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# Anna Dawid

Research Fellow

github.com/Shmoo137
@MolecularRobot

- Quantum physics
- Interpretable deep learning
- Ultracold molecules
- Quantum simulations

**Impact:** 11 scientific publications with 110+ citations, 2 funded research proposals, 3 awards, 1 invited talk, 14 contributed talks, 13 posters, and 20+ invited seminars

## Education and postdoctoral experience

**Research fellow,** Center of Computational Quantum Physics, Flatiron Institute, New York **Oct 2022 — now**

**Ph.D. in Physics (with honours),** University of Warsaw & ICFO - The Photonic Sciences, Barcelona, co-tutelle **Oct 2017 — Sept 2022**
Supervised by Prof. Michał Tomza & Prof. Maciej Lewenstein.
Interpretable machine learning for physical problems & Quantum simulations with ultracold molecules.

**M.Sc. in Chemistry (with honours),** University of Warsaw, speciality: Theoretical quantum chemistry **Oct 2015 — Jun 2017**
Supervised by Prof. Michał Tomza & Prof. Grzegorz Chałasiński. On two trapped ultracold molecules.

**B.Sc. in Chemistry,** University of Warsaw, speciality: Theoretical quantum chemistry **Oct 2012 — Jun 2015**
Supervised by Prof. Michał Tomza. On controlling Feshbach resonances with non-resonant laser field.

**B.Sc. in Biotechnology,** University of Warsaw, speciality: Molecular Biology **Oct 2012 — Jun 2015**
Supervised by Prof. Jan Fronk. On genetic mechanisms diversifying the proteome.

## Research

**Interpretable neural networks in physics,** ICFO, Universität Hamburg, & University of Warsaw **Jan 2019 — now**

- Hessian-based toolbox to interpret neural networks trained to recognize phases in 1D Fermi-Hubbard model and in experimental topological data (collaboration with Univ. of Hamburg). The toolbox provides a notion of similarity learnt by a model as well as uncertainty of its predictions
- Part of the grant *Preludium* awarded by Polish National Science Centre
- Results presented in three **publications**, in seven **talks**, e.g., on ML in PL Conference 2019 and 2021, CMD 2020, AMLD EPFL 2021, and eight **seminars** including PIQuIL in Waterloo, University of Toronto, University of British Columbia, and Max-Planck-Institute for Quantum Optics in Garching

**Quantum simulations with ultracold molecular systems,** University of Warsaw & ICFO **Jun 2016 — now**

- Study of two and more ultracold molecules in traps, their magnetic properties, and quench dynamics
- Results presented in the **MSc. thesis**, two **publications**, two **talks** on 61st Meeting of Polish Chemical Society (Cracow, Poland) and Quantum Optics X in Toruń and **posters**, e.g., on 26th ICAP (Barcelona, Spain), ITAMP workshop (Cambridge, USA), Les Houches School on Ultracold Fermions (France), and two **seminars** in Warsaw.

**Investigation of deprotonation/protonation of highly charged particles,** University of California, Irvine, USA **Jun 2015 — Sept 2015**

- Experimental study on how pH gradient impacts the transport of particles through a nanopore
- Results presented in the **publication** and as the **poster** (by Y. Qiu) on 61st Annual Meeting of Biophysical Society (New Orlean, USA)

## Organizational and Teaching Experience

**Coordinator** of the Summer School: Machine Learning in Quantum Physics and Chemistry **Feb 2021 — Sept 2021**
University of Warsaw https://ml2021.ckc.uw.edu.pl/

- Organization of the two-week summer school with lectures, specialized talks, and tutorials
- Responsible for contacting the lecturers and participants, forming the scientific program, preparing 10-hour tutorials accompanying the school, and supervising the finances and documentation related to the project.

**Teaching assistant** of the Machine Learning course **2019 — 2022**
University of Warsaw 3 winter semesters

- Highly rated by students (4.96/5.00).
- Preparing the majority of the course programming syllabus (Jupyter notebooks available on GitHub): decision trees, spam with Bayes classifier, support vector machines, neural networks.

## Skills

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| **Physics** | ultracold physics, molecules, quantum simulations |
| **Machine learning** | deep learning, interpretability methods, supervised and unsupervised learning |
| **Programming and numerics** | C++, Python, exact diagonalization |

