HU Radio Telescope

Bison Enterprises, Inc.,

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Presented By

Jarrett Goddard & Marlon Smith

Bison Enterprises' Team Members

Graduate Manager — Richard Farrell

Senior Team — Jarrett Goddard

Senior Team — Marlon Smith

Assistant Team — Erik Cooper

Assistant Team — Shaleen Shah

Background

Our objective is to build a portable radio telescope based on the designs of the MIT Haystack Radio Telescope. This instrument will allow the measurement of the galactic rotational curve, which will further Howard University's research in Dark Matter.

Problem Statement

Our client, Howard University's Physics Department, requires a portable radio telescope to be created based on the MIT Haystack Radio Telescope to detect radio frequencies emitted by hydrogen atoms at the halo of our galaxy. Our radio telescope's dish must be engineered so that it is small enough to be transported in a mid-size vehicle, or trailer. The size of the dish must still be capable of reflecting the desired signal to its receiver. The radio telescope is further required to operate for at least 24 hours continuously.

Design Requirements

- **Dish -** (Parabolic, Mesh, 2.28M or Less)
- **Dish Mount** - (Motorized, Horizon to Zenith)
- **Low-Noise Amplifier (LNA)**
- **Feed -** (Low Profile Helical)
- **Receiver -** (Tuned to the Freq. of the Hydrogen Line)
- **Personal Computer -** (Data Collection)
  - Software - (Java Platform, Dish Mount Rotor Controller)
  - PC Interface - (GUI)

