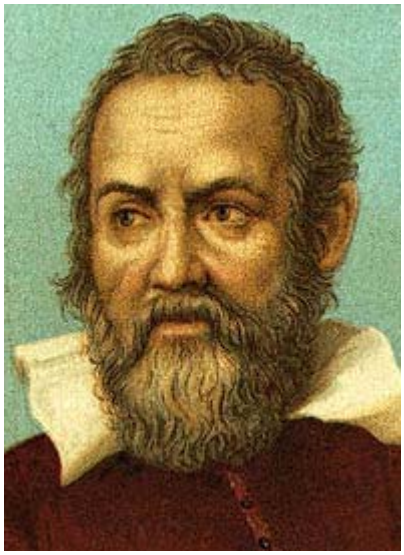
Introduction: History & brief intro to Radio Astronomy & Radio Telescopes

This Project is dedicated to our beloved scientist Galileo:



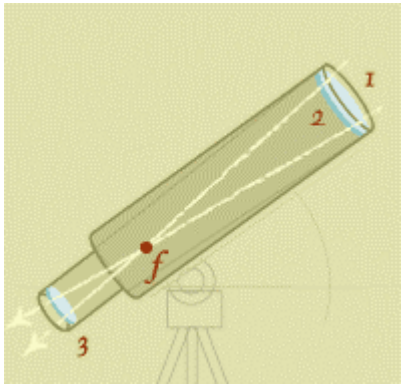
Galileo was born in Pisa, ITALY on February 15, 1564. His father, Vincenzo, was a musician. Galileo's mother was Giulia degli Ammannati.

Galileo was the first of six (though some people believe seven) children. His family belonged to the nobility but was not rich.

In the early 1570's, he and his family moved to Florance.

Introduction to Galileo:

Galileo's most famous invention: The Telescope.



Galileo made his first telescope in 1609, modeled after telescopes produced in other parts of Europe that could magnify objects three times. He created a telescope later the same year that could magnify objects twenty times.

With this telescope, he was able to look at the moon, discover the four satellites of Jupiter, observe a supernova, verify the phases of Venus, and discover sunspots.

Galileo's real originality lay in the way he approached scientific problems.

First, Galileo reduced those problems to very simple terms on the basis of everyday experience and common-sense logic.

Then he analyzed and resolved the problems according to simple mathematical descriptions.

The success with which Galileo applied this technique to the analysis of physics, especially the physics of motion, opened the way for the development of modern mathematical physics.

In this project we try to follow Galileo's above simplified methods in making a complex Radio Astronomy receiver using simple design that most amateurs can work on.

Radio Astronomy & Radio Telescope:

Astronomy began as people viewed the night sky with their naked eyes. When the optical telescope was invented in the 17th century, optical astronomy made great advances. Early errors, such as the assumption that the universe rotated around the earth, were discarded. The use of photographic methods, introduced in the last century, further advanced optical astronomy.

Radio astronomy began by accident. In 1931, Karl Jansky was looking for the source of radio interference at Bell Labs. He discovered a source of noise that moved across the sky so that it took not quite 24 hours to re-appear at the same place. The source moved with the stars, which lag the sun's apparent movement across the sky by about 4 minutes per day. Although it was not known then, the source of the radio waves was the center of our galaxy, where a large black hole resides. Radio waves are emitted because the black hole ingests hydrogen gas, along with anything else that comes near it, and the captured material is accelerated and ionized on approach and in the presence of a magnetic field produce radiation at radio frequencies. Of course, Jansky did not realize he had located a black hole!

Jansky was assigned to other projects when it was discovered that the interference could not be avoided. His discovery might have been lost, however, Grote Reber, a young amateur radio operator and later an electrical engineer, learned of Jansky's discovery. Reber, on his own, built a 9.5 meter parabolic dish antenna in his back yard. His equipment was primitive and it is a great tribute to him that he compiled the first map of the radio sky. When astronomers realized that the new radio telescope could observe radio waves from the center of the galaxy, which was blocked to their optical instruments by clouds of dust, the building of the great radio telescopes began.

What comes out of a radio telescope is not a picture, as we cannot picture radio waves. A change in the intensity of radio waves is marked by a change in the voltage at the output of the radio astronomy receiver. This was recorded on a strip chart in the early days, now the data, which

is the time, the voltage output of the receiver and the point in the sky at which the radio telescope is pointing, is organized by a computer and recorded on a hard disk or a tape.

Radio Astronomers:

Following Guglielmo Marconi's (photo above) successful transatlantic communications in 1901, commercial use of radio mushroomed. Ships were equipped with radio, huge commercial stations were set up to handle intercontinental messages after the fashion of the telegraph companies, and many other uses were found for the new technology.

At AT&T Bell Labs in New Jersey, a young radio engineer named Karl Jansky (left) was given the task of identifying the sources of short-wave noise. He built a highly directional antenna to work at about 22 MHz, and began to make systematic observations. Most of the noise he found was due to thunderstorms and other terrestrial causes.

