Title of the doctoral program
Metrologia / Metrology

Title of the research activity
Novel quantum Hall devices for resistance metrology

Short description of the research activity
The new International System of units (SI), approved on 16 November 2018, redefines all the units in terms of fundamental constants of Nature. In this new SI, the electromagnetic units are linked to the electron charge $e$ and the Planck constant $h$. Quantum phenomena in mesoscopic devices, such as the quantum Hall effect, will allow the realization of primary metrology experiments to link the electromagnetic units to $e$ and $h$. Present research in resistance metrology is focused on the design and realisation of more flexible quantum Hall devices, which allow the realisation of the SI unit of resistance for different values, relaxed experimental conditions (in the magnetic field and temperature required), ease of transfer of the quantum value to maintained resistance standard also in non-optimal environments, as industrial calibration laboratories.

INRIM, in collaboration with the National Enterprise for NanoScience and nanotechnology (NEST, Pisa, Italy) is actively engaged in the design, development, and metrological testing of novel quantum Hall devices for resistance metrology.

The PhD activity will include the design, modeling, realisation of new quantum devices, development of metrological setups for their characterisation, the participation to international intercomparisons to validate the traceability routes investigated.

Scientific tutor (name, surname, role, email)
Luca Callegaro
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Luca Callegaro is a director of research in INRIM. Scientific sector ING-INF/07 (Electric and electronic measurements). 18 papers on international journals in the last 5 years. 1289 citations, h-index 20 (Google Scholar).

Stefano Roddaro
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Stefano Roddaro is an assistant professor at the University of Pisa and research associate at NEST, working since many years in the design and realisation of quantum electronic devices. H-index 23, 1726 citations (Google Scholar).

**Type of research activity**
The activity is mainly experimental and includes the design and realisation of quantum devices, the realization of cryogenic experiments (quantum Hall effect) and of metrology setups, measurement activity, data analysis, reporting and publication.

**Site of activity**
INRIM, Strada delle Cacce 91 - 10135 Torino;  
NEST, Laboratorio NEST Scuola Normale Superiore, Piazza San Silvestro 12, 56127 Pisa - ITALY

**Active collaboration on the proposed research activity**

**Specific requirements (experiences, skills)**
Degree in electrical / electronic engineering, physics engineering, physics  
Interest in instrumentation and measurement  
Programming skills  
Willingness to travel between INRIM and NEST

**Website of the research group (if any)**
https://sites.google.com/inrim.it/quantel