sink, counter-weight system for RP self-extraction support.
- Provided support on-site for metrology and installation in the tunnel.

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ZDC - Run 3

- Assisted in design/developed and production of a portable shielding wall for facilitating ZDC installation during TS2 (2024), on-site support in assembly.



HGTD - Run 3

- Re-design and production of Low Voltage Power Supply housing and heat exchanger for the demonstrator.

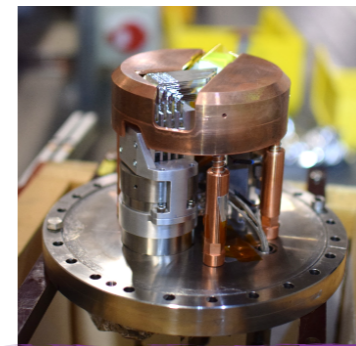


Operations and upgrade

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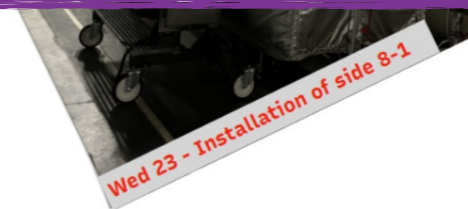


Provide accurate, affordable and prompt development, production, assembly and tests with complete technical documentation;

Collaboration with many workshops in Serbia, organisation of transport and clearance;

Anticipated continuation of ZDC and HGTD throughout Run3, LS3 & Run4.

a portable shielding wall for facilitating ZDC installation during TS2 (2024), on-site support in assembly.



HGTD - Run 3

- Re-design and production of Low Voltage Power Supply housing and heat exchanger for the demonstrator.

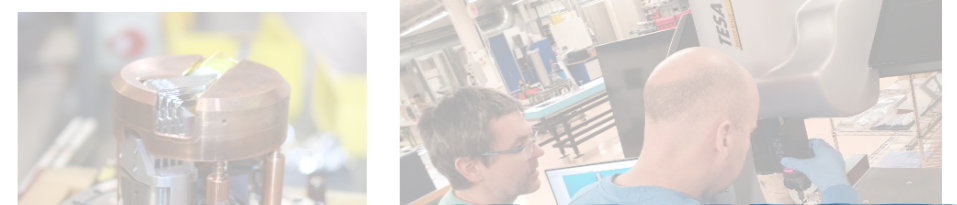


Operations and upgrade

Roman Pots (AFP/ALFA) - LS2 + Run 3

- Design/development and production of Out-of-Vacuum (OoV) solution for AFP Time-of-Flight (ToF) detector, AFP cable holder, Roman Pot

@ Faculty of Mechanical Engineering



Challenges:

- No secured funding for ATLAS upgrade;
- No funding to train and commit physicist in the ATLAS upgrade at CERN;
- Difficulty to employ technicians and engineers;
- No Associated Technical Institutes - would facilitate continuity in contributions.
- Only associated to the IPB individual engineers payed by projects at CERN.

in assembly.

HGTD - Run 3

- Re-design and production of Low Voltage Power Supply housing and heat exchanger for the demonstrator.



Grants and bilateral projects since 2012:

- Horizon 2020 Marie Skłodowska-Curie grant, J. Jovičević, 2021-2023;
- Bilateral with Germany, N. Vranješ, 2017 - 2019;

Joint PhD programs since 2012:

- Cotutelle with University Paris Sud, France, M. Marijanović, 2012 -2015;
- Erasmus with NIKHEF in Netherlands, E. Bakoš, 2018 - 2020;
- Cotutelle with University Paris Saclay, France, E. Maričić (2023 - ongoing).

CERN funded positions:

- Scientific Associateship (L. Živković 2016-2017), Senior Research Fellowship (J. Jovičević 2018-2021), many summer students.

Expert review and editorships:

- Expert reviewer for the European Executive agency;
- Expert reviewers for JHEP, editor for Chaos, Solitons & Fractals: X - Managing;
- LHCP 2023 Proceedings book Chair Editor;
- eQCD Proceedings book editor (2021-2023);

Conferences and workshops since 2012.

- LHCP 2023 main organisers;
- Workshop on probing space-time properties at HEP experiments (2023) - main organisers;
- ATLAS SM workshop 2019 main organisers;
- IAC: ECFA workshop on e⁺e⁻ Higgs, Electroweak and Top Factories (2024) LHCP (2023 - 2027), Excited QCD (2021-2023);
- Program Committees: LHCP, BPU, ATLAS Higgs workshop;
- Session convenerships: EPS-HEP 2021, LHCP2023, Corfu 2024.

National Awards:

- Annual IPB price to Nenad Vranjes in 2022;
- Serbian Excellence in Science for Lidija Živković in 2023.

Conferences and workshops since 2012.

- LHCP 2023 main organisers;

What could be improved in the future:

- High tax on international scientific grants. (monthly net received by researcher is ~60% of bruto payment);
 - National evaluations of researchers in large collaborations like ATLAS require specific rules. Although these rules are well-defined by the Ministry of Science's Committee for CERN Relations, inconsistent application often leads to the output of our researchers being improperly assessed, e.g. Excellence in Science.
- Annual IPB price to Nenad Vranjes in 2022;
 - Serbian Excellence in Science for Lidija Živković in 2023.

Education and outreach

Education of students:

- Courses for PhD students at University of Belgrade & University of Novi Sad;
- Since 2012: PhD thesis: - 3 accomplished, 4 ongoing, Master thesis: - 9 master accomplished, 1 ongoing;
- Currently 6 bachelor and master student's internships from University of Belgrade, Novi Sad, Niš and Kragujevac.

