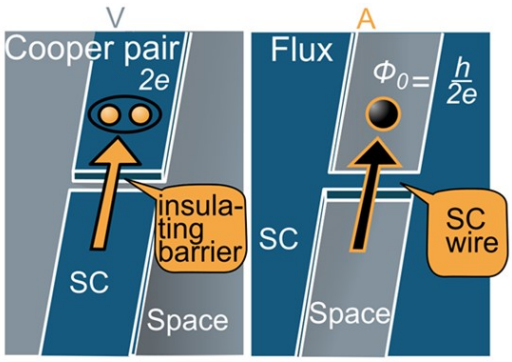
Toward new era of quantum electrical measurements through phase slips

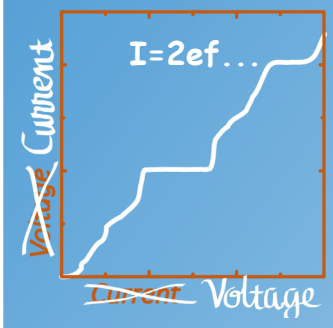
Quantum e-leaps

Background & objectives

Quantum e-leaps is a European Horizon 2020 FET-Open project aimed at delivering the foundations for a step-change in electrical quantum metrology by exploiting the unique properties of superconducting nanodevices.

By exploiting a phenomena called coherent quantum phase slips (CQPS) in superconducting nanowires, equivalent with coherent flux tunnelling across the nanowire, we will target the development of a standard for electrical current which is the quantum mechanical dual to the robust Josephson voltage standard currently used to disseminate the Volt.

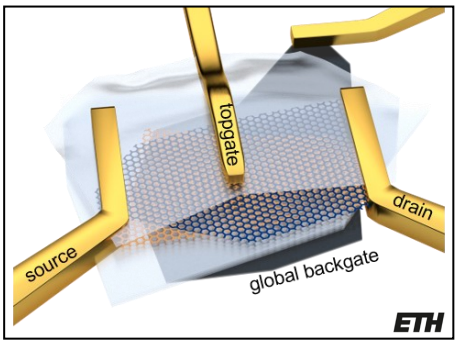




Technology

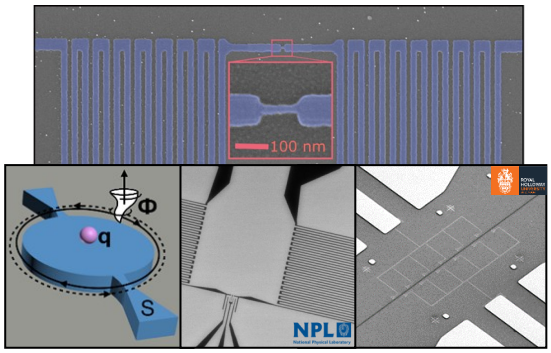
2d material superconductors

Novel superconductors based on 2d materials offer enhanced control and reproducibility; the project will explore materials such as single layer Nb_2Se_3 and 'magic' angle twisted bilayer graphene and develop 2d-material nanowire devices showing CQPS.



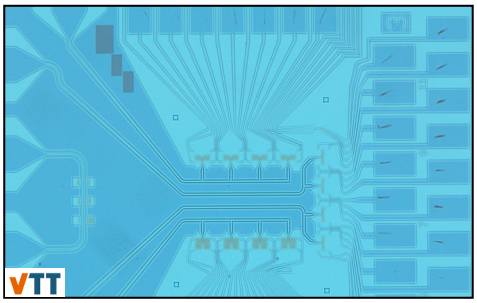
Atomic layer deposition and advanced nanofabrication

Atomic Layer Deposition (ALD) techniques offer precise control of thin film thickness and resistivity, and together with state-of-the-art nanofabrication the project will explore disordered conventional superconductors such as NbN close to the superconductor-insulator transition for phase slip physics.



CMOS technology for advanced control and integration

The high yield and robustness of CMOS fabrication technology allows for reliable integration and development tunable circuit components (e.g. resistors and inductors), some based on novel superconducting silicide and carbide materials, required for implementing the right environment for CQPS nanowires. This platform will be integrated with 2d-materials & ALD superconductor technologies.



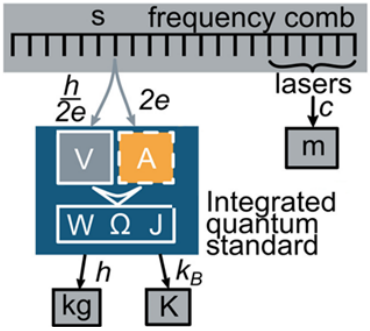
Vision

Demonstrating a robust quantum current standard

With state of the art technologies developed within the consortium we aim to demonstrate proof-of-concept of a quantised current source based on quantum phase slips, disseminating the current through the relation *I=2ef*, where *f* is a microwave drive frequency and *e* the electron charge. Such a current standard would require simple infrastructure to operate.

Fully integrated electrical metrology systems

Such a current standard would unlock the possibility of integration into the same system with the Josephson voltage standard, which can be utilised to disseminate a wide range of electrical units with shorter traceability chains, improving measurements for the electronics industry and driving development of new technologies.



www.e-leaps.eu

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VTT

ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich

Leibniz ipht Leibniz Institute of Photonic Technology

Aalto University

NPL National Physical Laboratory

UR Universität Regensburg

Royal Holloway University of London