Philipp Gadow

Research Associate · University of Hamburg

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Work history

University of Hamburg *Hamburg, Germany*

Research Staff *2024 – Present*

- Machine learning algorithms for jet flavour tagging, investigation of Higgs potential through searches for Higgs pair production (70%).
- Teaching, student supervision (30%).

CERN *Meyrin, Switzerland*

Senior Research Fellow *2023 – 2024*

- Searches for new phenomena in final states with top quarks, leadership of the ATLAS "Heavy Quarks, Top and Composite Higgs" physics sub-group, machine learning algorithms for jet flavour tagging and lepton isolation, silicon detector development for future collider experiments (90%).
- Co-supervision of two undergraduate students and CERN summer students (10%).

Deutsches Elektronensynchrotron DESY *Hamburg, Germany*

Quantum Universe Excellence Cluster Fellow *2020 – 2023*

- Searches for heavy resonances with four-top-quark events, leadership of ATLAS "Flavour Tagging Algorithms" combined performance sub-group, reinterpretation of searches with active learning (80%).
- Co-supervision of three PhD students and supervision of two summer students (20%).

Max Planck Institute for Physics (Werner-Heisenberg-Institut) *Munich, Germany*

Doctoral Research Assistent *2016 – 2020*

- Searches for dark matter with hadronically decaying bosons, RECAST reinterpretation of searches, muon trigger rate studies (80%).
- Tutor for experimental physics lectures and instructor for particle physics masterclasses in higher education schools (20%).

Education

Technical University of Munich *Munich, Germany*

Dr. rer. nat. Physics *2016 – 2020*

- Advisor: PD Dr. Oliver Kortner.
- Thesis: Search for Dark Matter Produced in Association with Hadronically Decaying Bosons at $\sqrt{s}$ = 13 TeV with the ATLAS Detector at the LHC.

Technical University of Munich *Munich, Germany*

Master of Science in Physics (Nuclear, Particle and Astrophysics) *2013 – 2016*

- Advisor: PD Dr. Oliver Kortner.
- Thesis: Development of a Concept for the Muon Trigger of the ATLAS Detector at the HL-LHC.
- Passed with distinction.

University of Edinburgh *Edinburgh, United Kingdom*

Erasmus+ Student Mobility for Studies *Winter 13*

- Courses (reported with ECTS, grade/mark): Philosophy of Science 1 (10 ECTS, B/64), Musical Acoustics (10 ECTS, A1/93), Quantum Physics (5 ECTS, A1/96), Quantum Theory (5 ECTS, A3/74), Relativistic Quantum Field Theory (5 ECTS, D/42).

Ludwig Maximilian University of Munich *Munich, Germany*

Teaching Degree for Upper Secondary Education "Gymnasiallehramt" (not completed) *2012 – 2016*

- With subjects physics, mathematics, and educational science.
- Completed educational science part (36/36 ECTS) and intensive internship (duration of 1 year, combination of SPS I and SPS II), partially completed mathematics part (66/105 ECTS) and physics part (84/105 ECTS), dropout in favour of PhD studies.

Technical University of Munich *Munich, Germany*

Bachelor of Science in Physics *2010 – 2013*

- Advisor: Prof. Dr. Laura Fabbietti.
- Thesis: dE/dx studies with pion and electron tracks of the ALICE GEM IROC prototype.
- Passed with merit.

Awards, Fellowships, & Grants

2024	**ATLAS Outstanding Achievement Award 2024**, for outstanding contributions to heavy flavour tagging algorithms based on Graph Neural Networks.	
2024	**Newton International Fellowship (declined)**, Royal Society	*GBP 284,800*
2024	**Leadership Academy 8 Fellowship**, German Scholars Organization.	*EUR 11,000*
2023 – 2025	**Senior Research Fellowship**, CERN.	*CHF 180,000*
2014	**Teaching Award "Goldene Kreide der Physikfachschaft"**, Technical University of Munich.	
2010 – 2016	**Full Scholarship**, Studienstiftung des deutschen Volkes.	

Leadership

Leadership Positions

2024	**ATLAS Physics Exotics HQT sub-group convener**, group consisting of 100 members with 2 conveners.
2022 – 2024	**ATLAS Control Room Shift Leader**, overseeing data taking (over 50 shifts, of which in 2024: 23 shifts, in 2023: 24 shifts, and in 2022: 11 shifts).
2021 – 2023	**ATLAS Combined Performance Flavour Tagging Algorithms sub-group convener**, group consisting of 30 members with 2 conveners.
2021 – 2024	**ATLAS Physics Analysis Contact**, for five analysis teams with teams consisting of between 5 to 40 members.

