Development of a superconducting thin-film Nb-coil:

for use in the miniGRAIL transducers

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Overview

Transducer design

Theory

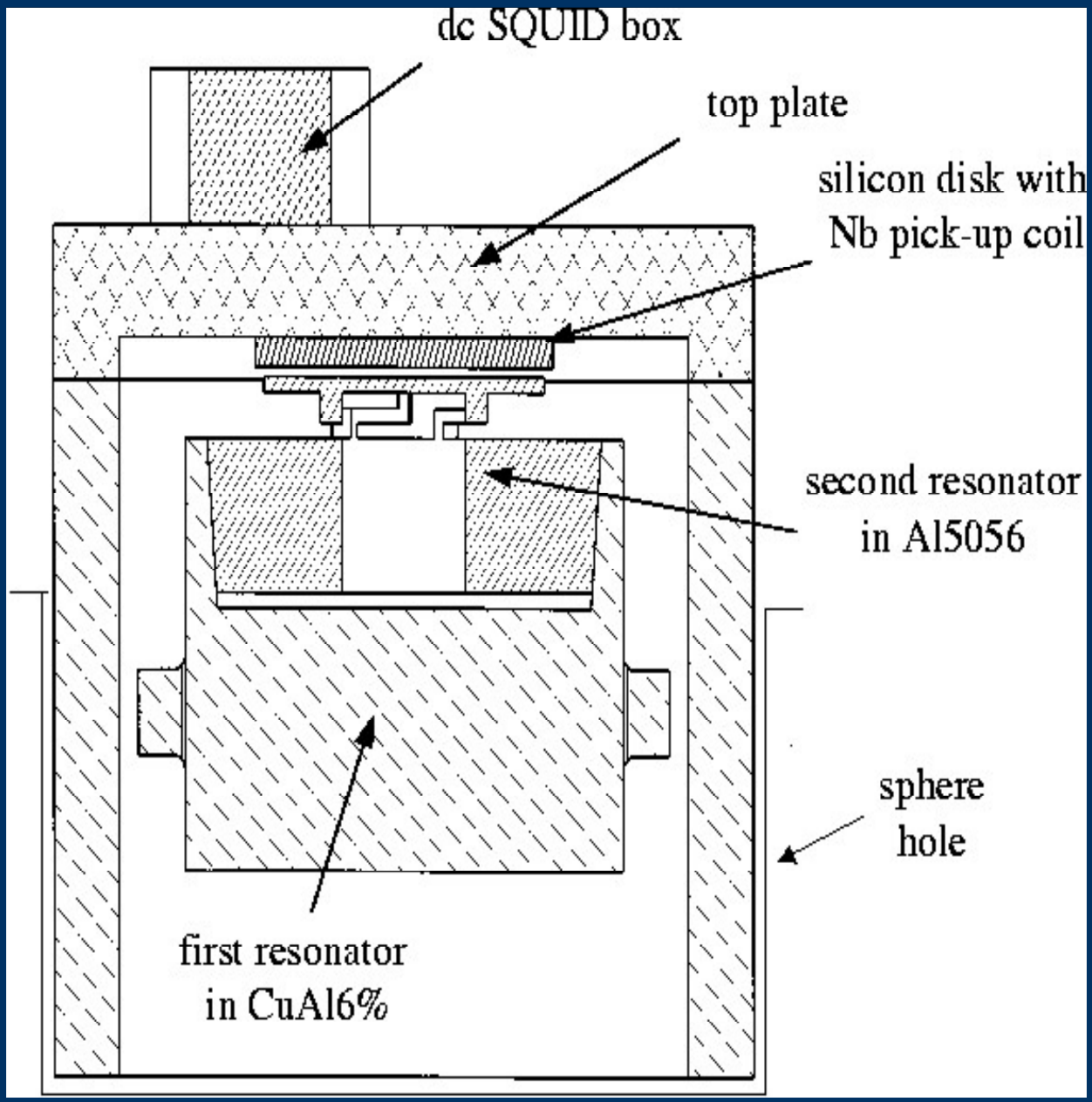
Design

Measurements

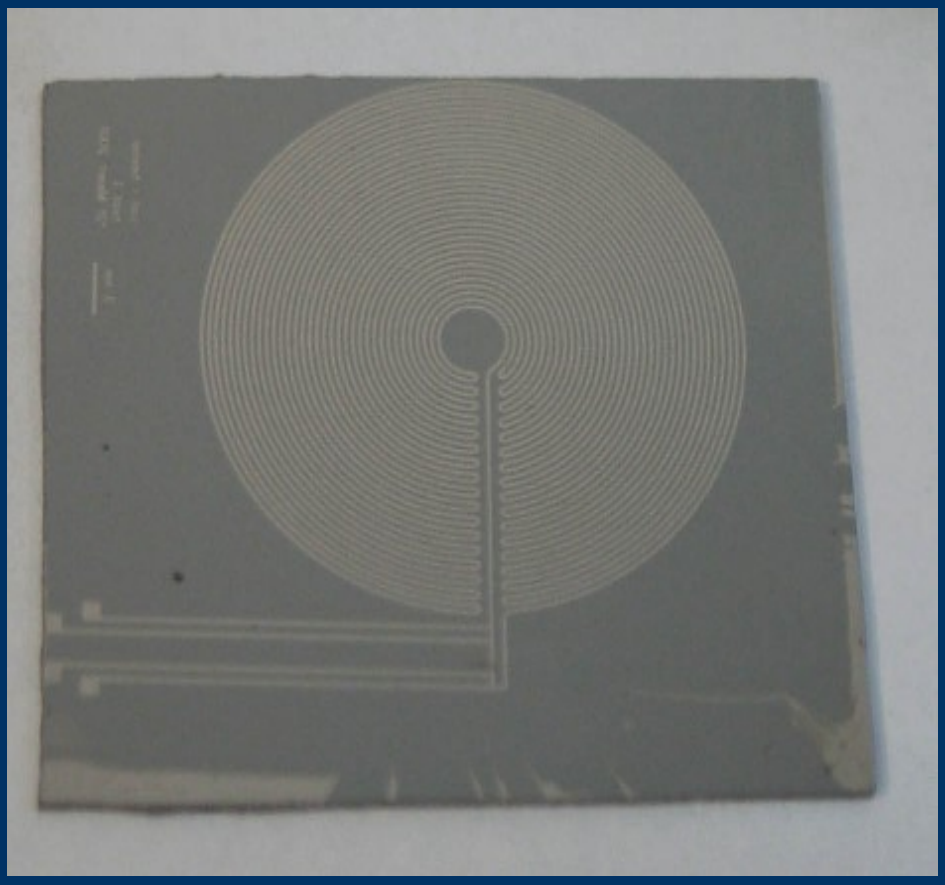
Future experiments

Conclusion

Transducer design



Transducer design



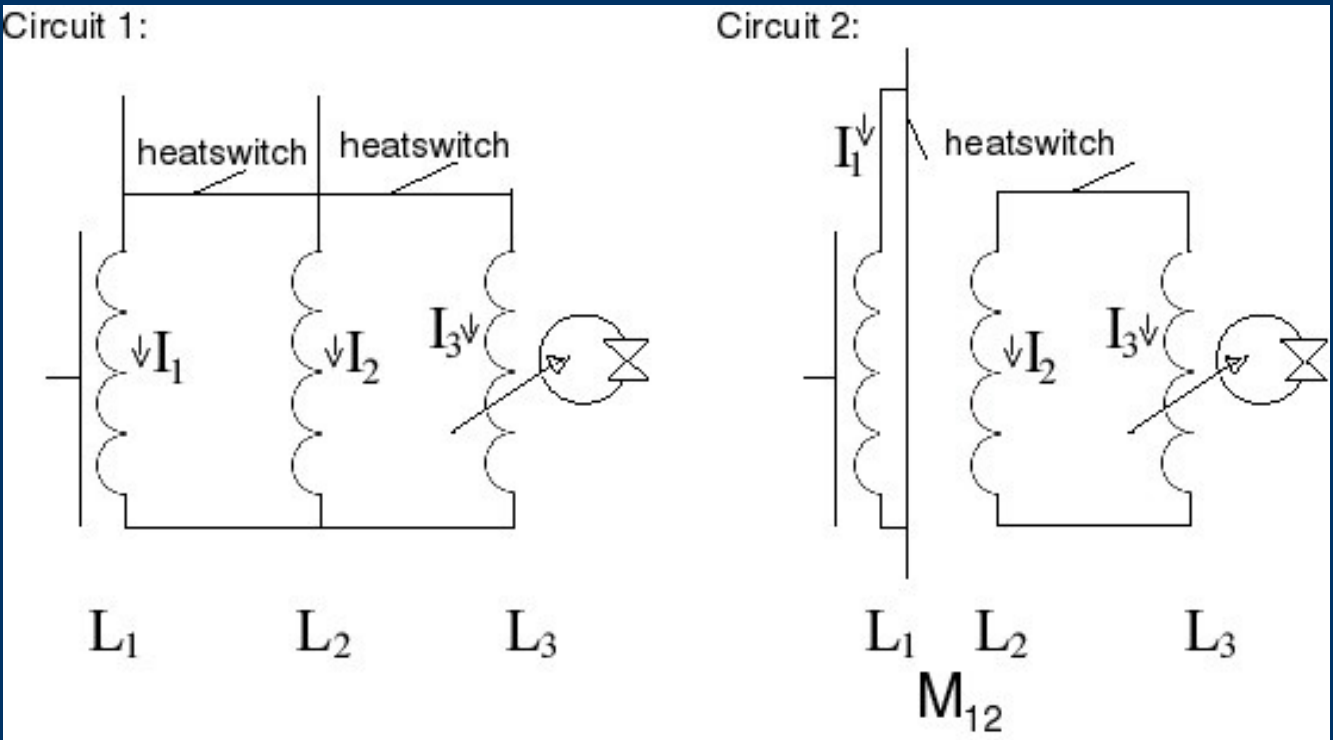
Theory

Coupling circuit between Coil and Squid

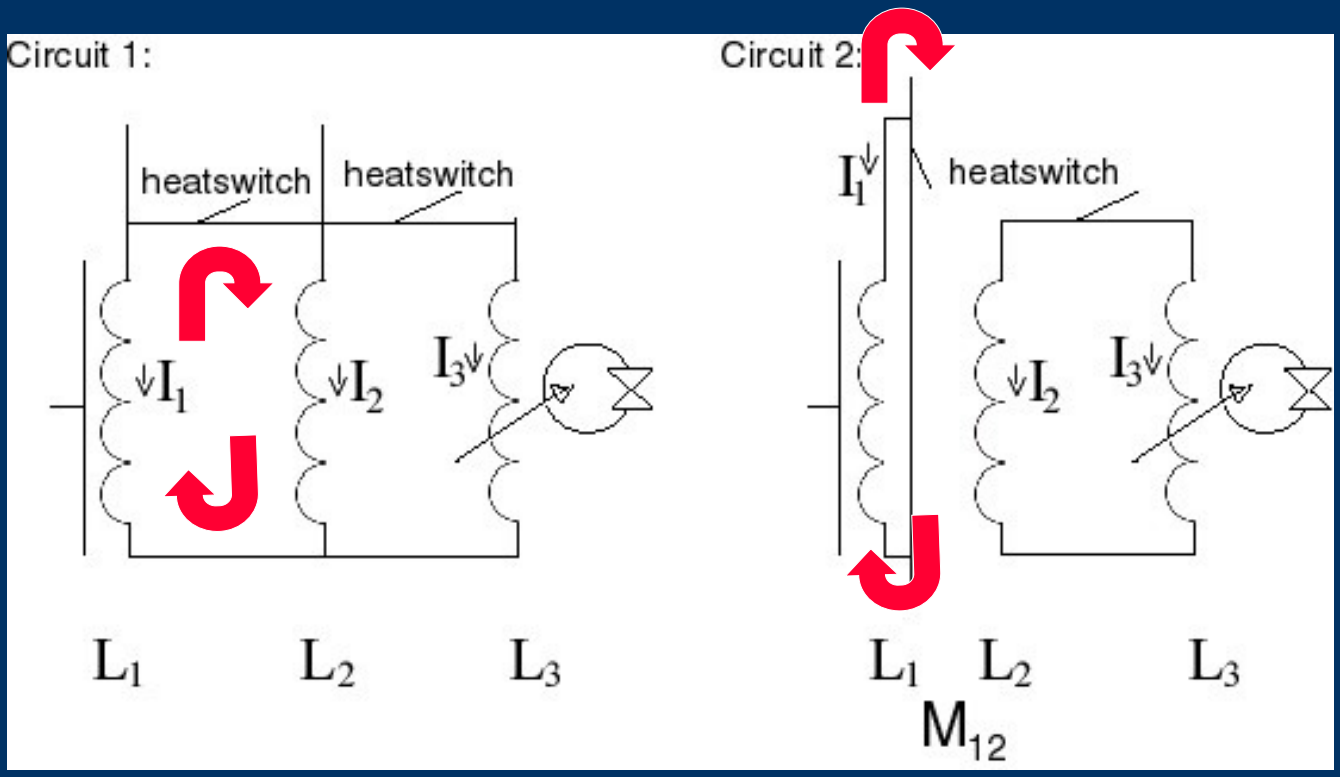
Inductance estimation

Persistent current

Theory


Circuit 1:
heatswitch