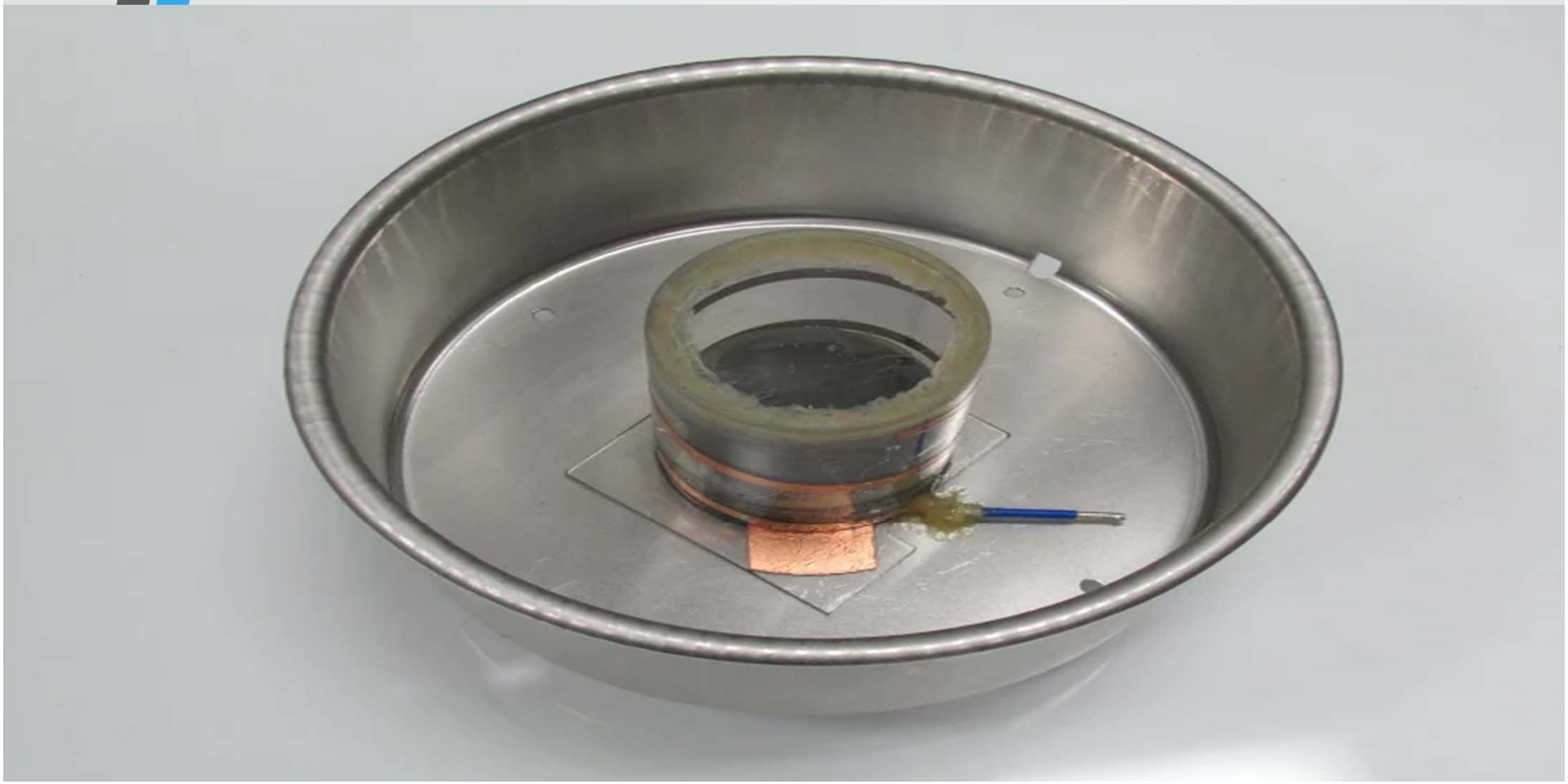
Current Status of Arts

Several versions of MIT's Haystack Radio Telescope is currently in operation at various universities including Massachusetts Institute of Technology and the University of Michigan. These radio telescopes were designed and permanently installed as intended for long-term local use.

Howard University seeks to create its own radio telescope based on MIT's design with some modifications. Howard University seeks to build a portable version of MIT's Haystack Radio Telescope with remote data-collection.

