## Quantum Point Contact Transistor and Ballistic Field-Effect Transistors

E. Grémion, D. Niepce, A. Cavanna, U. Gennser, and **Y. Jin**

CNRS, Laboratoire de Photonique et de Nanostructures, Route de Nozay, 91460 Marcoussis, France

It has long been a hope to devise a FET (Field-Effect Transistor) operating in the fully ballistic regime. Presently, thanks to remarkable theoretical and experimental progress in mesoscopic physics, ballistic field-effect devices are routinely achievable. Among them, the most investigated mesoscopic device is a nearly perfect 1D (one Dimensional) quantum ballistic conductor also called QPC (Quantum Point Contact), which is realized by split-gate constrictions on a high mobility 2DEG (Two-Dimensional Electron Gas). For turning such 1D devices into real ballistic FETs as building blocks - switches - for digital integrated circuits, the key point is to obtain a voltage gain greater than 1. And the maximum FET voltage gain is determined by the ratio of its transconductance over its output conductance.
We report here experimental results and theoretical understanding of the Quantum Point Contact Transistor - a fully ballistic 1D FET. Experimentally obtained voltage gain greater than 1 in our QPC devices at 4.2 K can be explained with the help of an analytical modeling based on the Landauer-Buttiker approach in mesosopic physics, the lowest 1D subband plays the key role to increase its transconductance, especially reduce its output conductance and thus to achieve a voltage gain higher than 1.[1] This work provides a general basis for devising future ballistic FETs and quantum limits found in this work may be used to estimate normalized transconductance and channel resistance in 2D FETs.

[1]E. Grémion, D. Niepce, A. Cavanna, U. Gennser, and Y. Jin, *Appl. Phys. Lett.* **97**, 233503 (2010).