heatswitch
I_1
I_2
I_3
L_1
L_2
L_3
Circuit 2:
I_1
heatswitch
I_2
I_3
L_1
L_2
L_3
M_{12}

Theory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L_1
L_2
L_3
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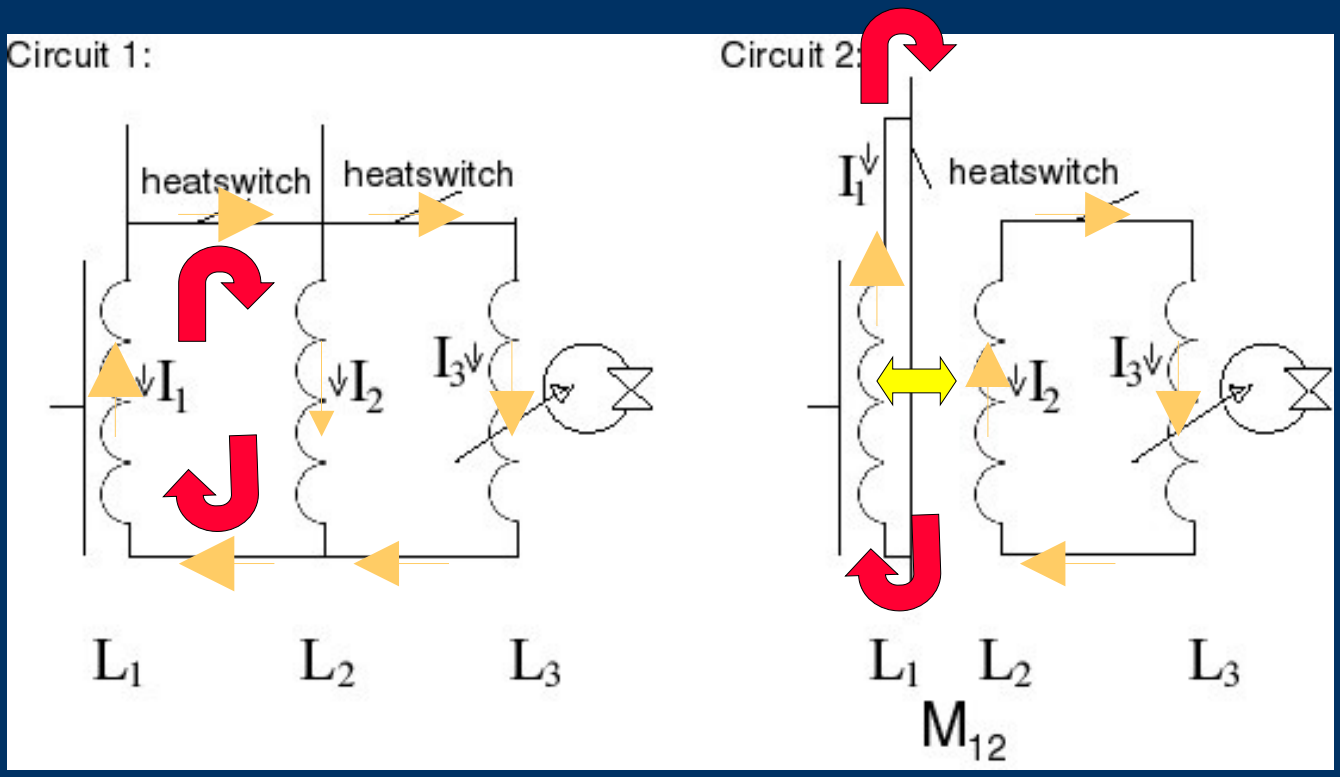
Theory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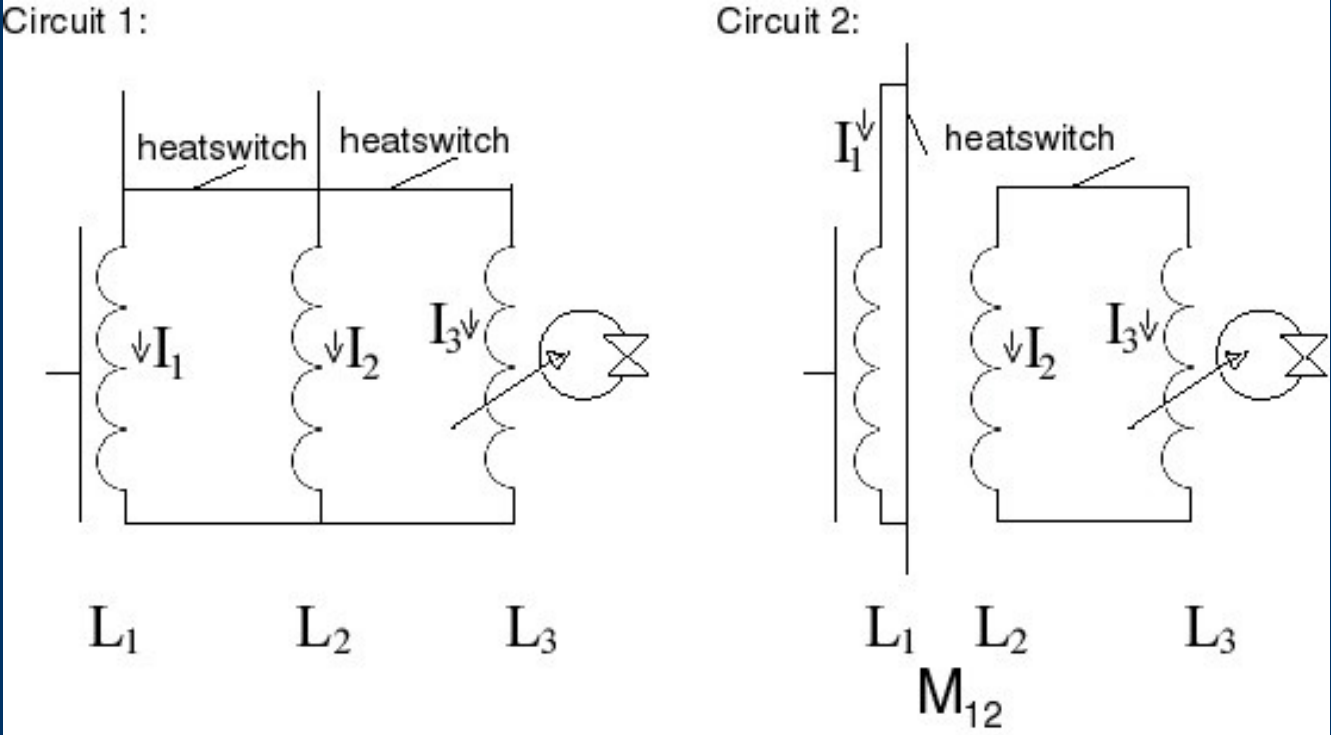
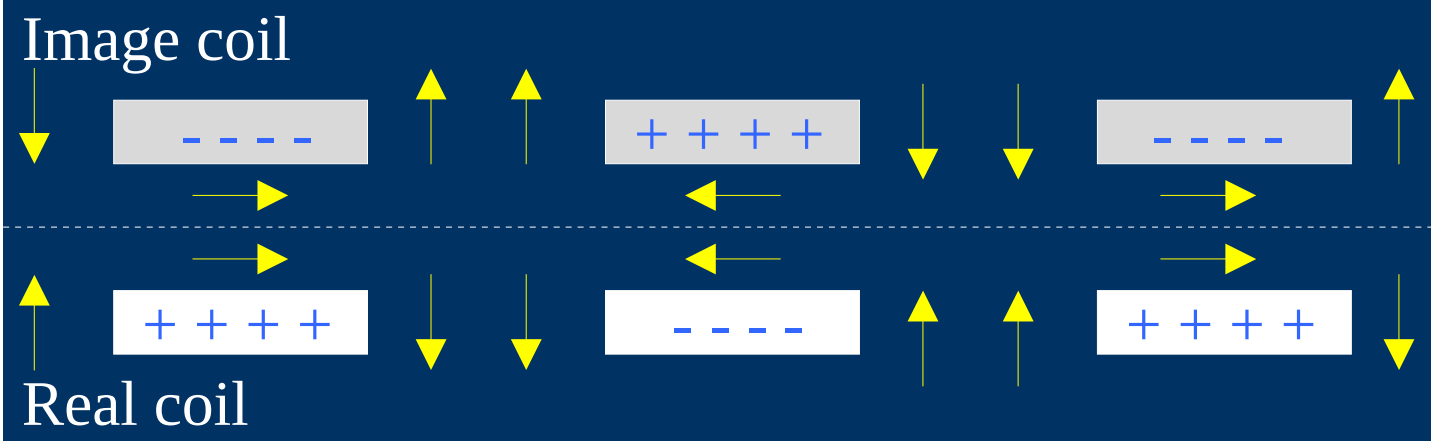


$$I_3 = \frac{L_1 L_2 I_1 \frac{x}{d}}{L_1 L_2 + L_1 L_3 + L_2 L_3} \quad \Leftrightarrow \quad I_3 = \frac{L_1 M_{12} I_1 \frac{x}{d}}{L_1 L_2 + L_1 L_3 + M_{12}^2}$$

