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# Dr Rauan Akylzhanov

## Work Experience

- 2018 Oct - present **Research Associate**, *Queen Mary University*, London.  
We develop elements of harmonic analysis associated with a Dirac-like operator affiliated with a semi-finite von Neumann algebra. In this setting, we establish Paley-type inequalities on semi-finite von Neumann algebras. Using these inequalities in combination with quantum group Pontryagin duality, we obtain a simple and elegant proof of Hörmander multiplier theorem. As a particular case, we recover Lorentz space formulation of the Euclidean Hörmander multiplier theorem. More details on my academic research can be found [here](#).
- 2017 Dec – 2018 Oct **Pure Research Associate**, *Imperial College*, London.  
I define and study dense Frechet subalgebras of compact quantum groups realised as smooth domains associated with a Dirac type operator with compact resolvent. Further, I characterize Connes spectral triples on compact quantum matrix groups in terms of Clebsch-Gordon coefficients and the eigenvalues of the Dirac operator. It can be observed that the finite spectral dimension implies a Schwartz kernel theorem for linear operators acting on the dense subalgebra. This naturally leads to global pseudo-differential operators on compact quantum groups. We provide necessary and sufficient conditions for algebraic differential calculi on Hopf subalgebras of compact quantum groups to extend to our proposed smooth subalgebra. This opens up whole wealth of K-theoretic results and further exciting investigations.

## Education

- 2014–2018 **PhD in Pure Mathematics**, awarded **July 2018**, *Imperial College*, London.  
I obtained new elegant and powerful results on the  $L^p - L^q$  bounds for Fourier multipliers on locally compact topological groups. The challenge was to deal with generally highly singular objects (unitary duals of groups) and measure the regularity on the dual. By employing the machinery of semi-finite von Neumann algebras, I managed to obtain universal solution. I wrote 9 preprints and 6 are published in peer-reviewed journals.
- Thesis title  $L^p$ - $L^q$  Fourier multipliers on locally compact groups.  
Advisor Michael Ruzhansky.  
Examiners Fulvio Ricci, Ari Laptev.
- 2012–2014 **Master of Science in Mathematics**, *Eurasian National University*.  
Training in theory and practice of university education (pedagogy)
- 2007–2012 **Specialist in Mathematics and Computer Science**, *Lomonosov Moscow State University*, Moscow.  
Training in programming and mathematics: algorithms and algorithmic languages, operating systems, computer architecture, optimisation theory, statistics, probability, multi-dimensional statistical analysis, relational databases (SQL).  
With Honours
- Diploma Title Well-posed solvability of functional-differential equations with unbounded operator coefficients.  
Advisor Victor Vlasov.

## Academic collaboration

- 2016-present **Professor Yulia Kuznetsova**, *Laboratoire de Mathématiques*, University of Franche-Comté.  
2016-present **Professor Shahn Majid**, *School of Mathematical Sciences*, Queen Mary University of London.

## Publications

- R. Akylzhanov and M. Ruzhansky. Hörmander-Mihlin theorem on noncommutative spaces. *in preparation*, 2018.
- R. Akylzhanov, S. Majid, and M. Ruzhansky. Smooth dense subalgebras and Fourier multipliers on compact quantum groups. *Comm. Math. Phys.*, 362(3):761–799, Sep 2018.
- R. Akylzhanov and A. Arnaudon. Contractions of group representations via geometric quantisation. *arXiv preprint arXiv:1802.03348*, 2018.

R. Akylzhanov and M. Ruzhansky. Net spaces on lattices, Hardy-Littlewood type inequalities, and their converses. *Eurasian Math. J.*, 8(3):10–27, 2017.

R. Akylzhanov and M. Ruzhansky. Fourier multipliers and group von Neumann algebras. *C. R. Math. Acad. Sci. Paris*, 354(8):766 – 770, 2016.

R. K. Akylzhanov, E. D. Nursultanov, and M. V. Ruzhansky. Hardy-Littlewood-Paley-type inequalities on compact Lie groups. *Mat. Zametki*, 100(2):287–290, 2016.

R. Akylzhanov, E. Nursultanov, and M. Ruzhansky. Hardy-Littlewood-Paley inequalities and Fourier multipliers on  $SU(2)$ . *Studia Math.*, 234(1):1–29, 2016.

R. Akylzhanov and M. Ruzhansky. Hausdorff-Young-Paley inequalities and  $L^p - L^q$  Fourier multipliers on locally compact groups. *arXiv:1510.06321*, 2015.

R. Akylzhanov, E. Nursultanov, and M. Ruzhansky. Hardy-Littlewood, Hausdorff-Young-Paley inequalities, and  $L^p-L^q$  multipliers on compact homogeneous manifolds. *arXiv:1504.07043*, 2015, to appear in Journal of Fourier Analysis and Applications.

R. K. Akylzhanov and V. V. Vlasov. Well-posed solvability of functional-differential equations with unbounded operator coefficients. *Differential Equations*, 50(9):1161–1172, 2014.

