



G H E N T A N A L Y S I S P D E



analysis-pde.org

MICHAEL RUZHANSKY

Senior Full Professor, Ghent University, Belgium

Professor of Mathematics, Queen Mary University of London, UK

Honorary Professor, Imperial College London, UK





Ongoing projects

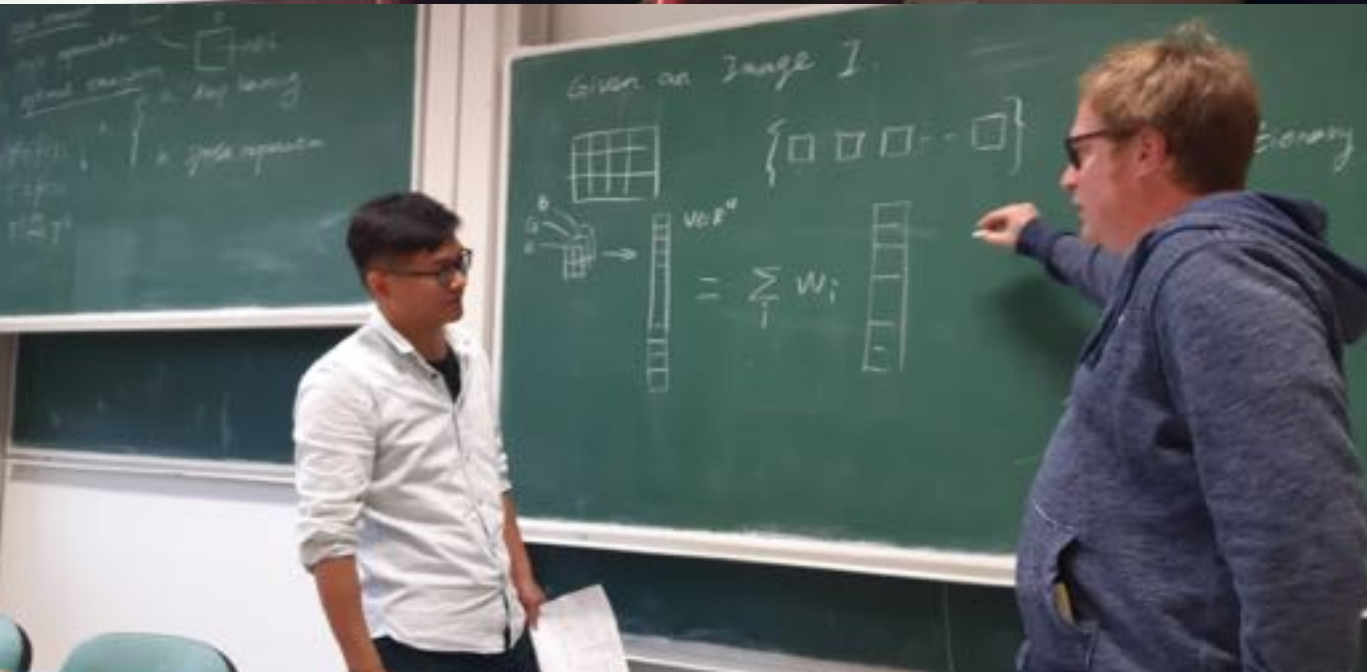
FWO ODYSSEUS 1
Analysis and Partial
Differential Equations €2,710,616

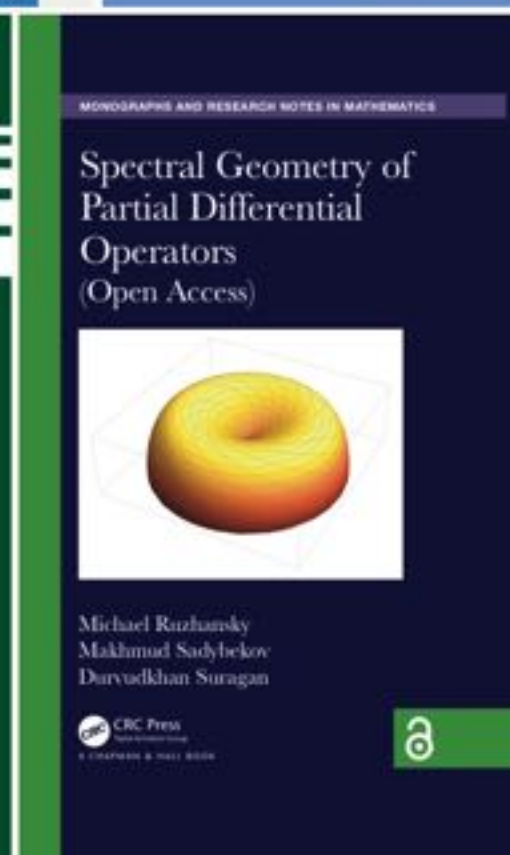
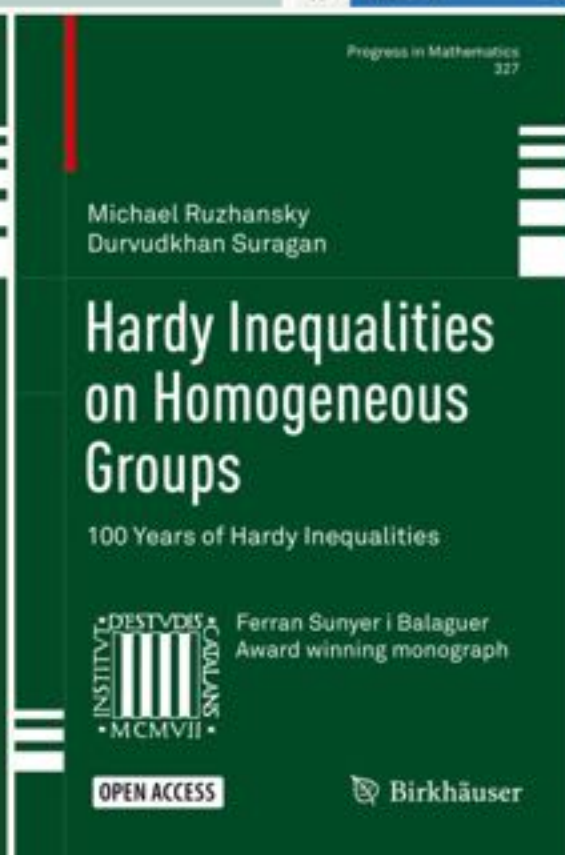
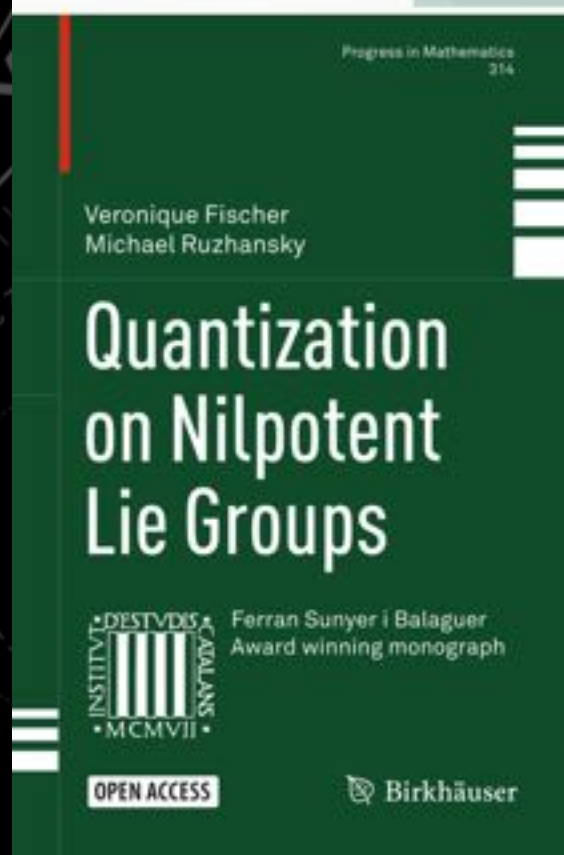
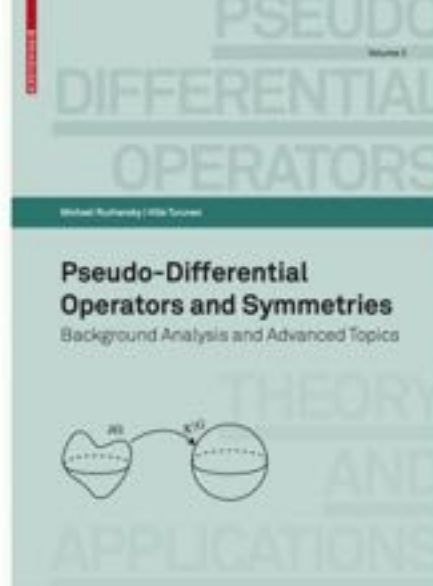
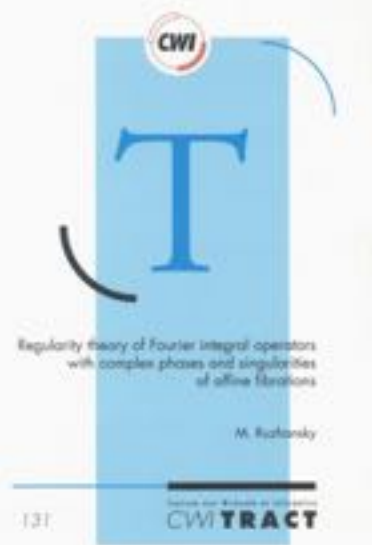
EP/R003025/1: Regularity in affiliated von
Neumann algebras and applications to partial
differential equations £498,675

EU H2020 Marie Curie: Lower bounds for
partial differential operators on compact
Lie groups with Serena Federico

BOF: Symbolic calculus of
eigenfunction expansions €200,000

Medical Imaging & Analysis





[illegible]



9 people 8 different nations





G H E N T
A N A L Y S I S
P D E



LJUBICA OPARNICA

POSTDOC RESEARCHER AT GHENT UNIVERSITY

FULL PROFESSOR AT THE UNIVERSITY OF NOVI SAD

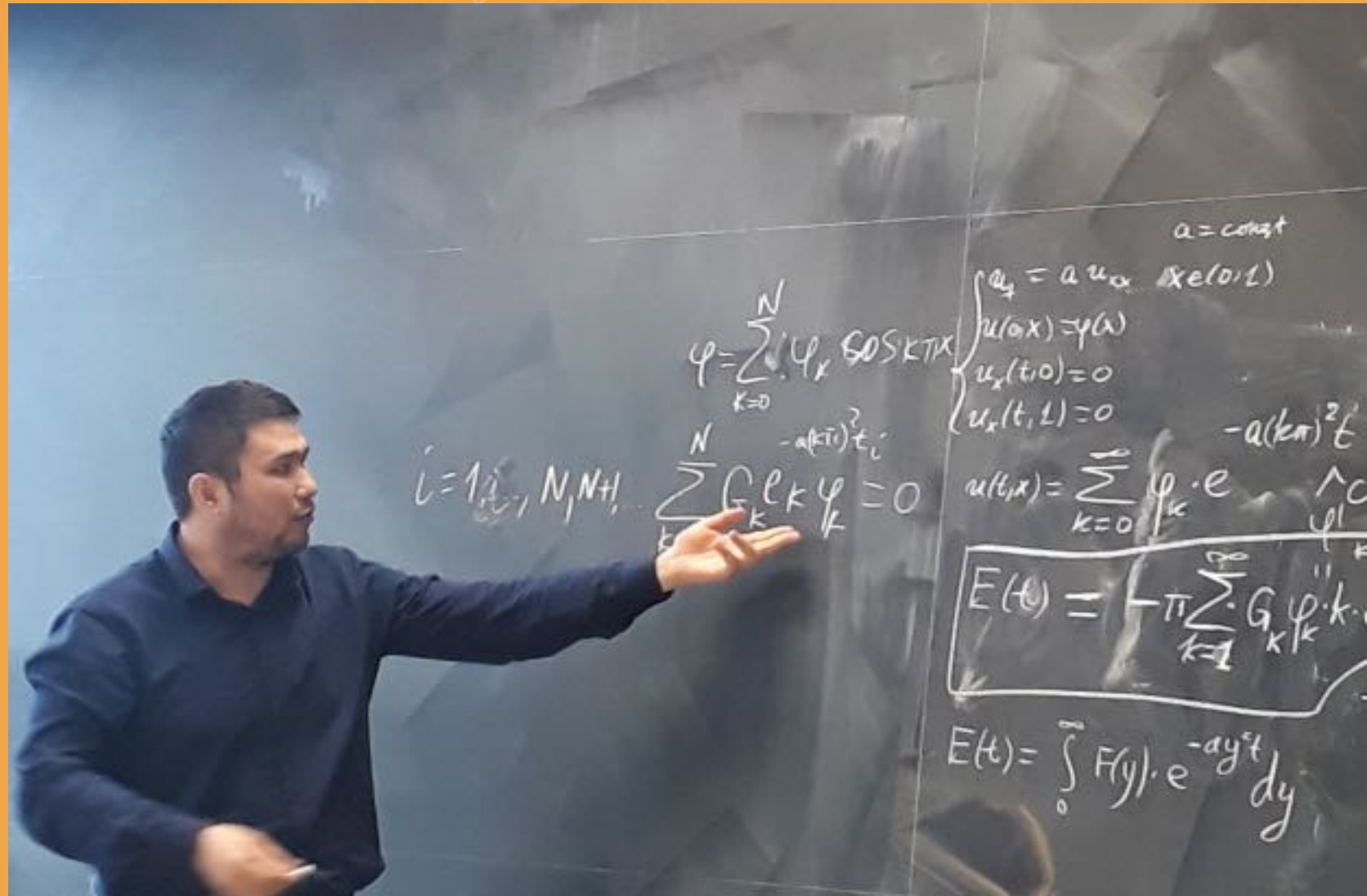
Research topic and Contribution to the Group:

Fractional calculus PDEs with singularities

- D. Zorica, Lj. Oparnica. **Energy dissipation for hereditary and energy conservation for non-local fractional wave equations.** *Phil. Trans. R. Soc. A* 378: 20190295, 2020.
- Lj. Oparnica, E. Süli. **Well-posedness of the fractional Zener wave equation for heterogeneous viscoelastic materials.** *Fractional Calculus and Applied Analysis*, 23(1), 126-166, 2020.
- Lj. Oparnica, D. Zorica, and A. Okuka. **Fractional Burgers wave equation.** *Acta Mechanica*, 230(12), 4321-4340, 2019.
- T. M. Atanackovic, Ljubica Oparnica, and Dusan Zorica, **Bifurcation analysis of rotating axially compressed imperfect nano-rod.** *ZAMM, Z. Angew. Math. Mech.*, 2019.
- S. Konjik, Lj. Oparnica, and D. Zorica. **Distributed-order fractional constitutive stress-strain relation in wave propagation modeling.** *Zeitschrift für angewandte Mathematik und Physik*, 70:51, 2019.