Theory



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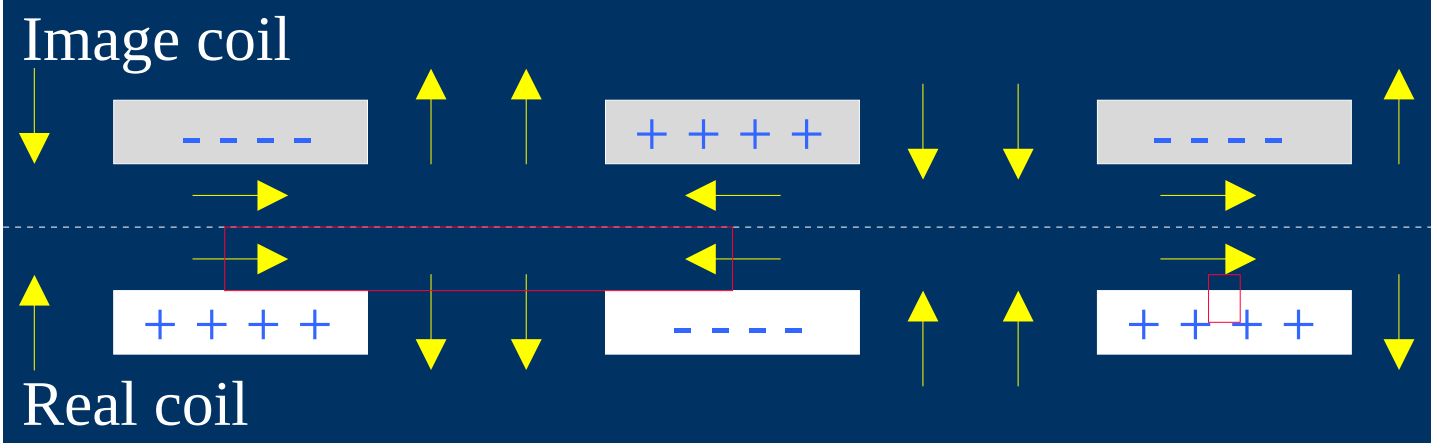
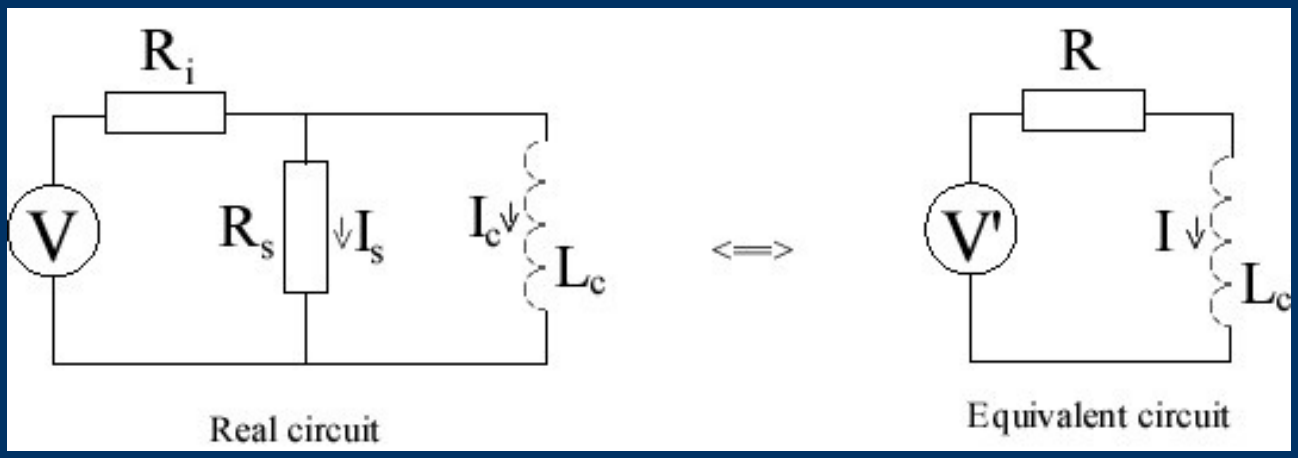


$$\Phi_i = 2\pi B d \left(r_i + r_{i-1} \right)$$

$$L = \frac{\pi \mu_0 d}{w} \left(r_1 N - 3wN + 4w \frac{N}{2} \left[\frac{N}{2} + 1 \right] \right)$$

Theory



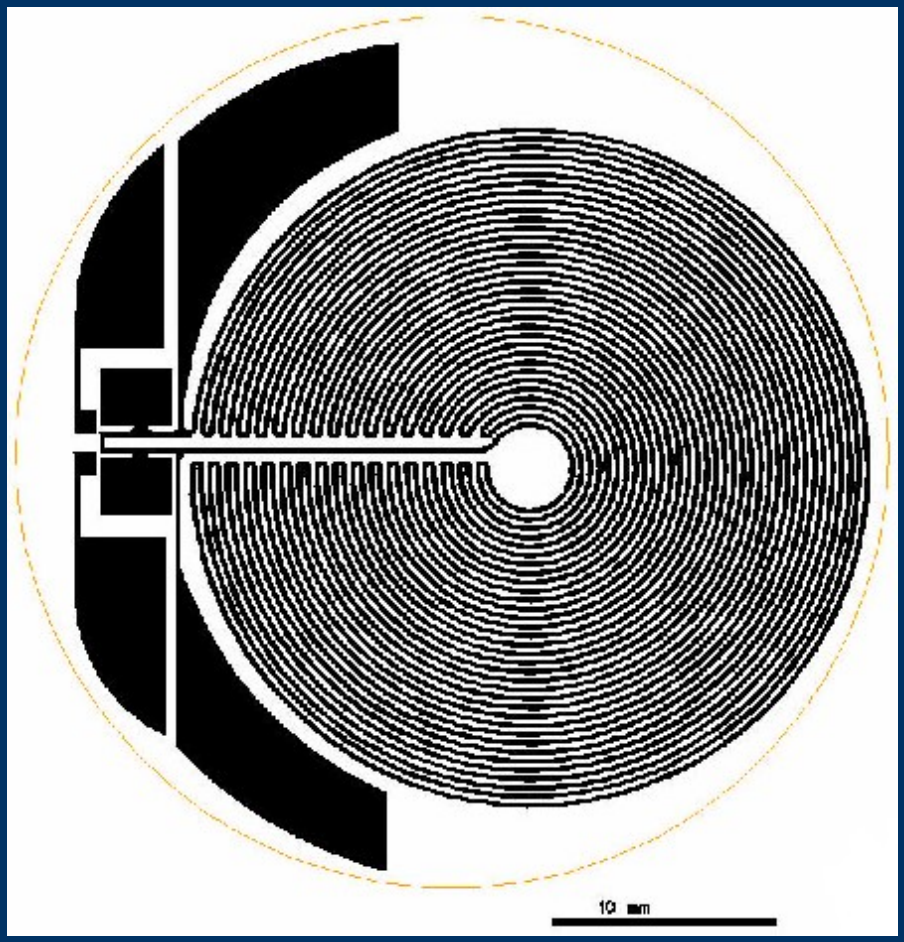
$$R = \frac{R_s R_i}{R_s + R_i}$$

$$V' = \frac{R_s V}{R_s + R_i}$$

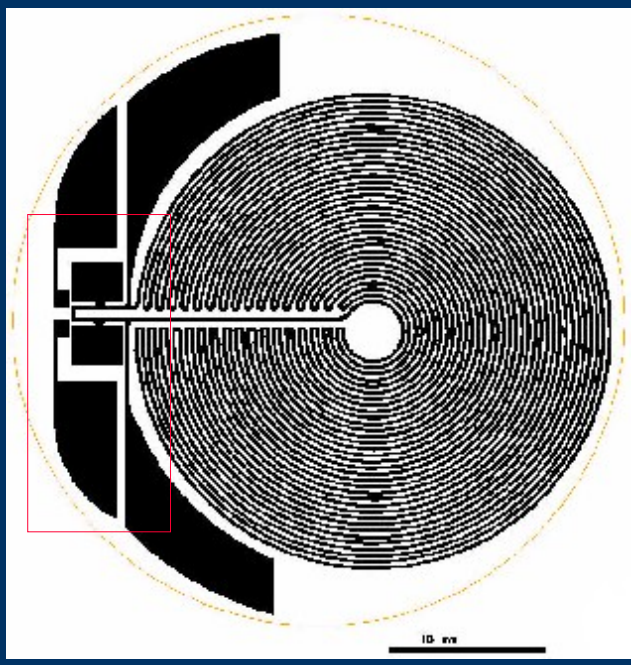
$$I(t) = I_0\left(1 - e^{\frac{t - t_0}{\tau}}\right) \qquad \tau = L\frac{R_0 + R_i}{R_0 R_i}$$

