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Education

2018-today (Palaiseau, France)	UNIVERSITÉ PARIS-SACLAY. **Ph.D.** candidate in *hardware oriented AI*.
2017-2018 (Paris, France)	ÉCOLE NORMALE SUPÉRIEURE. **M.Sc.** in Statistical and Quantum Physics.
2014-2017 (Paris, France)	ÉCOLE POLYTECHNIQUE. **M.Sc.** in Physics, **B.Sc.** in Applied Mathematics, Quantum Physics and Computer Science. Joined through a nationwide competitive exam, *ranked 31 out of 770 applicants.*
2012-2014 (Orsay, France)	LYCÉE BLAISE PASCAL. Classe préparatoire MP*. Intensive undergraduate program in Mathematics, Physics and Computer Science.

Research Experience

2018-today (Orsay, France)	UNIVERSITÉ PARIS-SACLAY. **Ph.D.** supervised by Damien Querlioz and Liza Herrera-Diez.

— <u>Relevant topics</u> : continual learning, biologically plausible deep learning, optimization, hardware design.
— <u>Collaborators for AI</u> : Benjamin Scellier (Google Zurich), Yoshua Bengio (Mila).
— <u>Collaborators for hardware</u> : Julie Grollier (UM-Φ CNRS, Thales), Jean-Michel Portal (Aix-Marseille Université), Elisa Vianello (CEA Leti).
— <u>Contributions</u> : 6 first author contributions (**3 journal publications**, 3 conference acceptances) in machine learning, physics and neuroscience, **1 paper award**.
— <u>Description</u> : I have been working on equilibrium propagation, a learning algorithm promising for on-chip learning. I showed that it could scale to deeper networks trained on natural scenes by estimating the loss gradient more accurately. I also developed a way to reduce 'catastrophic forgetting' in binarized neural networks without computational overhead by discovering links between synaptic models from computational neuroscience and binary optimization. On the hardware side, I upgraded a synapse design using emerging resistive memory technology from binary to ternary quantization, consistently increasing the model accuracy without overhead.

2018, 4 months (Orsay, France)	CENTRE FOR NANOSCIENCE AND NANOTECHNOLOGY. **Research assistant** in device physics in the Integnano team. Carried numerical simulations to study magnetic properties for the the design of a complex artificial synapse. Led to **one conference acceptance** (presenting author).
2017, 4 months (Paris, France)	ÉCOLE NORMALE SUPÉRIEURE (STATISTICAL PHYSICS LAB). **Research assistant** in Lydéric Bocquet team. Solved the problem of measuring friction forces on wet surfaces by designing a tribometer with a macroscopic tuning fork. Led to **one journal paper** (second author).

Teaching Experience

Orsay, France (2018-today)	UNIVERSITÉ PARIS-SACLAY. Taught children from 6 to 14 years old complex scientific concepts through practical tutorials on hydrodynamics, energy production and computer science.
Orsay, France (2015-2016)	LYCÉE BLAISE PASCAL. Trained undergraduate students in Mathematics, as an oral examiner, for the challenging entrance exams to top French engineering schools (two hours each week).

Computer skills

Deep learning	Python (PyTorch), standard libraries for data analysis (e.g. Pandas).
Software project	PHP, JavaScript (jQuery), MySQL.
Workflow	Git (code versioning), Vim (code editing), LaTeX (academic writing).

Journal Papers

1   **Laborieux, A.**, Ernoult, M. Hirtzlin, T. & Querlioz, D. (2021) Synaptic Metaplasticity in Binarized Neural Networks, <u>Nature Communications</u>, accepted

2   **Laborieux, A**, Ernoult, M., Scellier, B., Bengio, Y., Grollier, J., & Querlioz, D. (2021). Scaling equilibrium propagation to deep convnets by drastically reducing its gradient estimator bias. <u>Frontiers in neuroscience</u>, 15, 129.

3   **Laborieux, A.**, Bocquet, M., Hirtzlin, T., Klein, J. O., Nowak, E., Vianello, E., Portal, J-M & Querlioz, D. (2020). Implementation of Ternary Weights With Resistive RAM Using a Single Sense Operation per Synapse. <u>IEEE Transactions on Circuits and Systems I : Regular Papers</u>.

4   Diez, L. H., Liu, Y. T., ..., **Laborieux, A.**, ... & Ravelosona, D. (2019). Nonvolatile ionic modification of the Dzyaloshinskii-Moriya interaction. <u>Physical Review Applied</u>, 12(3), 034005.

5   Canale, L., **Laborieux, A.**, Mogane, A. A., Jubin, L., Comtet, J., Lainé, A., ... & Niguès, A. (2018). MicroMegascope. <u>Nanotechnology</u>, 29(35), 355501.

Conferences

1   **Laborieux, A.**, Ernoult, M. Hirtzlin, T. & Querlioz, D. Synaptic Metaplasticity in Binarized Neural Networks, <u>Computational and Systems Neuroscience (Cosyne) 2021</u>

2   **Laborieux, A**, Ernoult, M., Scellier, B., Bengio, Y., Grollier, J., & Querlioz, D. Scaling equilibrium propagation to deep convnets by drastically reducing its gradient estimator bias. <u>NeurIPS 2020 Workshop</u>, 'Beyond BackPropagation : Novel Ideas for Training Neural Architectures)

3   **Laborieux, A.**, Bocquet, M., Hirtzlin, T., Klein, J. O., Diez, L. H., Nowak, E., ... & Querlioz, D. (2020, March). Low power in-memory implementation of ternary neural networks with resistive RAM-based synapse. In Proceedings of the 2020 2nd IEEE <u>International Conference on Artificial Intelligence Circuits and Systems</u> (AICAS) (pp. 136-140). **2**$^{\text{nd}}$ **Best Paper Award**

4   Herrera-Diez, L., Liu, Y., ... **Laborieux, A.**, ... & Ocker, B. (2020, August). Electric field control of magnetism. In Proceedings of <u>Spintronics XIII</u> (Vol. 11470, p. 114703G). International Society for Optics and Photonics. (Presenting author)

5   **Laborieux, A.**, Hirtzlin, T., Herrera-Diez, L., & Querlioz, D. Memory Effects in Binarized Neural Networks, *X-Data Science Summer School 2019*

Additional Experiences & Skills

Military	French Military Police Force (Coulommiers, France, from Sep 2014 to Feb 2015).
Language	French (native), English (full professional), Chinese (full professional, HSK 5 in 2017).