Quantum Electrical Metrology group

Tue, 2017-03-21 18:56 - Poirier [1] **Research Type:** Experiment

The Laboratoire National de métrologie et d'Essais (LNE) is a state-owned enterprise (EPIC) attached to the French Ministry of Industry. It is not only involved in certification and testing of products but also in charge of managing the French Metrology. The Quantum Electrical Metrology group at LNE, as an intermediate between academia and industry, aims at exploiting solid-state quantum effects, such as quantum Hall effect [1], Josephson effect [2], single electron tunneling and coulomb blockade [3], to improve the realization of the units ohm, volt and ampère in the Système International (SI) to the benefit of end-users (calibration centers, companies). The group, a leader in the application of the quantum Hall effect, has a long experience in research about graphene-based quantum resistance standards [4-6]. It has demonstrated that graphene devices can operate under relaxed experimental conditions compared to their GaAs counterparts, which constitutes a milestone towards a user-friendly quantum resistance standard [7, 8]. More recently, the group has developed a quantum current generator by combining the Josephson and quantum Hall effects in an original quantum circuit based on the Ohm's law. This new quantum device gives the first realization of the ampere from the elementary charge with an uncertainty of 10 per billion [9]. All these research rely on the development of ultra-accurate, sensitive and low-noise instrumentation using quantum devices such as SQUIDs. Our future research is aimed at the development of a compact quantum calibrator/multimeter integrating several quantum standards and new quantum technologies.

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[3] X. Jehl et al, "Hybrid Metal-Semiconductor Electron Pump for Quantum Metrology", Phys. Rev. X 3, 021012 (2013);

[4] W. Poirier and F. Schopfer "Can graphene set new standards?", Nature Nanotech. 5, 171 (2010);

[5] J. Guignard et al., "Quantum Hall effect in exfoliated graphene affected by charged impurities: Metrological measurements", Phys. Rev. B 85, 165420 (2012);

[6] F. Lafont et al., "Anomalous dissipation mechanism and Hall quantization limit in polycrystalline graphene grown by CVD", Phys. Rev. B, 90, 115422 (2014);

[7] F. Lafont et al., "Quantum Hall resistance standard based on graphene grown by CVD on SiC", Nature Commun. 6, 6806 (2015);

[8] R. Ribeiro-Palau et al., 'Quantum Hall resistance standard in graphene devices under relaxed experimental conditions' Nature Nanotech. 10, 965 (2015);

[9] J. Brun-Picard et al., 'Practical Quantum Realization of the Ampere from the Elementary Charge' Phys. Rev. X, 6, 041051 (2016).
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Location

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- Quantum Engineering [2]
- Quantum Metrology, Sensing and Imaging [3]

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