NIYAZ TOKMAGAMBETOV

POSTDOC RESEARCHER
GHENT UNIVERSITY



Research topic and Contribution to the Group:

Direct and Inverse Problems for PDEs

Nonharmonic analysis

Very weak solutions

- Ruzhansky M., Tokmagambetov N., and Torebek B. **Inverse source problems for positive operators. I: Hypoelliptic diffusion and subdiffusion equations.** *Journal of Inverse and Ill-Posed Problems*. Vol. 27, no 6 (2019), pp. 891–911.
- Tokmagambetov N., and Torebek B. **Green's formula for fractional order differential equations.** *Journal of Mathematical Analysis and Applications*. Vol. 468, no 1 (2018), pp. 473–479.
- Ruzhansky M., Tokmagambetov N. **On nonlinear damped wave equations for positive operators. I. Discrete spectrum.** *Differential Integral Equations*, 32 (2019), 455-478.
- Ruzhansky M., Tokmagambetov N. **Wave equation for operators with discrete spectrum and irregular propagation speed.** *Arch. Ration. Mech. Anal.*, 226 (2017), 1161-1207.

SERENA FEDERICO

Marie Curie Fellow



G HENT
A N A L Y S I S
P D E



Research topic and contribution to the Group:

Smoothing and Strichartz estimates for Schrödinger-type operators Lower bounds for PDO's on compact Lie groups

- S. Federico, M. Ruzhansky, **Smoothing and Strichartz estimates for degenerate Schrödinger-type equations.** *arXiv*
- S. Federico, A. Parmeggiani, **On the Solvability of a Class of Second Order Degenerate Operators.** P. Boggiatto et al. (eds.), *Advances in Microlocal and Time-Frequency Analysis*, Springer Nature Switzerland AG 2020, pp. 207-226.
- S. Federico, **Sufficient conditions for local solvability of some degenerate PDO with complex subprincipal symbol.** *J. Pseudo-Differ. Oper. Appl.* 10 (4) (2019) 929-940.
- S. Federico, A. Parmeggiani, **On the local solvability of a class of degenerate second order operators with complex coefficients.** *Comm. Partial Differential Equations* 43 (10) (2018) 1485-1501.



G H E N T
A N A L Y S I S
P D E



DAVID ROTTENSTEINER

POSTDOCTORAL RESEARCHER AT GHENT UNIVERSITY



Def τ of π_τ of H_0 , the so-called Schrödinger rep's,
has phys meaning, $\frac{h}{2\pi} = h$ Planck's constant

$$\{x_n\}_{n \in \mathbb{N}} \subset \{x_n\}_{n \in \mathbb{N}} \text{ with } x_n \rightarrow 0, \quad H_n \rightarrow C$$

- ii) $H_0 \subseteq \mathbb{R}^{2n+1}$

$$(x, y, z) \cdot (x', y', z') = (x+x', y+y', z+z')$$

Research topic and Contribution to the Group:

Noncommutative analysis Time frequency analysis

- D. Rottensteiner and M. Ruzhansky. **The Harmonic Oscillator on the Heisenberg Group**. To appear in *C. R. Math. Acad. Sci. Paris*
- K. Gröchenig and J. L. Romero and D. Rottensteiner and J. T. van Velthoven. **Balian-Low Type Theorems on Homogeneous Groups**. To appear in *Anal. Math.*
- K. Gröchenig and D. Rottensteiner. **Orthonormal bases in the orbit of square-integrable representations of nilpotent Lie groups**. *J. Funct. Anal.* 275 (2018)
- M. Faulhuber, M. de Gosson and D. Rottensteiner. **Gaussian distributions and phase-space Weyl-Heisenberg frames**. *Appl. Comput. Harmon. Anal.* 48 (2018)

BERIKBOL TOREBEK

Postdoctoral researcher at Ghent University
 Leading researcher of the Institute of
 Mathematics and Mathematical Modeling,
 Kazakhstan







Leading researcher of the Institute of
Mathematics and Mathematical Modeling,
Kazakhstan



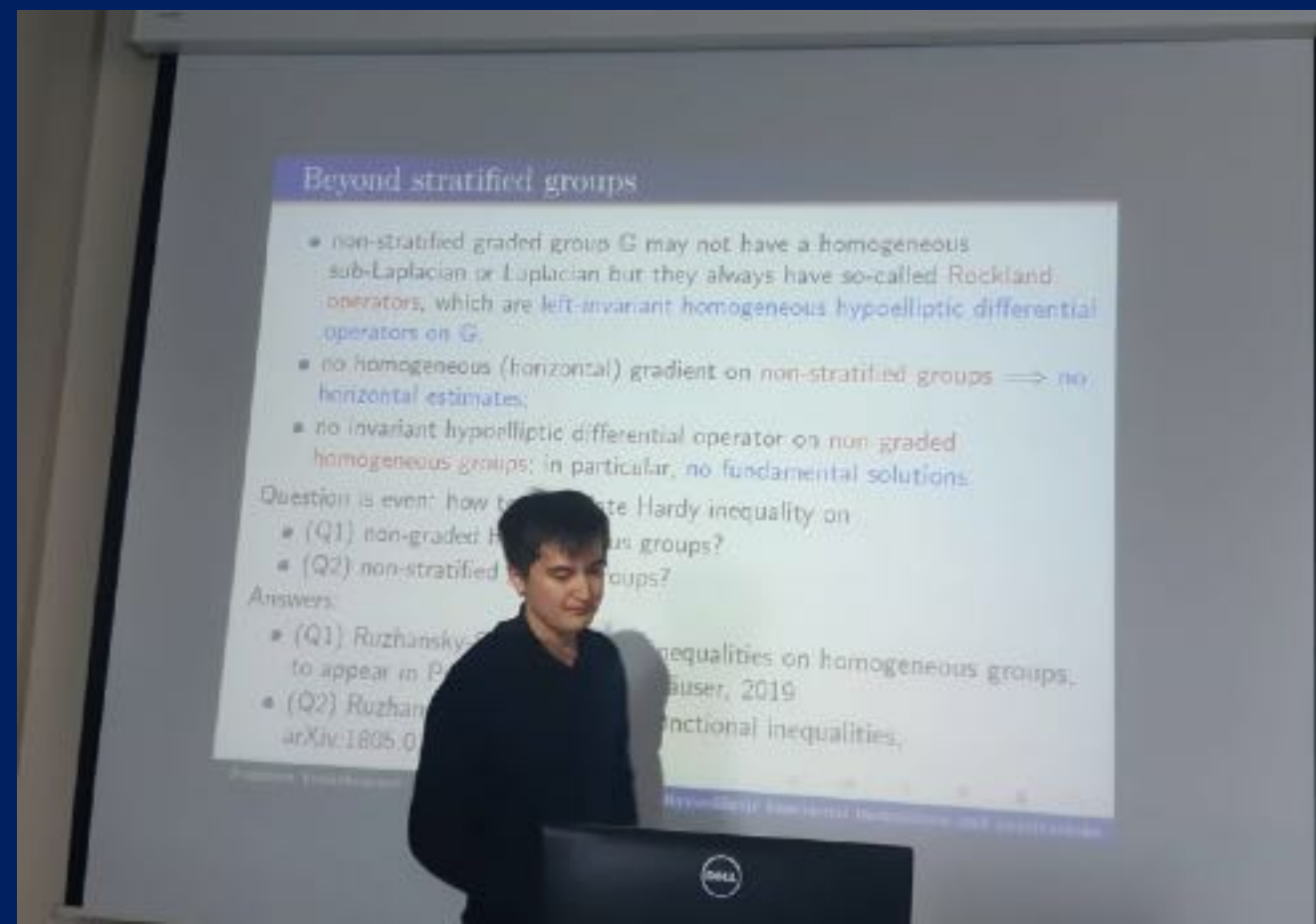
Research topic and Contribution to the Group:

Fractional calculus Inverse problems

- M. Ruzhansky, B. T. Torebek, **Van der Corput lemmas for Mittag-Leffler functions.** 2020, 1-32, *arXiv:2002.07492*
- M. Ruzhansky, B. T. Torebek, **Van der Corput lemmas for Mittag-Leffler functions. II. α -directions.** 2020, 1–19, *arXiv:2005.04546*
- M. Ruzhansky, N. Tokmagambetov, B. T. Torebek, **On a non-local problem for a multi-term fractional diffusion-wave equation.** *Fractional Calculus and Applied Analysis*, 23:2 (2020), 324-355.
- M. Kirane, B. T. Torebek, **Extremum principle for the Hadamard derivatives and its application to nonlinear fractional partial differential equations.** *Fractional Calculus and Applied Analysis*, 22:2 (2019), 358-378.
- B. T. Torebek, **Global Unsolvability of the Burgers Equation with Fractional Time Derivative.** *Differential Equations*, 55:6 (2019), 867–870.

NURGISSA YESSIRKEGENOV

POSTDOCTORAL RESEARCHER AT GHENT UNIVERSITY



Research topic and Contribution to the Group:

Noncommutative analysis

Functional inequalities

Linear and non-linear PDEs

- Ruzhansky M., Yessirkegenov N., **Very weak solutions to hypoelliptic wave equations.** *J. Differential Equations*, 268 (2020), 2063-2088.
- Laptev A., Ruzhansky M., Yessirkegenov N., **Hardy inequalities for Landau Hamiltonian and for Baouendi-Grushin operator with Aharonov-Bohm type magnetic field. Part I.** *Math. Scand.*, 125 (2019), no. 2, 239–269.
- Ruzhansky M., Yessirkegenov N., **Rellich inequalities for sub-Laplacians with drift.** *Proc. Amer. Math. Soc.*, 147 (2019), no. 3, 1335–1349.
- Ruzhansky M., Suragan D., Yessirkegenov N., **Extended Caffarelli-Kohn-Nirenberg inequalities, and remainders, stability and superweights for L_p -weighted Hardy inequalities.** *Trans. Amer. Math. Soc. Ser. B*, 5 (2018), 32-62.

