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Implementation of Quantum Hall Effect Based Precision Resistance Measurement System

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The National Metrology Institute of South African (NMISA) has a mandate to implement a primary resistance standard and to upgrade the DC resistance Laboratory. The Quantum Hall Effect (QHE) is the foundation for the implementation of the primary resistance standard. The QHE is a phenomenon that occurs in a two-dimensional electron gas (2DEG) when subject to a strong magnetic field perpendicular to the direction of current flow when the system is cooled down to low temperatures. MOSFETs or GaAs/AlGaAs devices are used for the QHE. The GaAs/AlGaAs heterostructure is the preferred material due to its high mobility and carrier concentration .

Electron density in the range of (3 to 5.5) x 10ˆ15 mˆ-2 is suitable in order to obtain wide and well quantised =2 plateau at 1.5 K and magnetic field in the range of 6 T to 11 T (Delahaye & Jeckelmann, 2003). The passing of current in the 2DEG in the presence of a strong magnetic field results in a transverse voltage called the Hall voltage V(H), the ratio of the Hall voltage to current has the units of resistance (Ω). The Hall voltage manifests itself as quantised plateaus where each plateau is a multiple of the Klaus von Klitzing constant given by

()=*h*/ˆ2 = 25812.807 Ω

which is given by fundamental constants. In this talk, I will present an introduction to the techniques used to realise a standard of electrical resistance based on the QHE and show the latest results from our group in the Department of Physics at UCT.

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No

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