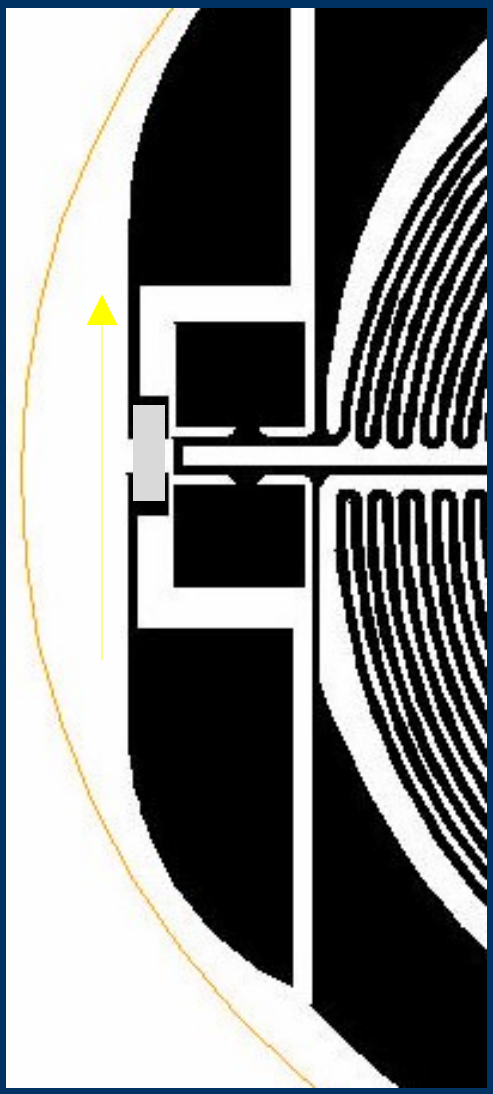
1st coil

Coil made with help from Marcel

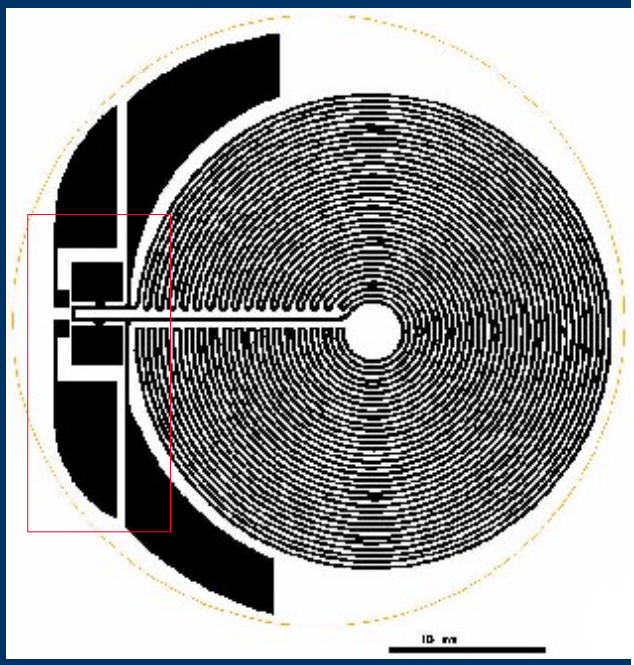


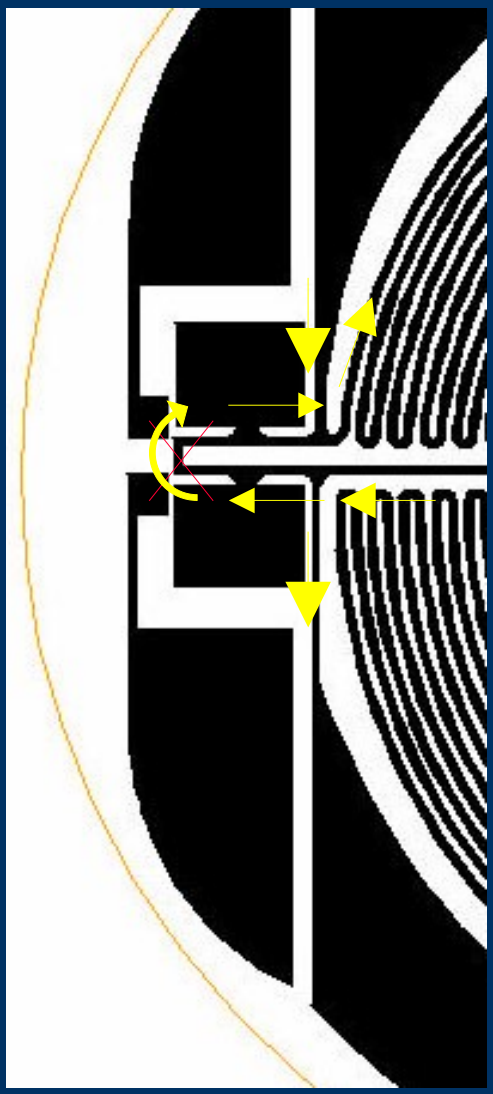
1st coil



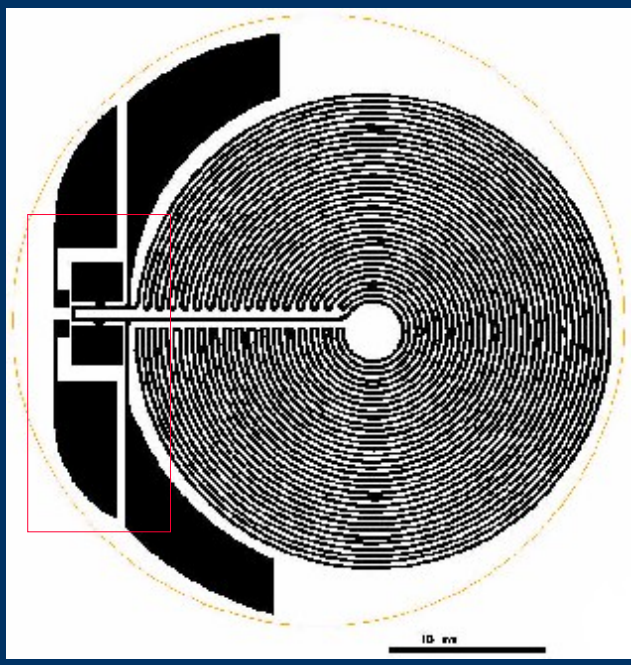


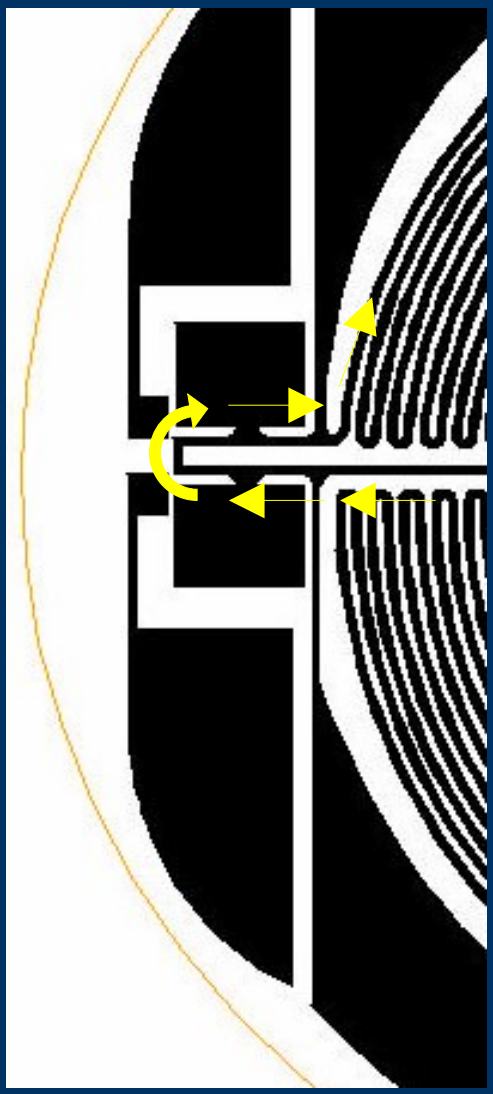
1st coil



