Postdoctoral position (24 months) at LNE

Quantum ampere: realisation of the new SI ampere and quantum metrological triangle

In the framework of the European EMRP project "Quantum ampere" (Realisation of the new SI ampere) and its present experimental activities on single electron transport devices, the French National Institute of Metrology LNE (Laboratoire National de Métrologie et d'Essais) proposes a 24 months postdoctoral position in its research team in quantum electrical metrology.

Description

This postdoctoral position is proposed in the framework of the EMRP project "Quantum ampere". This project comes within the scope of the efforts of the national metrology institutes to contribute to the forthcoming reform of the Système International d'unités (SI) and to improve the practical realisation of the SI definitions of units. The project deals with the development of new single electron transport (SET) devices delivering currents well above the picoampere range which will open interesting perspectives on both the **metrological triangle experiment** and the **realization of a quantum current standard**. Another expected benefit of this project is the improvement of the traceability to the SI of very low currents (<nA) answering to the recurring needs of applied metrology, microelectronics industry or the optical radiometry.

The postdoctoral fellow will contribute to the three main tasks of the project in close collaboration with the French team and the European partners: 1) Investigation on hybrid electron turnstiles and silicon pumps for the development of a quantum current standard; 2) Development of an ultra low noise current amplifier based on new cryogenic current comparators; 3) Implementation of the metrological triangle experiment.

The quantum metrological triangle experiment aims to check experimentally, at an uncertainty level of the order of one part in 10^8, the consistency of the three quantum phenomena used in fundamental electrical metrology: the Josephson and quantum Hall effects and the single electron tunnelling effect. It consists to apply Ohm's law to the quantities linked to the three effects: the voltage at the terminals of a resistance calibrated against quantum Hall effect standard and crossed by the current supplied by a SET device is compared to the Josephson voltage standard. Both Josephson and quantum Hall effect already offer universal representations of volt and ohm and are controlled with an uncertainty level which enables the realization of voltage and resistance standards with relative uncertainties of the order of 1 or 2 parts in 10^9. On the other hand single electron devices, developed as quantum standards of current which generate a current with an amplitude proportional to the electron charge, do not reach the same level of uncertainty yet.

The biggest efforts have to be carried on the measurement of the current generated by the SET device. This current is measured by means of a cryogenic current comparator with a relative uncertainty presently limited to a few parts in 10^6. The target relative uncertainty at the end of the Quantum ampere project in 2015 is one part in 10^7. Another part of the work will be the integration of the three effects in the same experiment taking into account the experimental

constraints due to the target uncertainty level. The main task for the postdoctoral fellow will be the development and improvement of the instrumentation combined with the metrological triangle experiment (cryogenic current comparator).

Due to the metrological environment and the specific task devoted to the postdoctoral fellow, the candidate should have developed an inclination and strong competences for high resolution instrumentation (SQUID especially) and low temperature and low noise transport measurements (dilution fridge).

The position is available from January 2013.

Contacts

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