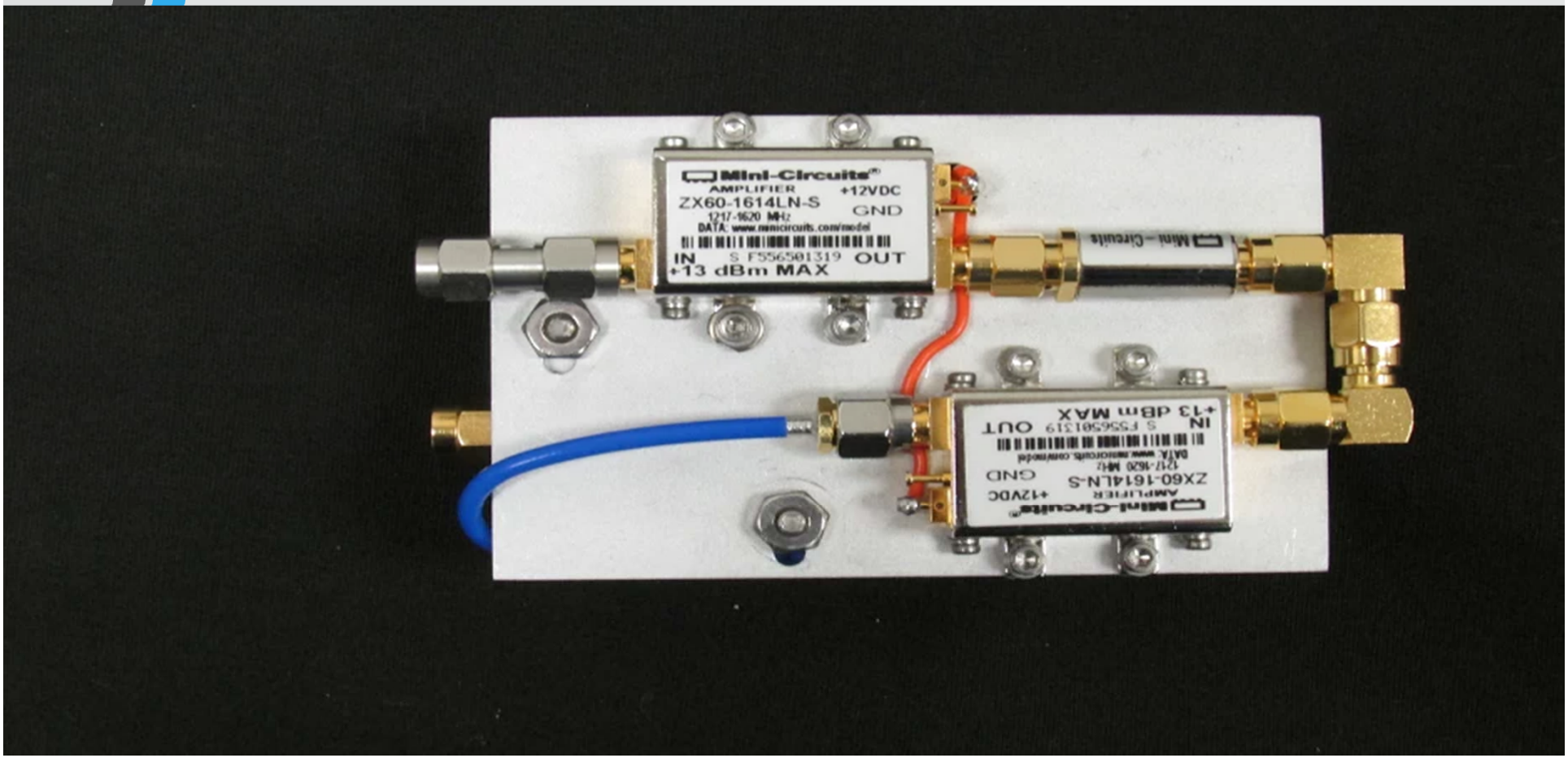
Conceptual Designs

Conceptual Design of Feed

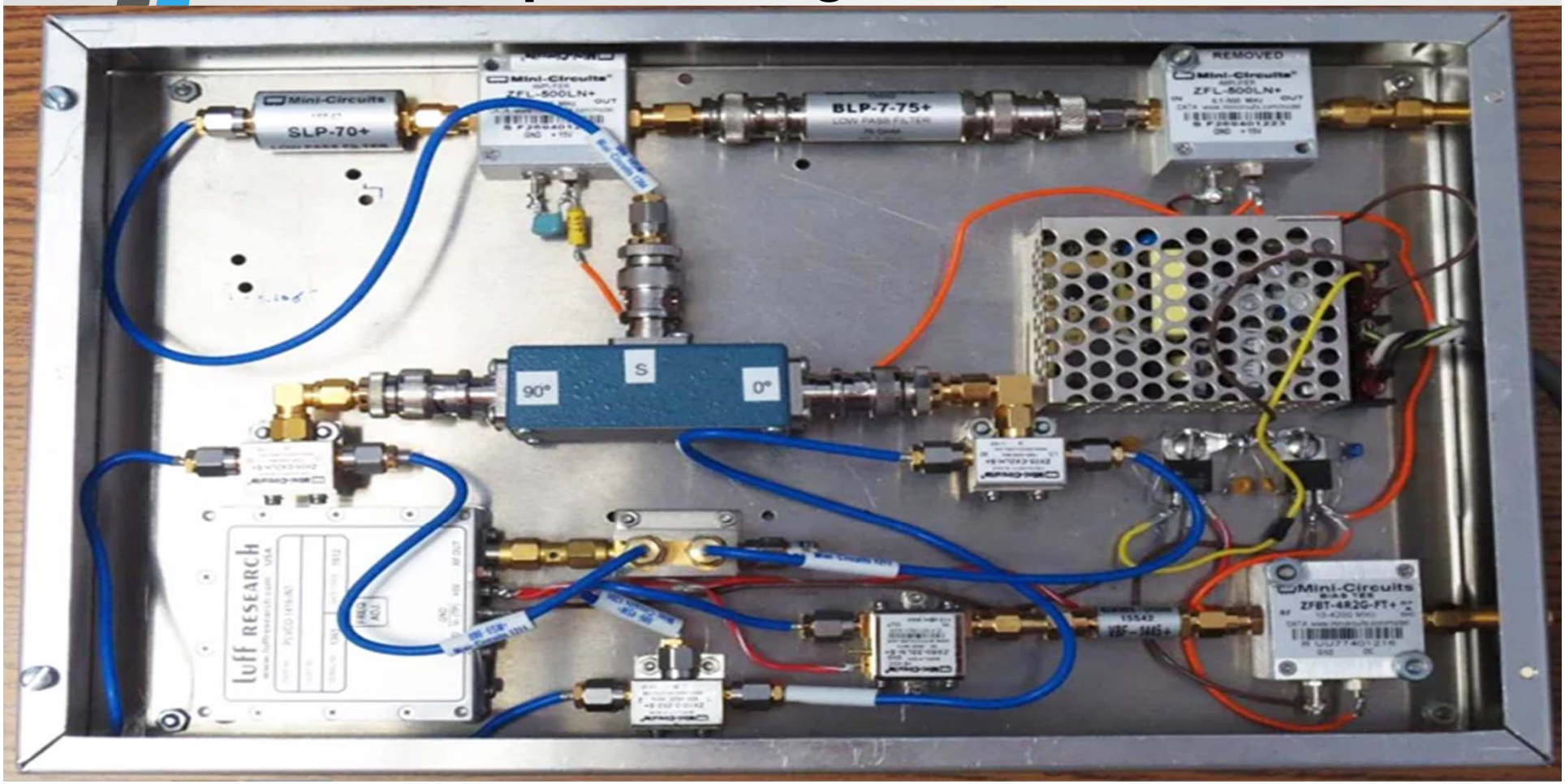