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## Invited Talks

- Apr 2018 Smooth dense subalgebras and Fourier multipliers on compact quantum groups, *Laboratoire de Mathématiques de Besançon*.
- May 2017 Smooth dense subalgebras and Fourier multipliers on compact quantum groups, *Quantum Algebras*, Queen Mary University London.
- May 2017 Multipliers on locally compact groups, *Recent developments in harmonic analysis*, Mathematical Sciences Research Institute.
- Sep 2016 The  $L^p-L^q$  bounds for pseudo-differential operators on quantum groups, *Analysis and Partial Differential Equations*, Imperial College.
- Apr 2016 Two Lie group contractions (joint with Alexis Arnaudon), *Noncommutative Analysis and Partial Differential Equations*, Imperial College.
- Dec 2015 Group von Neumann algebras and the  $L^p-L^q$  operator bounds on locally compact groups, *Imperial Analysis Seminar*.
- Apr 2015 Hardy-Littlewood, Hausdorff-Young-Paley inequalities, and  $L^p-L^q$  Fourier multipliers on compact homogeneous manifolds, *the 10-th ISAAC conference*, Macao University.
- Oct 2014 Contractions from  $SU_2$  to  $\mathbb{H}^1$  (joint with Chiara Taranto), *Imperial Analysis Seminar*.
- Sep 2014 Hardy-Littlewood inequalities and Fourier multipliers, *International Conference on Generalized Functions*, Southampton University.
- Sep 2014 Lorentz spaces and real interpolation, *Imperial Analysis Seminar*.
- Jan 2014 Converses (lower bounds) in Fourier multiplier theorems, *Imperial Analysis*.

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## Awards

- 2016 Doris Chen Merit Award, *Department of Mathematics, Imperial College*. exceptional early promise and achievement in mathematical research.
- 2012 "Bolashak" scholarship . success rate is 10-20 %-interview based

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## Professional Services

- 2017-present **Reviewer for zbMATH**, formerly *Zentralblatt MATH*.

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## Academic Affiliations

- Mar 2018-present **Newton Institute for Mathematical Sciences, Cambridge**, *Junior member*. encouraging mutually beneficial interaction between the Institute and young UK researchers in the Mathematical Sciences

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## Teaching experience

- 2015-2017 **Imperial College London**, I served the following courses as a Graduate Teaching Assistant:.
- Fall 2017 **M2AA2**, *Multivariable calculus*, Dr Walton Andrew, demonstrating & marking.

- Fall 2017 **M3C**, *High Performance Computing*, Dr Ray Prasun, marking.
- Fall 2017 **M3A50**, *Data Science*, Dr Caroline Colijn, marking.  
R computer sessions: Introduction to R
- Spring 2016 **M1P1**, *Analysis I*, Prof Richard Thomas, demonstrating & marking.
- Fall 2015 **M2PM1**, *Real analysis*, Prof Michael Ruzhansky.
- Fall 2015 **M1P2**, *Algebra*, Dr John Britnell, demonstrating & marking.
- Spring 2015 **Joint Maths and Computing (JMC) Tutor**.  
weekly small group tutorials for JMC students, was responsible for leading full session
- Spring 2015 **M1P1**, *Analysis I*, Prof Richard Thomas, demonstrating & marking.
- 2012-2014 **Faculty Assistant**, Moscow State University.  
elements of algorithm design (code in C, gcc, vim), calculus, real analysis  
**Analysis I**, *Theory and seminars*.  
**Analysis II**, *Theory and seminars*.  
**elements of algorithm design**, *practice sessions in Linux*, programming in C(gcc).

## Conferences

- May 2017 Recent Developments in Harmonic Analysis, *Mathematical Sciences Research Institute*, Berkeley.
- Aug 2017 Young Mathematicians in  $C^*$ -algebras, *The University of Copenhagen*.
- Oct 2016 Noncommutative index theory, *Simons Semester in the Banach Center*, Warsaw.
- Sep 2016 Geometric Representation Theory and Beyond, *Clay Research Conference*, Mathematical Institute, Oxford University.
- Sep 2016 Combinatorics and Operators in Quantum Information Theory, *LMS Research School*, Queen's University Belfast.
- May-June 2016 Constructive Approximation and Harmonic Analysis, *Centre de Recerca Matemàtica, Universitat de Autònoma, Barcelona*.
- April 2016 Noncommutative Analysis and Partial Differential Equations, *Analysis & PDE*, Imperial College.
- Nov 2015 Scottish Operator Algebras Research Meeting, *University of Glasgow*.
- Mar 2015 Spring School on Several Complex Variables, *School of Mathematics and Statistics*, Newcastle University.

## Societies

- 2017-present **Imperial College Data Science Society**.  
training in essential Data Science topics, platform for interaction between Imperial College and industry
- 2018-present **Imperial College Machine Learning Society**.  
tutorials, projects, hackathons, talks from experts in industry and researchers

## Programming Experience (taught)

- Languages C (fluent), Python (fluent), C++, C#, x86 assembly (taught).
- basic multi client server monopoly game simulation.  
client-server communication: Berkeley sockets via TCP/IP, select(), programmable bots with strategy written in a formal language specified by a Markov algorithm

## Machine Learning Projects

- DNN Classifier and symmetric polynomials **TensorFlow, SymPy**.  
This is the first step in my research to understand the boundaries of AI algorithms. I wrote a python script to generate symmetric polynomials (SymPy) and evaluate them on random integer numbers. Then this data is divided into test and train csv files which are fed to TensorFlow DNN classifier. The model "fails" to recognize symmetric polynomials (labels) of degree greater than one. The project code in Python is available [here](#).