Leadership Training

2024	**Leadership Academy 8**, full two weeks of courses, covering theory of leadership, self-reflection, input on lateral leadership, lean strategy, strategic tools for analysis and development, career development, selection of employees, conflict management, self-guidance and intensive feedback to participants.	*German Scholar Organization*
2021	**Leadership Training: Enable High Potential in Teams and Organize Effective Meetings**, two half-day course offered by COAST (Career Orientation and Skills Training for Postdocs) at Deutsches Elektronensynchrotron DESY.	*DESY*
2018	**Mental health at top performance**, full-day course, covering burn-out prevention and guidance on how to preserve a healthy life in oneself and others.	*Max Planck Society*

Research Experience

Current Research Activity

Heavy Flavour Jet Tagging *U. of Hamburg, CERN, DESY*

CMS Experiment, ATLAS Experiment *2021 – Present*

- Flavour tagging is a critical component of the ATLAS physics programme, essential for identifying jets originating from b- and c-quarks, which is vital for measurements involving Higgs bosons, top quarks, and searches for BSM physics. The use of advanced attention-based machine learning techniques using models with transformer encoders resulted in a fourfold improvement in background rejection compared to previous methods.
- **Scope of research:** I have pioneered advanced attention-based machine learning techniques using the transformer architecture and deep neural networks for flavour tagging, significantly improving background rejection by a factor of four compared to previous methods. In my role as sub-group convener for the ATLAS flavour tagging algorithms group, I have led the change in the group not only in using groundbreaking methods but also towards modern software with excellent documentation, training material and automated testing. I have contributed to software design and produced the datasets for training of the algorithms. In my two years as sub-group convener, I oversaw the projects of 20 doctoral students qualifying as ATLAS authors. I supervised an undergraduate student project on training charged particle track-based jets with variable jet radius with a Deep Sets algorithm. Further, I am supervising a master's thesis project that enhances the identification of c-jets with charged D^* mesons by using an auxiliary training objective to detect "slow pion" tracks from $D^{\pm *}$ decays. I have led the publication describing the flavour tagging algorithms used in the major part of the Run 2 ATLAS physics programme. I quantified the performance of various algorithms for simulated data of Run 2 and Run 3 detector configurations.
- **Main collaborators:** Prof. Tim Scanlon (UCL), Dr. Samuel Van Stroud (UCL), Dr. Nicole Hartman (TUM), Dr. Daniel Guest (HU Berlin), Dr. Francesco Armando Di Bello (INFN, University of Genova), Dr. Andrea Knue (University of Freiburg), Dr. Spyros Argyropoulos (University of Freiburg), Dr. Maximilian Goblirsch-Kolb (CERN), Dr. Markus Elsing (CERN), Dr. Michael Kagan (SLAC).

Search for non-resonant Higgs pair production *University of Hamburg*

CMS Experiment *2024 – Present*

- Investigation of the non-resonant production of Higgs boson pairs to explore the nature of electroweak symmetry breaking and self-interaction of the Higgs field.
- **Scope of Research:** Involvement in the analysis of the $bb\tau\tau$ decay channel, focusing on advanced signal extraction techniques, background modeling, and interpretation of results.
- **Main collaborators:** Prof. Kostas Nikolopoulos (University of Hamburg), Prof. Peter Schleper (University of Hamburg), Dr. Robert Ward.

Phenomenology of Extended Higgs Sectors with Top Quarks *DESY Hamburg, CERN*

Phenomenology *2022 – Present*

- Models with an extended Higgs sector predicting two or more Higgs bosons can exhibit significant interference effects not only between signal and background but also among the signals themselves. These interference effects can be substantial, leading to drastic modifications in predictions, resulting in different line-shapes and cross-sections in final states with two, three, or four top quarks. Only a comprehensive analysis investigating the presence of heavy resonances across all top quark multiplicities will be shown to conclusively search for these new particles.
- **Scope of research:** I investigated interference effects in final states with two, three and four top quarks on parton level in invariant mass distributions of top quarks originating from a scalar. I interpreted predictions with a recast of an LHC four-top-quark search to estimate the expected discovery significance of the different production modes in presence of interference effects.
- **Main collaborators:** Prof. Georg Weiglein (DESY), Dr. Henning Bahl (Heidelberg), Dr. Panagiotis Stylianou (DESY), Dr. Krisztian Peters (DESY).

Previous Research Activity

Heavy Resonance Rearches with Top Quarks *DESY Hamburg, CERN*

ATLAS Experiment *(2020 – 2024)*

- Searches for spin-1 and spin-0 heavy new bosons in challenging final states with three or four top quarks. This research is motivated by its complementarity to conventional searches in di-top-quark final states and further by the recent discovery of four-top-quark production with a moderate excess.
- **Scope of research:** I led an analysis team of 17 researchers coordinating the analysis of ATLAS data recorded during Run 2. I maintained the analysis software and contributed to fitting studies. Further, I studied the simulation of signal processes. From 2023 – 2024 I led an analysis team of 29 researchers, coordinating the combined analysis of ATLAS data taken during Run 2 and Run 3. I contributed to analysis strategy design, studies of background processes, simulations of signal and background processes and the coordination of distributed computing tasks. I have stepped down from the coordination role to avoid conflicts of interest with my sub-group convene role in which I should review and advise on the team's research.
- **Main collaborators:** Dr. Krisztian Peters (DESY), Prof. Jianming Qian (University of Michigan), Prof. Reinhard Schwienhorst (Michigan State University), Dr. Binbin Dong (Michigan State University), Dr. Nedaa-Alexandra Asbah (CERN).

