

Microwave multiplex read out for superconducting sensors

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erc

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²NIST, Boulder, CO, USA

5 030

20 30 Time (ms)

Time (ms)

11 015

11.030

Rf-SQUID read out with microvawe multiplexing

HEMT

amp 2 (~6 K) 2

> **current (µA)** 10

- DC biased TES

microwave

synthesizer

flux

ş

ramp

rf SQUID

TES

bias

INFN

- SQUID coupled with TES and a resonator circuit
- microwave rf-SQUID read out with flux ramp demodulation (common flux line inductively coupled to all SQUIDs

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microwave resonators

Bandwidth Budget:

- Effective sampling rate is set by the ramp f_r
- Necessary resonator bandwidth per flux ramp: $\Delta f \gtrsim 2n_{\Phi_0}f_r$
- To avoid cross talk spacing between resonances $f_n \ge 10 \Delta f$ [potentially reduced by a factor 2]
- To avoid distortions $f \ge 10/\tau_{r}$

[potentially reduced by a factor 2]

- Available ADC bandwidth f_{ADC} with ROACH2 system 550 MHz
- Mux factor:

$$n_{mux} = \frac{f_{ADC}}{f_n} = \frac{f_{ADC}\tau_r}{25 \cdot 2 n_{\Phi 0}}$$

- Number of flux per ramp n_{Φ_0}
 - currently 3, easily scalable to 2, feasible 1.1

$$\tau_{rise}$$
= 5 µs, n_{Φ_0} = 2 \rightarrow **n**_{mux} ≈ 50



Test in progress @ Milano-Bicocca

- μ mux 33 channels (2/3 of resonators shorted)
- + IF board with R_{shunt} + TES \rightarrow all provided by NIST.
- Available:
 - 'naked' resonators with input coil directly linked to external wires for simulating the TES response
 - resonators + TES with a ⁵⁵Fe source
 - (activity of few Bq)
- Homodyne set up developed in Milano-Bicocca