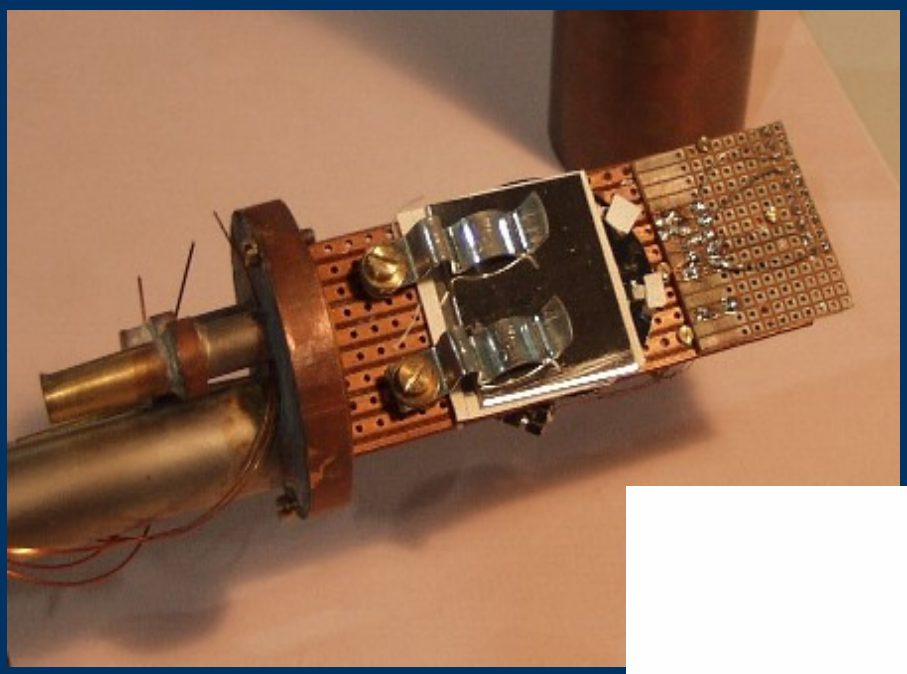


1st coil





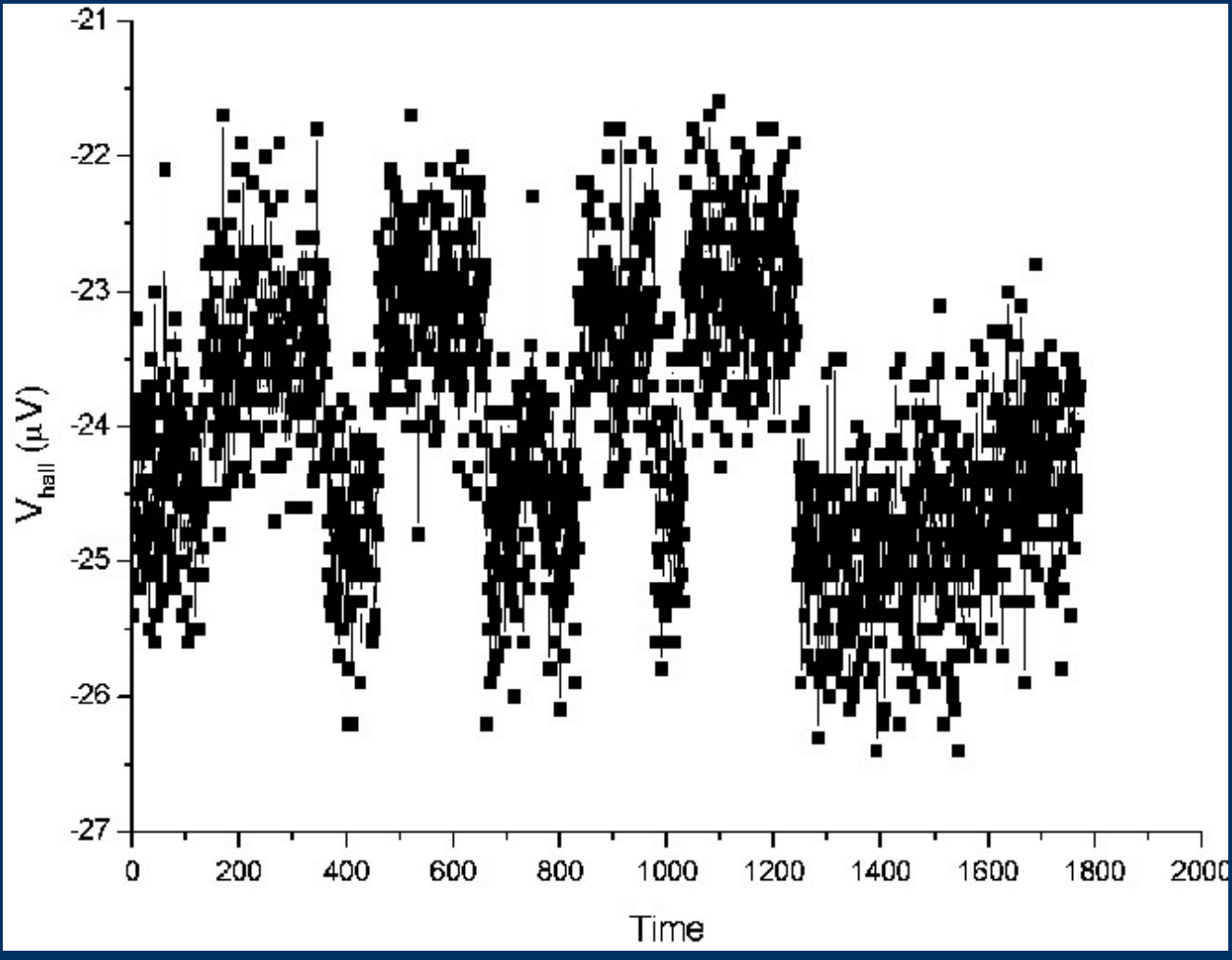
Measurements



Puls-generator with help from Hibbe

Results 1st coil

Output of hallprobe when trapping current



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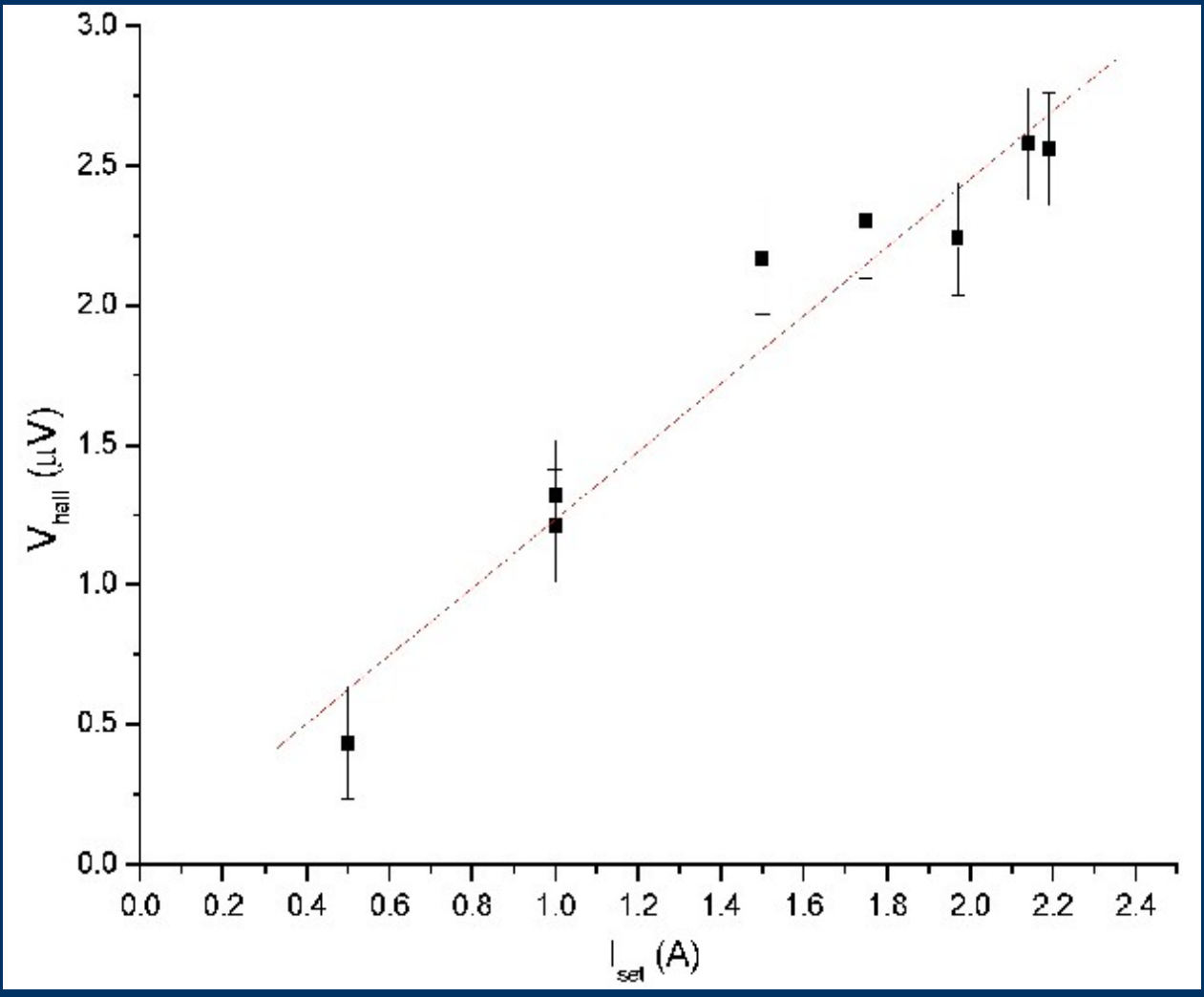