Searches for Vector-like Quarks *DESY Hamburg, CERN*

ATLAS Experiment *(2020 – 2024)*

- Vector-like Quarks (VLQs) are hypothetical colour triplet, spin-1/2 fermions whose left- and right-handed components have the same electro-weak transformations. They appear in several models beyond the SM, such as extra dimensions and Composite Higgs models, which address the naturalness issue of the Higgs boson mass. While low-mass VLQs are pair-produced via the strong interaction, higher masses suppress this process, making electroweak single production significant.
- **Scope of research:** I contributed to a search for the single production of VLQs decaying to a b-quark and a Higgs boson, using the full ATLAS Run 2 dataset, employing advanced jet substructure techniques and flavour tagging algorithms with studies of the signal process in consultation with theorists and simulation of the signal process. I also managed a search for single production of VLQs decaying to a b-quark and a Higgs boson decaying to two photons from 2021 to 2023, working together with a single doctoral researcher. I wrote the analysis software, simulated the signal process, studied the background prediction based on control region data including the estimate of associated uncertainties and performed initial fit studies. I am mentoring the doctoral student who has taken over the leadership of the analysis in 2023. Further, I am guiding the first searches for VLQs using ATLAS Run 3 data in my role as HQT sub-group convener and will be advising the teams and reviewing their results.
- **Main collaborators:** Dr. Marco Montella (Ohio State University), Dr. Krisztian Peters (DESY), Prof. Jahred Adelman (Northern Illinois University), Dr. Elin Bergeås Kuutmann (Uppsala University), Dr. Natascia Vignaroli (Salento University).

Lepton Isolation Techniques *CERN*

ATLAS Experiment *2023 – 2024*

- Lepton isolation techniques distinguish high-energy leptons originating from electroweak processes from those produced in semi-leptonic hadron decays, photon conversions, or mis-identified particles. They play a crucial role in the ATLAS physics programme for Higgs boson measurements, electroweak processes, and physics searches for phenomena Beyond the Standard Model. New approaches based on algorithms used as well for the identification of heavy flavour jets reduce backgrounds significantly and consequently enhance the sensitivity of multi-lepton final state analyses.
- **Scope of research:** I developed the "Prompt Lepton Isolation Tagger" using a multi-task transformer neural network to identify leptons from W/Z boson decays. This involved creating the necessary software to produce data products for training, generating large, preprocessed training datasets with balanced classes, and training initial models. Additionally, I implemented an ONNX-runtime-based version of the algorithm into the central ATLAS software. I also mentor a student who evaluates the algorithm's performance for muons in simulated data.
- **Main collaborators:** Dr. Frédéric Déliot (Saclay CEA), Dr. Henri Bachacou (Saclay), Prof. Jelena Jovičić (Belgrade IP), Dr. Marco Vanadia (Rome "Tor Vergata"), Dr. Nello Bruscino (Rome "La Sapienza"), Dr. Francisco Alonso (La Plata University), Dr. Nedaa-Alexandra Asbah (CERN), Dr. Knut Zoch (Harvard), Dr. Maximilian Goblirsch-Kolb (CERN).

Silicon Detector R&D for Future Collider Facilities *CERN*

CERN EP-R&D *2023 – 2024*

- The future of high-energy physics relies on advancing collider capabilities, with priorities such as an electron-positron Higgs factory for precision measurements and new physics exploration. Contributing to this goal, I study silicon pixel detector technologies for future collider facilities, evaluating pixel detectors fabricated using a 65 nm CMOS process in collaboration with DESY, as part of CERN EP department's strategic research and development programme on technologies for future experiments and detector technologies.
- **Scope of research:** I have characterised hybrid CLICpix2 sensors in the laboratory, calibrating the threshold settings of individual pixels to ensure uniform response across all pixels of the sensor, and performed a charge calibration with sources and fluorescence measurements with x-rays to obtain the absolute charge created by particle interactions in the active detector medium. I performed similar measurements for the novel H2M ("hybrid-to-monolithic") monolithic active pixel sensor, including determination of pixel noise. I participated in test- beam measurements at the CERN SPS facility of the H2M sensor and contribute to test-beam data analysis.
- **Main collaborators:** Dr. Dominik Dannheim (CERN), Dr. Peter Švihra (CERN), Dr. Younes Otarid (CERN), Dr. Michael Campbell (CERN), Dr. Simon Spannagel (DESY), Dr. Lennart Huth (DESY), Dr. Finn Feindt (DESY).

Searches for Dark Matter at Colliders *Max Planck Institute for Physics*

ATLAS Experiment *2016 – 2020*

- The Standard Model does not account for over 80% of the universe's gravitating matter – dark matter. Searches at the Large Hadron Collider aim to probe signatures of yet unobserved dark matter particles by detecting their recoil on visible particles in signatures with missing transverse momentum. I contributed to three such searches using heavy bosons: hadronically decaying vector bosons, Higgs bosons decaying to b-quarks, and hypothetical dark Higgs bosons decaying to pairs of vector bosons, all of which pioneered new analysis techniques and constrained models describing dark matter production.
- **Scope of research:** My contributions to dark matter searches have been extensive. In the search for dark matter produced in association with hadronically decaying vector bosons, I served as one of two central analysers and was responsible for developing and maintaining the analysis software, managing distributed computing, and conducting the statistical analysis. I developed a method for estimating the multi-jet background and applied it successfully. Further, I facilitated the incorporation of the results into a summary publication, their reinterpretation within an extended Higgs sector model, and their use in combined searches for invisible Higgs boson decays. For dark matter searches involving Higgs bosons decaying to b-quarks, I was a central analyser for the partial Run 2 data (2015–2017) and contributed to the full Run 2 result. My responsibilities included managing the analysis software, producing fit inputs, conducting statistical analysis, and commissioning a new object-based missing transverse momentum significance. I also estimated the multi-jet background and maintained the derivation datasets, as well as optimising selection requirements based on the new significance measure. In the search for dark Higgs bosons decaying to vector boson pairs, I was the central analyser, handling all critical aspects of this novel analysis. My contributions included simulating the signal process, designing the analysis strategy, developing the analysis software, managing distributed computing, and conducting the statistical analysis.
- **Main collaborators:** Dr. Sandra Kortner (MPP), Dr. Patrick Rieck (NYU), Dr. Krisztian Peters (DESY), Dr. Xuanhong Luo (Stockholm University), Dr. Katharina Behr (DESY), Prof. Oleg Brandt (Cambridge), Prof. Shi-Chieh Hsu (Washington University), Prof. Frank Filthaut (Nijmegen), Dr. Ruth Pöttgen (Lund University), Prof. Daniel Whiteson (UC Irvine), Prof. Lauren Tompkins (Stanford), Dr. Spyros Argyropoulos (University of Freiburg), Dr. Dan Guest (HU Berlin).