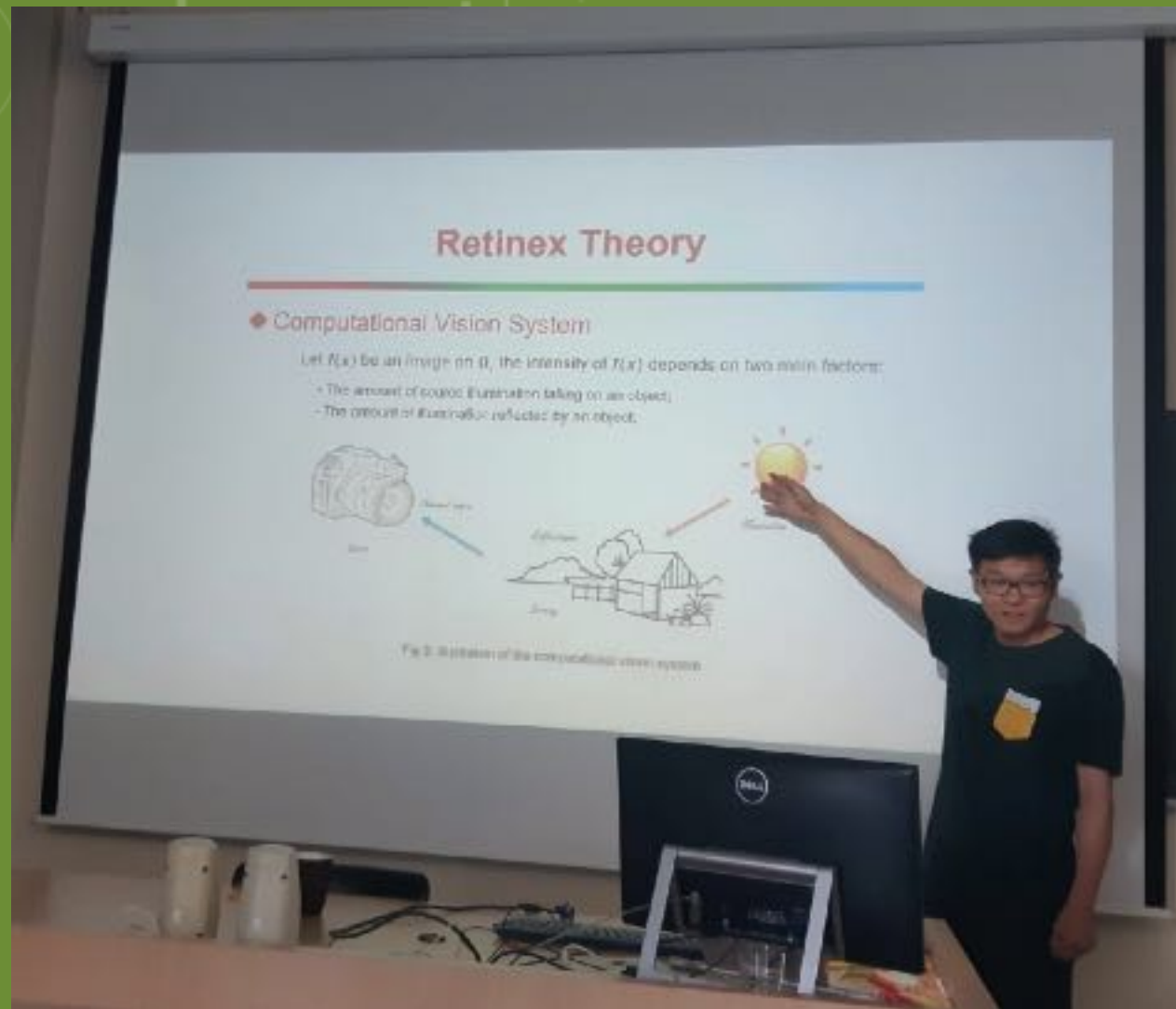
JUNQING HUANG



PHD STUDENT AT GHEENT UNIVERSITY



GHEENT
ANALYSIS
PDE



Research topic and Contribution to the Group:

Image processing

Theoretical Analysis of Deep Learning

- Mamaeva S.N., Kononova I.V., Ruzhansky M., Nikiforov P.V., Nikolaeva N.A., Pavlov A.N., Fedorova N.F., Huang J., Semenova M.N., Barashkova D.V., Frolova L.S., Maksimov G.V., **Using Scanning Electron Microscopy and Atomic Force Microscopy to Study the Formation of Nanoparticles on Red Blood Cell Surface in Cervical Cancer Patients.** *International Journal of Biomedicine*, 10(1): 70-75, 2020.
- Huang, J., Wang, L., and Wang, H. **Intrinsic image transfer for illumination compensation.** In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, submitted.
- Huang, J., Ruzhansky, M., Feng, H., Zheng, L., Huang, X., & Wang, H. **Feature extraction for license plate location based on L0-norm smoothing.** *Open Computer Science*, 9(1): 128-135, 2019.

Professor Sundaram Thangavelu
(Indian Institute of Science, Bangalore)
Heisenberg group

$$d(x, y) = |x^{-1}y|$$

homogeneous space

$B(a, r)$ = defined using d .

$$B(a, r) = a \cdot B(0, r) \text{ etc.}$$

is a notion of dyadic cubes

$$\bigoplus \mu_\nu$$

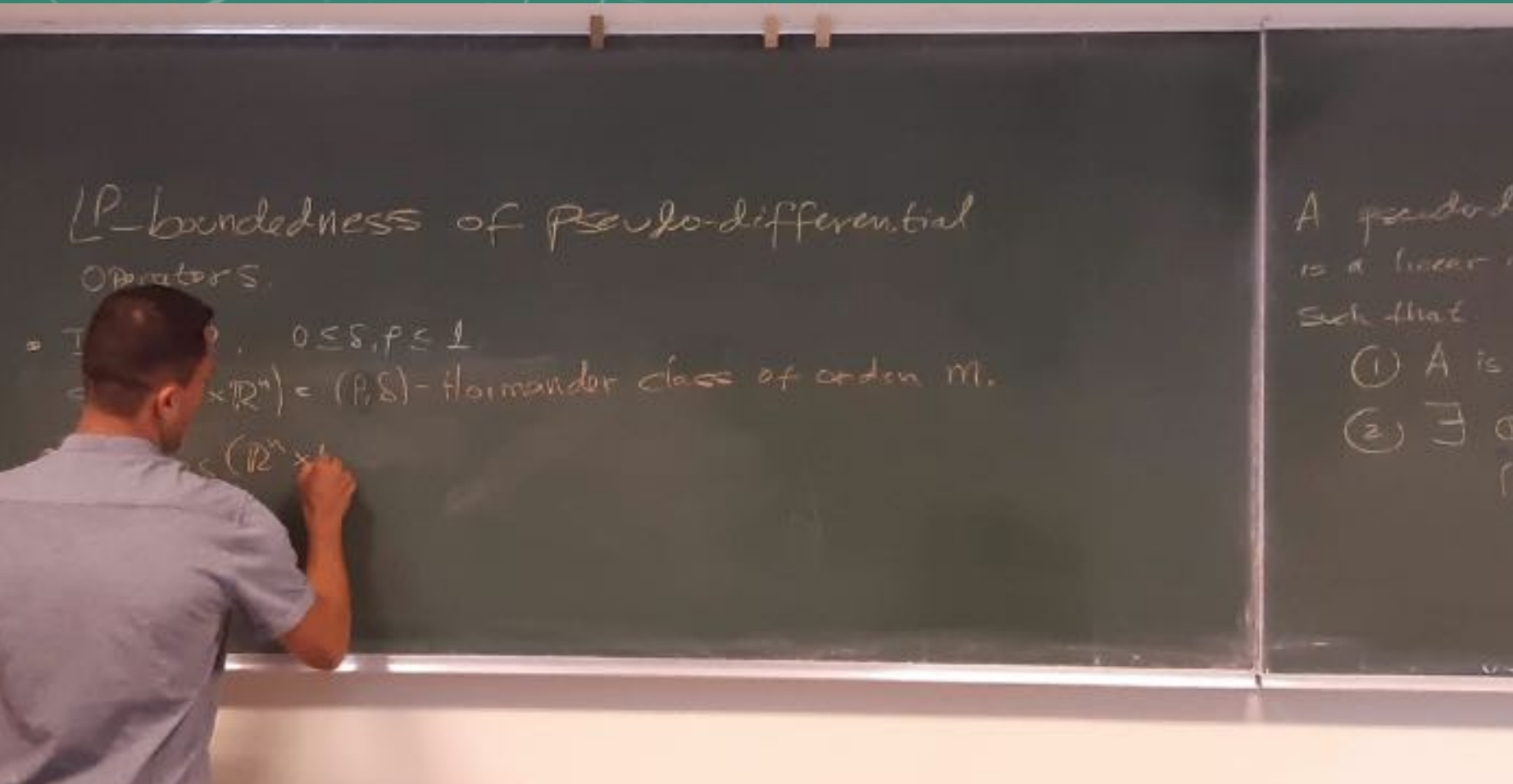
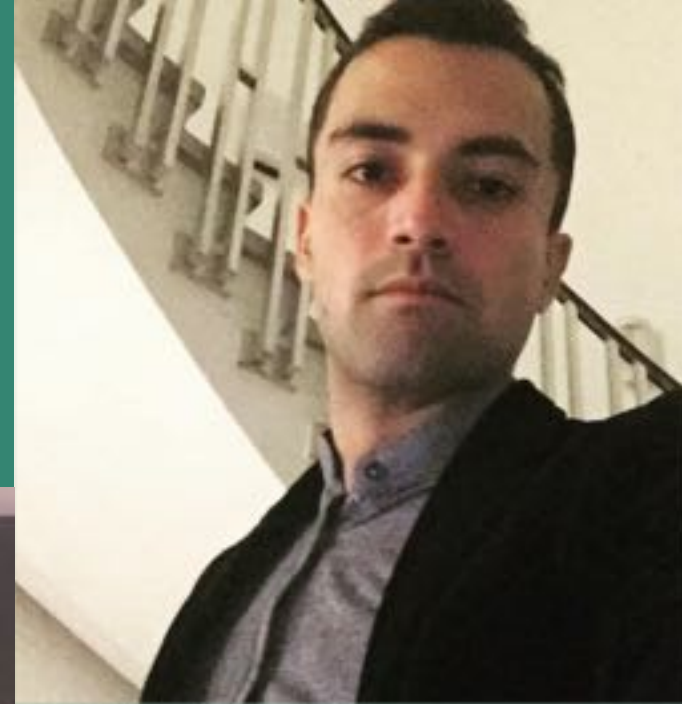
Hytönen -

$$0 < \delta < \frac{1}{96}$$



DUVÁN CARDONA SÁNCHEZ

PHD STUDENT AT GHENT UNIVERSITY



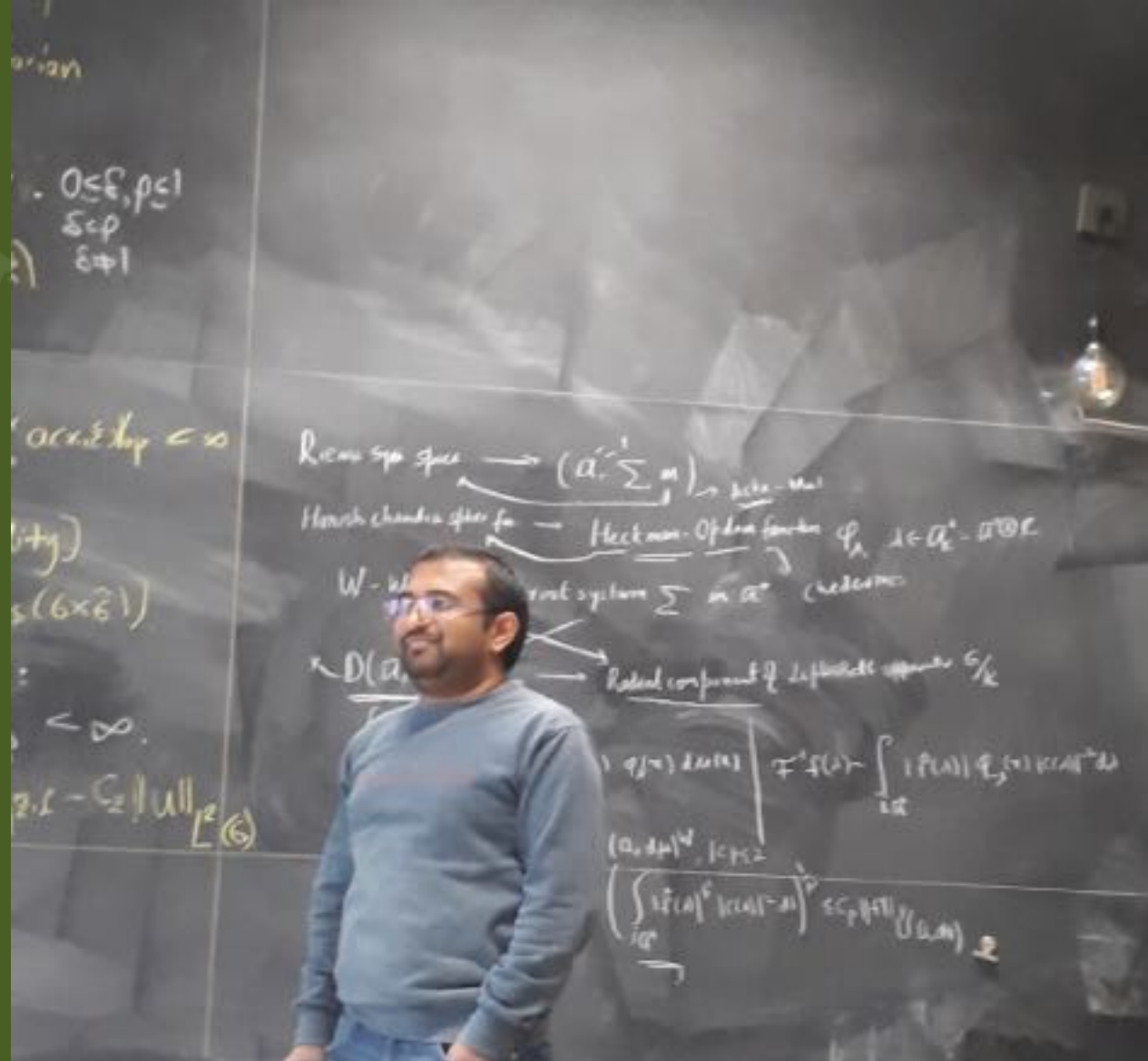
Research topic and Contribution to the Group:
Pseudo-differential Operators
Harmonic Analysis on Lie groups
Differential Geometry, PDE

- Cardona D., Kumar V., Ruzhansky M., Tokmagambetov N. **L_p - L_q boundedness of pseudo-differential operators on smooth manifolds and its applications to nonlinear equations**, *arXiv:2005.04936*
- Cardona D., Delgado J., Ruzhansky M. **L_p -bounds for pseudo-differential operators on graded Lie groups**, *arXiv:1911.03397*
- Cardona D., Ruzhansky M. **Boundedness of pseudo-differential operators in subelliptic Sobolev and Besov spaces on compact Lie groups**, *arXiv:1901.06825*
- Cardona D., Ruzhansky M. **Hörmander condition for pseudo-multipliers associated to the harmonic oscillator**, *arXiv:1810.01260*
- Cardona D., Ruzhansky M. **Littlewood-Paley theorem, Nikolskii inequality, Besov spaces, Fourier and spectral multipliers on graded Lie groups**, *arXiv*



VISHVESH KUMAR

POSTDOCTORAL RESEARCHER AT UGENT



G HENT
A N A L Y S I S
P D E

Harmonic analysis

Pseudo-differential operators

- V. Kumar and M. Ruzhansky, **Hausdorff-Young inequality for Orlicz spaces on compact homogeneous manifolds**, *Indag. Math. (N.S.)* 31(2) (2020), 266-276.
- A. Dasgupta and V. Kumar, **Hilbert-Schmidt and Trace class pseudo-differential operators on the abstract Heisenberg group**, *J. Math. Anal. Appl.*, 486(2) (2020), 123936.
- V. Kumar and M. Ruzhansky, **A note on K -functional, Modulus of smoothness, Jackson theorem and Nikolskii-Stechkin inequality on Damek-Ricci spaces**, (2020), *Arxiv*.
- M. Chatzakou and V. Kumar, **L^p - L^q boundedness of Fourier multipliers associated with the anharmonic Oscillator**, (2020) *Arxiv*.
- V. Kumar and M. Ruzhansky, **Hardy-Littlewood inequality and L^p - L^q Fourier multipliers on compact hypergroups**, (2020) *Arxiv*.



