

Master in Photonics – "PHOTONICS BCN" ERASMUS+ "EUROPHOTONICS"

MASTER THESIS PROPOSAL

Dates: April - September 2020

Laboratory : FAN (UB)+ MonteCarlo Group (UPC) Institution: U. Barcelona and U. Politecnica de Catalunya City, Country : Spain

Title of the master thesis: Quantum particles in fractal geometry"

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Keywords : Many-body quantum systems, Fractal dimensions

Summary of the subject (maximum 1 page) :

The behavior of quantum particles is well understood in three, two and one dimensions. For example, the Bose-Einstein condensation at zero temperature is present in 3D and 2D geometries, but not in 1D. On the other hand much less is known about what happens if a fractal external field is superimposed to a quantum gas. Would be the system superfluid and Bose-condensed if the space dimension is 1.5? An important step has been presented very recently with electrons rapped electrons in a fractal structure [1].

The goal of the project is to consider quantum particles in Sierpinski carpet geometry. The shape of the external potential will reproduce different iterations of the fractal structure. The question is if the energy and coherence properties can be described in the limit of many fractal iterations.



S. N. Kempkes, M. R. Slot, S. E. Freeney, S. J. M. Zevenhuizen, D. Vanmaekelbergh, I. Swart & C. Morais Smith Nature Physics volume 15, pages127–131 (2019)

Additional information :

* Required skills : Computational physics, Quantum physics, Many-body Quantum physics (prefereable)

* Miscellaneous :