Reinterpretation of New Physics Searches with RECAST *Max Planck Institute for Physics, DESY Hamburg*

ATLAS Experiment *2018 – 2022*

- Searches for new physics often involve significant investments of time and resources, making reinterpretation frameworks like RECAST essential for efficiently testing alternative signal hypotheses.
- **Scope of research:** I coordinated and co-edited the first ATLAS public result using the reinterpretation RECAST framework, which allows for the semi-automated reuse of background estimates, systematic uncertainties, and observed data to test alternative signal hypotheses, setting constraints on a dark matter model with a dark Higgs boson decaying to b-quarks. Additionally, I contributed to the study of an Active Learning approach to extend parameter scans efficiently, reducing the computational effort needed while expanding the dimensionality of the parameter space examined. For the latter, I implemented a fast parametrisation of the analysis and automated the simulation of the signal process.
- **Main collaborators:** Prof. Lukas Heinrich (TUM), Prof. Kyle Cranmer (Wisconsin), Dr. Patrick Rieck (NYU), Prof. Shih-Chieh Hsu (Washington University).

Muon Trigger Improvements for Run 2 and Run 4 *Max Planck Institute for Physics*

ATLAS Experiment *2015 – 2017*

- Highly selective first muon level triggers are essential to exploit the full physics potential of the ATLAS experiment.
- **Scope of research:** I optimised the first-level ATLAS muon trigger for the Run 2 data-taking campaign by refining the trigger coincidence logic using the tag-and-probe method with muon pairs from the J/ψ resonance, resulting in reduced trigger rates in the forward region while maintaining high efficiency for 2018 data-taking. For the ATLAS Run 4 muon trigger concept study, I estimated trigger rates incorporating precision tracking information from the monitored drift tube chambers and outlined a new pattern recognition strategy, which has been adopted as the baseline for the Phase-II muon trigger upgrade.
- **Main collaborators:**Dr. Oliver Kortner (MPP), Dr. Sandra Kortner (MPP), Prof. Yasuyuki Horii (Nagoya University), Prof. Junpei Maeda (Kobe University).

Mentoring

(Co-)Supervision of Graduate Students

2020 – 2022 **Dr. Alicia Wongel**, PhD student co-supervised with Dr. Krisztian Peters. *University of Hamburg*

2022 – 2023 **Elisaveta Sitnikova**, PhD student co-supervised with Dr. Krisztian Peters. *University of Hamburg*

2022 – 2023 **Jackson Barr**, PhD student co-supervised with Dr. Krisztian Peters and Prof. Tim Scanlon. *UCL*

(Co-)Supervision of Undergraduate Students

2024	**Milica Rajčić**, CERN Summer Student Project, "Characterisation of the H2M monolithic pixel sensor ASIC".	*University of Montenegro*
2024	**Maya Kvaratskhelia**, Boston Student Programme Project, "Improved lepton isolation for $H(ZZ^*)$ measurements".	*Notre Dame University*
2023 – 2024	**Laura Winkler**, Master Thesis Project, "Improved detection of charm jets using charged D^*-mesons".	*University of Geneva*
2022	**Stefan Katsarov**, DESY Summer Student Project, "Jet flavour tagging project with training a deep-sets-based algorithm to identify b-jets".	*University of Edinburgh*
2021	**John Lawless**, DESY Summer Student Project, "Machine learning techniques for top quark reconstruction in four-top-quark final states".	*Iowa State University*

Teaching Experience

Formal Pedagogical Training

Ludwig Maximilian University of Munich *Munich, Germany*

Educational science and Psychology for Upper Secondary Education Teaching Degree "Gymnasiallehramt" *2012 – 2016*

- Formal education in pedagogics through completed educational science and psychology part (36/36 ECTS) and intensive internship at Gymnasium Neufahrn (duration of 1 year, combination of SPS I and SPS II).

Technical University of Munich *Munich, Germany*

Undergraduate tutor qualification certificate *2011 – 2012*

- Provided by the central scientific institution for Higher Education Teaching "ProLehre (TUM)" of the Technical University of Munich.
- 61 work units, corresponding to a workload of 45 hours consisting of a basic training course for undergraduate tutors, a reflexion session, a conflict training and an open training course, as well as specialised workshops on exercise design, utilisation of blackboards and presentation training. The training was complemented by two teaching consultations.

