Ph.D. positions in experimental mesoscopic physics and nanoscience

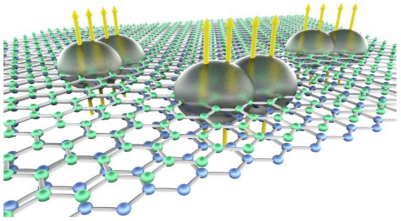
Quantum many body phenomena in two dimensions

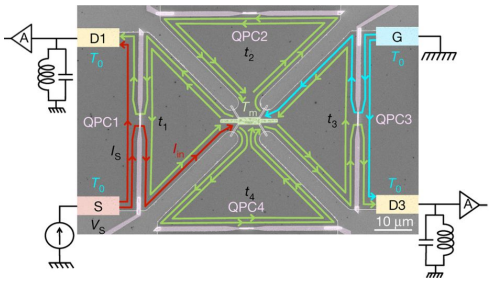
Mitali Banerjee (Mitali.Banerjee@epfl.ch) – Group starting from January 2020

Electrons restricted to live in two dimensions behave rather differently, and their various quantum many-body ground states yet to be understood fully. A good example is the quantum Hall effect, one of first known topological states of matter harboring *anyons*, namely, fractional charges and neutral exotic excitations. The anyons, due to their exotic characteristics, supposed to be excellent building blocks for topological quantum computation. However, experimental verification confirming their exclusiveness is yet to be demonstrated.

Electrical probes, which are extensively used, are not good enough when it comes to sense charge-neutral entities present in the system, thereby failing to elucidate on the complete picture. In this respect, heat or energy transport can offer complementary and important information [1]. The thermodynamic measurements in mesoscopic systems are by far not as trivial as the electrical measurements, but can unambiguously detect exotic para-fermions; for example Majorana fermions in the 5/2 quantum Hall state [2].

This is a golden era in terms of availability of intrinsic or engineered two-dimensional materials. The rich quantum many-body states they offer are subject of our interest. The materials that will provide an excellent playground for the proposed research are MBE grown GaAs and InAs, also van der Waal materials like graphene, and transition metal dicalchogenides like WSe_2, $MoSe_2$ and alike. Spectacularly, the van der Waal materials extended and enriched the realm to an extent that even a small twist angle between two layers exhibit rich quantum many body ground states, such as superconductivity, ferromagnetism, and Mott insulating phases, to name a few. The fast growing material catalogue including semiconductor, superconductor, ferromagnet, and insulators makes this a compelling platform to study cross-border correlated physics in two dimensions.





The new group headed by Mitali Banerjee will start from 1st January 2020, in the department of Physics, EPFL. We are seeking new members for the lab, someone highly motivated, curious to try new ideas, have excellent study records in physics or related disciplines up to the level of M.Sc. (awarded or expected soon). Prior laboratory experience in the fields of mesoscopic physics, nanoelectronics, cryogenics, circuit design, clean-room techniques, and knowledge of matlab, python is a plus.

Interested candidates are requested to send applications, including a cover letter and a CV including contact information of the References to Mitali.Banerjee@epfl.ch.

Reference:

1. Mitali Banerjee, Moty Heiblum, Amir Rosenblatt, *et al.*, Observed quantization of anyonic heat flow, ***Nature*** 545, 75 (2017).
2. Mitali Banerjee, Moty Heiblum, Vladimir Umansky, *et al.*, Observation of half-integer thermal Hall conductance, ***Nature*** 559, 205 (2018).