

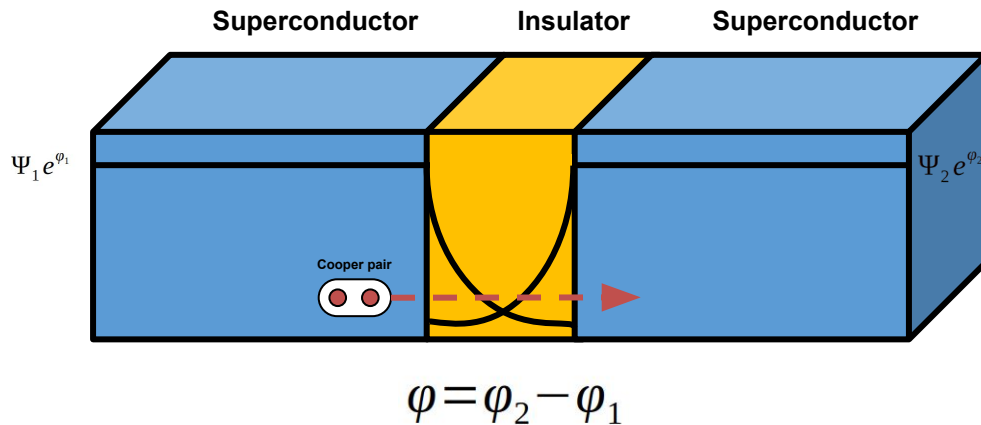
# Amplification-Free System for High-Resolution Josephson Junctions' Characterization

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IFD 2025 - 17/03/2025

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# Josephson junction



Josephson equations:

$$I = I_c \sin(\varphi)$$

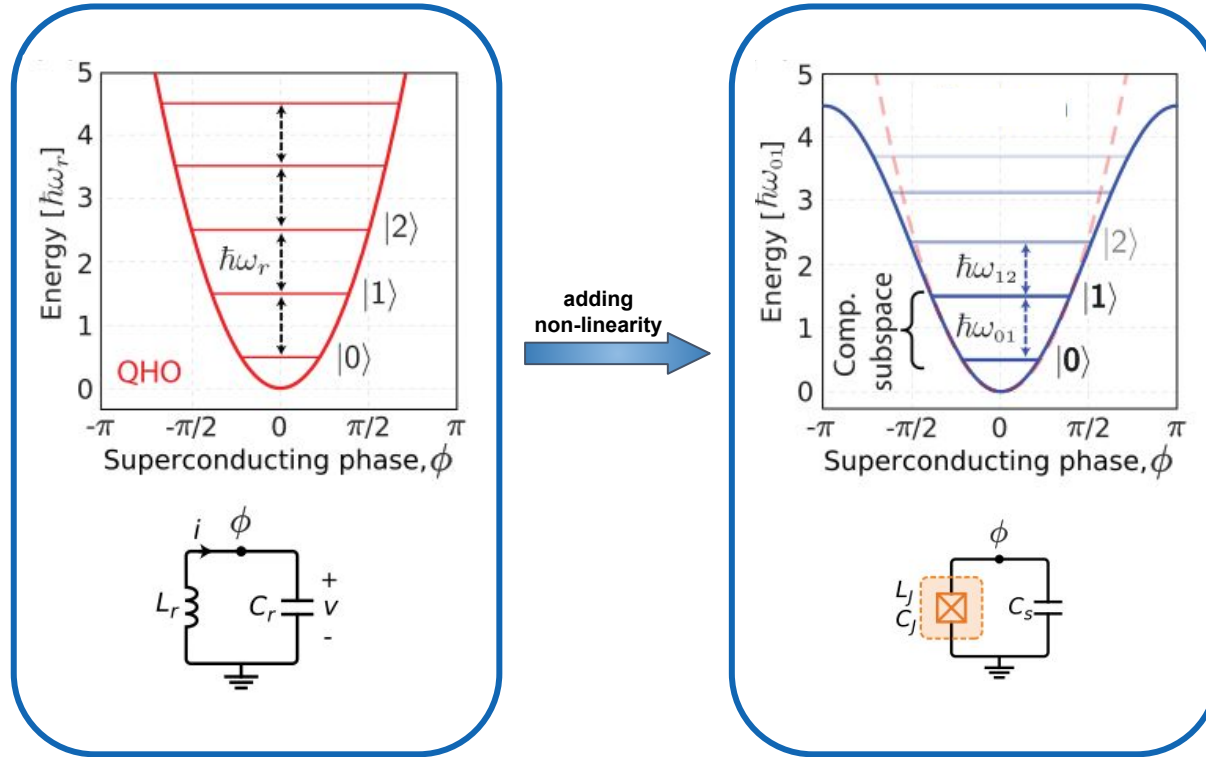
$$\frac{d\varphi}{dt} = \frac{2eV}{\hbar}$$