However, he found one source of static that seemed to appear four minutes earlier every day. As most amateur astronomers know, that is a telltale sign of something beyond the Earth. Indeed, what Jansky had found was radio noise emitted from the center of our own Milky Way Galaxy. He discovered this in 1932 and announced it in 1933. His announcement was reported on the front page of the New York Times on May 5, 1933.

Grote Reber/W9GFZ, another radio engineer who was an avid ham operator. Reber had spent much time making long-distance contacts on the amateur short-wave bands. He had "worked" all continents and 60 foreign countries. In those days, that was quite an achievement, and it left Reber thinking, as he later wrote, "that there were no more worlds to conquer." When he read of Jansky's discovery, he found some more worlds.

In 1937, Reber built his own 32-foot-diameter parabolic dish antenna in his backyard, to seek cosmic radio emissions. In an era when artificial satellites were only a dream and television had not yet emerged from the laboratory.

Today, the connection between radio astronomy and amateur radio remains strong. Many prominent radio astronomers first became interested in science through involvement with amateur radio as youngsters. These include the winner of the 1993 Nobel Prize in Physics, Dr. Joseph Taylor of Princeton University. Nearly 10 percent of the employees of the National Radio Astronomy Observatory are licensed amateurs

In 1997, the National Radio Astronomy Observatory Amateur Radio Club obtained a license from the Federal Communications Commission for an amateur radio station with the call sign W9GFZ, Grote Reber's call sign in the 1930s.

NASA’s Radio Jove Project:

FD-Galileo is basically designed for NASA’s Radio Jove project. I post here some basic information for your quick review.

NASA's Radio JOVE project is centered on the low cost radio telescope receiver, which can be used by science classes to collect planetary or solar radio astronomy data. Schools may opt to use other equipment to collect this data, but use of the Radio Jove receiver is highly recommended and provides good educational value to the students.

The radio telescope is intended for high school level classes, but may be appropriate for introductory college courses or advanced middle school students.

The students setup the receiver & understand receiver basics. They also construct the special antenna needed to receive the planetary or solar emissions. The antenna requires construction of a basic structure using wood

or pipe, ropes, stakes, etc. which gives them basic understanding of a Dipole antenna & its construction.

Once the receiver & antenna rigged & tested, the students determine a good time to observe Jupiter based on predictions supplied on the Radio JOVE website.

Note that Jupiter radio signals can only be received at night and the conditions are often best in the hours just before dawn. Also, the antenna needs to be set up in a location that is as free from electrical interference as possible.

This may be possible near some open areas such as play grounds or schools, but it is recommended that observing be done in nighttime field trips to locations away from power lines and other sources of interference.

The Radio Telescope designed for 20.1MHZ, High Performance/Low Noise, Direct Conversion Receiver such as Fox Delta "Galileo" may be purchased online.

FD-Galileo Radio Astronomy Receiver is supplied fully assembled and comes with following:

1. **Direct Conversion Receiver for 20.1MHZ**
2. **Uses SA602/612 Double balance mixer**
3. **Stable Oscillator with tuning range of over 100KHZ**
4. **Very low power consumption**
5. **Supplied in a powder coated metal case**
6. **Has built-in LCD Frequency counter**
7. **Built-in A/D Converter for direct connection to your PC**
8. **Built-in 20MHZ osc. (Option)**
9. **Front panel audio socket for tape recorders**
10. **Front panel switches to put off A/D, Freq Counter, LCD back light etc**

In addition to above, Galileo also includes:

1. **An antenna Splitter/Combiner**
2. **Antenna Balun/Cores & Center feed connector for Dipoles**

Antenna kit consisting 20.1MHZ dipoles and RG59 feeder is also available.

Fox Delta do not supply materials for supporting (poles etc) the antenna, tools that are necessary to put the antenna together, such as a soldering iron, wire clippers, and other typical tools which you will require for putting up the antenna.

In order to analyze the data and share it with others, you will require to capture the radio data. This may be done by either feeding the audio output of the receiver into a tape recorder or by directly connecting D25 connector of Galileo to a computer.

On a field trip it may be more convenient to use the tape recorder than to carry along a computer. Small tape recorders can be purchased for this purpose, but they must not have an automatic gain control (automatic volume adjustment) or the control must be capable of being switched off since such a control makes it difficult to measure the relative strength of the signals.

The Radio Jove project has created software for Window 95/98 that simulates a chart recorder for plotting the data on a 486 or better model personal computer having a sound card. The software is available from the Nasa's Jove project Website.

A central web site will accept files of data from observing groups around the country and make them available for schools and scientists to see and hear. The site also contains general information and activities relevant to the understanding of radio astronomy and, in particular, how to order, build, use, and understand the data from radio receiver kits. These web pages are currently under construction.

73s
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For more details on this project, Updates and details on radio astronomy kits available for Radio Amateurs, please visit http://www.foxdelta.com