Influence of Local Spherical Periodic Order on Dynamic Excitations and low-T Transport Properties.

P. Häussler†, H. Nowak‡, J. Barzola-Quiquia†
†Technical University Chemnitz, 09107 Chemnitz, Germany
‡Univ. Catolica del Peru, Lima 100, Peru

In amorphous metals, ionic glasses, as well as amorphous semiconductors there exists a *spherical periodic short- and medicum-range order* as an effect of electron - static-structure resonances. During phase formation the atomic sites as well as the electronic density both may adjust along different sceneries in order to optimize the resonance and hence the phase stability. The *spherical resonance* is analogous to those in the crystalline case where there may be a planary resonance of plane electron waves with the planar arrangement of the atoms. The local spherical periodic atomic arrangement acts as *a set of concentrical mirror spheres* for the electrons with the consequence of a pseudogap at E_F and electronic transport anomalies as e.g. improved localization. In amorphous semiconductors the spherical arrangement and, hence, the resonance with the electronic system seems to be improved due to angular correlations (order at the spheres). Consequently, the pseudogap becomes a real gap with strict localization of the electrons. In systems becoming quasicrystalline like Al-Pd-Re the transition to the quasicrystalline state, i.e. the transition from spherical order only to spherical and planary order, can go contineous with a *contineous* transition from a metallic to an insulating behaviour.

There are many experimental as well as theoretical indications that similar effects like a localization due to the spherical atomic order seem to exist also for dynamic excitation with effects on e.g. the heat conduction (plateau). Conduction electrons, once more, can get into resonance with these localized dynamical modes with additional consequences for electronic transport as e.g. the thermopower or the resistivity.

We propose a model, based on these resonances between the electronic system, the static atomic structure and the dynamic excitations which allows to calculate the resistivity and the thermopower (if the system is still metallic), as well as the thermal conductivity and the specific heat, with the latter showing a Boson-like peak at low temperatures.

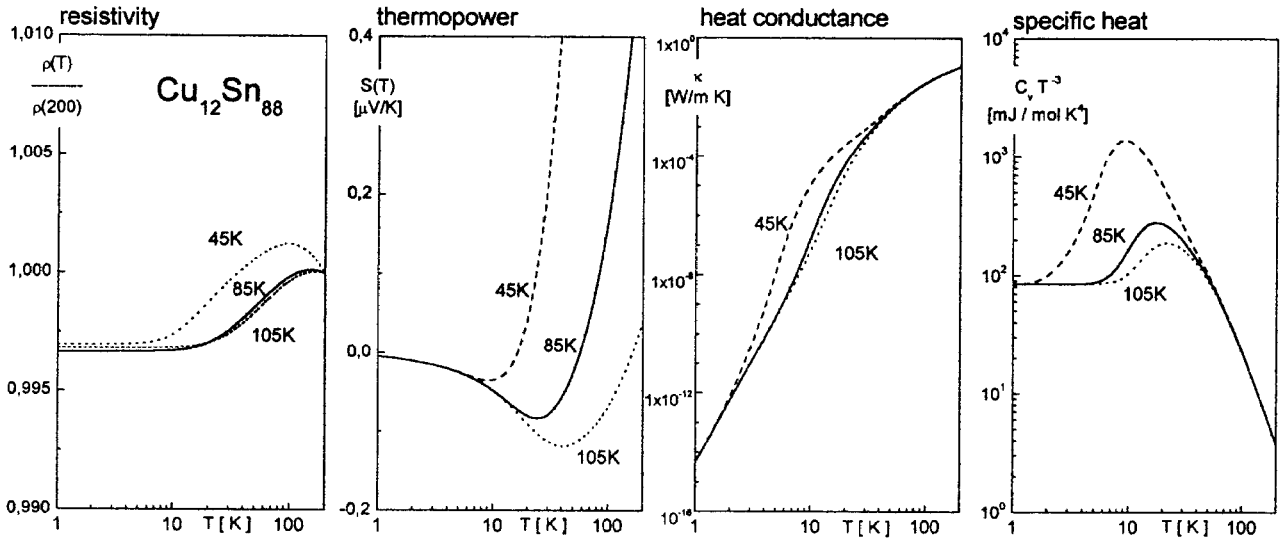

Figure 1: Different transport properties and the specific heat of a-$Cu_{12}Sn_{88}$ as calculated by the model with different temperatures of characteristic excitations