PHD STUDENT
GHENT UNIVERSITY

JUAN PABLO VELASQUEZ RODRIGUEZ



Research topic and Contribution to the Group:

Spectral symbolic analysis Harmonic analysis on locally profinite groups

Velasquez-Rodriguez J.P.

Hörmander classes of pseudo-differential operators over the compact group of p -adic integers.

p-Adic Numbers Ultrametric Anal. Appl., 12(2), 134-162, 2020.

Velasquez-Rodriguez J.P.

On some spectral properties of pseudo-differential operators on T .

J. Fourier Anal. Appl. 25, 2703–2732. 2019.



Friday no-time-limit GAP group seminar



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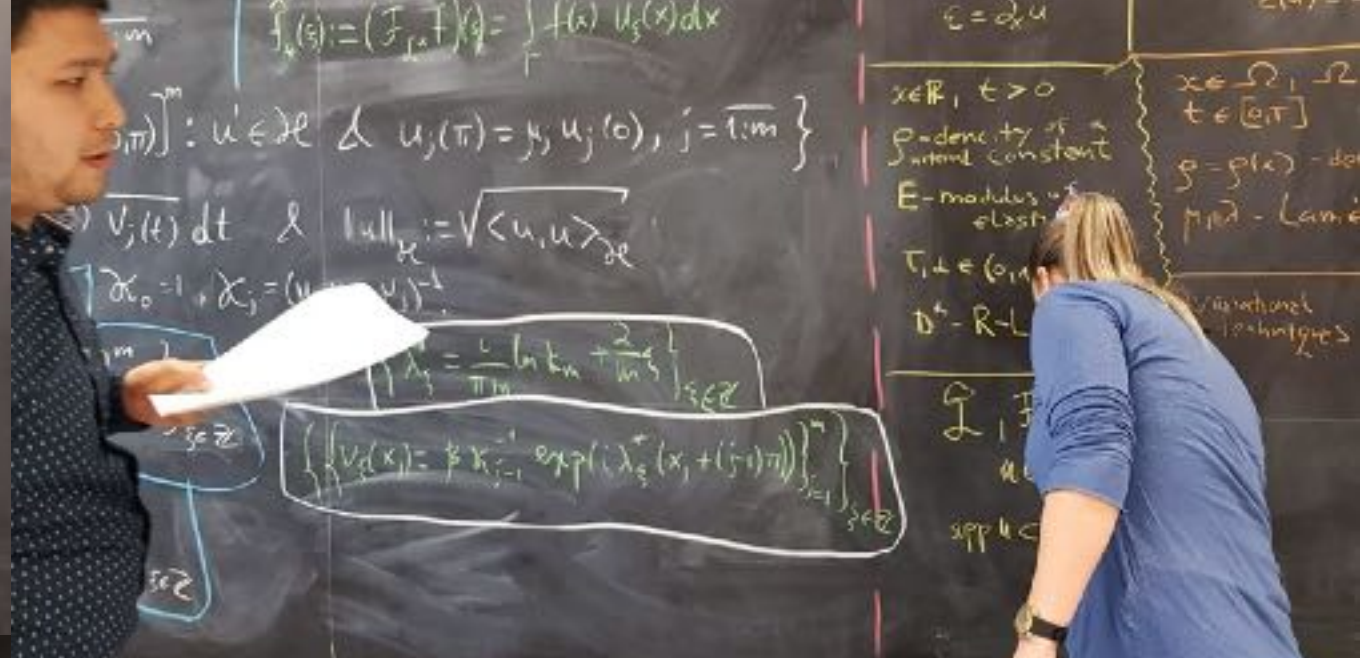
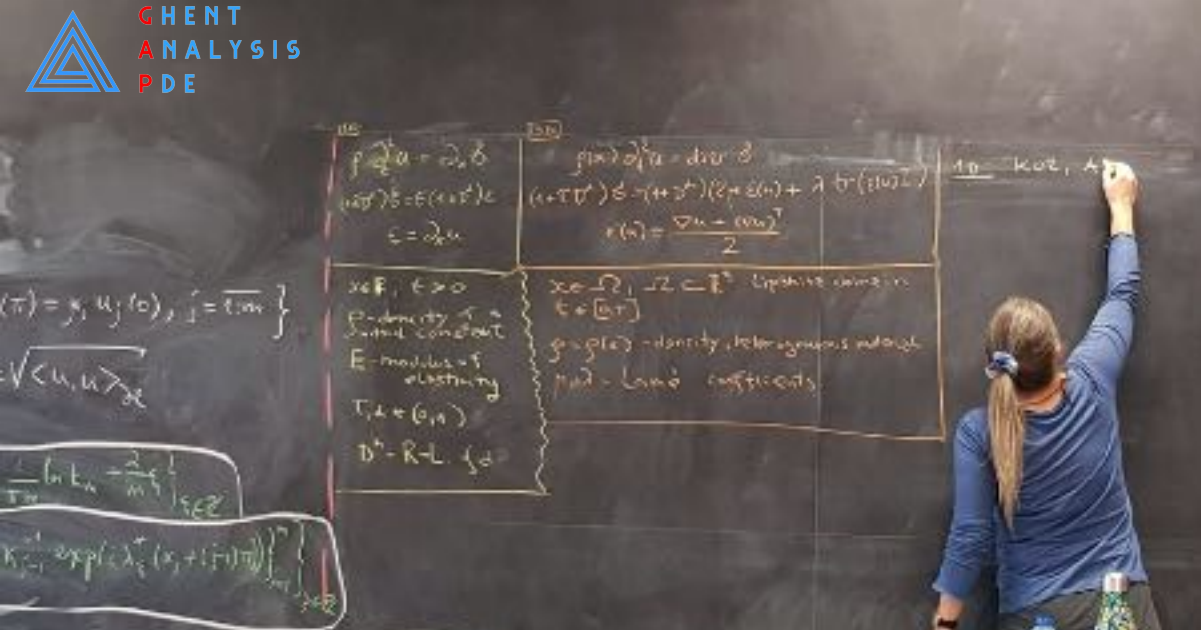
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**F r i d a y
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ARSHYN ALTYBAY

PHD STUDENT
GHENT UNIVERSITY
AND
AL-FARABI KAZAKH NATIONAL UNIVERSITY



GHENT
ANALYSIS
PDE

Research topic and Contribution to the Group:

Numerical analysis: high-performance computing

Numerical simulation of PDE

- A Altybay, M Ruzhansky, N Tokmagambetov. **A parallel hybrid implementation of the 2D acoustic wave equation**, *International Journal of Nonlinear Sciences and Numerical Simulation* (IJNSNS) 2020 accepted.
- A Altybay, M Ruzhansky, ME Sebih, N Tokmagambetov. **The heat equation with singular potentials**, *arXiv:2004.11255*
- A Altybay, M Ruzhansky, ME Sebih, N Tokmagambetov. **Fractional Schrodinger Equations with potentials of higher-order singularities**, *arXiv:2004.10182*
- A Altybay, M Ruzhansky, ME Sebih, N Tokmagambetov. **Fractional Klein-Gordon equation with strongly singular mass term**, *arXiv:2004.10145*

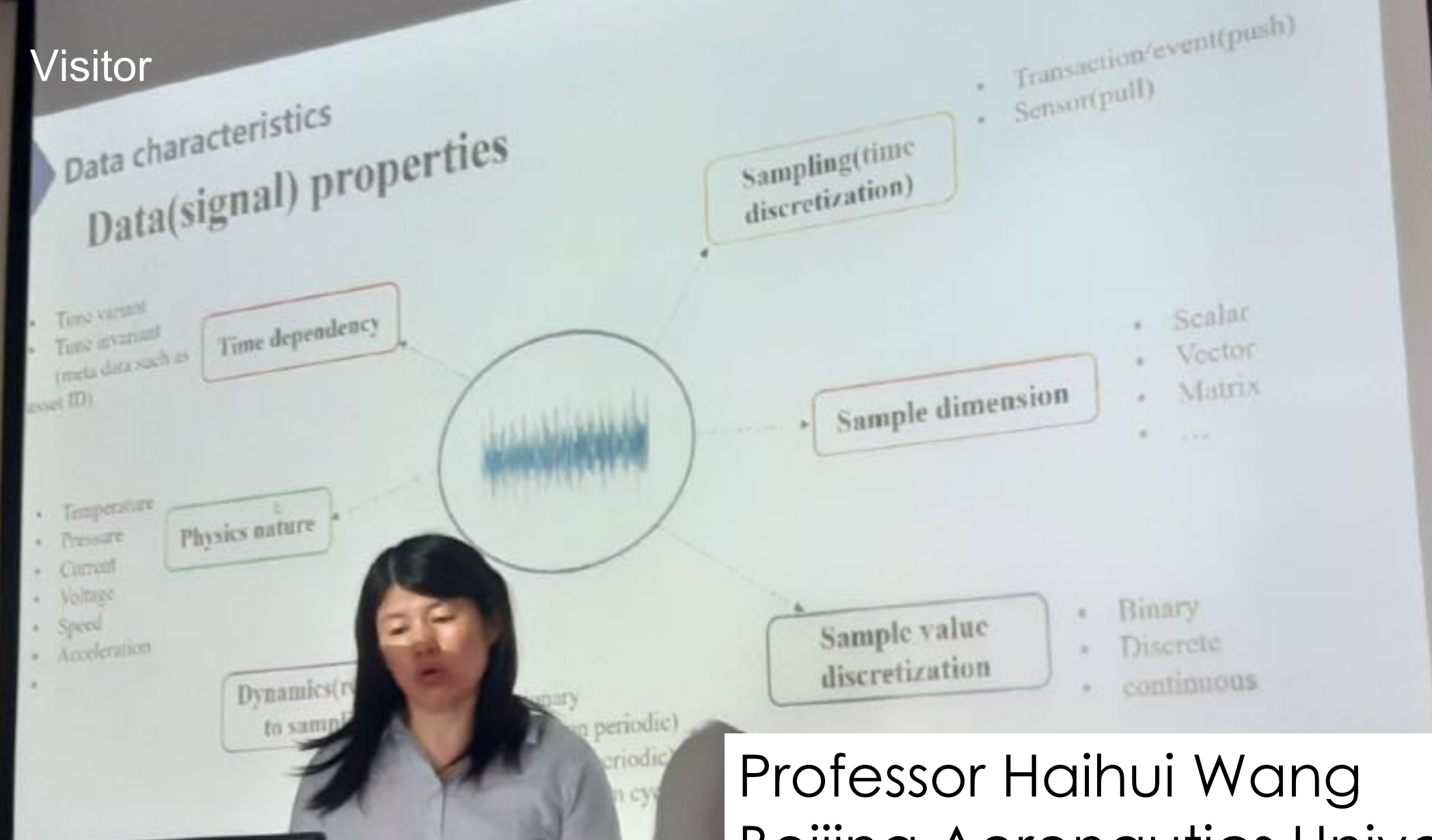
AIDYN KASSYMOV

PhD Student
Ghent University
and
Institute of Mathematics and Mathematical Modeling,
Almaty, Kazakhstan



Research topic and Contribution to the Group: Functional inequalities on groups Spectral geometry

- Kassymov A., Ruzhansky M., Suragan D., **Anisotropic fractional Gagliardo-Nirenberg, weighted Caffarelli-Kohn-Nirenberg and Lyapunov-type inequalities, and applications to Riesz potentials and p-sub-Laplacian systems**, *arxiv*, 2019.
- Kassymov A., Ruzhansky M., Suragan D., **Reverse Stein-Weiss, Hardy-Littlewood-Sobolev, Hardy, Sobolev and Caffarelli-Kohn-Nirenberg inequalities on homogeneous groups**, *arxiv*, 2020.
- Kassymov A., Ruzhansky M., Suragan D., **Fractional logarithmic inequalities and blow-up results with logarithmic nonlinearity on homogeneous groups**. *NoDEA Nonlinear Differential Equations Appl.*, 27 (2020), no. 1, Paper No. 7.
- Kassymov A., Ruzhansky M., Suragan D., **Hardy-Littlewood-Sobolev and Stein-Weiss inequalities on homogeneous Lie groups**. *Integral Transforms and Special Functions*, 30 (2019), 643-655.