Non-linear inductance:

$$L = \frac{\hbar}{2e} \frac{1}{I_c \cos(\varphi)}$$

# Why are Josephson junctions interesting?



## Applications examples:

- Quantum Computing (superconducting qubits)
- Quantum Sensing (Josephson parametric amplifiers)
- cQED Experiments

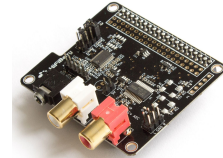
# Amplification-Free System

## Sound Card for High-Fidelity Music Applications:

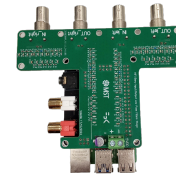
- DAC-ADC both with 2 channels
- 24 bit resolution
- 192 kHz sampling rate
- 110 dB SNR
- 2.15 Vrms maximum voltage input/output



1 x

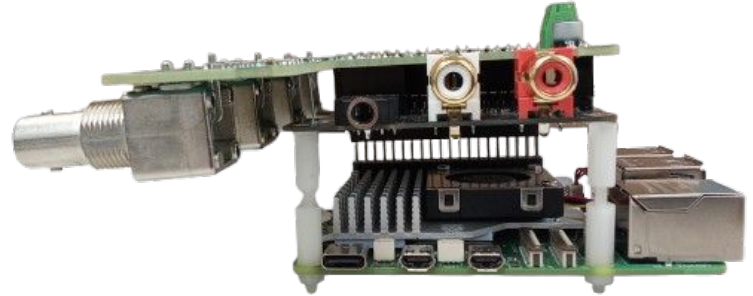
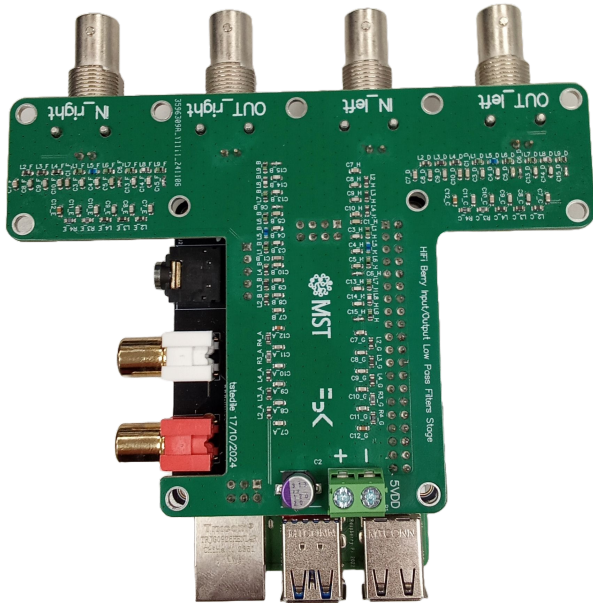


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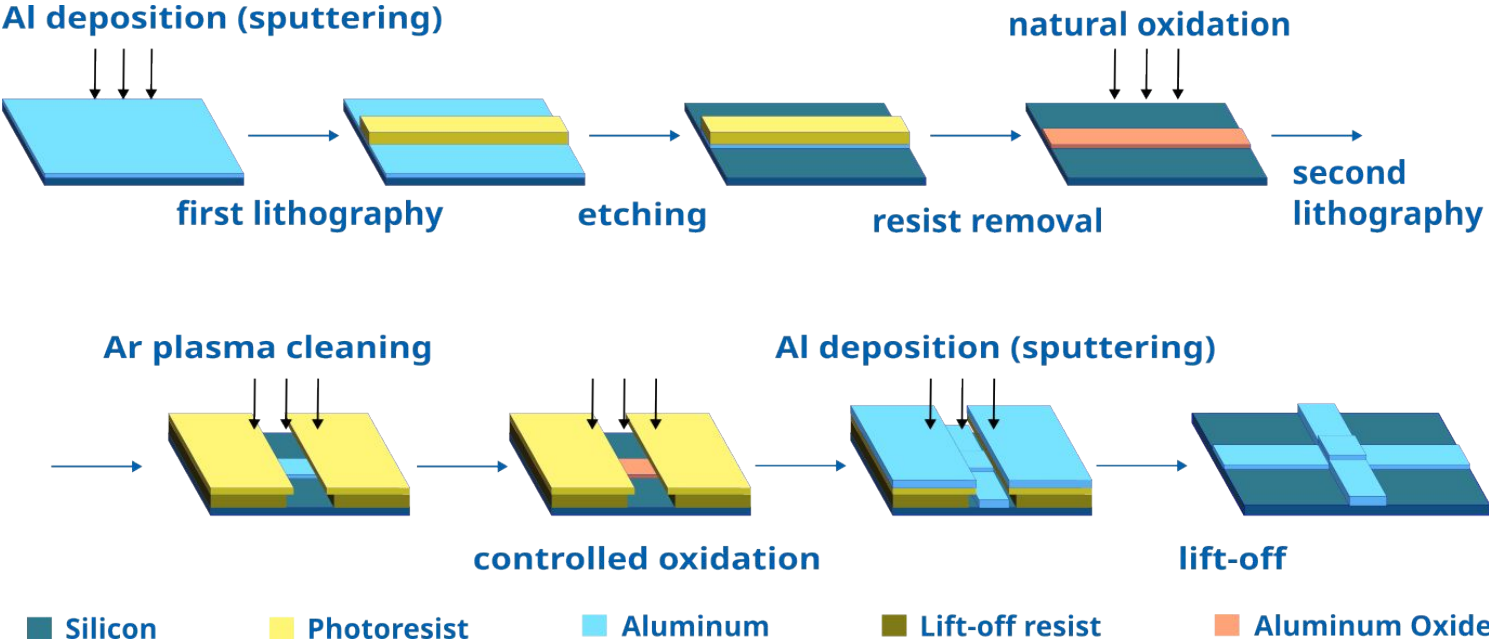


