



**TIFR Centre for Interdisciplinary Sciences,  
Narsingi, Hyderabad 500075**

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**Seminar**

**Novel Phase Behaviour and Unexpected Absence of 'Metal-to-Insulator' Transition in Low-Density Two-Dimensional Electron Systems**

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In this talk I will present results of our recent experimental investigations into the phase behaviour of two-dimensional electron systems (2DESs). We measure the thermopower  $S$  and electrical resistivity  $\rho_{2DES}$  of mesoscopic 2DESs ( $\sim 2 \mu\text{m} \times 8 \mu\text{m}$ ) realised in GaAs/AlGaAs-heterostructures and are particularly interested in the low-density ( $\sim 10^{14} \text{m}^{-2}$ ) regime where effects of inter-electron interactions become significant. At these low densities the 2DES is extremely resistive ( $\rho_{2DES} \gg h/e^2$ ) and intuitively one expects it to be strongly localised. Remarkably, however, and in sharp contrast to conventional studies on the controversial '2D metal-insulator transition', even at these extremely large  $\rho_{2DES}$  values, the 2DES shows no indication of a transition to insulating behaviour. Instead, the measured characteristics of the 2DES are strikingly metal-like as is evidenced by a linearly growing  $S$  as a function of  $T$  at low temperatures. Interestingly though, the metallicity is not simple Drude-like, the magnitude of  $S$  exceeding the Mott value valid for non-interacting metallic 2DESs at similar carrier densities by over two orders of magnitude. Furthermore, there is a curious decoupling between  $\rho_{2DES}$  and  $S$  in their density-dependence whereby strong oscillations and even sign changes are observed in the latter which are completely absent in the former. We present evidence to that suggests that the observed phenomena represent the quantum critical regime between ordered and disordered electron phases.

***Monday, Jan 6<sup>th</sup> 2014***

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

***Seminar Hall, TCIS***