Professor Haihui Wang
Beijing Aeronautics University
Wavelets, Data analysis

ATILE NEGA

PHD STUDENT
Ghent University
and
Addis Ababa University

Partial
Hypoellipticity of
Partial
Differential
Operators



BAYAN BEKBOLAT

PHD STUDENT
Ghent University
and
Al-Farabi Kazakh National University, Almaty
Kazakhstan

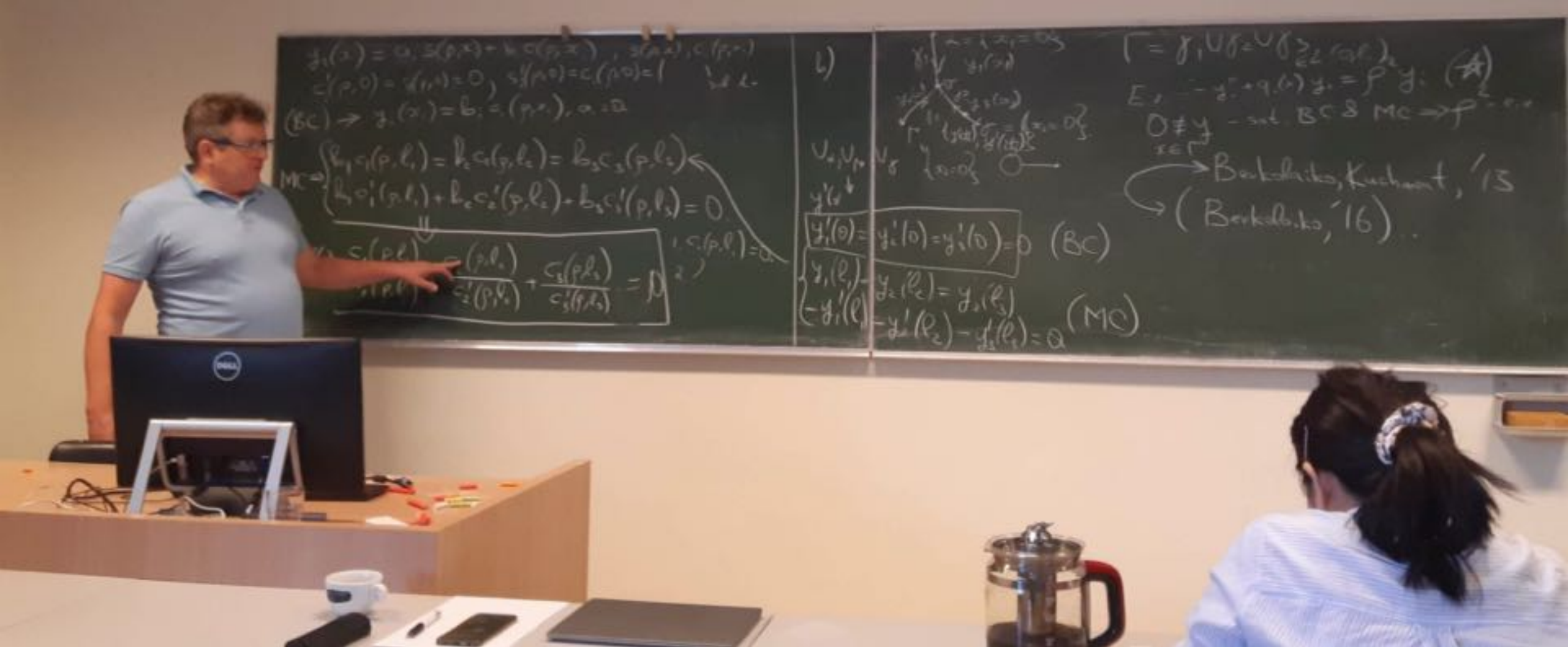


Research topic and Contribution to the Group:
Harmonic analysis associated with the Dunkl
operator

Bekbolat B., Kassymov A., Tokmagambetov N.

Blow-up of Solution of Nonlinear Heat Equation with Hypoelliptic Operators on Graded Lie Groups.

Complex Analysis and Operator Theory, 13 (2019), no. 7, pp. 3347-3357.



Lecturer: **Professor Igor Trooshin** (Shinshu University, Japan)
 Doctoral school on inverse spectral and scattering problems
 2-11 March 2020



MARIANNA CHATZAKOU

PHD STUDENT, GHENT ANALYSIS AND PDE GROUP

Imperial College London

Research topic and Contribution to the Group:

Noncommutative harmonic analysis

Pseudo-differential operators

- M. Chatzakou, V. Kumar, **$L_p - L_q$ boundedness of fourier multipliers associated with the anharmonic oscillator**, *arXiv:2004.07801*, 2020.
- M. Chatzakou, **Quantizations on the Engel and Cartan groups**, *arXiv:2003.10744*, 2020.
- M. Chatzakou M., J. Delgado, M. Ruzhansky, **On a class of anharmonic oscillators**, *arXiv:1811.12566*.

BOLYS SABITBEK

GHENT ANALYSIS AND PDE CENTER
POSTDOCTORAL RESEARCHER
AT QUEEN MARY UNIVERSITY OF LONDON



GHENT
ANALYSIS
PDE

Functional inequalities and applications

Noncommutative analysis

- M. Ruzhansky, B. Sabitbek, D. Suragan, **Geometric Hardy and Hardy-Sobolev inequalities on Heisenberg groups.** *Bulletin of Mathematical Sciences*, to appear.
- M. Ruzhansky, B. Sabitbek, D. Suragan, **Subelliptic geometric Hardy type inequalities on half-spaces and convex domains.** *Ann. Funct. Anal.*, to appear.
- M. Ruzhansky, B. Sabitbek, D. Suragan, **Hardy and Rellich inequalities for anisotropic p-sub-Laplacians.** *Banach Journal of Mathematical Analysis*, 14 (2020), 380-398.
- M. Ruzhansky, B. Sabitbek, D. Suragan, **Weighted anisotropic Hardy and Rellich type inequalities for general vector fields.** *NoDEA Nonlinear Differential Equations Appl.*, 26 (2019), no. 2, 26:13.
- M. Ruzhansky, B. Sabitbek, D. Suragan, **Weighted Lp-Hardy and Lp-Rellich inequalities with boundary terms on stratified Lie groups.** *Rev. Mat. Complutense*, 32 (2019), 19-35.



Seminars with cake break



AISHABIBI DUKENBAYEVA

PHD STUDENT
GHENT UNIVERSITY
AND
AL-FARABI KAZAKH NATIONAL UNIVERSITY

PDEs

(Non-local) Boundary Value Problems,
Inverse (Spectral) Problems

Sadybekov M., Dukenbayeva A.,

**Direct and inverse problems for the Poisson equation with
equality of flows on a part of the boundary.**

Complex Variables and Elliptic Equations, 64 (2019), no. 5, 777-791.



Visitor

Professor
Sanja Konjik
Novi Sad
Serbia

Fractional
Calculus

$$\begin{aligned} & d(\xi_1) \frac{(\xi_1 \eta)^{\frac{1+2\alpha}{2}}}{4s^2} (x\xi) e^{\frac{1-2\alpha}{2} - \frac{x^2 + \xi_1^2 + 2\xi^2}{4s}} \sum_{z=0}^{\infty} \frac{\left(\frac{\xi \xi_1 x}{4s} \sqrt{\frac{1}{\xi_1^2 + x^2}} \right)^{-\frac{1-2\alpha}{2} + 2z}}{z! \Gamma\left(-\frac{1-2\alpha}{2} + z + 1\right)} I_{-\frac{1-2\alpha}{2} + 2z} \left(\frac{\xi \sqrt{\xi_1^2 + x^2}}{2s} \right) d\xi_1 d\xi \\ & - (x\xi)^{\frac{1+2\alpha}{2}} e^{-\frac{x^2 + \xi_1^2 + 2\xi^2}{4s}} \sum_{r=0}^{\infty} \frac{\left(\frac{\xi \xi_1 x}{4s} \sqrt{\frac{1}{\xi_1^2 + x^2}} \right)^{-\frac{1-2\alpha}{2} + 2r}}{r!} I_{-\frac{1-2\alpha}{2} + 2r} \left(\frac{\xi \sqrt{\xi_1^2 + x^2}}{2s} \right) d\xi \leq \xi \\ & \leq C \left(\frac{\xi \sqrt{\xi_1^2 + x^2}}{2s} \right) \end{aligned}$$
$$|I_\nu(z)| \leq C |z|^\nu e^z$$
$$\frac{x}{z} = \frac{1}{8s^2}$$



DAURENBEK SERIKBAEV

Inverse source and initial problems for
evolution equations for positive operators

Ruzhansky M., Serikbaev D., Tokmagambetov N., Torebek B.,
**Direct and inverse problems for time-fractional
pseudo-parabolic equations.** *arXiv:2005.08297*, (2020)

PHD STUDENT
GHENT UNIVERSITY
AND
AL-FARABI KAZAKH NATIONAL UNIVERSITY



$$\lambda^2 \frac{\hat{\psi}(\lambda) - \hat{\phi}(\lambda) e^{-\lambda^2 t}}{1 - e^{-\lambda^2 T}}$$

$$\hat{\phi}(\lambda) + \frac{\hat{\phi}(\lambda) - \hat{\psi}(\lambda)}{1 - e^{-\lambda^2 T}} (e^{-\lambda^2 t} - 1)$$

$$\hat{\phi}(\lambda) = \phi(x) + \iint_{\mathbb{R} \times \mathbb{R}} \frac{[\phi(y) - \psi(y)] (e^{-\lambda^2 t} - 1)}{1 - e^{-\lambda^2 T}} \psi_\lambda^\alpha(y) \psi_{-\lambda}^\alpha(x) d\mu_\alpha(y)$$

$$= \iint_{\mathbb{R} \times \mathbb{R}} \frac{\psi(y) - \phi(y) e^{-\lambda^2 t}}{1 - e^{-\lambda^2 T}} \psi_\lambda^\alpha(y) \psi_{-\lambda}^\alpha(x) d\mu_\alpha(y) d\mu_\alpha(x)$$

$$\|f\|_{W_\alpha^{2,2}} = \|(1 + \lambda^2) \hat{f}\|$$

$\|$

$$\psi_\lambda^\alpha(y) \psi_{-\lambda}^\alpha(x) d\mu_\alpha(y)$$

Monday morning seminar

$$\begin{array}{lll}
 H^m : & f \in C_c(K \backslash G / K), & \mathcal{H}f(\lambda) \quad \forall \lambda \in \mathbb{C} \\
 & f \in \quad \quad \quad, & \mathcal{L}f(\lambda) \quad \underbrace{|\operatorname{Im} \lambda| \leq \rho} \\
 & f \in \quad \quad \quad, & \mathcal{H}f(\lambda) \quad \begin{array}{l} \varphi_\lambda \text{ bounded} \\ \lambda \in \mathbb{R} \end{array}
 \end{array}$$

Professor Jean-Philippe Anker (Université d'Orléans, France)
Mini-course on symmetric spaces



TOMMASO BRUNO

FWO Postdoctoral Fellow
Ghent University



Research topic and Contribution to the Group:

Harmonic Analysis and Analysis on Manifolds

- T. Bruno, M. M. Peloso, M. Vallarino, **Besov and Triebel–Lizorkin spaces on Lie groups**, *Math. Ann.* 377, 335–377 (2020).
- T. Bruno, **Endpoint results for the Riesz transform of the Ornstein–Uhlenbeck operator**, *J. Fourier Anal. Appl.* 25 (2019), no. 4, 1609–1631.
- T. Bruno, M. M. Peloso, A. Tabacco, M. Vallarino, **Sobolev spaces on Lie groups: embedding theorems and algebra properties**, *J. Funct. Anal.* 276 (2019), no. 10, 3014–3050.
- T. Bruno, **Maximal hypoellipticity for left-invariant differential operators on Lie groups**, *J. Lie Theory* 29 (2019), no. 3, 801–809.
- T. Bruno, M. Calzi, **Asymptotics for the Heat Kernel on H-type groups**, *Ann. Mat. Pura Appl.* (4) 197 (2018), no. 4, 1017–1049.



Relax time at PhD office



ERKINJON KARIMOV



Ghent Analysis and PDE Center

SENIOR RESEARCHER OF THE INSTITUTE OF MATHEMATICS
UZBEKISTAN ACADEMY OF SCIENCES

Research topic and Contribution to the Group:

Direct and Inverse Problems for PDEs with different fractional integro-differential operators

- Karimov E., Mamchuev M., Ruzhansky M. **Nonlocal initial problem for second order time-fractional and space-singular equation.** Accepted to *Hokkaido Mathematical Journal*
- Agarwal P., Karimov E., Mamchuev M., Ruzhansky M., **On boundary-value problems for a partial differential equation with Caputo and Bessel operators.** In *Novel Methods in Harmonic Analysis*, Vol. 2, pp. 707-719, (Pesenson, I., Le Gia, et al. editors), Applied and Numerical Harmonic Analysis. Birkhauser Basel, 2017.



