Mesoscopic Systems

The Macroscopic world is interpreted by classical physics. Quantum physics interpreted the Microscopic world. Then a serious question arises. What conditions enable a system to be validated by classical physics, or, equivalently, by quantum mechanics? What distinguishes both types of physics ?

Intermediate world bridging the quantum and classical physics is the Mesoscopic world.

”Meso-" comes from the Greek word meaning "middle" or "intermediate". Mesoscopic physics is a sub-discipline of condensed matter physics which deals with materials of an intermediate length scale. Mesoscopic and macroscopic objects have in common that they both contain a large number of atoms. Whereas average properties derived from its constituent materials describe macroscopic objects, as they usually obey the laws of classical mechanics, a mesoscopic object, by contrast, are affected by fluctuations around the average, and are subject to quantum mechanics .

Most tiny devices are known to show peculiar features specific to mesoscopic systems. So, the terminology mesoscopic system is very often used for the same systems as nanoscale structures or nanoscale devices. Here, "nano-" means a size on the order of several nanometers, namely, 10^{-9} m. In other words, the systems correspond to a scale of less than one micrometer, $1\mu m=10^{-6}$ m. Therefore, they are sometimes called alternatively "submicron systems."

These structures represent a challenge to experimentalists, since they demand elaborate fabrication processes and involve delicate measurements. The motivation for theoreticians is not any smaller, because, on the one hand, the approaches employed for systems on macroscopic scales no longer apply or at least need refinement. On the other hand, mesoscopic structures are often too large and complex to treat them starting from a microscopic model .

As the second part of the workshop which is dealing with mesoscopic systems, the following subjects will be discussed:

1. Heat transport in nanoscopic structure
2. Nano-detectors for electromagnetic radiation
3. Fractional exclusion statistics