

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. 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. Δ GSM 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