Results 1st coil

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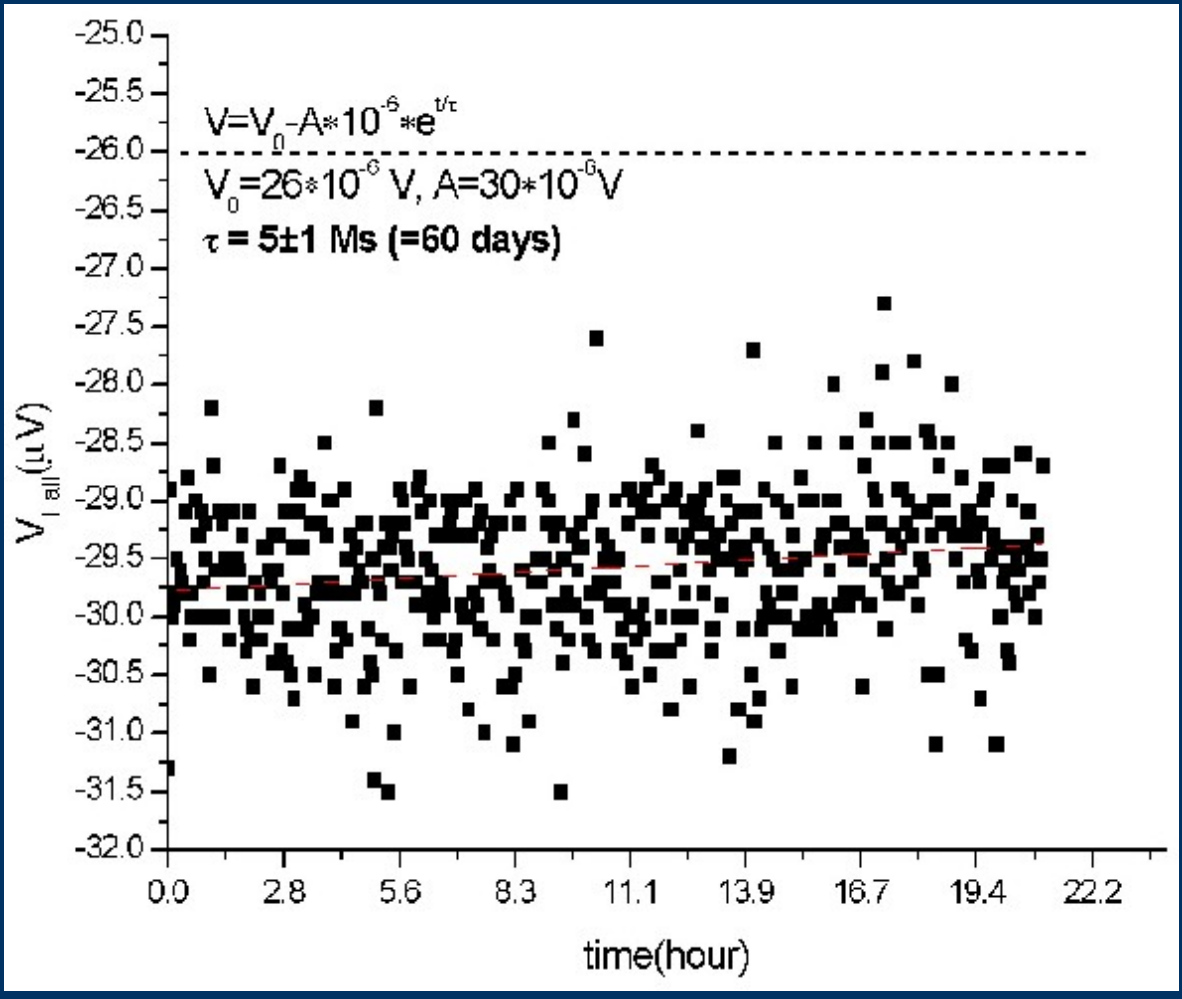
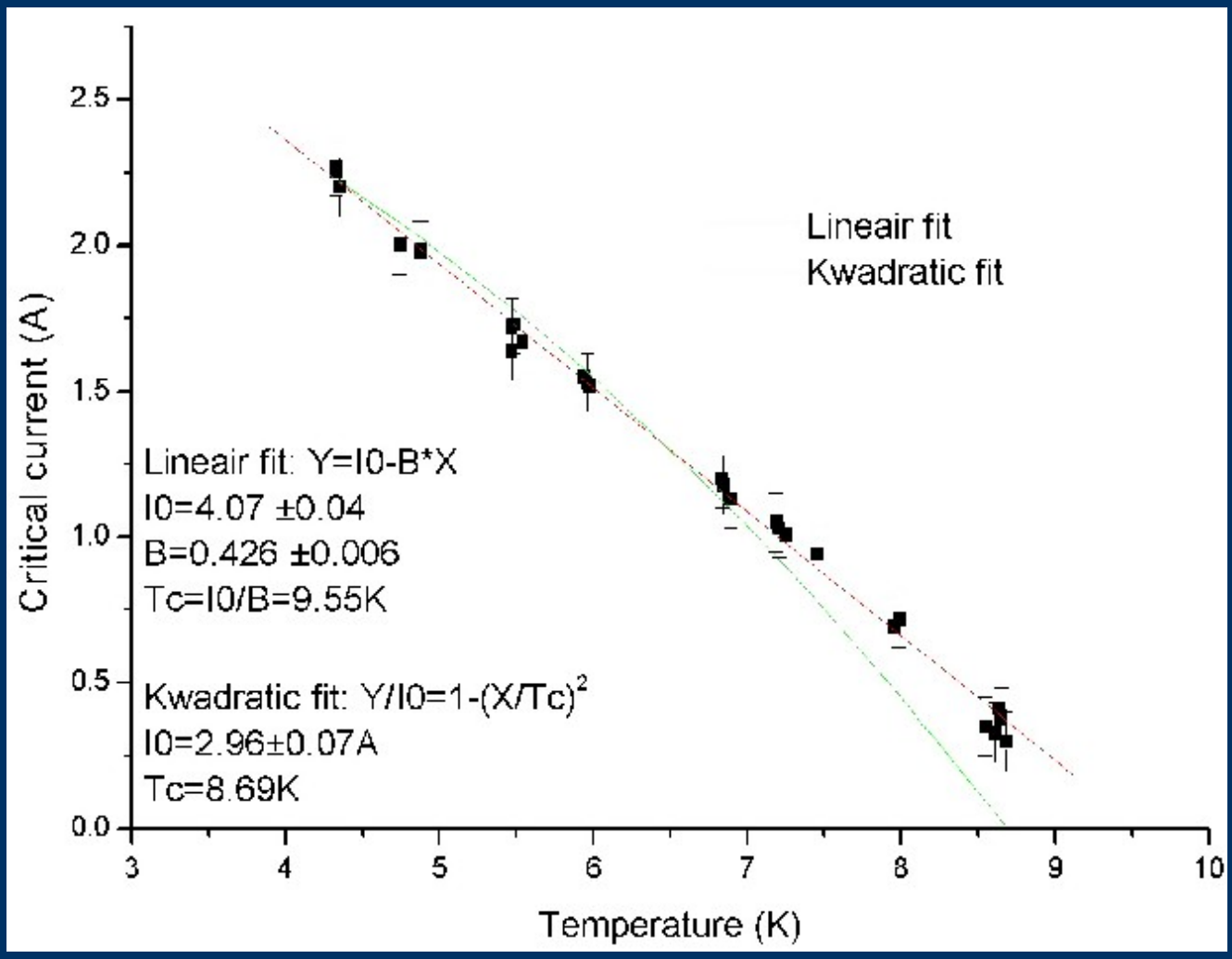
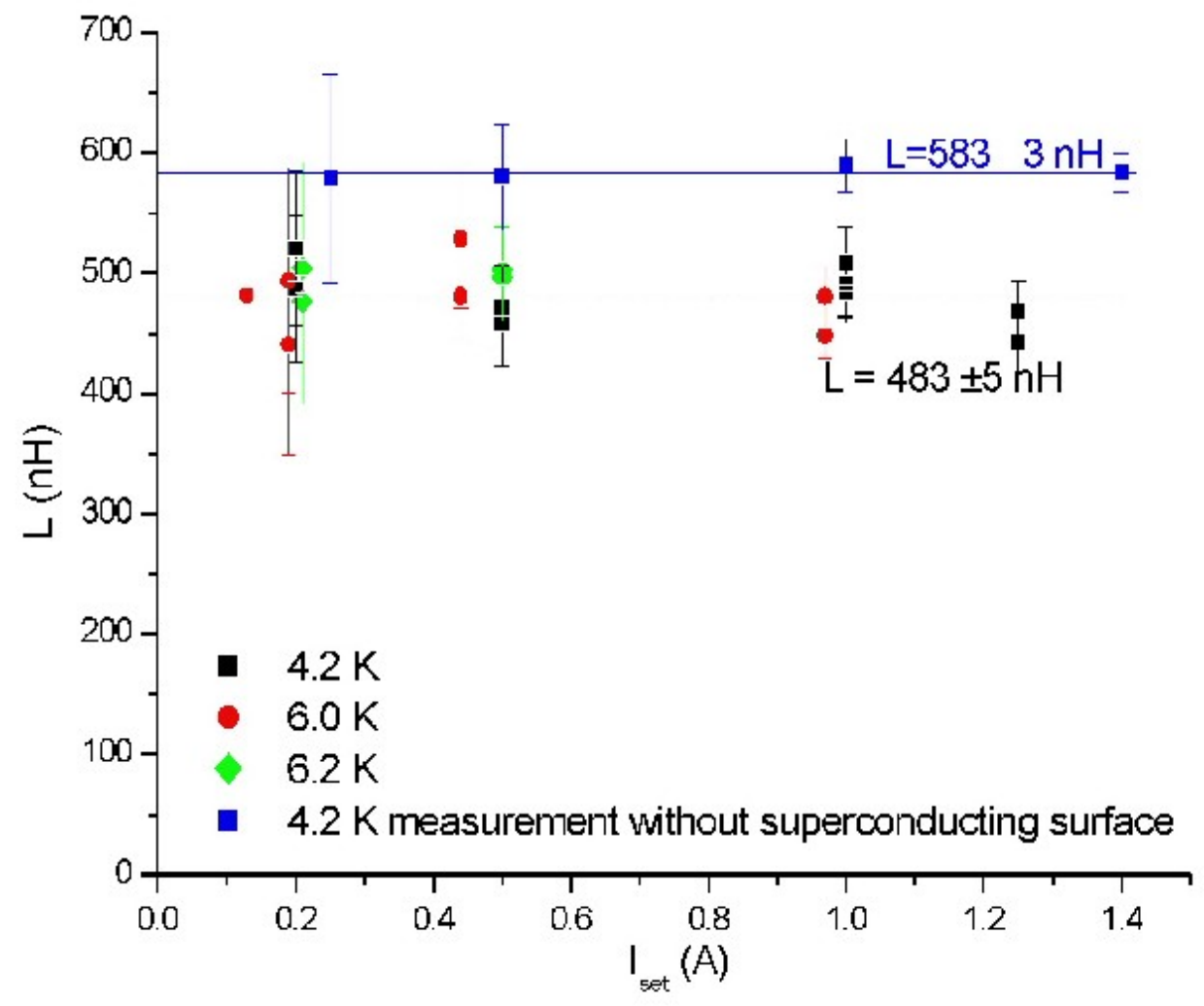


Results 1st coil



Results 1st coil

$$L = \frac{1}{I}\int V_c dt$$



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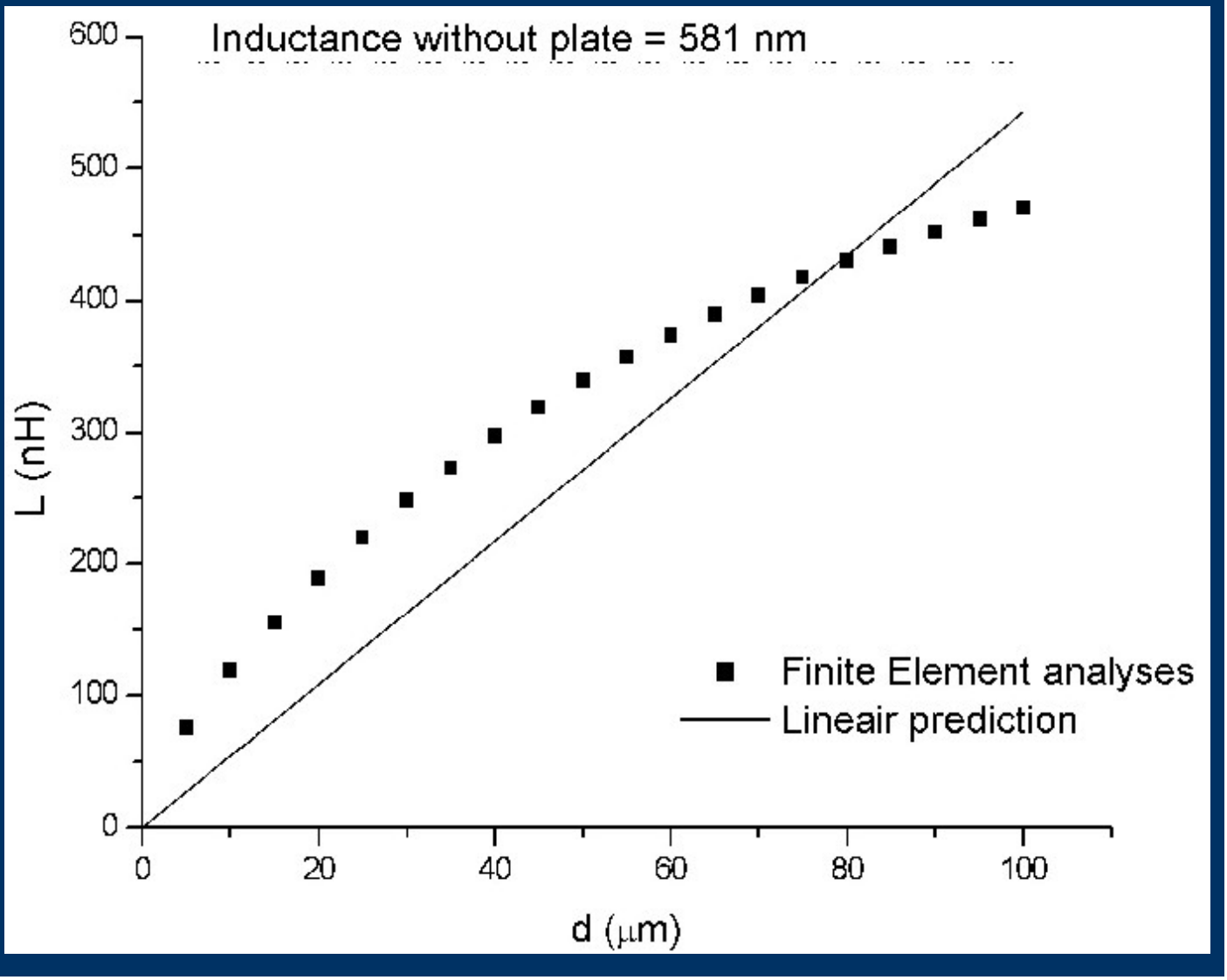

