Université Claude Bernard Lyon 1

# HABILITATION A DIRIGER DES RECHERCHES

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Nom de famille et prénom de l'auteur : **Madame GIORDANO Valentina**

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## Résumé


My research activity is focused on the microscopic understanding of thermal transport in complex materials for energy recovery and thermal management applications. My original approach consists in combining the microscopic investigation of the collective dynamics as measured using advanced techniques at large scale facilities (such as inelastic x-ray or neutron scattering at synchrotrons and nuclear reactors as well as transient grating technique at free electron lasers), with laboratory measurements of macroscopic properties such as electric and thermal conductivity, with the aim of understanding the microscopic mechanisms behind the transport properties.
This research line, that I developed in the last 10 years, is the result of a reflexion carried on on the basis of my previous research, and the opportunities offered by the scientific environment both in Lyon and within the international communities that I could meet in this period.

After completing my master studies at the University of L'Aquila (Italy), I got a PhD grant at the Laboratory for non-linear spectroscopy (LENS) in Florence, for a project in collaboration with the "Institut de minéralogie, de physique des matériaux et de cosmochimie" in Paris, on the high pressure high temperature properties of molecular carbon dioxide (2002-2005). During my PhD I could get acquainted with laboratory optical spectroscopies (Raman, FTIR, Brillouin Spectroscopy), X ray diffraction at synchrotron sources and high pressure techniques (diamond anvil cells).
I obtained then a postdoc position at the inelastic x ray scattering beamline ID16 at ESRF, in Grenoble, led, at that time, by Pr. Dr. Giulio Monaco, where I changed both of subject and experimental technique, and focused my research on the collective vibrational properties (phonons) of disordered materials, liquids and glasses (2006-2009).
At the end of my postdoc contract, I accepted an offer for a beamline scientist position at the same beamline, that I held from 2009 to 2011, keeping the same research line. I finally was recruted by CNRS in 2011 in Lyon, where I joined the "Extreme conditions and metastability" group led by Prof. Dr. A. San Miguel at the Laboratory of Physics of
Condensed Matter and Nanostructures (LPMCN, now Institut of Light and Matter - ILM). Here I changed again my subject to better integrate in the group, joining the research line on novel materials for thermoelectricity recently started by Stéphane Pailhès, focusing my interest on the microscopic mechanisms for thermal transport.

Since 2013, building on my expertise acquired during the years at ESRF, I have developed and lead a research activity on phonon dynamics and transport properties in nanocomposites and nanostructured materials, characterized by the intertwining at the nanoscale of materials with different conduction properties. Such research line is well inscribed in the scientific context of my group (now called "Transport, Nanomagnetism and Materials for Energy") as well as in the context of the Auvergne-Rhône-Alpes region. A first regional PhD grant on this subject (2014-2017) has allowed me to pave the way for a major project, for which I have built an excellent network of
experimentalists and theoreticians between Lyon and Grenoble. I have thus obtained a CIFRE funding with STMicroelectronics on the understanding of thermal transport in chalcogenide based nanocomposites for memory applications (2019-2022), a Pack Ambition Recherche grant from the Region in 2019, including a new PhD grant for 2020-2023, and an ANR in 2020. I have participated to an IDEX Lyon Scientific Breakthrough project on nanophononic systems for an improved photocatalysis thanks to photon focusing and phonon trapping (2018-2021), within which I got another PhD grant (2019-2022) and I currently participate to an international France-South-Africa
project on transport in implanted diamond nanostructures (2021-2024). In this framework, my research of the last 10 years can be divided in two main axes :

* Thermal transport and phonon dynamics in nanostructured materials
* The effect of disorder on thermal transport and phonon dynamics in
complex crystalline systems.

This latter axis joins the research line led by my colleague S. Pailhès on the effect of different scattering mechanisms on phonon dynamics and thermal transport in complex crystalline systems.

In the former years, I have also led a line on the microscopic understanding of aging and relaxation in metallic glasses for energy saving applications, in collaboration with B. Ruta.

I have funded my research by leading, as a PI, 7 projects with different funding entities (CNRS, Region, ANR) and participating to 8 projects funded by CNRS, ANR or IDEX. My research activity has allowed me to publish 64 articles in peer review journals and 3 books chapters.

Next to the research, I have been committed to student education and supervision. On one hand, I have supervised and co-supervised 7 PhD students since 2014, and many L3, M1 and M2 trainees. On the other, I gladly give lectures in specialized schools and since 2020 I share the teaching of the Nanophysics Class at the Master 2 of ENS in Lyon with my colleague S. Pailhès. He takes care of the electronic transport properties, while I cover the thermal transport properties at the nanoscale, with both master classes and directed works.
Since September 2022 I give 4.5h of master classes on the same subject within the master module « UE : Physique de la conversion et du stockage d'énergie » at Université Claude Bernard.

From the vulgarisation point of view, I have been author of several communications of the INP and Insis, I have published an open-access video-proceeding and have participated to scientific meetings with high school students, both at the laboratory and in the high schools of Lyon through the Declic association.

Finally, I have been engaged in several research management activities and responsibilities both at the laboratory level (member of the Institute Council), at the national level (past member of coCNRS section 5, current member of the bureau of SFP Condensed Matter division) and international level (past member of the program committee for ESRF, current member for Spring-8), and I am currently the scientific co-director of the Transport pole of ILMTech.