Laurent Bétermin

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arXiv   ORCID   Publons   Google Scholar

General Information

Born on 10/01/1983 in La Rochelle.   Married without children.
Nationality: French.

Current Position

since 09/2021	**Maître de Conférences (Associate Professor) in Mathematics**
	Institut Camille Jordan, Université Claude Bernard Lyon 1

Academic degrees and past positions

09/2019-08/2021 **Postdoctoral Researcher** in Mathematics, Applied Mathematics and Modeling group, University of Vienna
Group leader: Ulisse Stefanelli

09/2017-08/2019 **Postdoctoral Researcher** in Mathematics at the Villum Centre for the Mathematics of Quantum Theory (QMATH), University of Copenhagen
Group leader: Jan Philip Solovej

10/2015-08/2017 **Postdoctoral Researcher** in MATCH, Heidelberg University, Germany
Group leader: Hans Knüpfer

2015 **Ph. D. in Mathematics**, Université Paris-Est, Doctoral School MSTIC, France
Advisor: Etienne Sandier
Title: Lattice Energies and Variational Calculus
Jury:

Pr. Xavier BLANC	Université Paris Diderot	Reviewer
Pr. Djalil CHAFAÏ	Université Paris Dauphine	Examiner
Pr. Yuxin GE	Université Toulouse Paul Sabatier	Examiner
Pr. Etienne SANDIER	Université Paris-Est Créteil	Advisor
Pr. Sylvia SERFATY	Université Pierre et Marie Curie	Jury Chair
Pr. Florian THEIL	University of Warwick	Reviewer

2012-2015 **Ph.D. Study**, Université Paris-Est Créteil, France.

2011-2012 **M. Sc. in Mathematics - 2nd year** - Mathematics and Applications, Université Paris-Est Marne-la-Vallée, France
Specializations : Non-linear Analysis, PDE and Measure Theory.
Rank: 1. **With honours**.
Memoir: Lattice energies and crystallization. *Supervisor:* Etienne Sandier

2006-2011 **Teacher** of Mathematics in High School

2006 **French Agrégation in Mathematics**

2005 French CAPES in Mathematics (for teaching).

2004-2005	**M. Sc. in Mathematics - 1st year** - Mathematics and Applications, Université de La Rochelle, France. With honors.
	Specializations : Complex Analysis, Differential Geometry and Algebra.
2003-2004	Three-year University Degree in Mathematics - Mathematics and Applications, Université de La Rochelle, France. With honors.
2001-2003	**University-level preparation for the nation-wide competitive entrance exams of the French "Grandes Ecoles"** : Mathematics, Physics and Engineering Sciences. Lycée Jean Dautet, La Rochelle.

Peer-reviewed articles

1. L. Bétermin and P. Zhang. Minimization of energy per particle among Bravais lattices in the whole plane : Lennard-Jones and Thomas-Fermi cases. ***Communications in Contemporary Mathematics***, 17(6):1450049, 2015, DOI:10.1142/S0219199714500497.

2. L. Bétermin. Two-dimensional theta functions and crystallization among Bravais lattices. ***SIAM J. Math. Anal.*** 48(5):3236–3269, 2016, DOI:10.1137/15M101614X.

3. L. Bétermin and M. Petrache. Dimension reduction techniques for the minimization of theta functions on lattices. ***J. Math. Phys.*** 58(7):071902, 2017, DOI:10.1063/1.4995401.

4. L. Bétermin and E. Sandier. Renormalized energy and asymptotic expansion of optimal logarithmic energy on the sphere. ***Constr. Approx.*** 47(1):39–74, 2018, DOI:10.1007/s00365-016-9357-z.

5. L. Bétermin and H. Knüpfer. Optimal lattice configurations for interacting spatially extended particles. ***Lett. Math. Phys.*** 108(10):2213–2228, 2018, DOI:10.1007/s11005-018-1077-9.

6. L. Bétermin and H. Knüpfer. On Born's conjecture about optimal distribution of charges for an infinite ionic crystal . ***J. Nonlinear Sci.*** 28(5):1629–1656, 2018, DOI:10.1007/s00332-018-9460-3.