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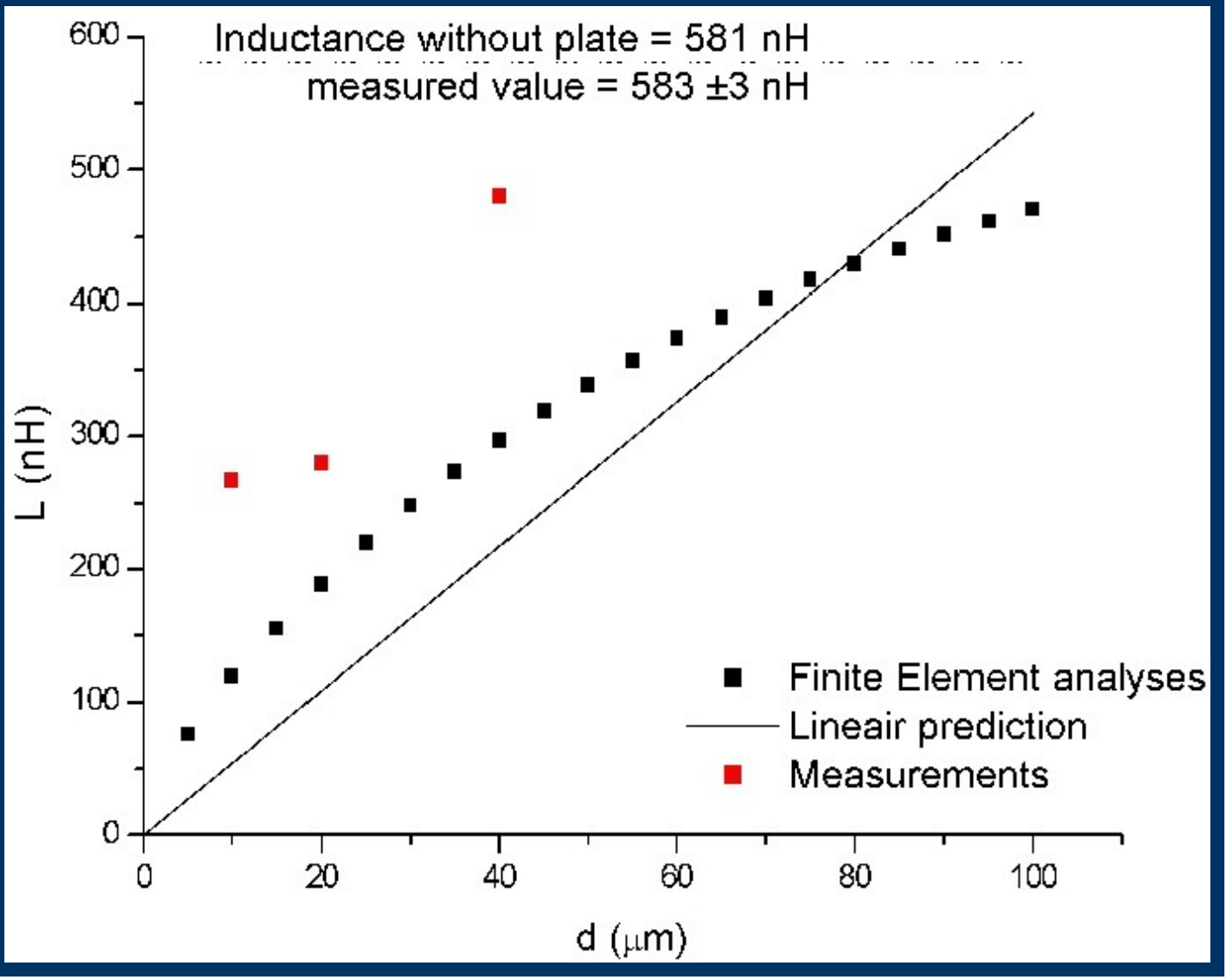
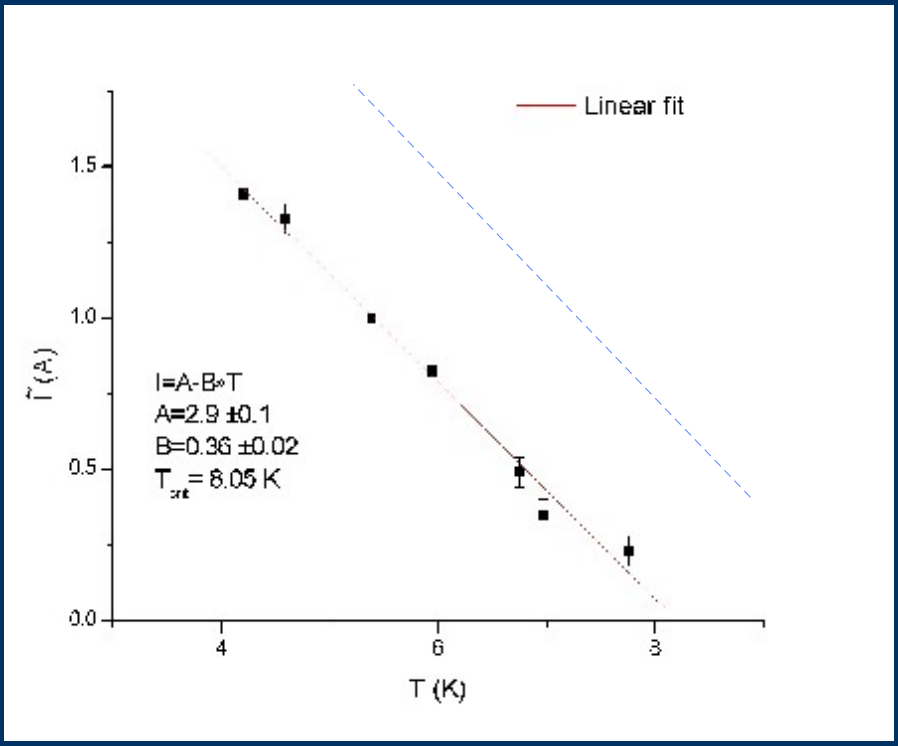
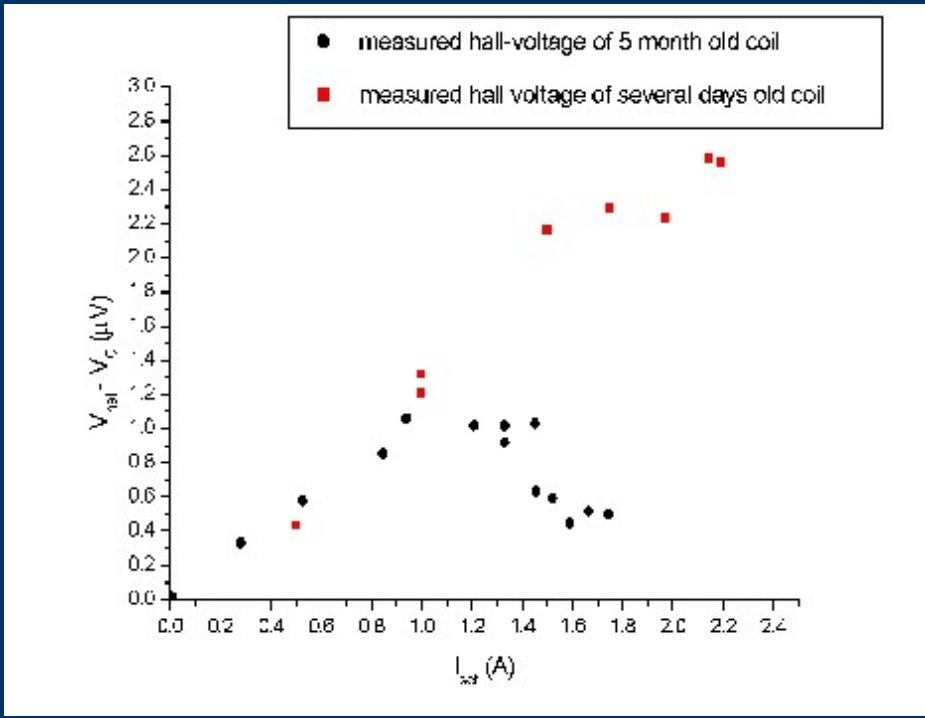
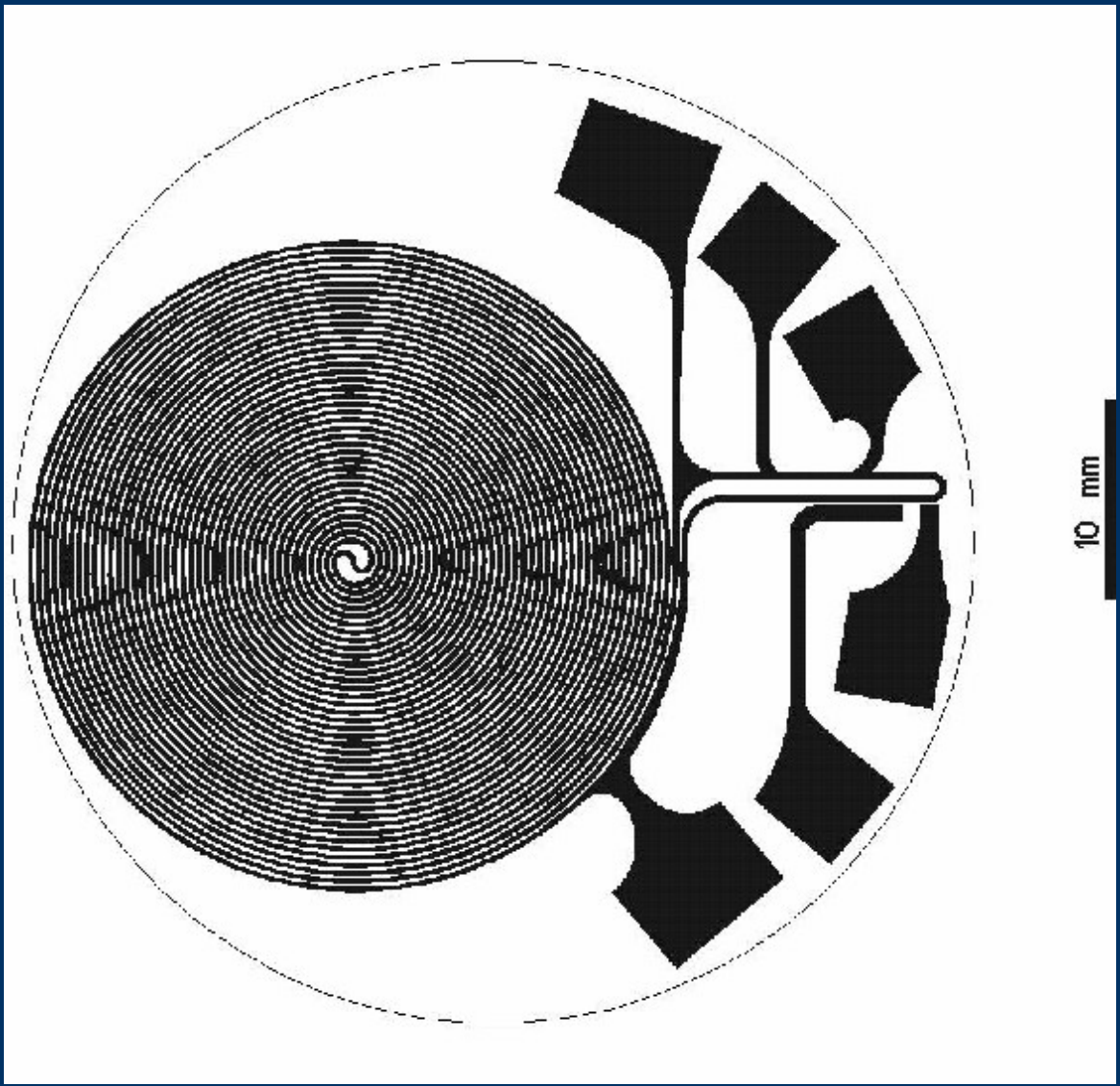


