Preliminary Thesis Outline

1. Introduction
    (a) 21-cm Basics
    (b) History of the Intergalactic Medium
        i. Cosmic Microwave Background and the Epoch of Recombination
        ii. Dark Ages
        iii. Cosmic Dawn
        iv. Epoch of Reionization
        v. Galaxy Evolution (is there a formal name?)
    (c) Global 21-cm Spectrum
    (d) 21-cm Spatial Structure and Intensity Mapping
2. Teaching 21-cm Cosmology to the Public
    (a) Overview
    (b) Storyboard and Script
        i. Introduction
        ii. 21-cm Science
        iii. Radio Telescopes
        iv. Green Bank Telescope and Intensity Mapping
        v. CHIME Telescope
        vi. Science Goals
    (c) On-site Filming
    (d) Working in the Planetarium Environment
    (e) Audio Production
    (f) Feedback and Evaluation
3. 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

4. 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)

5. 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

6. Current Results and Future Plans

(a) Current Dataset and Future Deployments of SCI-HI
(b) Expansion with South Africa