# Signal detection and amplification in FLASH: MSSQUID Test and Optimization

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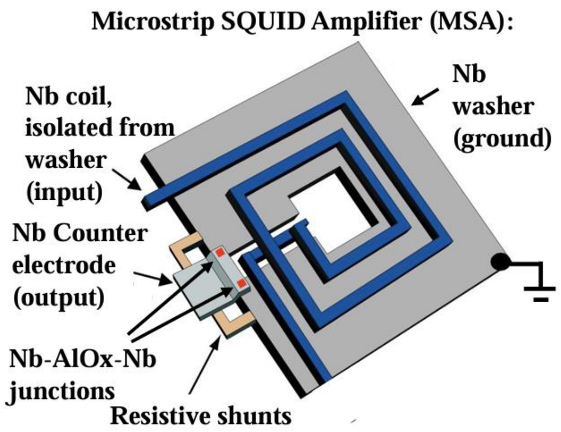
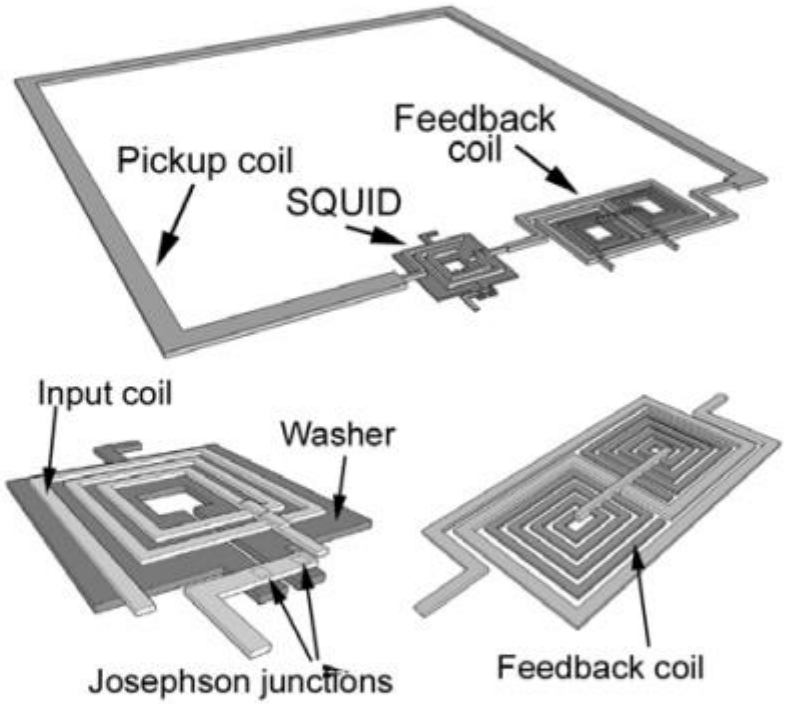
# Washer type SQUID Fabrication optimization and intrinsic noise reduction




Input coil
Washer
Josephson junctions
Parasitic capacitance
Secondary induction loop
Microstrip
Feed back coil
Max gain for inductive performance
H Shielding
Secondary stage amplification (HFET, BAW)