University Teaching

2017	**Experimental Physics 2: Electromagnetism and Special Relativity**, Tutorial.	*TUM*
2016/17	**Experimental Physics 1: Mechanics**, Tutorial.	*TUM*
2015/16	**Tutorial: Experimental Physics 3: Optics**, Tutorial.	*TUM*
2014	**Experimental Physics 2: Electromagnetism and Special Relativity**, Tutorial.	*TUM*
2013/14	**Experimental Physics 3: Optics**, Tutorial.	*TUM*
2012	**Experimental Physics 2: Electromagnetism and Special Relativity**, Tutorial.	*TUM*
2012/13	**Mathematics for physicists 1: Linear Algebra**, Tutorial.	*TUM*
2012	**Maths Introductory Course**, for first-year students (three weeks).	*TUM*
2011/12	**Mathematics for physicists 1: Linear Algebra**, Tutorial.	*TUM*
2011	**Maths Introductory Course**, for first-year students (three weeks).	*TUM*

Other Teaching

2021 – 2023	**ATLAS Flavour Tagging Group Tutorials**, Designed and supervised seven software tutorials for the ATLAS flavour tagging group. https://ftag.docs.cern.ch/software/tutorials/.	*ATLAS*
2021	**ATLAS SUSY+HDBS+Exotics RECAST tutorial**, Mentor for ATLAS virtual tutorial. https://indico.cern.ch/event/1009271/.	*ATLAS*
2020	**CI/CD pipeline tutorial**, Mentor for High Energy Physics Software Foundation virtual tutorial. https://indico.cern.ch/event/904759/.	*HSF*
2020	**Docker training tutorial**, Mentor for High Energy Physics Software Foundation virtual tutorial. https://indico.cern.ch/event/934651/.	*HSF*
2014 – 2015	**Secondary Education Teaching**, ”Lehr:werkstatt” intensive internship. Over the course of a year, I taught more than 250 hours in collaboration with an experienced teacher, independently prepared lessons, attended meetings and participated in school events.	*Neufahrn Gymnasium, Germany*

References

Tancredi Carli (CERN), tancredi.carli@cern.ch, +41 2276 71 120
Krisztian Peters (DESY), krisztian.peters@desy.de, +49 40 8998 3740
Tim Scanlon (UCL), timothy.scanlon@ucl.ac.uk, +44 7704107191

Outreach & Professional Development

Professional Memberships

Deutsche Physikalische Gesellschaft
Alumni der Studienstiftung des deutschen Volkes e. V.

Formal Training in Media and Communication

2023	**Science Communication for CERN Guides**, (16.08.2023), 4-hour long training, covering introduction to science communication and key communication skills.	*CERN*
2023	**CERN Guide Training**, (04.05.2023), course offered by CERN Visits Service.	*CERN*
2022	**Workshop Science Communication**, (27./28.10.2022), two-day workshop offered by NaWik (National Institute for Science Communication) as award for participation in "KlarText Preis für Wissenschaftskommunikation" competition.	*NaWik*
2017	**"Rhetorik extrem"**, (21.06.2017 – 23.06.2017), intensive course offered by the TUM Graduate School.	*TUM*
2014 – 2015	**City Guide Training**, (28.09.2014 – 13.04.2015), training course for becoming a city guide for the city of Munich.	*Weis(s)er Stadtvogel*
2012	**"Überzeugend auftreten – auch in schwierigen Situationen"**, (09.07.2012), course offered by "ProLehre (TUM)".	*TUM*
2011	**"Erfolgreich präsentieren – Präsentieren wie Steve Jobs?"**, (30.11.2011), course offered by "ProLehre (TUM)".	*TUM*

Science Communication

Public talks

04.07.2022	**Keynote Talk for Higgs Boson Discovery 10th Anniversity**, "Inspired by Higgs" at DESY / University of Hamburg. https://www.youtube.com/watch?v=sNs97If8vdw.
28.04.2022	**Symposium on Science Communication**, "Science Slams as a method of science communication" at Hamburg Research Academy.

CERN Science Show Presenter: CERN science shows are theatre-style presentations delivered by CERN scientists that promote science with interactive experiments. Each show lasts 50 min and has up to 200 visitors. In June 2024 I will have presented 9 science shows.

CERN Guide and ATLAS Underground Guide: CERN official guides provide tours to the general public and private visitor groups. In June 2024 I will have guided 24 private visits and 5 group visits.

ATLAS Virtual Visits: ATLAS virtual visits are live video connections where a CERN scientist guides a group through the ATLAS experiment, presenting its research, and answering audience questions directly from the ATLAS control room or the detector underground. In June 2024 I will have guided 7 virtual visits.

ATLAS Masterclasses: The ATLAS Masterclass programme is an educational outreach initiative that enables secondary school students to engage directly with particle physics. Students learn fundamental research methods by analysing measurements from actual collision events recorded by the ATLAS experiment.

02.05.2019	**ATLAS masterclass project day with lecture and experiments on particle physics**, Munich, Germany	*Bavaria, Germany*
09.04.2019	**ATLAS masterclass project day with lecture and experiments on particle physics**, Bavaria, Germany	
22.07.2016	**ATLAS masterclass project day with lecture and experiments on particle physics**, Bavaria, Germany	

Netzwerk Teilchenwelt Teacher Training Programme: I have imparted practical knowledge on cloud chamber experiments during teach-the-teacher training sessions for Bavarian teachers in the Bavarian state's teacher training centre

in Gars am Inn.

3 minute thesis" competition judge in panel for Hamburg Research Academy on 28.07.2022.

