GOETHE UNIVERSITÄT FRANKFURT AM MAIN

Fachbereich Physik
Institut für Theoretische Physik

CONDENSED MATTER THEORY SEMINAR

Subject: **Selected issues regarding unconventional superconductors**

Speaker: **Dr. Igor Mazin, NRL Washington D.C., USA**

Date & time: **Friday, April 28th, 2017 at 3:15 p.m.**

Venue: **Seminar room 1.114**

The seminar will consist of two independent short talks:

(1) Structure of spin-fluctuations and symmetry of the order parameter in the unconventional superconductor Sr2RuO4

We study ab initio a pyrochlore compound, CsW_2O_6, which exhibits a yet unexplained metal-insulator transition. We find that (1) the reported low-T structure is likely inaccurate and the correct structure has a twice larger cell; (2) the insulating phase is not of a Mott or dimer-singlet nature, but a rare example of a 3D Peierls transition, with a simultaneous condensation of three charge density waves; (3) spin-orbit interaction plays a crucial role, forming well-nested bands. The high-T phase, if stabilized, could harbor a unique $e_g + ie_g$ superconducting state that breaks the time reversal symmetry, but is not chiral. This state was predicted in 1999 by Agterberg et al, but never observed.

(2) Spin-orbit driven Peierls transition and possible Agterberg-Barzykin-Gorkov superconductivity in the pyrochlore CsW2O6

The superconductivity in the Sr_2RuO_4 has attracted a considerable interest comparable to that in cuprates and iron pnictides due to the presumed triplet character of the SC order parameter and spin-fluctuations mechanism of the electron pairing. Early NMR experiments suggested a triplet chiral OP, while recent probes of strained crystals point toward singlet pairing. Interpretation of the NMR data relies upon the idea that the order parameter vector rotates in an external field of ~200 Oe. We use first principles calculations to extract the isotropic and anisotropic exchange parameters. We write down an effective anisotropic double-exchange model based on our calculated parameters that can be used to analyze superconducting symmetry. In particular, we show that the magnetic anisotropy is several orders of magnitude too strong to allow for the order parameter rotation, thus rendering the NMR experiment completely inexplicable in terms of the conventional theory.