7. L. Bétermin. Local variational study of 2d lattice energies and application to Lennard-Jones type interactions. ***Nonlinearity*** 31(9):3973-4005, 2018, DOI:10.1088/1361-6544/aac75a.

8. L. Bétermin. Local optimality of cubic lattices for interaction energies. ***Anal. Math. Phys.*** 9(1):403–426, 2019, DOI:10.1007/s13324-017-0205-5.

9. L. Bétermin and M. Petrache. Optimal and non-optimal lattices for non-completely monotone interaction potentials. ***Anal. Math. Phys.*** 9(4):2033–2073, 2019, DOI:10.1007/s13324-019-00299-6.

10. L. Bétermin. Minimizing lattice structures for Morse potential energy in two and three dimensions. ***J. Math. Phys.*** 60(10):102901, 2019, DOI:10.1063/1.5091568.

11. L. Bétermin. Minimal soft lattice theta functions. ***Constr. Approx.*** 52(1):115-138, 2019, DOI:10.1007/s00365-019-09494-x.

12. L. Bétermin. On a lattice generalisation of the logarithm and a deformation of the Dedekind Eta function. ***Bulletin of the Australian Mathematical Society*** 102(1):118-125, 2020, DOI:10.1017/S000497272000012X.

13. L. Bétermin, H. Knüpfer and F. Nolte, Note on crystallization for alternating particle chains. ***J. Stat. Phys.*** 181(3):803-815, 2020, DOI:10.1007/s10955-020-02603-2.

14. L. Bétermin, M. Faulhuber and H. Knüpfer. On the optimality of the rock-salt structure among lattices and change distributions. ***Mathematical Models and Methods in Applied Sciences*** 31(2):293-325, 2021, DOI:10.1142/S021820252150007X.

15. L. Bétermin, L. De Luca and M. Petrache. Crystallization to the square lattice for a two-body potential. ***Archive for Rational Mechanics and Analysis*** 240:987-1053, 2021, DOI:10.1007/s00205-021-01627-6.

16. L. Bétermin. Effect of periodic arrays of defects on lattice energy minimizers. ***Annales Henri Poincaré*** 22:2995-3023, 2021, DOI:10.1007/s00023-021-01045-0.

17. L. Bétermin, On energy ground states among crystal lattice structures with prescribed bonds. ***J. Phys. A: Math. Theor.*** 54(24):245202, 2021, DOI:10.1088/1751-8121/abfc7e.

18. L. Bétermin. Theta functions and optimal lattices for a grid cells model. ***SIAM Journal of Applied Mathematics*** 81(5):1931-1953, 2021, DOI:10.1137/20M1376431.

19. L. Bétermin, M. Friedrich and U. Stefanelli. Lattice ground states for Embedded-Atom Models in 2D and 3D. ***Letters in Mathematical Physics*** 111(107), 2021, DOI:10.1007/s11005-021-01446-6.

20. C. Beltràn, L. Bétermin, P. Grabner and S. Steinerberger, How well-conditioned can the eigenvalue problem be?. *to appear in* ***Mathematics of Computation***, arXiv:2105.07922, 2021.

21. L. Bétermin, M. Friedrich and U. Stefanelli. Stability of $\mathbb{Z}^2$ configurations in 3D. ***Nonlinearity*** 34(12):8392-8413, 2021, DOI:10.1088/1361-6544/ac3383.

22. L. Bétermin and M. Faulhuber. Maximal theta functions - Universal optimality of the hexagonal lattice for Madelung-like energies. ***Journal d'Analyse Mathématique***, 2023, DOI:10.1007/s11854-022-0254-z.

23. L. Bétermin, L. Šamaj and I. Travěnec, Three-dimensional lattice ground states for Riesz and Lennard-Jones type energies. ***Studies in Applied Mathematics***, 2022, DOI:10.1111/sapm.12533.

24. L. Bétermin, Optimality of the triangular lattice for Lennard-Jones type lattice energies: a computer assisted method. ***J. Phys. A: Math. Theor.***, 2023, DOI:10.1088/1751-8121/acc21d.

