Correlation effects in some one dimensional systems
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SUMMARY

In this thesis a number of investigations on highly anisotropic materials is reported. The materials studied belong to the class of so called pseudo one dimensional electron band systems. One of the materials is the inorganic compound,

\[ \text{K}_2\text{Pt(CN)}_4 \text{Br}_{0.3} \text{n (H}_2\text{O)} \]

the other material is the (organic) complex TCNQ salt, methylethylmorpholiniumditetracyanoquinodimethanide. The emphasis in the investigations is on the magnetic properties. Of the inorganic compound only low field bulk magnetic properties were studied, whereas of the complex TCNQ salt low and high field bulk susceptibilities as well as local magnetics were studied. The local response of the

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electron system was also investigated, but this was done with X-ray photo electron spectroscopy (XPS). The experiments show that in both materials the electronic motions are correlated to a high degree. However the kind of correlation in the two materials appears to be totally different. In the platinum compound the electrons (or holes) apparently pair to form a dynamic (or itinerant) charge density wave (CDW) ground state, whereas in the complex TCNQ salt there appears to be a strong correlation due to the fact that the local electron electron repulsion is strong, i.e. much larger than the one electron bandwidth. One of the consequences of the latter is for instance a change in electronic state at low temperature, the low temperature state being effectively stabilized by a local exchange coupling between spins. The difference between the Pt salt and the TCNQ salt apparently is that in the former the effective electron electron interaction is attractive, whereas it is repulsive for the latter. Since the TCNQ salt shows semiconductive behavior the question arises whether or not this is compatible with the model used to describe the high temperature susceptibility. This problem is discussed briefly in chapter 6, no satisfactory answer has however been found.
During the nuclear spin echo measurements on the complex TCNQ salt, carried out to measure local magnetic susceptibilities, new magnetic field independent echoes were found. This aroused our interest in the possibly very general nature of echo generation. We performed a few calculations on simple classical oscillator systems, which turned out to show in a very simple manner the general features of echo generation: coherent excitation, dephasing, selective pick up, phase coincidence and non-linearity. Also a number of echo experiments on a few simple oscillator systems, i.e. piezoelectric materials, were carried out using r.f. pulses. After the outline of the echo calculations the experimental results are given.

In the last section of this thesis it is shown that more distant electron-electron interactions strongly affect the self energy of a doubly occupied or vacant site in a half filled band system. This means that the effective on-site electron-electron repulsion is strongly influenced by electronic polarization effects. It is shown that these polarization effects strongly depend on the state of the system, i.e. metallic or semiconducting and on the number of 'free' carriers. This explains why many materials are metals in spite of a large bare on-site electron-electron interaction and provides a mechanism for obtaining a semiconductor to metal transition with increasing temperature.