

Friday 14th October

14h00

Amphitheatre du C2N

## “Electron-phonon and exciton-phonon interactions in low dimensional carbon systems”

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Carbon, apart from providing the basis for life on Earth, nowadays plays a critical role in many aspects of technological development, (i.e. drug delivery, solar cells, optoelectronics, nano-electronics, etc.). Moreover, thanks to its valency and the possibility of forming hybrid orbitals, carbon can give rise to many allotropes. In this talk I would like to show how apparently simple systems such as carbon allotropes can host strongly correlated phases of matters, such as charge-density-waves (CDW) and topological insulating phase transitions, and how they can affect their optical properties. As a matter of fact the light mass of carbon atoms and low dimensionality enhance the relevance of the many-body nature of electron-electron, electron-phonon and exciton-phonon interactions, as well as a strong anharmonicity of lattice vibrations. In order to do so I will talk about some recent works on linear [1] and cyclic [2] carbon chains as well as topologically insulating poly-acene polymers [3].

[1] "Dominant Role of Quantum Anharmonicity in the Stability and Optical Properties of Infinite Linear Acetylenic Carbon Chains", D. Romanin, L. Monacelli, R. Bianco, I. Errea, F. Mauri and M. Calandra, *The Journal of Physical Chemistry Letters* 12 (42), 10339-10345 (2021)

[2] "Giant quantum anharmonic effects on the stability, vibrational and optical properties of cyclo $[4n+2]$ carbon.", D. Romanin and M. Calandra, *Carbon Trends* 9, 100207 (2022)

[3] "Highly tunable optics across a topological transition in organic polymers", D. Romanin, M. Calandra and A. W. Chin, *arXiv preprint arXiv:2204.00321* (2022)



**Davide Romanin** has obtained a B.Sc. in Physical Engineering (2015) and a M.Sc. in Physics of Complex Systems (2017) from Politecnico di Torino (Turin; Italy), together with an M2 in Physics of Complex Systems (2017) from Sorbonne University (Paris, France). After that he decided to specialize in the ab-initio investigation of materials properties: he then obtained a PhD cum laude in Physics from Politecnico di Torino (2021) under the supervision of Prof. Dario Daghero (Politecnico di Torino, Italy) and Prof. Matteo Calandra (Trento University, Italy), where he focused on electron-phonon interactions with a particular interest in conventional superconductivity, charge-density waves and the anharmonic picture of lattice vibration. After that he started a Post-Doc in Dr. Alex W. Chin group, at the Institut de Nanosciences de Paris (Paris, France), where he studied Excitonic properties of organic polymers and carbon molecules and the effects of lattice vibration on the optical absorption. He has been recently recruited as Maître de conférences at Paris-Saclay University and he continues his research in the Computational Electronics group at C2N, where he intends to study the effects of low-dimensionality and topological phase transitions on Excitonic and thermoelectric properties of materials.