Preprints

25. L. Bétermin. Sufficient condition for a compact local minimality of a lattice. arXiv:1505.08047, 2015.

26. L. Bétermin, M. Faulhuber and S. Steinerberger, A variational principle for Gaussian lattice sums. arXiv:2110:06008. Submitted, 2021.

27. L. Bétermin, L. Šamaj and I. Travěnec, Interplay between critical and off-critical zeros of two-dimensional Epstein zeta functions, arXiv:2110.09368. Submitted, 2022.

28. L. Bétermin, L. Šamaj and I. Travěnec, On off-critical zeros of lattice energies in the neighborhood of the Riemann zeta function, arXiv:2307.06002. Submitted, 2023.

29. L. Bétermin, L. Šamaj and I. Travěnec, Structural transitions in interacting lattice systems, arXiv:2312.01395. Submitted, 2023.

Book

1. L. Bétermin, M. Haussmann, M. Leip, F. Pazuki and A. Torres, Topics in Mathematics for the Traveling Student, Polyteknisk, 2020.

Reports

1. (with A. Benoit, P.-L. Colin, H. Decaster, R. Romo Romero and T. Wallez) Analysis, critic and improvement of a model of bioreactor, in French, 2015.

2. Oberwolfach report - Soft Lattice Theta Functions - Workshop on Emergence of Structures in Particle Systems: Mechanics, Analysis and Computation, 2018.

3. Oberwolfach report - From potentials to minimizing structures - Workshop on Mathematics of Crystallisation, 2019.

Thesis

1. Energies de réseaux et cristallisation, Master thesis, Université Paris-Est, in French, 2012.

2. Lattice energies and the calculus of variations, PhD thesis, Université Paris-Est, Hal tel-01227814, defended on September 21th, 2015.

Papers for the Layman

1. Des cristaux de SMS, in *Un Jour/Une brève, 2013 Mathématiques pour la planète Terre*, CNRS, May 2013

2. Du miel, des frites et un hexagone, in *Brèves de Maths : Mathématiques pour la planète Terre*, under the supervision of M. Andler, L. Bel, S. Benzoni, T. Goudon, C. Imbert and A. Rousseau, Editions Nouveau Monde, November 2014

Research funding

09/2022	Member of ANR JCJC SING. Project Coordinator: Xavier Lamy (IMT Toulouse).
03/2022	BQR fund of 10 000 euros, Université Claude Bernard Lyon 1
10/2020	**Lise-Meitner Programme** "New Challenges for the Mathematics of Crystallization" (M 2998-N). Grants awarded by the FWF (Austrian Science Fund): 175780 euros. **Principal Investigator: Laurent Bétermin** - Co-applicant: Pr. Ulisse Stefanelli. University of Vienna, Faculty of Mathematics. *Obtained but not used.*
03/21-08/21	Research funded by the the Austrian Science Fund (FWF) project/grant I 4354-N "Variational Modeling of Molecular Geometries". Leader: Pr. Ulisse Stefanelli. University of Vienna, Faculty of Mathematics.
06/20-02/21	Research (partially) funded by the Austrian Science Fund (FWF) project/grant F65 "Taming Complexity in Partial Differential Systems (Multiphysics effects in solids)". Leader: Pr. Ulisse Stefanelli. University of Vienna, Faculty of Mathematics.
09/19-06/20	Research funded by the project "Variational Modeling of Carbon Nanostructures" - WWTF grant no. MA14-009. Leader: Pr. Ulisse Stefanelli. University of Vienna, Faculty of Mathematics.
09/17-08/19	Postdoctoral Fellowship, for **two years**, from ERC Advanced grant "Mathematics of the Structure of Matter" (project no. 321029). Leader: Pr. Jan Philip Solovej. Also funded by VILLUM FONDEN via the QMATH Centre of Excellence (Grant No. 10059). University of Copenhagen.
10/15-08/17	Postdoctoral Fellowship, for **two years**, from the Deutsche Forschungsgemeinschaft (DFG) Excellence Initiative. Heidelberg University.
10/12-09/15	Doctoral Fellowship, for **three years**, from Université Paris-Est. Université Paris-Est Créteil. Project: *Lattice energies and variational calculus*, with Pr. Etienne Sandier.

