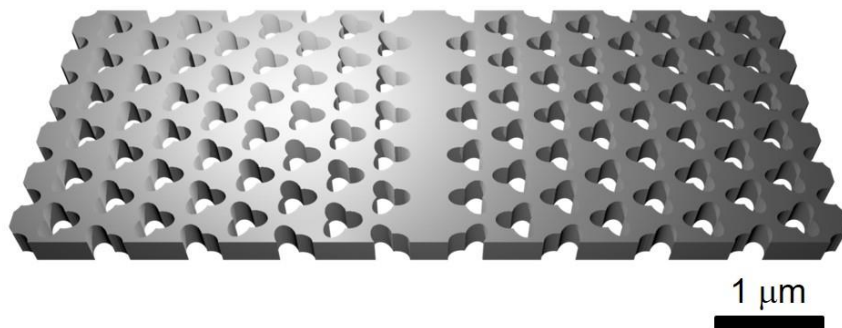


## PhD experimental position on nonlinear dynamics in optomechanical networks

Understanding the brain – neural networks – is among the most challenging problems to which a scientist can be attracted. Artificial intelligence algorithms are indeed routed in artificial neural networks but most of them just mimic the general properties of a neural network implemented with a standard Von Neumann architecture. This is energetically very inefficient. Just as an example: to solve a complex problem, the human brain typically consumes about 10W to 20W in total. In comparison, the training of an algorithm to process language (a typical complex problem) takes about 1000kW/h. Only very recently, physical implementations of neural networks using complex systems have been explored as real hardware for neuromorphic computing. In this PhD project, we will exploit [complexity](#) in optomechanical networks as a possible implementation of an artificial neural network. This is an experimental PhD project but will be topped-up with a participation in basic design and modelling of the systems under interest.



**Figure:** Our platform to test nonlinear dynamics of optomechanical nanostructures fabricated in silicon [1].

### Main goals

The activity will be focus on developing experiments on photonics and optomechanics. Optomechanical systems fabricated in silicon by electron-beam lithography (see the Figure) will be characterized with light and eventually actuated electrically. The main activities involve:

- To master an experimental setup of evanescent coupling based on a tapered fiber.
- To characterize single and coupled optomechanical resonators. To explore their nonlinear dynamical regimes. This includes solving and mastering the differential equations ruling the dynamics of the system and compare the solutions to our experimental results.
- To actuate electrically the optomechanical node and characterize the effect on light transmitted through the system.

In addition, the position offers a unique possibility to be participate in a funded EU project – NEUROPIC – starting on March 1<sup>st</sup> 2023 coordinated by the ICMM – CSIC and in collaboration with other research institutes, universities and small-to-medium companies located in Spain, Denmark, Ireland and Germany. The PhD trainee will have the option to collaborate and build up a research network at EU level and a unique opportunity to get in contact with industrial partners located in Denmark and Germany.

### Requirements

We are looking for Masters in Physics or Engineering. Experience on photonics and/or experimental physics will be strongly valued. Programing skills in Python or Matlab will be also a plus. But most important than anything: passionate and enthusiastic candidates are strongly encouraged to apply to this PhD position.

### **The Institute - ICMM**

The [Material Science Institute of Madrid \(ICMM\)](#) is a research centre of the [Spanish National Research Council \(CSIC\)](#) located in the [University Campus of Excellence](#) in the north of Madrid, Spain. Our mission is to generate new fundamental and applied knowledge on materials and processes with added value, and transfer this knowledge to the productive sectors at the local, national and European scales. The ICMM aims to provide an environment of excellence with an interdisciplinary and transversal view on material science and applications with research lines devoted to a Sustainable World (energy and green processes), Health (therapy, diagnosis and nanomedicine) and Information and Communication Technologies (advanced photonic, electronic and quantum technologies).

### **Summary of conditions**

- Full time work (37,5h/week)
- Time duration: four years
- Salary (negotiable) will depend on qualifications and demonstrated experience.
- Estimated incorporation date: **March 2023**

### **How to apply**

The PhD position is fully funded by a National Research Project and the EU project EUROPIE. All applications will be made via the [Ministry web page](#) (call still to be announced) and will include the following:

- A cover letter.
- A full CV including contact details.
- 2 Reference letters or referee contacts.

Informal enquiries regarding the vacancy and how to apply can be made directly to the coordinator of the project **Dr. P. David García**: [pd.garcia@csic.es](mailto:pd.garcia@csic.es) and/or to **Prof. Cefe López**: [c.lopez@csic.es](mailto:c.lopez@csic.es)

### **Equal opportunities and diversity**

ICMM - CSIC is an equal opportunity employer. The research group and the project coordinator are particularly committed to diversity and inclusion. People with different backgrounds and minorities are encouraged to apply to this PhD research position.

### **References**

[1] *Engineering nanoscale hypersonic phonon transport*. O. Florez, G. Arregui, M. Albrechtsen, R. C. Ng, J. Gomis-Bresco, S. Stobbe, C. M. Sotomayor-Torres, P. D. García. [Nature Nanotechnology](#) **17**, 947 (2022).