Conceptual Design of Dish & Dish Mount

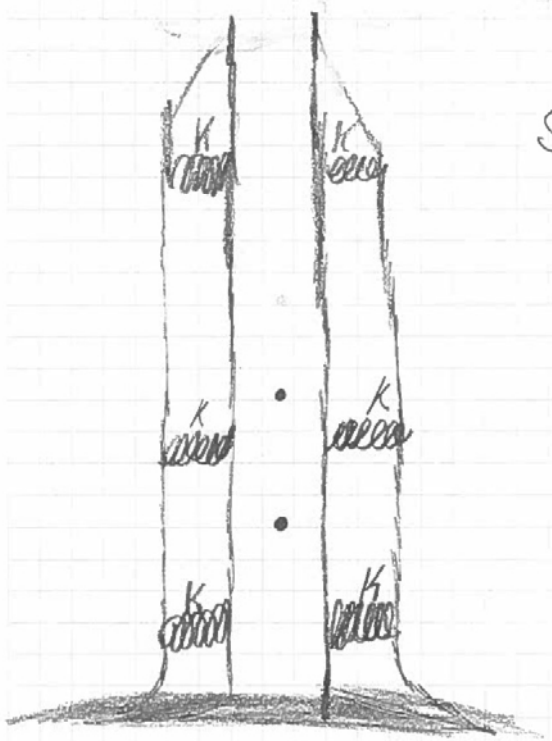
Conceptual Design of Low-Noise Amplifier