Communications

Forthcoming talks (if any)

2023	Séminaire Pizza, Institut Camille Jordan, Lyon (France)
	Rencontre ANR SING, Institut de Mathématiques de Toulouse (France)
	Groupe de Travail EDP, LAMA, Créteil (France)
	Séminaire d'Analyse, Institut de Mathématiques de Bordeaux (France)
	Séminaire EDPA, Institut Camille Jordan, Lyon (France)
2022	**15th International Conference on Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing (MCQMC 2022)** Special session "Periodic Point Configurations and Lattice Point Interactions", Linz (Austria)
	10th International Conference on Curves and Surfaces Mini-symposium "Point configurations on curves and surfaces and related energy problems", Arcachon (France)
	Seminar at Jiangxi Normal University, Nanchang (China, Online)
	Point Distributions Webinar, Online
	Seminar "Theory of Duality" Department of Mathematical Methods in Physics, University of Warsaw (Poland, Online)
	Séminaire d'Analyse, Institut de Mathématiques de Toulouse Université Paul Sabatier, Toulouse (France)
	Workshop on "Optimal Point Configurations on Manifolds", Erwin Schrödinger Institute, Vienna (Austria) Video of the talk
2021	Journée de rentrée de l'équipe EDPA, Institut Camille Jordan, Lyon (France)
	SIAM Conference on Mathematical Aspects of Material Sciences, Bilbao (Spain, Online)
	Seminar at Jiangxi Normal University, Nanchang (China, Online)
	AIM Workshop on "Minimal energy problems with Riesz potentials", San Jose (USA, Online) Video of the talk
	Séminaire d'Analyse Appliquée A^3, Université d'Amiens (France, Online)
	Séminaire d'Analyse Numérique et Calcul Scientifique, Université de Besançon (France, Online)
	Séminaire "Analyse, Phénomènes Stochastiques et Applications", Université de Brest (France, Online)
2020	Point Distributions Webinar, Online. Video of the talk.
	Séminaire Analyse Numérique et EDP, Université d'Orsay (France, Online)
	Calculus of Variations Seminar, University of Vienna (Austria, Online)
	PDE Afternoon, TU Vienna (Austria)
2019	Applied Analysis Seminar, Heidelberg University (Germany)
	Numerical Harmonic Analysis Seminar, University of Vienna (Austria)
	1st Austrian Calculus of Variations Day, University of Vienna (Austria)
	International Congress on Industrial and Applied Mathematics (ICIAM), Minisymposium "Discrepancy and Minimal Energy", Valencia (Spain)
	MFO Mini-Workshop: Mathematics of Crystallisation, Oberwolfach (Germany)
2018	Applied Analysis Seminar, Heidelberg University (Germany)
	Statistical Mechanics Seminar, University of Warwick (UK)
	MFO Workshop on Emergence of Structures in Particle Systems: Mechanics, Analysis and Computation, Oberwolfach (Germany)

PDE Afternoon, University of Vienna (Austria)

Analysis Seminar, Aarhus University (Denmark)

XIX International Congress on Mathematical Physics (ICMP), Montreal (Canada)

Workshop on Optimal and random point configurations, ICERM, Brown University, Providence (USA)
Video of the talk

2017   **Masterclass on Geometric Analysis on Noncompact Manifolds**, University of Copenhagen (Denmark)

Optimal point configurations and orthogonal polynomials 2017, CIEM, Castro Urdiales (Spain)

2016   **AIM Workshop** on Soft packings, nested clusters and condensed matter, San Jose (USA)

PIMS Workshop on Nonlocal Variational Problems and PDEs, Vancouver (Canada)

Trends in Mathematical Crystallization, Mathematics Institute, Warwick (UK)

Applied Analysis Seminar, Institut für Angewandte Mathematik, Heidelberg University (Germany)