CLAUDIA GARETTO

Ghent Analysis and PDE Center

SENIOR LECTURER
LOUGHBOROUGH UNIVERSITY

Research topic and Contribution to the Group:

Hyperbolic equations Hyperbolic systems with singularities and multiplicities

Garetto C., Jäh C., Ruzhansky M., **Hyperbolic systems with non-diagonalisable principal part and variable multiplicities, II: microlocal analysis.** *J. Differential Equations*, to appear.

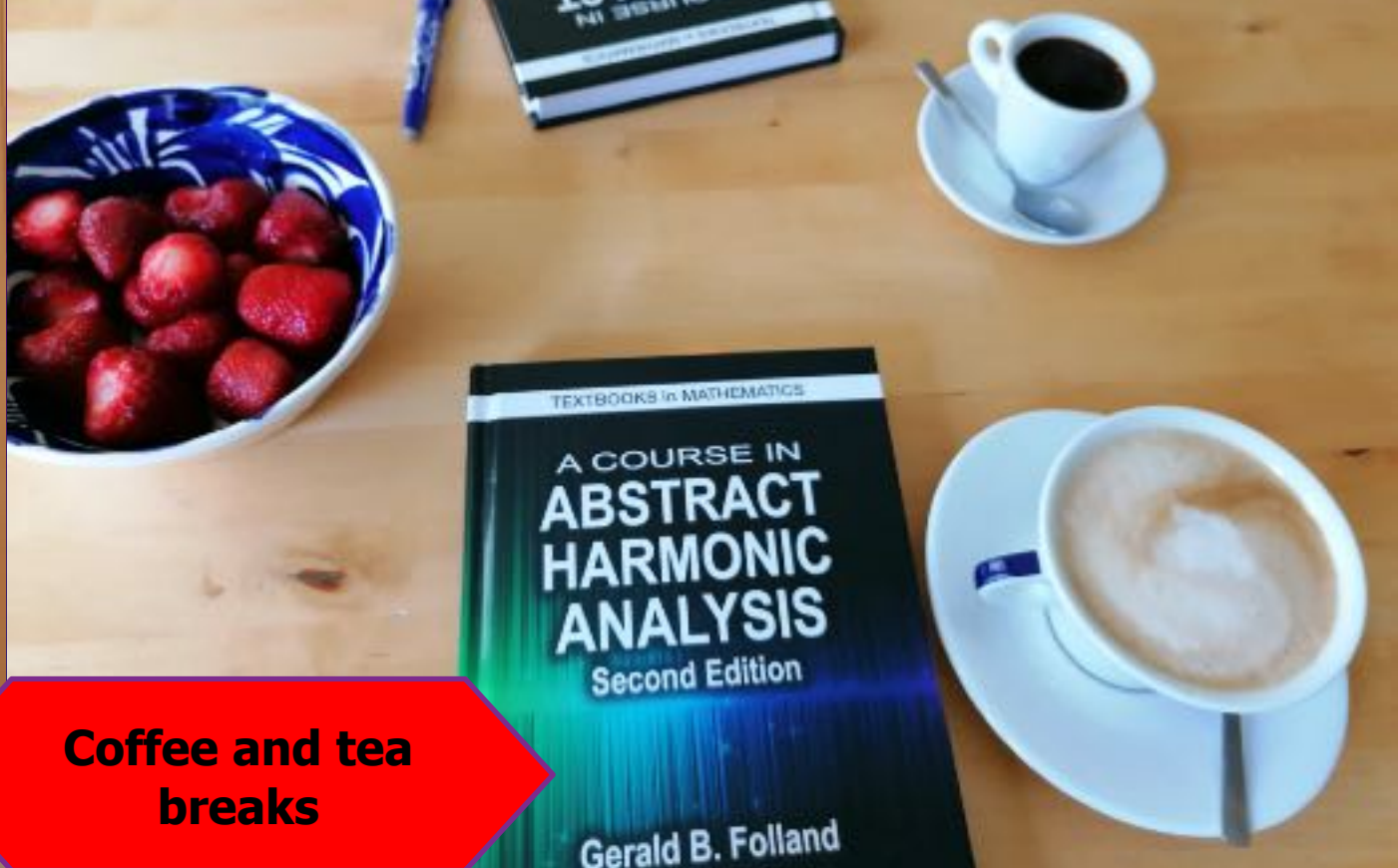
Garetto C., Jäh C., Ruzhansky M., **Hyperbolic systems with non-diagonalisable principal part and variable multiplicities, I: well-posedness.** *Math. Ann.*, 372 (2018), 1597–1629.

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G H E N T
A N A L Y S I S
P D E



Coffee and tea
breaks



JULIO DELGADO

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POSTDOCTORAL RESEARCH ASSISTANT
Queen Mary University of London, UK

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Research topic and Contribution to the Group:
Pseudo-differential Operators
Harmonic Analysis on Lie groups
Spectral Theory

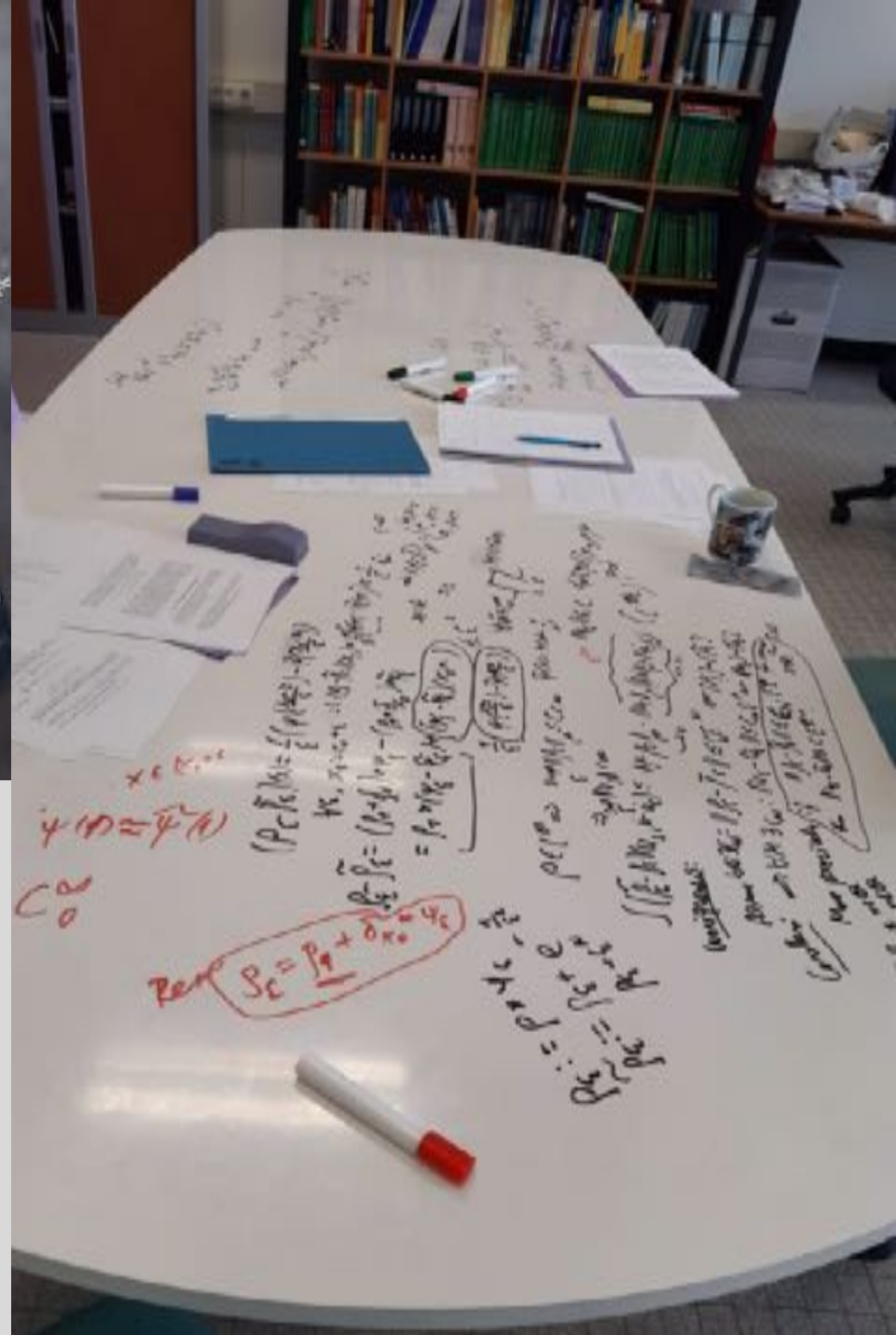
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- Delgado J., Ruzhansky M., Wang B., **Grothendieck-Lidskii trace formula for mixed-norm and variable Lebesgue spaces**, *J. Spectr. Theory*, 6 (2016), 781-791.
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Ω - domain occupied by viscoelastic material
 with boundary $\partial\Omega$
 $T > 0$
 equation of motion
 $(EM) \quad \rho \ddot{u} = \text{div } \underline{\underline{\sigma}} + \underline{\underline{F}}$ in $(0, T) \times \Omega$
 $\rho > 0$ - the density of a material
 u - displacement vector
 $\underline{\underline{\sigma}}$ - stress tensor
 $\underline{\underline{F}}$ - load vector $\underline{\underline{F}} \in (C(\bar{\Omega}), H_0^1(\Omega))$

Hooke's law
 $\underline{\underline{\sigma}} = 2\mu \underline{\underline{\epsilon}}(u) + \lambda \underline{\underline{\epsilon}}(u) \text{tr}(\underline{\underline{\epsilon}}(u)) \underline{\underline{I}}$
 $\underline{\underline{\epsilon}}(u) = \frac{1}{2} (\nabla u + (\nabla u)^T)$ - stress tensor
 λ - shear modulus, μ - first Lamé coefficient
 Zener fractional model (solid type)
 $(\underline{\underline{\epsilon}})^{\alpha} (1 + \tau^{\alpha} D_t^{\alpha}) \underline{\underline{\sigma}} = (1 + \tau^{\alpha} D_t^{\alpha}) [2\mu \underline{\underline{\epsilon}}(u) + \lambda \underline{\underline{\epsilon}}(u) \text{tr}(\underline{\underline{\epsilon}}(u)) \underline{\underline{I}}]$
 τ - relaxation time, τ^{α} - retardation time
 D_t^{α} - Caputo fractional derivative
 Laplace transform $(EM) \quad \underline{\underline{\sigma}}(s) = (1 + \tau^{\alpha} s^{\alpha})^{-1} [2\mu \underline{\underline{\epsilon}}(u) + \lambda \underline{\underline{\epsilon}}(u) \text{tr}(\underline{\underline{\epsilon}}(u)) \underline{\underline{I}}] + \underline{\underline{G}}$
 $\underline{\underline{\sigma}}(x) = \begin{cases} \underline{\underline{\sigma}}(x) & x \neq 0 \\ \underline{\underline{\sigma}}(0) & x = 0 \end{cases}$
 2nd order non-local evolution equation

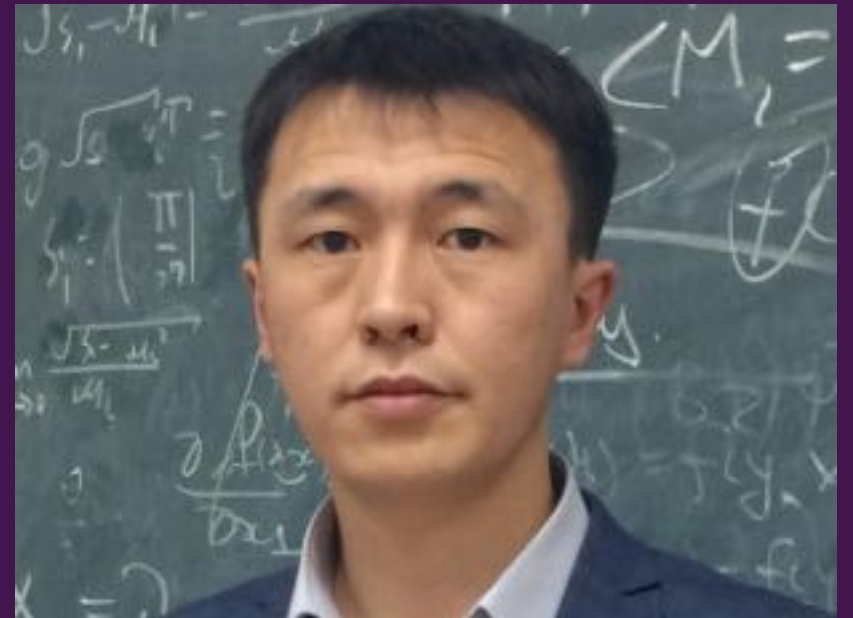
OUR BOARDS



DURVUDKHAN SURAGAN

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NAZARBAYEV UNIVERSITY, NUR-SULTAN, KAZAKHSTAN



Research topic and Contribution to the Group:
Functional inequalities and related analysis

Lp-Caffarelli-Kohn-Nirenberg type inequalities on homogeneous groups, *Quarterly Journal of Mathematics*, 70 (2019), 305-318. (with Ozawa T. and Ruzhansky M.)

