

# Phase-engineering of artificial Josephson topological materials in three-terminal proximity interferometers

Introduce:

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## Abstract

Multi-terminal superconducting Josephson junctions based on the proximity effect offer the bright opportunity to tailor non trivial quantum states in nanoscale weak-links. These structures can realize exotic topologies in several dimensions [1] as, for example, artificial topological superconductors able to support Majorana bound states [2], and pave the way to emerging quantum technologies and future quantum information schemes.

In this talk I shall report the first realization of a three-terminal double-loop Josephson interferometer (referred to as the  $\omega$ -SQUIPT due to its characteristic shape) based on a proximized nanosized metallic weak-link [3]. Our tunneling spectroscopy measurements reveal transitions between gapped (i.e., *insulating*) and gapless (i.e., *conducting*) states, those being controlled by the phase configuration of the three superconducting leads connected to the junction. We show the *topological* nature of these transitions: A gapless state necessarily occurs between two gapped states of different topological index, very much like the interface between two insulators of different topology is necessarily conducting. The topological numbers characterizing such gapped states are given by superconducting phase windings over the two loops forming the Josephson interferometer. Since these gapped states cannot be transformed to one another continuously without passing through a gapless condition, these are topologically *protected*. The same behavior pertains to all the points of the weak-link confirming that this topology is a *nonlocal* property [4].

Our observation of the gapless state is pivotal for enabling phase engineering of more sophisticated artificial topological materials.

## References

- [1] R-P. Riwar, M. Houzet, J. S. Meyer, & Yu. V. Nazarov, Nat. Commun. 7, 11167 (2016).
- [2] V. Mourik, et al., Science 336, 1003 (2012).
- [3] E. Strambini, S. D'Ambrosio, F. Vischi, F. S. Bergeret, Yu. V. Nazarov, and F. Giazotto, Nat. Nanotech. 11, 1055 (2016).
- [4] F. Vischi, M. Carrega, E. Strambini, S. D'Ambrosio, F. S. Bergeret, Yu. V. Nazarov, and F. Giazotto, Phys. Rev. B 95, 054504 (2017).

## Seminario

Mercoledì 31 maggio 2017

Sala Riunioni, ore 15.00

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