Science Slams are competetive events in which scientists present their research in a given time frame to a diverse audience in an entertaining way. I participated in over 30 such events with a talk about dark matter searches at the Large Hadron Collider, including the Southern German championship. In 2022, I organised a two-day science communication workshop about science communication for doctoral researchers at DESY.

30.11.2024 **Science Slam Weingarten (Ravensburg)**, Weingarten, Germany
29.11.2024 **Science Slam Friedrichshafen**, Friedrichshafen, Germany
19.10.2024 **1. Science Slam in Affoltern am Albis**, Affoltern a. A., Switzerland
16.10.2024 **Science Slam Bern 2.0**, Bern, Switzerland
10.07.2024 **Science Slam Planetarium Berlin**, Berlin, Germany
23.05.2024 **Science Slam University of Fribourg**, Fribourg, Switzerland
01.07.2022 **Science Slam Public Library Munich**, Munich, Germany
04.05.2022 **1st PIER Science Slam**, Hamburg, Germany
30.09.2021 **Einstein Slam, "Highlights der Physik"**, Würzburg, Germany
20.11.2019 **Productronica Science Slam**, Munich, Germany
23.10.2019 **Science Slam Esslingen**, Esslingen, Germany
12.06.2019 **Science Kabarett in Seidlvilla Munich**, Munich, Germany
06.04.2019 **Science Slam Schaffhausen**, Schaffhausen, Switzerland
01.04.2019 **German Physics Society "Einstein Slam"**, Regensburg, Germany
21.02.2019 **Science Slamm Lippstadt**, Lippstadt, Germany
24.01.2019 **Science Show Grafing**, Grafing, Germany
17.10.2018 **Materialprüfungsanstalt Stuttgart**, Stuttgart, Germany
14.09.2018 **Max Planck Society "Max Planck Tag" Science Slam**, Munich, Germany
26.06.2018 **Munich Science Slam in Burda Bootcamp Munich**, Munich, Germany
15.06.2018 **"Faust Slam" Central Public Library Munich**, Munich, Germany
13.05.2018 **Science Slam in Lustspielhaus Munich**, Munich, Germany
14.04.2018 **"Turm der Sinne Slam" Nuremberg**, Nuremberg, Germany
11.04.2018 **Science Slam Planetarium Berlin**, Berlin, Germany
26.03.2018 **Science Slam in "Heppel und Ettlich" Munich**, Munich, Germany
22.03.2018 **Dornier Aircraft Yard Science Slam Friedrichshafen**, Friedrichshafen, Germany
21.03.2018 **Science Slam Michelstadt**, Michelstadt, Germany
06.02.2018 **Science Slam Roxy Ulm**, Ulm, Germany
02.02.2018 **Science Slam Chemiepark Gendorf**, Gendorf, Germany
25.01.2018 **Science Slam Studio Theatre Munich**, Munich, Germany
17.11.2017 **Science Slam at University of Clausthal-Zellerfeld**, Clausthal-Zellerfeld, Germany
25.10.2017 **Science Slam "Übel und gefährlich" Hamburg**, Hamburg, Germany
07.10.2017 **Southern German Championship 2017 Alte Feuerwache Mannheim**, Mannheim, Germany
06.05.2017 **Science Slam Weingarten**, Weingarten, Germany
03.11.2016 **Science Slam "Affentheater"**, Gießen, Germany
05.12.2014 **Science Slam Vereinsheim Munich**, Munich, Germany
06.11.2014 **Science Slam "Affentheater"**, Gießen, Germany
24.07.2014 **TUM Young Academy Science Slam at Deutsches Museum Munich**, Munich, Germany

Publications

As a member of the ATLAS Collaboration, I am a co-author of over 500 peer-reviewed journal articles. I included those where I have made a substantial contribution below. The full list is available here through https://inspirehep.net, which also serves as the source for the number of citations of the publications (updated on 28.05.2024).

Selection of five most significant publications

1. **ATLAS Collaboration**. 2024. "Search for heavy resonances in four-top-quark final states in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector." Eur. Phys. J. C 84 (2024) 157.
   https://doi.org/10.1140/epjc/s10052-023-12318-9. 4 citations.
   Personal contributions: leadership of analysis, statistical analysis, signal simulation, analysis software.

2. **ATLAS Collaboration**. 2023. "ATLAS flavour-tagging algorithms for the LHC Run 2 pp collision dataset." Eur.Phys.J.C 83 (2023) 7, 681.
   https://doi.org/10.1140/epjc/s10052-023-11699-1. 160 citations.
   Personal contributions: leadership of the publication, performance studies.

3. **ATLAS Collaboration**. 2021. "Search for dark matter produced in association with a Standard Model Higgs boson decaying into b-quarks using the full Run 2 dataset from the ATLAS detector." JHEP 11 (2021) 209.
   https://doi.org/10.1007/JHEP11(2021)209. 61 citations.
   Personal contributions: analysis software maintenance, derivation software and requests, optimisation of missing transverse momentum significance, study of tight-jet cleaning.

4. **ATLAS Collaboration**. 2021. "Search for dark matter produced in association with a dark Higgs boson decaying to WW or ZZ in fully hadronic final states using pp collisions at $\sqrt{s} = 13$ TeV recorded with the ATLAS detector." Phys. Rev. Lett. 126, 121802.
   https://doi.org/10.1103/PhysRevLett.126.121802. 23 citations.
   Personal contributions: main analyser (of 2), analysis software development and maintenance, analysis strategy, track-assisted-reclustered jet optimisation, statistical analysis, signal simulation.

