N°70: Quantum oscillations in topological materials

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The aim of this practical work is to study the Landau quantification of the cyclotron orbits of electrons/holes in topological semi-metals at low temperature in the presence of a magnetic field. Under the action of a magnetic field, electron/hole charge carriers can only occupy orbitals of discrete (or quantum) energy, called "Landau levels". This quantized occupation of energy levels generates abrupt changes in the density of states generating depend magnetic field induced quantum oscillations. These quantum oscillations can be manifested by different probes such as resistivity (Shubnikov effect of Haas), magnetization (De Haas-Van Alphen effect), thermoelectric power as well as specific heat.
In this practical work, you will realize electrical contacts on the semi-metallic material TaAs for resistivity measurement and perform measurements of quantum oscillations at low temperature (2K) as a function of the magnetic field (9T). From these measurements you will be able to extract the size of extremal cross section of the Fermi surface perpendicular to the magnetic field as well as the complete topology of the Fermi surface by changing the orientation of the magnetic field.