

## RANDOM MATRIX TECHNIQUES IN QUANTUM INFORMATION THEORY (RMTQIT)

### Goal of the project

The field of Quantum Information Theory (QIT) attracted lately the interest of scientific community due to its ambitious goals meant to create new technologic systems (quantum computers) and new more secured methods to transmit the information. Nowadays, QIT is a multi-faceted field, with large connections in the subfields of Mathematics, such as Functional Analysis, Operator Theory, Linear Algebra, Probability Theory. The project RMTQIT purposes to give answers to open questions from QIT, using techniques from random matrix theory.

### Short description of the project

The project RMTQIT focuses on a systematic exploration of theoretical questions in QIT about random quantum states and random quantum channels. These problems have attracted the attention lately in a very naturally connection to fundamental issues of QIT theory, such as entanglement theory and classical (or quantum) capacities for channels.

### Project implemented by

1. The Department of Mathematics, Politehnica University of Timișoara.
2. Laboratoire de Physique Théorique de Toulouse, Université Paul Sabatier Toulouse III, France.

### Implementation period

01.03.2013 - 29.02.2016



### Main activities

- In 2015 the project RMTQIT reached the third year of intensive research activities. It mainly focused on completing the tasks proposed initially, but also to expend the expertise developed along all these years of existence.
- It worth to mention that the team of the project published a joint paper with new results related to the derivation of thresholds points for reduction criterion and its absolutely version. This paper also succeeds to collect all the results about thresholds for entanglement criteria from similar papers, for making comparisons between the criteria and to give a complete picture of the subject under scrutiny. These results have been presented with several occasions at international conferences and workshops, such as Central European Workshop on Quantum Optics, Warsaw, 6-10 July 2015 (talk presented by M.A. Jivulescu), Quantum Thermodynamics and Quantum Information Theory, Toulouse, 9-11 September 2015 ((talk presented by M.A. Jivulescu)) and International Conference on Theory and Applications in Mathematics and Informatics, Alba-Iulia, 17-20 September 2015 (talk presented by N. Lupa).
- On November 2015 it took place the Workshop On the Mathematical Methods in Quantum Information Theory, workshop within the project RMTQIT, as satellite event of the 14th edition of International Conference in Mathematics and its Applications, organized by the Department of Mathematics, Politehnica University Timisoara. The workshop aimed to gather participants to discuss the latest themes in Quantum Information Theory, as well to establish new possible collaborations. We were happy to welcome here at Timisoara high-level scientists from well-know groups from Europe and to facilitate their interactions with the local research environment.

## Results

The results of our research activity were resumed in the papers listed below:

1. Maria Anastasia Jivulescu, Nicolae Lupa, Ion Nechita-Thresholds for reduction-related entanglement criteria in quantum information theory, *Quantum Information and Computation*, Vol. 15, No 13&14, 2015, pp 1165-1184
2. Benoit Collins, Ion Nechita, Random matrix techniques in quantum information theory, (arXiv:1509.04689)
3. Maria Anastasia Jivulescu, Nicolae Lupa, Ion Nechita - On the reduction criterion for random quantum states - *JOURNAL OF MATHEMATICAL PHYSICS*, Vol. 55, Issue 11, Article Number: 112203-1-27, NOV 2014
4. Maria Anastasia Jivulescu, Pasc Gavruta-Indices of sharpness for Parseval frames, quantum effects and observables, submitted to *Buletinul Stiintific al Universitatii Politehnica Timisoara, seria Matematica -Fizica*, 2015
5. Laura Gavruta, Pasc Gavruta, Some properties of operator-valued frames, submitted to *Acta Mathematica Scientia*, 2015 (arXiv:1504.06504)
6. António J. G. Bento, Nicolae Lupa, Mihail Megan, César M. Silva - Integral conditions for nonuniform  $\mu$ -dichotomy - arXiv:1405.2946
7. Maria Anastasia Jivulescu, Nicolae Lupa, Ion Nechita, David Reeb - Positive reduction from spectra -*LINEAR ALGEBRA and its APPLICATIONS*, Volume 469, NOV 2014, Pag. 276-304, doi:10.1016/j.laa.2014.11.031 (arXiv:1406.1277)
8. M.R. Abdollahpour, A. Najati, P. Gavruta - Multipliers of pg-Bessel sequences in Banach spaces - arXiv:1501.01146v1

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## Research Team

Assist. Prof. Maria Anastasia Jivulescu

Dr. Ion Nechita

Prof. Găvrută Pașc

Assist. Dr. Nicolae Lupa

## Contact information

Assist. Prof. Maria Anastasia JIVULESCU

Department of Mathematics

Address: Victoriei Square, no 2, RO300006, Timișoara

Phone: (+40) 256 403 098

Fax.: (+40) 256 403 109

Mobile: (+40) 740 517 340

E-mail: maria.jivulescu@upt.ro

Web: <https://sites.google.com/site/rmtqit2013/>