Flux Locked Loop in a SQUID

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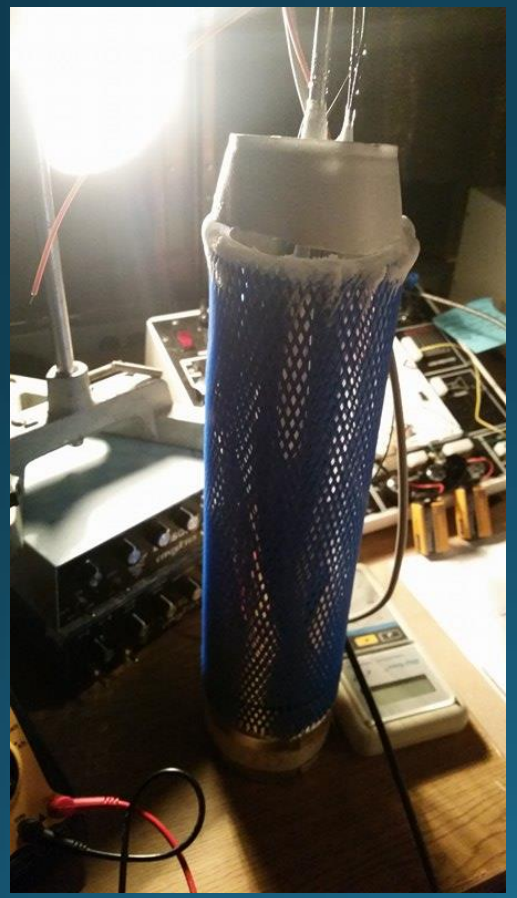

