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Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science

Proposal for Thesis Research in Partial Fulfillment
of the Requirements for the Degree of
Masters of Engineering

Title: **Defect Identification in Superconducting 2-Terminal Devices**

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Expected Date of Completion: May 2022

Laboratory: Quantum Nanostructures and Nanofabrication under the Research Laboratory for Electronics

Supervision Agreement:
The program outlined in this proposal is adequate for a Master's thesis. The supplies and facilities required are available, and I am willing to supervise the research and evaluate the thesis report.

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K. K. Berggren, Prof. of Elec. Eng.

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1 Introduction

1.1 Non-linearity in superconducting nanowires

1.2 Nanowire Elements

1.2.1 SNSPDs

1.2.2 SNSPIs

1.2.3 Tapers

1.2.4 hTron

1.3 Problems Simulating Nanowires

2 SPICE

spice-daemon and qnn-spice

2.1 QNN SPICE

2.2 Dynamic Models

E.g. Tapers

2.3 Generating Noise

2.4 Arbitrary S_{xy} models

2.4.1 2-port model

E.g. Tapers!

2.4.2 n-port model

E.g. Bias Tee

2.5 Postprocessing

3 Model Stability

3.1 Stability in F.D.M.

3.1.1 Stabiltiy in LTSpice

3.2 Malicious Circuits

Why? How? (tline timestepping with half res?)

3.2.1 Proof of Equivalence to Stability

3.3 Better nanowire models

3.3.1 Current nanowire model

Layout of in-depth model

3.3.2 S.A. of current nanowire model

3.3.3 Different Integrator

3.3.4 1 Element Models

3.3.5 0 Resistance Models

4 Efficient Simulation

Julia simulator

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4.1.2 Kernel

4.1.3 GPU

4.2 Harmonic Balance

4.2.1 TD Assist

4.3 Device Symmetries

4.4 Coupling Diff. Eq. (or Thermal Model?)

Maybe sections should be separate. Phonon-Electron transport.
Complex electric coupling

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4.4.2 SNSPI coupling

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4.6 ML Optimization

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Note on resistive groups? -¿ Sonnet?

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4.6.5 Monte Carlo Simulation

5 Time Domain Reflectometry

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