

# Philipp Gadow

## Curriculum Vitae

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### Employment and education

- Mar 2023+ **Senior Research Fellow**, CERN, Meyrin, Switzerland
- Nov 2020–Feb 2023 **Postdoctoral Research Fellow**, Deutsches Elektronensynchrotron DESY, Hamburg, Germany
- Sep 2016–Oct 2020 **PhD Physics**, Max-Planck-Institut für Physik, Munich, Germany  
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
- 2013–2016 **M.Sc. Particle Physics**, Technical University of Munich, Munich, Germany  
Thesis: Development of a Concept for the Muon Trigger of the ATLAS Detector at the HL-LHC
- Winter 2013 **Erasmus SMS**, University of Edinburgh, Edinburgh, United Kingdom
- 2010–2013 **B.Sc. Physics**, Technical University of Munich, Munich, Germany  
Thesis: dE/dx studies with pion and electron tracks of the ALICE GEM IROC prototype

### Leadership

- 2023+ **Analysis contact**, ATLAS experiment  
Co-coordination (3 contacts) of the combined Run-2 and Run-3 multi-top-quark search.
- 2021–2023 **Flavour tagging algorithms sub-group convener**, ATLAS experiment  
Co-coordination (2 conveners) of a group consisting of 40 physicists working on machine learning algorithms for the identification of heavy-flavour jets at the ATLAS experiment.
- 2021–2023 **Analysis contact**, ATLAS experiment  
Coordination of a search for vector-like  $B$  quarks decaying to  $H(\gamma\gamma) + b$ .
- 2021–2023 **Analysis contact**, ATLAS experiment  
Co-coordination (2 contacts) of the heavy resonances search in four-top-quark final states.

### Research experience

#### Searches for heavy particles

- 2020+ **Search for heavy resonances in four-top-quark final states**  
*Explicit resonance search in challenging four-top-quark final state.*  
For a Run-2 analysis, I co-lead the analysis team, maintained the analysis software and contributed to fitting studies and studied the simulation of signal processes. Currently, I co-lead the combined Run-2 and Run-3 search for signatures of physics beyond the Standard Model in three- and four-top-quark final states.

#### Searches for dark matter

- 2018–2021 **Dark matter search with dark Higgs bosons decaying to vector boson pairs**  
*The first exploration of the signature with missing transverse momentum and resonantly produced vector boson pair, using a novel track-assisted-reclustering jet algorithm.*  
I was the central analyser, responsible for all essential parts of this new analysis, involving signal process simulation, analysis strategy design, analysis software, distributed computing, and statistical analysis.

2017–2021 **Dark matter searches with Higgs bosons decaying to  $b$ -quarks**

*Unprecedented sensitivity to Higgs bosons with large recoil by using jets built from inner detector tracks with a variable radius. The results provide highly competitive constraints on dark matter models with extended Higgs sector.*

I was a central analyser in the search using the partial Run-2 data collected during 2015–2017 and contributed to the full Run-2 search. In the former, I was responsible for the analysis software, producing the fit inputs, the statistical analysis, the commissioning of a new object-based missing transverse momentum significance, and the multijet background estimate. In the latter, I contributed to maintaining the derivation datasets and the optimisation of the object-based missing transverse momentum significance-based selection requirements.

2016–2018 **Dark matter search with hadronically decaying vector bosons**

*Reconstruction of hadronic vector boson decays using jet substructure and jet flavour tagging information. Relevant signature for simplified dark matter models, models with extended Higgs sector and searches for invisible Higgs boson decays.*

I was a central analyser (of 2), responsible for the analysis software, distributed computing, and statistical analysis. I developed and evaluated a method for estimating the multijet background. Further, I was a liaison for incorporating the results for a summary publication, their reinterpretation in terms of a model with an extended Higgs sector and contributed to their use in a combination of searches for invisible Higgs boson decays.

ATLAS combined performance

2023+ **Lepton isolation**

*The identification of prompt leptons is instrumental for analyses investigating leptonic top quark decays. Machine learning techniques are used for separating prompt leptons from those produced in decays of heavy flavour hadrons.*

Using the techniques pioneered in jet flavour tagging, I develop algorithms based on transformer models to identify leptons from  $W$  and  $Z$  boson decays.

2021+ **Flavour tagging algorithms**

*Jet flavour tagging underpins a large part of the ATLAS physics programme. Machine learning techniques are used for inferring the jet flavour.*

I contribute to the development of the next generation of recommended flavour tagging algorithms for Run-3 ATLAS physics analysis. During the years 2021–2023 I co-lead the flavour tagging algorithms sub-group.

Reinterpretation and reproducible research

2019–2023 **ATLAS RECAST reinterpretation framework**

*Preservation and automated reinterpretation of searches drastically increase their relevance to a broader class of theoretical models. All recently published ATLAS searches are required to provide a RECAST reinterpretation framework implementation.*

I coordinated the reinterpretation of a dark matter search with Higgs bosons decaying to  $b$ -quarks in terms of a dark Higgs model with the RECAST framework and co-edited the first dedicated public note on RECAST. Further, I am interested in improving the limit setting in searches by exploiting active learning algorithms based on RECAST.

