Preliminary Thesis Outline

1. Introduction
    (a) Background
        i. 21-cm Basics
        ii. History of the Intergalactic Medium
            A. Cosmic Microwave Background and the Epoch of Recombination
            B. Dark Ages
            C. Cosmic Dawn
            D. Epoch of Reionization
            E. Galaxy Evolution (is there a formal name?)
        iii. Dark Energy and Cosmic Structure
        iv. Intensity Mapping
    (b) Global 21-cm Spectrum
        i. SCI-HI
2. SCI-HI System Development
    (a) Antenna
        i. Design Considerations
        ii. Simulation
        iii. Scale Model Testing
        iv. Antenna Pattern and Impedence
        v. Construction
        vi. Portability and Travel
    (b) Electronics
        i. Calibration Switch
        ii. Amplifiers
        iii. Impedence and Efficiency
        iv. Filters and Attenuation
    (c) Data Processing (aka Computer)
        i. ADC (sampling, integration, etc)
        ii. Power (AC vs DC, Consumption and Heating)
        iii. Noise Generation
        iv. Faraday Cage

3. Radio Frequency Interference (RFI) and Site Testing
    (a) Overview
    (b) Site Evaluations
        i. Pittsburgh
        ii. Zona del Silencio
        iii. Algonquin
        iv. Green Bank, West Virginia
    (c) Isla Guadalupe
        i. Site evaluation (aka summit vs fishing village)
        ii. Logistical Challenges
        iii. Weather Impacts (both to experiment and to expeditions)
        iv. Measurements
    (d) Potential Low RFI Sites
        i. Isla Socorro
        ii. Isla Clarion
        iii. South Africa (Marion and Gough Islands)
4. SCI-HI Data Processing
    (a) Pre-calibration Processing
        i. Integration and Sampling
        ii. RFI
            A. Ionospheric effects
            B. FM band
            C. AM band
            D. Time variability
            E. Local RFI (aka village generator, spark plugs for trucks, etc.)
    (b) Calibration
        i. Calibration Datasets
        ii. Impedence and Efficiency
        iii. Milky Way Galaxy (GSM) Modelling
        iv. Calibration Factor (K)
            A. Johnson Noise Calibration
            B. Daily Variance and GSM Modelling
            C. GSM Calibration

D. ΔGSM Calibration
v. 21-cm Signal Loss and Calibration
(c) Foreground Removal
i. Polynomial Fitting
ii. Residuals
iii. Frequency Limitations
5. Current Results and Future Plans
(a) Current Dataset and Future Deployments of SCI-HI
(b) Expansion with South Africa