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Seminar

Universal scaling in disordered systems and non-universal exponents

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The effect of an electric field on conduction in a disordered system is an old but largely unsolved problem. Experiments cover an wide variety of systems - amorphous/doped semiconductors, conducting polymers, organic crystals, manganites, composites, metallic alloys, double perovskites - ranging from strongly localized systems to weakly localized ones, from strongly correlated ones to weakly correlated ones. Theories have singularly failed to predict any universal trend resulting in separate theories for separate systems. Here we discuss an one-parameter scaling that has recently been found to give a systematic account of the field-dependent conductance in two diverse, strongly localized systems of conducting polymers and manganites. The nonlinearity exponent, x associated with the scaling was found to be nonuniversal and exhibits structure. For two-dimensional (2D) weakly localized systems, the nonlinearity exponent x is >7 and is roughly inversely proportional to the sheet resistance. Existing theories of weak localization prove to be adequate and a complete scaling function is derived. In a 2D strongly localized system a temperature-induced scaling-nonscaling transition (SNST) is revealed. For three-dimensional (3D) strongly localized systems the exponent lies between -1 and 1, and surprisingly is quantized (x = 0.08 n). This poses a serious theoretical challenge.

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11:30 AM (Tea/Coffee at 11:15 AM)

Seminar Hall, TCIS