UNIMORE Dipartimento di Scienze Fisiche, Informatiche e Matematiche
UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA

CNRNANO MODENA S3

FIM-S3 SEMINAR

Excitonic order and structural transition in Ta_2NiSe_5

Wednesday May 5th, 2021 – 16.00

Online streaming using Google Meet
Link: https://meet.google.com/yud-upbp-mno

Speaker

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Abstract

The so-called excitonic insulator state is a prominent example of an elusive state of matter. Already several decades ago, this state of matter has been identified with the spontaneous condensation of excitons stemming from the Coulomb attraction between electrons and holes in the conduction and valence bands. However, the unambiguous observation of this phase remains to date an open question. In bulk materials, the absence of a well-defined symmetry-breaking field and the coupling with other types of electronic and lattice instabilities pose challenges to the task. In recent years, Ta_2NiSe_5 (TNS) has attracted an increasing deal of attention as possible candidate material. The material shows a metal-to-insulator accompanied by the lowering of the lattice symmetry. Currently, the material is at the center of an intense debate focused on the origin of this simultaneous transitions, with the excitonic instability proposed as the main driving force [1].

In this seminar I will review recent progresses in the understanding the physics of this material focusing on the relation between possible excitonic order and lattice distortion. I will first discuss symmetry aspects of this transition by identifying a purely electronic order parameter of excitonic nature which is related to a set of discrete symmetry of the charge density with respect to the lattice. At the model level, I will show how the spontaneous breaking of these symmetries can occur as a result of the competition between local and non-local interactions [2]. Next, I will address the relation of such a spontaneous symmetry breaking with the experimentally observed lattice distortion from an orthorhombic to a monoclinic phase. From an ab-initio perspective I will show how the opening of a finite electronic gap is subordinate to a finite lattice distortion [3]. Eventually, I will relate these results to recent Raman studies [4-6] highlighting phonon anomalies in the absence of a phonon soft mode at the structural phase transition.

[1] Y.F.Lu et al. Nat. Commun. 8, 14408 (2017)
[2] G. Mazza, M. Rosner et al. Phys. Rev. Letters 124, 197601 (2020)
[3] L. Windgatter, M. Rosner et al. in preparation (2021)
[4] M. Ye et al arXiv:2102.07912 (2021)
[5] K. Kim et al. Nat. Comm. 12, 1969 (2021)
[6] M.J. Kim et al. Phys. Rev. Research 2, 042039 (2020)

In collaboration with

MAX DRIVING THE EXASCALE TRANSITION

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