Mathis Dubau

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Doctor in High Energy Physics and member of the ATLAS Collaboration. Skilled in Electroweak physics measurement via Vector Boson Scattering of longitudinal states, with the development of Machine Learning methods, and experienced in data analysis, statistical modelling, and Neural Networks development.

Education

2023 – 2026 **PhD in Particle Physics**, *Multivariate study of polarisation states in electroweak vector boson scattering WZ events using ATLAS data at the LHC*, Laboratoire d'Annecy de Physique des Particules, *Haute-Savoie*
Supervisor: Olivier ARNAEZ [1]

2021 – 2023 **Master's Degree in Physics**, *"Subatomic" path*, Université Claude Bernard Lyon 1, *Rhône*

2018 – 2021 **Bachelor's Degree in Physics**, Université de Bordeaux, *Gironde*

2015 – 2018 **Scientific High School Diploma**, *Physics-chemistry option*, Lycée François Mauriac, *Gironde*

Research activities

2023 – 2026 **Main Analysis**, *Polarisation in VBS* WZ *in Run-2+3*, Standard Model, [2]

- Development of a DNN-based method to extract the best precision for polarisation measurements
- Novel binning method using clustering algorithm and Voronoi region, increasing the significance greatly
- Statistical analysis
- On Arxiv [2] and in Submission, Presented at ICHEP 2026

2023 – 2025 **Application of AL to Theory**, *On the efficiency of parameter space exploration: A scotogenic case study*, Collaboration with Laboratoire d'Annecy de Physique Théorique (LAPTh), with Björn HERRMANN and Ugo DE NOYERS

- Hyper-parameter space scan via AL and DNN to a theoretical high-energy physics model: the scotogenic ones
- Comparison with their previous method using the Markov-Chain Monte Carlo method
- Edition of a paper on Arxiv [4] and in Submission in SciPost

2023 – 2026 **Combined Performance**, *Identification of forward electrons with ITk and HGTD in Run-4*, e/γ CP group, Supervisor: Jean-Baptiste DE VIVIE DE REGIE

- Development of new Working Points via DNN for forward electrons in Run-4 using the new variables provided by ITk and HGTD, increasing the track coverage to $|\eta| < 4.0$. Usage of the decorrelation technique to make the extrapolation at higher p_{T} more robust.
- DNN-based energy calibration for future forward electrons.
- Comparison with Run-3 to cross-check the potential loss of performance in this new workflow.
- Implementation within the ATLAS software framework Athena

March – July 2023 **Laboratory Internship, M2**, *Coverage extension studies for future polarization measurements in* WZ *events in the electroweak sector*, Laboratoire d'Annecy de Physique des Particules (LAPP), Supervisor: Olivier ARNAEZ

- Preliminary studies for the PhD thesis on the potential gain in sensitivity for polarisation measurement via an extension of ATLAS's tracker coverage for the HL-LHC

May – June 2022 **Laboratory Internship, M1**, *Application of machine learning to the sampling of high-dimensional supersymmetric parameter spaces*, Institut de Physique des 2 Infinis de Lyon (IP2I), Supervisors: Nazila MAHMOUDI and Mohamed Amine BOUSSEJRA

- Development of an Active Learning method to scan efficiently MSSM reduced phase space (PMSSM/NMFV) via DNN

May – June 2021 **Laboratory Internship, L3**, *Determination of the probability of 2 and 3 flavour neutrino oscillations*, Centre d'Études Nucléaires de Bordeaux-Gradignan (CENBG), Supervisor: Cécile JOLLET

Teaching and outreach

2024 – Present **CERN Guide**, Outreach, CERN, Geneva, Switzerland

1st semester 2024 **University lectures**, *Introduction to Python*, Teaching, Université Savoie Mont Blanc, Le Bourget-du-Lac, France

October 2024 **Journée de la Science**, Outreach, LAPP, Annecy, France

Talks and conferences

September 2026 WZ **Run-3 Umbrella Workshop 2026**, **Talk:** *VBS Run-3 polarisation: future plans*, Indico, LAPP, Annecy, France