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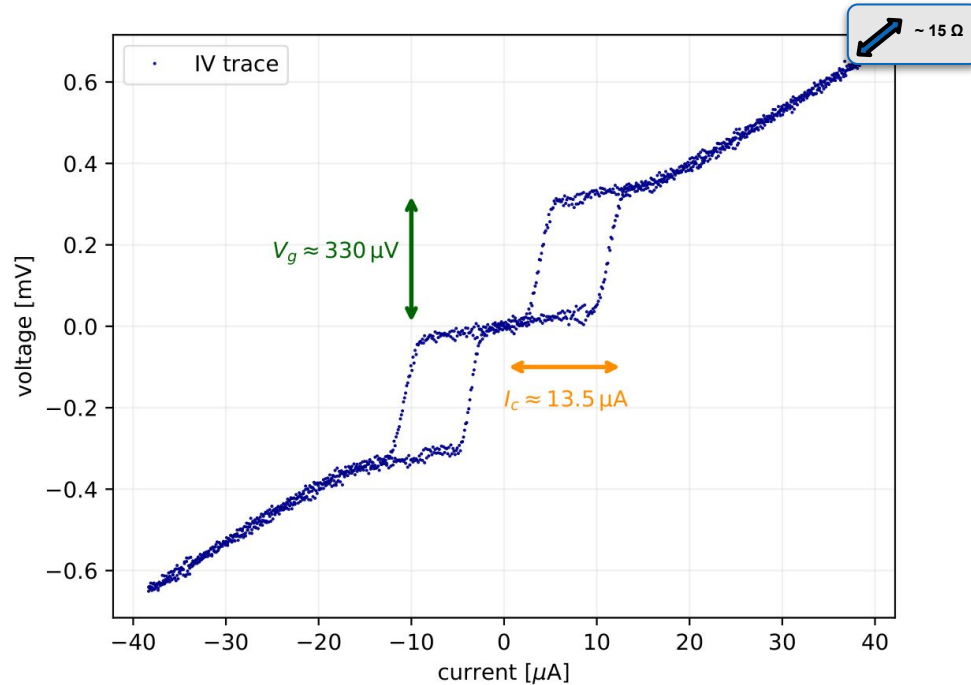
# Amplification-Free System



# Fabrication Process



# mK Characterization



- Gap Voltage  $V_g$  - in agreement with literature values
- Critical current  $I_c$  - in agreement with RT estimation
- Characteristic hysteresis of an underdamped junction observed

# The FBK team



External collaborators in Trento:

*Experimentalists:* Paolo Falferi, Renato Mezzena, Andrea Vinante

*Theoreticians:* Iacopo Carusotto, Gianluca Rastelli, Stephanie Matern

*From left to right:*

- |                              |                            |
|------------------------------|----------------------------|
| Enrico Bogoni                | - PhD student              |
| Marcello Faggionato          | - Master student           |
| Benno Margesin               | - Senior fellow            |
| <b>Federica Mantegazzini</b> | - Researcher & Team leader |
| Nicolò Crescini              | - Researcher               |
| Alessandro Irace             | - PhD student              |
| Felix Ahrens                 | - Researcher               |



Collaboration with **Milano Bicocca**:  
*Andrea Giachero, Angelo Nucciotti,*  
*Marco Faverzani and colleagues*