Conceptual Design of Receiver

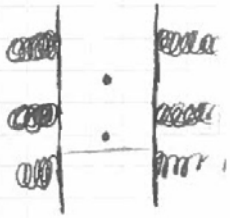


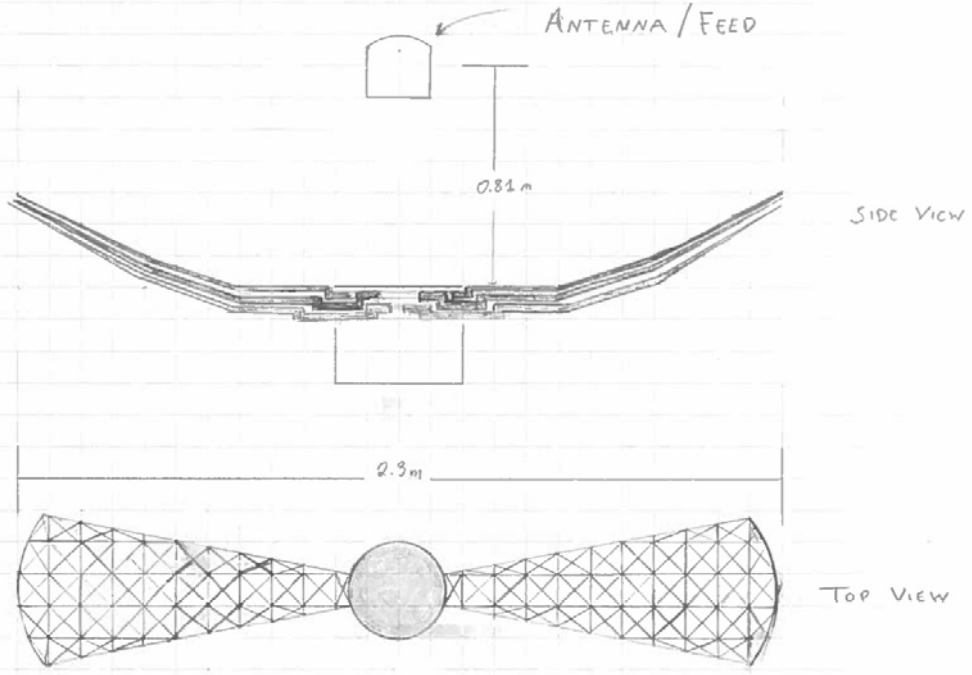
Conceptual Design of Rotor Controller



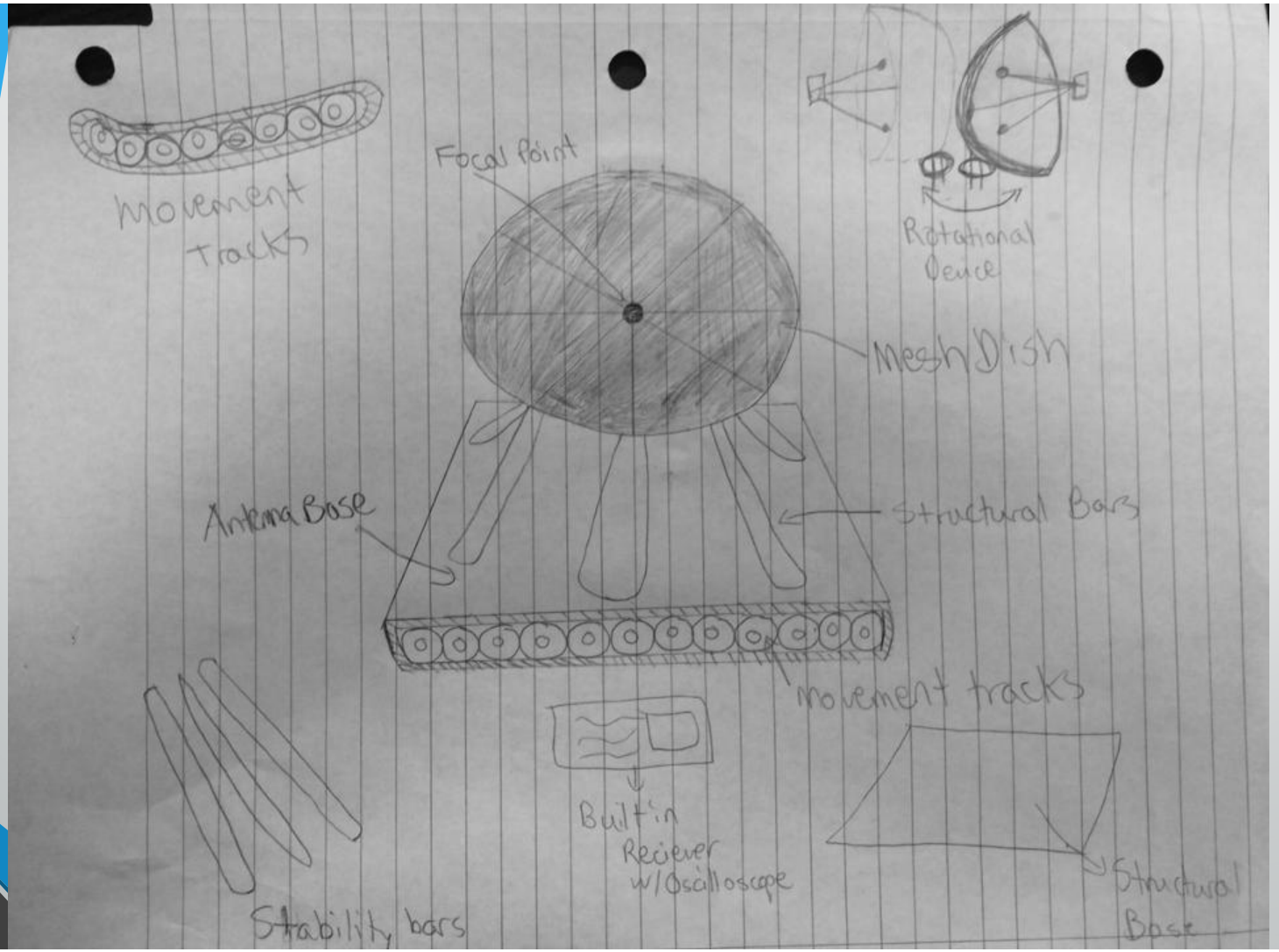
Shock absorbing Springs
Sheathed by "body guard"

