532nd ASRC Seminar

Date：10：30 ～12:00, 18 October

Location：Meeting room 302, ASRC Building

Speaker：Prof. Veljko Zlatic
(Institute of Physics, Zagreb)

Title：Thermoelectric properties of bad metals

We discuss the transport properties of "bad metals", systems with large and often linear high-temperature resistivity which can exceed the Mott-Ioffe-Regel limit. Bad metals are found among many oxides close to the Mott-Hubbard insulating phase and we are interested in the unusual thermoelectric response of these systems. We describe bad metals by a simplified Hubbard model (Falicov-Kimball model) and calculate the transport coefficients by the dynamical mean field theory, which provides a very good description of doped Mott insulators. This simplified model captures also the main features of the incoherent phase of the full Hubbard model.

Our results show that the high-temperature resistivity is a quasi linear function of temperature and that the thermoelectric response depends on the level of hole doping. We find three types of behavior that are clearly seen in the high-Tc cuprates and are, in our view, typical of bad metals. (i) at very low doping (lightly doped Mott insulators) the resistivity $\rho(T)$ and the thermopower $\alpha(T)$ have pronounced low-T peaks that shift to higher-T with doping; (ii) at moderate doping (underdoped samples) $\rho(T)$ is a monotonically increasing function of temperature, linear in a large temperature interval, while$\alpha(T)$ has a small low-T peak that shifts to lower-T with doping and has a high-T sign change; (iii) at the highest doping (overdoped samples) the linear resistivity region is shifted to higher T and $\alpha(T)$ is a monotonic function of temperature which is more negative at higher T. We show that the simplified Hubbard model provides an easy to understand description of this phenomenon due to the universal form for the chemical potential versus T for doped Mott insulators and the applicability of the Kelvin formula for the thermopower.

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