Outreach:

- CERN IPPOG masterclasses for more than 10 years, in 5 cities in Serbia,;
- Organisation and lecturing at National Teacher's and High School Programs;
- ATLAS underground, Visitor Center & Virtual VIsit, Science Gateway guides;
- Video material for school students;
- Public lectures devoted to CERN70I



Foto TF Čačak



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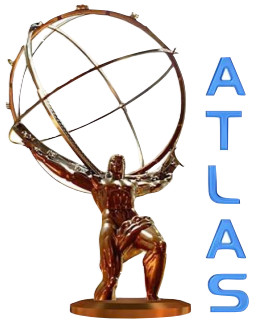
Outreach:

- Special CERN guest lectures;
- Serbia has active representative in European Particle Physics Communication Network (EPPCN)
IPB's Communications Department;
New co-chair Slobodan Bubnjević.
- Hosted EPON meeting in May 2023,
- Significant involvement in organisation of exhibition that will be open tonight.





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Additional activities

Non-ATLAS activities at CERN

SHIP experiment:

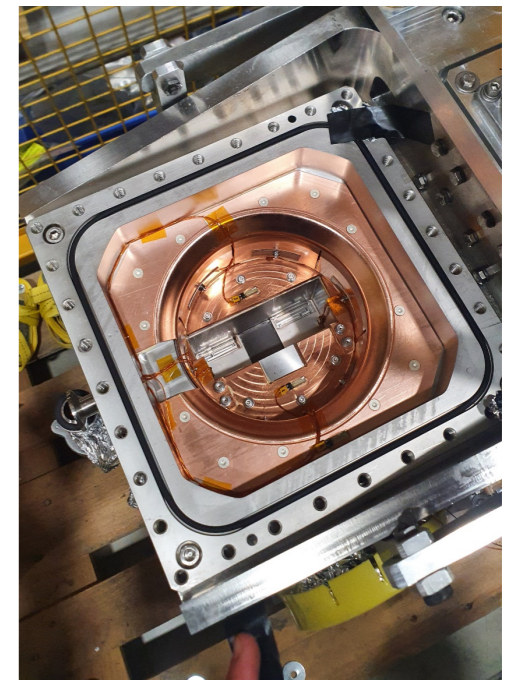
- IPB participation in the experiment construction will include activities planned as a part of a sub-project related to subdetector infrastructure and electronics.
- Researchers: Dr. Antun Balaž, Dr. Dejan Joković;

FASER-2:

- Master thesis in 2024: Testing FASER-2 sensitivity for the BSM particle detection under supervision of M. Vranješ Milosavljević.

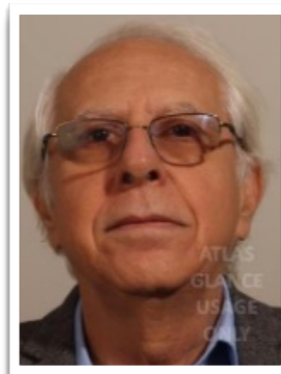
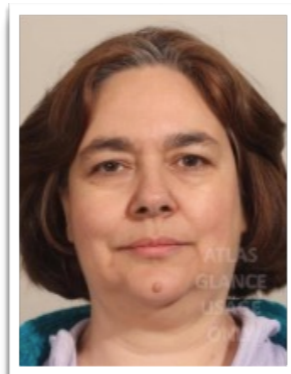
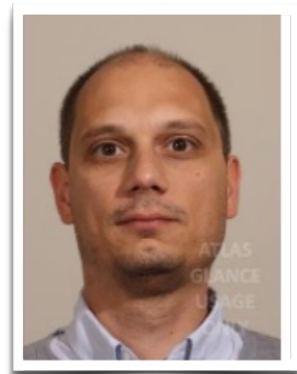
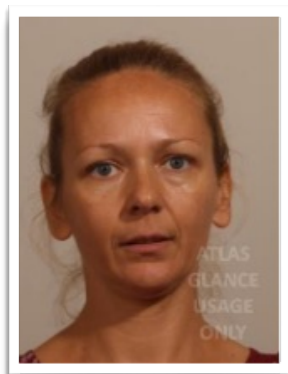
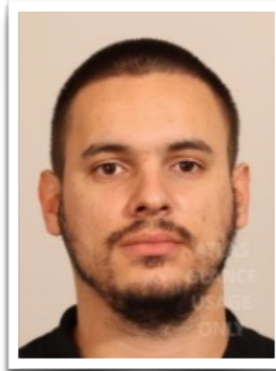
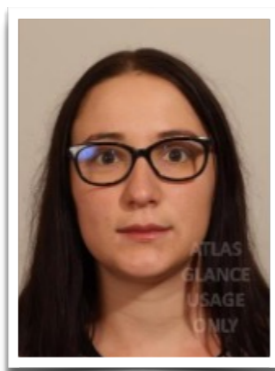
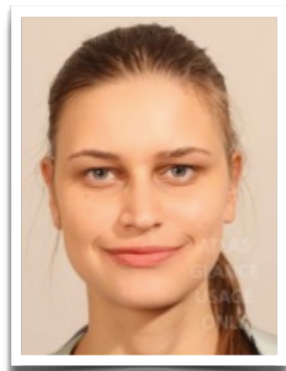
TWOCRYST/ALADDIN:

- Faculty of Mechanical Engineering - G. Mladenovic, D. Jevtić;
- Project support during takeover of ALFA Roman Pots;
- Anticipated continuation of collaboration throughout LS3 & Run4.





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Thank you!