## Publications

1. Sabanayagam, M., Behrens, F., Adomaityte, U. & **Dawid**, **A.** *Dissecting the decision boundary via the Hessian: A perspective on generalization* in *submitted to ICML* (2023).
2. **Dawid, A., et al**. *Modern applications of machine learning in quantum sciences* in press (Cambridge University Press, 2023).
3. Suchorowski, M., **Dawid**, **A.** & Tomza, M. Two highly magnetic atoms in a one-dimensional harmonic trap. *Phys. Rev. A* **24,** 015001 (2022).
4. Sroczyńska, M., **Dawid**, **A.**, Tomza, M., Calarco, T., Idziaszek, Z. & Jachymski, K. Controlling the dynamics of ultracold polar molecules in optical tweezers. *New J. Phys.* **24,** 015001 (2022).
5. **Dawid**, **A.**, Huembeli, P., Tomza, M., Lewenstein, M. & Dauphin, A. Hessian-based toolbox for reliable and interpretable machine learning in physics. *Mach. Learn.: Sci. Technol.* **3,** 015002 (2022).
6. Käming*, N., **Dawid***, **A.**, Kottmann*, K., Lewenstein, M., Sengstock, K., Dauphin, A. & Weitenberg, C. Unsupervised machine learning of topological phase transitions from experimental data. *Mach. Learn.: Sci. Technol.* **2,** 035037 (2021).
7. **Dawid**, **A.** & Tomza, M. Magnetic properties and quench dynamics of two interacting ultracold molecules. *Phys. Chem. Chem. Phys.* **22,** 28140–28153 (2020).
8. **Dawid**, **A.**, Huembeli, P., Tomza, M., Lewenstein, M. & Dauphin, A. Phase Detection with Neural Networks: Interpreting the Black Box. *New J. Phys.* **22,** 115001 (2020).
9. Dawid, L., Tomza, M. & **Dawid**, **A.** Estimation of Usable Area of Flat-Roof Residential Buildings Using Topographic Data with Machine Learning Methods. *Remote Sens.* **11,** 2382 (2019).
10. **Dawid**, **A.**, Lewenstein, M. & Tomza, M. Two ultracold interacting molecules in a one-dimensional harmonic trap. *Phys. Rev. A* **97.** (Editors' Suggestion), 063618 (2018).
11. Qiu, Y., **Dawid**, **A.** & Siwy, Z. Experimental Investigation of Dynamic Deprotonation / Protonation of Highly Charged Particles. *J. Phys. Chem. C* **121,** 6255–6263 (2017).

## Awards & Grants

- **START 2022** fellowship of the Foundation for Polish Science for the best young scientists under thirty
- **Etiuda 8** grant no. 2020/36/T/ST2/00588 (National Science Centre, Poland), 132 688 PLN (≈€30 000), Jan 2021 - Sept 2022, *"Quantum many-body physics with ultracold atoms and molecules: exact dynamics and machine learning"*
- **Preludium 17** grant no. 2019/33/N/ST2/03123 (National Science Centre, Poland), 69 600 PLN (≈ €15 000), Feb 2020 - Jan 2022, *"Can an artificial neural network teach us quantum physics?"*
- **Polish Chemical Society's prize** of Prof. Jacek Rychlewski for the best Master's thesis in quantum chemistry or using quantum chemistry methods in different areas of science in the academic year 2016/2017
- **Scholarships of Polish Minister of Science and Higher Education** for outstanding academic achievements in the academic years 2015/2016 and 2016/2017
- The Best Talk Audience Runner-up Award at ML in PL Conference 2021, Warsaw
- 2nd prize for the best student talk of 15th National Session of Physics Students' Associations

## Invited and contributed talks, selected posters, and seminars

**Invited talk,** Americal Physical Society March Meeting, Chicago, USA **14-18 March 2022**
*Towards interpretable and reliable machines learning physics.*

**Talk,** ML in PL Conference, Warsaw, Poland **6-7 Nov 2021**
*Let's open the black box! Hessian-based toolbox for interpretable and reliable machines learning physics.*

**Talk,** Applied Machine Learning Days, online **30 Sept 2021**
*Let's open the black box! Hessian-based toolbox for interpretable and reliable machines learning physics.*

**Talk,** Quantum Optics X, Toruń, Poland **6-10 Sept 2021**
*Magnetic and electric properties of ultracold molecular systems of increasing complexity.*

**Talk** (45-min), Quantum simulation in AMO physics and condensed matter, Cargèse, France **2-6 Aug 2021**
*Let's open the black box! Hessian-based toolbox for more interpretable and reliable machines learning physics.*

**Talk,** CMD2020GEFES, online **31 Aug 2020**
*Phase detection with neural networks: interpreting the black box.*

**Talk,** ML in PL Conference, Warsaw, Poland **22-24 Nov 2019**
*Can a learning machine teach us quantum physics?*

**Talk,** 61st PTChem 2018, Kraków, Poland **17-21 Sept 2018**
*Two interacting ultracold molecules in a one-dimensional harmonic trap.*

**Poster,** 26th International Conference on Atomic Physics, ICAP 2018, Barcelona, Spain **22-27 Jul 2018**
*Quantum magnetism with two ultracold molecules.*

**Seminars** at the Perimeter Institute Quantum Intelligence Lab (PIQuIL), Canada, Harvard University, Columbia University, Cornell University, University of Toronto, Max Planck Institute of Quantum Optics, Germany, University of British Columbia, JILA, Okinawa Institute of Science and Technology, Japan, University of Warsaw, Jagiellonian University, Poland, and more.