5. **ATLAS Collaboration**. 2018. "Search for dark matter in events with a hadronically decaying vector boson and missing transverse momentum in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector." JHEP 10 (2018) 180.
   https://doi.org/10.1007/JHEP10(2018)180. 132 citations.
   Personal contributions: main analyser (of 2), analysis software maintenance, estimate of multi-jet background, statistical analysis.

Published peer-reviewed journal articles

1. **Barr, S., P. Gadow., et al.** 2024. "Umami: A Python toolkit for jet flavour tagging." Journal of Open Source Software, 9(102), 5833.
   https://doi.org/10.21105/joss.05833. 0 citations.

2. **ATLAS Collaboration**. 2024. "Search for top-philic heavy resonances in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector." Eur. Phys. J. C 84 (2024) 157.
   https://doi.org/10.1140/epjc/s10052-023-12318-9. 4 citations.

3. **ATLAS Collaboration**. 2023. "Search for single vector-like B quark production and decay via $B \to bH(bb)$ in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector." JHEP 11 (2023) 168.
   https://doi.org/10.1007/JHEP11(2023)168. 7 citations.

4. **ATLAS Collaboration**. 2023. "ATLAS flavour-tagging algorithms for the LHC Run 2 pp collision dataset." Eur.Phys.J.C 83 (2023) 7, 681.
   https://doi.org/10.1140/epjc/s10052-023-11699-1. 160 citations.

5. **ATLAS Collaboration**. 2021. "Search for dark matter produced in association with a Standard Model Higgs boson decaying into b-quarks using the full Run 2 dataset from the ATLAS detector." JHEP 11 (2021) 209.
   https://doi.org/10.1007/JHEP11(2021)209. 61 citations.

6. **ATLAS Collaboration**. 2021. "Search for dark matter produced in association with a dark Higgs boson decaying to WW or ZZ in fully hadronic final states using pp collisions at $\sqrt{s} = 13$ TeV recorded with the ATLAS detector." Phys. Rev. Lett. 126, 121802.
   https://doi.org/10.1103/PhysRevLett.126.121802. 23 citations.

7. **ATLAS Collaboration**. 2019. "Combination of Searches for Invisible Higgs Boson Decays with the ATLAS Experiment." Phys. Rev. Lett. 122, 231801.

https://doi.org/10.1103/PhysRevLett.122.231801. 197 citations.

8. **ATLAS Collaboration**. 2019. "Constraints on mediator-based dark matter and scalar dark energy models using $\sqrt{s} = 13$ TeV pp collision data collected by the ATLAS detector." JHEP 1905 (2019) 142. https://doi.org/10.1007/JHEP05(2019)142. 165 citations.

9. **ATLAS Collaboration**. 2018. "Search for dark matter in events with a hadronically decaying vector boson and missing transverse momentum in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector." JHEP 10 (2018) 180. https://doi.org/10.1007/JHEP10(2018)180. 132 citations.

Conference Publications

The ATLAS Collaboration also produces internally-reviewed "conference notes" and "public notes" in advance of conferences, so that results may be discussed with colleagues in other experiments and in the theory community. Conference notes are removed from the following list when they have been superseeded by a peer-reviewed publication.

1. **Bhatti, Z.**, K. Cranmer, I. Espejo, L. Heinrich, P. Gadow, P. Rieck, J. von Ahnen. "Efficient Search for New Physics Using Active Learning in the ATLAS Experiment". 2024. EPJ Web Conf. 295 (2024) 09013. https://doi.org/10.1051/epjconf/202429509013.

2. **ATLAS Collaboration**. "Active Learning reinterpretation of an ATLAS Dark Matter search constraining a model of a dark Higgs boson decaying to two b-quarks." 2022. ATL-PHYS-PUB-2022-045. http://cds.cern.ch/record/2839789.

3. **Malik, S.**, P. Gadow et al. "Software Training in HEP." 2021. Comput.Softw.Big Sci. 5 (2021) 1, 22. https://doi.org/10.1007/s41781-021-00069-9.

4. **Cieri, D.**, P. Gadow et al. "A Lightweight First-Level Muon Track Trigger for Future Hadron Collider Experiments." 2019. PoS TWEPP2018 (2019) 051. https://doi.org/10.22323/1.343.0051.

5. **Abovyan, S.**, P. Gadow et al. "First-level muon track trigger for future hadron collider experiments." 2019. Nucl.Instrum.Meth.A 936 (2019) 321-322. https://doi.org/10.1016/j.nima.2019.01.035.

6. **ATLAS Collaboration**. 2019. "RECAST framework reinterpretation of an ATLAS Dark Matter Search constraining a model of a dark Higgs boson decaying to two b-quarks." ATL-PHYS-PUB-2019-032. https://cds.cern.ch/record/2686290.

7. **ATLAS collaboration**. 2018. "Search for Dark Matter Produced in Association with a Higgs Boson Decaying to bb at √s = 13 TeV with the ATLAS Detector using 79.8 fb^{-1} of pp collisions." ATLAS-CONF-2018-039. https://cds.cern.ch/record/2632344.

