

# Alfred Kirsch

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## Summary

With a training in Mathematics and Physics, I am currently doing my PhD in Mathematics at CERMICS, École des Ponts and Materials Inria (Paris), under the supervision of Éric Cancès and David Gontier (PhD defense on 11/18/2024).

The subject is to mathematically analyse *embedding methods* such as Density Matrix Embedding Theory (DMET) or Dynamical Mean-Field Theory (DMFT). During my PhD, I have been involved in various teachings, the supervision of an intern and the organization of the bimonthly Young Researchers seminar at CERMICS (École des Ponts ParisTech).

## Preprints

- Cancès, E., Faulstich, F. M., Kirsch, A., Letournel, E., Levitt, A. (2023). Some mathematical insights on density matrix embedding theory. arXiv preprint arXiv:2305.16472. <https://doi.org/10.48550/arXiv.2305.16472>. Submitted to Communications on Pure and Applied Mathematics.
- Cancès, É., Kirsch, A., Perrin-Roussel, S. (2024). A mathematical analysis of IPT-DMFT. arXiv preprint arXiv:2406.03384. <https://doi.org/10.48550/arXiv.2406.03384>.
- Cancès, É., Kirsch, A., Perrin-Roussel, S. «A mathematical analysis of the discretized IPT-DMFT equations.» 2024, in preparation.

## Publications

- Schäfer, T., Wentzell, N., Šimkovic IV, F., He, Y. Y., Hille, C., Klett, M., ... Kirsch, A., ..., Georges, A. (2021). Tracking the footprints of spin fluctuations: A multimethod, multimessenger study of the two-dimensional Hubbard model. *Physical Review X*, 11(1), 011058. <https://doi.org/10.1103/PhysRevX.11.011058>.

## Current position

PhD in applied mathematics at CERMICS and Materials under the supervision of David Gontier and Éric Cancès. Subject: "A mathematical analysis of embedding methods in quantum mechanics." 2021-.

## Invited Talks

- A mathematical analysis of IPT-DMFT, EMC2 Roscoff'24, Roscoff (France), July 2024.

- A mathematical analysis of IPT-DMFT, Young Researchers Symposium, International Congress of Mathematical Physics, Strasbourg, June 2024.
- Mathematical insights on DMFT on a Hubbard model, Model Systems in Quantum Mechanics, Toulouse, January 2024.
- Some mathematical insights on DMET, GDR REST General Meeting, Oléron, June 2023.
- Some mathematical insights on DMET (jointly with É. Letournel), EMC2 Seminar, Paris, May 2023.

## Poster Sessions

Some mathematical insights on Density Matrix Embedding Theory, Precision Many-Body workshop, Collège de France Paris, June 2023.

## Teaching Experiences

- Electrons in a crystal: theory and applications (Math./Phys. oriented), École des Ponts, 2023-2024.
- Introduction to Quantum Physics (Mathematics oriented), École des Ponts, 2021-2024.
- Solid-state physics: theory and applications (Physics oriented), École des Ponts, 2021-2023.
- Introduction to Statistical Physics (Physics oriented), École des Ponts, 2021-2023.
- Electromagnetism (Physics oriented), Université Gustave Eiffel, 2021-2022.

## Students

Maxime Vinteler (undergraduate student), subject: "Modèle de Hubbard". June-July 2023.

## Academic Services

- Organizer of the Young Researchers Seminar at CERMICS, 2021-.
- Weekly oral exams in Mathematics and Physics ("colles" in "classes préparatoires") at Voltaire, Saint-Louis highschools and Institut Bossuet (Paris), 2019-2023.
- Popularization talks "Initiation à la physique statistique : la température et les foules" for the Journées Nationales des Cordées de la Réussite, 2021-2024.

## Education

- National selective exam for teaching abilities ("Agrégation") in Physics, rank: 10, Paris, 2021.
- Masters degree at International Centre for Fundamental Physics, Quantum Physics option, École Normale Supérieure, Paris, 2018-2019.

- Masters degree at École Polytechnique, "Cycle ingénieur", major : Mathematics and Physics, Paris area, 2015-2019.
- Selective exams preparation at Montaigne highschool, Bordeaux, 2013-2015.

## Academic Employment

- Mathematics internship at CERMICS under the supervision of David Gontier and Éric Cancès. Subject: "The mathematics of strongly interacting electrons." June 2021.
- Physics internship at Collège de France and École Polytechnique, under the supervision of Michel Ferrero and Antoine Georges. Subject: "Compétition des effets de conduction et de magnétisme du modèle de Hubbard dans l'approximation de la théorie du champ moyen dynamique." June 2019.

## Schools and conferences

- Workshop on Model Systems in Quantum Mechanics, Université Paul Sabatier, Toulouse, January 2024.
- BIRS Workshop on Moire Superlattices, Banff, October 2023.
- GDR Rest General Meeting, Oléron, June 2023.
- GDR NBODY Mini-schools, UPMC Paris, June 2022,2023,2024.
- TRIQS General Meeting, Collège de France, Paris, September 2023.
- CCQ Moire Materials Meeting, Flatiron Institute Simons Foundation, New York, May 2023.
- International Summer School on Computational Quantum Materials, USherbrooke, Sherbrooke, July 2022.
- IPAM Advancing Quantum Mechanics with Mathematics and Statistics, UCLA, Los Angeles, March-June 2022.

## Languages

Native French. Fluent English and Spanish. Beginner German and Swedish. Learning Italian.

Native Python (TRIQS user). Fluent Julia.

Last update: October 2024.