June 2026 e/γ **Workshop 2026**, **Talk:** *Reconstruction plan and activities for Run-4*, Indico, Edinburgh, Scotland, UK

December 2025 **End-of-the-year Physics Workshop 2025**, **Talk:** e/γ *reconstruction perspective for Run-4*, Indico, CERN, Geneva, Switzerland

December 2025 **Journées de Rencontre des Jeunes Chercheurs**, **Talk:** *Polarisation measurements in* WZ *VBS production, proceeding [3]*, Indico, Côtes-d'Armor, France

October 2025 **WZ Run-3 Umbrella Workshop 2025**, **Talk:** *ML techniques for the enhancement of WZ VBS polarised final states*, Indico, CERN, Geneva, Switzerland

May 2025 **Physique ATLAS France 2025**, **Talk:** *Polarisation measurements in WZ VBS production*, Indico, LAPP, Annecy, France

May 2025 **e/γ Workshop 2025**, **Talk:** *Forward electrons in Run-3 and Run-4*, Indico, CERN, Geneva, Switzerland

November 2024 **Jagiellonian University Physics Department**, **Talk:** *Machine learning for polarisation measurement in VBS at the LHC (seminar)*, Krakow, Poland

September 2024 **COMETA Workshop on Vector Boson Polarisation**, *Workshop*, Indico, L2IT, Toulouse, France

April 2024 **e/γ Workshop 2024**, *Workshop*, Indico, Valencia, Spain

Regular talks in ATLAS meetings

2025 – 2026 **SM and EB reviews**, WZ *VBS polarisation*

2024 – 2026 **SM Electroweak group**, WZ *VBS analysis status reports*

2024 – 2026 **e/γ plenary**, *Upgrade studies: HL-LHC forward electron identification and calibration*

2023 – 2026 **Informal Electroweak**, WZ *leptonic analysis, full Run-2 and Run-3*

Schools

November 2025 **École de GIF: les futurs collisionneurs et leur physique**, Indico, IPHC, Strasbourg, France

July 2025 **CERN School of Computing CSC 2025**, Indico, Lund, Sweden

October 2024 **European School of High-Energy Physics ESHEP 2024**, Indico, Peebles, Scotland, UK

Technical Skills

Programming Python (advanced), C, C++ (proficient), ROOT, bash, Fortran (minimal)

Data Analysis Pandas, Numpy, Matplotlib, Plotly

ML TensorFlow, Keras, Scipy, Scikit-learn, XGboost, TMVA

Software LaTeX, Tikz, Beamer, Git, Docker, Athena

Languages

French Native language

Spanish A2-B1 – High School level

English C1 – Fluent

Italian A1-A2 – Currently learning

Interests

Sports Triathlon, Marathon, badminton

Hobbies Board games, movies

References

[1] M. Dubau, *Multivariate study of polarisation states in electroweak vector boson scattering WZ events using ATLAS data at the LHC*, PhD thesis: Université Savoie Mont Blanc, 2026, URL: https://repository.cern/records/cw32k-7w243.

[2] ATLAS Collaboration, *Evidence for longitudinally polarised Z bosons in electroweak $\mathrm{W}^{\pm}\mathrm{Z}$ production in association with two jets from pp collisions at $\sqrt{s} = 13\,\mathrm{TeV}$ and $\sqrt{s} = 13.6\,\mathrm{TeV}$ with the ATLAS Detector*, 2026, arXiv: 2607.20246 [hep-ex], URL: https://arxiv.org/abs/2607.20246.

[3] *JRJC 2025 - Journées de Rencontre Jeunes Chercheur×se×s. Book of Proceedings*, Saint-Jacut de la Mer, France, 2026, URL: https://hal.science/hal-05634943.

[4] U. de Noyers, M. Dubau, B. Herrmann and O. Arnaez, *On the efficiency of parameter space exploration: A scotogenic case study*, 2025, arXiv: 2512.06378 [hep-ph], URL: https://arxiv.org/abs/2512.06378.