Seminar "Problèmes spectraux en Physique Mathématique", Institut Henri Poincaré, Paris

2015   Seminar, Institute of Scientific Computing, TU Dresden (Germany)

Applied Analysis Seminar, Instut für Angewandte Mathematik, Heidelberg University (Germany)

Week for interactions between Maths and Firms, Université de Nantes (France)
With A. Benoit, P-L. Colin, H. Decaster and T. Wallez

PhD Seminar, Ecole Nationale des Ponts et Chaussées, Marne-la-Vallée (France)

2014   **Workshop on "Optimal Point Configurations and Applications"**, ESI, Vienna (Austria)

MIA's days, Université de La Rochelle (France)

Ph.D. students day of MSTIC School, Marne-la-Vallée (France)

Groupe de Travail de Physique Mathématique, Université de Cergy-Pontoise (France)

Organization of Workshop, Conference and Seminar

August 2017   Co-organizer of the Workshop "Modern trends in Structures Forming Systems", Heidelberg, August 7-11

04/16 - 08/17   Co-organizer of the Applied Analysis Seminar, Heidelberg

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Other Scientific Activities

since 2021   Member of the International Society for the Interaction of Mechanics and Mathematics (ISIMM)

2018-2022   Reviewer for the American Mathematical Society (Mathscinet).

since 2015   Reviewer for many journals: *Journal of Physics, Journal of Nonlinear Science, Portugaliae Mathematica, ARMA, Mathematical Models and Methods in Applied Sciences, Journal of Mathematical Analysis and Applications, Journal of Complexity, Ramanujan Journal, Communications in Mathematical Physics, Journal of Mathematical Physics, Journal of the European Mathematical Society, Journal d'Analyse Mathématique, Mathematische Annalen.*

May 2015	Mathematics/Firms Week, AMIES, Université de Nantes (France)
	Model for a bio-reactor (collaboration with CEMOSIS)
June 2013	Culture and Maths Games exhibition: Animation on the theme of crystallization on the CNRS stand.
2011-2017	Reviewer for the website *Images des Mathématiques* of CNRS.

Teaching

2021	**Université Claude Bernard Lyon 1**
	Bachelor in Computer Sciences - first year: Fundamentals of Mathematics (Lectures and Tutorials).
	Bachelor in Computer Sciences - first year: Analysis 1 and Algebra 1 (Tutorials).
	Bachelor in Mathematics and Economics - second year: Analysis 4 (Lectures and Tutorials).
	Bachelor in Mathematics and Economics - third year: Topology and Measure Theory (Tutorials).
2017-2019	**University of Copenhagen**
	Topics in Mathematics for the travelling students (course responsible)
	Advanced Mathematical Physics: Potential Theory and Coulomb Gases (Master/PhD course - course co-responsible).
January 2016	**University of Heidelberg**
	Master degree: Conservation laws and entropy solutions.
2012-2015	**University Paris-Est Créteil**
	Bachelor - second year : Tutorials in Linear Algebra and Multivariable Calculus.
	Bachelor - third year : Oral examinations in Integration Theory.
2008-2009	**University Paris 8**
	Bachelor - first year: Tutorials in Arithmetic, Complex Numbers and Linear Algebra.
2006-2011	Teaching in High School (France).
	Lycée André Boulloche (Livry-Gargan, 2010-2011)
	Lycée Honoré de Balzac (Mitry-Mory, 2007-2010)
	Lycée Léonce Vieljeux (La Rochelle, 2006-2007)
2002-2003	Cours Pieber, La Rochelle.
	Help for struggling students in Mathematics, Physics and Chemistry.

Administrative Duties

2022-now	Elected member of the "Conseil de Département"
	Faculté des Sciences, Université Claude Bernard Lyon 1
2022-now	Jury's presidency of the French Baccalauréat Professionnel "Métiers de l'Accueil"
2022-2023	Active member of the committee "Environmental Impact"
	Institut Camille Jordan
2006-2011	Examiner for the French Baccalauréat

Languages

French	Mother tongue.
English	Level C1.
German	Level A2.