

# The center GPP

## Geometry, Physics and Probability

April 26, 2024

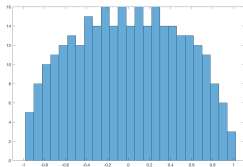
# Why "Geometry, Physics and Probability" ?

- ▶ Physics uses mathematics in its very formulation and fundamentals.
- ▶ Many mathematical concepts and theories emerge from physical considerations. In a large number of cases, the knowledge of relevant physics is an important guide in developing new mathematics.
- ▶ Main reason of existence of GPP (created by Pierre van Moerbeke in 2005): a center driving synergy between mathematicians and theoretical physicists whose main scientific interests are explicitly formalised on common grounds.

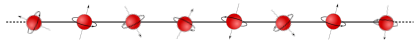
# Permanent academic members



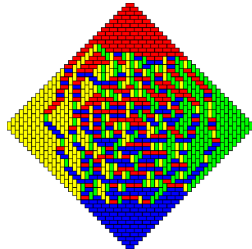
Prof. Pierre Beliaevsky



Prof. Tom Claeys



Prof. Christian Walmsley Hagendorf



Prof. Philippe Ruelle

# Research Theme I : Random matrices and determinantal point processes (Tom Claeys)

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- ▶ Spectral characteristics of random matrices (largest, gaps)
- ▶ Specific perturbations within given ensemble
- ▶ Toeplitz/Hankel determinants for singular symbols
- ▶ Random matrix theory: rigidity of eigenvalues, gap probabilities
- ...
- ▶ Determinantal point processes
- ▶ Integrable differential equations
- ▶ Asymptotic analysis of Fredholm, Toeplitz and Hankel determinants
- ▶ Riemann-Hilbert problems

# Research Theme II : Low dimensional statistical mechanics (Christian Walmsley Hagendorf)

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- ▶ Integrable vertex models and SOS models
- ▶ Enumerative combinatorics of alternating sign matrices
- ▶ Exact ground-state properties and correlation functions of integrable spin chains
- ▶ Quantum inverse scattering method and quantum separation of variables
- ▶ Spin chains and lattice supersymmetry

# Research Theme III : Phase transitions and arctic phenomena (Philippe Ruelle)

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- ▶ Combinatorics of tiling problems (Aztec diamonds) and related dimer models, with extension to non-uniform measures
- ▶ Arctic phenomena (tilings, alternating sign matrices, 6V model) and arctic curves
- ▶ Study of validity and applications of the tangent method
- ▶ Lattice path fluctuations around arctic curves (Tracy-Widom)
- ▶ Field-theoretic description inside random phases (liquid/rough and gaseous/smooth) and correlations

# Research Theme IV : Differential geometry, quantization and noncommutative geometry (Pierre Bieliavsky)

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- ▶ Differential Geometry, symplectic and Poisson Geometry
- ▶ Symmetric spaces
- ▶ Representation theory of Lie groups and harmonic analysis
- ▶ Non-commutative geometry and operator algebras
- ▶ Non-formal deformation quantization (star products)
- ▶ Applications in analytical number theory
- ▶ Quantum groups in operator algebraic context.

# Postdocs : from 2017 to present

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Giuseppe Orsatti

Julian Mauersberger

Sofia Tarricone

Giulio Ruzza

Meng Yang

Alexander Minakov

Gary Bosnjak

Alexi Morin-Duchesne

Alexandre Lazarescu

Axel Marcillaud de Goursac

Jean-Philippe Michel

Thibaut Grouy

Jérémie Pierard de Maujouy

Gilles Parez



# PhD students : from 2017 to present

Antoine Doeraene,

Gabriel Glesner

Jean Liénardy

Sandrine Brasseur

Gilles Parez

Adrien Poncelet

Bryan Debin

Nicolas Robert

Alban Jago

Valentin Dendoncker

Natacha Cappelle

Ismael Ahlouche

Louis De Man

Arthur Massar

- ▶ 2024-2029 : ARC (Action de Recherche Concertée) project  
EMOTIONS (joint with UNamur)  
**Emergent Motives in Interconnected Systems**  
Budget : 571.875 euros for UCLouvain node  
Christian Walmsley Hagendorf, Philippe Ruelle.
- ▶ 2018-2024 : PDR (Projet De Recherche), (joint with U. Genève, Swiss)  
**Trends in Quantization**  
Budget : 360.000 euros for UCLouvain node  
Anton Alekseev (U.Genève), Pierre Bieliavsky (PI).
- ▶ 2023-2026 : PDR (Projet De Recherche),  
**Determinantal point processes in integrable models**  
Budget : 220.000 euros  
Tom Claeys

- ▶ 2012-2017 : ERC starting grant : CRaMIS  
**CRITICAL phenomena in random Matrix theory and Integrable Systems**  
Budget : 1.130.000  
Tom Claeys
- ▶ 2018-2023 : EOS (Excellence of Science) project PRIMA (joint with KULeuven, UGhent)  
**Partners in Research on Integrable Models and Application**  
Budget : 709.000 euros for UCLouvain node  
Tom Claeys, Christian Walmsley Hagendorf, Philippe Ruelle.
- ▶ 2012-2017 : IAP (Interuniversity Attraction Pole) : DyGeST  
**Dynamics, Geometry and Statistical Physics**  
Budget : 900.000 euros for UCLouvain node.  
Pierre Beliaevsky (PI), Jean Bricmont, Tom Claeys, Christian Walmsley Hagendorf, Philippe Ruelle, Pierre van Moerbeke.

- ▶ Pierre Bieliavsky received 2005 **De Donder prize**, awarded every three years by the Belgian Royal Academy of Science (group of mathematics)
- ▶ Tom Claeys awarded 2011 **Gabor Szegö Prize**, on Orthogonal Polynomials, Special Functions, and Applications (prize of the SIAM Activity Group OPSFA)
- ▶ Pierre Bieliavsky received 2015 **Catalan prize**, awarded every five years by the Belgian Royal Academy of Science (group of mathematics)
- ▶ Tom Claeys was Co-recipient of the **A. Wetrems Prize** 2018 of the Académie Royale de Belgique, Classe des Sciences

- ▶ 2021 : Prof. Luc Haine (GPP) Emeritus. Position remains in IRMP.
- ▶ Traditionally, vacant positions due to retirements open internationally under a profile in the same field.
- ▶ This was not so in the case of Prof. Luc Haine's position and GPP lost the position.

- ▶ Next Departures in GPP and MATH :  
Ph. Ruelle (GPP, FNRS) : 2029  
P. Lambrechts (MATH) : 2031  
E. Vitale (MATH) : 2031.
- ▶ Philippe Ruelle's FNRS position disappears.
- ▶ Concern : After Philippe Ruelle's departure in 2029, the GPP center would be reduced to 3 permanent academics.