dr Konrad Jerzy Kapcia; decription for the general public of project entitled **„Insulator-metal transitions in strongly correlated electron systems with longer-range interactions"** (Sonatina 1)

The research included this project proposal addresses the problems to answer the question: why some materials conduct electricity and others not? In the project we will analyze model systems, in which by changing some of their parameters (which correspond to interactions between electrons) we will be able to change from a (non-conducting) insulating state into a metallic (conductive) state. In the case of such a transition, which is called the insulator-metal transition, it is also important that the electrons in the solid state may exhibit some particular order. In this project we will consider two types of such order. The first is the charge order, which is related to the heterogeneous spatial distribution of electrons. On the other hand, the magnetic order (antiferromagnetic or ferromagnetic) is associated to the arrangement of electron spins (their own internal magnetic moments). We will analyze the physics of insulator-metal transition in the presence of such types of electronic order. For this purpose, we will solve model system of strongly correlated elektron systems on the lattice mainly by a dynamic mean field theory approach (advanced computational method for systems consisting of many interacting electrons) for any electron concentration.

The proposed research topics included in the proposal are theoretical in character. Planned project tasks concern the basic research problems. The results obtained during the project realization may be important for understanding the relationship between the competitive effects in the confessed matter, especially in the vicinity of the metal-insulator transition. The results of the project may be used to design new narrow-band materials (possibly some groups thereof), where electron correlations play a very important role (e.g. transition metal oxides: manganites or orthoferrites) for potential engineering applications as fast switches or memory (disks) of high-record density.