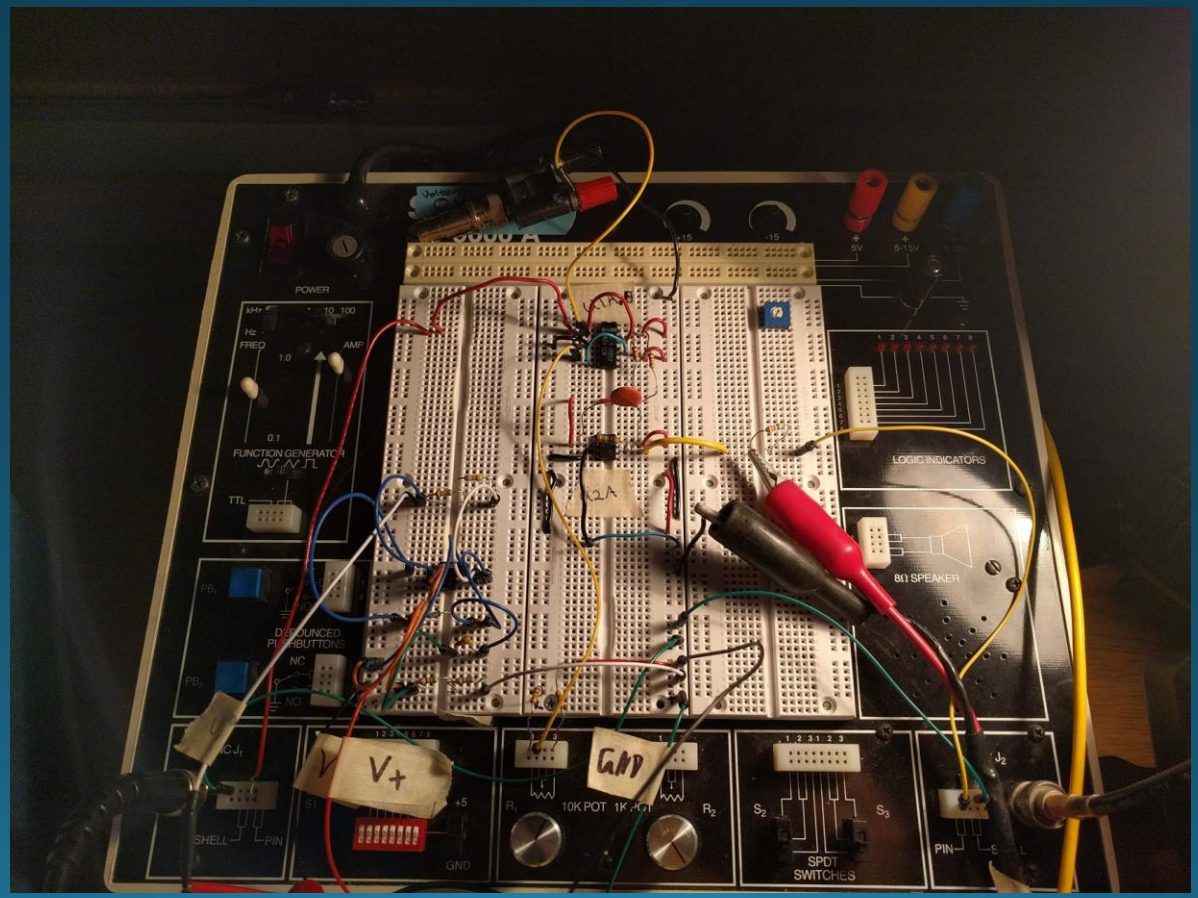

Table of Contents

What is a SQUID?

- Superconducting Quantum Interference Device
- 2 Types (RF vs DC)
- YBCO ($Y_1Ba_2Cu_3O_7$)
- Josephson Junction
- $\Phi_o = h/(2e) \approx 2.067833831(13)\times10^{-15}$ Wb

