**Institute of Computer Science AGH and IBM Software Laboratory in Krakow invite to**



**Krakow Quantum Informatics Seminar (KQIS)  
(KQIS is an official seminar of the Quantum Computing Section of the Computer Science Committee of the Polish Academy of Sciences)**<https://www.informatyka.agh.edu.pl/en/kqi-seminars/> **Tuesday, 28 March 2023, 9.30-11.00 via Webex**<https://ibm.webex.com/meet/tomasz.stopa>

**Joan Falco Roget**

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**On the use of quantum technologies to discover brain structure**

**Abstract** Recent advancements in network neuroscience are pointing in the direction of considering the brain as a small-world system with an efficient integration-segregation balance that facilitates different cognitive tasks and functions. In this context, community detection is a pivotal issue in computational neuroscience. In this paper we explored community detection within brain connectomes using the power of quantum annealers, and in particular the Leap’s Hybrid Solver in D-Wave. By reframing the modularity optimization problem into a Discrete Quadratic Model, we show that quantum annealers achieved higher modularity indices compared to the Louvain Community Detection Algorithm without the need to overcomplicate the mathematical formulation. We also found that the number of communities detected in brain connectomes slightly differed while still being biologically interpretable. These promising preliminary results, together with recent findings, strengthen the claim that quantum optimization methods might be a suitable alternative against classical approaches when dealing with community assignment in networks.

**References**

[1] Wierzbiński, M., Falcó-Roget, J. & Crimi, A. Community detection in brain connectomes with hybrid quantum computing. *Sci Rep* **13**, 3446 (2023). <https://www.nature.com/articles/s41598-023-30579-y>

**Bio** Joan Falco Roget isgraduated from the Faculty of Physics of the University of Barcelona where he studied a physics. The same year, he moved to study a master’s in physics of Condensed Matter and Biological Systems at the Autonomous University of Madrid. There he worked, and continue working, on behavioral models of Reinforcement Learning to understand dopamine activity in the macaque brain under the supervision of Prof. Nestor Parga. During COVID he kept his affiliation there working as a research assistant before moving, at the end of 2021, to Sano to pursue a PhD in computational neuroscience with Dr. Alessandro Crimi. His current research focuses on the use of computational methods to discover structure of brain networks in healthy, brain tumors and stroke scenarios.