# Actuator-SQUID for Lunar gravitational Wave detector:

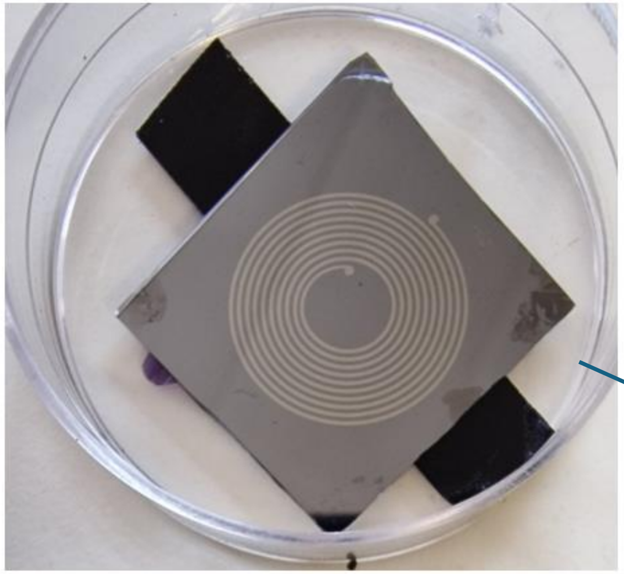
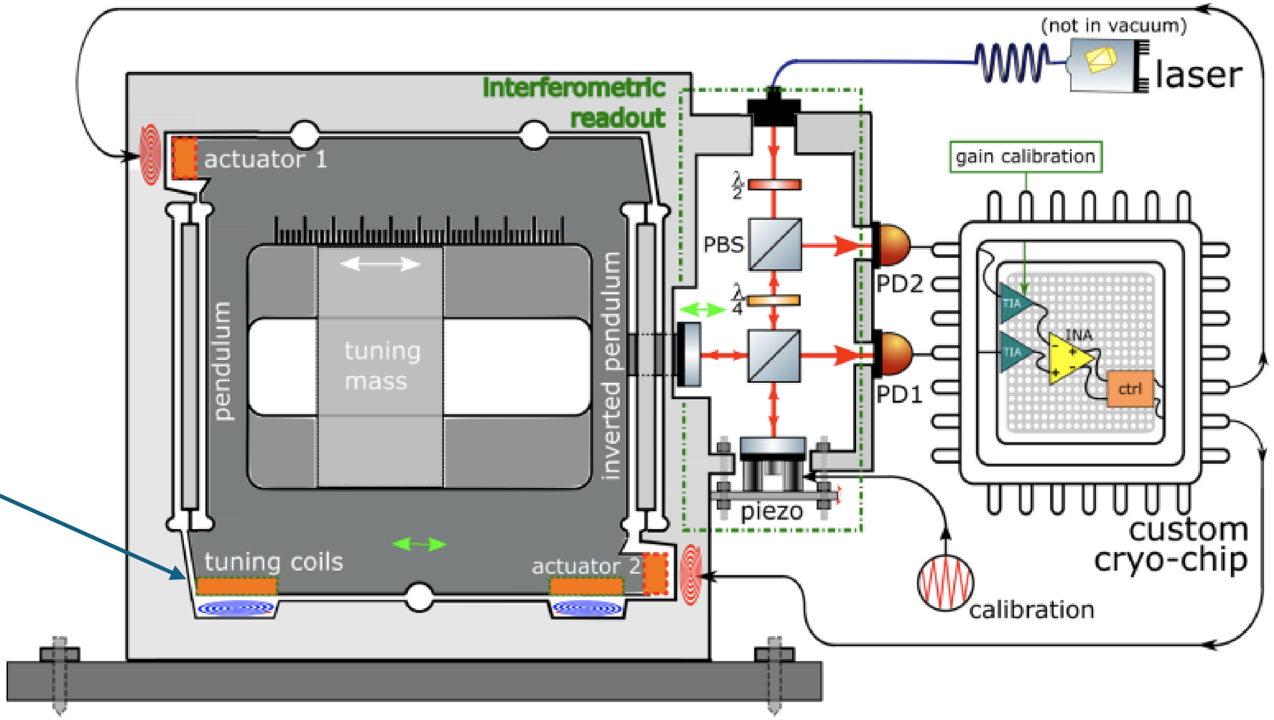


Figure 1. Photo of the sample MS250, a 10 turns NbN coil, fabricated from a 500 nm thick film deposited on a Si wafer.