Extended Caffarelli-Kohn-Nirenberg inequalities, and remainders, stability and superweights for Lp-weighted Hardy inequalities, *Transactions of the American Mathematical Society, Ser. B*, 5 (2018), 32-62. (with Ruzhansky M. and Yessirkegenov N.)

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On horizontal Hardy, Rellich, Caffarelli-Kohn-Nirenberg and p-sub-Laplacian inequalities on stratified groups, *Journal of Differential Equations*, 262 (2017), 1799-1821. (with Ruzhansky M.)

TOKIO MATSUYAMA

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Research topic and Contribution to the Group

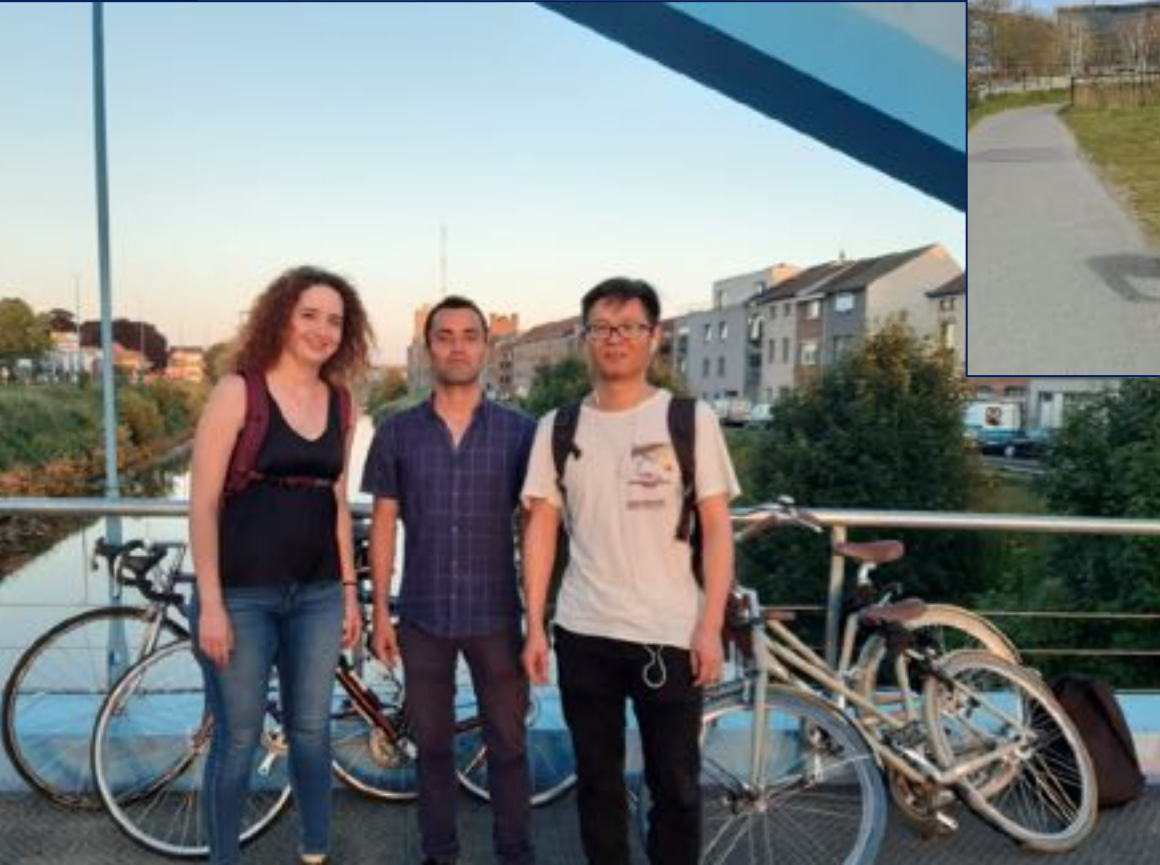
Functional Analysis

PDE

- Matsuyama T., Ruzhansky M., **On the Gevrey well-posedness of the Kirchhoff equation.** *J. Anal. Math.*, 137 (2019), 449-468.
- Matsuyama T., Ruzhansky M., **Almost global well-posedness of Kirchhoff equation with Gevrey data,** *C. R. Acad. Sci. Paris*, 355 (2017), 522-525.
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- Matsuyama T., Ruzhansky M., **Global well-posedness of Kirchhoff systems,** *J. Math. Pures Appl.*, 100 (2013), 220-240.
- Matsuyama T., Ruzhansky M., **Scattering for strictly hyperbolic systems with time-dependent coefficients,** *Math. Nachr.*, 286 (2013), 1191-1207.



Free
time



JENS WIRTH

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Research topic and Contribution to the Group

Pseudo-Differential Operators

Compact Lie groups

PDEs

Ruzhansky M., Wirth J., **Lp Fourier multipliers on compact Lie groups**, *Math. Z.*, 280 (2015), 621-642.

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Ruzhansky M., Turunen V., Wirth J., **Hörmander class of pseudo-differential operators on compact Lie groups and global hypoellipticity**, *J. Fourier Anal. Appl.*, 20 (2014), 476-499.

Ruzhansky M., Wirth J., **On multipliers on compact Lie groups**, *Funct. Anal. Appl.*, 47 (2013), 72-75.

Ruzhansky M., Wirth J., **Dispersive type estimates for Fourier integrals and applications to hyperbolic systems**, *Disc. Cont. Dyn. Systems, Suppl.* (2011), 1263-1270.

VILLE TURUNEN

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Research topic and Contribution to the Group

Time-Frequency Analysis Pseudo-Differential Operators

- Ruzhansky M., Turunen V., Wirth J., **Hörmander class of pseudo-differential operators on compact Lie groups and global hypoellipticity**, *J. Fourier Anal. Appl.*, 20 (2014), 476-499.
- Ruzhansky M., Turunen V., **Global quantization of pseudo-differential operators on compact Lie groups, $SU(2)$ and 3-sphere**, *Int. Math. Res. Not. IMRN* 2013, no. 11, 2439-2496.
- Ruzhansky M., Turunen V., **Sharp Garding inequality on compact Lie groups**, *J. Funct. Anal.*, 260 (2011), 2881-2901.
- Ruzhansky M., Turunen V., **Quantization of pseudo-differential operators on the torus**, *J. Fourier Anal. Appl.*, 16 (2010), 943-982.



Home made Belgian waffles and Belgian chocolates



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8. Ergashev T.G., Hasanov A. Fundament ...
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Darboux equation, Electron. J. Diff. Equ., ...
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Gellerstedt Equation, Book: "Functional Eq ...
Notions", Nova Science Publishers Inc. NY ...
11. A. Hasanov and E.T. Karimov, Fundament ...

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Special functions

ANVAR HASANOV



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LEADING RESEARCHER AT INSTITUTE OF MATHEMATICS,
UZBEK ACADEMY OF SCIENCES, TASHKENT, UZBEKISTAN

Degenerate PDE Special functions

Ruzhansky M., Hasanov A. **Self-similar solutions of some model degenerate partial differential equations of the second, third and fourth order.** *Lobachevskii J. Math.*, 41 (2020), 1103-1114.

Hasanov A., Ruzhansky M. **Hypergeometric expansions of solutions of the degenerate model parabolic equations of the third order.** *Lobachevskii J. Math.*, 41 (2020), 27-31.

Ruzhansky M., Hasanov A. **Euler-type integral representations for hypergeometric functions of three second-order variables.** *Bulletin of the Institute of Mathematics*. 2019, 6, pp.73-223.

Srivastava H.M., Hasanov A., Ergashev T.G. **A family of potentials for elliptic equations with one singular coefficient and their applications.** *Mathematical Methods in Applied Sciences*. 2020. Vol.43, 10, 6181-6199.

Hasanov A., Choi J. **Note on Euler-Bernoulli Equation.** *Sohag Journal of Mathematics* 7 (2), 2020, 33-36.

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Al-Farabi Kazakh National University
Almaty, Kazakhstan



Research topic and Contribution to the Group

Spectral Theory PDEs

- Kanguzhin B., Ruzhansky M., Tokmagambetov N. **On convolutions in Hilbert spaces**, *Funct. Anal. Appl.*, 51, 221-224, (2017)
- Kanguzhin B., Tokmagambetov N., Tulenov K. **Pseudo-differential operators generated by a non-local boundary value problem**. *Complex Variables and Elliptic Equations* 60 (1), 107-117, (2018)
- Kanguzhin B., Tokmagambetov N. **A regularized trace formula for a well-perturbed Laplace operator**. *Doklady Mathematics* 91 (1), 1-4, (2015)
- Kanguzhin B., Tokmagambetov N. **Resolvents of well-posed problems for finite-rank perturbations of the polyharmonic operator in a punctured domain**. *Siberian Mathematical Journal* 57 (2), (2016)

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Assistant Professor
University of Delhi



Hardy inequalities

Ruzhansky M., Verma D., **Hardy inequalities on metric measure spaces.**
Proc. R. Soc. A, 475 (2019), 20180310, 15pp.

Associated researcher



Marián Slodička

Ghent Analysis and PDE Center

Full Professor
Ghent University



Research topic and Contribution to the Group:

Applied PDEs

Inverse problems

- M. Slodička, K. Šišková and K. Van Bockstal. **Uniqueness for an inverse source problem of determining a space dependent source in a time-fractional diffusion equation.** *Applied Mathematics Letters*, 91:15-21, 2019.
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APARAJITA DASGUPTA

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Research topic and Contribution to the Group:

Harmonic analysis

Pseudo-differential operators

- Dasgupta A., Ruzhansky M., **Eigenfunction expansions of ultradifferentiable functions and ultradistributions. III. Hilbert spaces and Universality.** *Arxiv*.
- Dasgupta A., Ruzhansky M., **Eigenfunction expansions of ultradifferentiable functions and ultradistributions. II. Tensor representations,** *Trans. Amer. Math. Soc. Ser. B.*, 5 (2018), 81-101.
- Dasgupta A., Ruzhansky M., **Eigenfunction expansions of ultradifferentiable functions and ultradistributions.** *Trans. Amer. Math. Soc.*, 368 (2016), 8481-8498.
- Dasgupta A., Ruzhansky M., **Gohberg lemma, compactness, and essential spectrum of operators on compact Lie groups.** *J. Anal. Math.*, 128 (2016), 179-190.
- Dasgupta A., Ruzhansky M., **Gevrey functions and ultradistributions on compact Lie groups and homogeneous spaces.** *Bull. Sci. Math.*, 138 (2014), 756-782.

10 people 10 nations

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Austria
Kazakhstan
Colombia
Ethiopia
China
Italy
Serbia



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MOHAMMED ELAMINE SEBIH

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ASSISTANT AT THE UNIVERSITY MUSTAPHA STAMBOULI
OF MASCARA, ALGERIA



Research topic and Contribution to the Group:

Partial differential equations with irregular coefficients

- Altybay A., Ruzhansky M., Sebih M., Tokmagambetov N., **Tsunami propagation for singular topographies**. Arxiv : 2005.11931 (2020)
- Altybay A., Ruzhansky M., Sebih M., Tokmagambetov N., **The heat equation with singular potentials**. Arxiv : 2004.11255 (2020)
- Altybay A., Ruzhansky M., Sebih M., Tokmagambetov N., **Fractional Schrödinger equations with potentials of higher-order singularities**. Arxiv : 2004.10182 (2020)
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LINDA BOTCHWAY

Ghent Analysis and PDE Center
PhD student at University of Ghana



Pseudo-differential calculus on the lattice
and applications

Botchway L., Kibiti G., Ruzhansky M.

Difference equations and pseudo-differential operators on $\mathbb{Z}_n$
J. Funct. Anal., 278 (2020), no. 11, 108473, 41pp.