8. **Gadow, P.** 2018. "Search for dark matter produced in association with a hadronically decaying Z' vector boson with the ATLAS detector at the LHC." PoS LHCP2018 (2018) 016. https://doi.org/10.22323/1.321.0016.

9. **Abovyan, S.**, P. Gadow et al. "Hardware Implementation of a Fast Algorithm for the Reconstruction of Muon Tracks in ATLAS Muon Drift-Tube Chambers for the First-Level Muon Trigger at the HL-LHC." 2017. Proceedings, 2017 IEEE Nuclear Science Symposium and Medical Imaging Conference and 24th international Symposium on Room-Temperature Semiconductor X-Ray & Gamma-Ray Detectors (NSS/MIC 2017). https://doi.org/10.1109/NSSMIC.2017.8532900.

10. **Gadow, P.**, O. Kortner, S. Kortner, H. Kroha, F. Müller, R. Richter. "Performance of a First-Level Muon Trigger with High Momentum Resolution Based on the ATLAS MDT Chambers for HL-LHC." 2016. Proceedings, 2015 IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC 2015). https://doi.org/10.1109/NSSMIC.2015.7581794.

11. **Nowak, S.**, P. Gadow et al. "Optimisation of the Read-out Electronics of Muon Drift-Tube Chambers for Very High Background Rates at HL-LHC and Future Colliders." 2016. Proceedings, 2015 IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC 2015). https://doi.org/10.1109/NSSMIC.2015.7581815.

Technical Design Reports

1. **ATLAS Collaboration**. 2017. ”Technical Design Report for the Phase-II Upgrade of the ATLAS Muon Spectrometer.” CERN-LHCC-2017-017.
https://cds.cern.ch/record/2285580.

Presentations

Invited Talks

July 2023. *Heavy flavor jet tagging algorithms in ATLAS*. Invited talk: To b or not to b - CMS BTV Workshop 2023, Brussels, Belgium.
https://indico.cern.ch/event/1274182/contributions/5458302/.

Feb 2020. *Dark matter searches with the ATLAS detector at the LHC*. Seminar talk: Cavendish Laboratory HEP Seminar, Cambridge, United Kingdom.

International Conferences

Mar 2024. *A Scalable Platform for Training and Inference Using Kubeflow at CERN*. Workshop talk: Kubeflow Summit Europe, Paris, France.
https://sched.co/1YFhA/.

Feb 2024. *Educational Outreach with AI-Assisted CERN Open Data Analysis*. Workshop talk: 1st Large Language Models in Physics Symposium, Hamburg, Germany.
https://indico.desy.de/event/38849/contributions/162122.

Jul 2023. *Searches for new phenomena in final states with 3rd generation quarks using the ATLAS detector*. Conference talk: SUSY2023, Southampton, United Kingdom.
https://indico.cern.ch/event/1214022/contributions/5461065/.

Jul 2022. *Searches for new phenomena in final states with 3rd generation quarks using the ATLAS detector*. Conference talk: PHENO2023, Pittsburgh, United States of America.
https://indico.cern.ch/event/1089132/contributions/4855516/.

Jul 2019. *ATLAS Highlights on Dark Matter Searches in Exotic Models*. Conference talk: XIII International Workshop on Interconnections between Particle Physics and Cosmology, Cartagena, Columbia.

Oct 2018. *Search for dark matter produced in association with a Higgs boson decaying to bb*. Young Scientist Forum talk: Puzzle of Dark Matter Workshop, DESY Hamburg, Germany.
https://indico.desy.de/event/19155/contributions/34313/.

Jun 2018. *Search for Dark Matter in association with a hadronically decaying Z' vector boson with the ATLAS detector in pp collisions at 13 TeV*. Poster: Sixth Annual Conference on Large Hadron Collider Physics, Bologna, Italy.
https://indico.cern.ch/event/681549/contributions/2956249/.

National Conferences

Sep 2019. *Signal reweighting using BDTs*. Parallel talk: ATLAS Germany Meeting, Munich, Germany.
https://indico.cern.ch/event/811522/contributions/3541796.

Mar 2019. *Dark Matter + Mono-h(bb): How to get rid of the multijet background using the object-based E_T^{miss} significance*. Parallel talk: DPG spring meeting, Aachen, Germany.

Sep 2018. *Object-based E_T^{miss} significance in Mono-H($\bar{b}b$)*. Parallel talk: ATLAS Germany Meeting, Freiburg, Germany.
https://indico.cern.ch/event/700593/contributions/3092043/.

Mar 2018. *Search for Dark Matter produced in association with a hadronically decaying W or Z boson with ATLAS Run-2 data*. Parallel talk: DPG spring meeting, Würzburg, Germany.

Mar 2017. *Search for Dark Matter produced in association with a hadronically decaying W or Z boson with ATLAS Run-2 data*. Parallel talk: DPG spring meeting, Münster, Germany.

Mar 2017. *Development of a new Level-0 Muon Trigger for the ATLAS Experiment at High-Luminosity-LHC*. Parallel talk: DPG spring meeting, Münster, Germany.

Mar 2016. *Development of fast track reconstruction algorithms for the ATLAS MDT-precision-chamber-based Level-0 Muon Trigger at HL-LHC*. Parallel talk: DPG spring meeting, Hamburg, Germany.

Mar 2016. *Study of the MDT-precision-chamber-based Level-0 Muon Trigger selectivity for the ATLAS experiment at HL-LHC*. Parallel talk: DPG spring meeting, Hamburg, Germany.