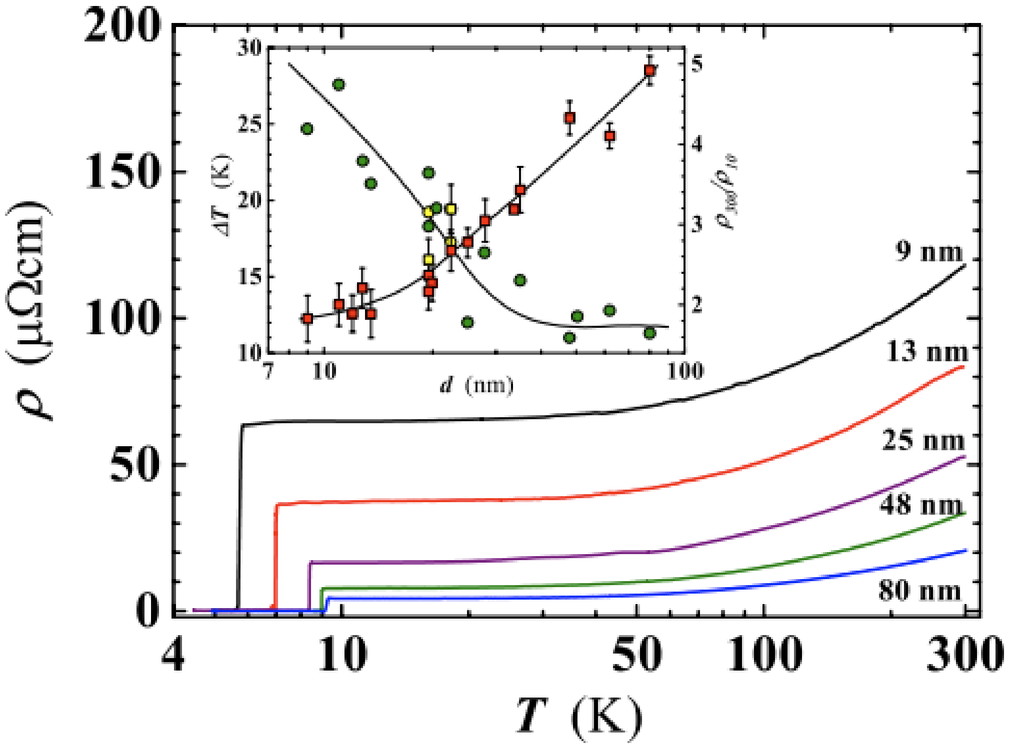



Fabrication at Lund and INRiM : The quality check under progress

## SQUID Coils parameters effect the performance :

Input coil thickness optimization

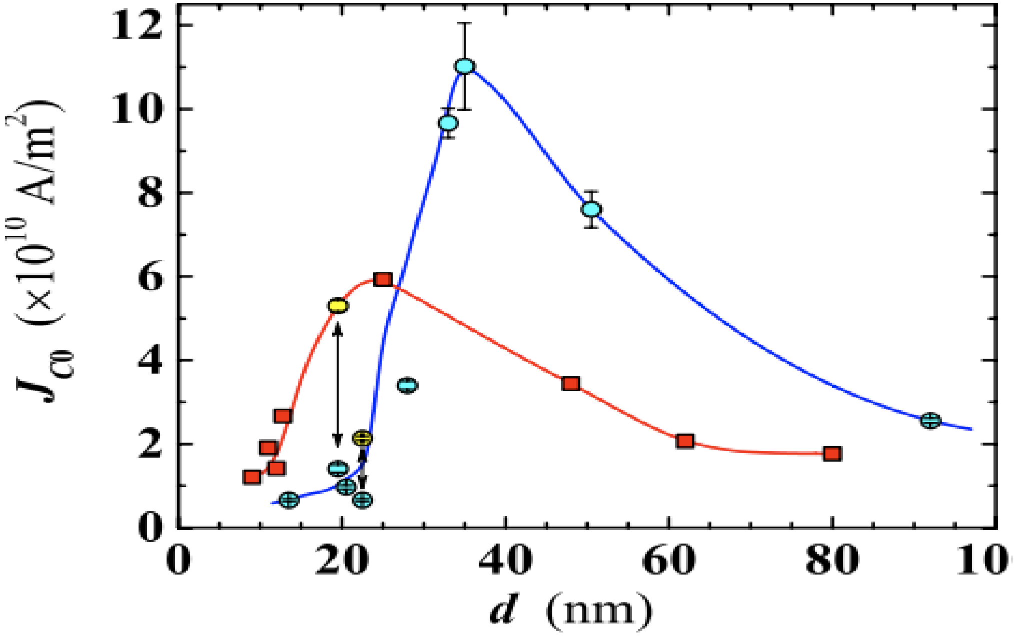
TC and Jc and Hc




Temperature dependence of the resistivity for selected Nb flms, with a thickness ranging from 9nm to 80nm. Inset: width of the plateau region (ΔT), above TC, as a function of d (circles).

