Unconventional metal-insulator transition in Fe(Si,Ge)

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When the interaction strength in a metal is increased to a critical value, the charge degrees of freedom may freeze in an insulating phase. In this usual type of metal-insulator transitions, magnetic ordering of the more correlated phase is only a by-product of the transition in the charge sector. However, in the isoelectronic and isostructural alloys Fe(Si,Ge) a completely different phenomenology is observed: the less correlated compound FeSi is insulating, whereas the more correlated compound FeGe is metallic. On the other hand, from the magnetic point of view, the phase transition in Fe(Si,Ge) is conventional: FeSi is paramagnetic, whereas FeGe is magnetically ordered.

In this talk, after describing the relevant experimental data for the Fe(Si,Ge) alloys, I will argue that the metal-insulator transition in this system forms a novel universality class, one in which it is the magnetic instability of the paramagnetic insulator which drives the charge delocalization. Afterwards I will introduce what we believe to be a minimal microscopic model for this universality class. I will further demonstrate that an approximate treatment of the minimal model leads to qualitative agreement with several experiments on the Fe(Si,Ge) alloys, but also on the related system of FeGe under pressure. Finally I will conclude by listing some of the open questions in this problem.