Variable length
Stand base

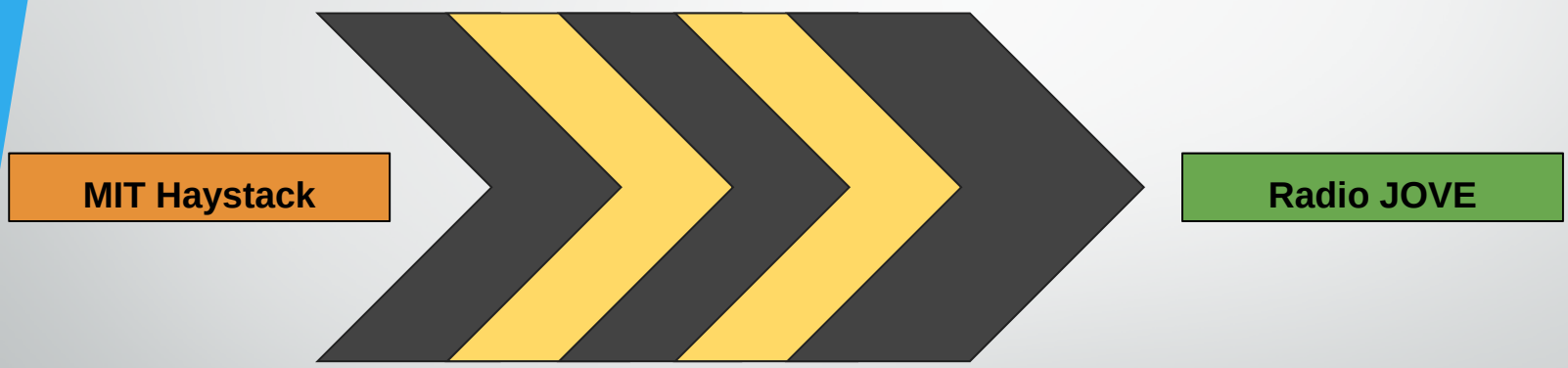




GAIN = 38.1 dBi


Movement Tracks
Focal Point
Rotational Device
Mesh Dish
Structural Bars
Antenna Base
movement tracks
Built-in Reciever w/Oscilloscope
Structural Base
Stability bars

Project Shift



Radio JOVE Receiver

JOVE Radio Telescope

The ambitious task set before us was to design, materialize, and install Howard University's first radio telescope for the purpose of measuring the galactic rotational curve. To accomplish this lofty goal it was imperative to familiarize the team with the concepts of radio astronomy. This is when examination and operation of NASA's Jove radio receiver began and with it the goal of understanding its intricate workings inside and out. For the sake of thoroughness this goal became the team's secondary objective, in essence an additional project in itself. This report will contain data gleaned from the Jove project along with information from the HU-Radio Telescope project, which must be stressed as an on-going project

