UNIVERSITÀ DI TRENTO | Department of Physics

A Quantum of Matter

Excitons in condensed matter and their coupling with other excitations: state-of-the-art and beyond

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Aula A104 – Polo Ferrari (Povo 1), Povo

Among the emerging fields of condensed matter physics is "excitonics". It is focused on the study of excitons and their dynamics with the final aim of superseding the standard technology based on the electron transport with a new one based on exciton flux control. An exciton is an excited state of matter consisting of a bound electron–hole pair that is generated by photon absorption and represents the crucial intermediate for energy transduction and nano-scale light control. As a consequence it is potentially well suited to the development of an alternative to standard electronics with a great potential to achieve a breakthrough in photovoltaics, information processing and optoelectronics in general. To achieve this ambitious goal the exciton must be controlled and manipulated during its formation in space and time. This requires the ability to describe excitons as well as their mutual interaction and their coupling with lattice vibrations that play a key role in setting exciton dynamics. In this talk I will illustrate the basic physics behind the excitonic effect and how it can be described using first-principles methods devoting particular attention to low dimensional semiconductors where excitonic effects are strongly enhanced due to the charge confinement. Moreover I will propose a new approach that allows to describe excitons including dynamical electronic correlations and electron-phonon coupling that are neglected in state-of-the-art methods.

Who is Pierluigi Cudazzo?
Pierluigi Cudazzo achieved his Ph.D. in Physics at University of L'Aquila in 2008. He spent five years as a postdoc at the NanoBio spectroscopy group of Prof. Angel Rubio (San Sebastian, Spain), and subsequently at Ecole Polytechnique (Palaiseau, France) in the group of Dr. Lucia Reining where he stayed for four years. In 2018 he achieved a senior researcher position at University of Luxemburg. Since September 2022 he is Senior Assistant Professor (RTDB) in the condensed matter theory group at the Department of Physics of the University of Trento.

A Quantum of Matter is a series of events dedicated to the research in Physics of Matter that is carried out in the **Physics Department of the University of Trento**. The goal of **A Quantum of Matter** is to develop synergies and collaborations between research groups: for this reason, the seminars will focus not only on the results obtained, but also on the techniques employed by the groups and on the possible research themes that could be developed in partnership, leaving plenty of room for exchange of opinions and discussion.

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