

Report on the main advances in the field on superconducting junctions for detectors and quantum devices, including the workshop and publications related to the WG2 of the Action.

This WG has taken part in the workshops:

Coherent superconducting hybrids and related materials, <https://nanocohybri.inc.uam.es/workshop-coherent-superconducting-hybrids-and-related-materials/>, 26-29 March 2018.

School on quantum materials and workshop on vortex behavior in unconventional superconductors, <https://nanocohybri.inc.uam.es/school-on-quantum-materials-and-workshop-on-vortex-behavior-in-unconventional-superconductors-7-12-october-2018/>, 7-12 October, 2018

Joint workshop between MOLSPIN and NANOCOBYBRI – Superconductivity meets Molecular Spins, <https://nanocohybri.inc.uam.es/superconductivity-meets-molecular-spins-20-22-march-2019/>, 20-22 March 2019

International workshop on vortex matter 2019, <https://nanocohybri.inc.uam.es/international-workshop-on-vortex-matter-2019-antwerp-belgium-may-20-25/>, 20-25 May 2019.

The Action reports on studies of modifications of Josephson junction behavior by ferromagnetic exchange interaction, studies on the influence of exchange interaction on superconductivity, at macroscopic and atomic scales, coherent emission of radiation in nanofabricated films and in junctions involving magnetic systems or anomalous behavior produced by vortices in Josephson junctions.

Some of the instruments available within the Action that are related to this working group are described at <https://nanocohybri.inc.uam.es/vi-working-group-2/>.

We can highlight the following publications, often resulting from a collaborative arrangement sparked by the Action.

Tuning of Magnetic Activity in Spin-Filter Josephson Junctions Towards Spin-Triplet Transport. <https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.122.047002>

Magnon–fluxon interaction in a ferromagnet/superconductor heterostructure. <https://www.nature.com/articles/s41567-019-0428-5>

Unique interplay between superconducting and ferromagnetic orders in EuRbFe₄As₄. <https://journals.aps.org/prb/abstract/10.1103/PhysRevB.98.140506>

Domain Meissner state and spontaneous vortex-antivortex generation in the ferromagnetic superconductor EuFe₂(As_{0.79}P_{0.21})₂. <https://advances.sciencemag.org/content/4/7/eaat1061>

Anomalous Josephson effect controlled by an Abrikosov vortex. <https://journals.aps.org/prb/abstract/10.1103/PhysRevB.96.214515>

Microwave emission from superconducting vortices in Mo/Si superlattices. <https://www.nature.com/articles/s41467-018-07256-0>.

Electrodynamics of Josephson junctions containing strong ferromagnets. <https://journals.aps.org/prb/abstract/10.1103/PhysRevB.98.144516>

Influence of Magnetic Ordering between Cr Adatoms on the Yu-Shiba-Rusinov States of the Superconductor. <https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.120.167001>

Some STSM or ITC grants made related to this WG:

Fluctuation conductivity in strong electric fields in superconductor nanostructures.

Stsm Beneficiary: Todor Mishovov - University of Sofia (Bulgaria) **Host:** SPIN - CNR (Institute of Superconductivity and Innovative Materials and Devices) (Italy)

Fabrication of hBN/graphene heterostructures with superconducting side contacts.

Stsm Beneficiary: Mr Máté Kedves - Budapest University of Technology and Economics (Hungary) **Host:** University of Basel (Switzerland)

Topological insulator nanoribbons for superconducting quantum technologies.

Stsm Beneficiary: Dr Matteo Salvato Università di Roma Tor vergata (Italy) **Host:** Chalmers University of Technology Quantum Device Physics Laboratory (Sweden)

Engineered topological superconductivity.

Stsm Beneficiary: Dr Andras Palyi - Budapest University of Technology and Economics (Hungary) **Host:** TU Delft (The Netherlands)

Ferromagnetic transmon qubit.

Stsm Beneficiary: Mr Alessandro Miano University of Naples Federico II (Naples) **Host:** Innsbruck University (Austria)

Ionic liquid gating BiTeBr/hBN heterostructures for investigating the gigantic Rashba-effect.

Stsm Beneficiary: Mr Mátyás Kocsis Budapest University of Technology and Economics (Hungary) **Host:** University of Groningen (The Netherlands)