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Colombia

Quantum groups
Wave equations



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PhD Student
University of Paraná, Curitiba
Brazil



Research topic and Contribution to the Group:

Hypoellipticity and solvability

- Kirilov A., De Moraes W., Ruzhansky M., **Partial Fourier series on compact Lie groups.** *Bull. Sci. Math.*, 160 (2020), 102853
- Kirilov A., De Moraes W., Ruzhansky M., **Global properties of vector fields on compact Lie groups in Komatsu classes. II. Normal forms.** arXiv
- Kirilov A., De Moraes W., Ruzhansky M., **Global properties of vector fields on compact Lie groups in Komatsu classes.** arXiv
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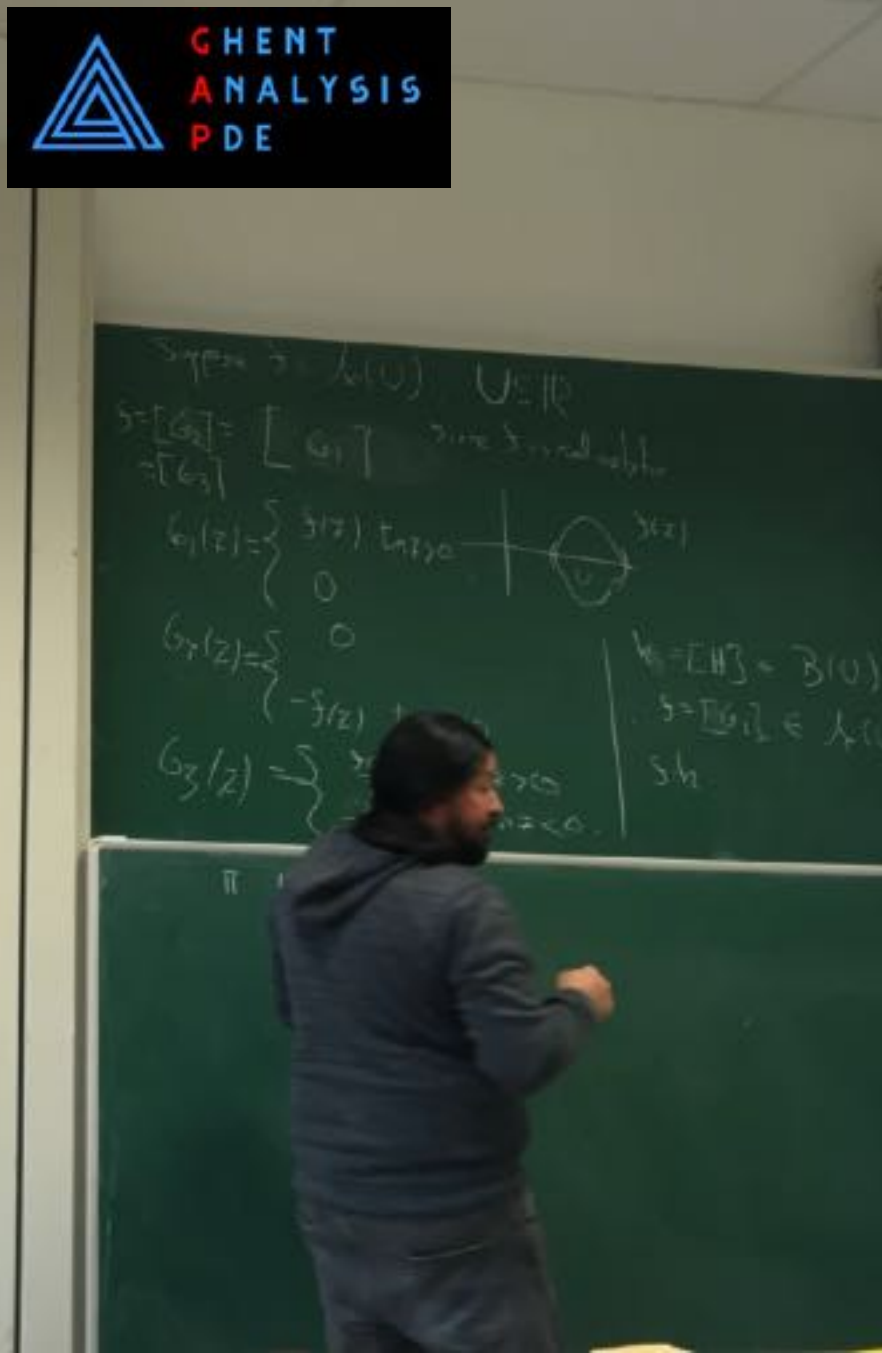
Department lunch



JASSON VINDAS

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Functional Analysis

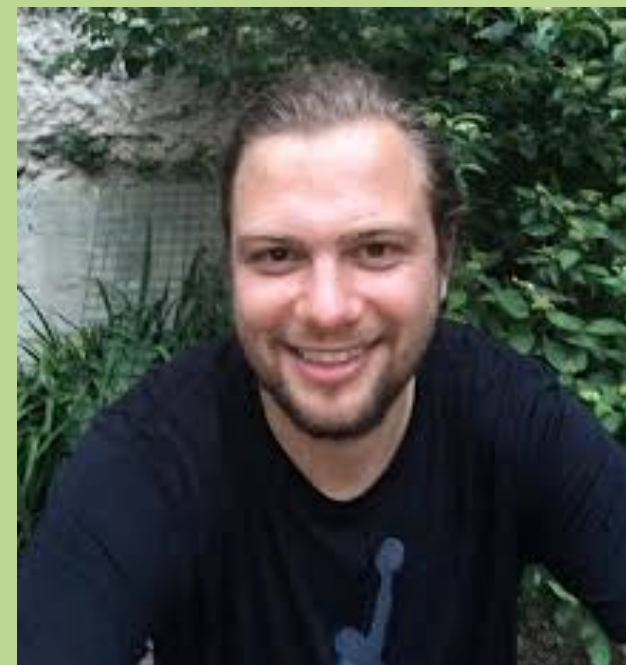
Harmonic Analysis

Analytic Number Theory

- F.Broucke, G.Debruyne, J.Vindas, **Beurling integers with RH and large oscillation**, *Adv. Math.* 370 (2020), 107240.
- A.Debrouwere, J.Vindas, **Topological properties of convolutor spaces via the short time Fourier transform**, *Trans. Amer. Math. Soc.*, in press.
- R.Estrada, J.Vindas, Y.Yang, **The Fourier transform of thick distributions**, *Anal. Appl. (Singap.)*, accepted.
- A.Debrouwere, L.Neyt, J.Vindas, **Characterization of nuclearity for Beurling-Björck spaces**, *Proc. Amer. Math. Soc.*, accepted.

ANDREAS DEBROUWERE

FWO Postdoctoral Fellow
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Research topic and Contribution to the Group:

Functional Analysis

- A. Debrouwere, **Solution to the Stieltjes moment problem in Gelfand-Shilov spaces**, *Studia Math.*, accepted.
- A. Debrouwere, **Quasinormable C_0 -groups and translation-invariant Frechet spaces of type D_E** , *Results Math.*, accepted.
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LENNY NEYT

PHD STUDENT
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Research topic and Contribution to the Group:

Generalized functions Functional Analysis

Andreas Debrouwere, Lenny Neyt, Jasson Vindas. **The nuclearity of Gelfand-Shilov spaces and kernel theorems**, *Collect. Math.*, in press.

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$$0 \leq \delta, \rho \leq 1$$

$$\Pi_{\text{inf}} = \sum_{j=1}^{\infty} \frac{1}{j^2}$$

Natural condition NDI is 10, 100, 1000

Then $\pi(x) \sim \frac{x}{\log x} \sim$

$$T_{\text{eff}} = \frac{\prod_{i=1}^N T_i}{\prod_{i=1}^N T_i} = L_{\text{eff}}$$

Titel = Li₂ + Cl₂ = LiCl

replaced by B. Delvaux, Vinder

451. 1853

and others

(v) $f = \varphi(x) = \phi(x, \eta(x))$, $\forall x \in X$
History $\frac{3}{n \times 2}$ $M \rightarrow \infty$

- distribution: Schmale flucht

Pliginsk and Stanovoi found for

$$f = P(D)f_1 + f_2, \quad f_0 \in C_0 \omega(\mathbb{M}^n)$$

covered by ^{on right}



if M, A weight sequences satisfying (1.1), (1.2)

$$\frac{1}{\Gamma} \in S_{[A]}^{(1)}(H^1) \text{ auf } \Gamma \quad (*)$$

$$(9) f = \sum_{n \in \mathbb{N}} f(n)$$

$$w(x) = \frac{1}{\sqrt{x}}$$

for some (k, n) $\forall \epsilon > 0$

Frederik Broucke

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F.Broucke, G.Debruyne, J.Vindas,
Beurling integers with RH and large oscillation, *Adv. Math.* 370
(2020), 107240.

Gregory Debruyne

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Ghent University

Post-doctoral Francqui Foundation Fellow
University of Illinois at Urbana-Champaign



Approximation theory/ Tauberian theory Analytic number theory and combinatorics

F. Broucke, G. Debruyne, J. Vindas, **Beurling integers with RH and large oscillation**, *Adv. Math.* 370 (2020), 107240.

G. Debruyne, F. Maes, J. Vindas, **Halász's theorem for Beurling generalized numbers**, *Acta Arith.* 194 (2020), 59-72.

G. Debruyne, D. Seifert, **Optimality of the quantified Ingham-Karamata theorem for operator semigroups with general resolvent growth**, *Arch. Math.* 113 (2019), 617-627.

G. Debruyne, D. Seifert, **An abstract approach to optimal decay of functions and operator semigroups**, *Israel J. Math.* 233 (2019), 439-451.



GHENT

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Research topic and Contribution to the Group:

Generalized functions Nonstandard analysis

A. Debrouwere, H. Vernaev, J. Vindas, **A non-linear theory of infrahyperfunctions**, *Kyoto J. Math.*, (2019) 59 (4): 869-895

A. Debrouwere, H. Vernaev, J. Vindas, **Optimal embeddings of ultradistributions into differential algebras**. *Monatshefte fuer Mathematik* (2018) 186: 407-438.

H. Vernaev, **Microlocal analysis in generalized function algebras based on generalized points and generalized directions**, *Monatshefte für Mathematik* (2016) 181: 205-215

H. Vernaev, **Regularity of nonlinear generalized functions: a counterexample in the nonstandard setting**. *arXiv*.



ANDREAS WEIERMANN

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Senior Full Professor
Ghent University

Research topic and Contribution to the Group:

Analytic logic Proof theory

Weiermann, Andreas, et al. "Calculating Maximal Order Types for Finite Rooted Unstructured Labeled Trees." The Legacy of Kurt Schütte, edited by Reinhard Kahle, Springer, 2020.

Weiermann, Andreas, et al. "Predicatively Unprovable Termination of the Ackermannian Goodstein Process." Proceedings of the American Mathematical Society, edited by Heike Mildenberger, American Mathematical Society, 2020, pp. 1–16.

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GHENT ANALYSIS & PDE CENTRE



We are an intercontinental **mathematical research centre** with highly diverse backgrounds

WIDE RANGE OF RESEARCH TOPICS

- Partial differential equations (PDE)
- Non-commutative analysis
- Pseudo-differential operators
- Spectral theory
- Functional analysis
- Harmonic and nonharmonic analysis
- Inverse problems
- Fractional derivatives
- Image processing/deep learning
- Applications to applied sciences

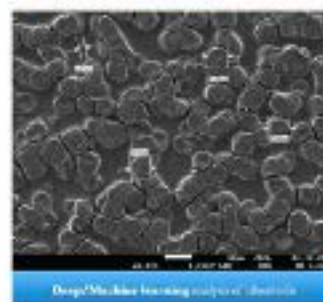


RESEARCH GRANTS OF OUR MEMBERS

- 2016-2025 FWO Odysseus I Project: Analysis and Partial Differential Equations
- FWO and BOF Grants
- EU H2020 Marie Curie Training Fellowship
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Interdisciplinary research is welcome

- We seek out collaborations across fields: engineering, physics, medicine, biology, etc.
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- 2 ISAAC Prizes
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- Adams Award
- Award for talented young scientists



Contact us if you have a mathematical question or need a consultation

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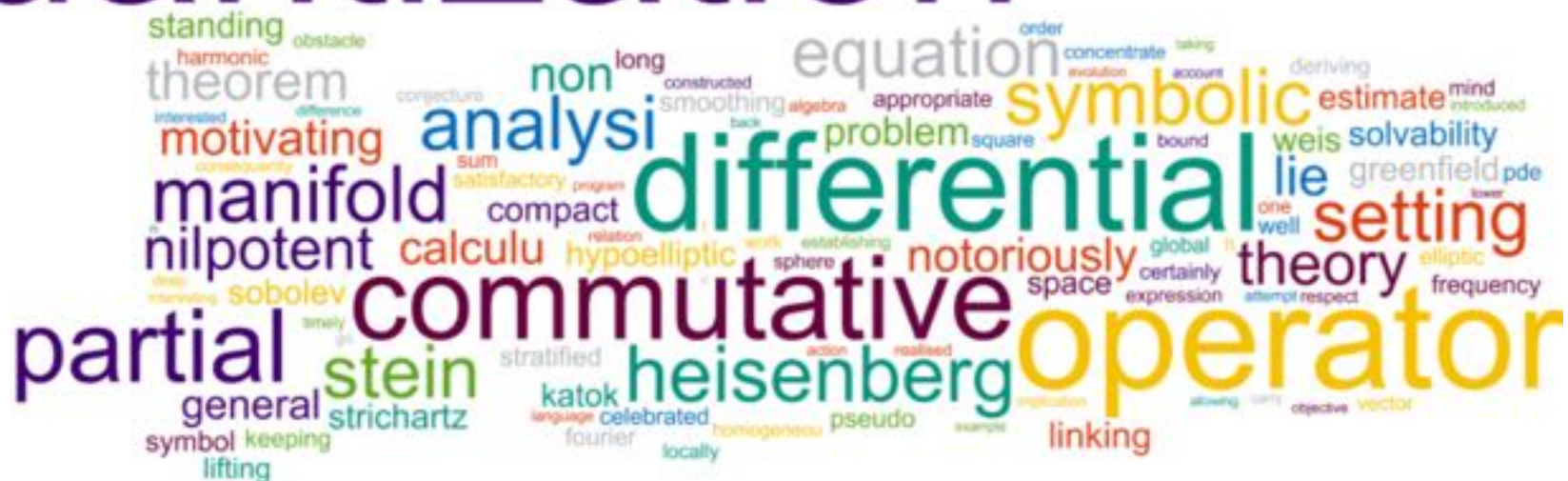
Head of group: Prof. Dr. Michael Burdzy
UGent, WE16, Coupure Street, 58, Level 2



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