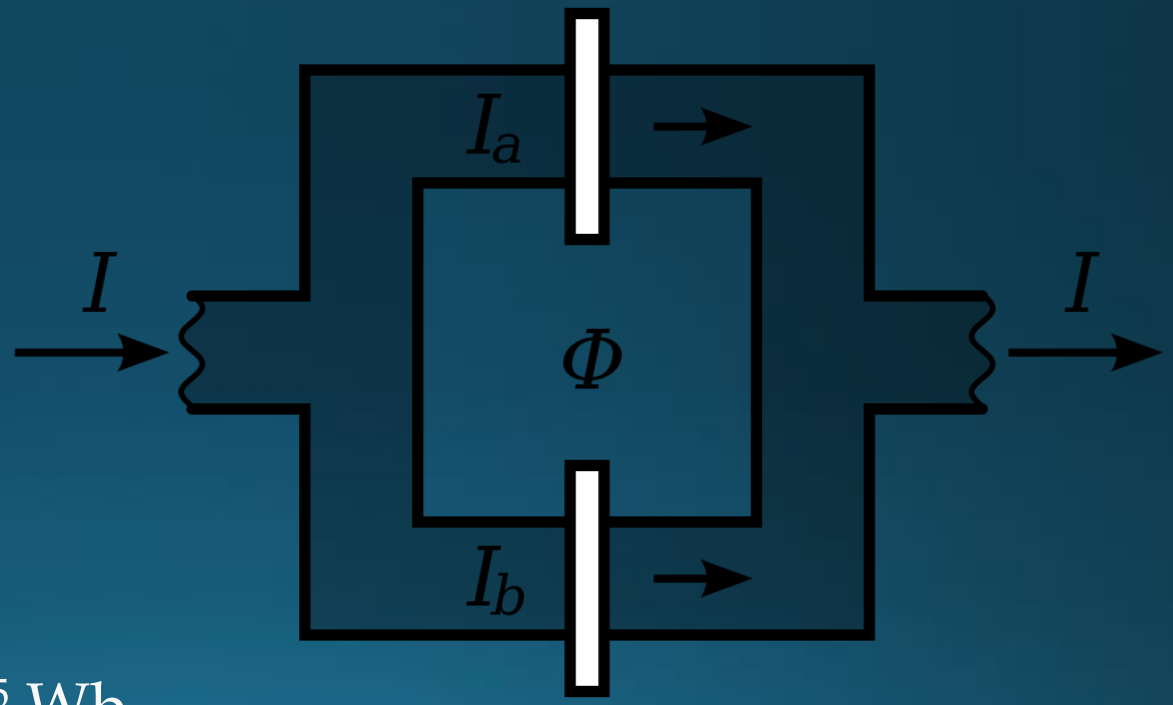

Figure 1: DC Squid

Typical Behaviour

- 77 K
- Flux Trapping Problem

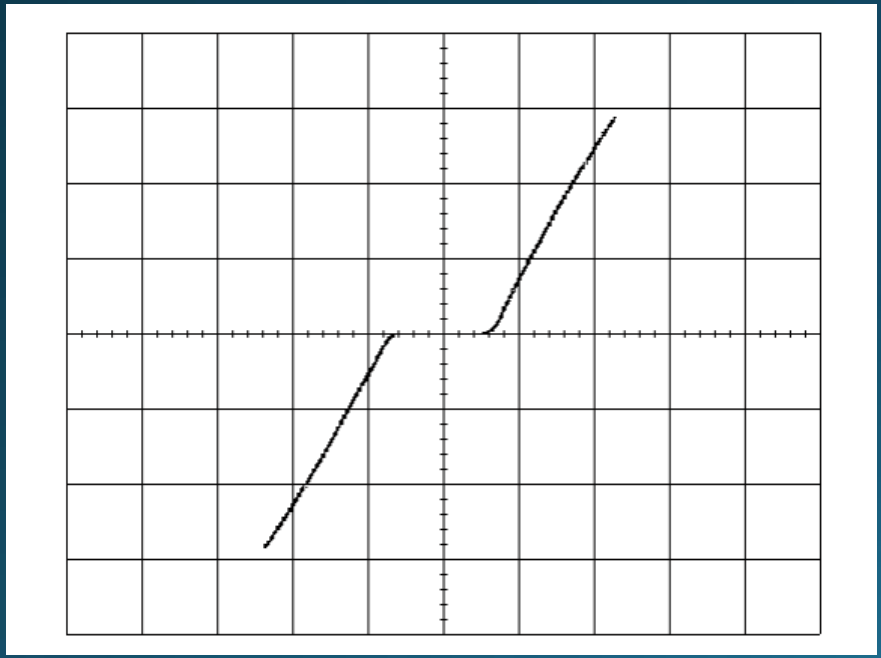

Figure 2: V-I Behavior of SQUID[2]

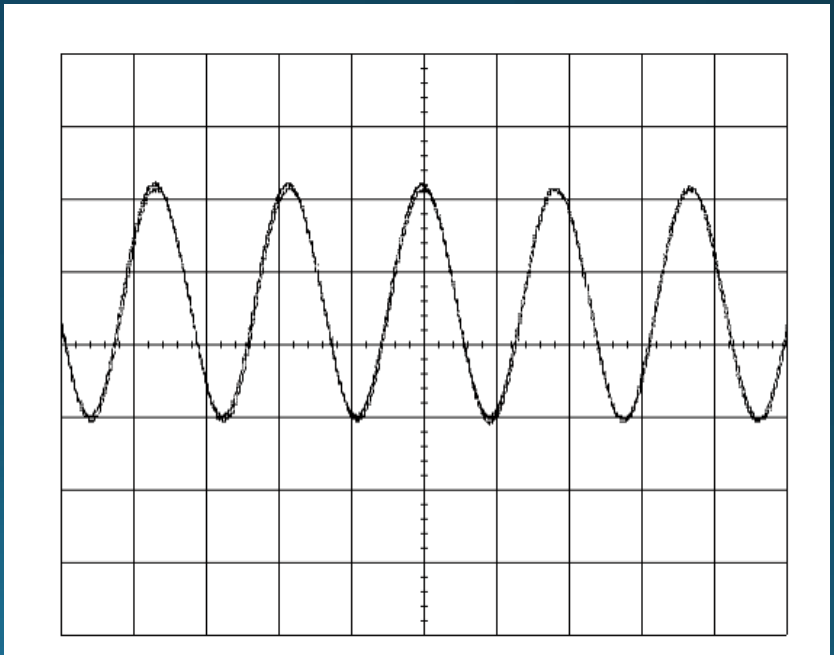

Figure 3: V-Φ Behavior of SQUID[2]

What is a Flux Locked Loop?