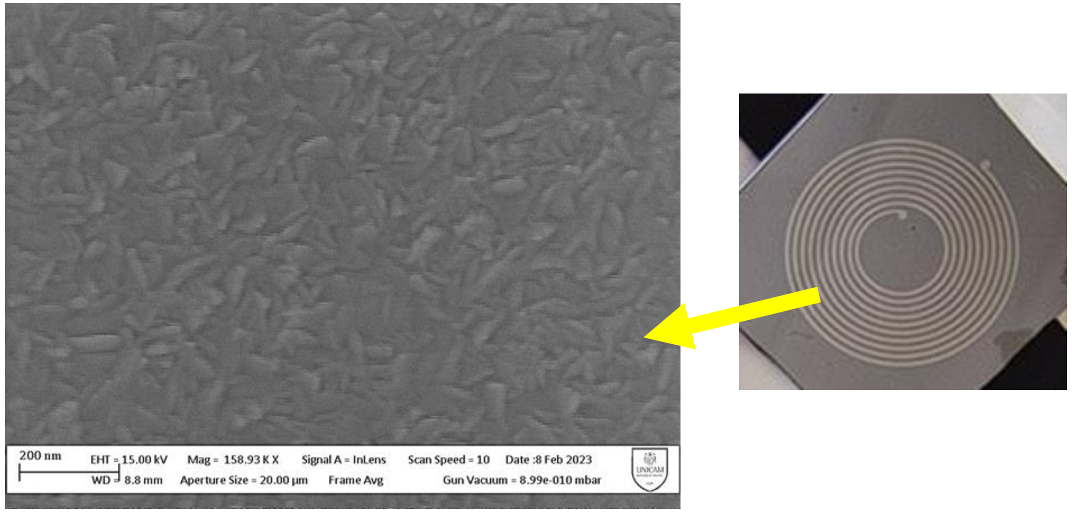
Input coil width optimization

Jc

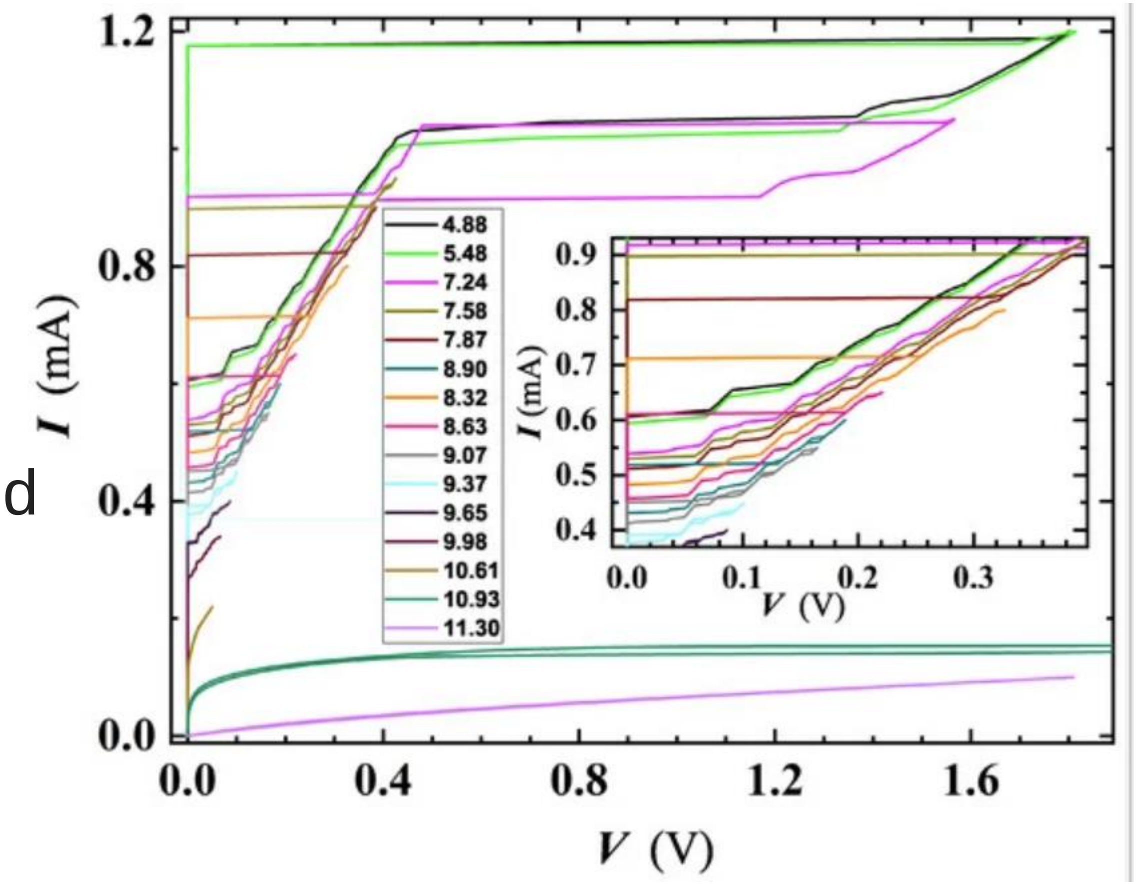



Tickness dependence of the critical current density extrapolated at 0K. Circles: flms w = 10μm wide; yellow flled symbols correspond to the flms deposited on sapphire substrates. Squares: w = 50μm wide