Degredation of 1st coil

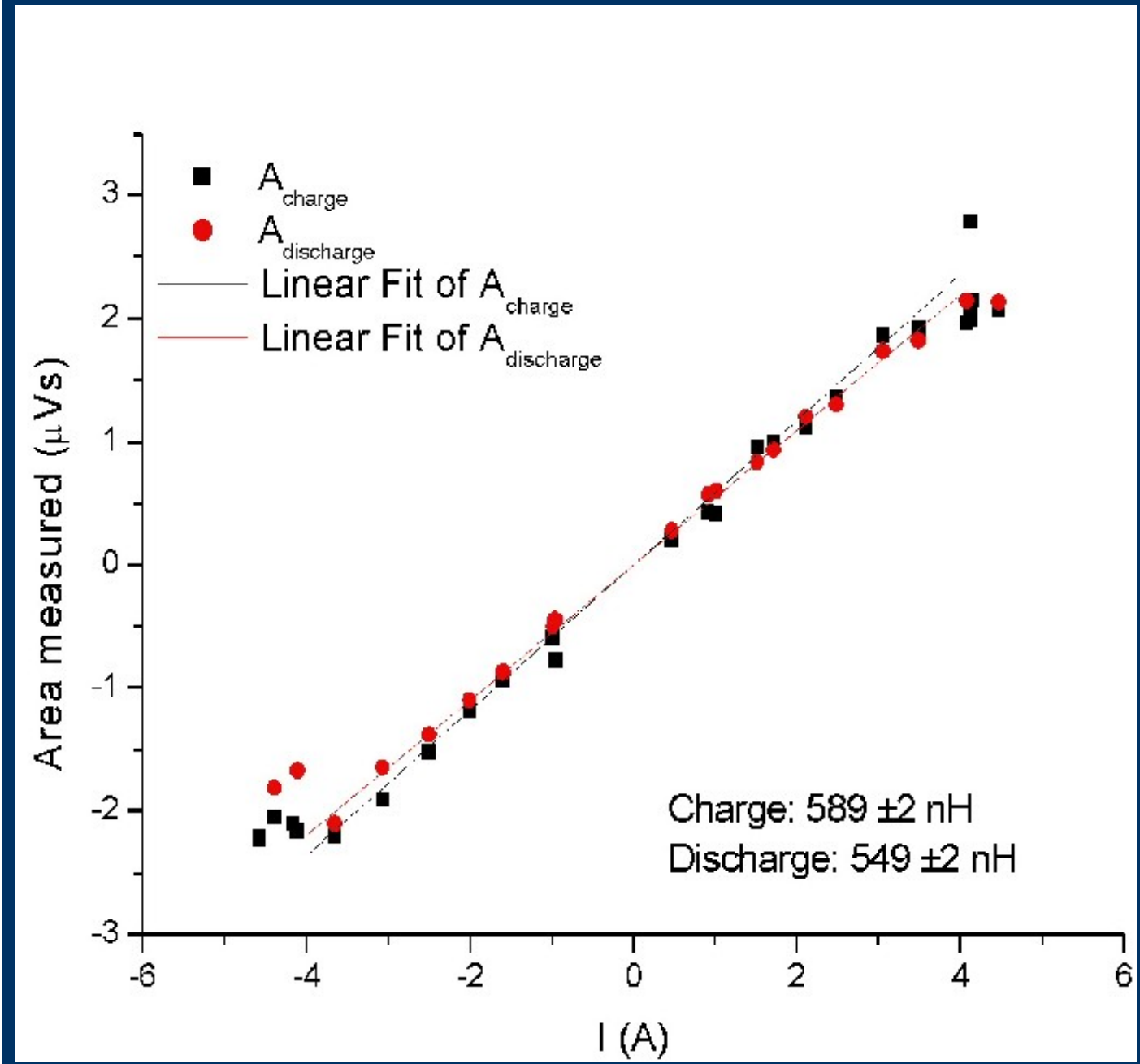




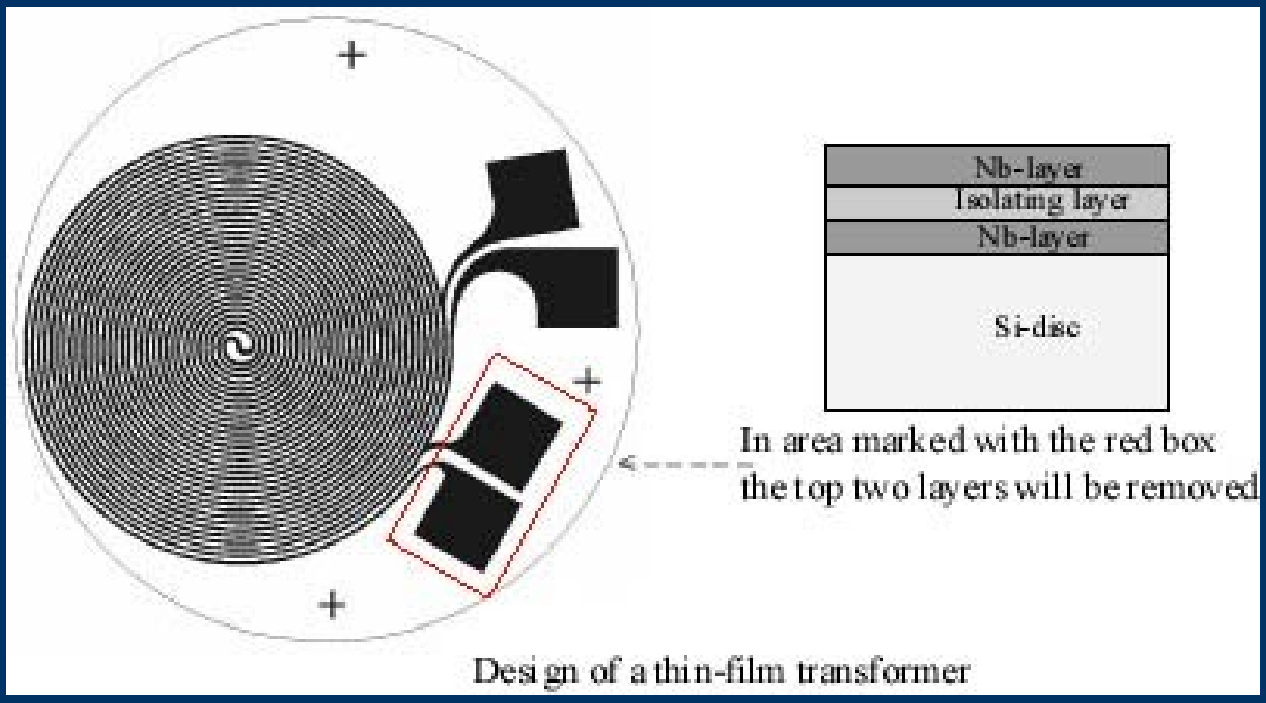
2nd coil



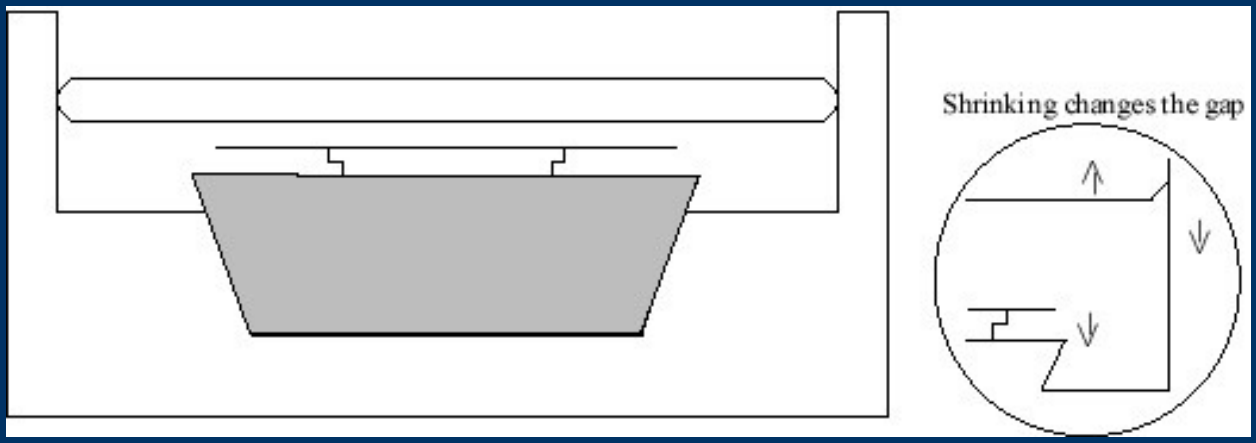
Results 2nd coil



Future



Design of a thin-film transformer



Conclusions

Able to design and manufacture coils capable of a 4A persistent current

Two equally sensitive connection circuits

Tests are designed for gap-creation and mutual-inductance measurement

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