- External coil cancels flux
- Slope is error of cancellation

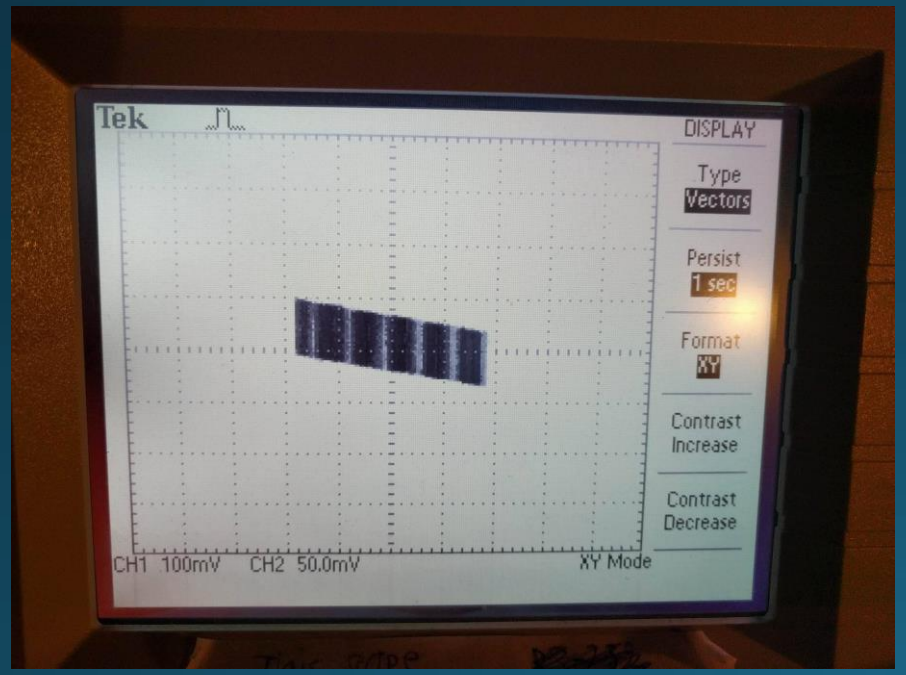

Figure 4: Flux Locked Loop on oscilloscope

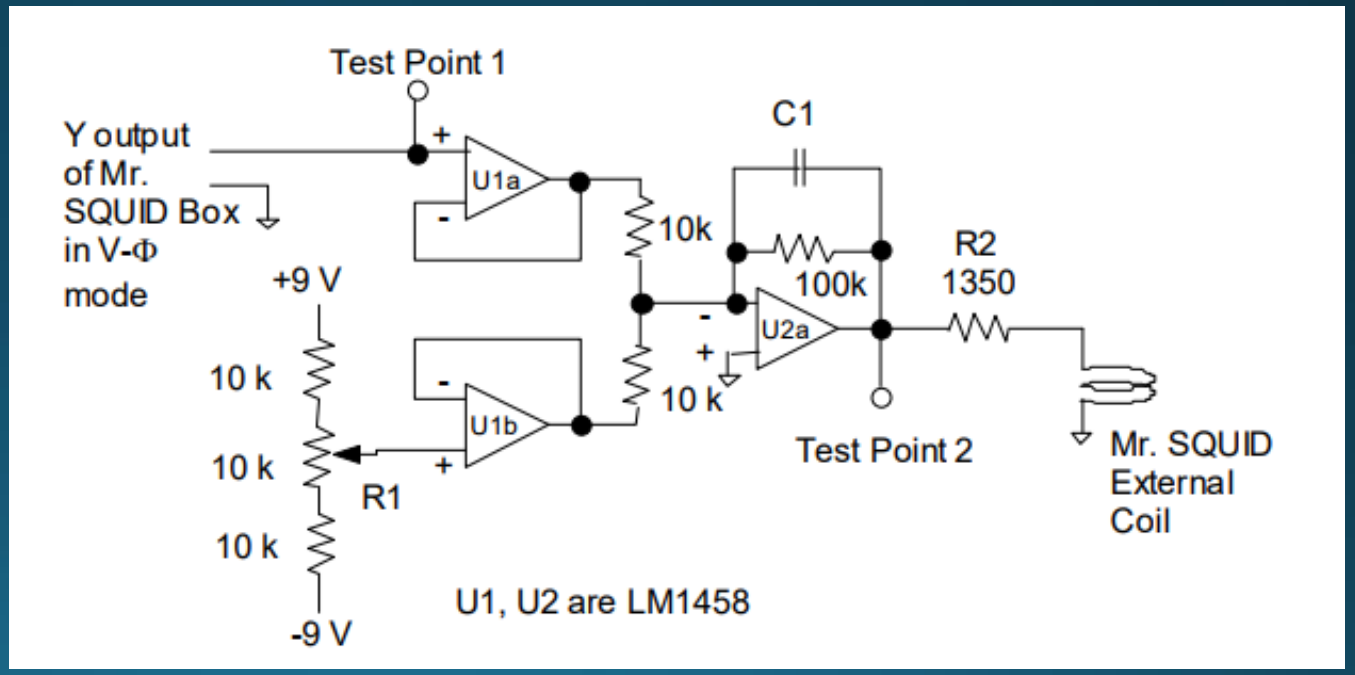

Figure 5: Flux Locked Loop Circuit[2]

Our Results

- Successfully flux locked loop
- First reading $39 \pm 4\%$
- Got locking error down to $14 \pm 4\%$

Errors and Future Improvements

- Improving Circuit
  - Capacitance
  - Op Amp Gain
- Reducing Flux Trapping
- Degaussing Mu Metal Shield
- Use as fine Voltmeter

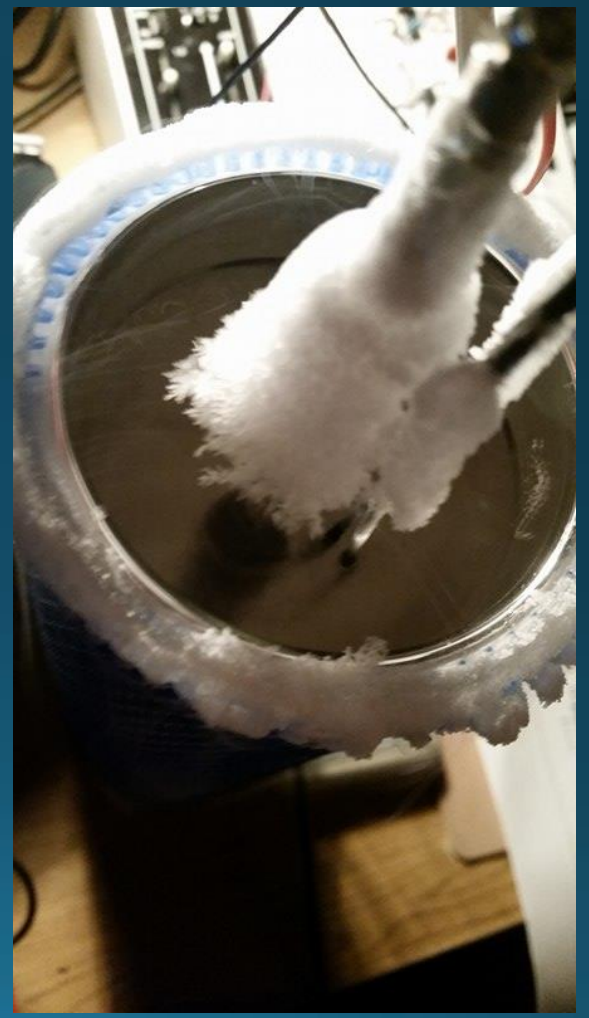

Figure 6: Inside Dewar

Acknowledgments

I would like to express gratitude to my wonderful partner Nate Avish as well as the senior scientists Dan, Situ, Duan, and Prof. Sulak at the AdLab in Boston University

1. C. Jaklevic; J. Lambe; A. H. Silver & J. E. Mercereau (1964). "Quantum Interference Effects in Josephson Tunneling". Physical Review Letters. 12 (7): 159160

2. Simon, Randy W, et al. *MR. SQUID User's Guide*. STAR Cryoelectronic, 2000.

Wrap Up

- SQUID is a high temperature superconducting device sensitive to magnetic flux
- Implemented circuit to flux lock our SQUID loop and use as sensitive magnetometer
- In the future can be used as a sensitive voltmeter