Detector development

2023+ **Characterisation of 65 nm CMOS silicon detectors**

*Within the CERN EP R&D group new module concepts for hybrid and monolithic CMOS pixel detectors are investigated for their use at future collider facilities.*

I characterise the new silicon devices CLICpix2 and H2M as part of the CERN EP R&D group with Dominik Dannheim in collaboration with DESY Hamburg. I equalised the non-uniformity of the pixel response and calibrated the collected charge using X-ray absorption from fluorescence and the absorption of radiation from radioisotope sources with known gamma-ray peaks.

## Upgrade studies

### 2015–2017 **First-level muon trigger for High-Luminosity-LHC**

*Highly selective first-level muon triggers are essential for the ATLAS experiment at the High-Luminosity LHC. Including the precision monitored-drift-tube information substantially increases the trigger selectivity.*

I studied a concept for a highly selective muon trigger, which is included in the Technical Design Report for the Phase-II Upgrade of the ATLAS Muon Spectrometer. Further, I studied fast track reconstruction algorithms which can be applied at the trigger-level.

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## Talks and posters

### Invited talks

July 2023 **Heavy flavor jet tagging algorithms in ATLAS**, *To b or not to b - CMS BTV Workshop 2023*, Brussels, Belgium, plenary talk

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

### International conferences

Jul 2023 **Searches for new phenomena in final states with 3rd generation quarks using the ATLAS detector**, *SUSY2023*, Southampton United Kingdom, conference talk

Jul 2022 **Searches for new phenomena in final states with 3rd generation quarks using the ATLAS detector**, *PHENO2023*, Pittsburgh, United States of America, conference talk

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

Oct 2018 **Search for dark matter produced in association with a Higgs boson decaying to  $b\bar{b}$** , *Puzzle of Dark Matter Workshop*, DESY Hamburg, Germany, Young Scientist Forum talk

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**, *Sixth Annual Conference on Large Hadron Collider Physics*, Bologna, Italy, poster

### National conferences

Sep 2019 **Signal reweighting using BDTs**, *ATLAS Germany Meeting*, Munich, Germany, parallel talk

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

Sep 2018 **Object-based  $E_T^{\text{miss}}$  significance in Mono-H( $b\bar{b}$ )**, *ATLAS Germany Meeting*, Freiburg, Germany, parallel talk

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

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

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

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

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

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## Awards

- 2010-2016 **Full scholarship**  
Studienstiftung des deutschen Volkes (German Academic Scholarship Foundation)  
*The German Academic Scholarship Foundation is Germany's largest and most prestigious scholarship foundation. Scholarships are awarded to fewer than 0.5% of German students.*
- 2014 **Teaching award**  
Goldene Kreide der Physikfachschaft  
*The "Goldene Kreide" is awarded annually by the student council of the physics department to distinguish outstanding student tutors.*

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## Schools

- Jul 2019 **Fifth Machine Learning in High Energy Physics Summer School 2019**, DESY, Hamburg, Germany, 10 days
- Sep 2017 **49. Herbstschule für Hochenergiephysik 2019**, University of Siegen, Maria Laach, Germany, 10 days

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## Student supervision

### Graduate Students

- 2022–2023 **Jackson Barr**, DESY / University College London (Physics)  
Flavour tagging algorithm development
- 2021–2023 **Elisaveta Sitnikova**, DESY / University of Hamburg (Physics)  
Search for heavy resonances in four-top-quark final states
- 2020–2022 **Alicia Wongel**, DESY / University of Hamburg (Physics)  
Search for heavy resonances in four-top-quark final states
- 2020–2022 **Janik von Ahnen**, DESY / University of Hamburg (Physics)  
Flavour tagging algorithm development, limits on a dark Higgs model with active learning

### Undergraduate Students

- 2023 **Laura Winkler**, University of Geneva Master Student  
Improved detection of charm jets using charged  $D^*$ -mesons
- 2022 **Stefan Katsarov**, DESY Summer Student  
Machine learning techniques for top quark reconstruction in four-top-quark final states
- 2021 **John Lawless**, DESY Summer Student  
Machine learning techniques for top quark reconstruction in four-top-quark final states

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## Teaching

- 2021 **SUSY+HDBS+Exotics RECAST Tutorial**, HEP Software Foundation, mentor
- 2020 **Docker training**, HEP Software Foundation, mentor
- 2020 **CI/CD pipelines training**, HEP Software Foundation, mentor
- 2016/17 **Mechanics**, TU Munich, tutor
- 2016/17 **Mechanics**, TU Munich, tutor
- 2012, 2014, 2017 **Electromagnetism and Special Relativity**, TU Munich, tutor
- 2012/13, 2015/16 **Optics**, TU Munich, tutor
- 2011/12, 2012/13 **Linear Algebra**, TU Munich, tutor

2011/12, **Maths introductory course for first-year students, TU Munich**, tutor  
2012/13

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## Outreach

### **CERN guide + science show host**

Guided tours for CERN visitors on the campus, virtual visits and guided visits to the ATLAS cavern, as well as science shows in the CERN Science Gateway.

### **ATLAS Masterclass**

High school students learn about the fundamentals of particle physics in lectures and engage in hands-on data analysis. I participated in ATLAS masterclasses by preparing and giving lectures and instructing the students in the hands-on session.

### **Science Slams**

Science slams are competitive 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.