The CMP Electrical-Transport Experiment

Electrical transport in metals and semiconductors is the basis of the most technologically-important fruit of the ósolid-state revolutionô, and from a fundamental-physics point of view depends on the density and mobility of charge carriers. Access to these parameters is provided by measurement of the resistivity, and the Hall coefficient, in samples. The predictions of theoretical models can be compared to the observed temperature dependence of these properties.

TeachSpinôs CMP initiative aims to bring these experimental capabilities into any advanced lab, independent of the research activities of a department, or the technical background of the instructor. Our **Dewar system** makes accessible a controlled temperature in the 80 ï 400 K range, and our sample holder accommodates a variety of samples. Our Dewar comes ready-equipped with electrical connections ample for the most general electrical-transport experiment.

TeachSpin has taken the initiative to develop a line of **semiconductor samples** suitable for advanced-lab use. Our samples are visible, yet encapsulated, and are professionally mounted and wire-bonded to a óchip carrierô printed-circuit board. The geometry of our samples is specified and controlled. We are starting with n- and p-type monocrystalline silicon samples, and expect to branch out to other semiconductor materials. We also will make available a patterned but empty printed-circuit board, so that users can incorporate their own samples into our measurement system.

Electronic support for this experiment is also available, including a precision bidirectional current source making available a ófloatingô current in the range 1 µA to 100 mA, of easily-reversible polarity. Combined with a recommended DMM of 1-µV sensitivity, this permits 2- and 4-wire resistance measurements over a huge range of conductivities.

The TeachSpin Dewar system includes a radiation shield that can be thermally grounded (or thermally ófloatedô), and which also carries a coil providing the **magnetic field** needed for semi-conductor Hall-effect measurements. An external dc current of ±2 Amperes provides magnetic fields at the sampleôs location of ±2 mT (±20 gauss).