Cost, Resources and Budget

MIT Haystack

$11,154.89

Radio JOVE

$200.00

Spring 2016 Target Goal & Deliverables

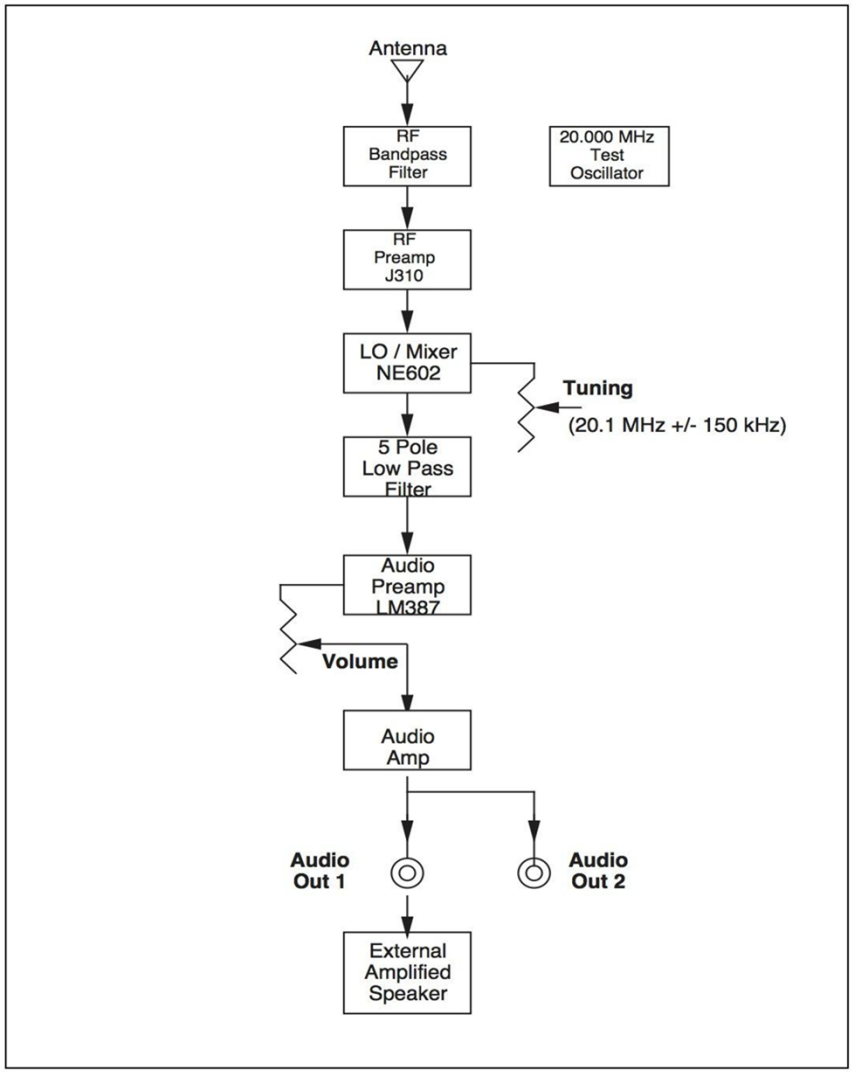
- Our project shifted from the MIT Haystack Radio Telescope to the JOVE Radio Telescope due to unforeseen circumstances with funding from Howard University.
- The target goal for Spring 2016 is to install the JOVE Radio Receiver and recommence the Haystack project.
- The delivered Spring 2016 product, Jove, will actually be a first for Howard as well Jove will a fully functional radio telescope that will track and record signals from Jupiter.

Project's Final Goals & Deliverables

The final goal of the project is the implementation of Howard University's first portable radio telescope and data sharing community. Bison Enterprises will design and create a MySQL proprietary database system to store and share the data collected from the MIT Haystack and JOVE radio telescopes.

Implementation, Testing, and Evaluation (JOVE)

1. The receiver and its accompanying antenna are designed to operate over a narrow range of short-wave frequencies centered on 20.1 MHz (megahertz).
2. We tested our radio receiver using the supplied testing and alignment procedures in the JOVE Radio Receiver Manual (Page 34) to ensure that the receiver was operating correctly.
3. With an input frequency of 20.101 MHz, our radio receiver outputs a radio signal of 1.5 KHz.


Antenna
RF Bandpass Filter
20.000 MHz Test Oscillator
RF Preamp J310
LO / Mixer NE602
Tuning
(20.1 MHz +/- 150 kHz)
5 Pole Low Pass Filter
Audio Preamp LM387
Volume
Audio Amp
Audio Out 1
Audio Out 2
External Amplified Speaker

Conclusion

The team set out to build and install a fully functional portable radio telescope based on the Massachusetts Institute of Technology Haystack design. Unforeseen circumstance led to the a pause in development, where the opportunity to research and improve understanding of the radio astronomy, and with it the client's, needs came about. The team is confidence this secondary objective will lead to a high quality of product Howard can be proud of.

As stated before Howard University's Haystack project will recommence with a much crisper and wholesome understanding. Projected plans have Haystack finished by Fall 2016 along with the database

Future Works

- Advice for future team members would be to not be too reliant on outside funding. There is no guarantee of deliverability.
- Do not assume previous team did everything correctly, there could be a crucial piece of the puzzle missing.
- When you are finished with the project be courteous and store your project as pristinely as possible to make it accessible to others wishing to continue your work
- Most importantly have fun and take pride in your craft.


Questions?