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Sensengasse 8/12, 1090 Vienna, AUSTRIA | t: +43 (0)1 4277-51402
@ doris.hecht-aichholzer@univie.ac.at

Magnetic vacancies in Graphene:
Disordered impurity physics within the variational cluster approach

A TALK BY DI Martin Nuss, Institute of Theoretical and Computational Physics, Graz University of Technology

DATE / TIME	21.05.2012 , 04:00 p.m. (CET)
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ABSTRACT

Graphene is one of the most widely studied materials in recent times. Partly owing to its two dimensional character, it exhibits a plethora of remarkable physical phenomena which both promise sophisticated future applications as well as tag Graphene an ideal candidate to study theoretical concepts in condensed matter physics. Besides extraordinary electrical, thermal and mechanical properties, which suggest applications for example in nano-technology or spintronics, fascinating phenomena like Dirac electrons or anomalous quantum hall physics have been found in Graphene.
Modifying Graphene by deposition of ad atoms, introducing vacancies or impurities further extends the realm of its capabilities. Lately Lithium ad atom induced superconductivity has been reported while studies of irradiation induced vacancies reveal the Kondo effect. The theoretical understanding of such effects proves difficult because of the disordered character. The latter being an inherent many-body phenomenon in addition.
This seminar will particularly focus on the recently discovered Kondo-effect in Graphene. Studies have shown that vacancies in Graphene may behave like magnetic impurities, thus altering the transport behavior of the material [1]. This setup leads to a highly disordered model of magnetic impurities in Graphene, which we model within an interacting tight binding - impurity lattice Hamiltonian. Appealing methods to study many-body model are the disordered Cluster Perturbation Theory and disordered Variational Cluster Approach [2, 3], both capable of treating interactions as well as disorder. We will first give an introduction to the above mentioned many-body cluster methods and elaborate on the extensions necessary to tackle disordered models. A model for magnetic vacancies of Graphene will be presented and the application of the disordered many-body cluster methods will be discussed. Results for dynamic quantities like the dispersion relation and density of states will be presented.

[1] Chen J-H, Li L, Cullen WG, Williams ED, Fuhrer MS. Tunable Kondo effect in graphene with defects. Nat. Phys. 7, 535-538 (2011)
[2] Potthoff M, Balzer M. Self-energy-functional theory for systems of interacting electrons with disorder. Phys. Rev. B. 75, 1-22 (2007)
[3] Knap M, Arrigoni E, von der Linden W. Excitations in disordered bosonic optical lattices. Phys. Rev. A. 81, 1-16 (2010)