## Intrinsic structural properties (performance and structural Noise):



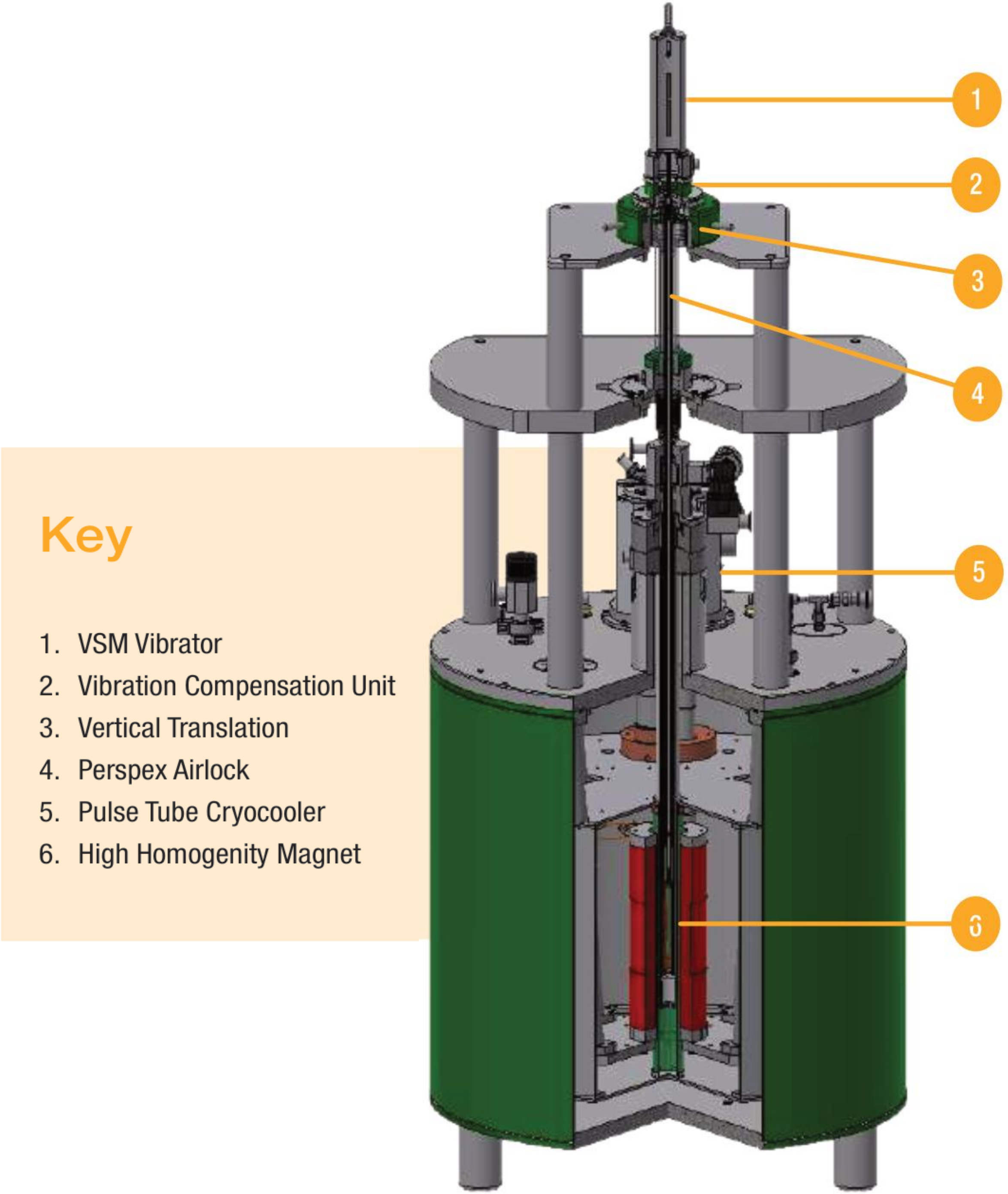

I-V characteristics for the NbN stripes, carried out at several *T*. Both up- and down-current sweeps evidence the presence of slanted steps due to the occurrence of intermediate resistive regimes before the complete transition to the normal state. Inset: magnification of the central part of the plot.




# Quantum phase slip due to Granular Structure


- T Range 3.8 K to 800 K
- DC and AC measurments
- Impedance measurments
- Capacitanca measurements
- Magnetif field upto 1T
- Magnetic field resolution of 10μT
- Low T guassmetry

- T Range 1.5 K to 300 K
- DC and AC measurments
- Impedance measurments
- Capacitanca measurements
- Magnetif field upto 12T
- Possibility to upgrade:
- To 300 mK T range
- sample rotation



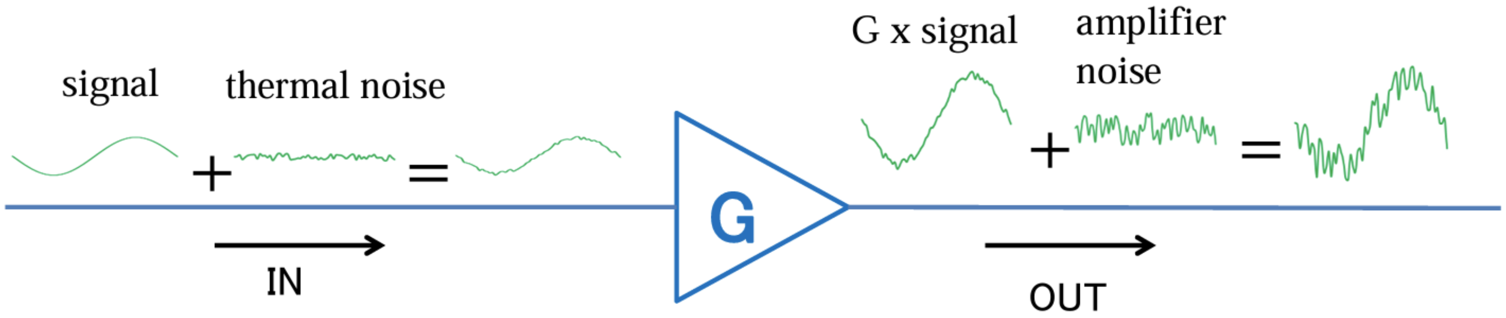
## Intrisic test performed:

1- The inrtrinsic properties of the junctions and the MSSQUID to optimiz the geometry design and fabrication process

2- The full functionality test below Tc and at variable T and H

3- Bias and flux current test and optimization

# NOISE TEST:




The noise temperature $T_n$ of an MSA scales linearly with the operation frequency and temperature:

1- Static (DC) noise test
2- AC noise test at low and high frequency (< 1GHz)
3- wide band noise measurment
3- input gain test for inductive regime performance
4- Possible HFET post amplification developement and noise test (at 4 K) :MBE available at UNICAM
5- Microstrip resonance test

## Sheilding TESTs:

External magnetic fields will also change the flux bias of the SQUID, the gain might drift or be modulated with changing external fields

1- Packaging in a stainless-steel tube and using superconducting magnetic shield.
2- Lead-foil cylinder with an outer layer of (ferromagnetic) Conetic AA foil.
3- Mu metal with the design rings for the compensation of the magnetic field
4- Resilient test under high magnetic field (100μT to 10 T)

# Thanks